SHOP MANUAL

KOMATSU

GD700-4 SERIES

MACHINE MODEL	SERIAL No.
GD705R-4	**16001 and up**
GD705A-4	**21001 and up**

- This shop manual may contain attachments and optional equipment that are not available in your area. Please consult your local Komatsu distributor for those items you may require. Materials and specifications are subject to change without notice.
- GD705R-4, GD705A-4 mount the 6D125, S6D125 engine.
  For details of the engine, see the 6D125 Series Engine Shop Manual.

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⚠ IMPORTANT SAFETY NOTICE

Proper service and repair is extremely important for the safe operation of your machine. The service and repair techniques recommended by Komatsu and described in this manual are both effective and safe methods of operation. Some of these operations require the use of tools specially designed by Komatsu for the purpose.

To prevent injury to workers, the symbol ⚠ is used to mark safety precautions in this manual. The cautions accompanying these symbols should always be followed carefully. If any dangerous situation arises or may possibly arise, first consider safety, and take the necessary actions to deal with the situation.

⚠ SAFETY

GENERAL PRECAUTIONS

Mistakes in operation are extremely dangerous. Read the Operation and Maintenance Manual carefully BEFORE operating the machine.

1. Before carrying out any greasing or repairs, read all the precautions given on the decals which are fixed to the machine.
2. When carrying out any operation, always wear safety shoes and helmet. Do not wear loose work clothes, or clothes with buttons missing.
   - Always wear safety glasses when hitting parts with a hammer.
   - Always wear safety glasses when grinding parts with a grinder, etc.
3. If welding repairs are needed, always have a trained, experienced welder carry out the work. When carrying out welding work, always wear welding gloves, apron, glasses, cap and other clothes suited for welding work.
4. When carrying out any operation with two or more workers, always agree on the operating procedure before starting. Always inform your fellow workers before starting any step of the operation. Before starting work, hang UNDER REPAIR signs on the controls in the operator's compartment.
5. Keep all tools in good condition and learn the correct way to use them.
6. Decide a place in the repair workshop to keep tools and removed parts. Always keep the tools and parts in their correct places. Always keep the work area clean and make sure that there is no dirt or oil on the floor. Smoke only in the areas provided for smoking. Never smoke while working.

PREPARATIONS FOR WORK

7. Before adding oil or making any repairs, park the machine on hard, level ground, and block the wheels or tracks to prevent the machine from moving.
8. Before starting work, lower blade, ripper, bucket or any other work equipment to the ground. If this is not possible, insert the safety pin or use blocks to prevent the work equipment from falling. In addition, be sure to lock all the control levers and hang warning signs on them.
9. When disassembling or assembling, support the machine with blocks, jacks or stands before starting work.
10. Remove all mud and oil from the steps or other places used to get on and off the machine. Always use the handrails, ladders or steps when getting on or off the machine. Never jump on or off the machine. If it is impossible to use the handrails, ladders or steps, use a stand to provide safe footing.

PRECAUTIONS DURING WORK

11. When removing the oil filler cap, drain plug or hydraulic pressure measuring plugs, loosen them slowly to prevent the oil from spurting out.
    Before disconnecting or removing components of the oil, water or air circuits, first remove the pressure completely from the circuit.
12. The water and oil in the circuits are hot when the engine is stopped, so be careful not to get burned.
    Wait for the oil and water to cool before carrying out any work on the oil or water circuits.
13. Before starting work, remove the leads from the battery. Always remove the lead from the negative (−) terminal first.
14. When raising heavy components, use a hoist or crane.
    Check that the wire rope, chains and hooks are free from damage.
    Always use lifting equipment which has ample capacity.
    Install the lifting equipment at the correct places. Use a hoist or crane and operate slowly to prevent the component from hitting any other part. Do not work with any part still raised by the hoist or crane.
15. When removing covers which are under internal pressure or under pressure from a spring, always leave two bolts in position on opposite sides. Slowly release the pressure, then slowly loosen the bolts to remove.
16. When removing components, be careful not to break or damage the wiring. Damaged wiring may cause electrical fires.
17. When removing piping, stop the fuel or oil from spilling out. If any fuel or oil drips on to the floor, wipe it up immediately. Fuel or oil on the floor can cause you to slip, or can even start fires.
18. As a general rule, do not use gasoline to wash parts. In particular, use only the minimum of gasoline when washing electrical parts.
19. Be sure to assemble all parts again in their original places.
    Replace any damaged parts with new parts.
    - When installing hoses and wires, be sure that they will not be damaged by contact with other parts when the machine is being operated.
20. When installing high pressure hoses, make sure that they are not twisted. Damaged tubes are dangerous, so be extremely careful when installing tubes for high pressure circuits. Also, check that connecting parts are correctly installed.
21. When assembling or installing parts, always use the specified tightening torques. When installing protective parts such as guards, or parts which vibrate violently or rotate at high speed, be particularly careful to check that they are installed correctly.
22. When aligning two holes, never insert your fingers or hand. Be careful not to get your fingers caught in a hole.
23. When measuring hydraulic pressure, check that the measuring tool is correctly assembled before taking any measurements.
24. Take care when removing or installing the tracks of track-type machines.
    When removing the track, the track separates suddenly, so never let anyone stand at either end of the track.

FOREWORD

This shop manual has been prepared as an aid to improve the quality of repairs by giving the serviceman an accurate understanding of the product and by showing him the correct way to perform repairs and make judgements. Make sure you understand the contents of this manual and use it to full effect at every opportunity.

This shop manual mainly contains the necessary technical information for operations performed in a service workshop.

For ease of understanding, the manual is divided into chapters for each main group of components; these chapters are further divided into the following sections.

STRUCTURE AND FUNCTION

This section explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for troubleshooting.

TESTING AND ADJUSTING

This section explains checks to be made before and after performing repairs, as well as adjustments to be made at completion of the checks and repairs.

Troubleshooting charts correlating "Problems" to "Causes" are also included in this section.

DISASSEMBLY AND ASSEMBLY

This section explains the order to be followed when removing, installing, disassembling or assembling each component, as well as precautions to be taken for these operations.

MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

NOTICE

The specifications contained in this shop manual are subject to change at any time and without any advance notice. Contact your KOMATSU distributor for the latest information.

HOW TO READ THE SHOP MANUAL

VOLUMES

Shop manuals are issued as a guide to carrying out repairs. They are divided as follows:

Chassis volume: Issued for every machine model
Engine volume: Issued for each engine series
Electrical volume : } Each issued as one volume to cover all models
Attachments volume : }

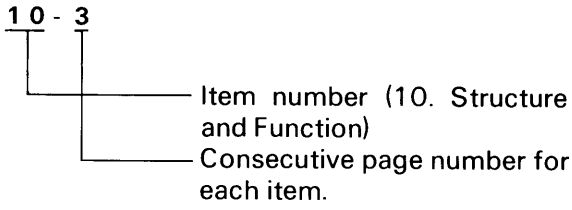
These various volumes are designed to avoid duplicating the same information. Therefore to deal with all repairs for any model, it is necessary that chassis, engine, electrical and attachment volumes are ready.

DISTRIBUTION AND UPDATING

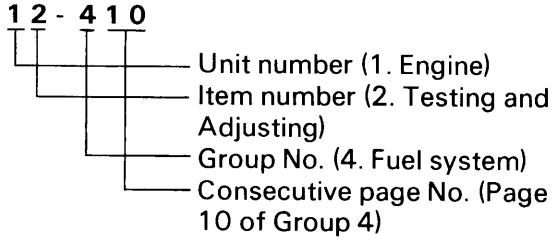
Any additions, amendments or other changes will be sent to KOMATSU distributers. Get the most up-to-date information before you start any work.

FILING METHOD

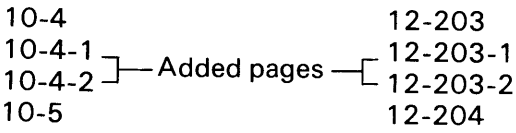
1. See the page number on the bottom of the page. File the pages in correct order.
2. Following examples shows how to read the page number.
   Example 1 (Chassis volume):



   Example 2 (Engine volume):



3. Additional pages: Additional pages are indicated by a hyphen (-) and number after the page number. File as in the example.
   Example:



REVISED EDITION MARK (①②③ ····)

When a manual is revised, an edition mark is recorded on the bottom outside corner of the pages.

REVISIONS

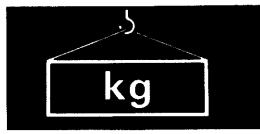
Revised pages are shown at the LIST OF REVISED PAGES on the between the title page and SAFETY page.

SYMBOLS

So that the shop manual can be of ample practical use, important places for safety and quality are marked with the following symbols.

Symbol	Item	Remarks
⚠	Safety	Special safety precautions are necessary when performing the work.
★	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing the work.
kg	Weight	Weight of parts or systems. Caution necessary when selecting hoisting wire, or when working posture is important, etc.
kgm	Tightening torque	Places that require special attention for the tightening torque during assembly.
	Coat	Places to be coated with adhesives and lubricants, etc.
	Oil, water	Places where oil, water or fuel must be added, and the capacity.
	Drain	Places where oil or water must be drained, and quantity to be drained.

HOISTING INSTRUCTIONS



⚠ Heavy parts (25 kg or more) must be lifted with a hoist etc. In the **Disassembly and Assembly** section, every part weighing 25 kg or more is indicated clearly with the symbol kg

1. If a part cannot be smoothly removed from the machine by hoisting, the following checks should be made:
   - Check for removal of all bolts fastening the part to the relative parts.
   - Check for existence of another part causing interference with the part to be removed.

2. Wire ropes

1) Use adequate ropes depending on the weight of parts to be hoisted, referring to the table below:

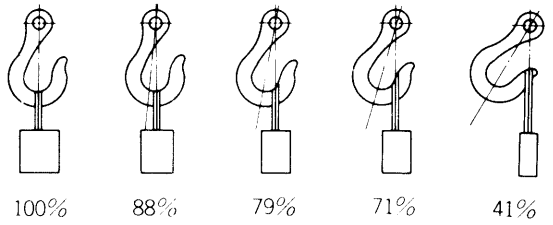
Wire ropes
(Standard "Z" or "S" twist ropes without galvanizing)

Rope diameter (mm)	Allowable load (tons)
10	1.0
11.2	1.4
12.5	1.6
14	2.2
16	2.8
18	3.6
20	4.4
22.4	5.6
30	10.0
40	18.0
50	28.0
60	40.0

The allowable load value is estimated to be one-sixth or one-seventh of the breaking strength of the rope used.

2) Sling wire ropes from the middle portion of the hook.

Slinging near the edge of the hook may cause the rope to slip off the hook during hoisting, and a serious accident can result. Hooks have maximum strength at the middle portion.



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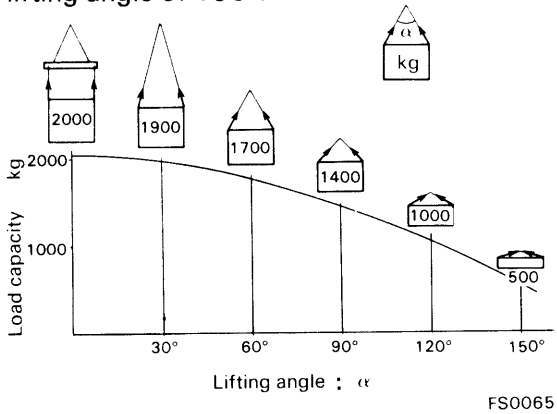
3) Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound on to the load.

⚠ Slinging with one rope may cause turning of the load during hoisting, untwisting of the rope, or slipping of the rope from its original winding position on the load, which can result in a dangerous accident.

4) Do not sling a heavy load with ropes forming a wide hanging angle from the hook.

When hoisting a load with two or more ropes, the force subjected to each rope will increase with the hanging angles. The table below shows the variation of allowable load (kg) when hoisting is made with two ropes, each of which is allowed to sling up to 1000 kg vertically, at various hanging angles.

When two ropes sling a load vertically, up to 2000 kg of total weight can be suspended. This weight becomes 1000 kg when two ropes make a 120° hanging angle. On the other hand, two ropes are subjected to an excessive force as large as 4000 kg if they sling a 2000 kg load at a lifting angle of 150°.



FS0065

kgm

STANDARD TIGHTENING TORQUE

1. STANDARD TIGHTENING TORQUE OF BOLTS AND NUTS

The following charts give the standard tightening torques of bolts and nuts. Exceptions are given in sections of "**Disassembly and Assembly**".

Thread diameter of bolt (mm)	Width across flat (mm)	(T)	(H)
		kgm	Nm
6	10	1.35±0.15	13.2±1.4
8	13	3.2±0.3	31.4±2.9
10	17	6.7±0.7	65.7±6.8
12	19	11.5±1.0	112±9.8
14	22	18.0±2.0	177±19
16	24	28.5±3	279±29
18	27	39±4	383±39
20	30	56±6	549±58
22	32	76±8	745±78
24	36	94.5±10	927±98
27	41	135±15	1320±140
30	46	175±20	1720±190
33	50	225±25	2210±240
36	55	280±30	2750±290
39	60	335±35	3280±340

This torque table does not apply to the bolts with which nylon packings or other non-ferrous metal washers are to be used, or which require tightening to otherwise specified torque.

★ **Nm (newton meter): 1Nm ≒ 0.1 kgm**

2. TIGHTENING TORQUE OF SPLIT FLANGE BOLTS

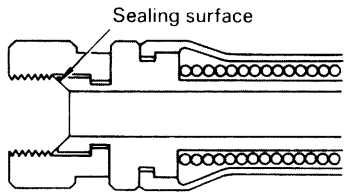
Use these torques for split flange bolts.

Thread diameter of bolt (mm)	Width across flats (mm)	Tightening torque	
		kgm	Nm
10	14	6.7±0.7	65.7±6.8
12	17	11.5±1	112±9.8
16	22	28.5±3	279±29

kgm

3. TIGHTENING TORQUE FOR NUTS OF FLARED

Use these torques for nut part of flared



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Thread diameter of nut part (mm)	Width across flats of nut part (mm)	Tightening torque	
		kgm	Nm
14	19	2.5±0.5	24.5±4.9
18	24	5±2	49±19.6
22	27	8±2	78.5±19.6
24	32	14±3	137.3±29.4
30	36	18±3	176.5±29.4
33	41	20±5	196.1±49
36	46	25±5	245.2±49
42	55	30±5	294.2±49

COATING MATERIALS

The recommended coating materials prescribed in Komatsu Shop Manuals are listed below.

Nomenclature	Komatsu code	Applications
Adhesives	LT-1A	Used to apply rubber pads, rubber gaskets, and cork plugs.
	LT-1B	Used to apply resin, rubber, metallic and non-metallic parts when a fast, strong seal is needed.
	LT-2*	Preventing bolts, nuts and plugs from loosening and leaking oil.
	LT-3	Provides an airtight, electrically insulating seal. Used for aluminum surfaces.
	LT-4	Used to coat plugs (plate shaped, bowl shaped) and holes, and mating portion of shaft.
Sealant gasket	LG-1	Used with gaskets and packings to increase sealing effect.
	LG-3	Heat-resistant gasket for precombustion chambers and exhaust piping.
	LG-4	Used by itself on mounting surfaces on the final drive and transmission cases. (Thickness after tightening: 0.07 — 0.08 mm)
	LG-5	Used by itself to seal grease fittings, tapered screw fittings and tapered screw fittings in hydraulic circuits of less than 50 mm in diameter.
	LG-6	Silicon base type used in combination with LG-1 and LG-4.
	LG-7	Has a shorter curing time than LG-6, and is easier to peel off.
Antifriction compound (Lubricant including molybdenum disulfide)	LM-P	Applied to bearings and taper shafts to facilitate press-fitting and to prevent sticking, burning or rusting.
Grease (Lithium grease)	G2-LI	Applied to bearings, sliding parts and oil seals for lubrication, rust prevention and facilitation of assembling work.
Vaseline	—	Used for protecting battery electrode terminals from corrosion.

*LT-2 is also called LOCTITE in the shop manuals.

ELECTRIC

ELECTRIC WIRE CODE

In the wiring diagrams, various colors and symbols are employed to indicate the thickness of wires.
This wire code table will help you understand WIRING DIAGRAMS.
Example: 5WB indicates a cable having a nominal number 5 and white coating with black stripe.

CLASSIFICATION BY THICKNESS

Nominal number	Copper wire			Cable O.D. (mm)	Current rating (A)	Applicable circuit
	Number strands	Dia. of strands (mm)	Cross section (mm^2)			
0.85	11	0.32	0.88	2.4	12	Starting, lighting, signal etc.
2	26	0.32	2.09	3.1	20	Lighting, signal etc.
5	65	0.32	5.23	4.6	37	Charging and signal
15	84	0.45	13.36	7.0	59	Starting (Glow plug)
40	85	0.80	42.73	11.4	135	Starting
60	127	0.80	63.84	13.6	178	Starting
100	217	0.80	109.1	17.6	230	Starting

CLASSIFICATION BY COLOR AND CODE

Priority	Classification \ Circuits		Charging	Ground	Starting	Lighting	Instrument	Signal	Other
1	Primary	Code	W	B	B	R	Y	G	L
		Color	White	Black	Black	Red	Yellow	Green	Blue
2	Auxiliary	Code	WR	–	BW	RW	YR	GW	LW
		Color	White & Red	–	Black & White	Red & White	Yellow & Red	Green & White	Blue & White
3		Code	WB	–	BY	RB	YB	GR	LR
		Color	White & Black	–	Black & Yellow	Red & Black	Yellow & Black	Green & Red	Blue & Red
4		Code	WL	–	BR	RY	YG	GY	LY
		Color	White & Blue	–	Black & Red	Red & Yellow	Yellow & Green	Green & Yellow	Blue & Yellow
5		Code	WG	–	–	RG	YL	(GB)	(LB)
		Color	White & Green	–	–	Red & Green	Yellow & Blue	(Green & Black)	(Blue & Black)
6		Code	–	–	–	RL	YW	(GL)	–
		Color	–	–	–	Red & Blue	Yellow & White	(Green & Blue)	–

CONVERSION TABLE

Method of using the Conversion Table

The Conversion Table in this section is provided to enable simple conversion of figures. For details of the method of using the Conversion Table, see the example given below.

Example

- Method of using the Conversion Table to convert from millimeters to inches

1. Convert 55 mm into inches.
   (1) Locate the number 50 in the vertical column at the left side, take this as Ⓐ, then draw a horizontal line from Ⓐ.
   (2) Locate the number 5 in the row across the top, take this as Ⓑ, then draw a perpendicular line down from Ⓑ.
   (3) Take the point where the two lines cross as Ⓒ. This point Ⓒ gives the value when converting from millimeters to inches. Therefore, 55 mm = 2.165 inches.

2. Convert 550 mm into inches.
   (1) The number 550 does not appear in the table, so divide by 10 (move the decimal point one place to the left) to convert it to 55 mm.
   (2) Carry out the came procedure as above to convert 55 mm to 2.165 inches.
   (3) The original value (550 mm) was divided by 10, so multiply 2.165 inches by 10 (move the decimal point one place to the right) to return to the original value. This gives 550 mm = 21.65 inches.

Millimeters to inches

1 mm = 0.03937 in

	0	1	2	3	4	Ⓑ 5	6	7	8	9
0		0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
Ⓐ 50	1.969	2.008	2.047	2.087	2.126	Ⓒ 2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Millimeters to Inches

1 mm = 0.03937 in

	0	1	2	3	4	5	6	7	8	9
0		0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Kilogram to Pound

1 kg = 2.2046 lb

Kilogram	0	1	2	3	4	5	6	7	8	9
		2.20	4.41	6.61	8.82	11.02	13.23	15.43	17.64	19.84
10	22.05	24.25	26.46	28.66	30.86	33.07	35.27	37.48	39.68	41.89
20	44.09	46.30	48.50	50.71	51.91	55.12	57.32	59.53	61.73	63.93
30	66.14	68.34	70.55	72.75	74.96	77.16	79.37	81.57	83.78	85.98
40	88.18	90.39	92.59	94.80	97.00	99.21	101.41	103.62	105.82	108.03
50	110.23	112.44	114.64	116.85	119.05	121.25	123.46	125.66	127.87	130.07
60	132.28	134.48	136.69	138.89	141.10	143.30	145.51	147.71	149.91	152.12
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.76	171.96	174.17
80	176.37	178.57	180.78	182.98	185.19	187.39	189.60	191.80	194.01	196.21
90	198.42	200.62	202.83	205.03	207.24	209.44	211.64	213.85	216.05	218.26

Liter to U.S. Gallon

1 ℓ = 0.2642 U.S. Gal

	0	1	2	3	4	5	6	7	8	9
		0.264	0.528	0.793	1.057	1.321	1.585	1.849	2.113	2.378
10	2.642	2.906	3.170	3.434	3.698	3.963	4.227	4.491	4.755	5.019
20	5.283	5.548	5.812	6.076	6.340	6.604	6.869	7.133	7.397	7.661
30	7.925	8.189	8.454	8.718	8.982	9.246	9.510	9.774	10.039	10.303
40	10.567	10.831	11.095	11.359	11.624	11.888	12.152	12.416	12.680	12.944
50	13.209	13.473	13.737	14.001	14.265	14.529	14.795	15.058	15.322	15.586
60	15.850	16.115	16.379	16.643	16.907	17.171	17.435	17.700	17.964	18.228
70	18.492	18.756	19.020	19.285	19.549	19.813	20.077	20.341	20.605	20.870
80	21.134	21.398	21.662	21.926	22.190	22.455	22.719	22.983	23.247	23.511
90	23.775	24.040	24.304	24.568	24.832	25.096	25.361	25.625	25.889	26.153

Liter to U.K. Gallon

1 ℓ = 0.21997 U.K. Gal

	0	1	2	3	4	5	6	7	8	9
		0.220	0.440	0.660	0.880	1.100	1.320	1.540	1.760	1.980
10	2.200	2.420	2.640	2.860	3.080	3.300	3.520	3.740	3.950	4.179
20	4.399	4.619	4.839	5.059	5.279	5.499	5.719	5.939	6.159	6.379
30	6.599	6.819	7.039	7.259	7.479	7.969	7.919	8.139	8.359	8.579
40	8.799	9.019	9.239	9.459	9.679	9.899	10.119	10.339	10.559	10.778
50	10.998	11.281	11.438	11.658	11.878	12.098	12.318	12.528	12.758	12.978
60	13.198	13.418	13.638	13.858	14.078	14.298	14.518	14.738	14.958	15.178
70	15.398	15.618	15.838	16.058	16.278	16.498	16.718	16.938	17.158	17.378
80	17.598	17.818	18.037	18.257	18.477	18.697	18.917	19.137	19.357	19.577
90	19.797	20.017	20.237	20.457	20.677	20.897	21.117	21.337	21.557	21.777

kgm to ft.lb

1 kg.m = 7.233 ft.lb

	0	1	2	3	4	5	6	7	8	9
		7.2	14.5	21.7	28.9	36.2	43.4	50.6	57.9	65.1
10	72.3	79.6	86.8	94.0	101.3	108.5	115.7	123.0	130.2	137.4
20	144.7	151.9	159.1	166.4	173.6	180.8	188.1	195.3	202.5	209.8
30	217.0	224.2	231.5	238.7	245.9	253.2	260.4	267.6	274.9	282.1
40	289.3	296.6	303.8	311.0	318.3	325.5	332.7	340.0	347.2	354.4
50	361.7	368.9	376.1	383.4	390.6	397.8	405.1	412.3	419.5	426.8
60	434.0	441.2	448.5	455.7	462.9	470.2	477.4	484.6	491.8	499.1
70	506.3	513.5	520.8	528.0	535.2	542.5	549.7	556.9	564.2	571.4
80	578.6	585.9	593.1	600.3	607.6	614.8	622.0	629.3	636.5	643.7
90	651.0	658.2	665.4	672.7	679.9	687.1	694.4	701.6	708.8	716.1
100	723.3	730.5	737.8	745.0	752.2	759.5	766.7	773.9	781.2	788.4
110	795.6	802.9	810.1	817.3	824.6	831.8	839.0	846.3	853.5	860.7
120	868.0	875.2	882.4	889.7	896.9	904.1	911.4	918.6	925.8	933.1
130	940.3	947.5	954.8	962.0	969.2	976.5	983.7	990.9	998.2	1005.4
140	1012.6	1019.9	1027.1	1034.3	1041.5	1048.8	1056.0	1063.2	1070.5	1077.7
150	1084.9	1092.2	1099.4	1106.6	1113.9	1121.1	1128.3	1135.6	1142.8	1150.0
160	1157.3	1164.5	1171.7	1179.0	1186.2	1193.4	1200.7	1207.9	1215.1	1222.4
170	1129.6	1236.8	1244.1	1251.3	1258.5	1265.8	1273.0	1280.1	1287.5	1294.7
180	1301.9	1309.2	1316.4	1323.6	1330.9	1338.1	1345.3	1352.6	1359.8	1367.0
190	1374.3	1381.5	1388.7	1396.0	1403.2	1410.4	1417.7	1424.9	1432.1	1439.4

kg/cm^2 to lb/in^2

1 kg/cm^2 = 14.2233 lb/in^2

	0	1	2	3	4	5	6	7	8	9
		14.2	28.4	42.7	56.9	71.1	85.3	99.6	113.8	128.0
10	142.2	156.5	170.7	184.9	199.1	213.4	227.6	241.8	256.0	270.2
20	284.5	298.7	312.9	327.1	341.4	355.6	369.8	384.0	398.3	412.5
30	426.7	440.9	455.1	469.4	483.6	497.8	512.0	526.3	540.5	554.7
40	568.9	583.2	597.4	611.6	625.8	640.1	654.3	668.5	682.7	696.9
50	711.2	725.4	739.6	753.8	768.1	782.3	796.5	810.7	825.0	839.2
60	853.4	867.6	881.8	896.1	910.3	924.5	938.7	953.0	967.2	981.4
70	995.6	1010	1024	1038	1053	1067	1081	1095	1109	1124
80	1138	1152	1166	1181	1195	1209	1223	1237	1252	1266
90	1280	1294	1309	1323	1337	1351	1365	1380	1394	1408
100	1422	1437	1451	1465	1479	1493	1508	1522	1536	1550
110	1565	1579	1593	1607	1621	1636	1650	1664	1678	1693
120	1707	1721	1735	1749	1764	1778	1792	1806	1821	1835
130	1849	1863	1877	1892	1906	1920	1934	1949	1963	1977
140	1991	2005	2020	2034	2048	2062	2077	2091	2105	2119
150	2134	2148	2162	2176	2190	2205	2219	2233	2247	2262
160	2276	2290	2304	2318	2333	2347	2361	2375	2389	2404
170	2418	2432	2446	2460	2475	2489	2503	2518	2532	2546
180	2560	2574	2589	2603	2617	2631	2646	2660	2674	2688
190	2702	2717	2731	2745	2759	2773	2788	2802	2816	2830
200	2845	2859	2873	2887	2901	2916	2930	2944	2958	2973
210	2987	3001	3015	3030	3044	3058	3072	3086	3101	3115
220	3129	3143	3158	3172	3186	3200	3214	3229	3243	3257
230	3271	3286	3300	3314	3328	3343	3357	3371	3385	3399
240	3414	3428	3442	3456	3470	3485	3499	3513	3527	3542

Temperature

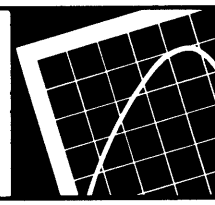
Fahrenheit-Centigrade Conversion. —A simple way to convert a Fahrenheit temperture reading into a Centigrade temperature reading or vice versa is to enter the accompanying table in the center or boldface column of figures. These figures refer to the temperature in either Fahrenheit or Centigrade degrees.

If it is desired to convert from Fahrenheit to Centigrade degrees, consider the center column as a table of Fahrenheit temperatures and read the corresponding Centigrade temperature in the column at the left.

If it is desired to convert from Centigrade to Fahrenheit degrees, consider the center column as a table of Centigrade values, and read the corresponding Fahrenheit temperature on the right.

°C		°F	°C		°F	°C		°F	°C		°F
−40.4	−40	−40.0	−11.7	11	51.8	7.8	46	114.8	27.2	81	117.8
−37.2	−35	−31.0	−11.1	12	53.6	8.3	47	116.6	27.8	82	179.6
−34.4	−30	−22.0	−10.6	13	55.4	8.9	48	118.4	28.3	83	181.4
−31.7	−25	−13.0	−10.0	14	57.2	9.4	49	120.2	28.9	84	183.2
−28.9	−20	−4.0	−9.4	15	59.0	10.0	50	122.0	29.4	85	185.0
−28.3	−19	−2.2	−8.9	16	60.8	10.6	51	123.8	30.0	86	186.8
−27.8	−18	−0.4	−8.3	17	62.6	11.1	52	125.6	30.6	87	188.6
−27.2	−17	1.4	−7.8	18	64.4	11.7	53	127.4	31.1	88	190.4
−26.7	−16	3.2	−7.2	19	66.2	12.2	54	129.2	31.7	89	192.2
−26.1	−15	5.0	−6.7	20	68.0	12.8	55	131.0	32.2	90	194.0
−25.6	−14	6.8	−6.1	21	69.8	13.3	56	132.8	32.8	91	195.8
−25.0	−13	8.6	−5.6	22	71.6	13.9	57	134.6	33.3	92	197.6
−24.4	−12	10.4	−5.0	23	73.4	14.4	58	136.4	33.9	93	199.4
−23.9	−11	12.2	−4.4	24	75.2	15.0	59	138.2	34.4	94	201.2
−23.3	−10	14.0	−3.9	25	77.0	15.6	60	140.0	35.0	95	203.0
−22.8	−9	15.8	−3.3	26	78.8	16.1	61	141.8	35.6	96	204.8
−22.2	−8	17.6	−2.8	27	80.6	16.7	62	143.6	36.1	97	206.6
−21.7	−7	19.4	−2.2	28	82.4	17.2	63	145.4	36.7	98	208.4
−21.1	−6	21.2	−1.7	29	84.2	17.8	64	147.2	37.2	99	210.2
−20.6	−5	23.0	−1.1	30	86.0	18.3	65	149.0	37.8	100	212.0
−20.0	−4	24.8	−0.6	31	87.8	18.9	66	150.8	40.6	105	221.0
−19.4	−3	26.6	0	32	89.6	19.4	67	152.6	43.3	110	230.0
−18.9	−2	28.4	0.6	33	91.4	20.0	68	154.4	46.1	115	239.0
−18.3	−1	30.2	1.1	34	93.2	20.6	69	156.2	48.9	120	248.0
−17.8	0	32.0	1.7	35	95.0	21.1	70	158.0	51.7	125	257.0
−17.2	1	33.8	2.2	36	96.8	21.7	71	159.8	54.4	130	266.0
−16.7	2	35.6	2.8	37	98.6	22.2	72	161.6	57.2	135	275.0
−16.1	3	37.4	3.3	38	100.4	22.8	73	163.4	60.0	140	284.0
−15.6	4	39.2	3.9	39	102.2	23.3	74	165.2	62.7	145	293.0
−15.0	5	41.0	4.4	40	104.0	23.9	75	167.0	65.6	150	302.0
−14.4	6	42.8	5.0	41	105.8	24.4	76	168.8	68.3	155	311.0
−13.9	7	44.6	5.6	42	107.6	25.0	77	170.6	71.1	160	320.0
−13.3	8	46.4	6.1	43	109.4	25.6	78	172.4	73.9	165	329.0
−12.8	9	48.2	6.7	44	111.2	26.1	79	174.2	76.7	170	338.0
−12.2	10	50.0	7.2	45	113.0	26.7	80	176.0	79.4	175	347.0

01 GENERAL



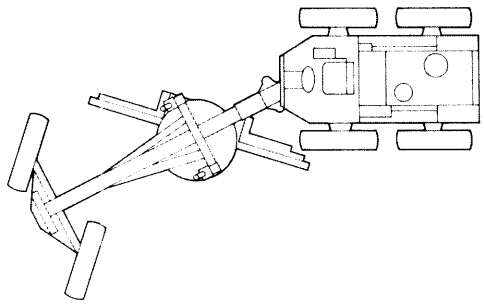
MOTOR GRADER NUMBERING CODE

G D 7 0 5 A - 4

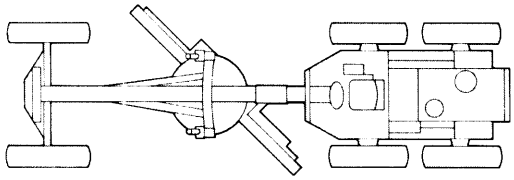
- 4: Type
- A: Basic mode — A: Articulated; R: Rigid
- 5: Driving system — 0: Direct drive; 5: Power shift drive; HYDROSHIFT transmission or TORQFLOW transmission
- 7: Machine size — 20, 30, 40, 50, 60, 70 in ascending order
- GD: Indicates motor grader

Example: **GD705R-4 Hydroshift drive, rigid type**
GD705A-4 Hydroshift drive, articulated type

Basic mode A: Articulated



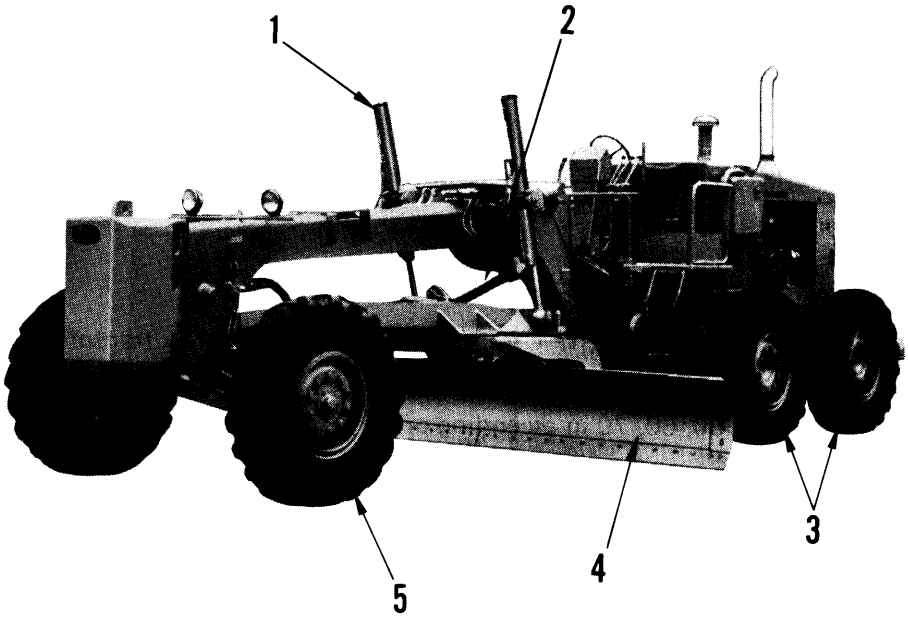
R: Rigid



F23KA036

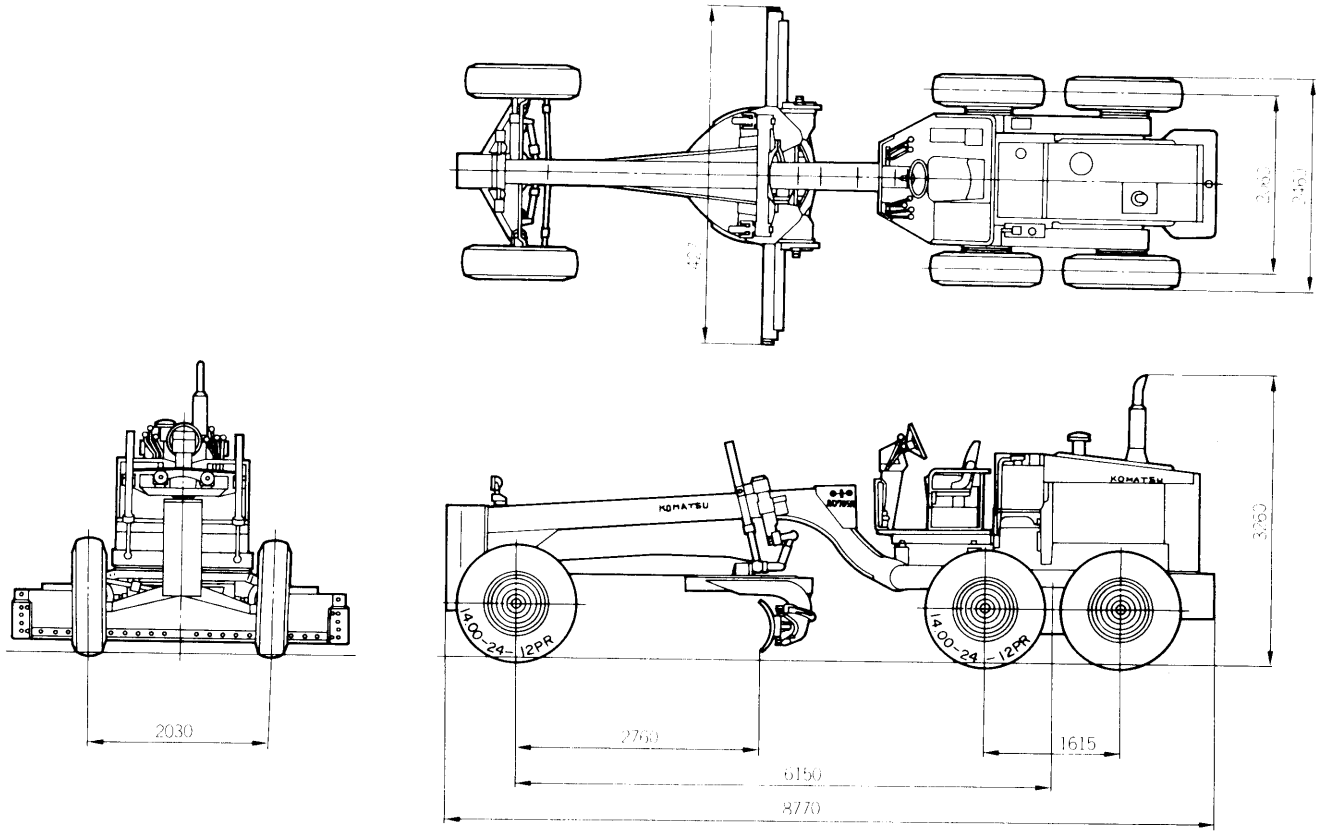
GENERAL VIEW

GD705R-4



1. Blade lift cylinder
2. Drawbar side shift cylinder
3. Rear tire
4. Blade
5. Front tire

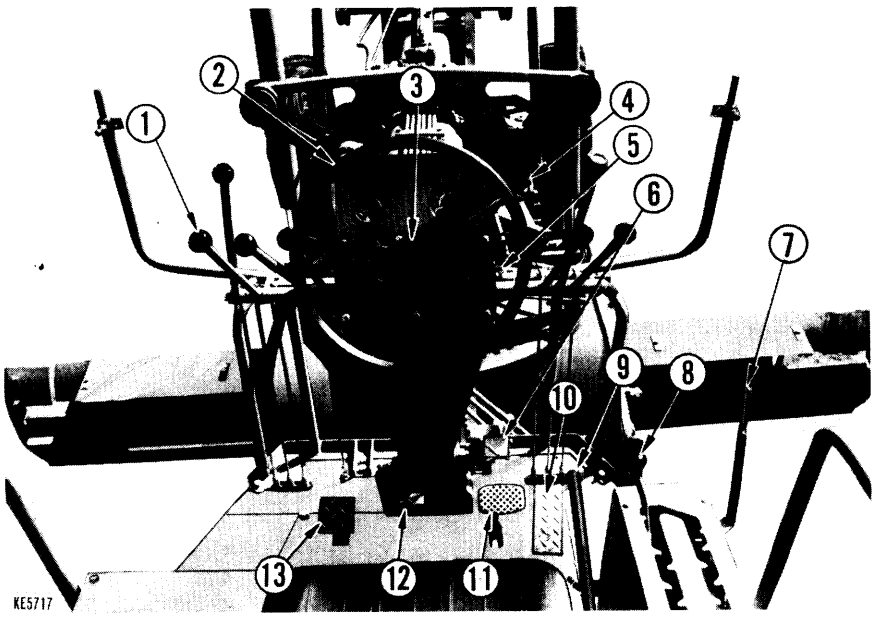
P23E04001

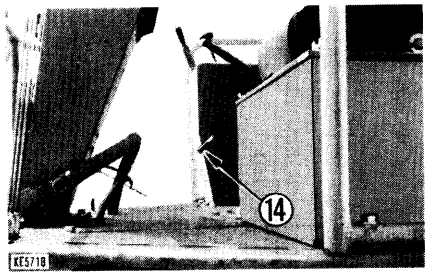


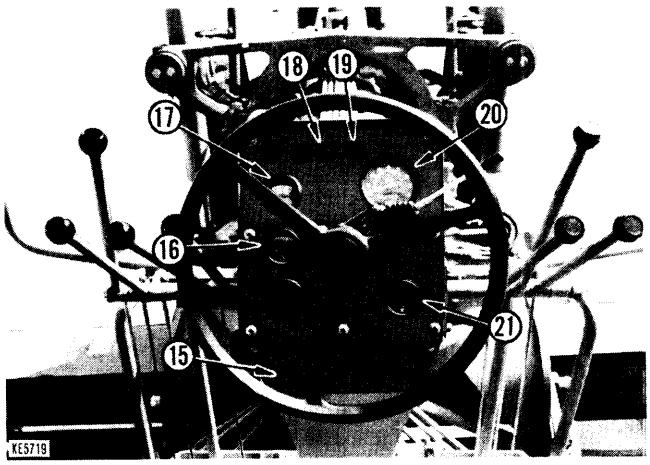
F23E04001

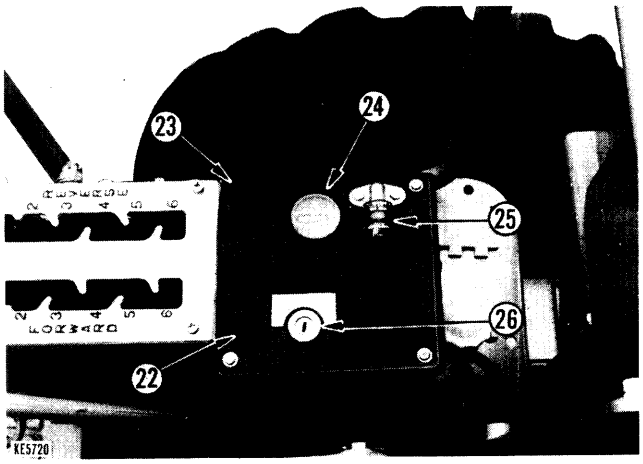
OPERATOR'S COMPARTMENT

GD705R-4





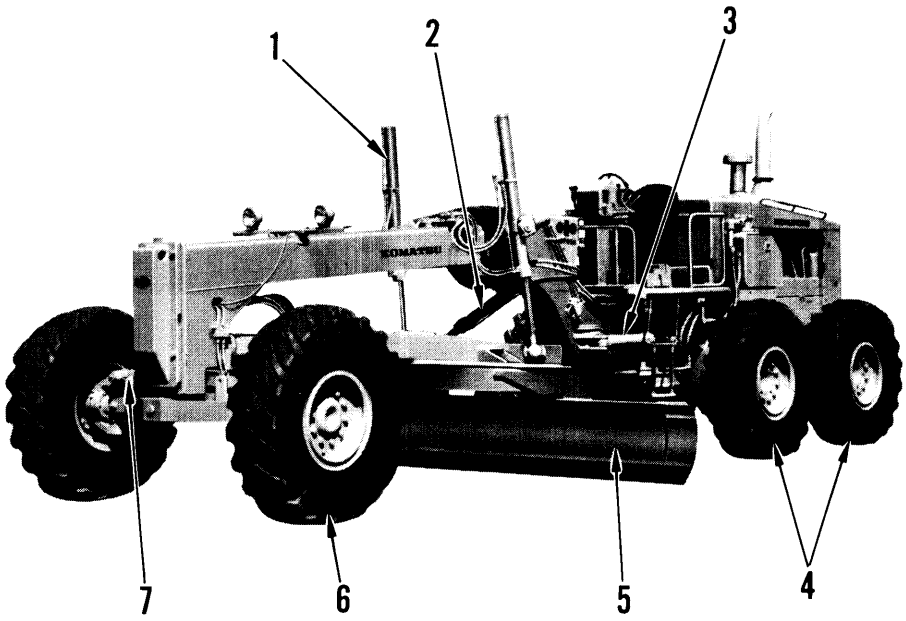




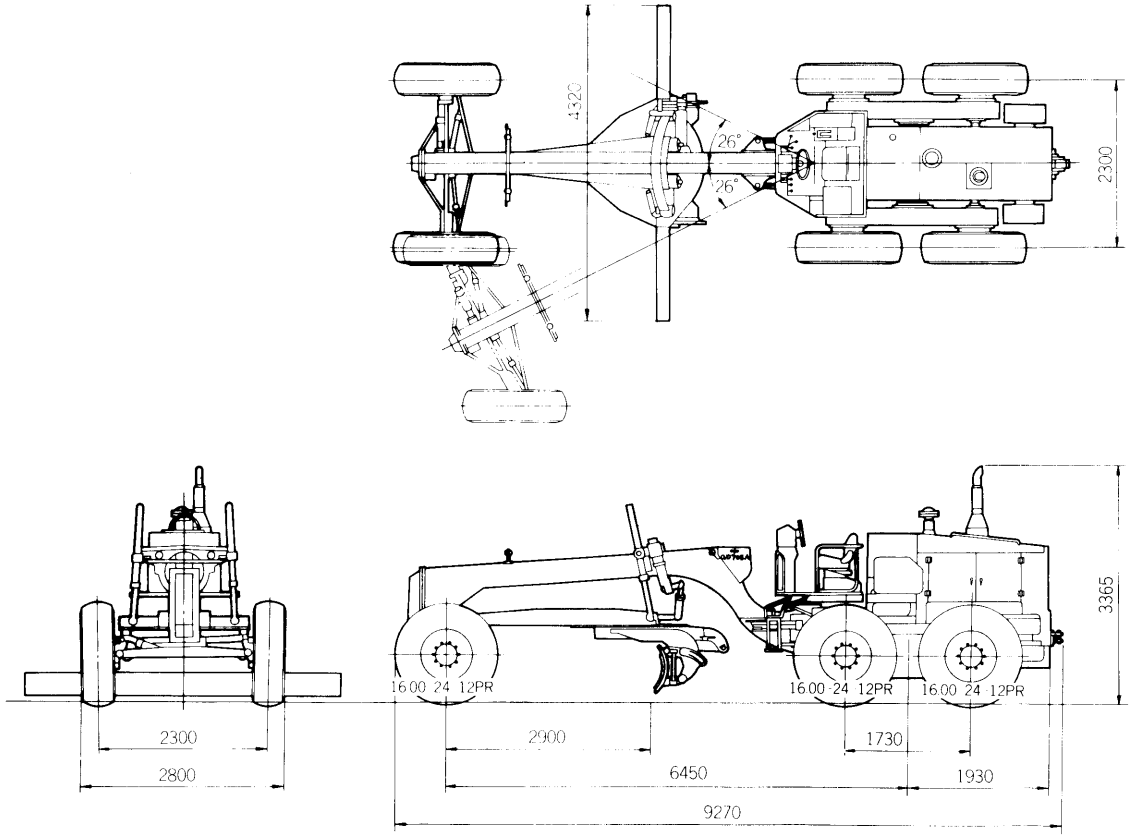
1. Work equipment control lever
2. Steering wheel
3. Horn button
4. Turn signal, dimmer switch (If equipped)
5. Safety lock (for work equipment control lever)
6. Steering post tilt pedal
7. Fuel control lever
8. Gear shift lever
9. Parking brake lever
10. Accelerator pedal
11. Brake pedal
12. Lifter lock pin pedal
13. Inching pedal
14. Safety lock lever (for gear shift lever)
15. Head lamp switch,
16. Engine oil pressure gauge
17. Water temperature gauge
18. Battery charging lamp
19. Parking brake pilot lamp acts also as brake oil level warning lamp (If equipped)
20. Speedometer
21. Fuel gauge
22. Heater signal
23. Panel lamp
24. Service meter
25. Dust indicator
26. Starting switch

GENERAL VIEW

GD705A-4



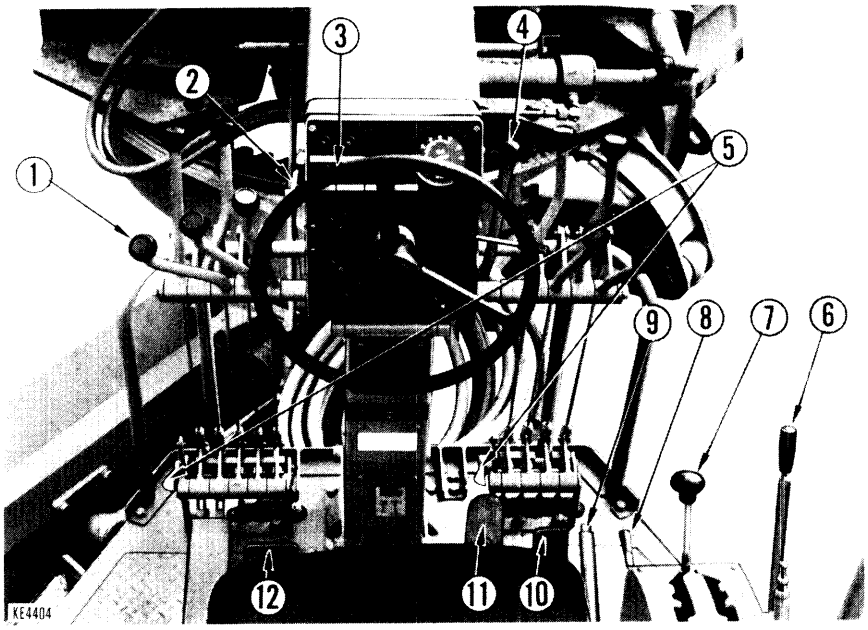
1. Blade lift cylinder
2. Drawbar side shift cylinder
3. Articulation cylinder
4. Rear tire
5. Blade
6. Front tire
7. Leaning cylinder

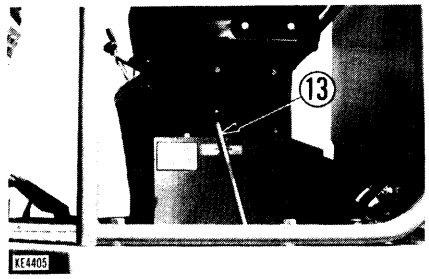


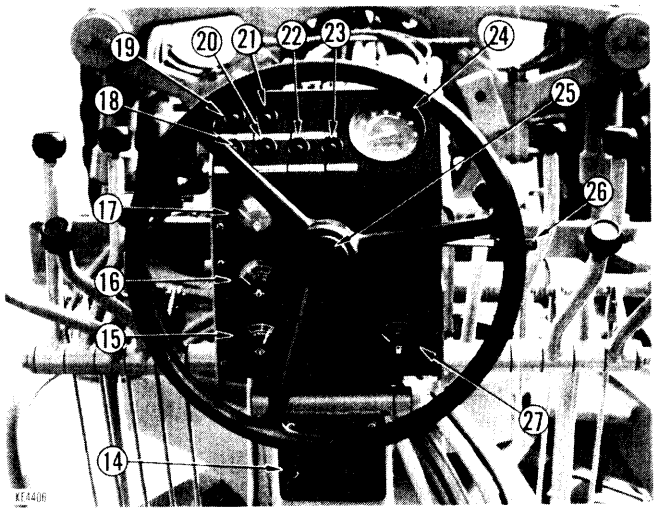
F2340400 I

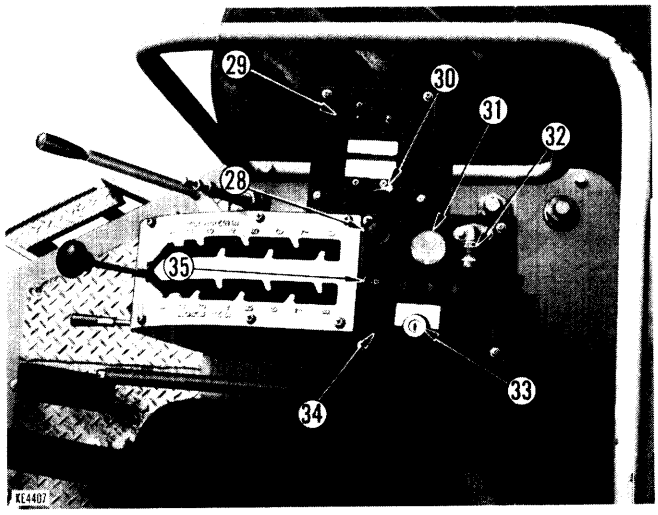
OPERATOR'S COMPARTMENT

GD705A-4





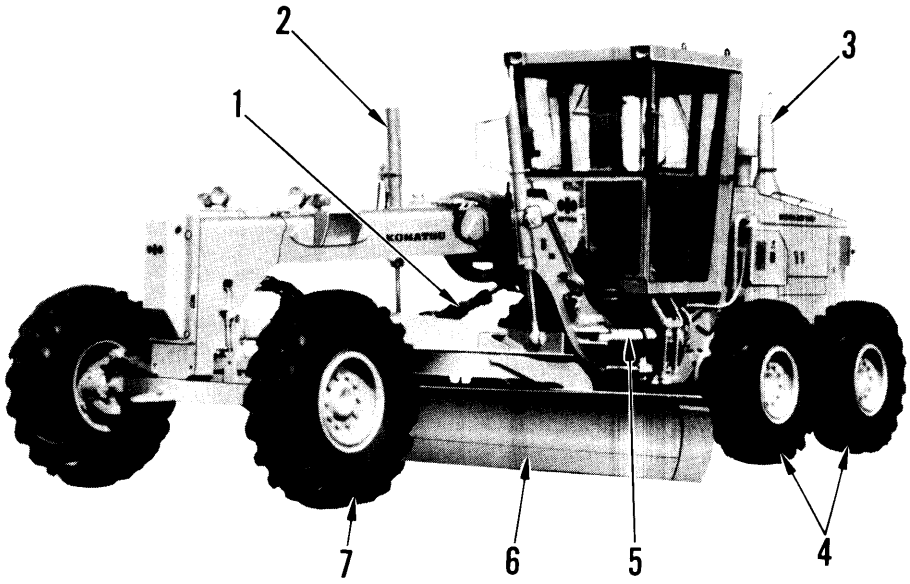




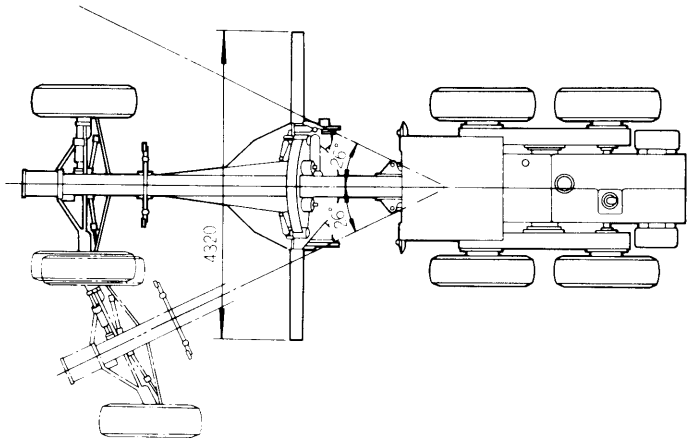
1. Work equipment control lever
2. Steering wheel tilt lever
3. Steering wheel
4. Steering post tilt lever
5. Safety lock (for work equipment control lever)
6. Fuel control lever
7. Gear shift lever
8. Safty lock lever (for gear shift lever)
9. Parking brake lever
10. Accelerator pedal
11. Brake pedal
12. Inching pedal
13. DDV lever
14. Head lamp switch
15. Air pressure gauge
16. Engine oil pressure gauge
17. Water temperature gauge
18. High beam pilot lamp (If equipped)
19. Articulation lock pilot lamp (If equipped)
20. Parking brake pilot lamp
21. Differential lock pilot lamp
22. Battery charging lamp
23. Engine oil temperature warning lamp
24. Speedometer
25. Horn button
26. Turn signal, dimmer switch
27. Fuel gauge
28. Panel lamp
29. Lifter lock release switch
30. Differential control switch
31. Service meter
32. Dust indicator
33. Starting switch
34. Heater signal
35. Working lamp switch (If equipped)

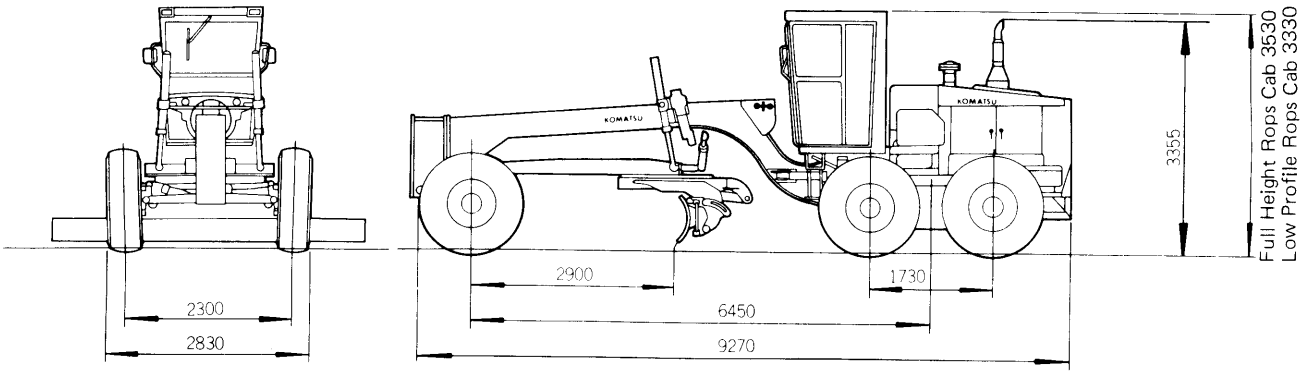
GENERAL VIEW

GD705A-4 (Serial No. 31001 and up)



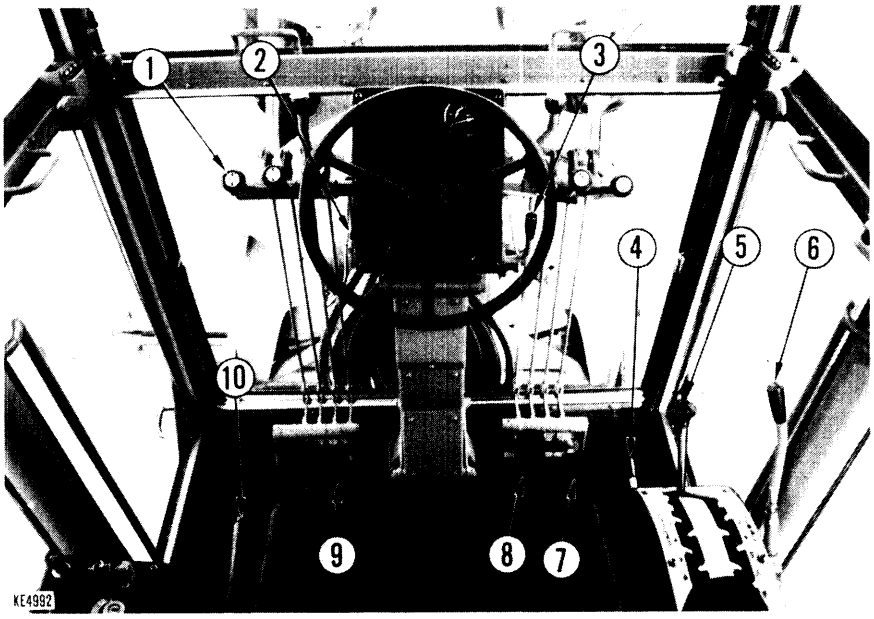
1. Drawbar side shift cylinder
2. Blade lift cylinder
3. Muffler
4. Rear tire
5. Articulation cylinder
6. Blade
7. Front tire

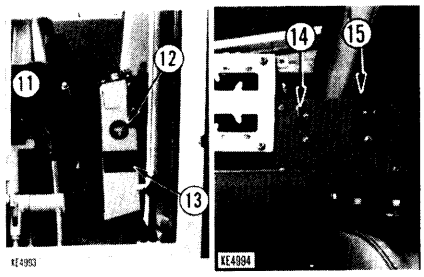


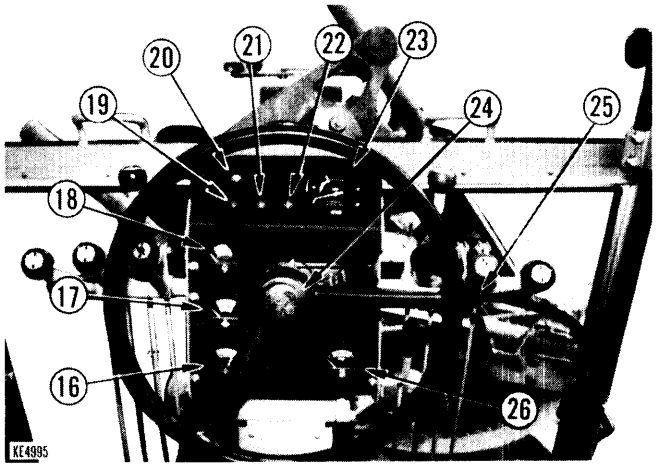


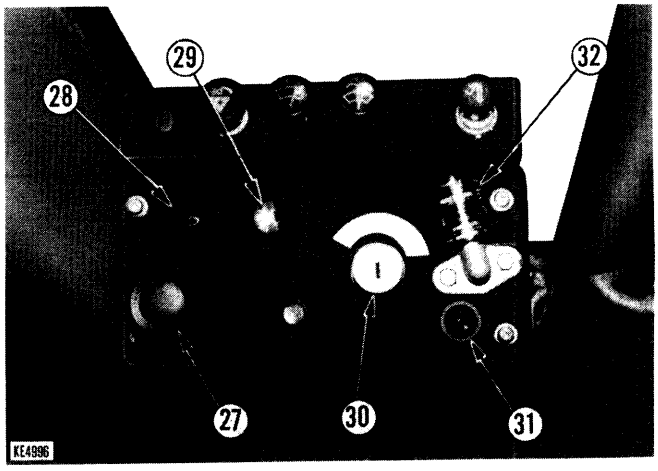
OPERATOR'S COMPARTMENT

GD705A-4 (Serial No. 31001 and up)









1. Work equipment control lever
2. Steering wheel tilt lever
3. Steering post tilt lever
4. Safety lock lever (for gear shift lever)
5. Gear shift lever
6. Fuel control lever
7. Accelerator pedal
8. Brake pedal
9. Inching pedal
10. Parking brake lever
11. DDV lever
12. Service meter
13. Fuse box
14. Differential control switch
15. Lifter lock release switch
16. Air pressure gauge
17. Engine oil pressure gauge
18. Water temperature gauge
19. Parking brake pilot lamp
20. Differential lock pilot lamp
21. Battery charging lamp
22. Engine oil temperature warning lamp
23. Speedometer
24. Horn button
25. Turn signal, dimmer switch
26. Fuel gauge
27. Panel lamp
28. Working lamp switch
29. Head lamp switch
30. Starting switch
31. Heater signal
32. Dust indicator

SPECIFICATIONS

Model				GD705R-4
Serial Numbers				16001 and up
Weight	Operating weight		(kg)	17500
	On front axle (32.2%)		(kg)	5640
	On rear axle (67.8%)		(kg)	11860
Dimensions	Overall length		(mm)	8770
	Overall width		(mm)	2460
	Overall height		(mm)	3260
	Wheel base		(mm)	6150
	Rear wheel base		(mm)	1615
	Tread (Front)		(mm)	2030
	Tread (Rear)		(mm)	2060
	Ground clearance		(mm)	360
Performance	Travel speed	Forward	1st (km/h)	3.7
			2nd (km/h)	6.6
			3rd (km/h)	11.1
			4th (km/h)	15.3
			5th (km/h)	27.7
			6th (km/h)	46.0
		Reverse	1st (km/h)	4.4
			2nd (km/h)	7.8
			3rd (km/h)	13.1
			4th (km/h)	18.2
			5th (km/h)	32.6
			6th (km/h)	53.9
	Maximum drawbar pull		(kg)	9490
	Turning radius		(m)	11.5
	Over turn angle		(°)	35

Model				GD705R-4
Serial Number				16001 and up
Wheels	Tire (Front)			14.00 – 24 – 12 PR (3.5 kg/cm^2)
	Tire (Rear)			14.00 – 24 – 12 PR (3.5 kg/cm^2)
	Rim (Front)			8.00 TG x 24
	Rim (Rear)			8.00 TG x 24
Blade	Blade dimension		(mm)	
	(Length x Height x Thickness)			4270 x 700 x 19
	Cutting edge dimension		(mm)	
	(Number – Length x Width x Thickness)			2 x 2134 x 152 x 15.9
	Turning angle		(°)	360
	Cutting angle			
	[Standard]		(°)	32
	[Maximum]		(°)	74
	[Minimum]		(°)	24
Engine	Engine model			Komatsu 6D125-1 Diesel Engine
	type			4-cycle, water-cooled, overhead valve, direct injection type
	Cylinder number – bore x stroke		(mm)	6 – 125 x 150
	Piston displacement		(cc)	11040
	Firing order			1 – 5 – 3 – 6 – 2 – 4
	Dimension	Overall length	(mm)	1563
		Overall width	(mm)	881
		Overall height	(mm)	1507
	Performance	Flywheel horsepower	(HP/rpm)	182/1850
		Maximum torque	(kgm/rpm)	80/1100
		High idling	(rpm)	2100 ± 50
		Low idling	(rpm)	650 $^{+50}_{-0}$
		Fuel consumption ratio	(g/HP.h)	158
	Dry weight		(kg)	1300
	Fuel oil			Diesel fuel ASTM D975 No. 2 or No. 1
	Fuel pump			Bosch type PE-NB
	Governor			Bosch RSV centrifugal, all-speed type
	Alternator			24V, 13A
	Starting motor			24V, 7.5 kW
	Battery			12V, 150 Ah x 2

( ): Low Profile Rops Cab

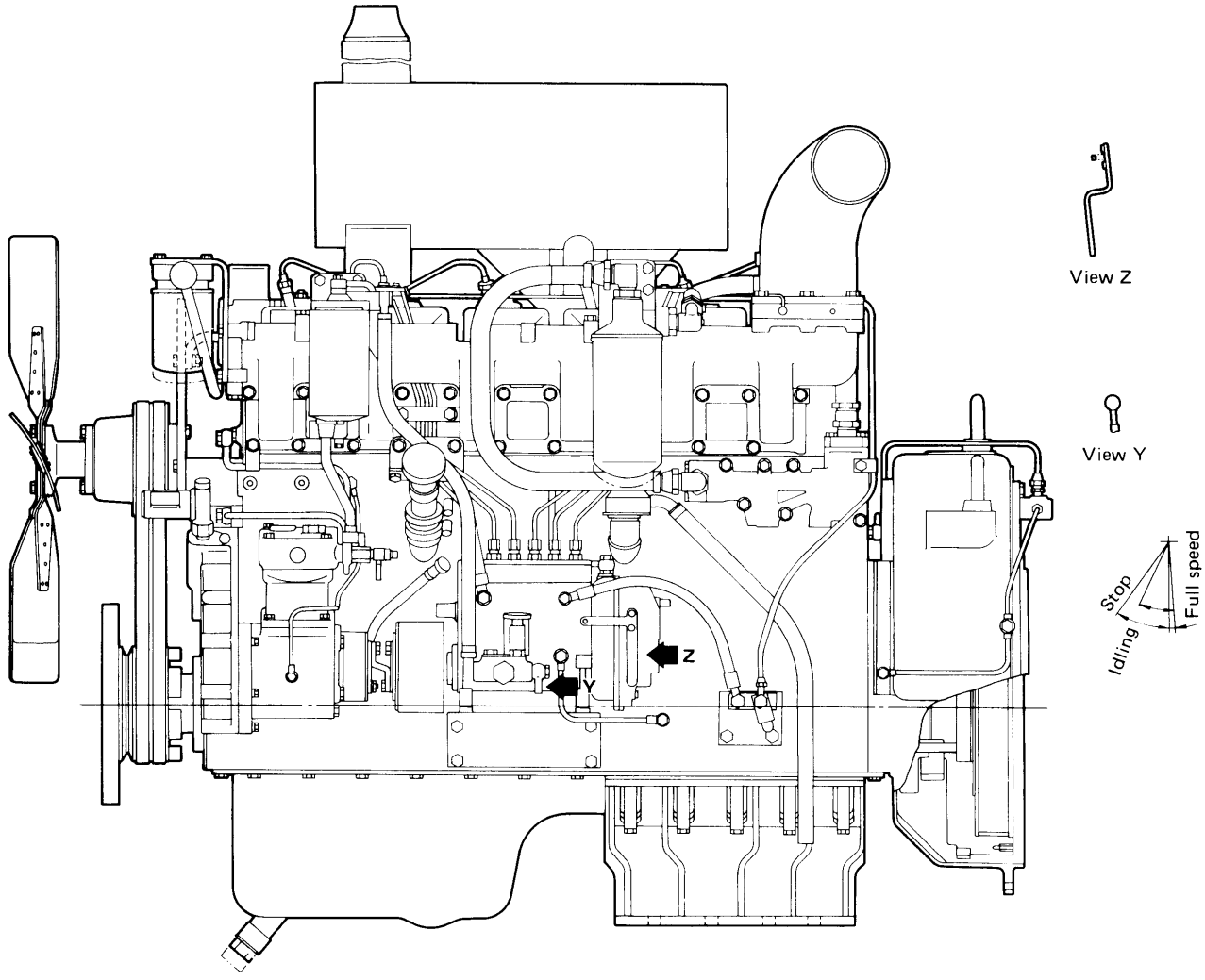
Model				GD 705A-4	
Serial Numbers				21001 and up	31001 and up
Weight	Operating weight		(kg)	17620	18880 (18840)
	On front axle (27.7%)		(kg)	4885	5110 (5100)
	On rear axle (72.3%)		(kg)	12735	13770 (13740)
Dimensions	Overall length		(mm)	9270	9270
	Overall width		(mm)	2800	2830
	Overall height		(mm)	3365	3530 (3355)
	Wheel base		(mm)	6450	6450
	Rear wheel base		(mm)	1730	1730
	Tread (Front)		(mm)	2300	2300
	Tread (Rear)		(mm)	2300	2300
	Ground clearance		(mm)	410	410
Performance	Travel speed	Forward	1st (km/h)	3.9	
			2nd (km/h)	5.2	
			3rd (km/h)	7.6	
			4th (km/h)	11.0	
			5th (km/h)	15.2	
			6th (km/h)	20.5	
			7th (km/h)	30.0	
			8th (km/h)	43.0	
		Reverse	1st (km/h)	4.1	
			2nd (km/h)	5.6	
			3rd (km/h)	8.1	
			4th (km/h)	11.7	
			5th (km/h)	16.2	
			6th (km/h)	21.8	
			7th (km/h)	31.9	
			8th (km/h)	45.9	
	Maximum drawbar pull		(kg)	10180	11010 (10990)
	Turning radius		(m)	7.5	7.5
	Over turn angle		(°)	35	35

Model				GD705A-4	
Serial Number				21001 and up	31001 and up
Wheels	Tire (Front)			16.00 – 24 – 12 PR (2.2 kg/cm^2)	
	Tire (Rear)			16.00 – 24 – 12 PR (2.2 kg/cm^2)	
	Rim (Front)			1000 VA x 24 SDC	
	Rim (Rear)			1000 VA x 24 SDC	
Blade	Blade dimension (Length x Height x Thickness)		(mm)	4320 x 700 x 25	
	Cutting edge dimension (Number – Length x Width x Thickness)		(mm)	2 – 2134 x 203 x 16	
	Turning angle		(°)	360	
	Cutting angle				
	[Standard]		(°)	34	
	[Maximum]		(°)	84	
	[Minimum]		(°)	26	
Engine	Engine model			Komatsu S6D 125-1 Diesel Engine	
	type			4-cycle, water-cooled, overhead valve, direct injection type with turbocharger	
	Cylinder number – bore x stroke		(mm)	6 – 125 x 150	
	Piston displacement		(cc)	11040	
	Firing order			1 – 5 – 3 – 6 – 2 – 4	
	Dimension	Overall length	(mm)	1556	
		Overall width	(mm)	877	
		Overall height	(mm)	1703	
	Performance	Flywheel horsepower	(HP/rpm)	200/2000	
		Maximum torque	(kgm/rpm)	92/1300	
		High idling	(rpm)	2200 ± 50	
		Low idling	(rpm)	650^{+50}_{-0}	
		Fuel consumption ratio	(g/HP.h)	152	
	Dry weight		(kg)	1175	
	Fuel oil			Diesel fuel ASTM D975 No. 2 or No. 1	
	Fuel pump			Bosch PE-P type	
	Governor			Bosch RSV centrifugal, all-speed type	
	Alternator			24V, 35A	24V, 60A
	Starting motor			24V, 7.5 kW	24V, 11 kW
	Battery			12V, 200Ah x 2	12V, 200Ah x 2

ENGINE ASSEMBLY

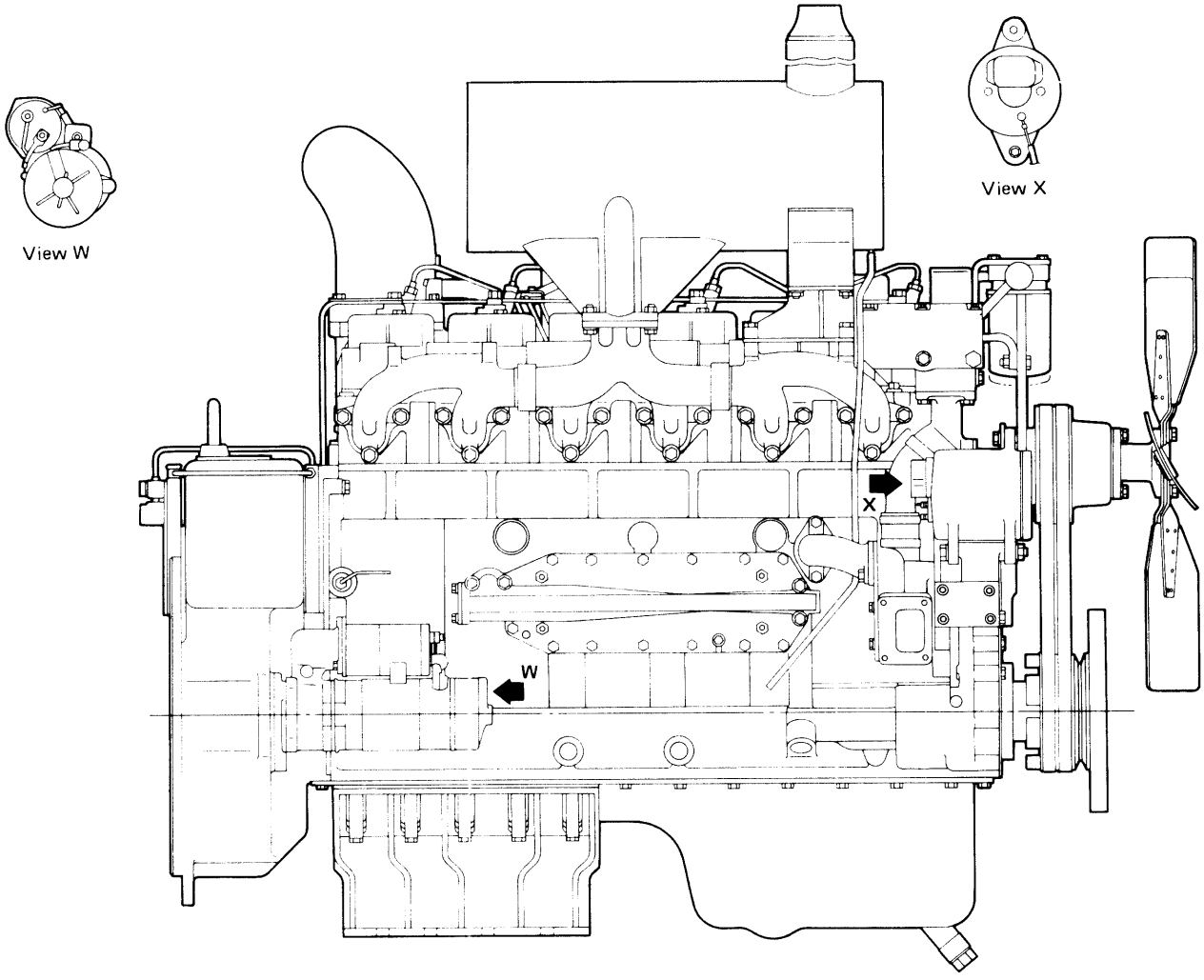
KOMATSU 6D125-1 (GD705R-4)

- **Left side view**



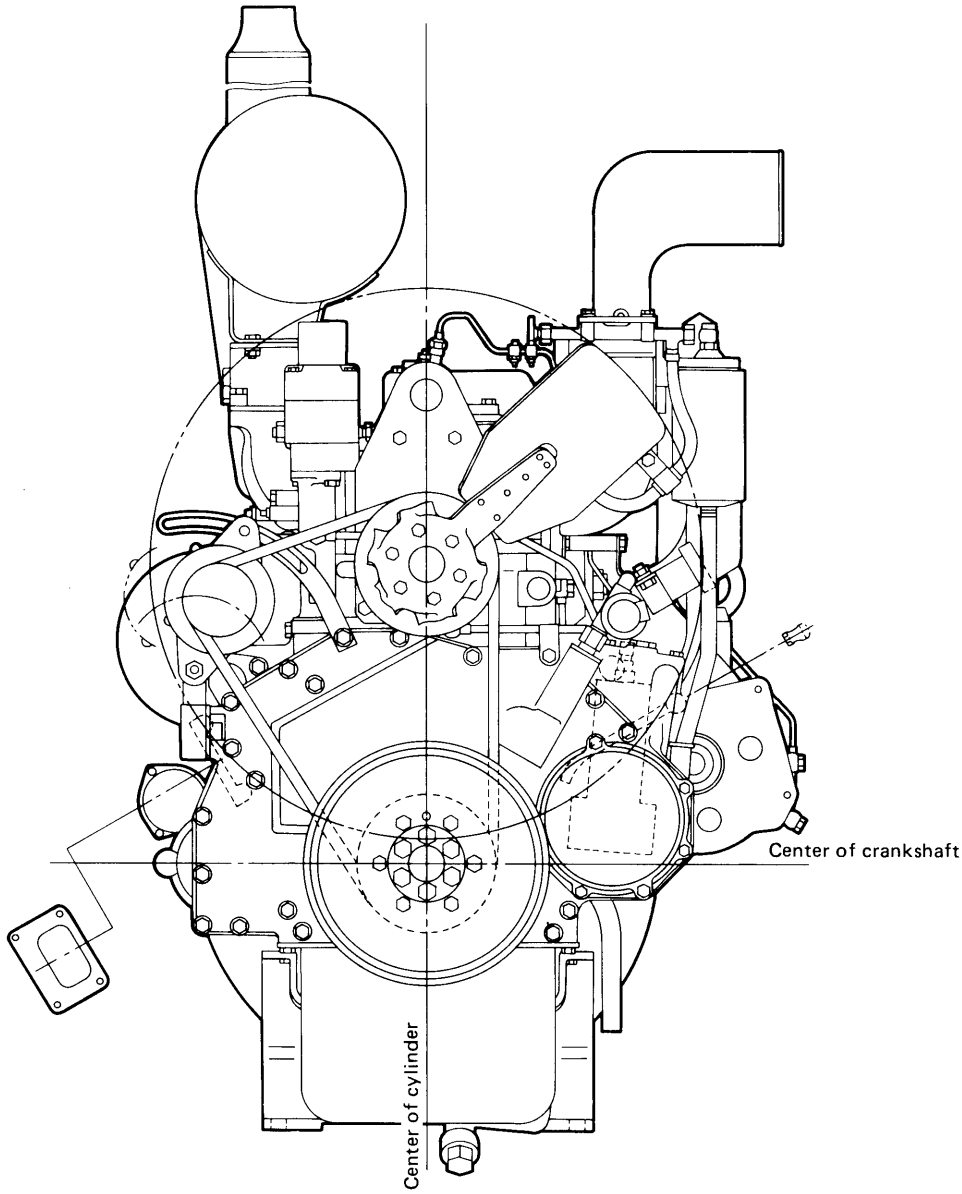
F23E04002

- **Right side view**



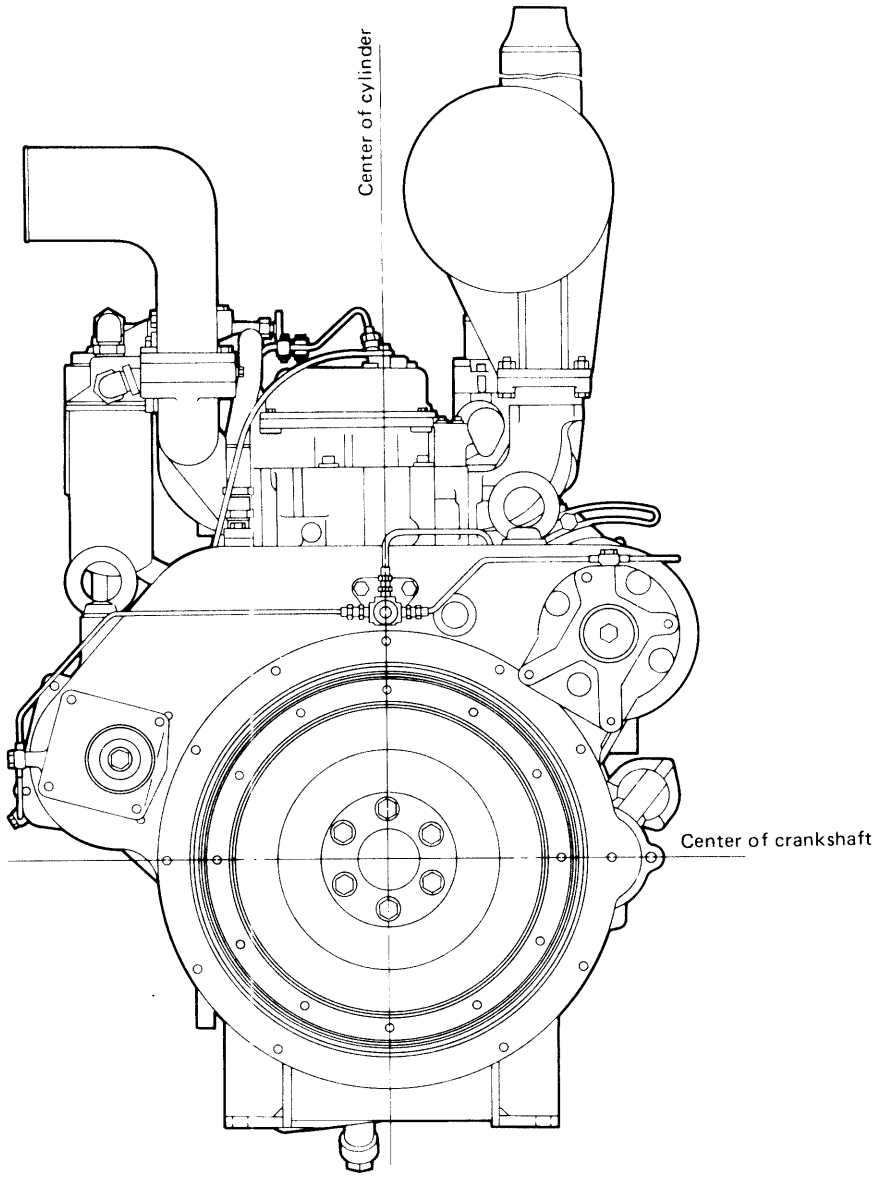
F23E04003

- **Front side view**



F23E04004

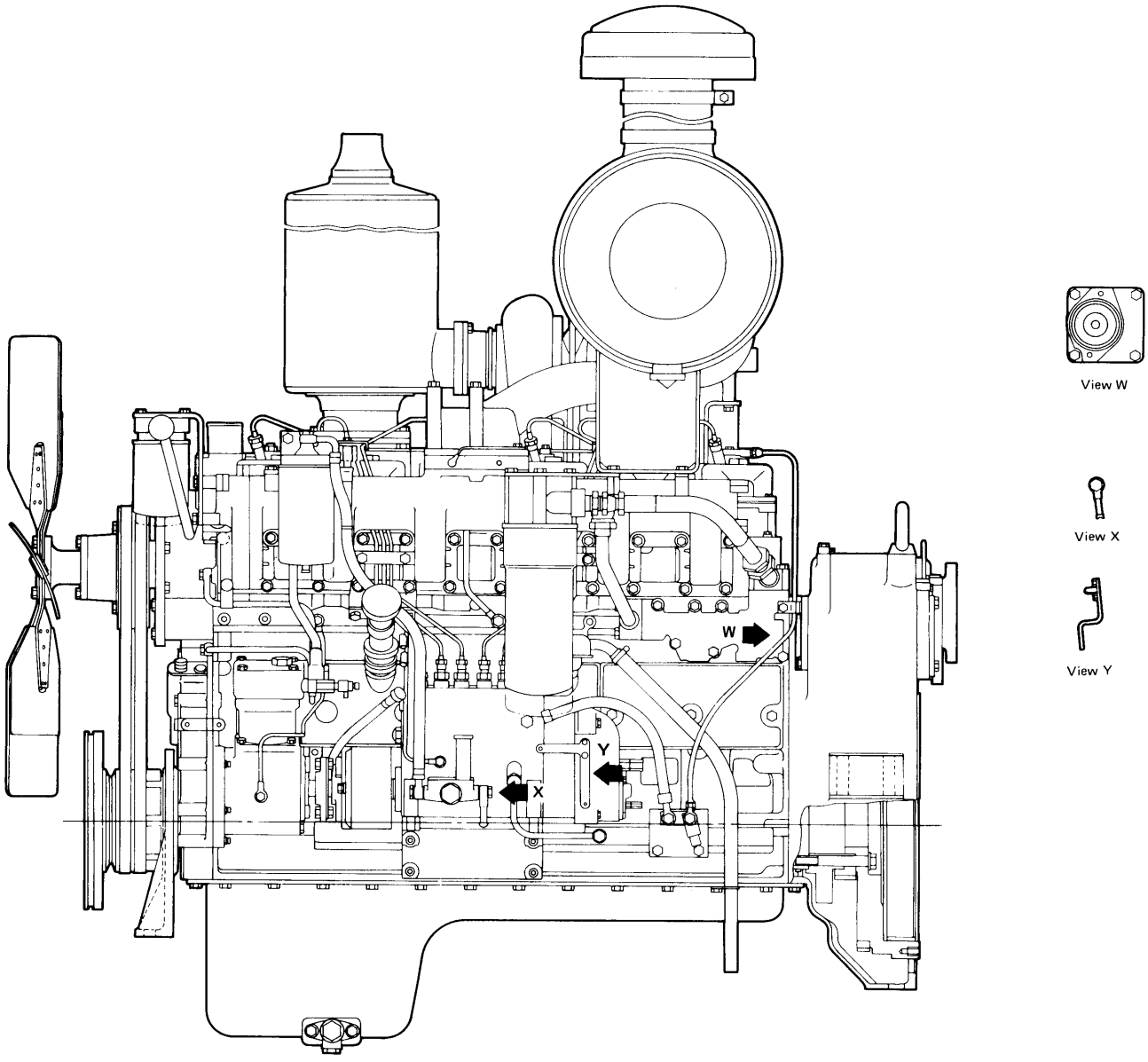
- **Rear side view**



F23E04005

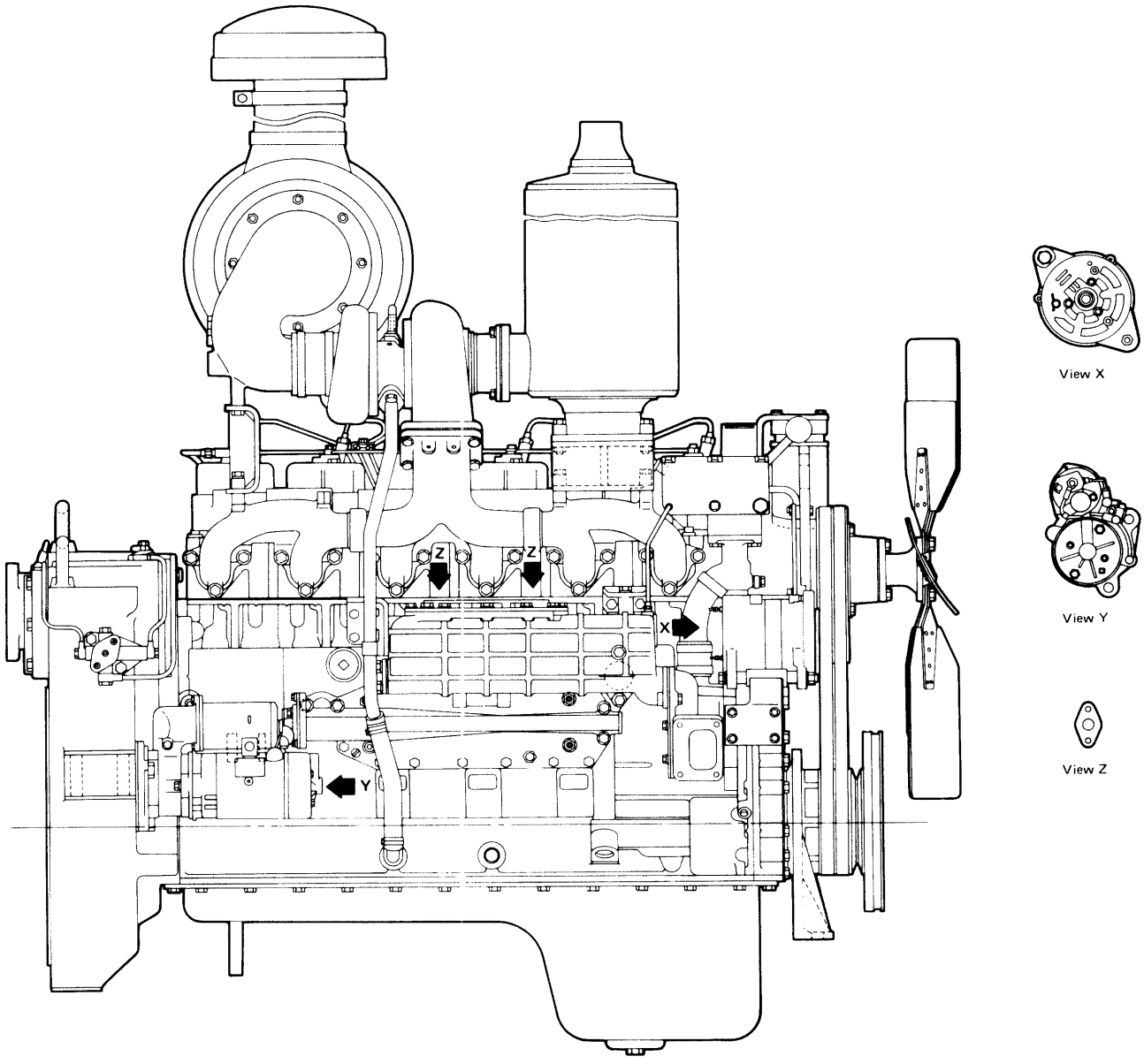
KOMATSU S6D125-1 (GD705A-4)

- **Left side view**



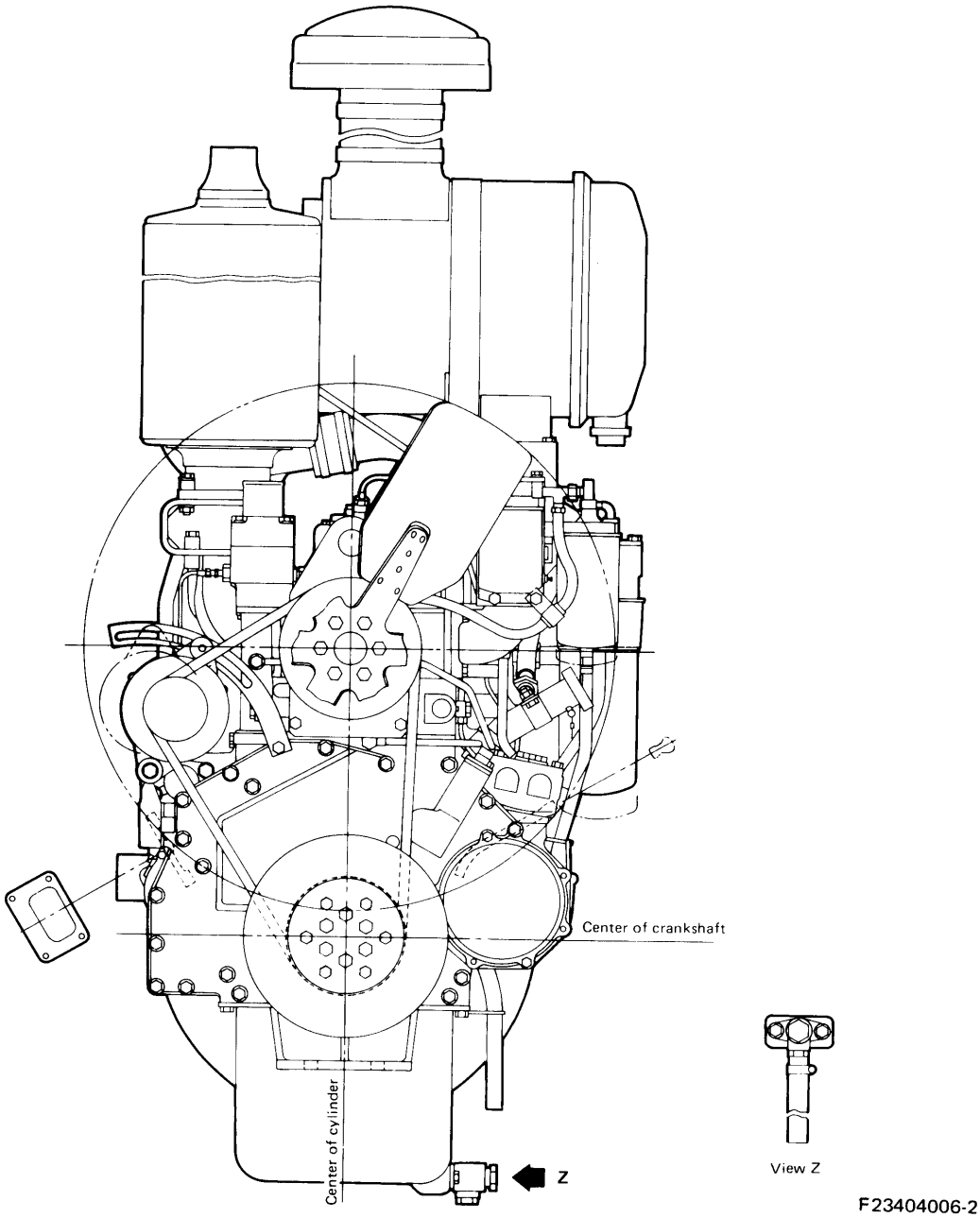
F23404007-1

- **Right side view**



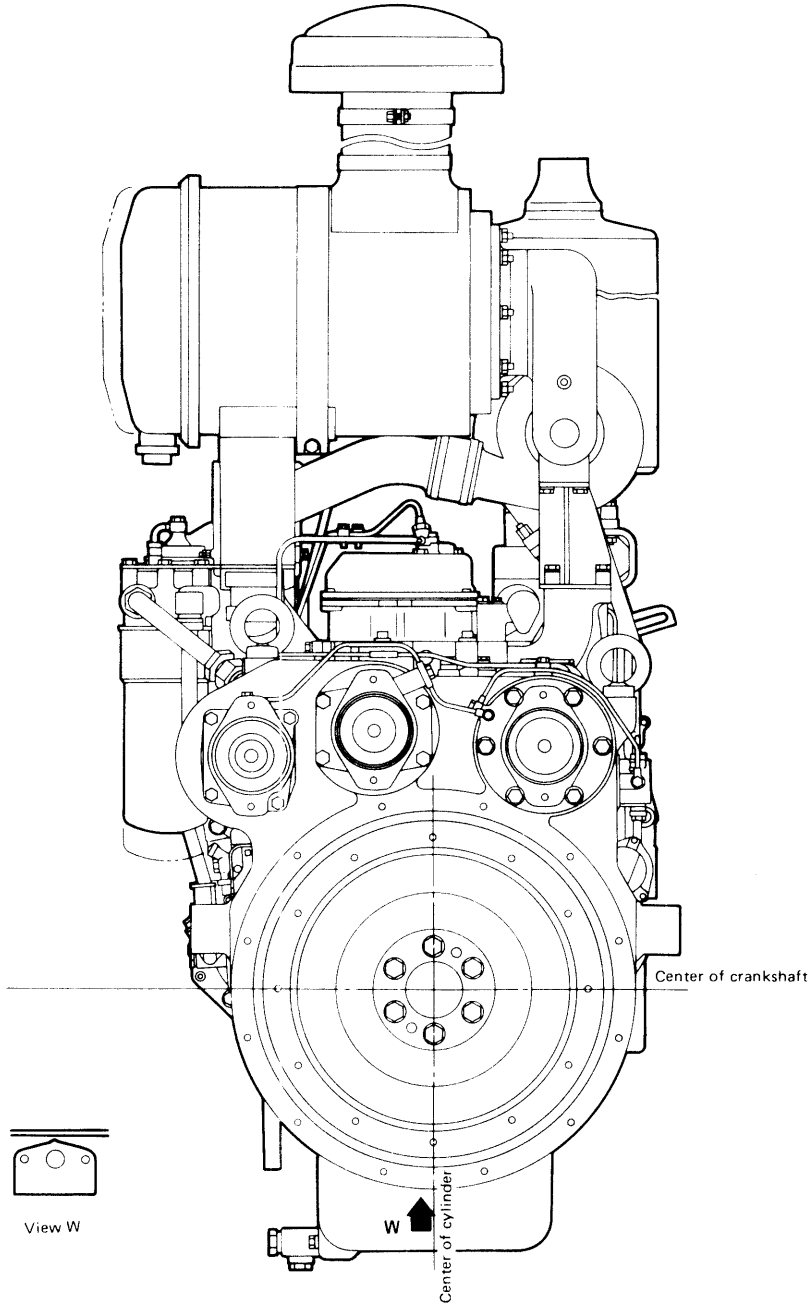
F23404006-1

- **Front side view**



F23404006-2

- **Rear side view**



F23404007-2

WEIGHT TABLE

⚠ **This weight table is a guide for use when transporting or handling components.**

( ): GD705A-4 Serial No. 31001 and up Unit: kg

Model	GD705R-4	GD705A-4
Serial Numbers	16001 and up	21001 and up
Engine assembly (dry)	1300	1175
Radiator assembly (dry)	85	132
Fuel tank assembly (dry)	175	256
Transmission (dry)	805	950
Final drive assembly	940	1154
Tandem drive assembly (each)	900 x 2	1029 x 2
Front axle assembly (except leaning cylinder)	475	640
Parking brake	17	25
Frame assembly	3400	3160
Front frame assembly	–	1910
Rear frame assembly	–	1250
Operator's compartment assembly (inc. control)	250	260 (350)
ROPS canopy assembly	–	– (800)
Drawbar assembly	1010	1735
Blade assembly	900	849
Lifter assembly		334
Circle rotation assembly	95	176
Wheel assembly	160 x 6	235 x 6
Power tilt cylinder assembly	–	41
Leaning cylinder assembly	15	23
Blade lift cylinder assembly	55	63

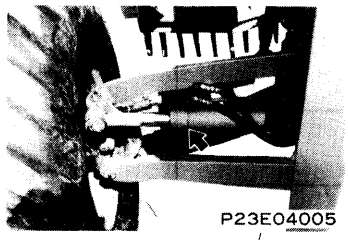
Unit: kg

Model	GD705R-4	GD705A-4
Serial Numbers	16001 and up	21001 and up
Drawbar shift cylinder assembly	30	43
Blade side shift cylinder assembly	45	72
Steering cylinder	8	11
Articulate cylinder	–	44
Ripper cylinder (dry)	–	105
Scarifier cylinder assembly (If equipped)	30	–
Scarifier assembly (If equipped)	520	–
Hydraulic tank (dry)	60	64
Hydraulic pump	SAR020 + 020 6	SAR050 + 050 14 SAL050 6
Steering pump	LAR016 3	SAR032 5
Transmission pump	SAL045 6	SAL050 6
Circle rotation motor	10	19

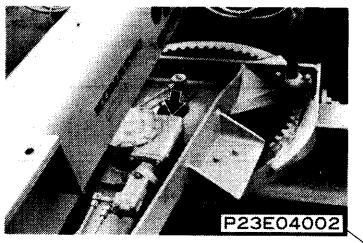
SERIAL NUMBER LOCATIONS

GD705R-4

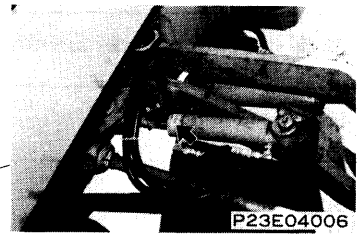
- Leaning cylinder No.



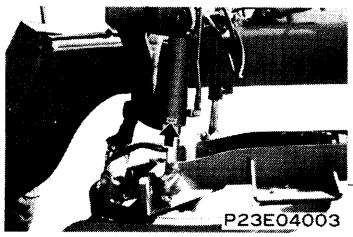
- Circle rotation gear No.



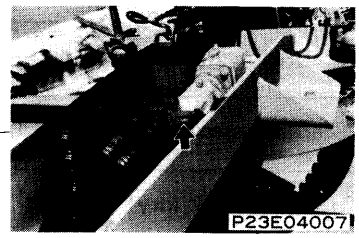
- Steering cylinder No.

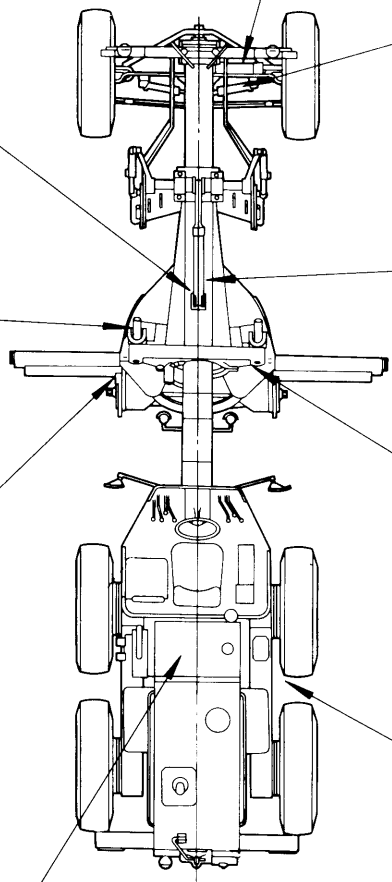


- Blade lift cylinder No.

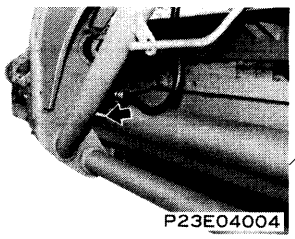


- Circle rotation motor No.

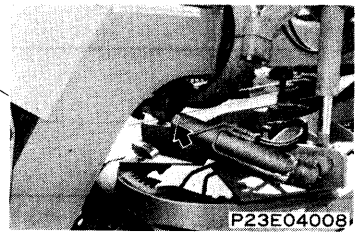




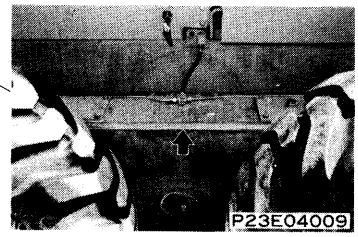
- Blade side shift cylinder No.



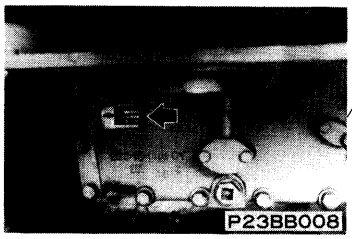
- Drawbar shift cylinder No.



- Tandem drive case No.

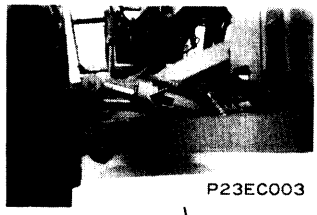


- Transmission No.

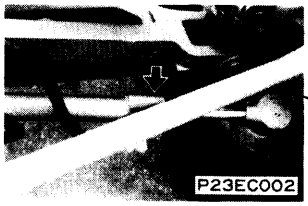


GD705A-4

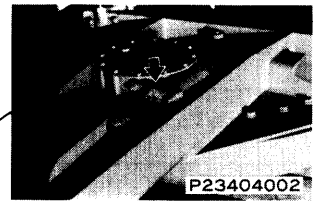
- Leaning cylinder No.



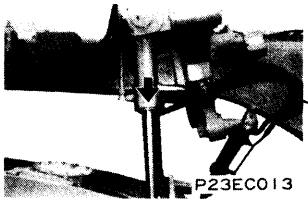
- Steering cylinder No.



- Circle rotation gear No.

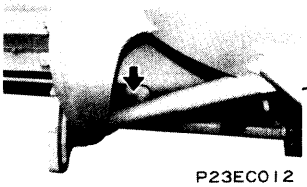


- Blade lift cylinder No.

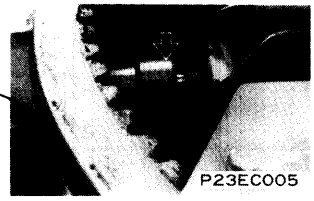


- Circle rotation motor No.

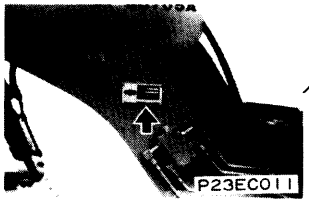
- Blade side shift cylinder No.



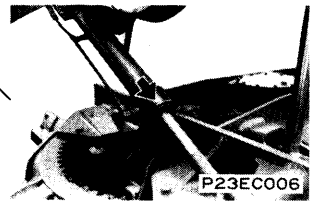
- Power tilt cylinder No.



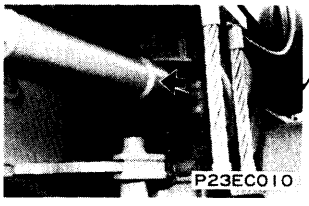
- Chassis No.



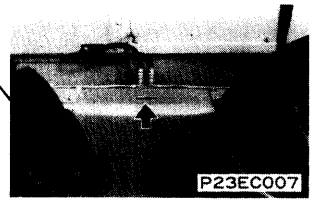
- Drawbar shift cylinder No.

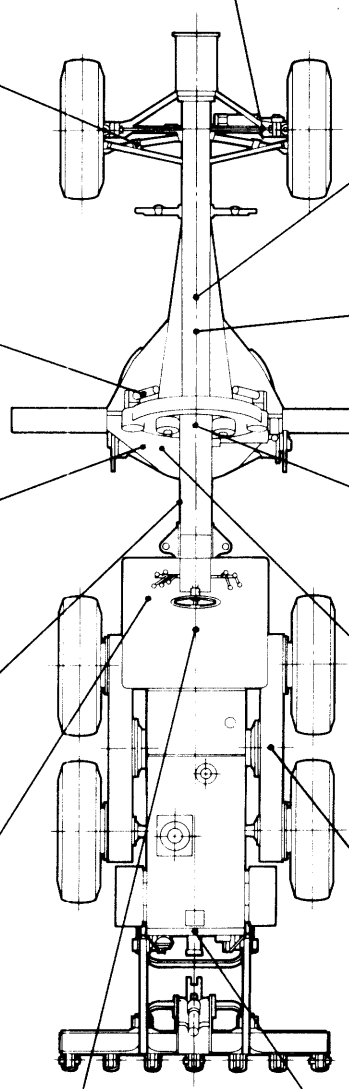


- Articulate cylinder No.

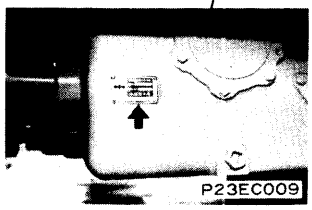


- Tandem case No.

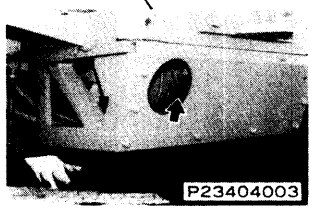




F23404002



- Transmission No.



- Air reservoir No.

LIST OF LUBRICANT AND WATER

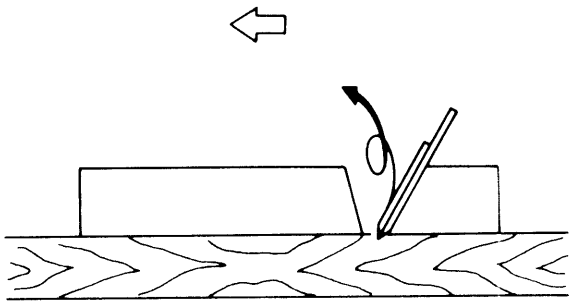
Unit: ℓ

MODEL	GD705R-4	GD705A-4	Remark
SERIAL NUMBERS	16001 and up	21001 and up	
Engine cooling system	55	55	Water
Fuel tank	300	400	Diesel fuel ASTM D975 No. 2 or No. 1
Engine oil pan	30	30	Engine oil class CD SAE30, SAE10W SAE10W-30, SAE15W-40
Hydroshift transmission case	40	48	Engine oil class CD SAE30 or SAE10W
Tandem drive case (each)	36	105	
Hydraulic tank (incl. hydraulic circuit)	68	140	Engine oil class CD SAE10W, SAE10W-30, SAE15W-40
Final drive case	30	40	Gear oil SAE90
Circle rotation gear case	4	12	
Brake fluid tank	0.8	–	Brake fluid SAE J-1703f
Hydromaster	0.06	–	Vacuum cylinder oil

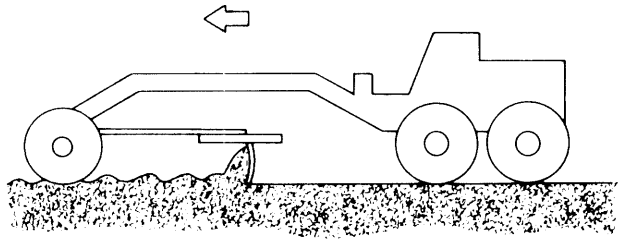
MOTOR GRADER DESCRIPTION

FUNCTION

The major functions of a motor grader are to level road surfaces and dig ditches of fixed shape. In terms of function, a grader can be likened to a gigantic carpenter's plane.



Carpenter's plane 230F001



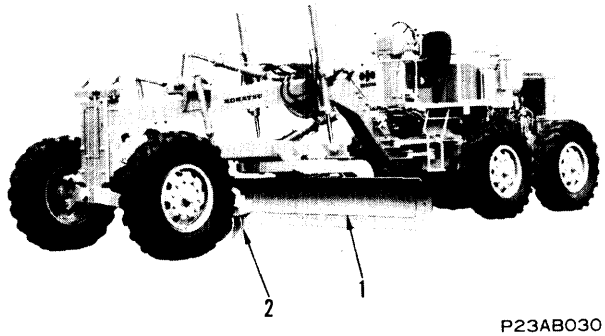
Motor grader 230F002

STRUCTURAL FEATURES

Since the major purpose of a motor grader is levelling of ground surfaces, mainly by use of a blade, vertical and lateral movement should be kept to a minimum during travel.

For this reason, motor graders have a long wheel base with the blade assembly (1) mounted in the center. Consequently, the engine, transmission and driving gear are located at the rear of the machine. The driver's seat is positioned behind the blade assembly and above the transmission and drive gear.

The scarifier assembly (2) (If equipped) can either be behind or in front of the front wheels. All grader travel and work operations are controlled by a single operator in the driver's seat.



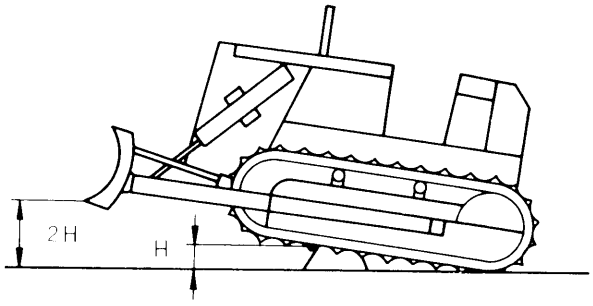
P23AB030

Road Levelling

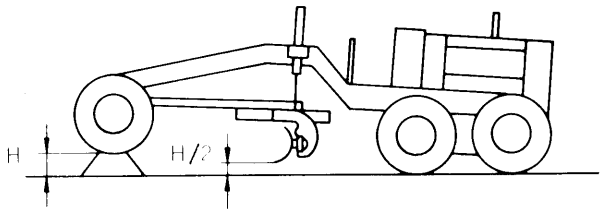
When performing road levelling operations, the grader itself has to travel over uneven surfaces. To minimize the vertical movement in the chassis and blade assembly caused by this uneveness, the grader incorporates special structural features.

1. **Large wheel base**
   When automobiles travel along an uneven road, those with a larger wheel base experience less vibration than those with a smaller wheel base. By designing motor graders with a large wheel base, vertical movement is kept to a minimum.

2. **Blade assembly mounted in center of grader**
   When a bulldozer with the blade located at the front runs over a rock, the blade is lifted to a relatively large degree. With graders whose blade is located in the center, the vertical movement of the blade is only 1/4 that of the bulldozer blade lift.

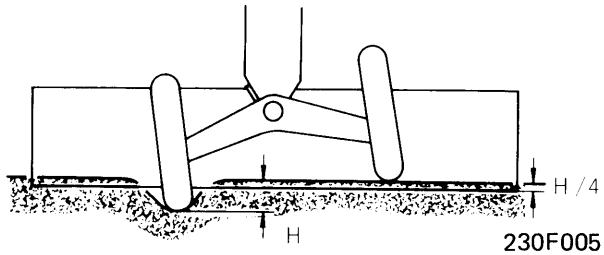


230F003



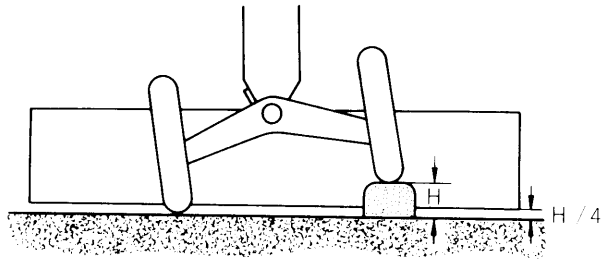
230F004

3. **Seesaw motion in front wheel axle**
   If one of the front wheels runs over a rock or dips into a hole, the seesaw motion of the front wheel axle about the center pin ensures that the blade assembly remains horizontal.



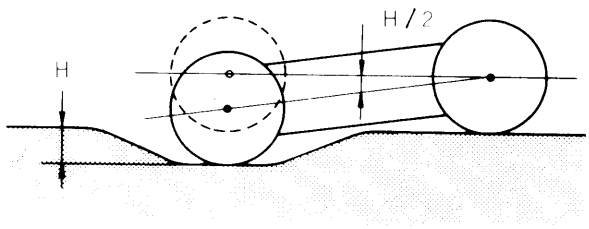
230F005

One wheel dips into a hole



One wheel runs over a rock 230F006

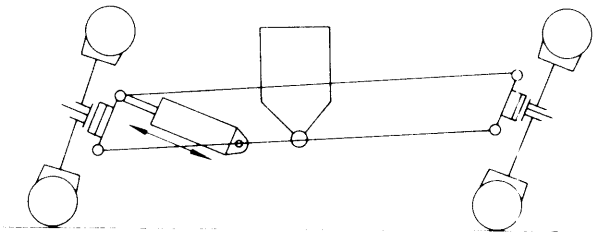
4. **Rear wheel tandem mechanism**
   Motor graders have four rear wheels (two on the left and two on the right) working in tandem. This permits the two pairs of rear wheels to move vertically in respect to each other, thereby ensuring that all four drive wheels remain in contact with the ground when moving over uneven surfaces. In addition to minimizing driving force, this also minimizes the effect on the blade assembly levelling precision.
   In small graders (such as GD22), where turning radius is important, there is only a single pair of rear wheels.



230F007

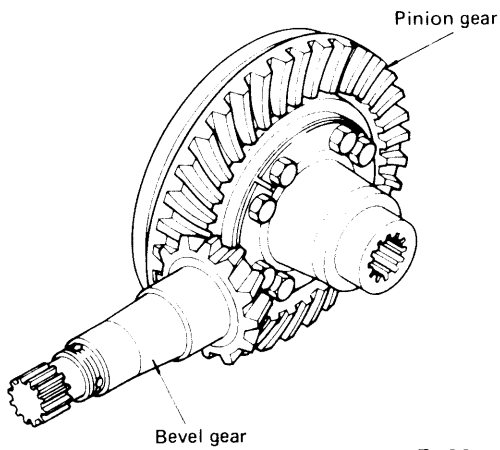
Improved forward drive

1. **Leaning mechanism**
   This mechanism shifts the front wheels to the left or right by utilizing a conical rolling action. By putting the front wheels at an angle according to the load on the blade, lateral slipping of the front wheels is reduced during operation, thereby facilitating easier forward drive.
   The leaning mechanism also reduces the turning circle.



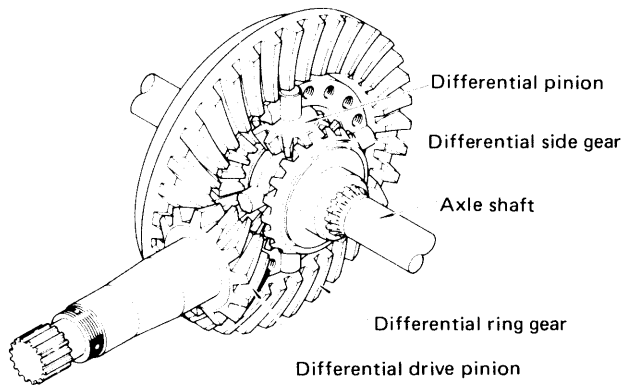
230F008

2. **Non-differential reduction gear**
   Graders are often put to work on very rough surfaces and construction sites. To prevent zig-zagging due to loss of traction when slipping in mud and when there is a sudden change in the load applied to the blade, a differential gear has not been included. Although this may result in a little extra strain on the machine when turning corners, it does make forward drive easier.
   GD705A includes a lock-unlock differential gear as an option.



230F009

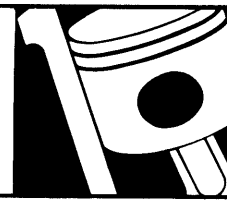
Lock-unlock differential gear



230F010

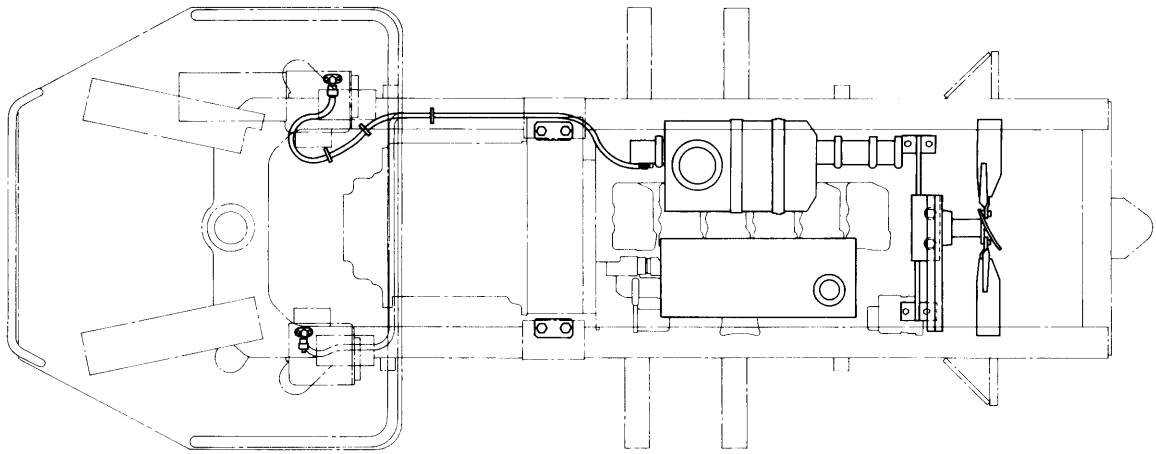
ENGINE

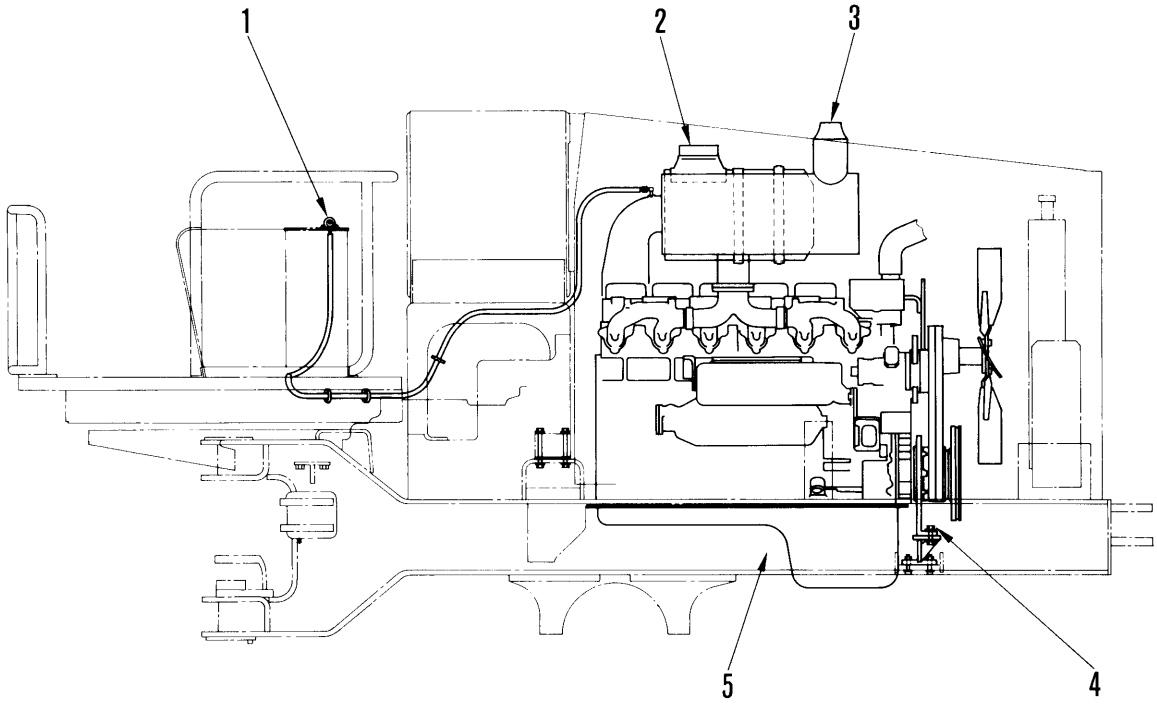
11 STRUCTURE AND FUNCTION



ENGINE MOUNTING

GD705R-4

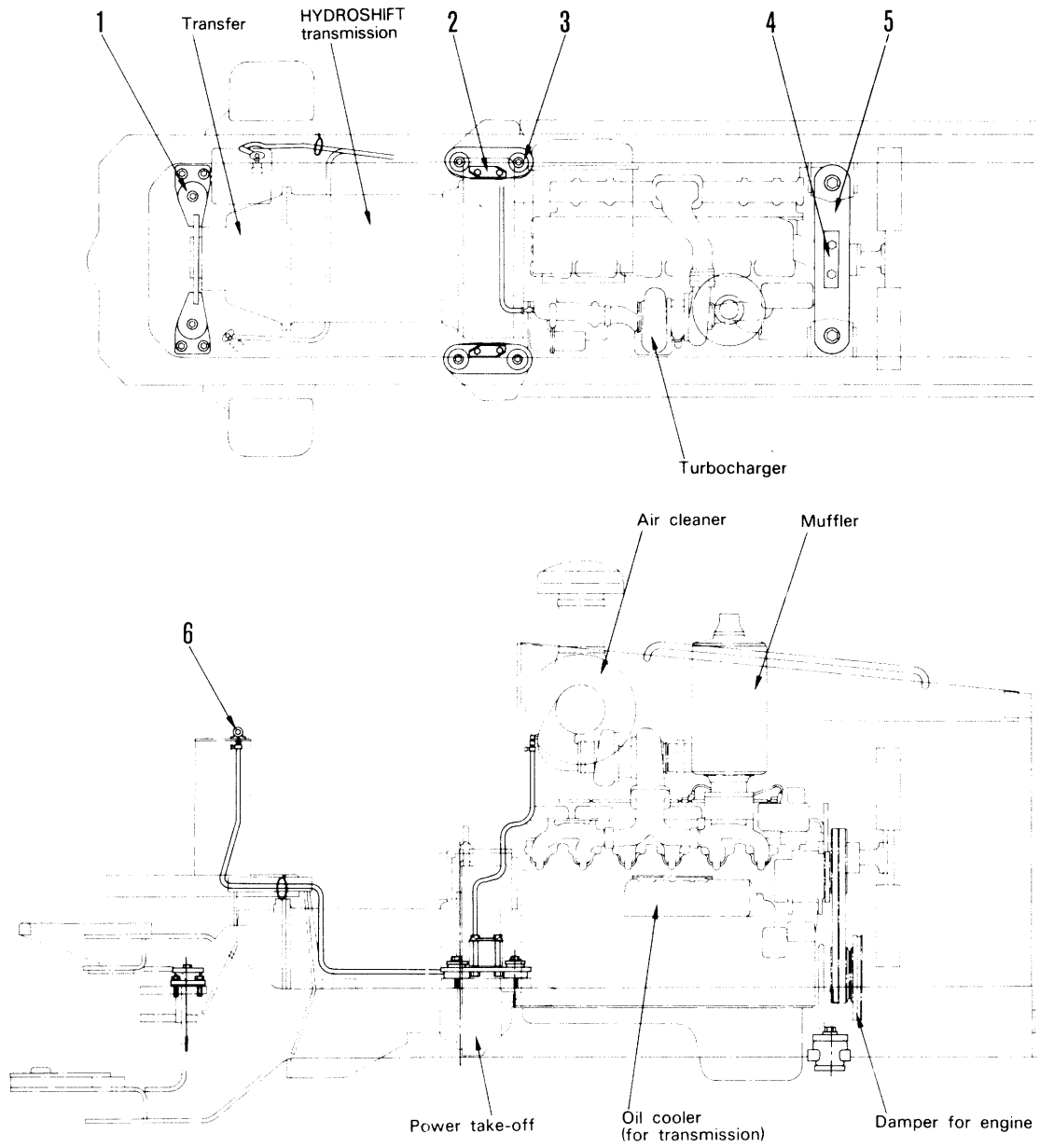




F23B03003

1. Dust indicator
2. Air cleaner
3. Muffler
4. Mounting bolt
5. Main frame

GD705A-4

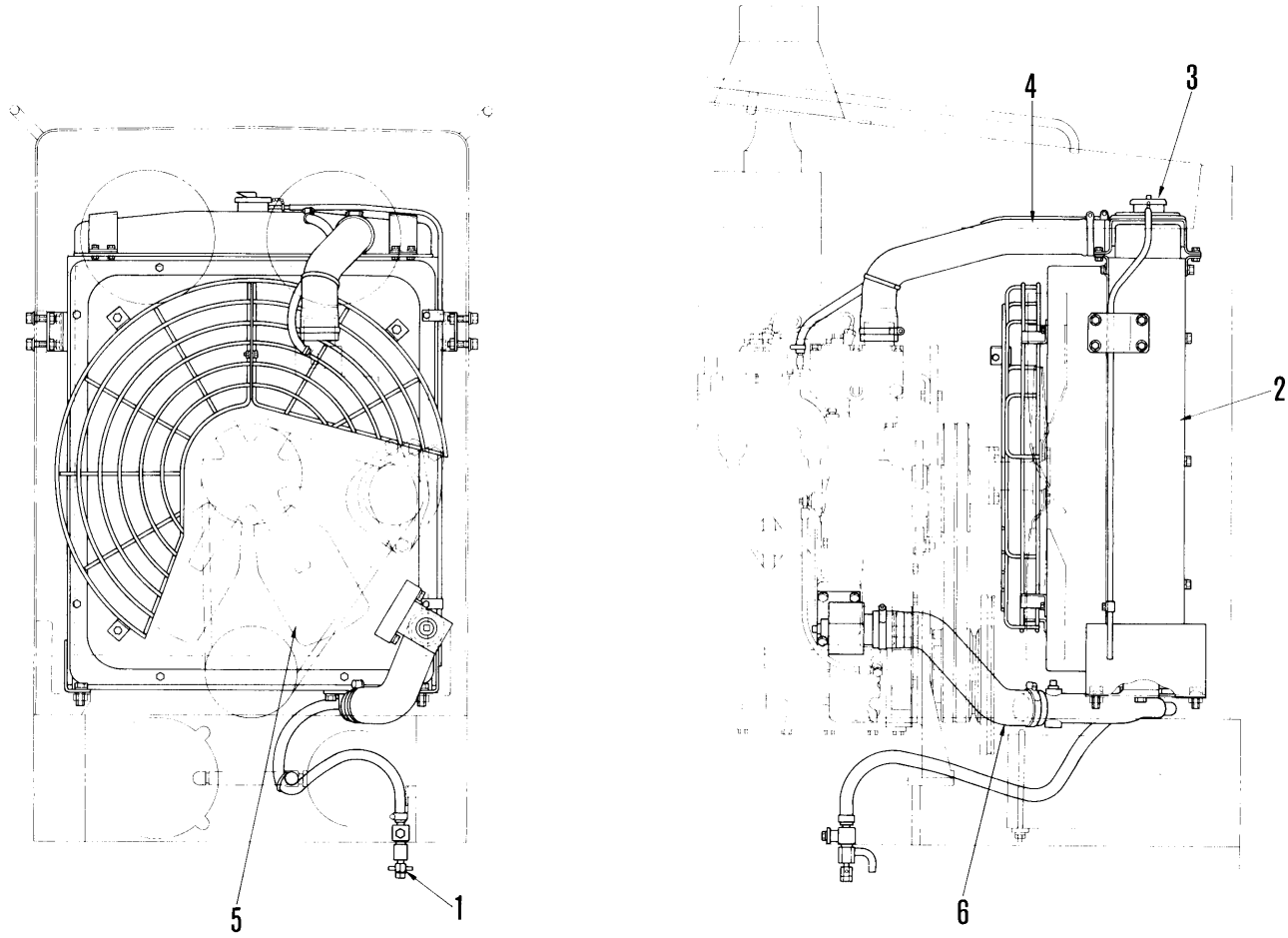


F23404003

1. Bracket
2. Lock plate
3. Plate
4. Shim
5. Plate
6. Dust indicator

RADIATOR

GD705R-4

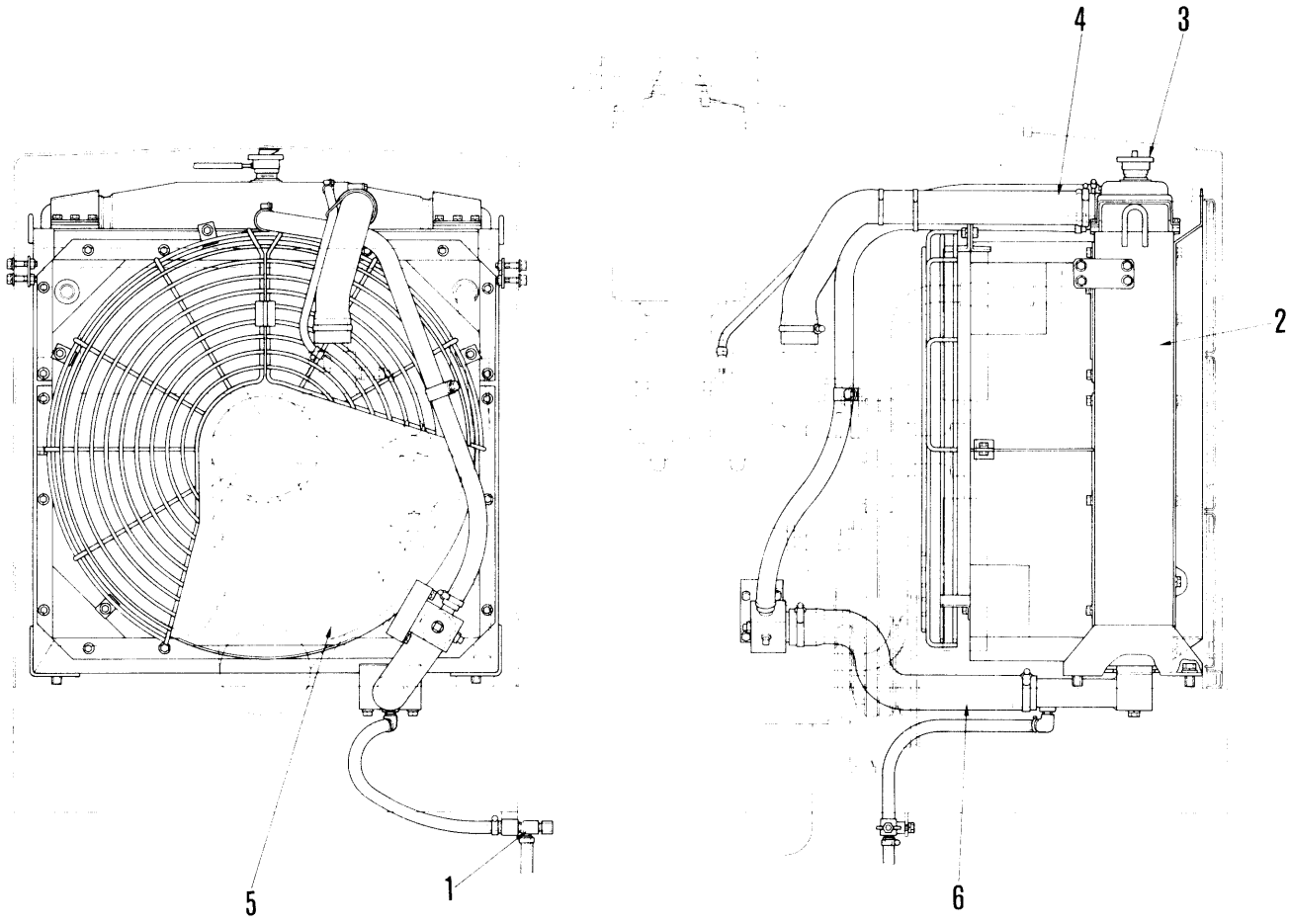


F23E04007

Radiator Core type: Model G6
Total radiation area: 35.84 m^2

1. Drain plug
2. Radiator core
3. Water filler cap
4. Inlet hose
5. Fan
6. Outlet hose

GD705A-4



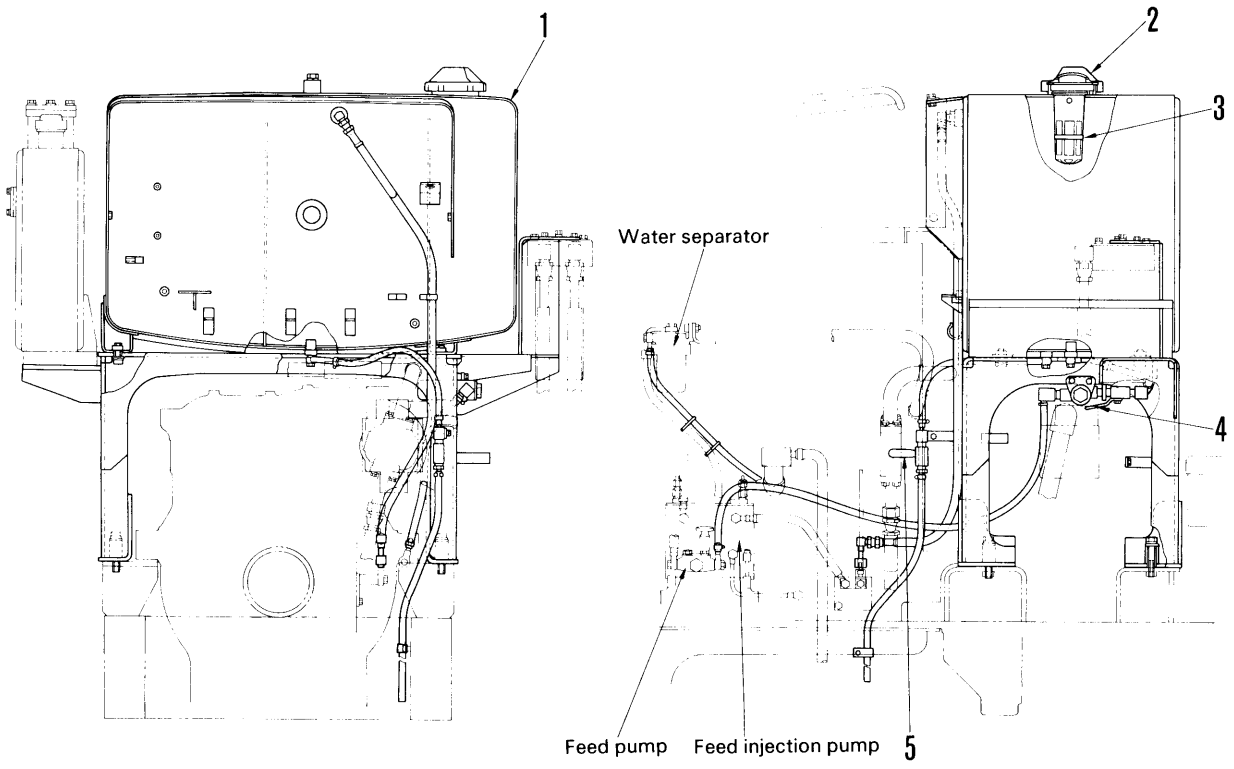
F23E04008

Radiator Core type: Model G6
Total radiation area: 46.89 m^2

1. Drain plug
2. Radiator core
3. Water filler cap
4. Inlet hose
5. Fan
6. Outlet hose

FUEL TANK AND PIPING

GD705R-4

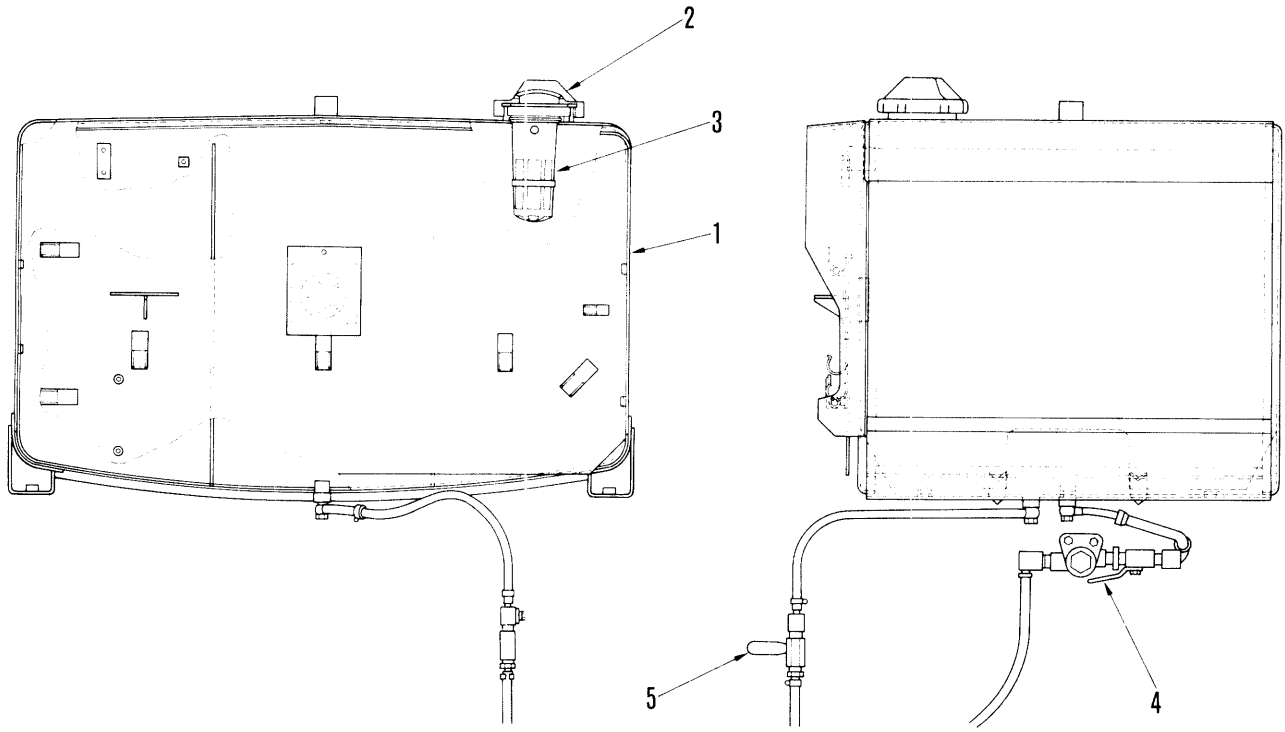


F23E04009

Fuel tank capacity: 300 ℓ

1. Fuel tank
2. Fuel filler cap
3. Strainer
4. Fuel line valve
5. Drain cock

GD705A-4



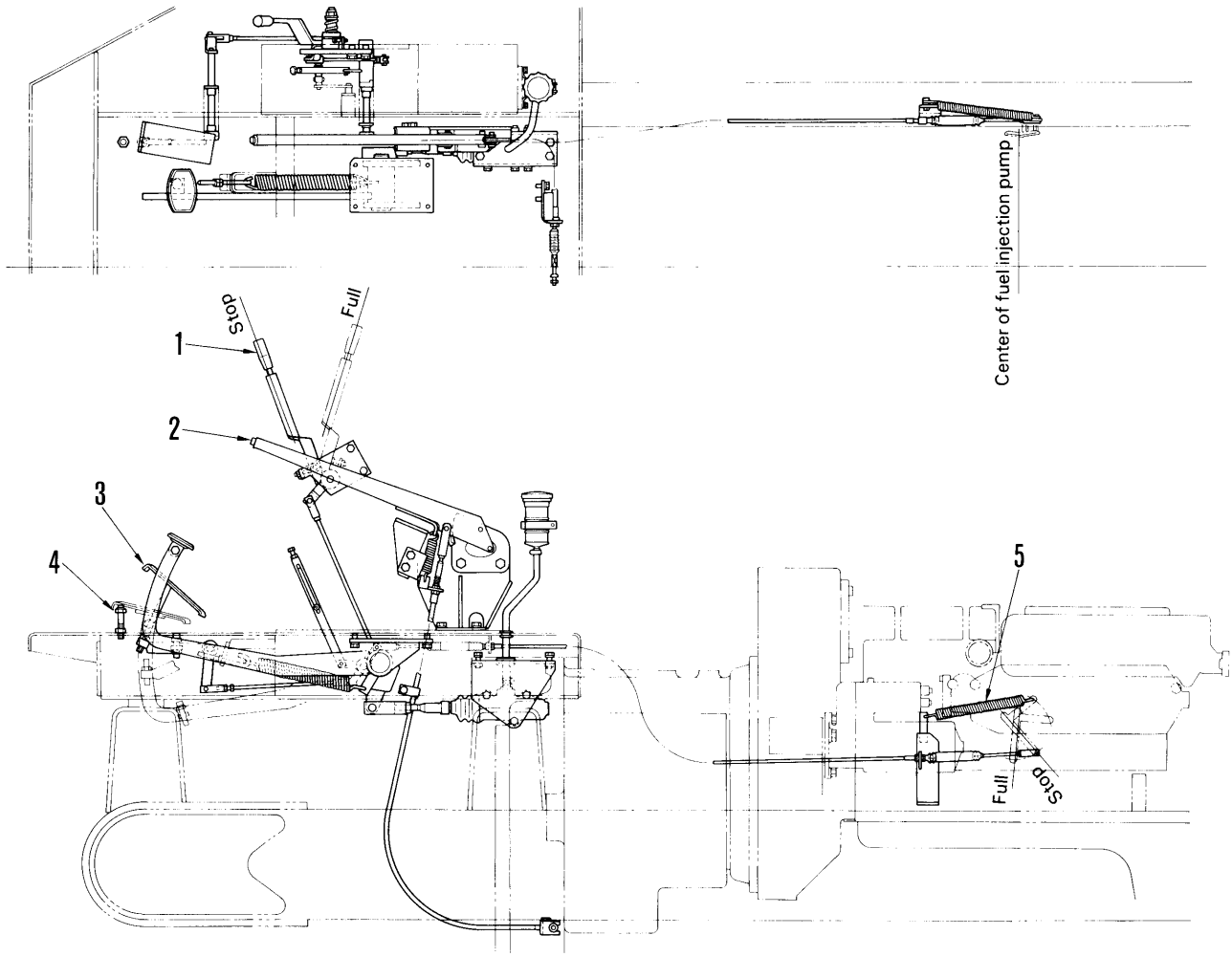
F23E04010

Fuel tank capacity: 400 ℓ

1. Fuel tank
2. Fuel filler cap
3. Strainer
4. Fuel line valve
5. Drain cock

ACCELERATOR CONTROL

GD705R-4



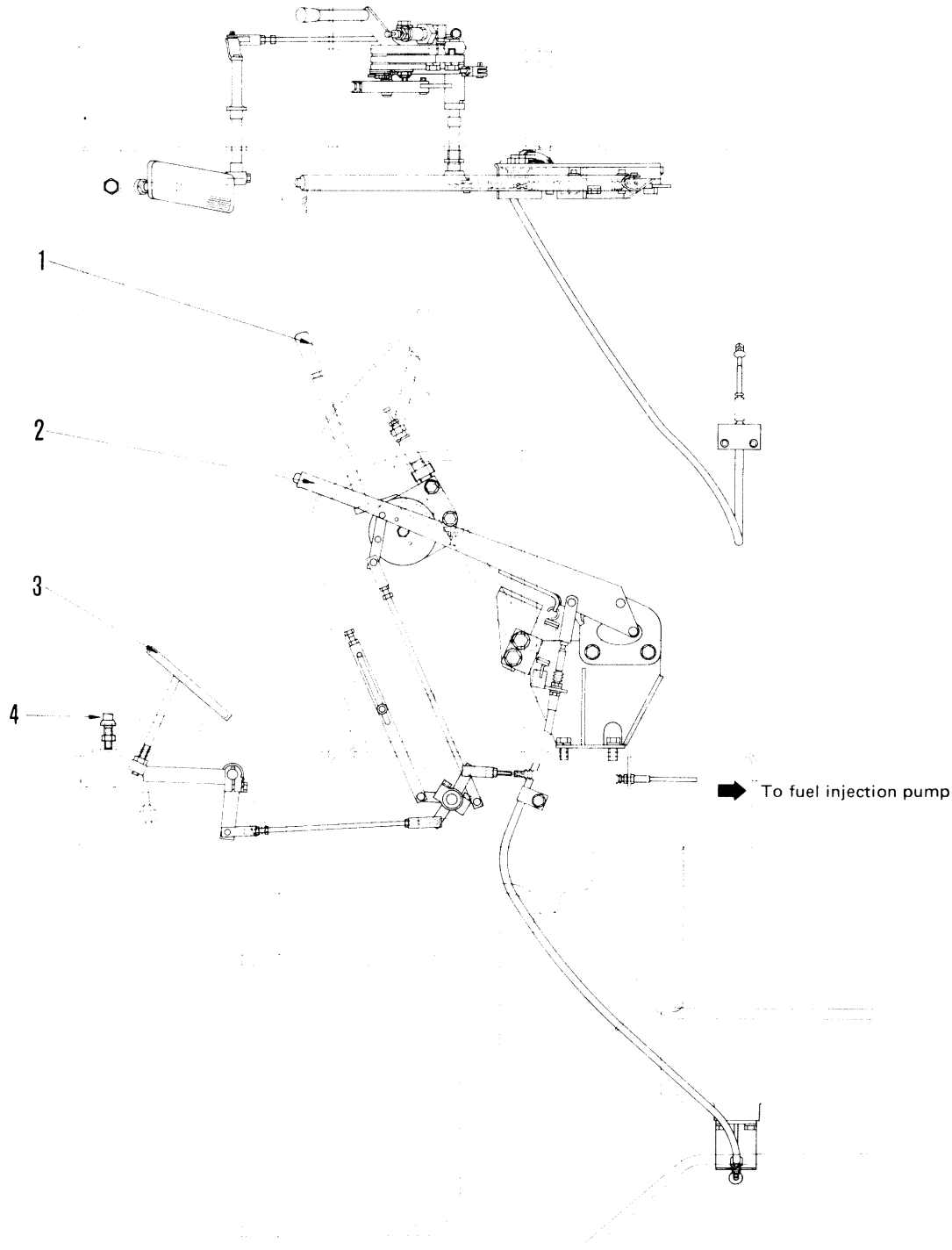
F23E04011

OPERATION

When the accelerator pedal (3) is depressed it operates the engine governor through each linkage and sends the appropriate quantity of fuel to the injection pump. When the engine is at full rpm and the governor is contacting the stopper, if the accelerator pedal is depressed further, the governor or governor lever may be damaged. To prevent this a stopper bolt (4) is installed. The fuel control lever is to keep engine revolutions steady during operation.

1. Fuel control lever
2. Parking brake lever
3. Accelerator pedal
4. Stopper bolt
5. Accelerator return spring

GD705A-4

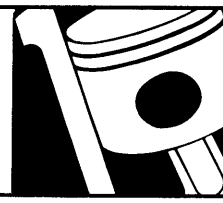


F23E04012

1. Fuel control lever
2. Parking brake lever
3. Accelerator pedal
4. Stopper bolt

ENGINE

12 TESTING AND ADJUSTING



TESTING AND ADJUSTING DATA

Machine model				GD705R-4		GD705A-4	
Engine model				6D125-1		S6D125-1	
Classification	Item	Condition, etc.	Unit	Standard value	Permissible value	Standard value	Permissible value
Performance	Engine speed	High idling speed	rpm	2100 ± 50	–	2200 ± 50	–
		Low idling speed	rpm	650 $^{+50}_{0}$	–	650 $^{+50}_{0}$	–
	Necessary starting speed	0°C	rpm	Min. 100	–	Min. 100	–
		–20°C (Using starting aid)	rpm	Min. 85	–	Min. 85	–
Intake and exhaust system	Intake resistance	All speed	mmH_2O	Max. 380	635	Max. 180	Max. 365
	Intake pressure	All speed	mmHg	–	–	Max. 35	Max. 45
	Exhaust temperature	All speed (intake air temp.: 20°C)	°C	Max. 600	650	Max. 600	Max. 650
	Exhaust gas color	Quick acceleration	Bolch scale	Max. 3.0	5.0	Max. 4.0	5.5
		At high idling		Max. 1.0	2.0	Max. 1.0	2.0
	Valve clearance at 20°C	Intake valve	mm	0.33	–	0.33	0.33
		Exhaust valve	mm	0.71	–	0.71	0.71
Engine body	Compression pressure (SAE30)	Oil temperature: 40 – 60°C	kg/cm^2	34 – 38	–	32 – 36	–
		(Engine speed)	(rpm)	(200 – 250)		(200 – 250)	
	Blow-by pressure (SAE30)	At high idling (Water temperature operating range)	mmH_2O	Max. 50	100	Max. 100	200
Lubrication system	Oil pressure (SAE30, Oil temperature: Min. 80°C)	At high idling (Water temperature operating range)	kg/cm^2	3.0 – 5.0	Min. 1.8	3.5 – 5.5	2.0
		At low idling (Water temperature operating range)	kg/cm^2	Min. 1.3	0.8	Min. 1.3	0.8
	Oil temperature	All speed (Oil in oil pan)	°C	90 – 115	120	95 – 115	120
	Oil consumption ratio	At continuous rated output (Ratio to fuel consumption)	%	Max. 0.5	1.0	Max. 0.5	1.0
Fuel system	Fuel injection pressure	Nozzle tester	kg/cm^2	Min. 225	180	250	200
	Fuel injection timing	B.T.D.C.	Degree	22 ± 1	–	26 ± 1	26 ± 1
Cooling system	Radiator pressure valve function	Opening pressure (Differential pressure)	kg/cm^2	0.7 ± 0.1	–	0.7 ± 0.1	0.7 ± 0.1
	Fan speed	At rated rpm	rpm	1850	1757	–	–
		At high idling speed		–	–	1700	1615
	Fan belt tension	Deflect when pushed with a force of 6 kg	mm	13	10 – 16	13	10 – 16

TESTING AND ADJUSTING TOOL LIST

No.	Testing and measuring item	Fault finding tool	Part No.	Remarks
1	Engine speed	Multi-tachometer	799-203-8000	Digital reading, pressure sensing type 60 – 19,999 rpm
2	Battery S.G.	Battery coolant tester	795-500-1000	1.100 – 1.300
3	Freezing temperature of cooling water			–5 to –50°C
4	Water temperature, oil temperature, air intake temperature	Thermistor temperature gauge	790-500-1300	0 – 200°C
5	Exhaust temperature			0 – 1,000°C
6	Lubrication oil pressure	Engine pressure measuring kit	799-203-2002	0 – 10 kg/cm²
7	Fuel pressure			0 – 20 kg/cm²
8	Intake pressure, exhaust pressure			0 – 1,500 mmHg
9	Blow-by pressure			0 – 1,000 mmH_2O
10	Intake resistance			–1,000 – 0 mmH_2O
11	Compression pressure	Compression gauge	795-502-1203	0 – 70 kg/cm²
		Adapter	795-502-1360	
12	Blow-by pressure	Blow-by checker	799-201-1503	0 – 500 mmH_2O
13	Valve clearance	Feeler gauge	795-125-1360	Intake 0.33 mm, Exhaust 0.71 mm
14	Exhaust gas color	Handy smoke checker	799-201-9000	Dirtiness 0 – 70% with standard color (Dirtiness % x 1/10 ≒ Bosch scale)
15	Water and fuel content in oil	Engine oil checker	799-201-6000	Provided with 0.1 and 0.2% water content standard samples
16	Fuel injection pressure Fuel injection nozzle spray condition	Nozzle tester	Commercially available	0 – 300 kg/cm²
17	Coolant quality	Water quality tester	799-202-7001	PH, nitrite ion concentration
18	Pressure valve function Leakage in cooling water system	Radiator cap tester	799-202-9001	0 – 2 kg/cm²
19	Radiator blockage (wing speed)	Anemometer (Air speed gauge)	799-202-2001	0 – 40 m/s
20	Engine cranking	Cranking kit	795-610-1000	Engine with DC24V starting motor
21	Electrical circuits	Tester	Commercially available	Current, Voltage, Resistance

TESTING AND ADJUSTING VALVE CLEARANCE

Special tool

	Part number	Part name	Q'ty
A	795-125-1360	Feeler gauge	1

★ Adjust clearance between rocker lever and top of crosshead to following value.

Intake valve (at 20°C)	Exhaust valve (at 20°C)
0.33 mm	0.71 mm

1. When adjusting the valve clearance for cylinders No. 3 to 6, remove air cleaner.

2. Remove cylinder head cover.

3. Rotate the crankshaft in the normal direction to align pointer (2) with the 1.6 TOP mark or crankshaft damper (1). When rotating, check the movement of the intake valves of No. 1 cylinder and No. 6 cylinder. Set with No. 1 cylinder at compression top dead center.
   ★ When No. 1 cylinder is at compression top dead center, the intake valve of No. 6 cylinder opens.

4. When No. 1 cylinder is at compression top dead center, adjust the valves marked ●. Then rotate the crankshaft one turn in the normal direction, set No. 6 cylinder to compression top dead center, and adjust the valves marked ○.

Cylinder No.	1		2		3		4		5		6	
Intake valve		●		●		○		●		○		○
Exhaust valve	●		○		●		○		●		○	

5. To adjust, insert tool **A** between rocker lever (3) and crosshead (4) and turn adjustment screw (5) until clearance is a sliding fit.

6. Tighten locknut (6) to hold adjustment screw in position.

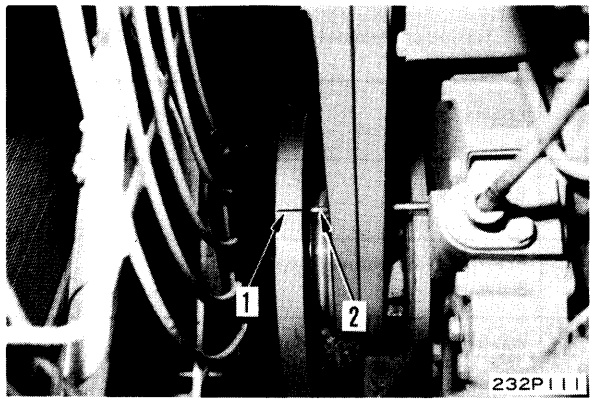
   kgm Locknut: 6.7 ± 0.7 kgm

   ★ After adjusting No. 1 cylinder at compression top dead center, it is also possible to turn the crankshaft 120° each time and adjust the valve clearance of each cylinder according to the firing order.

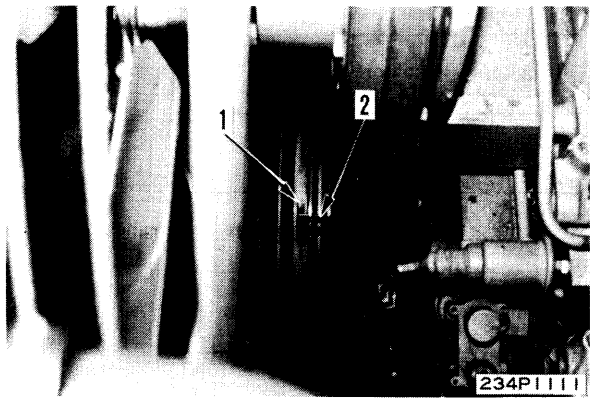
   ● Firing order: 1 – 5 – 3 –6 – 2 – 4

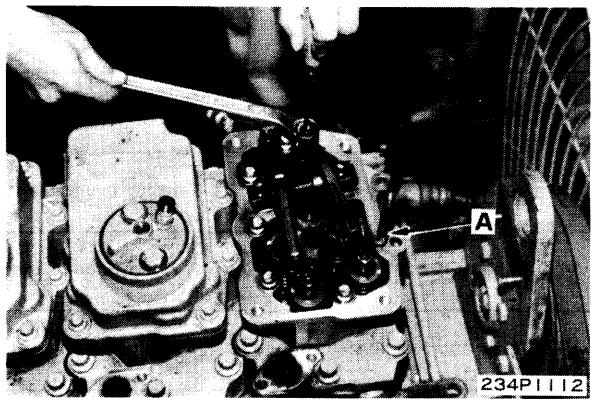
   ★ After tightening the locknut, check the clearance again.

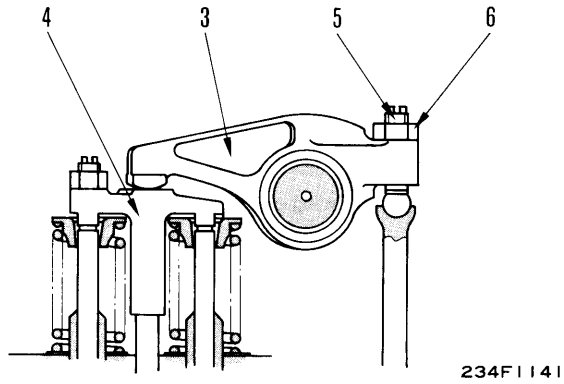
GD705R-4



GD705A-4







MEASURING COMPRESSION PRESSURE

Special tools

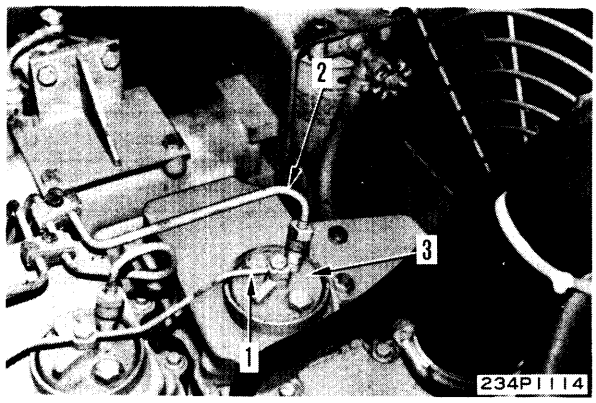
	Part number	Part name	Q'ty
A	795-502-1360	Adapter	1
B	795-502-1203	Compression gauge	1

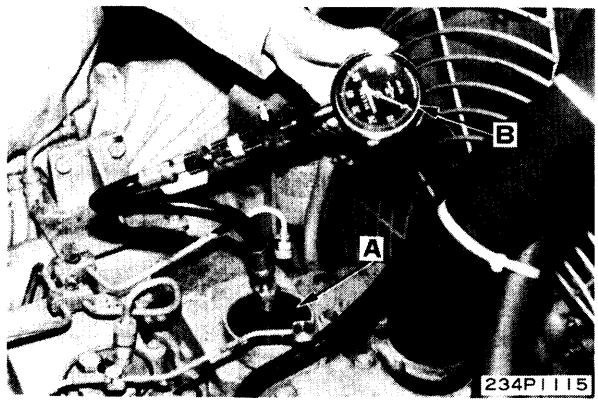
★ Warm up the engine (oil temperature: 40 – 60°C) before measuring the compression pressure.

1. Adjust valve clearance.
2. Remove spill tube (1), then disconnect fuel injection tube (2) and remove nozzle holder assembly (3).
   ★ When removing the nozzle holder assembly, use the mounting bolt of the spill pipe and lever the nozzle holder assembly out with a bar.
3. Install tool **A** in mount of nozzle holder assembly, and tighten to specified torque.
   kgm Mounting bolt: 2.2 ± 0.3 kgm
4. Connect tool **B** to adapter.
5. Place fuel control lever (4) in NO INJECTION position. Crank engine with starting motor and measure compression pressure.
   ★ Measure the compression pressure at the point where the compression gauge indicator remains steady.
   ★ If the adapter mount is coated with a small amount of oil, leakage is reduced.

⚠ If the fuel control lever is not set to the NO INJECTION position, the engine will start.

⚠ When measuring the compression pressure, be careful not to touch the exhaust manifold or muffler, or to get caught in rotating parts.





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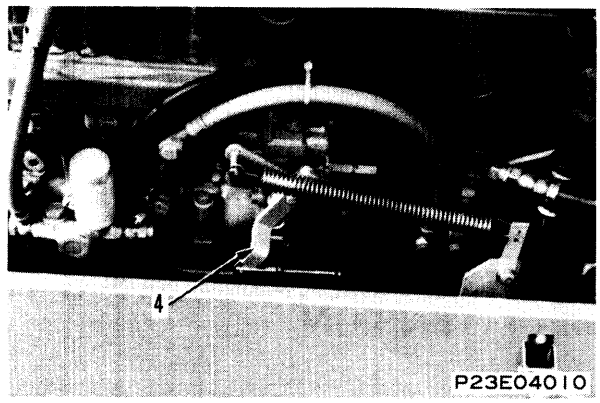

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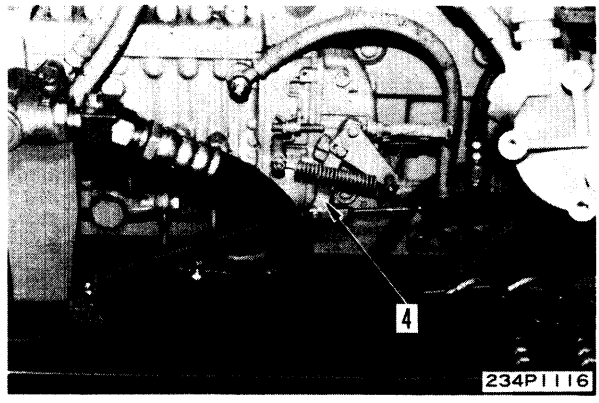
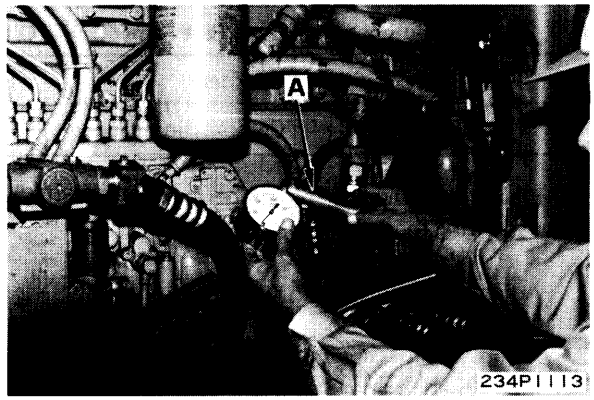


MEASURING BLOW-BY

Special tool

	Part number	Part name	Q'ty
A	799-201-1503	Blow-by checker	1



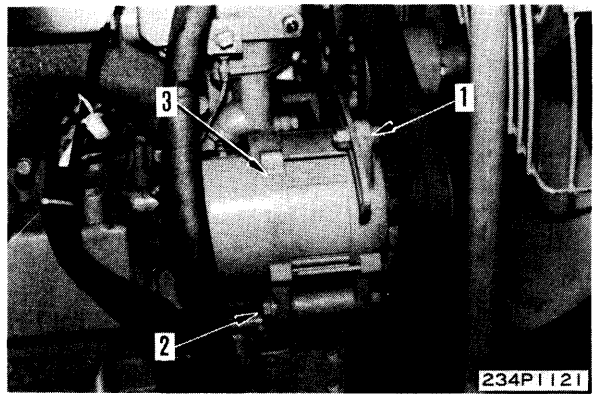
1. **Measuring blow-by**
   Connect tool A to breather hose.
   ★ Check that the oil filler and dipstick are properly sealed.

2. **Precautions when measuring blow-by**
   ★ Measure blow-by with the engine properly warmed up (oil temperature: 60°C) and running at rated output.
   - When measuring in the field, a similar value will be obtained at stall speed.
   - If it is impossible to run the engine at rated output or at stall speed, measure at high idling.
     The blow-by value obtained at high idling will be about 80% of the value at rated output.

   ★ Blow-by varies greatly according to the condition of the machine, so if the value obtained is considered abnormal, check for factors related to defective blow-by. These factors include excessive oil consumption, defective exhaust gas color, deterioration and early discoloration of oil.

TESTING AND ADJUSTING FAN BELT TENSION

- Check that the fan belt deflects by approx. 13 mm when pushed with a force of 6 kg. at a point midway between the alternator pulley and the crankshaft pulley.



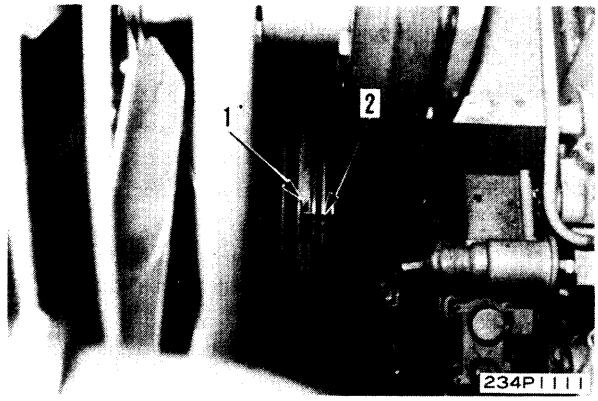
- Adjusting fan belt tension
  1) Loosen adjustment bolt (1) and mounting bolt (2).
  2) Using a bar or pipe, raise alternator (3) and adjust tension of belt. Tighten adjustment bolt (1) and mounting bolt (2).
  ★ Check the pulley groove and belt for wear. The belt must not be in contact with the bottom of the groove.
  ★ Replace both belts if the belt is stretched so much that the tension cannot be adjusted, or if the belt is cut or cracked.

TESTING AND ADJUSTING FUEL INJECTION TIMING

When installing the fuel injection pump on the engine, test and adjust the fuel injection timing as follows.

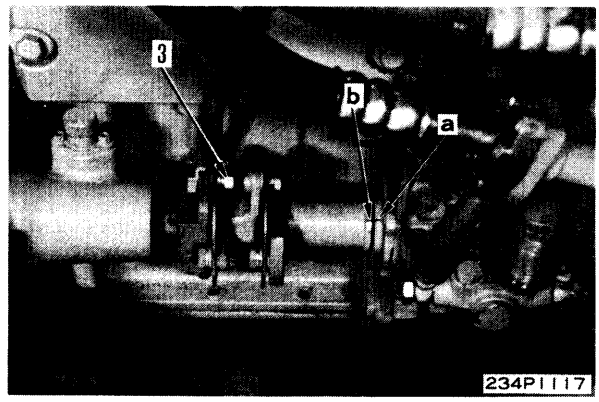
- Aligning match mark
  Use this method when the fuel injection pump is put back on the same engine without being repaired.
- Delivery check method
  Use this method when replacing or installing a repaired fuel injection pump.

★ Set the No. 1 cylinder to top dead center when testing and adjusting.

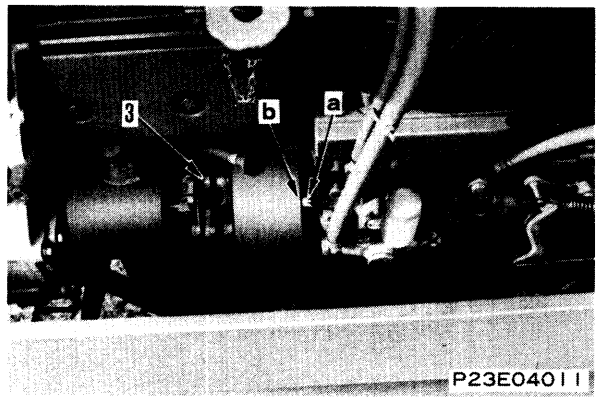


1. Testing and adjusting by aligning match mark

1) Set the No. 1 cylinder to top dead center, then rotate the crankshaft 30° – 40° in the reverse direction. Next, rotate the crankshaft in the normal direction and align the fuel injection line on crankshaft damper (1) with pointer (2).

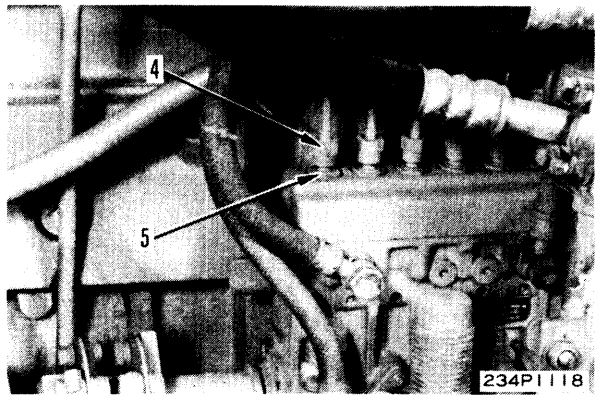


2) Check that line "a" on the injection pump and line "b" on the coupling are aligned.
   ★ If the lines are not aligned, loosen nut (3). Move the coupling to align the lines, then tighten the nut.
   kgm Nut: 6.2 ± 0.2 kgm



2. Testing and adjusting fuel injection timing by delivery check

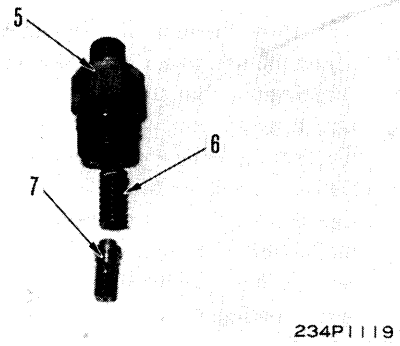
1) Disconnect fuel injection tube (4) of No. 1 cylinder.
2) Remove delivery valve holder (5).



3) Remove spring (6) and delivery valve (7), then install delivery valve holder (5) again.

4) Place fuel control lever at FULL position, then operate priming pump and rotate crankshaft slowly in normal direction. Check point where fuel stops flowing from delivery valve holder.

5) Check that fuel injection timing line on crankshaft damper and pointer are aligned at point where fuel stops flowing.
   ★ BEYOND injection timing line:
   Timing RETARDED
   ★ BEFORE injection timing line:
   Timing ADVANCED



3. If the test shows that the fuel injection timing is incorrect, adjust as follows.

1) Set the No. 1 cylinder to top dead center, then rotate the crankshaft 30° – 40° in the reverse direction.

2) Next, rotate the crankshaft in the normal direction and align the fuel injection line on the crankshaft damper with the pointer correctly.

3) Loosen nut (3) in oblong hole of mounting flange of fuel injection pump. Operate priming pump and rotate flange at pump end a little at a time. Stop at point where fuel stops flowing from delivery valve holder.

4) Tighten nut in oblong hole of mounting flange of fuel injection pump.
   ★ After tightening the nut, check again that the fuel injection timing is correct.

ENGINE

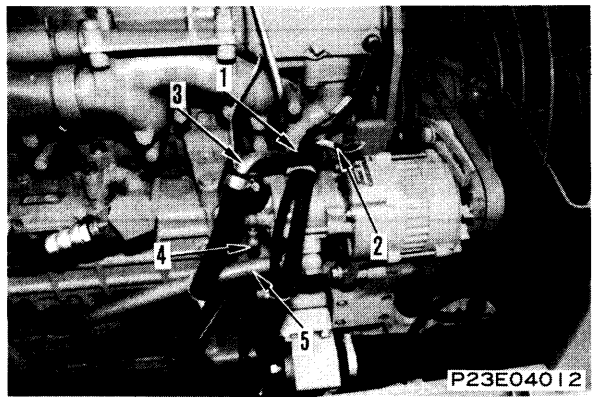
13 DISASSEMBLY AND ASSEMBLY

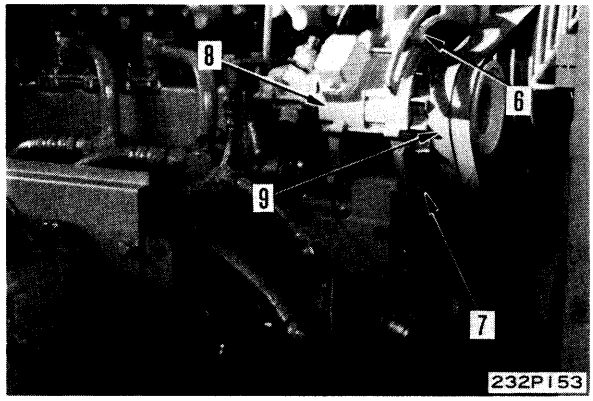
REMOVAL OF ALTERNATOR ASSEMBLY

GD705R-4

⚠ Disconnect the lead from the negative (−) terminal of the battery.

1. Disconnect wire (1) of water temperature gauge and wire (2) of alternator.
2. Disconnect tubes (3), (4) and (5) of vacuum pump.
3. Remove adjustment bolt (6), then loosen mounting bolt (7).
4. Move alternator assembly (8) towards block, and remove belt (9).
5. Remove mounting bolt, then remove alternator assembly.





INSTALLATION OF ALTERNATOR ASSEMBLY

GD705R-4

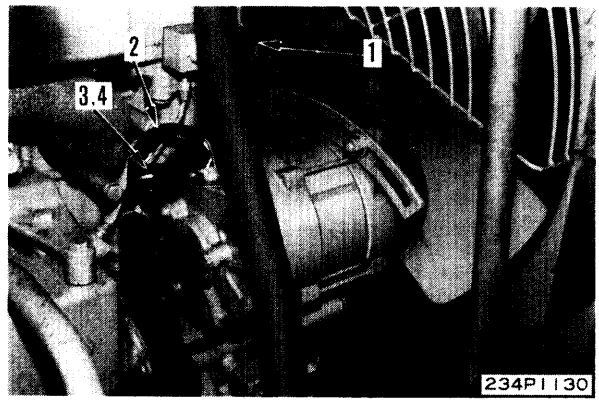
1. Install alternator assembly (8), then temporarily tighten mounting bolt (7).
2. Install belt (9), then temporarily tighten adjustment bolt (6).
3. Adjust belt tension.
   ★ For details, see TESTING AND ADJUSTING.
4. Tighten bolts (6) and (7) fully.
5. Fit gaskets and connect tubes (5), (4) and (3) of vacuum pump.
6. Connect wire (2) of alternator, and wire (1) of water temperature gauge.
7. Connect lead to negative (−) terminal of battery.

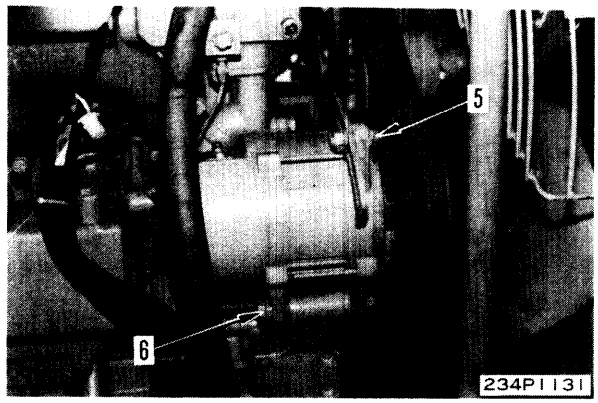
REMOVAL OF ALTERNATOR ASSEMBLY

GD705A-4

⚠ Disconnect the cable from the negative (−) terminal of the battery.

1. Disconnect L.H. engine side cover.
2. Disconnect wire (1) of water temperature gauge.
3. Disconnect wires (2), (3) and (4) of alternator.
4. Remove adjustment bolt (5), then loosen mounting bolt and nut (6).
5. Move alternator assembly inside, and remove fan belt (7) from pulley groove.
6. Remove mounting bolt and nut (6), then remove alternator assembly (8).

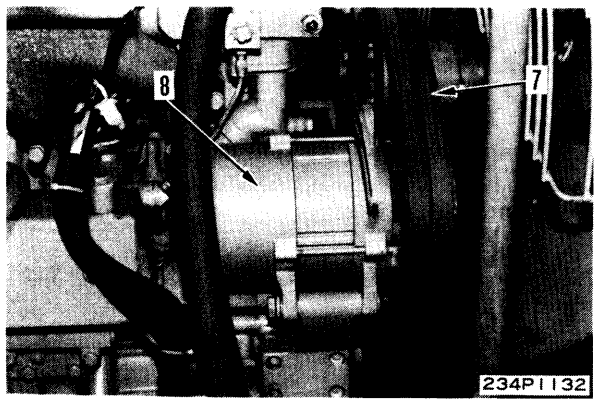




INSTALLATION OF ALTERNATOR ASSEMBLY

GD705A-4

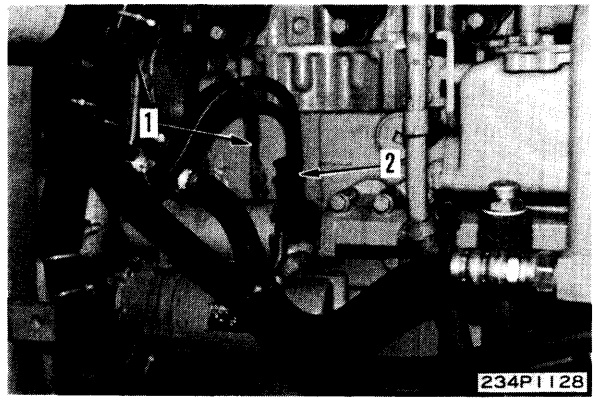
1. Install alternator assembly (8), then temporarily tighten mounting bolt and nut (6).
2. Fit fan belt (7) on pulley.
3. Temporarily install mounting bolt (5) of adjustment plate. Raise alternator assembly to outside and adjust belt tension.
   ★ For details, see TESTING AND ADJUSTING.
4. Tighten mounting bolt and nut (6), and adjustment bolt (5) fully.
5. Connect wires (4), (3) and (2) of alternator.
6. Connect wire (1) of water temperature gauge.
7. Install L.H. engine side cover.
8. Connect cable to negative (−) terminal of battery.



REMOVAL OF STARTING MOTOR ASSEMBLY

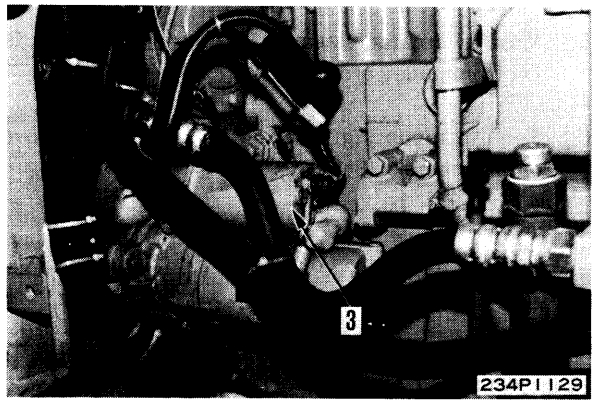
⚠ Disconnect the cable from the negative (−) terminal of the battery.

1. Remove L.H. engine side cover.
2. Disconnect wires (1) and (2).
3. Remove starting motor assembly (3).



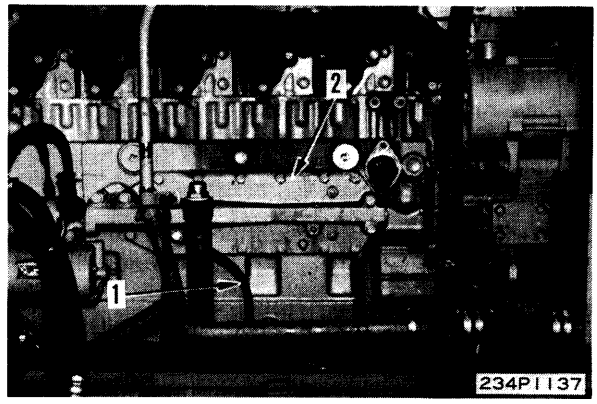
INSTALLATION OF STARTING MOTOR ASSEMBLY

1. Fit gasket and install starting motor assembly (3).
2. Connect wires (2) and (1).
3. Install L.H. engine side cover.
4. Connect cable to negative (−) terminal of battery last.



REMOVAL OF OIL COOLER ASSEMBLY

1. Remove hydroshift transmission oil cooler assembly. For details, see 13 REMOVAL OF HYDROSHIFT TRANSMISSION OIL COOLER ASSEMBLY.
2. Disconnect ground connection (1).
3. Remove oil cooler assembly (2).



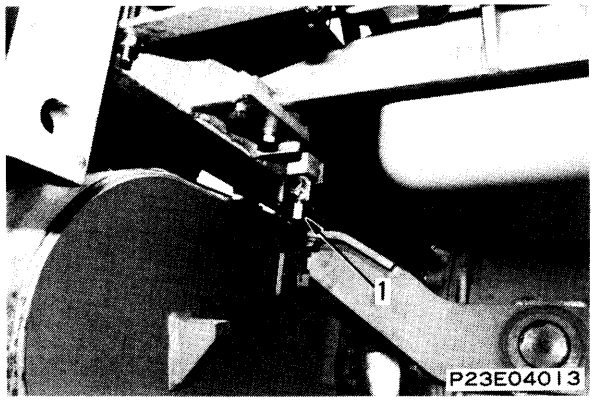
INSTALLATION OF OIL COOLER ASSEMBLY

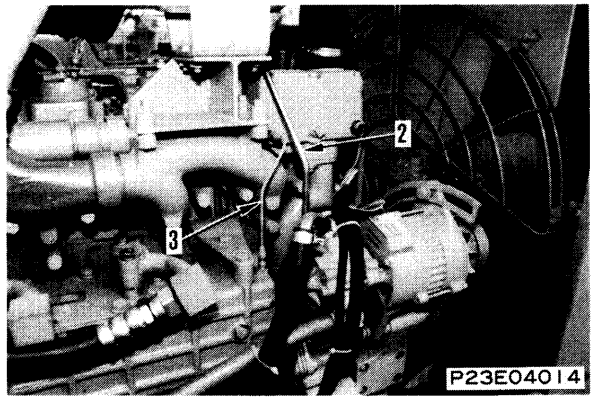
1. Fit gasket and install oil cooler assembly (2).
2. Connect ground connection (1).
3. Install hydroshift transmission oil cooler assembly. For details, see 13 INSTALLATION OF HYDROSHIFT TRANSMISSION OIL COOLER ASSEMBLY.

REMOVAL OF HYDROSHIFT TRANSMISSION OIL COOLER ASSEMBLY

GD705R-4

1. Loosen drain valve (1) and drain cooling water.
   ★ If the coolant contains antifreeze, dispose of it correctly.
2. Remove L.H. engine side cover.
3. Remove air bleed tube (2).
4. Remove water drain tube (3) of muffler.
5. Remove inlet and outlet tubes (4) and (5) of oil cooler.
6. Remove brackets (6) and (7).
7. Remove oil cooler assembly (8).



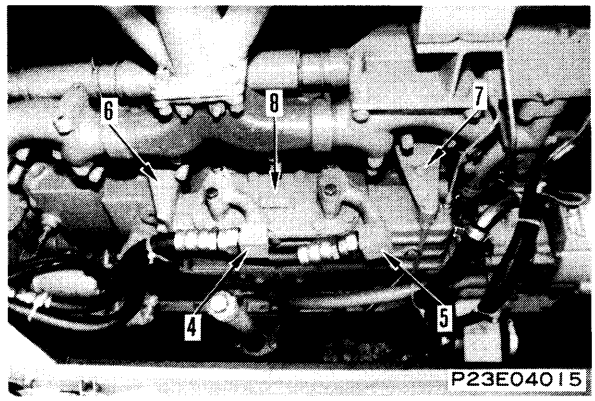


INSTALLATION OF HYDROSHIFT TRANSMISSION OIL COOLER ASSEMBLY

GD705R-4

1. Fit gasket and install oil cooler assembly (8).
2. Secure oil cooler assembly with brackets (7) and (6).
3. Fit O-rings and install inlet and outlet tubes (5) and (4) of oil cooler.
4. Install water drain tube (3) of muffler.
5. Install air bleed tube (2).
6. Install L.H. engine side cover.
7. Tighten drain valve (1) and add water through water filler to the specified level.

★ Run the engine to circulate the water through the system.
Then check the water level again.

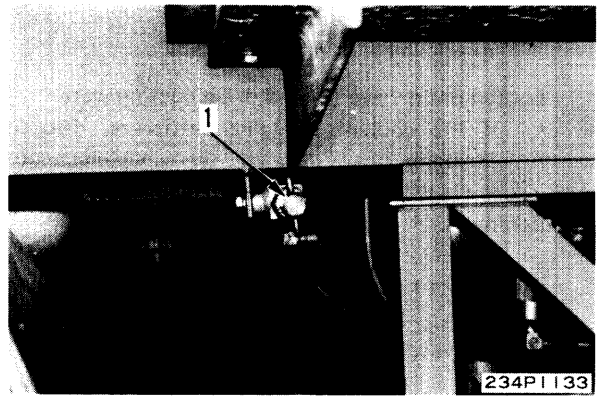


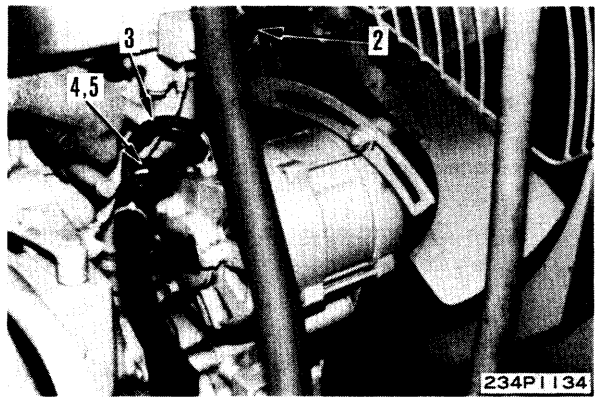
REMOVAL OF HYDROSHIFT TRANSMISSION OIL COOLER ASSEMBLY

GD705A-4

⚠ Disconnect the cable from the negative (−) terminal of the battery.

1. Loosen drain valve (1) and drain cooling water.
   ★ If the coolant contains antifreeze, dispose of it correctly.
2. Remove L.H. engine side cover.
3. Disconnect wire (2) of water temperature gauge and wire (3), (4) and (5) of alternator.
4. Remove air bleed tube (6).
5. Disconnect inlet and outlet tubes (7) and (8) of oil cooler.
6. Remove brackets (9) and (10).
7. Remove oil cooler assembly (11).



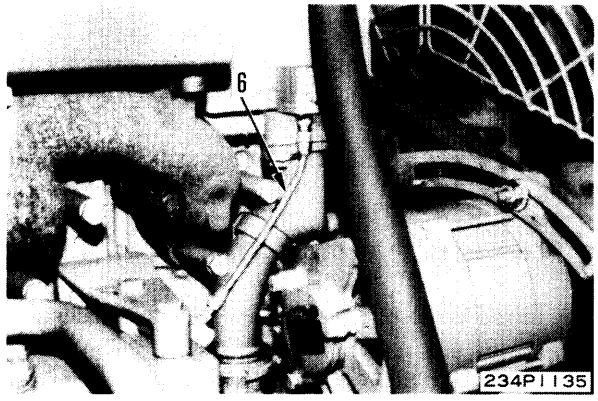


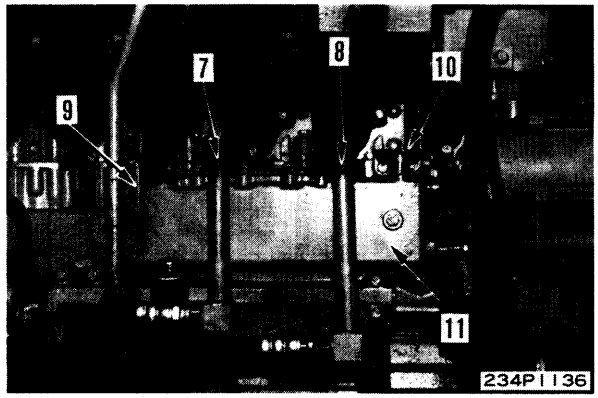
INSTALLATION OF HYDROSHIFT TRANSMISSION OIL COOLER ASSEMBLY

GD705A-4

1. Fit gasket and install oil cooler assembly (11).
2. Secure oil cooler assembly with brackets (10) and (9).
3. Fit O-rings and connect inlet and outlet tubes (8) and (7) of oil cooler.
4. Install air bleed tube (6).
5. Connect wires (5), (4) and (3) of alternator and wire (2) of water temperature gauge.
6. Install L.H. engine side cover.
7. Connect cable to negative (−) terminal of battery.
8. Tighten drain valve (1) and add water through water filler to the specified level.

★ Run the engine to circulate the water through the system. Then check the water level again.

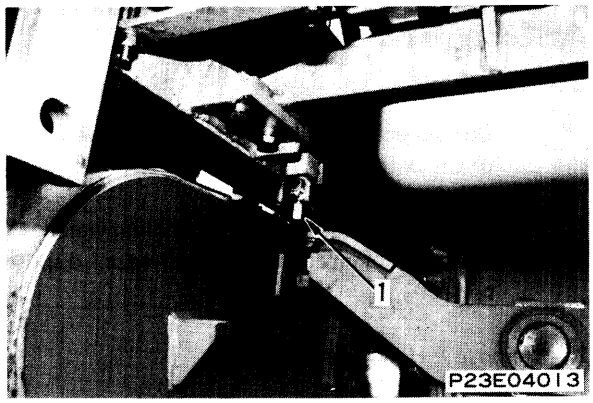


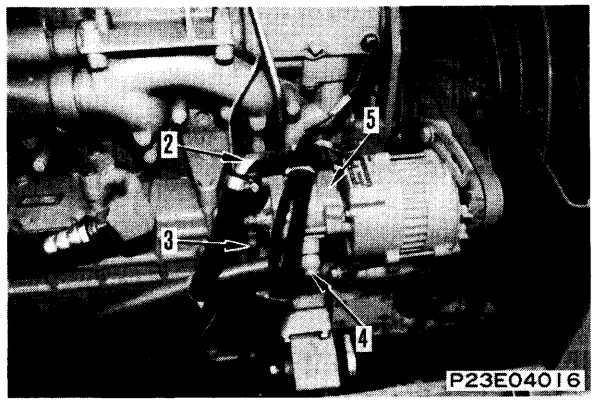


REMOVAL OF WATER PUMP ASSEMBLY

GD705R-4

1. Loosen drain valve (1) and drain cooling water.
   ★ If the coolant contains antifreeze, dispose of it correctly.
2. Remove L.H. engine side cover.
3. Disconnect tubes (2), (3) and (4) of vacuum pump.
4. Remove vacuum pump assembly (5).
5. Remove hydroshift transmission oil cooler assembly.
   For details, see 13 REMOVAL OF HYDROSHIFT TRANSMISSION OIL COOLER ASSEMBLY.
6. Disconnect radiator outlet hose (6).
7. Disconnect bypass tube (7) at hose.
8. Remove 3 mounting bolts (8), then remove water pump assembly (9).



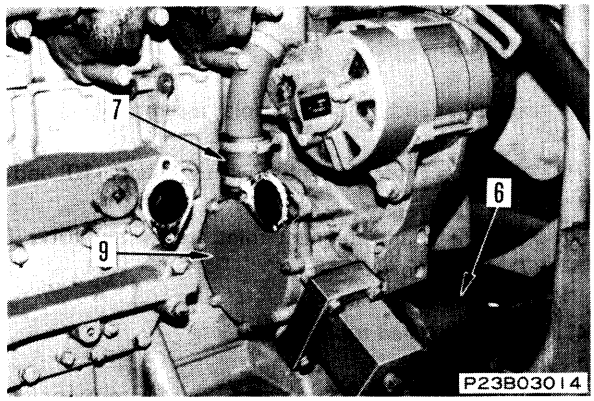


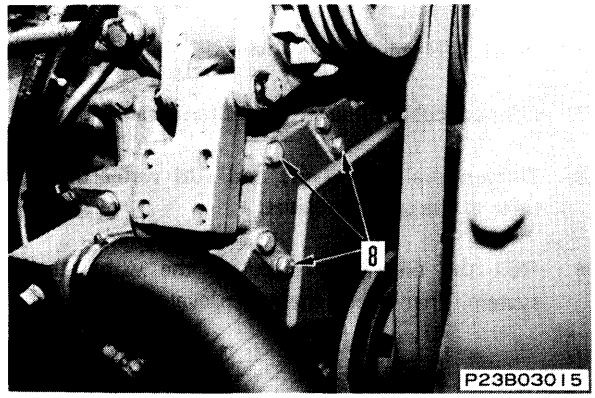
INSTALLATION OF WATER PUMP ASSEMBLY

GD705R-4

1. Fit gasket and install water pump assembly (9), then tighten 3 mounting bolts (8).
2. Connect bypass tube (7) at hose, then secure with hose clamp.
3. Connect radiator outlet hose (6).
4. Install hydroshift transmission oil cooler assembly.
   For details, see 13 INSTALLATION OF HYDROSHIFT TRANSMISSION OIL COOLER ASSEMBLY.
5. Fit gasket and install vacuum pump assembly (5).
6. Fit gaskets and connect tubes (4), (3) and (2) of vacuum pump.
7. Install L.H. engine side cover.
8. Tighten drain valve (1) and add water through water filler to the specified level.

★ Run the engine to circulate the water through the system.
Then check the water level again.

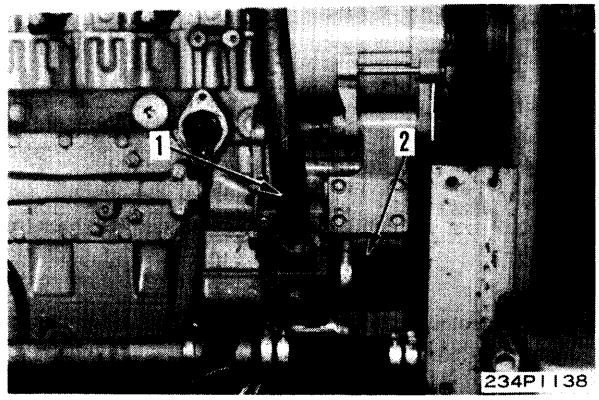


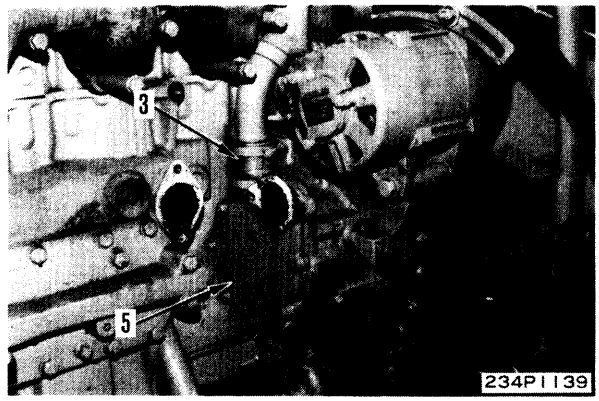


REMOVAL OF WATER PUMP ASSEMBLY

GD705A-4

1. Remove hydroshift transmission oil cooler assembly.
   For details, see 13 REMOVAL OF HYDROSHIFT TRANSMISSION OIL COOLER ASSEMBLY.
2. Disconnect hose (1).
3. Disconnect radiator outlet hose (2).
4. Disconnect bypass tube (3) at hose.
5. Remove 3 mounting bolts (4), then remove water pump assembly (5).

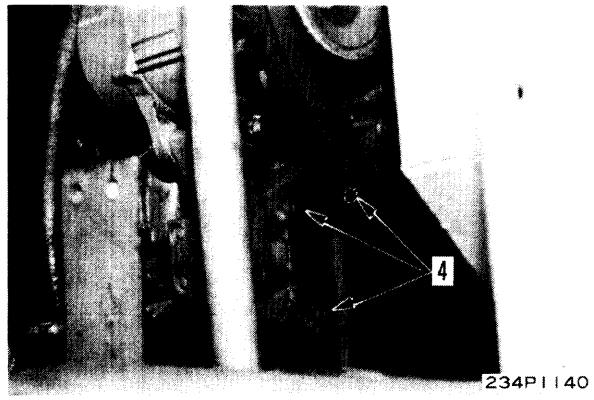




INSTALLATION OF WATER PUMP ASSEMBLY

GD705A-4

1. Fit gasket and install water pump assembly (5), then tighten 3 mounting bolts (4).
2. Connect bypass tube (3) at hose, then secure with hose clamp.
3. Connect radiator outlet hose (2).
4. Connect hose (1).
5. Install hydroshift transmission oil cooler assembly.
   For details, see 13 INSTALLATION OF HYDROSHIFT TRANSMISSION OIL COOLER ASSEMBLY.

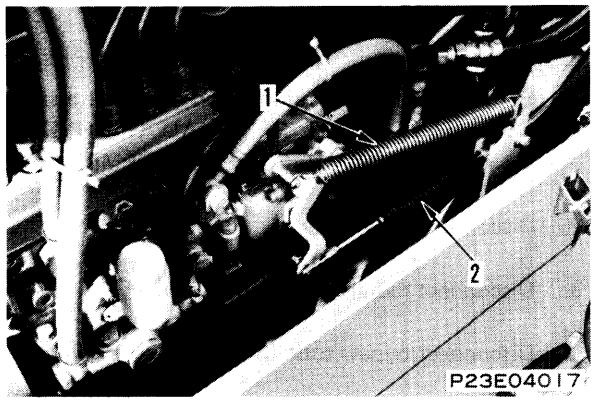


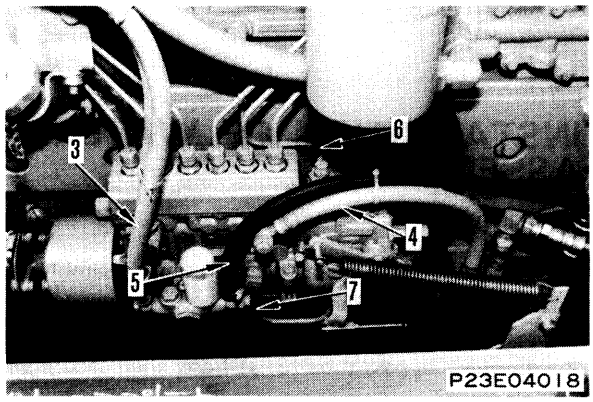
REMOVAL OF FUEL INJECTION PUMP ASSEMBLY

GD705R-4

★ Close the fuel supply lever to stop the supply of fuel.

1. Remove R.H. engine side cover.
2. Remove spring (1), then disconnect fuel control cable (2).
3. Disconnect 2 connector hoses (3) of fuel filter, and fuel return hose (4).
4. Remove fuel supply tube (5).
5. Remove lubrication tubes (6) and (7).
6. Disconnect fuel injection tube (8).
7. Remove 4 mounting bolts (9) of fuel injection pump.
8. Remove 2 mounting bolts (10) of drive shaft.
9. Remove fuel injection pump assembly (11).

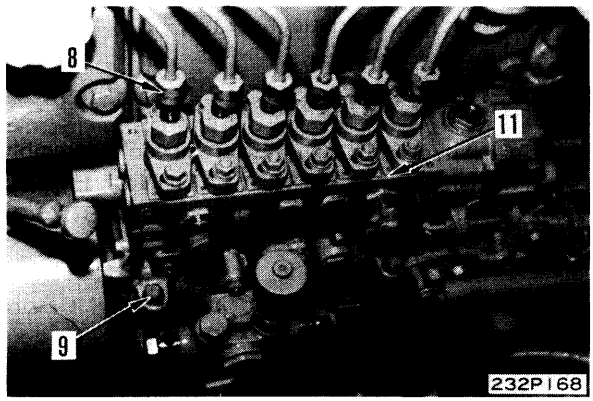


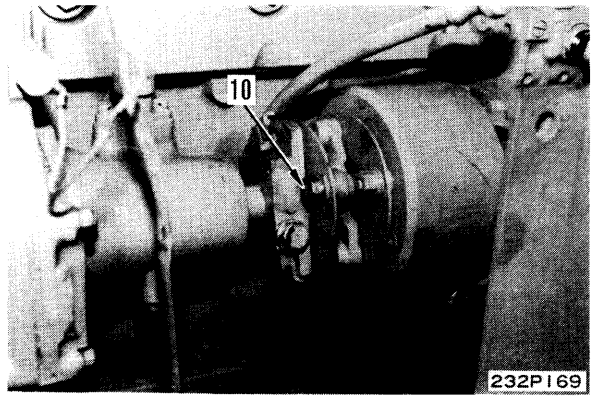


INSTALLATION OF FUEL INJECTION PUMP ASSEMBLY

GD705R-4

1. Fit fuel injection pump assembly (11) on bracket, then set in mounting position.
2. Tighten 2 mounting bolts (10) of drive shaft.
3. Tighten 4 mounting bolts (9) of fuel injection pump.
   ★ Tighten the mounting bolts uniformly in turn.
4. Connect fuel injection tube (8).
   kgm Sleeve nut: 3.0 ± 1.0 kgm
5. Fit gaskets and install lubrication tubes (7) and (6).
6. Fit gasket and install fuel supply tube (5).
7. Fit gaskets and connect fuel return hose (4), and 2 connector hoses (3) of fuel filter.
8. Connect fuel control cable (2), secure with locknut, then install spring (1).
9. Install R.H. engine side cover.



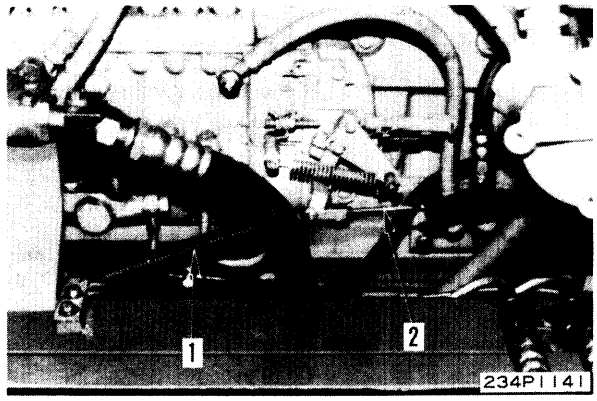


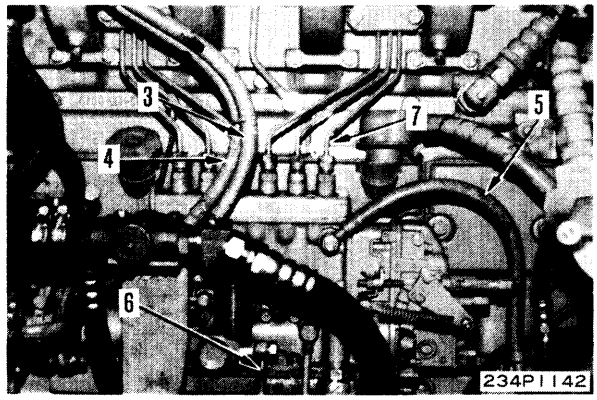
REMOVAL OF FUEL INJECTION PUMP ASSEMBLY

GD705A-4

★ Close the fuel supply lever at the bottom of the fuel tank to stop the supply of fuel.

1. Remove R.H. engine side cover.
2. Remove spring (1), then disconnect fuel control cable (2).
3. Disconnect fuel hoses (3) and (4), and fuel return hose (5).
4. Remove fuel supply tube (6).
5. Disconnect fuel injection tube (7).
6. Remove lubrication tubes (8) and (9).
7. Remove 4 mounting bolts (10) of fuel injection pump.
8. Remove 2 mounting bolts (11) of drive shaft.
9. Remove fuel injection pump assembly (12).

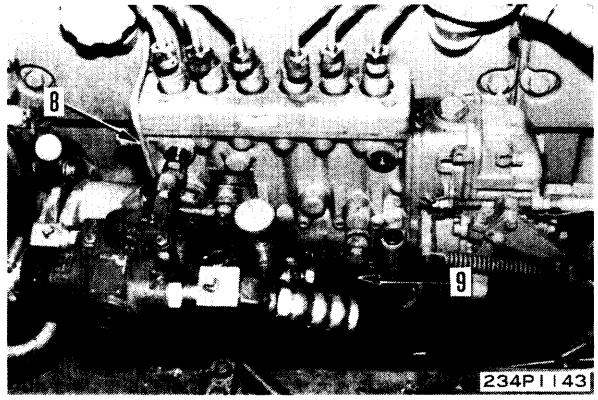


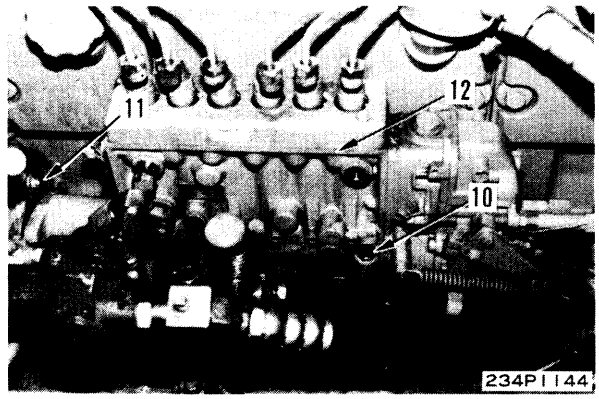


INSTALLATION OF FUEL INJECTION PUMP ASSEMBLY

GD705A-4

1. Fit fuel injection pump assembly (12) on bracket, then set in mounting position.
2. Tighten 2 mounting bolts (11) of drive shaft.
3. Tighten 4 mounting bolts (10) of fuel injection pump.
   ★ Tighten the mounting bolts uniformly in turn.
4. Fit gaskets and install lubrication tubes (9) and (8).
5. Connect fuel injection tube (7).
   kgm Sleeve nut: 3.0 ± 1.0 kgm
6. Fit gaskets and install fuel supply tube (6).
7. Fit gaskets and connect fuel return hose (5), and fuel hoses (4) and (3).
8. Connect fuel control cable (2), secure with locknut, then install spring (1).
9. Install R.H. engine side cover.

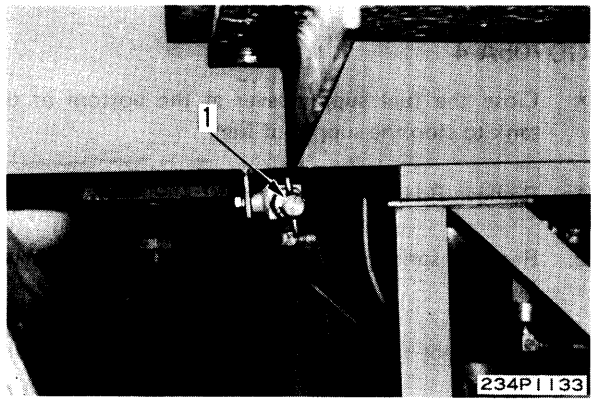


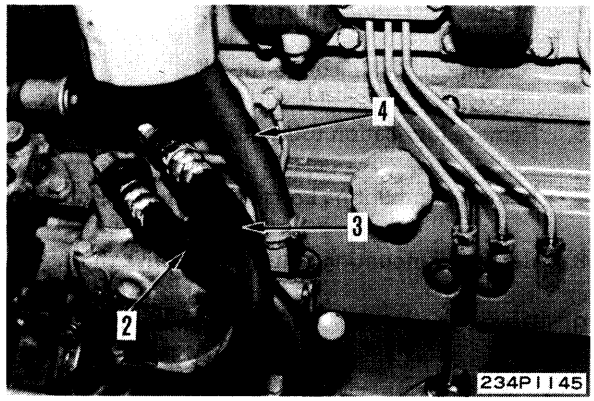


REMOVAL OF AIR COMPRESSOR ASSEMBLY

GD705A-4

1. Loosen drain valve (1) and drain cooling water.
   ★ If the coolant contains antifreeze, dispose of it correctly.
2. Remove fuel injection pump assembly.
   For details, see 13 REMOVAL OF FUEL INJECTION PUMP ASSEMBLY.
3. Disconnect air hoses (2) and (3), and suction hose (4).
4. Remove lubrication tube (5) and cooling tubes (6) and (7).
5. Remove air compressor assembly (8).



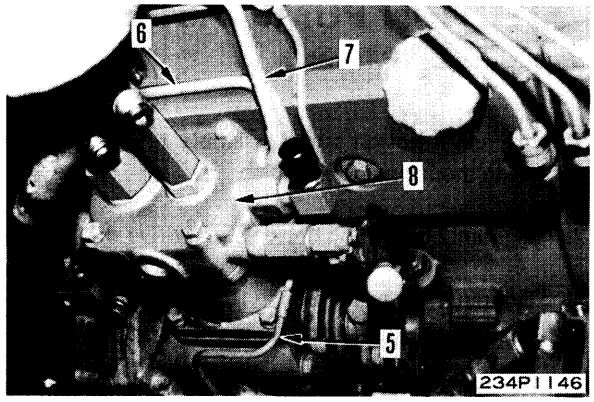


INSTALLATION OF AIR COMPRESSOR ASSEMBLY

GD705A-4

1. Fit O-ring and install air compressor assembly (8).
2. Fit gasket and install cooling tubes (7) and (6), and lubrication tube (5).
3. Connect suction hose (4) and air hoses (3) and (2).
4. Install fuel injection pump assembly.
   For details, see 13 INSTALLATION OF FUEL INJECTION PUMP ASSEMBLY.
5. Tighten drain valve (1) and add water through water filler to the specified level.

★ Run the engine to circulate the water through the system. Then check the water level again.

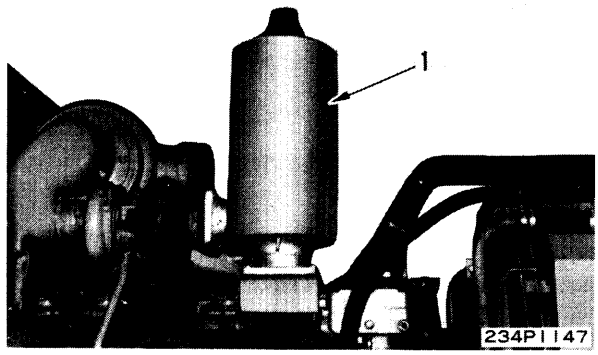


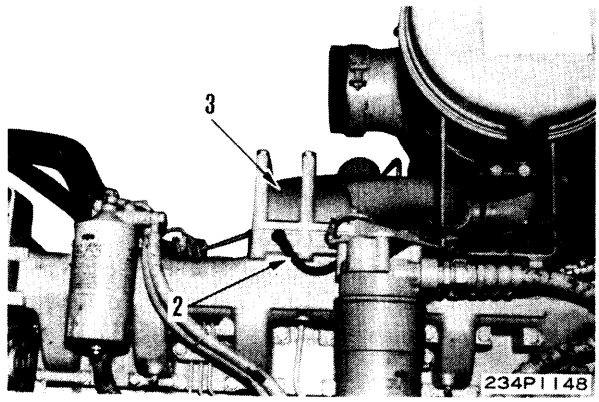
REMOVAL OF TURBOCHARGER ASSEMBLY

GD705A-4

⚠ Disconnect the cable from the negative (−) terminal of the battery.

1. Remove hood.
2. Remove muffler assembly (1).
3. Disconnect wire (2) of electric heater, then remove connector pipe (3).
4. Disconnect oil supply tube (4).
5. Disconnect drain tube (5).
6. Disconnect hose (6), then remove turbocharger assembly (7).

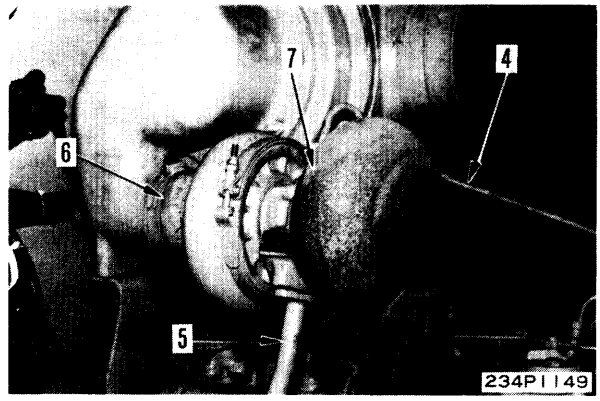




INSTALLATION OF TURBOCHARGER ASSEMBLY

GD705A-4

1. Fit gasket and install turbocharger assembly (7), then connect hose (6).
2. Fit gasket and connect drain tube (5).
3. Fit gasket and connect oil supply tube (4).
4. Fit gasket and install connector pipe (3), then connect wire (2) of electric heater.
5. Fit seal ring and install muffler assembly (1).
6. Install hood.
7. Connect cable to negative (−) terminal of battery.

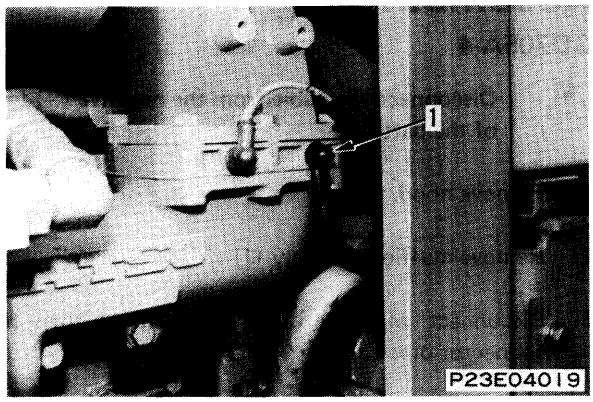


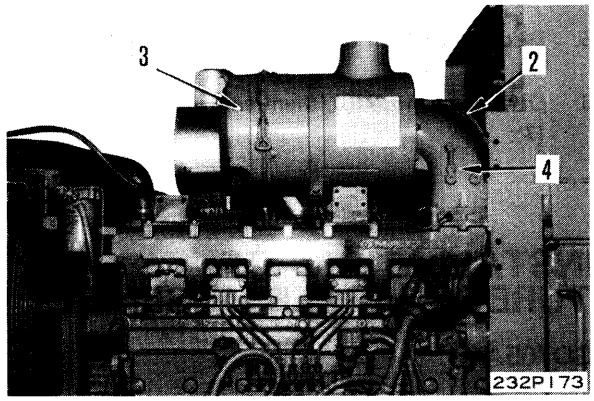
REMOVAL OF NOZZLE HOLDER ASSEMBLY

GD705R-4

⚠ Disconnect the lead from the negative (−) terminal of the battery.

1. Remove L.H. and R.H. engine side covers.
2. Lift off hood.
3. Disconnect wire (1) of electric heater.
4. Disconnect dust indicator hose (2).
5. Remove air cleaner assembly (3) together with connector pipe (4).
6. Disconnect fuel injection tube (5).
7. Remove spill tube (6).
8. Using a bar, remove nozzle holder assembly (7).
   ★ When removing the nozzle holder, clean around the nozzle holder and fit a blind plug to prevent dust or dirt from entering.

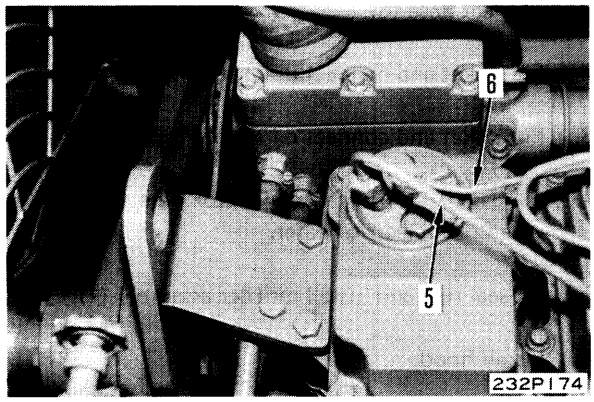


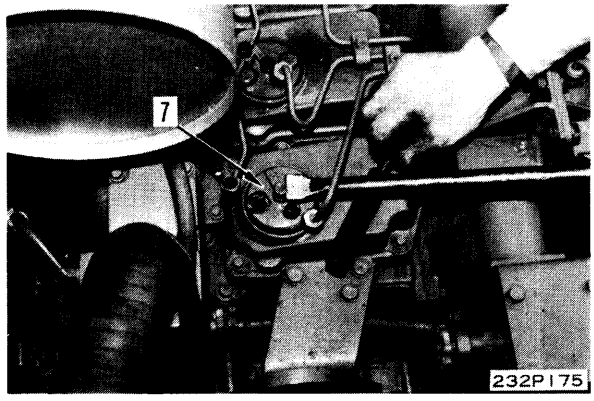


INSTALLATION OF NOZZLE HOLDER ASSEMBLY

GD705R-4

1. Fit O-ring and install nozzle holder assembly (7).
   ★ Tighten the nozzle holder mounting bolts uniformly.
   kgm Mounting bolt: 2.2 ± 0.3 kgm
2. Fit gasket and install spill tube (6).
3. Connect fuel injection tube (5).
   kgm Sleeve nut: 3.0 ± 1.0 kgm
4. Install air cleaner assembly (3) together with connector pipe (4).
5. Connect dust indicator hose (2).
6. Connect wire (1) of electric heater.
7. Install hood.
8. Install L.H. and R.H. engine side covers.
9. Connect lead to negative (−) terminal of battery.



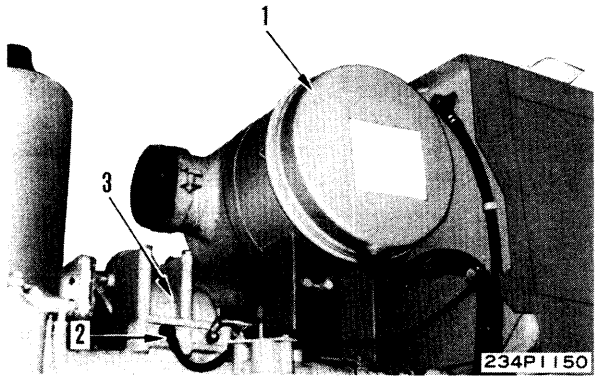


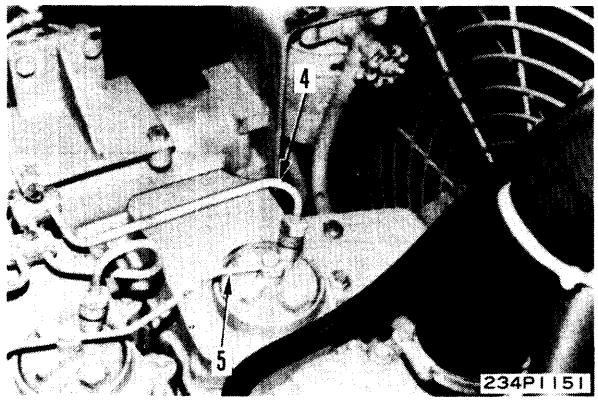
REMOVAL OF NOZZLE HOLDER ASSEMBLY

GD705A-4

⚠ Disconnect the cable from the negative (−) terminal of the battery.

1. Remove left and right engine side covers.
2. Lift off hood.
3. Remove air cleaner assembly (1).
4. Remove wire (2) of electric heater, then remove connector pipe (3).
5. Disconnect fuel injection tube (4).
6. Remove spill tube (5).
7. Using a bar, remove nozzle holder assembly (6).
   - ★ When removing the nozzle holder, clean around the nozzle holder and fit a blind plug to prevent dust or dirt from entering.
   - ★ Mark the nozzle holders with tags showing the cylinder no. and keep in a safe place. If there is no abnormality in the nozzle holder, install in the same position when assembling.





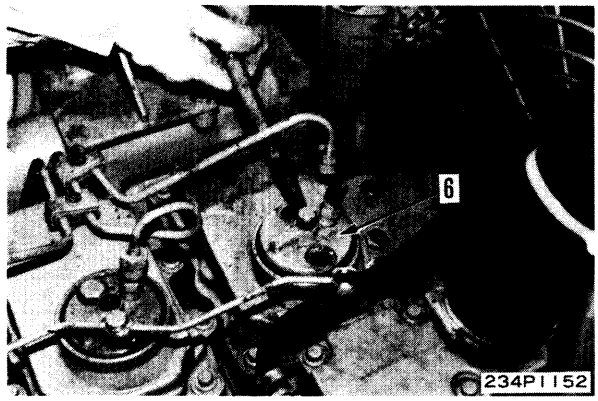
INSTALLATION OF NOZZLE HOLDER ASSEMBLY

GD705A-4

1. Fit O-ring and install nozzle holder assembly (6).
   - ★ Tighten the nozzle holder mounting bolts uniformly.

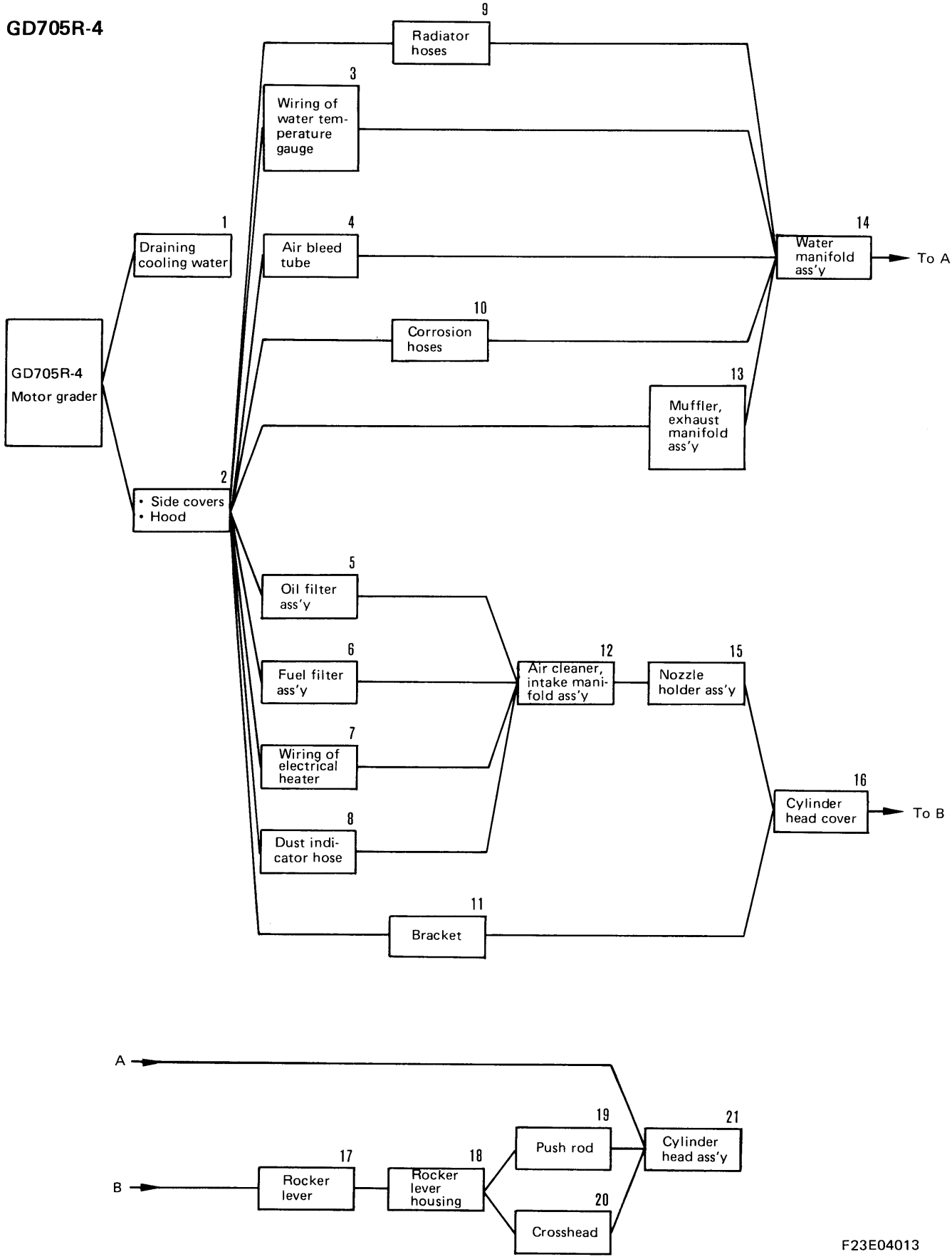
   kgm Mounting bolt: 2.2 ± 0.3 kgm
2. Fit gasket and install spill tube (5).
3. Connect fuel injection tube (4).

   kgm Sleeve nut: 3.0 ± 1.0 kgm
4. Install connector pipe (3), then connect wire (2) of electric heater.
5. Install air cleaner assembly (1).
6. Install hood.
7. Install left and right engine side covers.
8. Connect cable to negative (−) terminal of battery.



REMOVAL OF CYLINDER HEAD ASSEMBLY

GD705R-4



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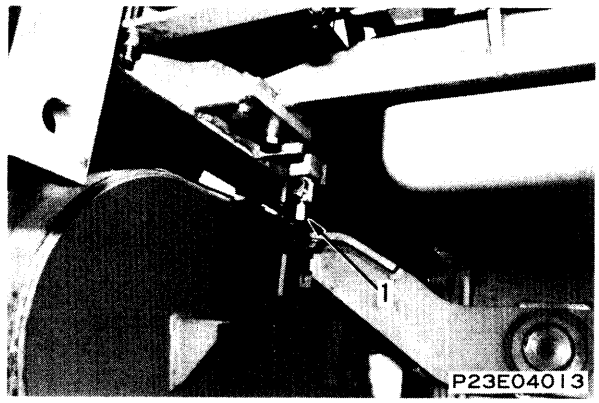
⚠ Disconnect the lead from the negative (−) terminal of the battery.

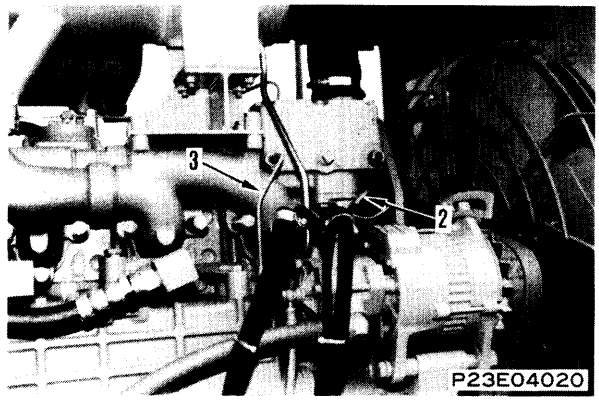
1. **Draining cooling water**
   Loosen drain valve (1) and drain cooling water.
   ★ If the coolant contains antifreeze, dispose of it correctly.



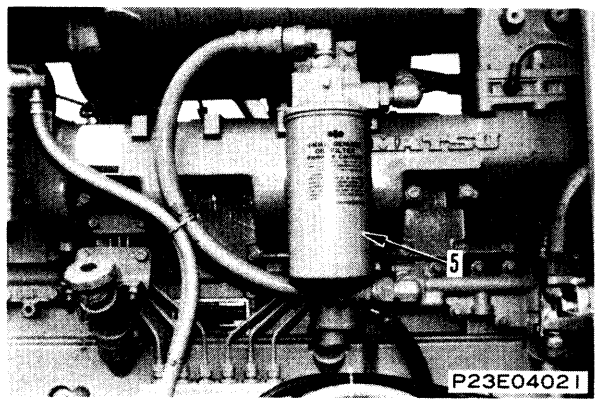
2. **Side covers, hood**
   1) Remove L.H. and R.H. engine side covers.
   2) Lift off hood.

3. **Wiring of water temperature gauge**
   Disconnect wire (2) of water temperature gauge.

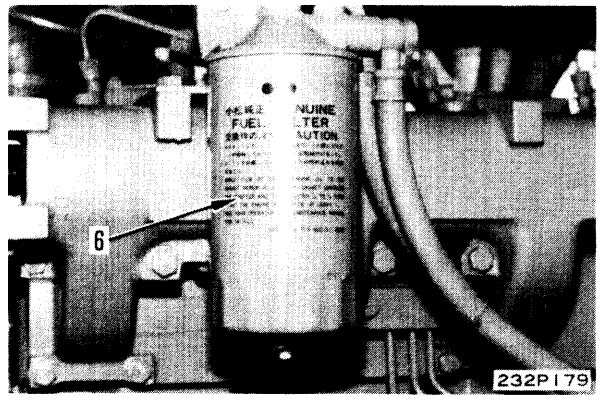
4. **Air bleed tube**
   Remove air bleed tube (3).



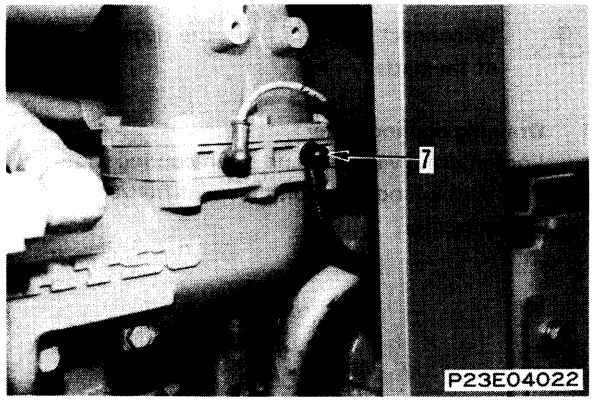
5. **Oil filter assembly**
   Remove oil filter assembly (5) from intake manifold.



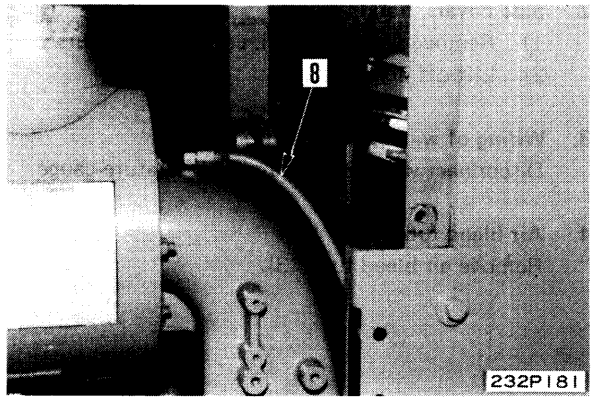
6. **Fuel filter assembly**
   Remove fuel filter assembly (6) from intake manifold assembly.



7. **Wiring of electrical heater**
   Disconnect wire (7) of electrical heater.



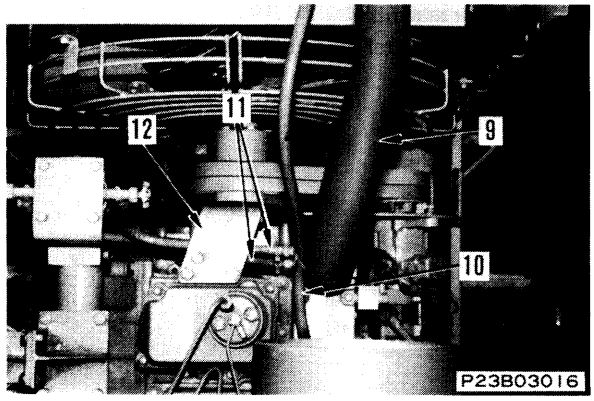
8. **Dust indicator hose**
   Disconnect dust indicator hose (8).



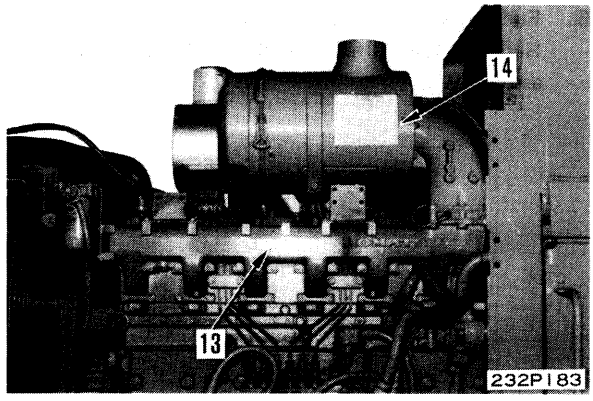
9. **Radiator hoses**
   Disconnect radiator inlet hose (9) and aeration hose (10).

10. **Corrosion hoses**
    Disconnect 2 corrosion hoses (11) from water manifold.

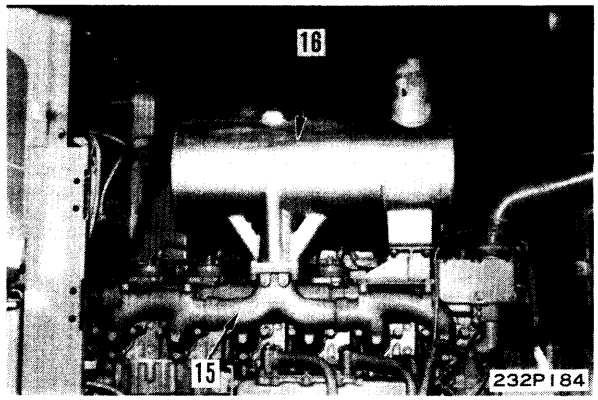
11. **Bracket**
    Remove bracket (12).



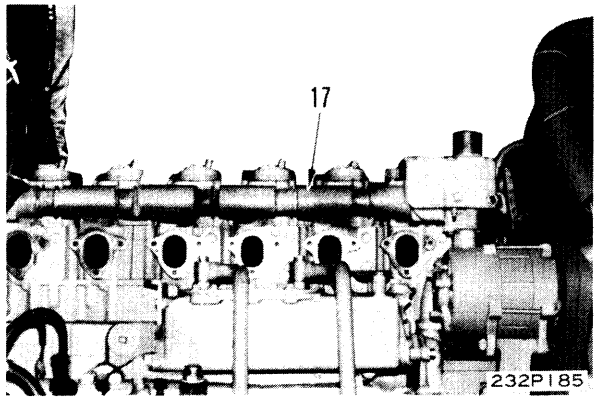
12. **Air cleaner, intake manifold assembly**
    Remove intake manifold assembly (13) together with air cleaner and connector pipe assembly (14).



13. **Muffler, exhaust manifold assembly**
Remove exhaust manifold assembly (15) together with muffler assembly (16).

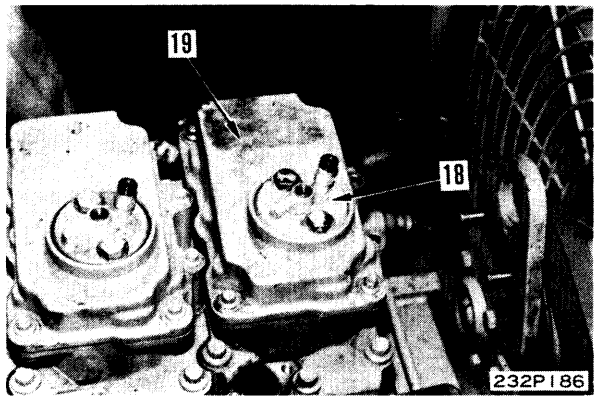


14. **Water manifold assembly**
Remove water manifold assembly (17).

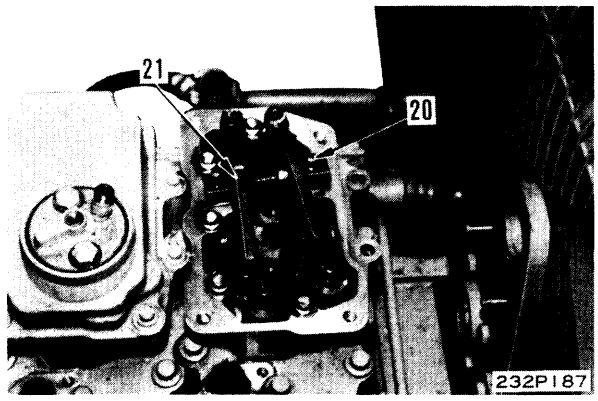


15. **Nozzle holder assembly**
Remove nozzle holder assembly (18).
For details, see 13 REMOVAL OF NOZZLE HOLDER ASSEMBLY.

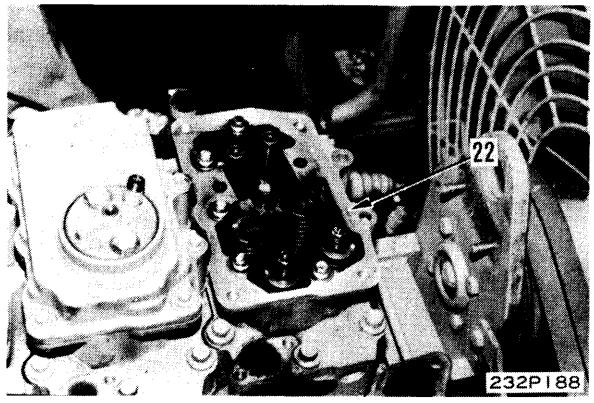
16. **Cylinder head cover**
Remove cylinder head cover (19).



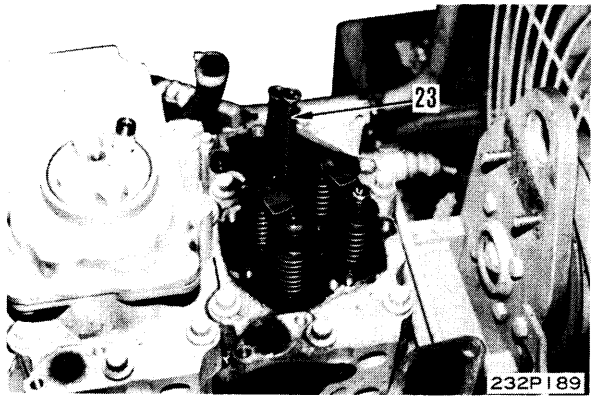
17. **Rocker lever**
Remove mounting bolts (20), then remove rocker lever (21).



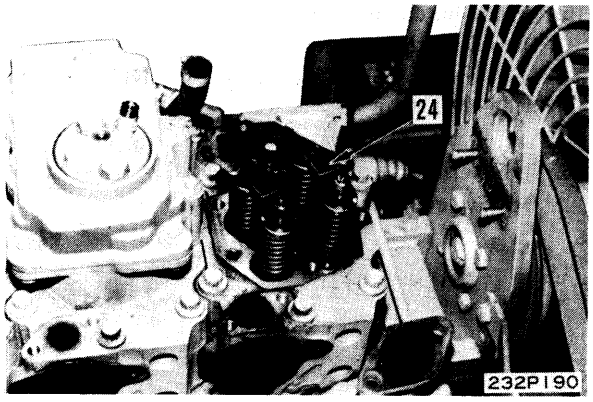
18. **Rocker lever housing**
Remove rocker lever housing (22).



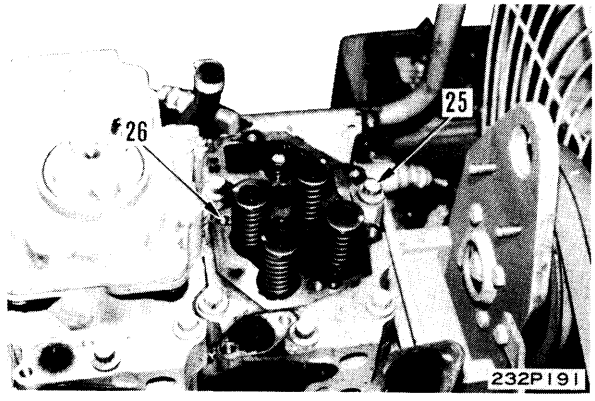
19. **Push rod**
Remove push rod (23).



20. **Crosshead**
Remove crosshead (24).

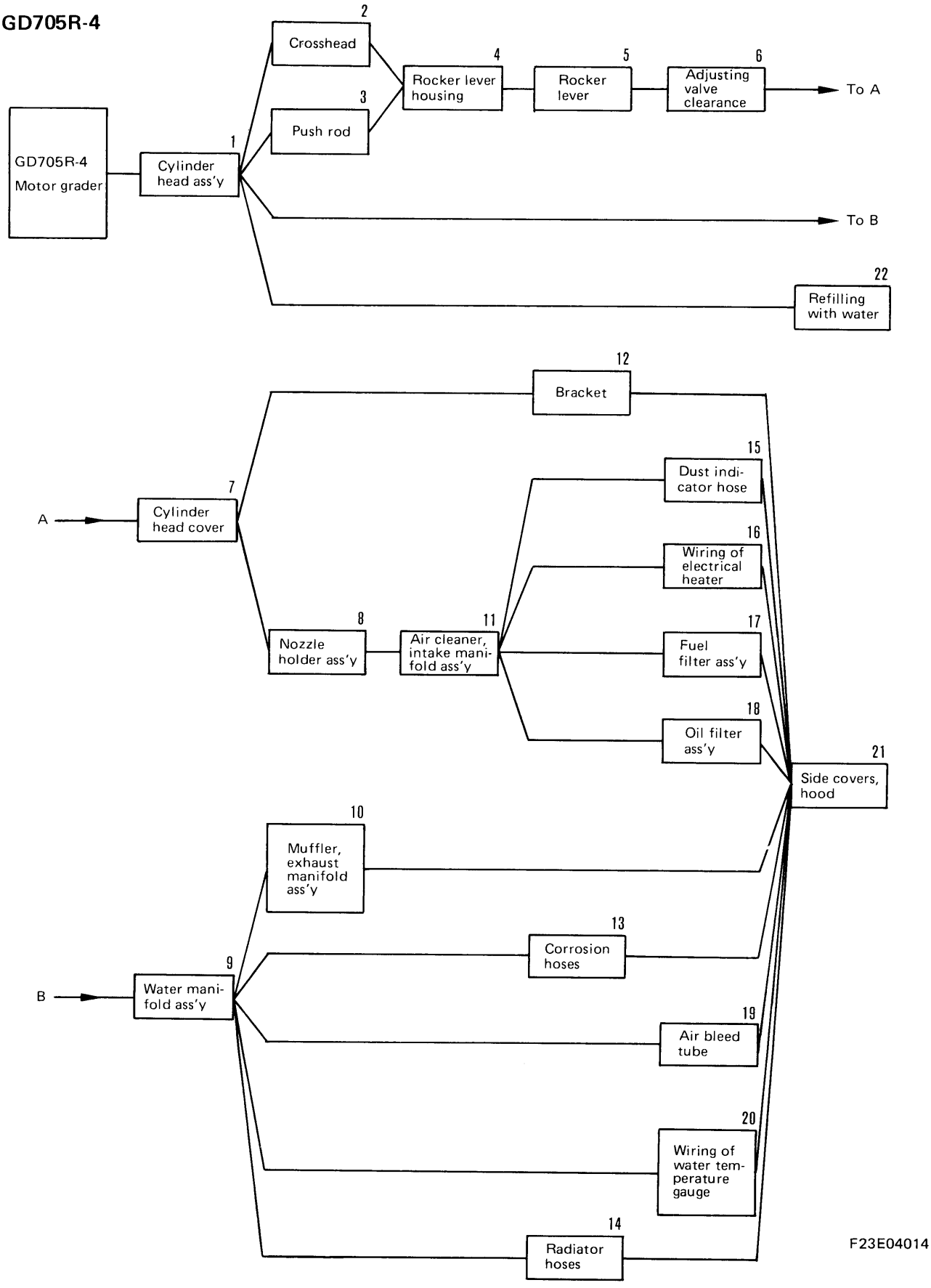


21. **Cylinder head assembly**
Remove mounting bolts (25), then remove cylinder head assembly (26).



INSTALLATION OF CYLINDER HEAD ASSEMBLY

GD705R-4



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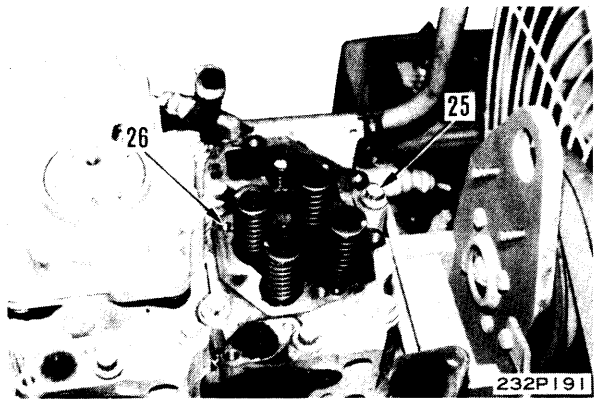
Special tool

	Part number	Part name	Q'ty
A	795-125-1360	Feeler gauge	1



★ Remove all carbon and dirt from the contact surfaces of the cylinder block and cylinder head. Remove all burrs and damage, and clean out all dirt from inside the cylinder block.

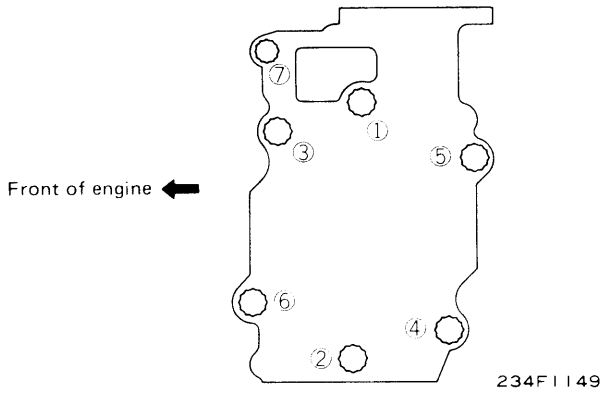
1. Cylinder head assembly

1) Install cylinder head gasket.
2) Install cylinder head assembly (26).
3) Tighten mounting bolts (25).

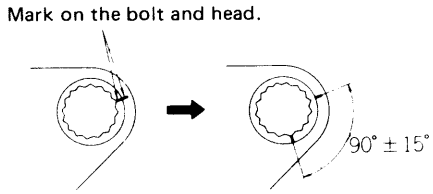
Coat the bolt thread and the under part of the bolt head with antifriction agent (LM-P) before tightening.

★ First, screw in the mounting bolts by hand at least 2 to 3 times, then tighten as follows. (Bolts ① to ⑥)

1st step: 10 ± 1 kgm
2nd step: 14 ± 0.5 kgm
3rd step: Put a mark on the bolt and head, then turn the bolt 90° ± 15°



★ Tighten bolt ⑦ to 6.7 ± 0.7 kgm



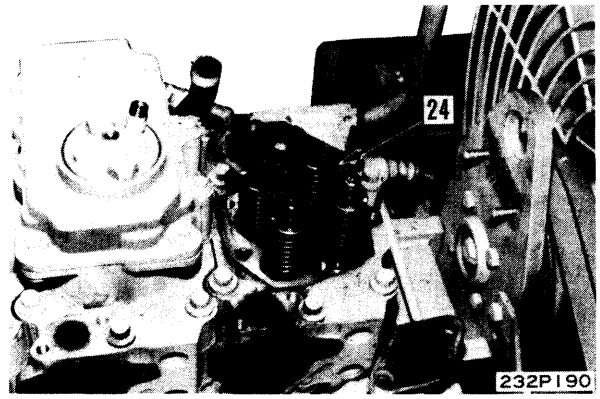
2. Crosshead

Install crosshead (24).

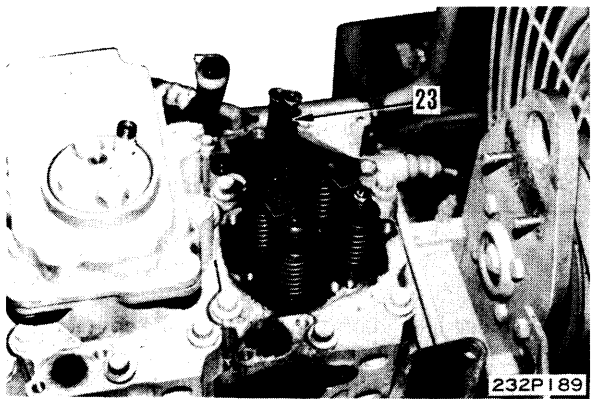
★ Adjust the crosshead as follows.

i) Loosen locknut, then loosen adjustment screw.
ii) Hold top of crosshead lightly with finger and tighten adjustment screw.
iii) When adjustment screw touches valve system, tighten a further 20°.
iv) Hold adjustment screw and tighten locknut.

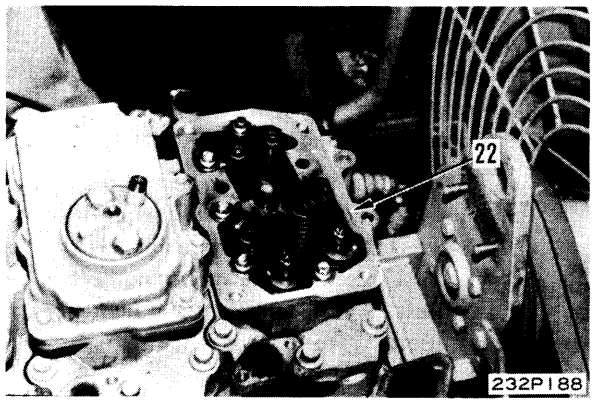
kgm Locknut: 3.8 ± 0.35 kgm



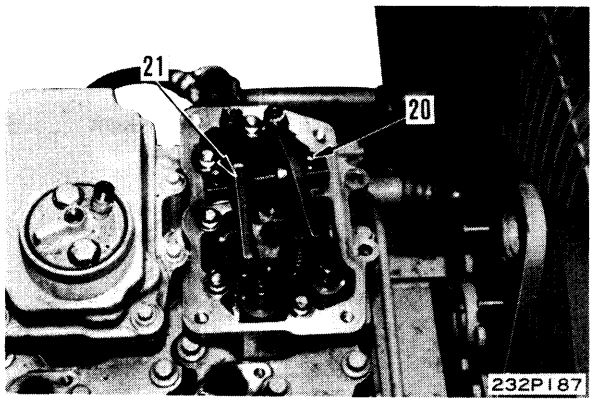
3. **Push rod**
Install push rod (23).
★ Check that the push rod is fitted completely into the socket of the camshaft follower.



4. **Rocker lever housing**
Install rocker lever housing (22).
kgm Mounting bolt: 6.7 ± 0.7 kgm

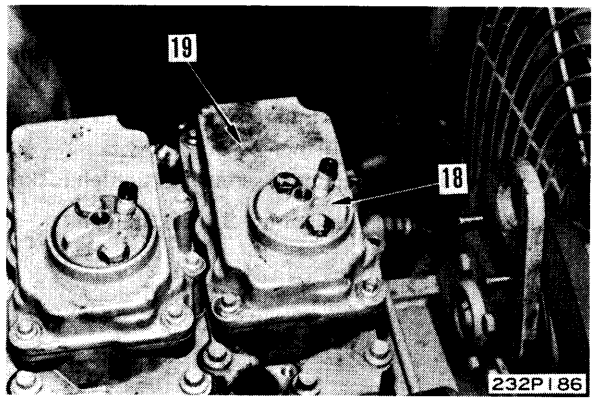


5. **Rocker lever**
Set rocker lever (21) in position, then tighten 12 mounting bolts (20).
★ Check that the ball of the adjustment screw is fitted properly into the socket of the push rod before tightening the mounting bolt.
★ Clean the oil hole before installing.
kgm Mounting bolt: 6.7 ± 0.7 kgm



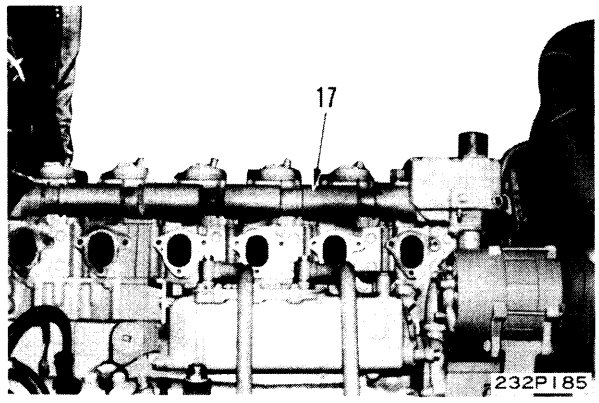
6. **Adjusting valve clearance**
Adjust valve clearance.
For details, see 12 ADJUSTING VALVE CLEARANCE.

7. **Cylinder head cover**
Fit gasket and install cylinder head cover (19).

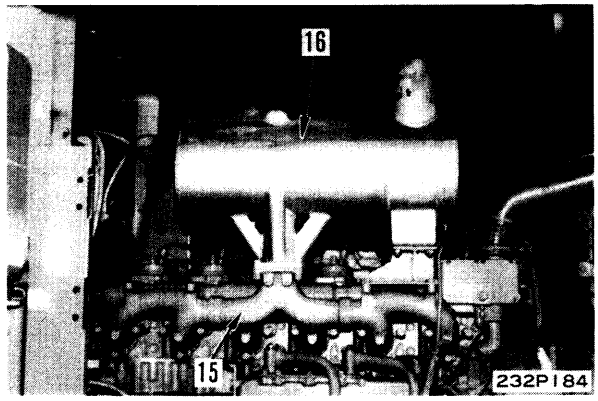


8. **Nozzle holder assembly**
Install nozzle holder assembly (18).
For details, see 13 INSTALLATION OF NOZZLE HOLDER ASSEMBLY.

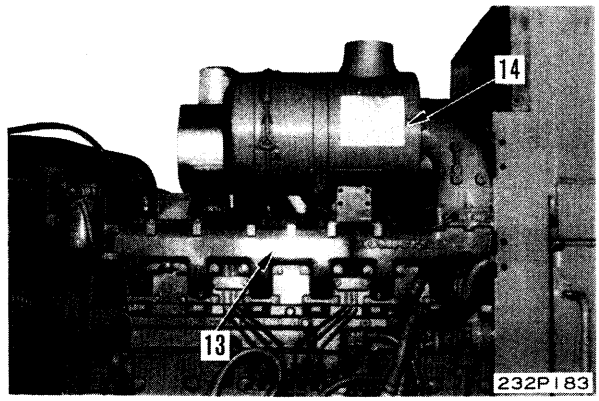
9. **Water manifold assembly**
   Fit gasket and install water manifold assembly (17).



10. **Muffler, exhaust manifold assembly**
    Fit gasket and install exhaust manifold assembly (15) together with muffler assembly (16).



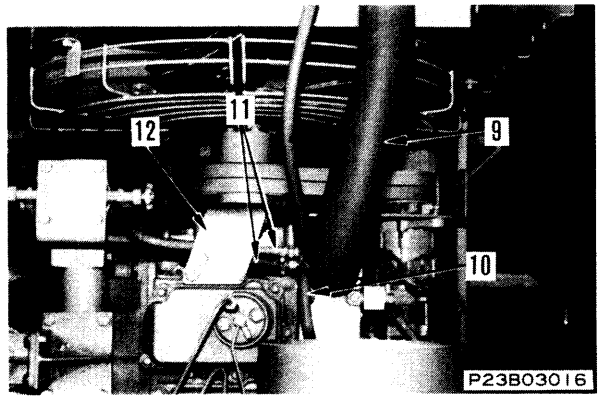
11. **Air cleaner, intake manifold assembly**
    Fit gasket and install intake manifold assembly (13) together with air cleaner and connector pipe assembly (14).



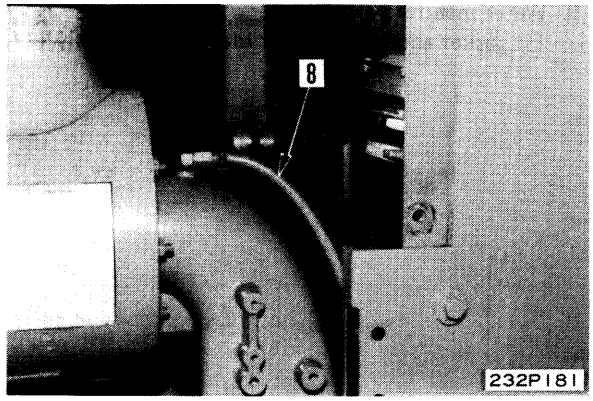
12. **Bracket**
    Install bracket (12).

13. **Corrosion hoses**
    Connect corrosion hoses (11) to water manifold.

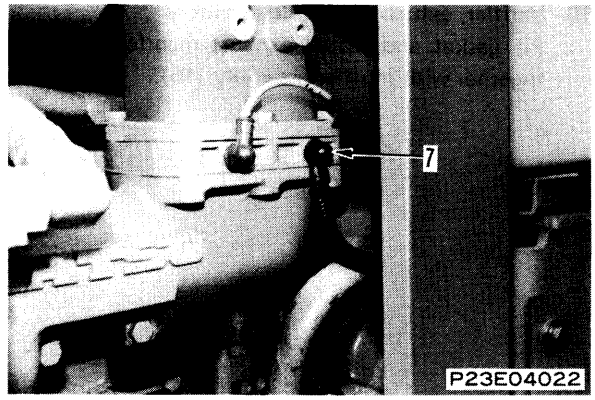
14. **Radiator hoses**
    Connect aeration hose (10) and radiator inlet hose (9).



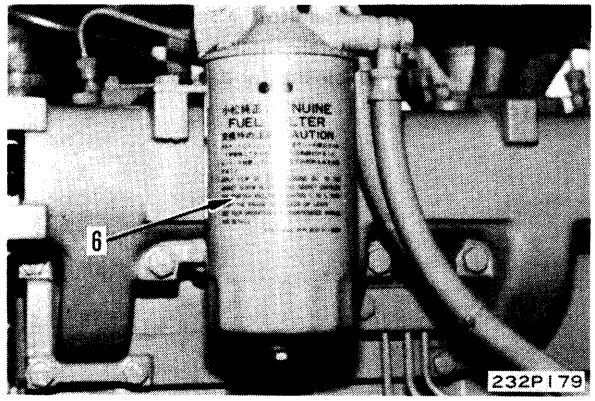
15. Dust indicator hose
Connect dust indicator hose (8).



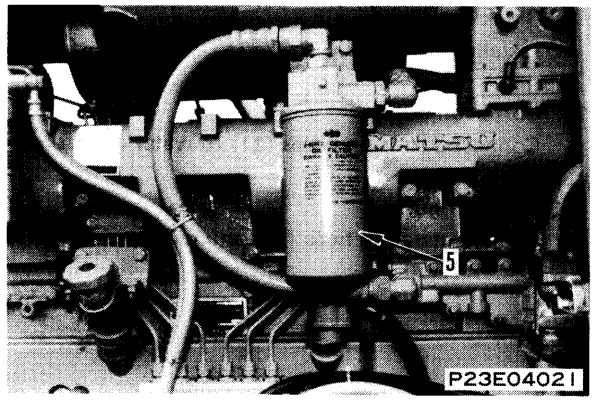
16. Wiring of electrical heater
Connect wire (7) of electrical heater.



17. Fuel filter assembly
Install fuel filter assembly (6).



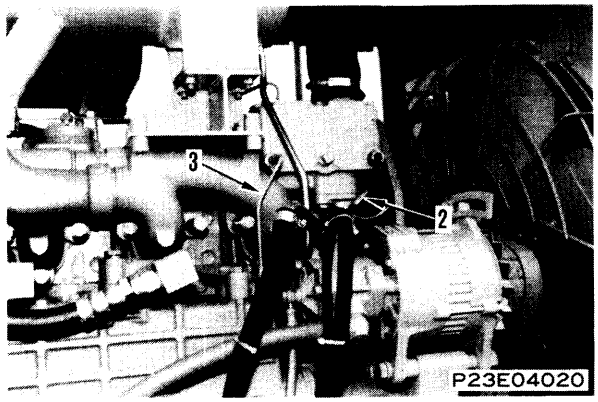
18. Oil filter assembly
Install oil filter assembly (5).



19. **Air bleed tube**
Install air bleed tube (3).

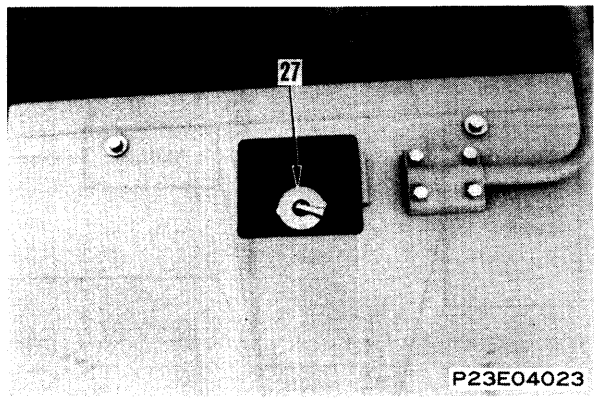
20. **Wiring of water temperature gauge**
1) Connect wiring of water temperature gauge (2).
2) Connect lead to negative (—) terminal of battery.

21. **Side covers, hood**
1) Raise hood and install.
2) Install L.H. and R.H. engine side covers.



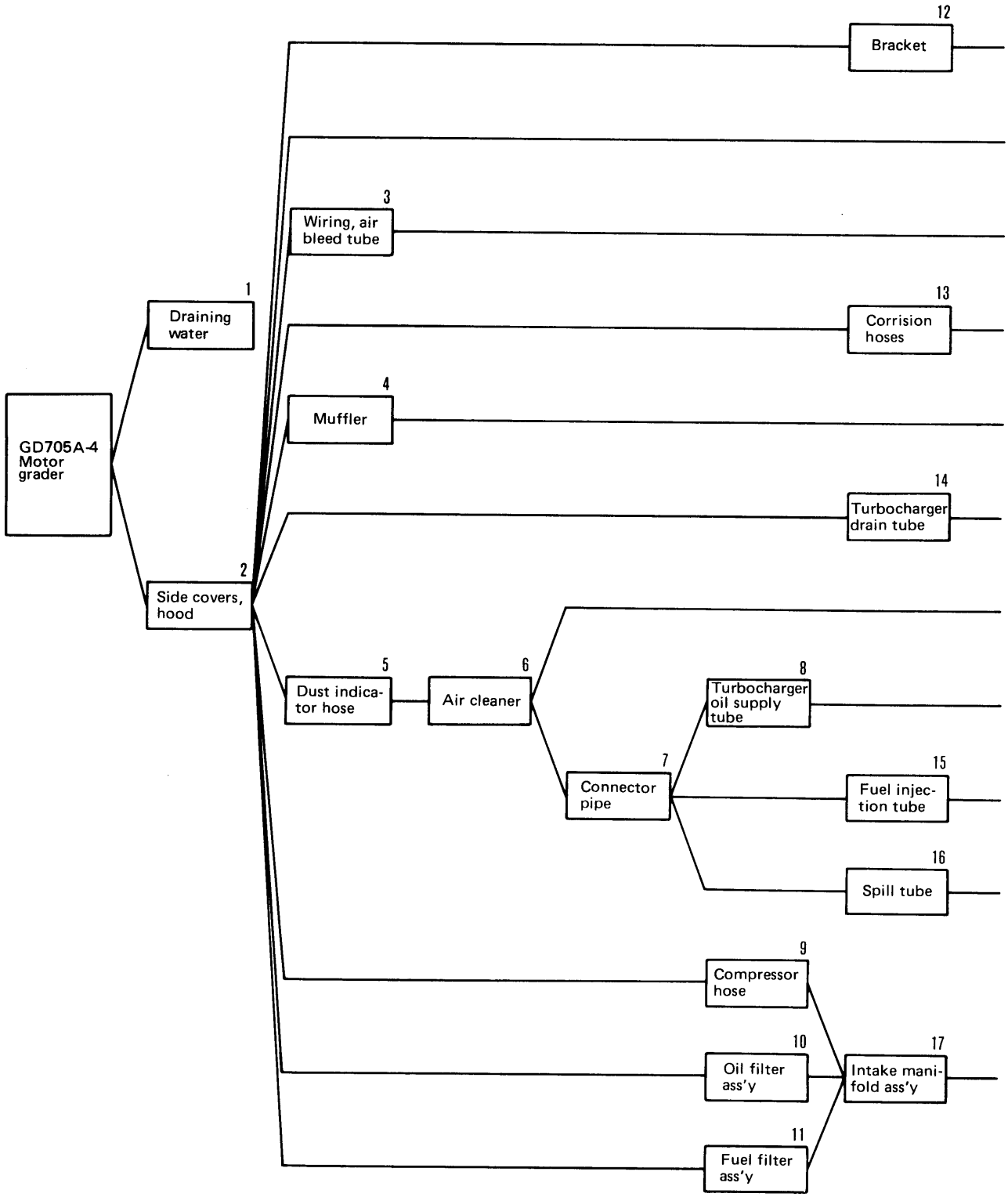
22. **Refilling with water**
Tighten drain valve and add water cooling water through water filler (27) to the specified level.

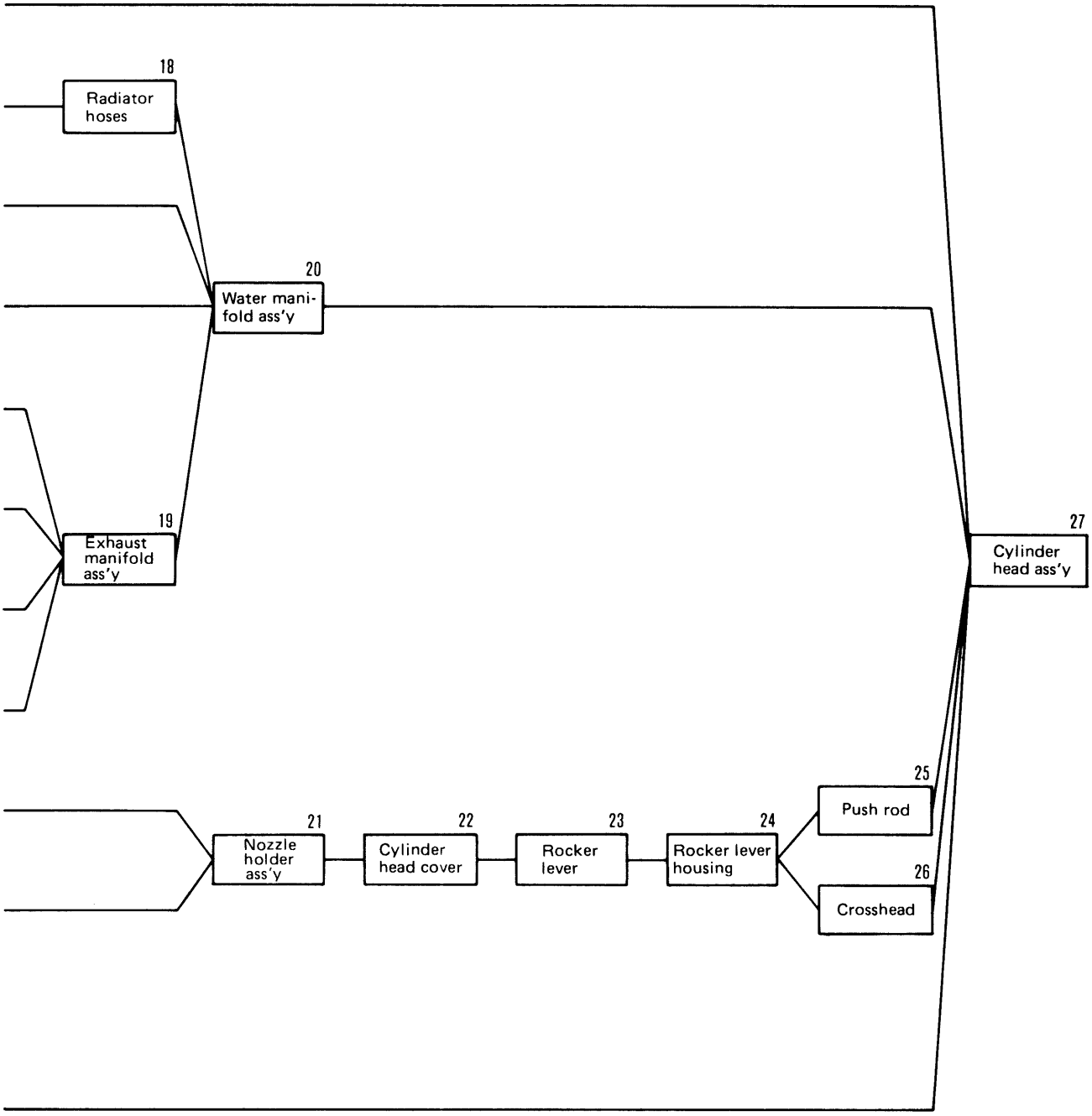
★ Run the engine to circulate the water through the system.
Then check the water level again.



REMOVAL OF CYLINDER HEAD ASSEMBLY

GD705A-4

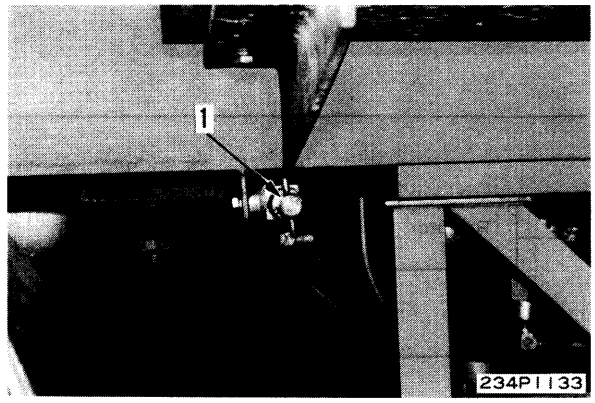



18
Radiator hoses
20
Water manifold ass'y
19
Exhaust manifold ass'y
27
Cylinder head ass'y
25
Push rod
21
Nozzle holder ass'y
22
Cylinder head cover
23
Rocker lever
24
Rocker lever housing
26
Crosshead

234F1147

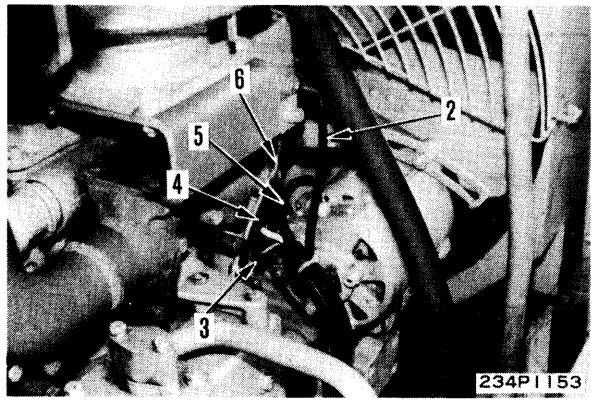
⚠ Disconnect the cable from the negative (−) terminal of the battery.

1. **Draining water**
   Loosen drain valve (1) and drain cooling water.
   ★ If the coolant contains antifreeze, dispose of it correctly.

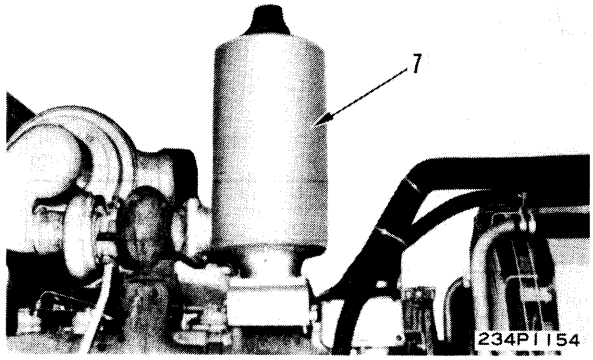


2. **Side covers, hood**
   1) Remove left and right engine side covers.
   2) Lift off hood.

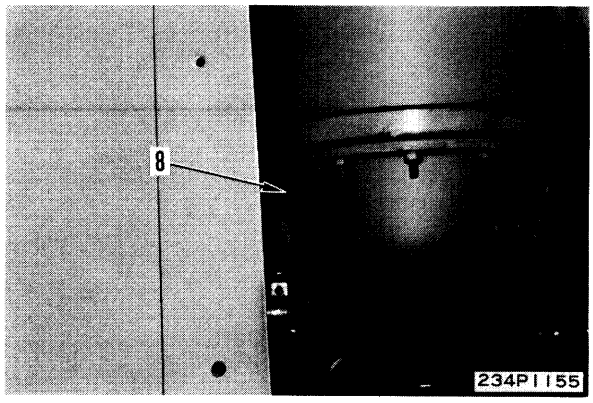
3. **Wiring, air bleed tube**
   1) Disconnect wire (2) of water temperature gauge.
   2) Disconnect wires (3), (4) and (5) of alternator.
   3) Remove air bleed tube (6).



4. **Muffler**
   Lift off muffler assembly (7).

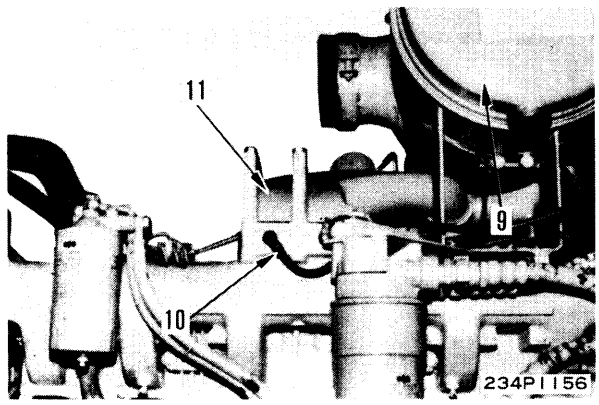


5. **Dust indicator hose**
   Disconnect dust indicator hose (8).

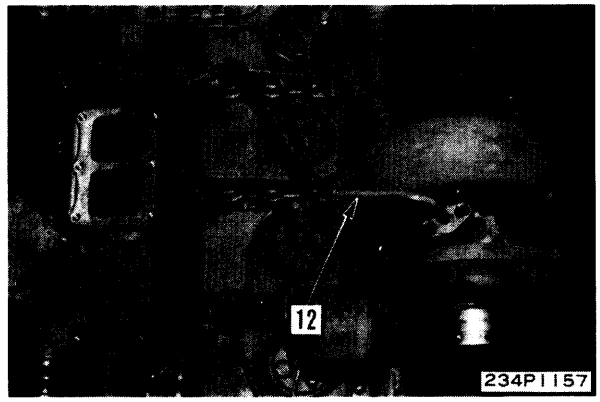


6. **Air cleaner**
   Remove air cleaner assembly (9).

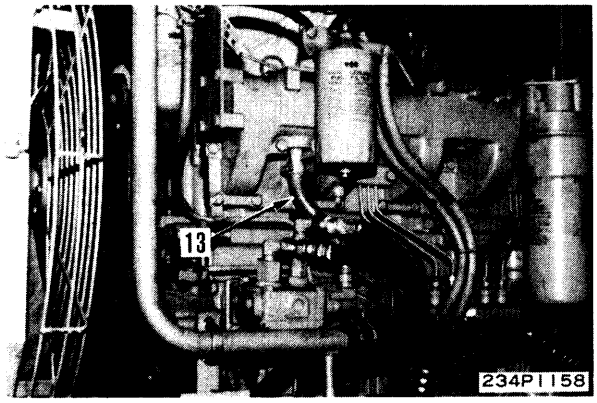
7. **Connector pipe**
   1) Disconnect wire (10) of electric heater.
   2) Remove connector pipe (11).



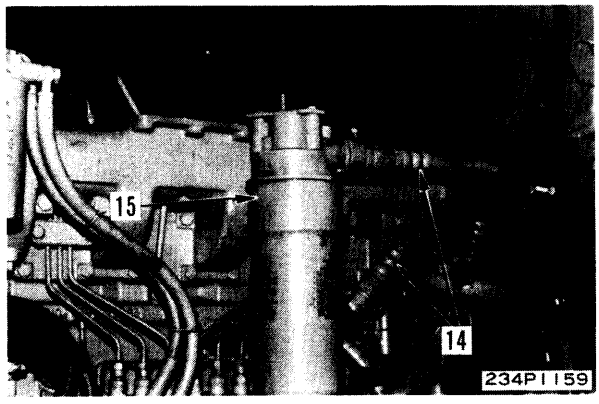
8. **Turbocharger oil supply tube**
   Remove oil supply tube (12).



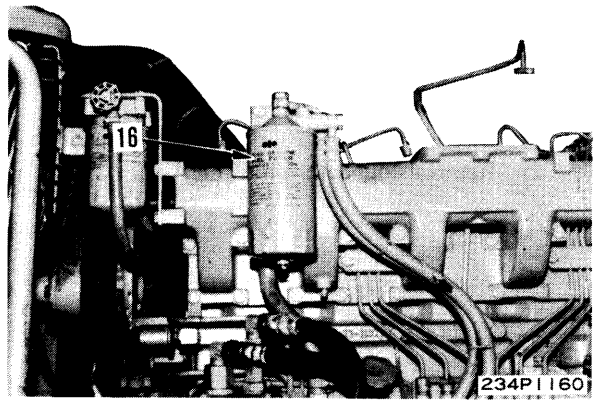
9. **Compressor hose**
   Disconnect compressor suction hose (13).



10. **Oil filter assembly**
    Disconnect 2 oil hoses (14), remove oil filter assembly (15).

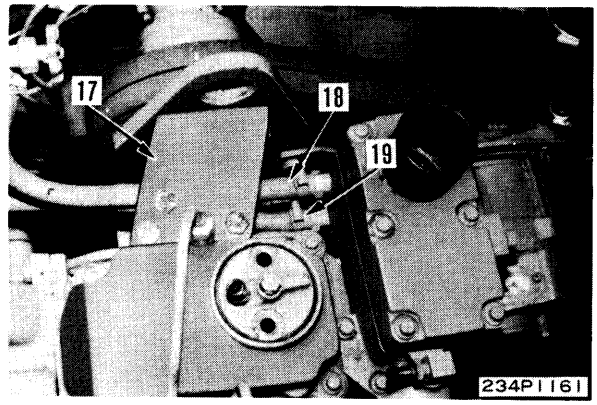


11. Fuel filter assembly
Remove fuel filter assembly (16).

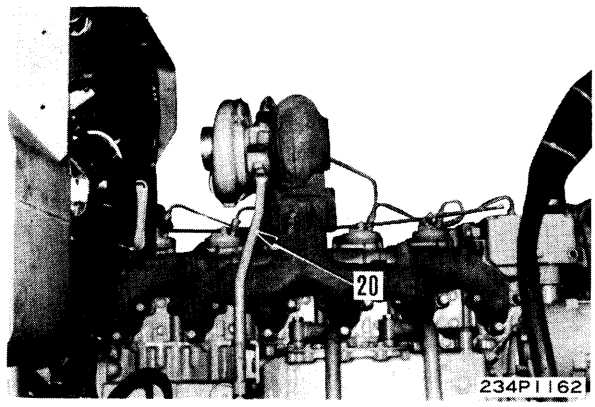


12. Bracket
Remove bracket (17).

13. Corrosion hoses
Disconnect corrosion hoses (18) and (19) at water manifold end.

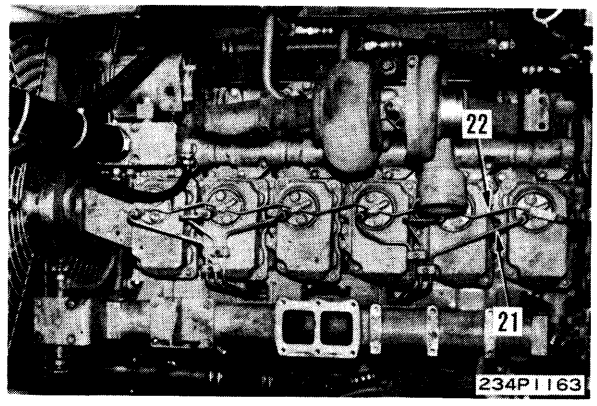


14. Turbocharger drain tube
Disconnect drain tube (20).



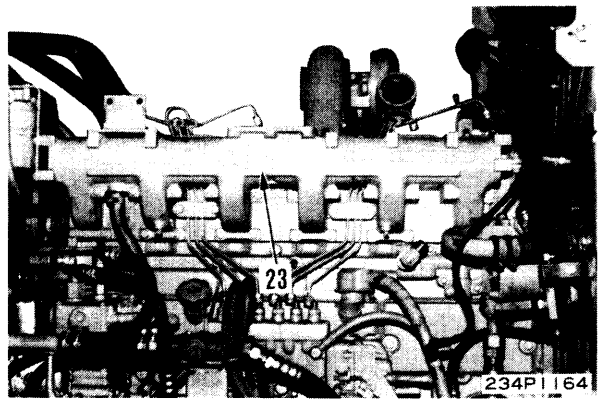
15. Fuel injection tube
Remove fuel injection tube (21).

16. Spill tube
Remove spill tube (22).



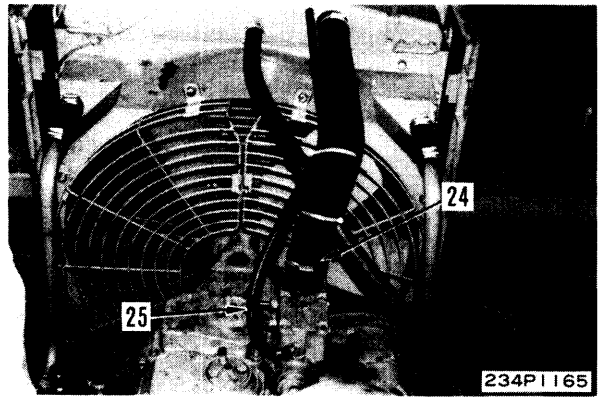
17. Intake manifold assembly

Remove intake manifold assembly (23) together with corrosion resistor assembly.



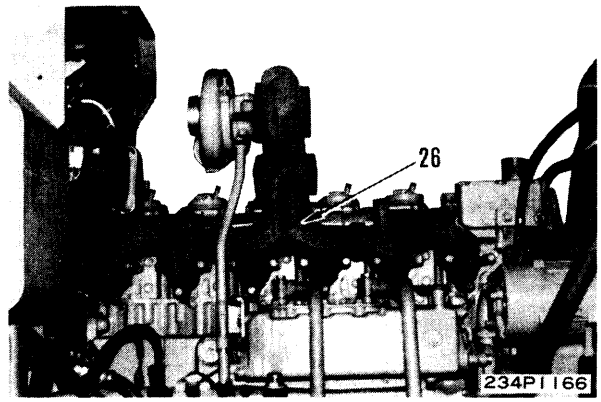
18. Radiator hoses

Disconnect radiator inlet hose (24) and aeration hose (25).



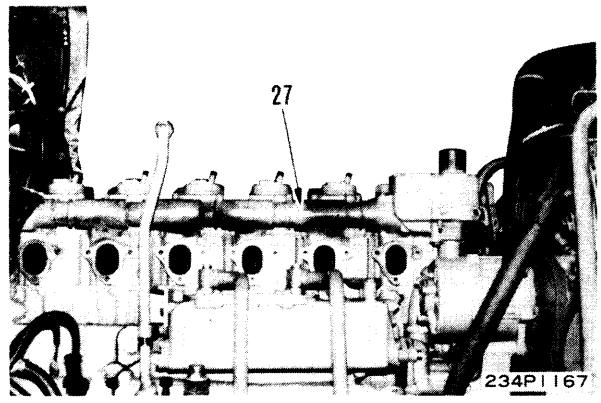
19. Exhaust manifold assembly

Remove exhaust manifold assembly (26) together with turbocharger assembly.



20. Water manifold assembly

Remove water manifold assembly (27).

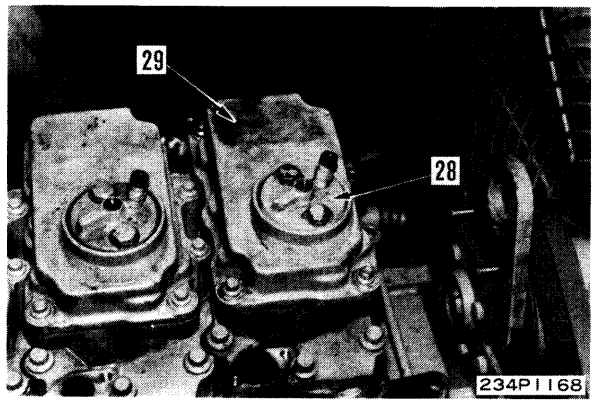


21. Nozzle holder assembly

Remove nozzle holder assembly (28).

★ When removing the nozzle holder, clean around the nozzle holder and fit a blind plug to prevent dust or dirt from entering.

★ Mark the nozzle holders with tags showing the cylinder no. and keep in a safe place. If there is no abnormality in the nozzle holder, install in the same position when assembling.

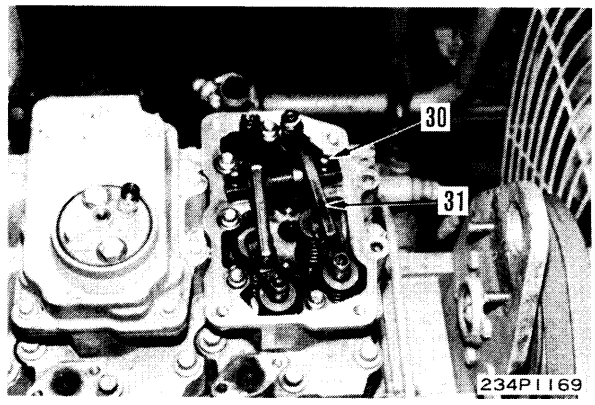


22. Cylinder head cover

Remove cylinder head cover (29).

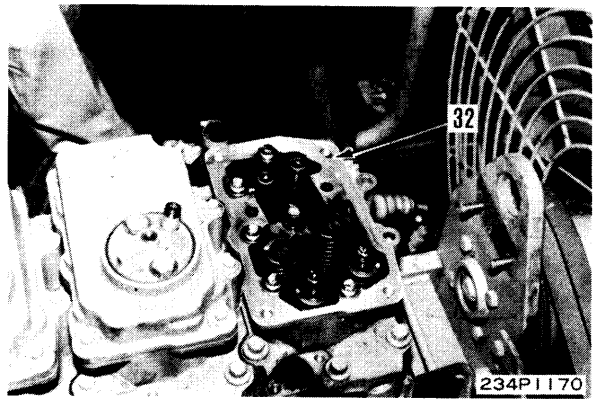
23. Rocker lever

Remove mounting bolts (30), then remove rocker lever (31).



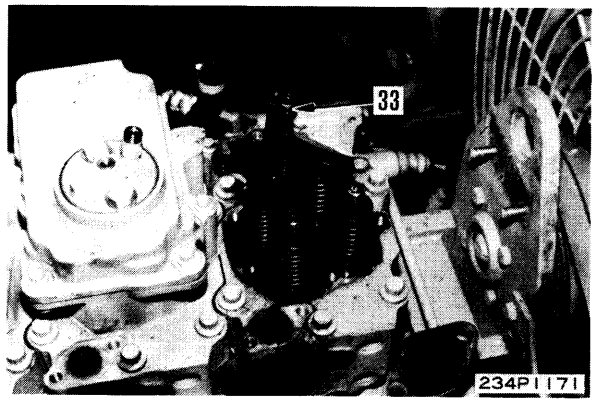
24. Rocker lever housing

Remove rocker lever housing (32).



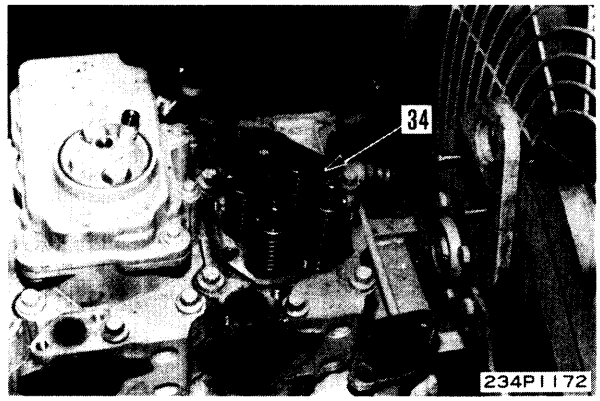
25. Push rod

Remove push rod (33).



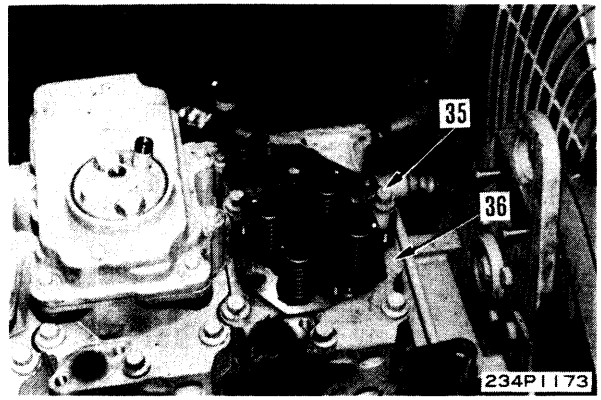
26. Crosshead

Remove crosshead (34).



27. Cylinder head assembly

Remove mounting bolts (35), then remove cylinder head assembly (36).



INSTALLATION OF CYLINDER HEAD ASSEMBLY

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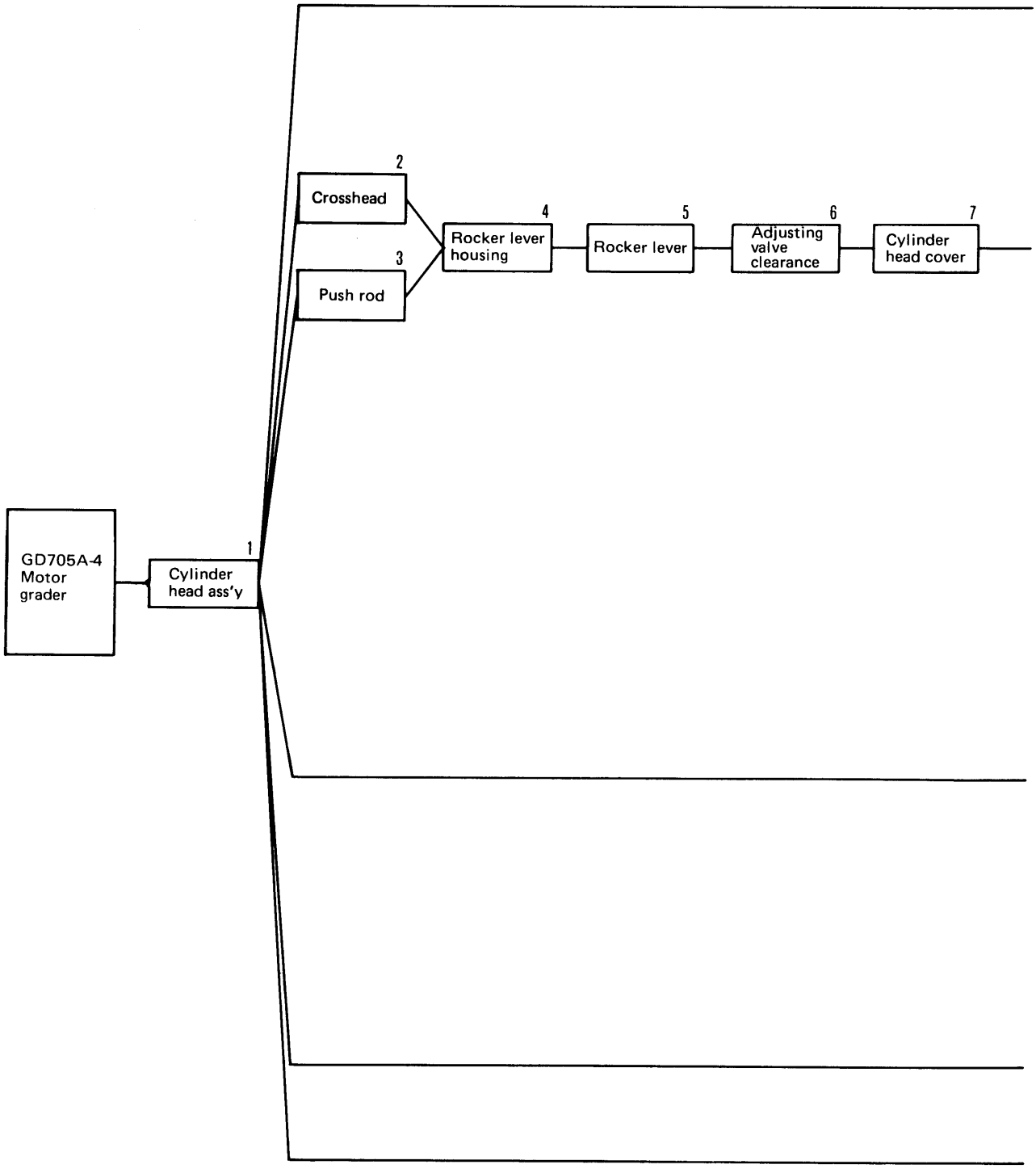
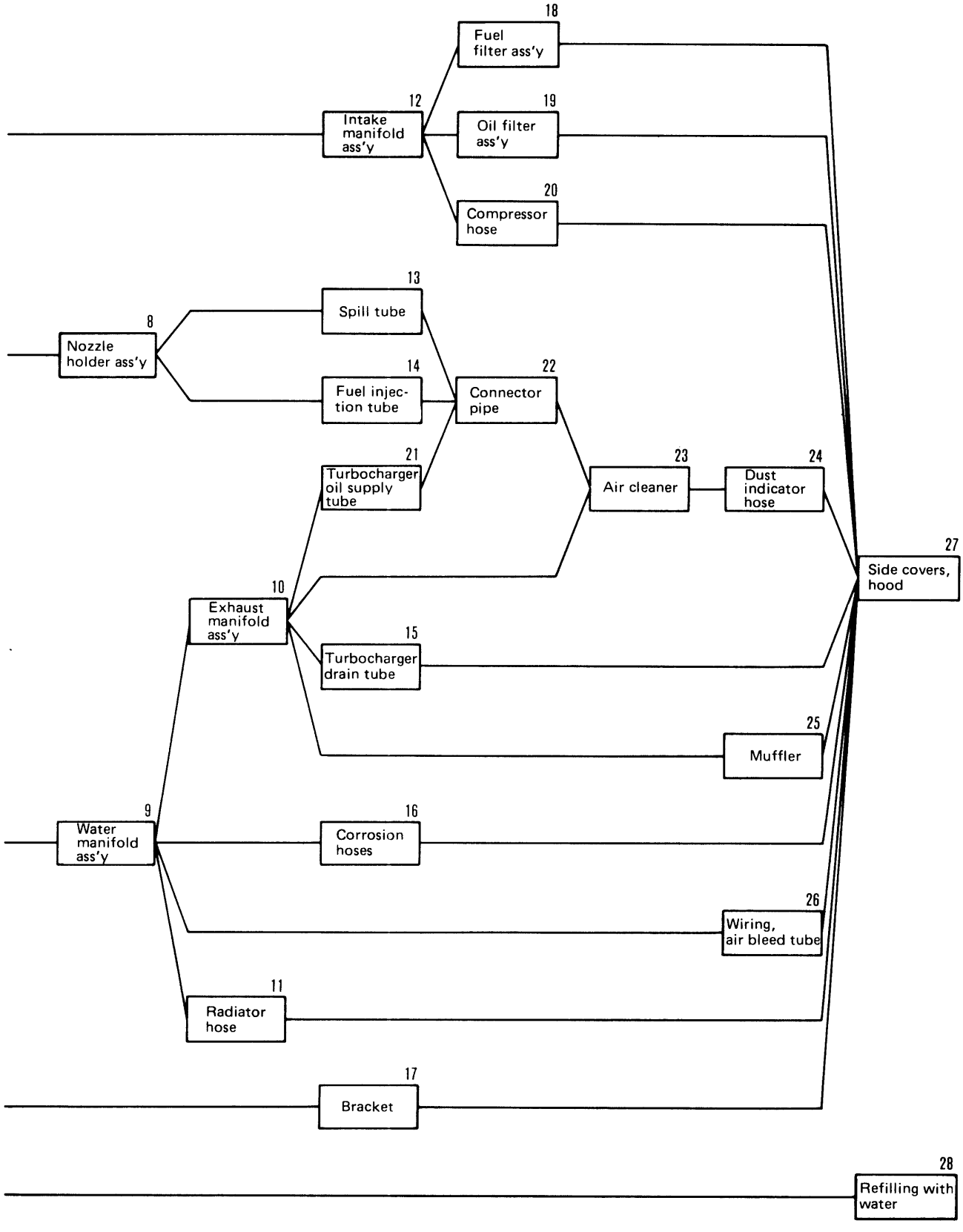



18
Fuel filter ass'y
12
Intake manifold ass'y
19
Oil filter ass'y
20
Compressor hose
13
Spill tube
8
Nozzle holder ass'y
14
Fuel injection tube
22
Connector pipe
21
Turbocharger oil supply tube
23
Air cleaner
24
Dust indicator hose
27
Side covers, hood
10
Exhaust manifold ass'y
15
Turbocharger drain tube
25
Muffler
9
Water manifold ass'y
16
Corrosion hoses
26
Wiring, air bleed tube
11
Radiator hose
17
Bracket
28
Refilling with water

234F1148

Special tool

	Part No.	Part Name	Q'ty
A	795-125-1360	Feeler gauge	1

★ Remove all carbon and dirt from the contact surfaces of the cylinder block and cylinder head. Remove all burrs and damage, and clean out all dirt from inside the cylinder block.

1. Cylinder head assembly

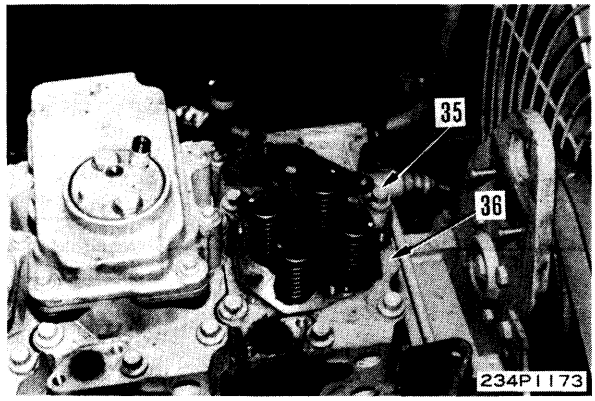
1) Install cylinder head gasket.
2) Install cylinder head assembly (36).
3) Tighten mounting bolts (35).

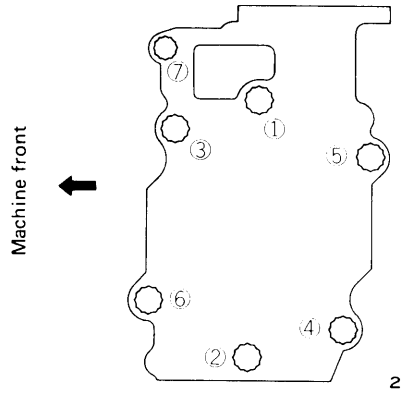
Coat the bolt thread and the under part of the bolt head with antifriction compound (LM-P) before tightening.

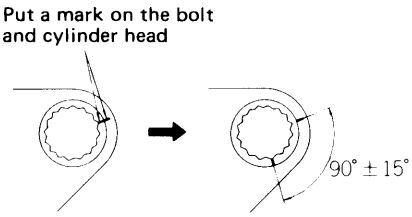
★ First, screw in the mounting bolts by hand 2 to 3 times, then tighten as follows. (Bolts ① to ⑥)

kgm
1st step: 10 ± 1 kgm
2nd step: 14 ± 0.5 kgm
3rd step: Put a mark on the bolt and cylinder head, then turn the bolt 90° ± 15°

★ Tighten bolt ⑦ to 6.7 ± 0.7 kgm







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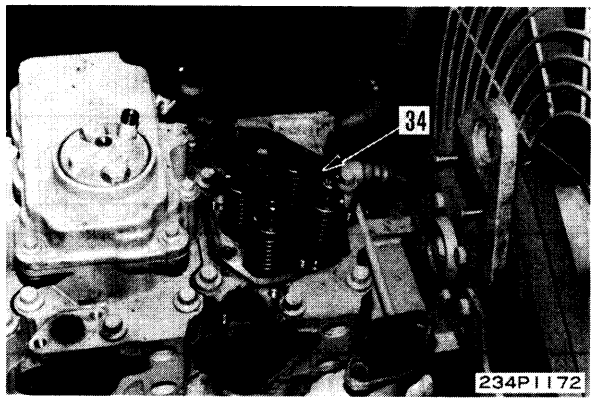
2. Crosshead

Install crosshead (34).

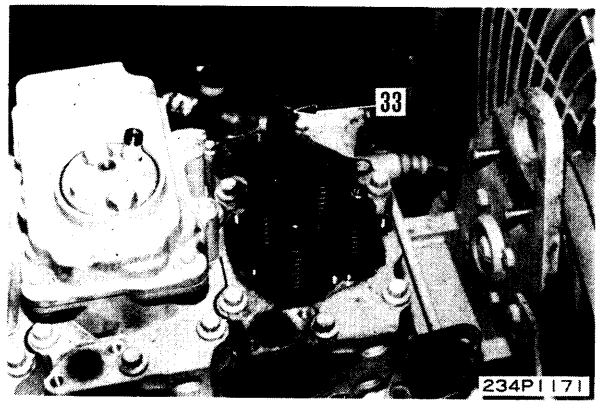
★ Adjust the crosshead as follows.

i) Loosen locknut, then loosen adjustment screw.
ii) Hold top of crosshead lightly with fingers and tighten adjustment screw.
iii) When adjustment screw touches valve stem, tighten a further 20°.
iv) Hold adjustment screw and tighten locknut.

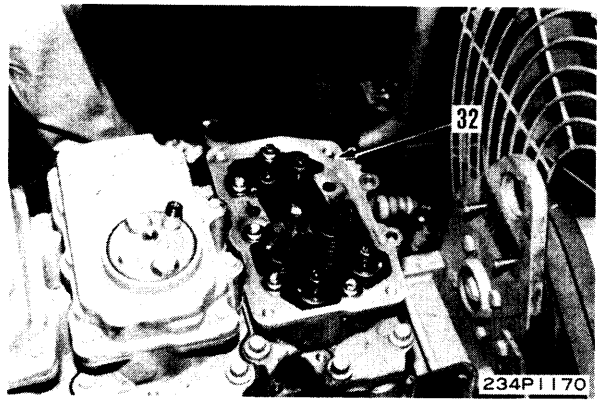
kgm Locknut: 3.8 ± 0.35 kgm



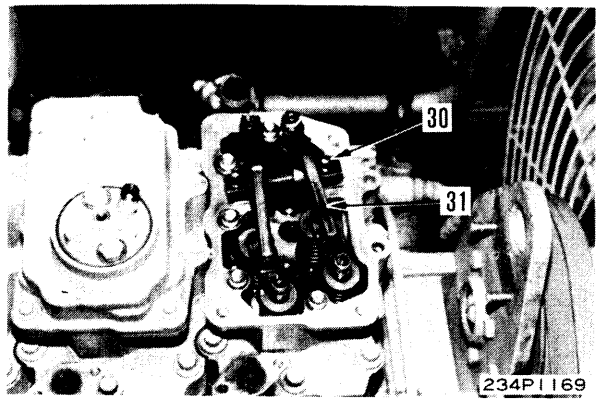
3. **Push rod**
Install push rod (33).
★ Check that the push rod is fitted completely into the socket of the camshaft follower.



4. **Rocker lever housing**
Install rocker lever housing (32).
kgm Mounting bolt: 6.7 ± 0.7 kgm



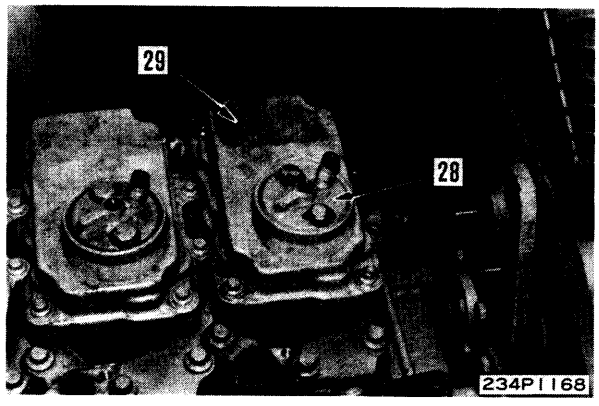
5. **Rocker lever**
Set rocker lever (31) in position, then tighten 12 mountint bolts (30).
★ Check that the ball of the adjustment screw is fitted properly into the socket of the push rod before tightening the mounting bolt.
★ Clean the oil holes of the bolts before installing.
kgm Mounting bolt: 6.7 ± 0.7 kgm



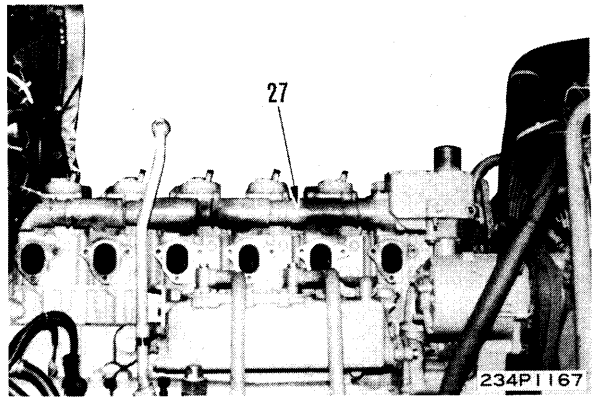
6. **Adjusting valve clearance**
Adjust valve clearance. (For details, see 12 ADJUSTING VALVE CLEARANCE.)

7. **Cylinder head cover**
Fit gasket and install cylinder head cover (29).

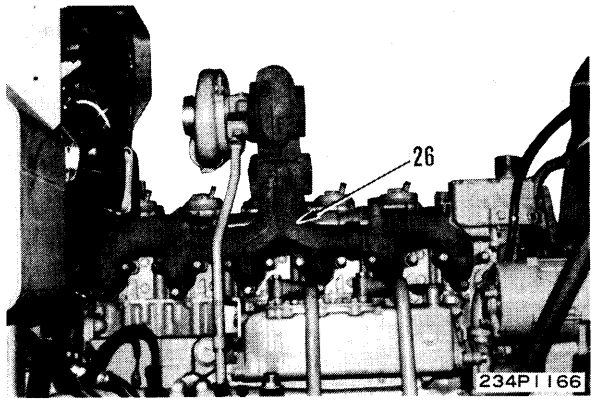
8. **Nozzle holder assembly**
★ Check that there is no dirt or dust inside the sleeve of the nozzle holder.
Fit O-ring, install nozzle holder (28) in cylinder head, then tighten mounting bolts.
★ Tighten the nozzle holder mounting bolts uniformly.
kgm Mounting bolt: 2.2 ± 0.3 kgm



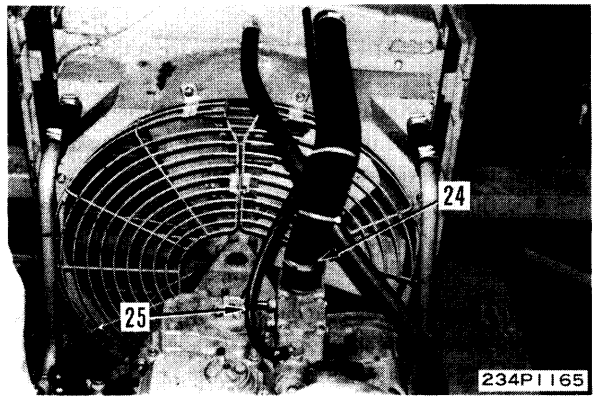
9. **Water manifold assembly**
   Fit gasket and install water manifold assembly (27).



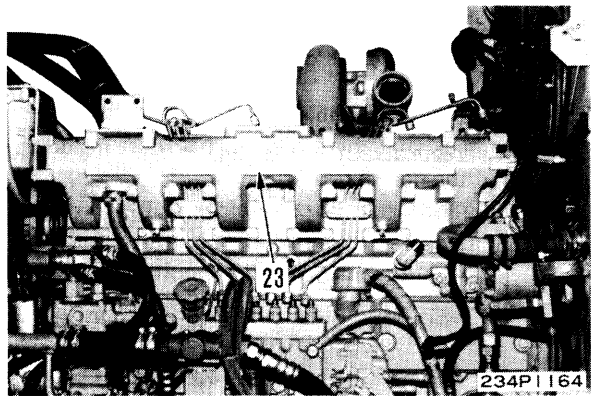
10. **Exhaust manifold assembly**
    Fit gasket and install exhaust manifold assembly (26) together with turbocharger assembly.



11. **Radiator hoses**
    Connect aeration hose (25) and radiator inlet hose (24).

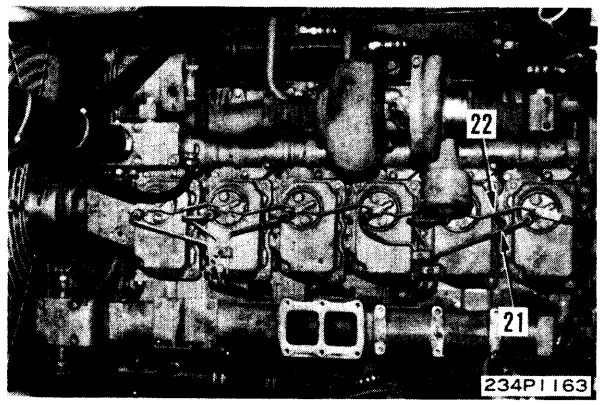


12. **Intake manifold assembly**
    Fit gasket and install intake manifold assembly (23) together with corrosion resistor assembly.

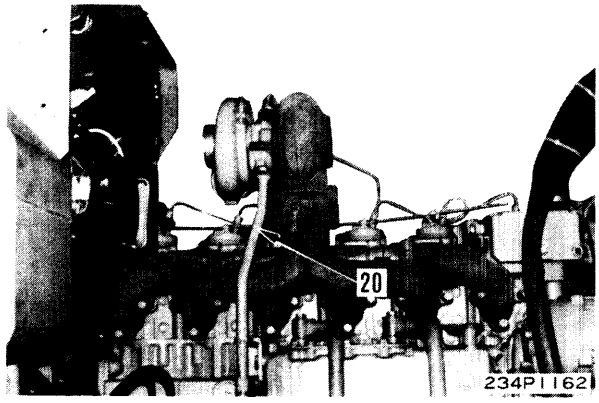


13. **Spill tube**
Fit gasket and install spill tube (22).

14. **Fuel injection tube**
Install fuel injection tube (21).
kgm Sleeve nut: 3.0 ± 1.0 kgm

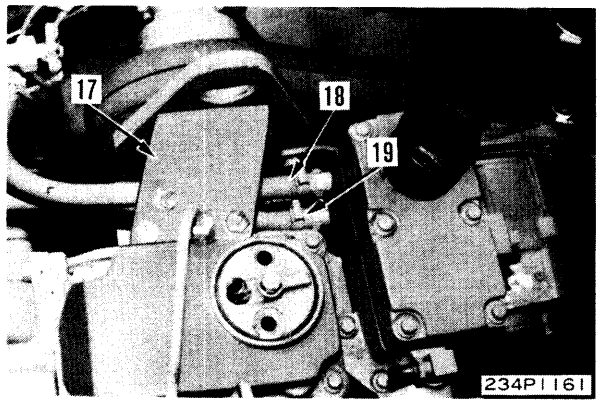


15. **Turbocharger drain tube**
Fit gasket and connect drain tube (20).

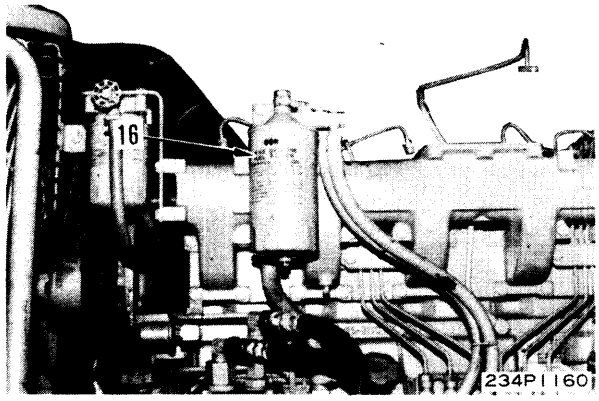


16. **Corrosion hoses**
Connect corrosion hoses (19) and (18).

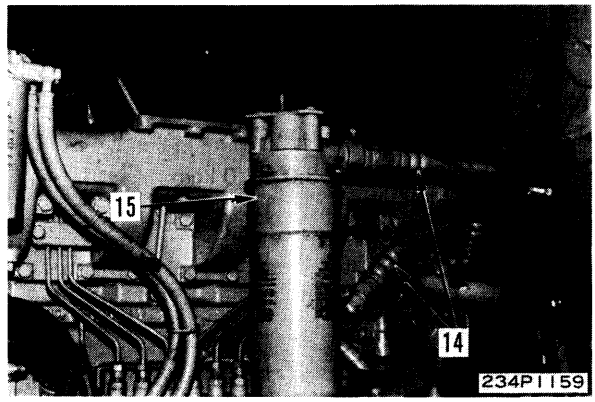
17. **Bracket**
Install bracket (17).



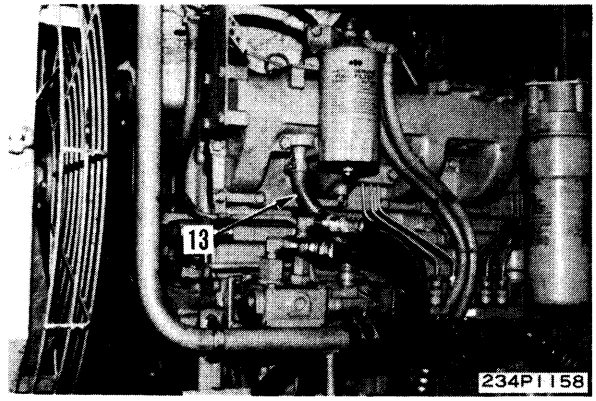
18. **Fuel filter assembly**
Install fuel filter assembly (16).



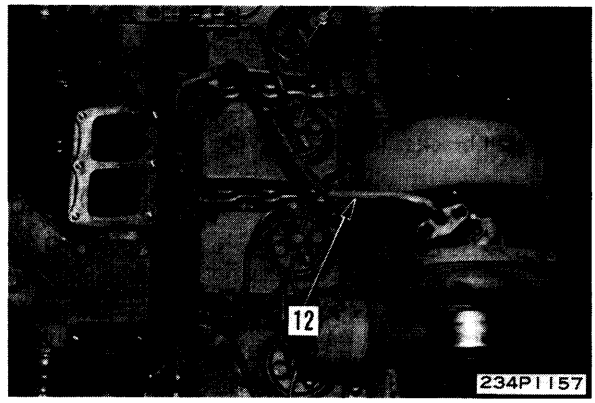
19. Oil filter assembly
Install oil filter assembly (15), then connect 2 oil hoses (14).



20. Compressor hose
Connect compressor suction hose (13).

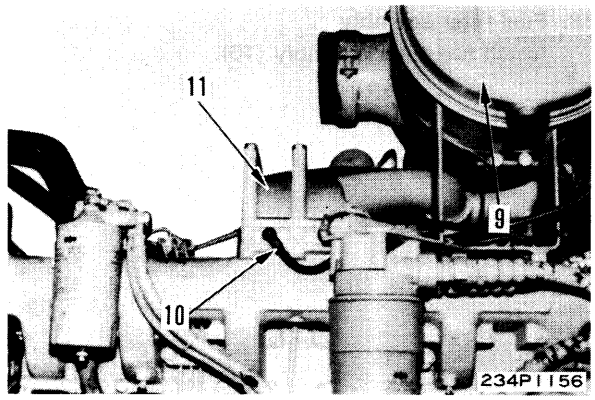


21. Turbocharger oil supply tube
Install oil supply tube (12).



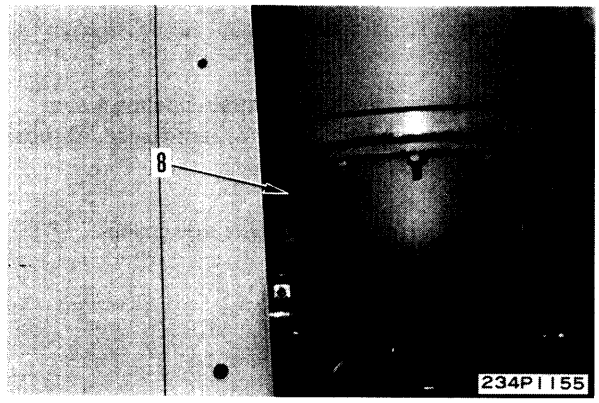
22. Connector pipe
1) Fit gasket and install connector pipe (11).
2) Connect wire (10) of electric heater.

23. Air cleaner
Install air cleaner assembly (9).



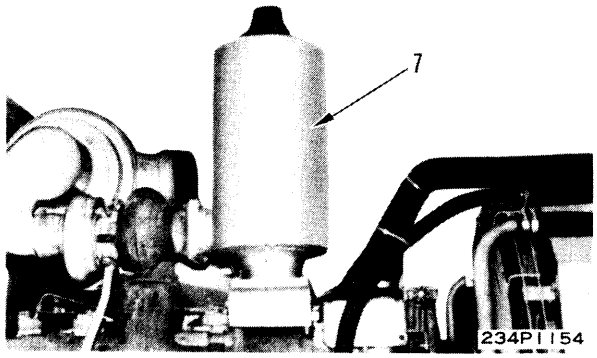
24. Dust indicator hose

Connect dust indicator hose (8).



25. Muffler

Fit seal ring and install muffler assembly (7).

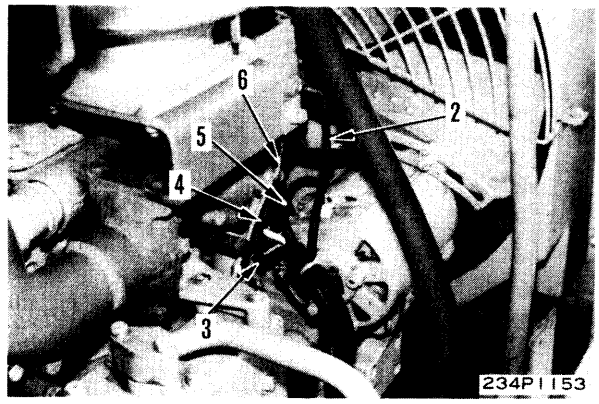


26. Wiring, air bleed tube

1) Install air bleed tube (6).
2) Connect wires (5), (4) and (3) of alternator.
3) Connect wire (2) of water temperature gauge.
4) Connect cable to negative (−) terminal of battery.

27. Side covers, hood

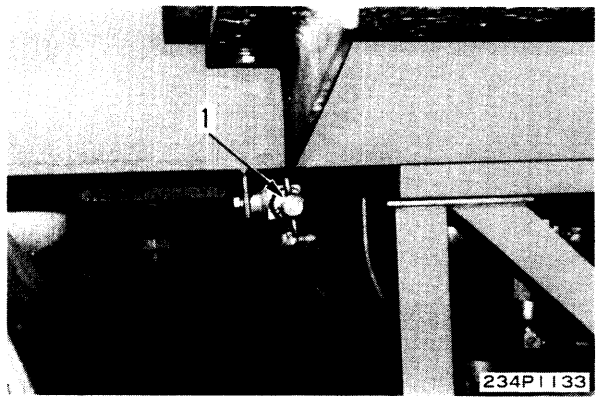
1) Raise hood and install.
2) Install left and right engine side covers.



28. Refilling with water

Tighten drain valve (1) and add water through water filler to the specified level.

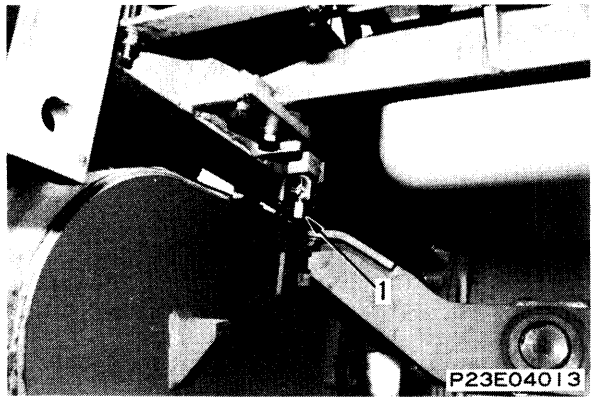
★ Run the engine to circulate the water through the system. Then check the water level again.



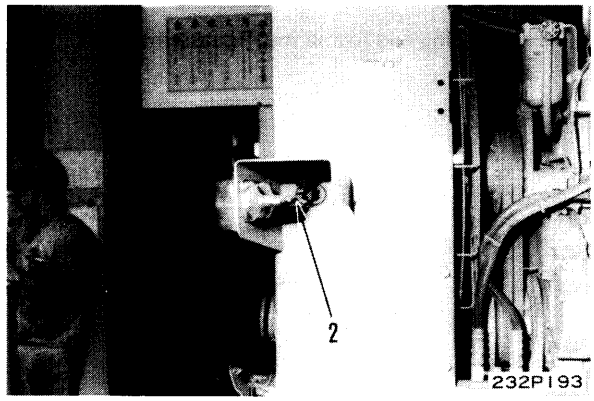
REMOVAL OF RADIATOR ASSEMBLY

GD705R-4

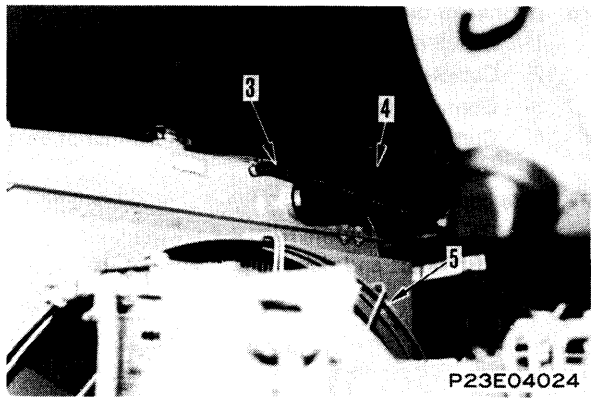
1. Loosen drain valve (1) and drain cooling water.
   ★ If the coolant contains antifreeze, dispose of it correctly.
2. Remove L.H. and R.H. engine side covers.
3. Lift off hood.



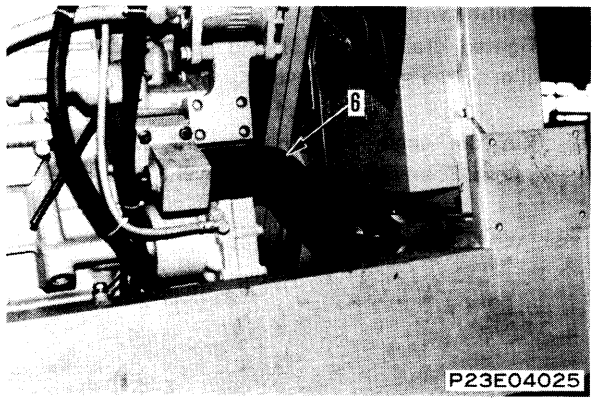
4. Disconnect wiring (2) at connector.



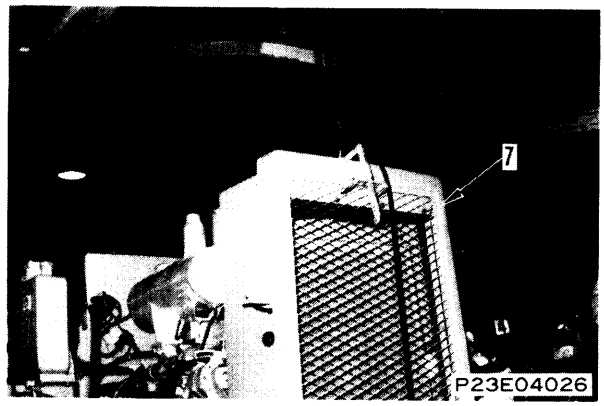
5. Disconnect aeration hose (3) and radiator inlet hose (4).
6. Remove fan guard (5).



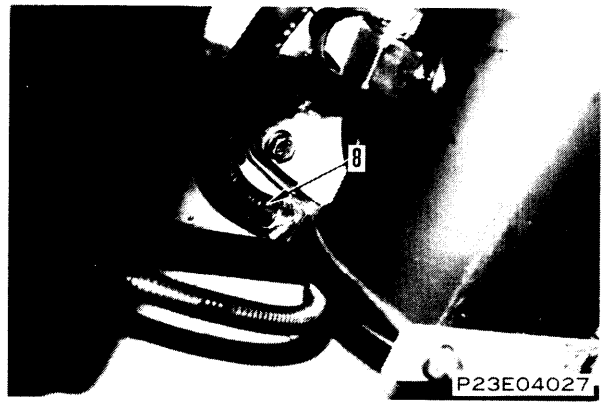
7. Disconnect radiator outlet hose (6).



8. Lift off radiator mask (7).

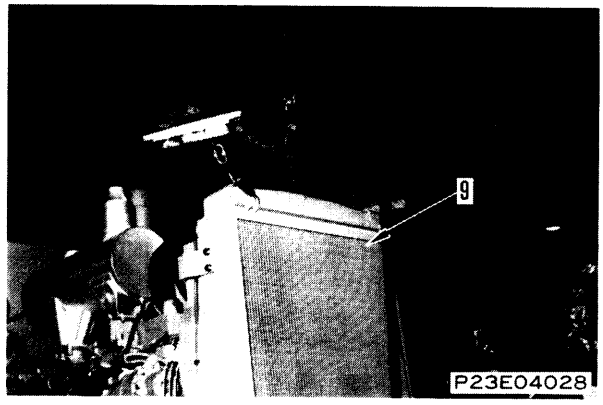


9. Disconnect radiator drain hose (8).



10. Lift off radiator assembly (9).

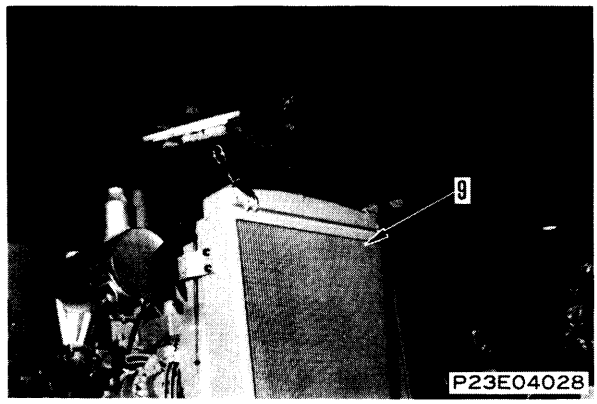
kg Radiator assembly: 85 kg



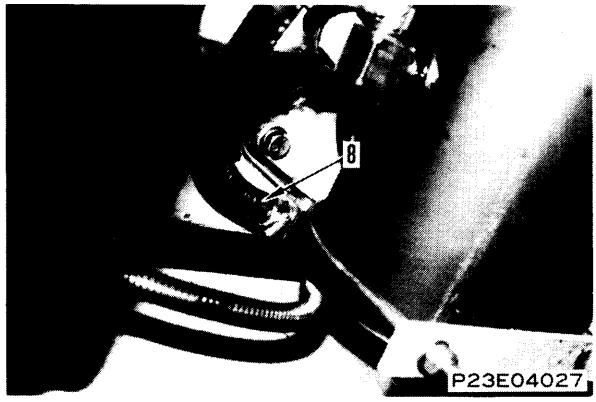
INSTALLATION OF RADIATOR ASSEMBLY

GD705R-4

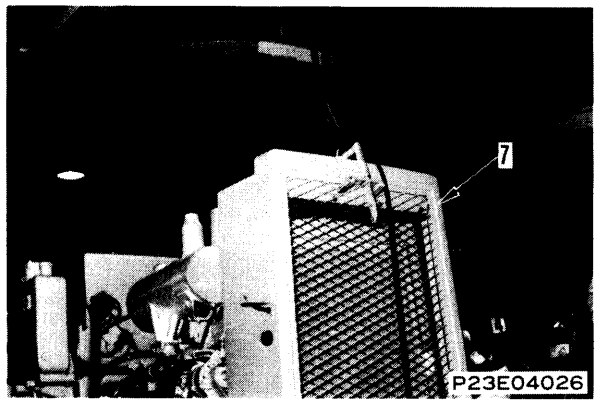
1. Raise radiator assembly (9) and install.



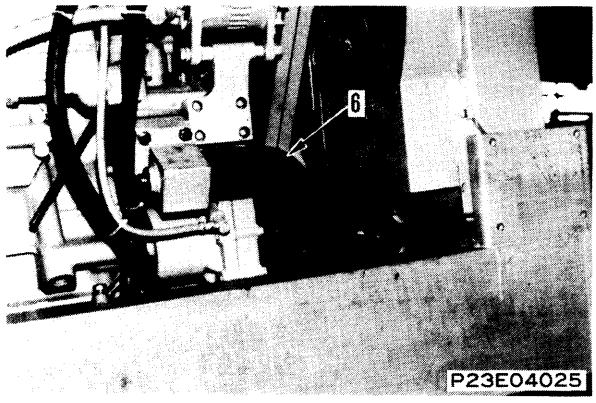
2. Connect radiator drain hose (8).



3. Raise radiator mask (7) and install.

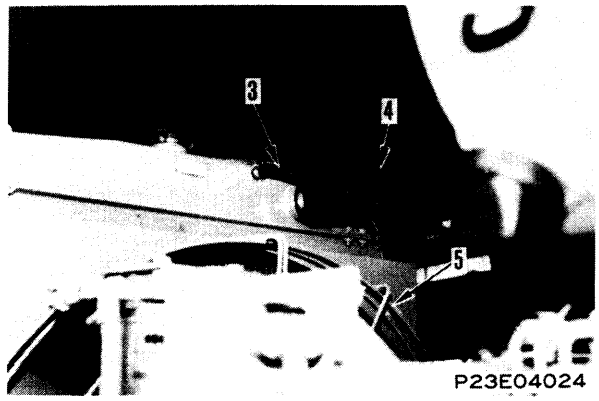


4. Connect radiator outlet hose (6).



5. Install fan guard (5).

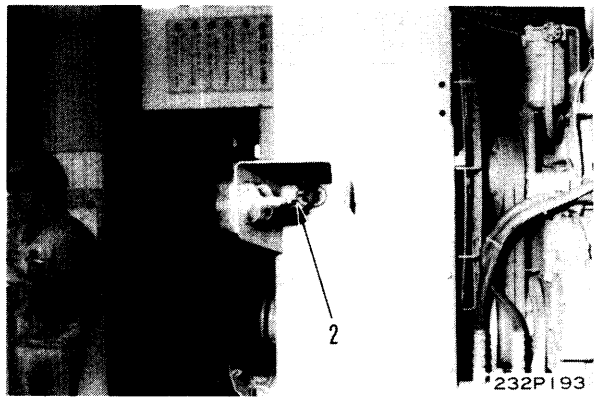
6. Connect radiator inlet hose (4) and aeration hose (3).



7. Connect wiring (2).

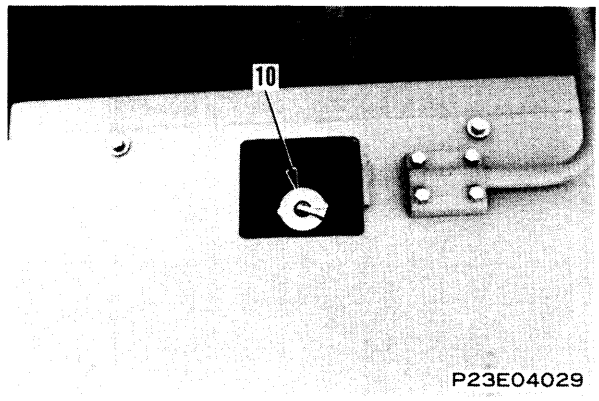
8. Raise hood and install.

9. Install L.H. and R.H. engine side covers.



10. Tighten drain valve and add cooling water through water filler (10) to the specified level.

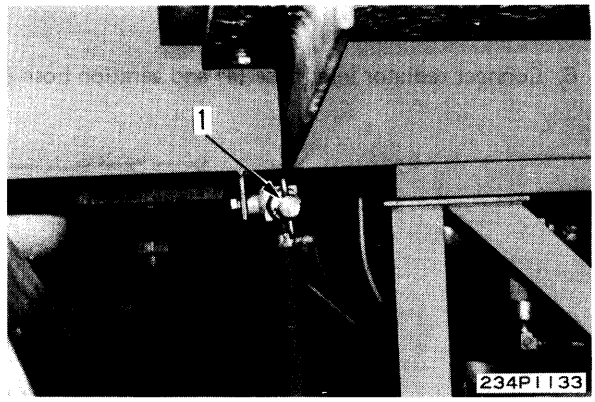
★ Run the engine to circulate the water through the system.
Then check the water level again.



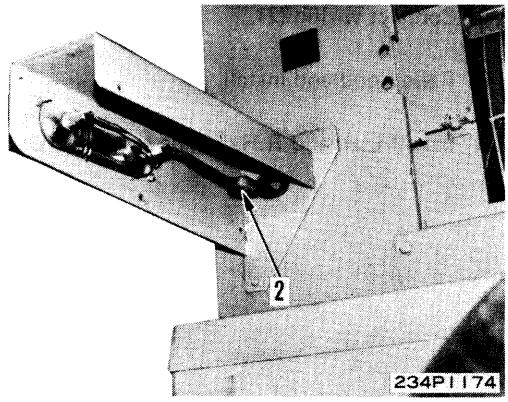
REMOVAL OF RADIATOR ASSEMBLY

GD705A-4

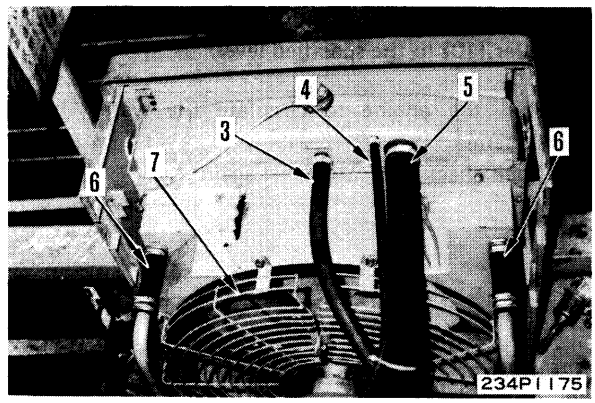
1. Loosen drain valve (1) and drain cooling water.
   ★ If the coolant contains antifreeze, dispose of it correctly.
2. Remove L.H. and R.H. engine side covers.
3. Lift off hood.



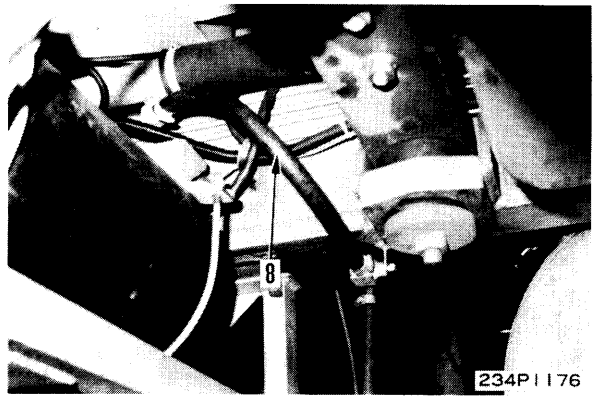
4. Disconnect wiring (2) at connector.



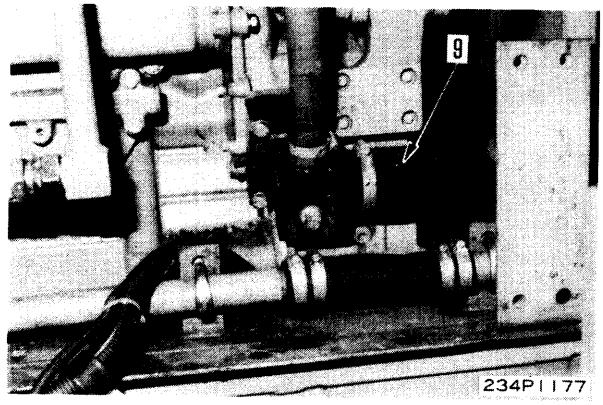
5. Disconnect hose (3), aeration hose (4) and radiator inlet hose (5).
6. Remove 2 left and right steering pipes (6).
7. Remove fan guard (7).



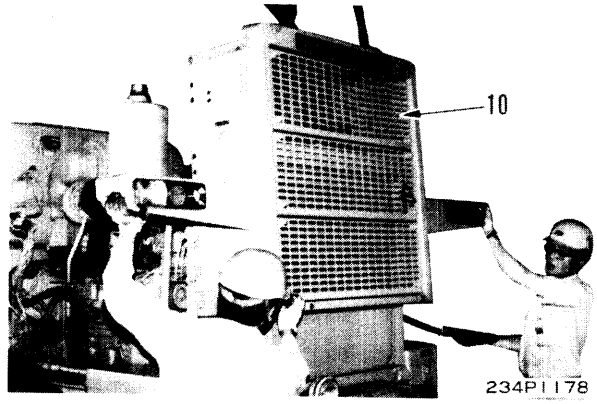
8. Disconnect drain hose (8).



9. Disconnect radiator outlet hose (9).

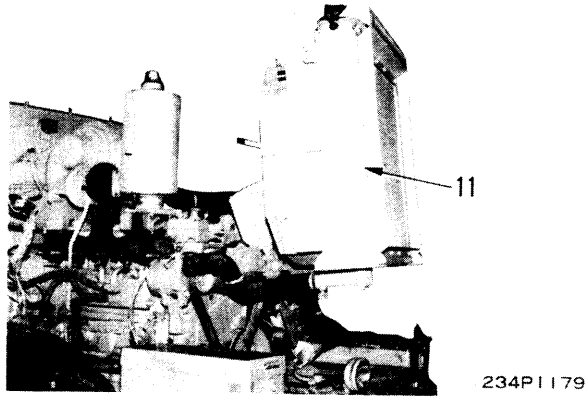


10. Lift off radiator mask (10).



11. Lift off radiator assembly (11).

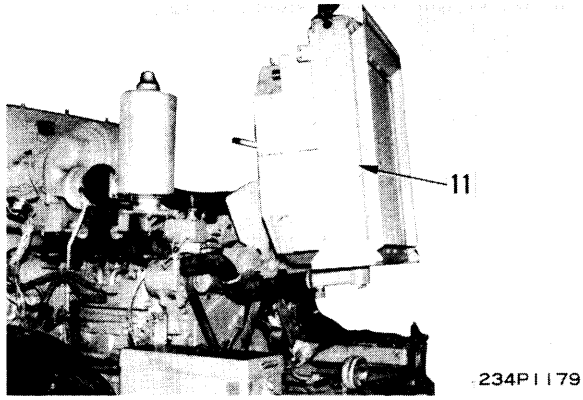
kg Radiator assembly: 132 kg



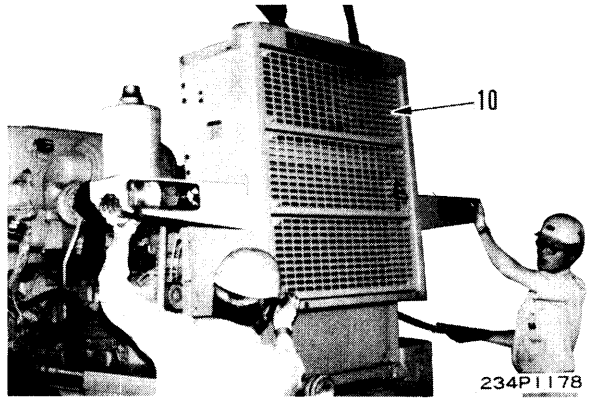
INSTALLATION OF RADIATOR ASSEMBLY

GD705A-4

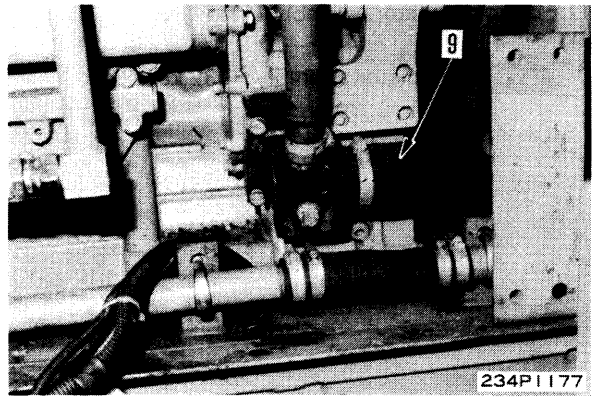
1. Raise radiator assembly (11) and install.



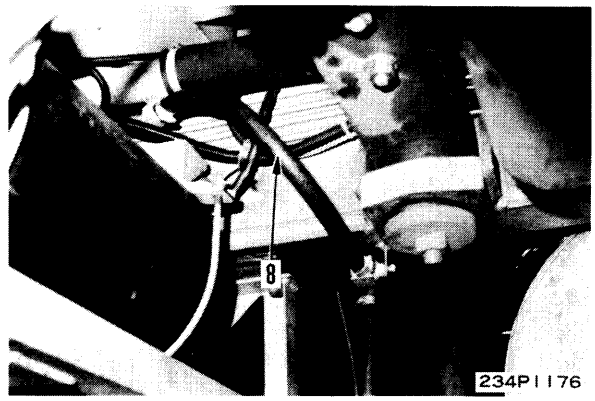
2. Raise radiator mask (10) and install.



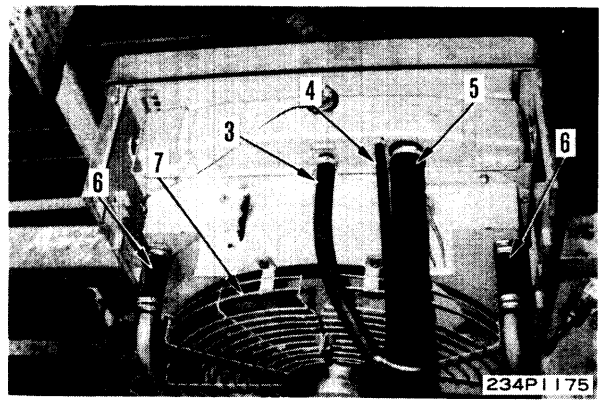
3. Connect radiator outlet hose (9).



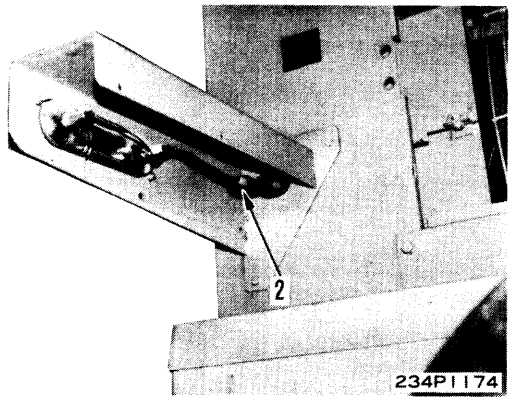
4. Connect drain hose (8).



5. Install fan guard (7).
6. Install 2 left and right steering pipes (6).
7. Connect radiator inlet hose (5), aeration hose (4) and hose (3).

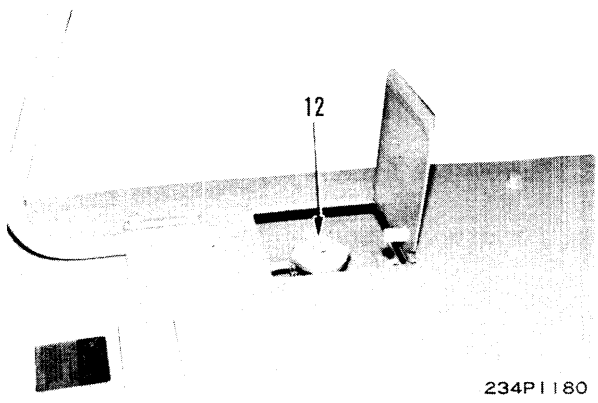


8. Connect wiring (2).
9. Install hood.
10. Install L.H. and R.H. engine side covers.



11. Tighten drain valve and add water through water filler (12) to the specified level.

★ Run the engine to circulate the water through the system. Then check the water level again.



REMOVAL OF FUEL TANK ASSEMBLY (incl. HYDRAULIC TANK)

GD705R-4

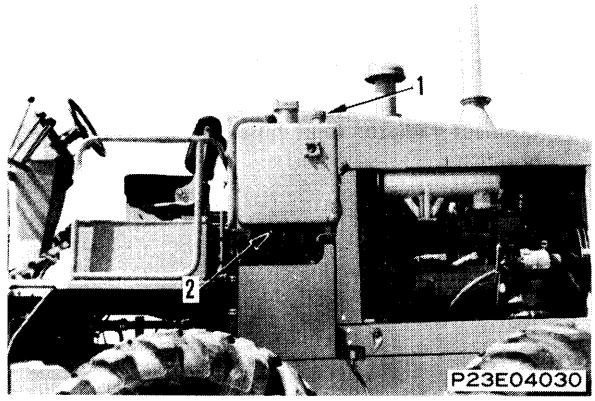
⚠ Disconnect the lead from the negative (–) terminal of the battery.

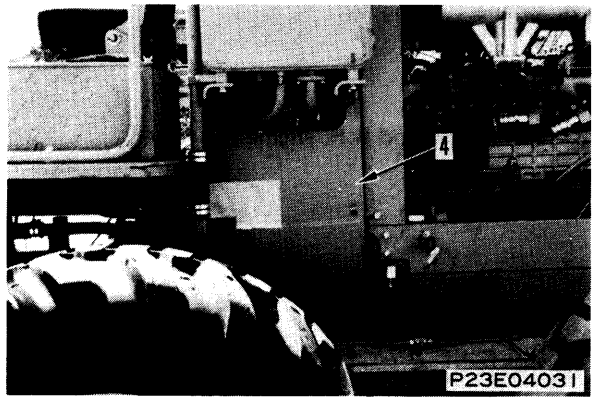
⚠ Loosen oil filler cap (1) to release pressure inside hydraulic tank.

1. Remove drain plug (2) and drain oil from hydraulic tank.

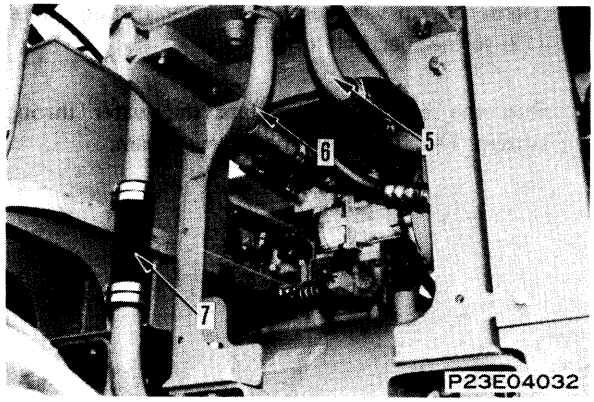
   Hydraulic tank: Approx. 27ℓ

2. Remove cover (4).

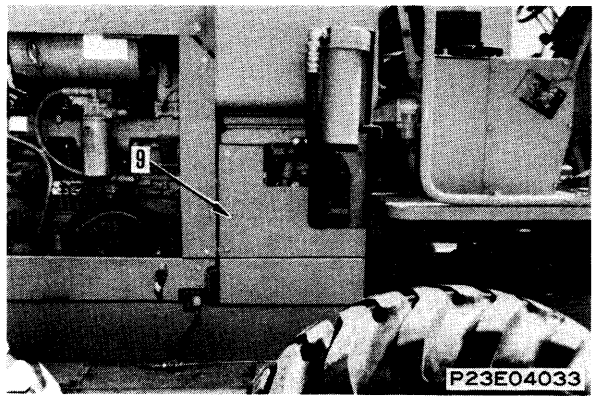




3. Remove tubes (5) and (6).
4. Disconnect hose (7).
5. Remove L.H. and R.H. engine side covers.
6. Lift off hood.

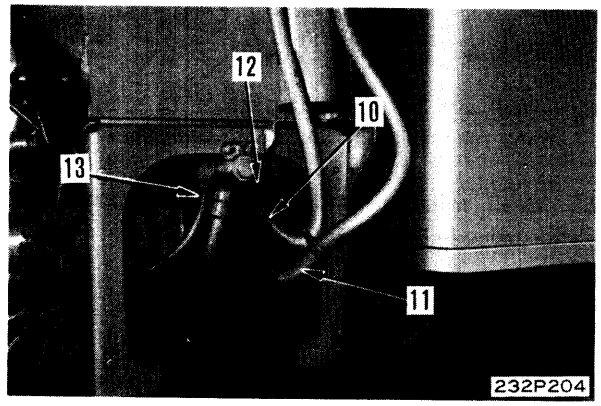


7. Remove cover (9).



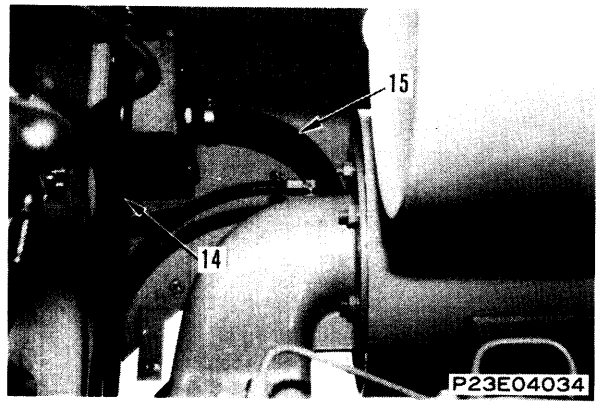
8. Disconnect transmission filter hoses (10) and (11) from transmission control valve.

9. Close fuel supply lever (12), then disconnect fuel hose (13).



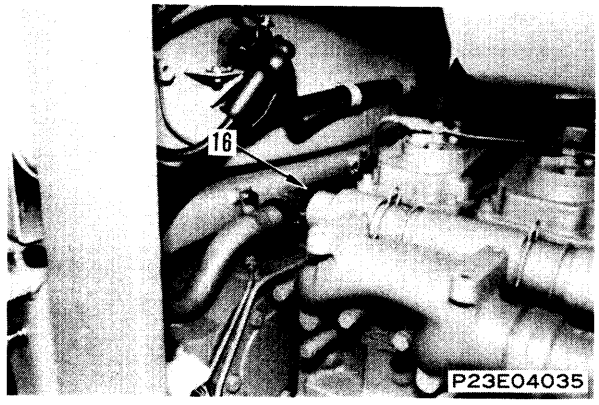
10. Disconnect fuel return hose (14).

11. Disconnect hydromaster air supply hose (15) from air cleaner.



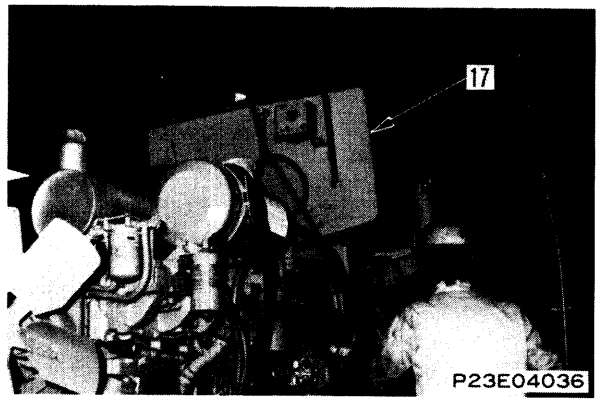
12. Disconnect inlet tube of steering pump at hose (16).

13. Remove wiring behind fuel tank, and move it towards engine.



14. Install eye bolts (Thread dia. = 12 mm, Pitch = 1.75 mm), remove mounting bolts of frame, then lift off fuel tank and frame assembly (17).

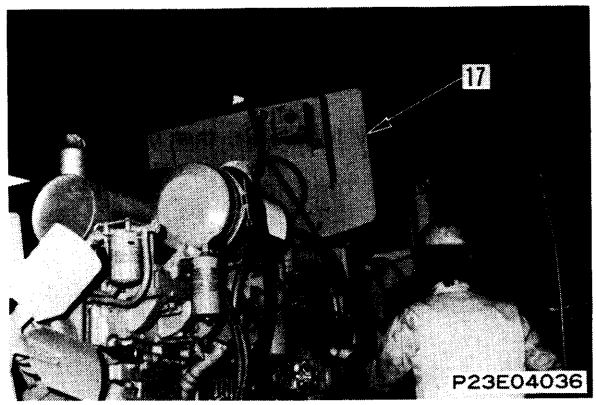
kg Fuel tank assembly (incl. hydraulic tank): 450 kg (with 300ℓ of fuel)



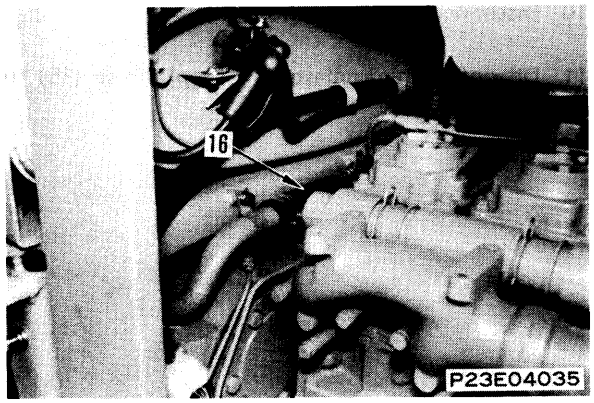
INSTALLATION OF FUEL TANK ASSEMBLY (incl. HYDRAULIC TANK)

GD705R-4

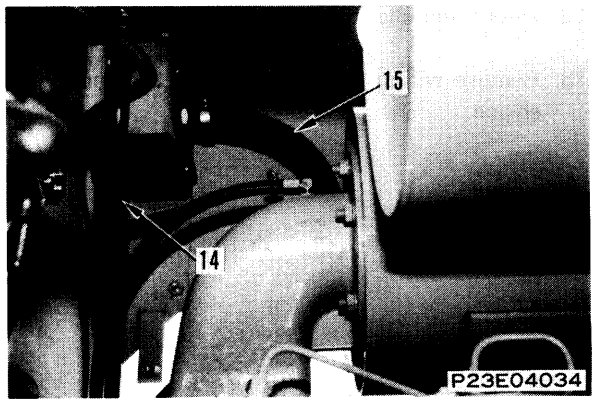
1. Install eye bolts (Thread dia. = 12 mm, Pitch = 1.75 mm), raise fuel tank and frame assembly (17) and install.
2. Install wiring behind fuel tank, and connect lead to negative (—) terminal of battery.



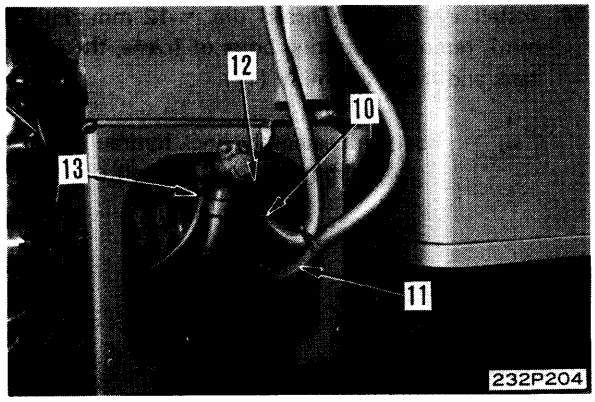
3. Connect inlet tube of steering pump at hose (16), and secure with clamp.



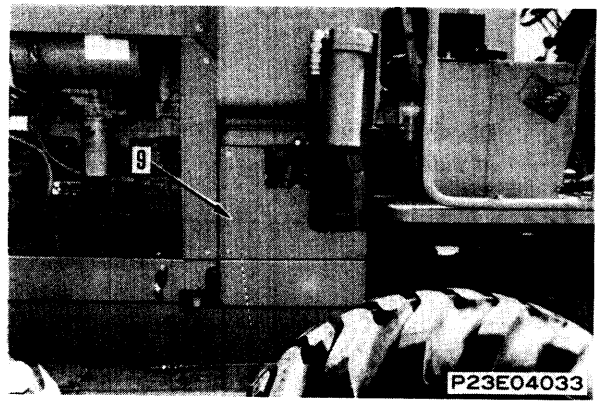
4. Connect hydromaster air supply hose (15) to air cleaner, and secure with clamp.
5. Connect fuel return hose (14).



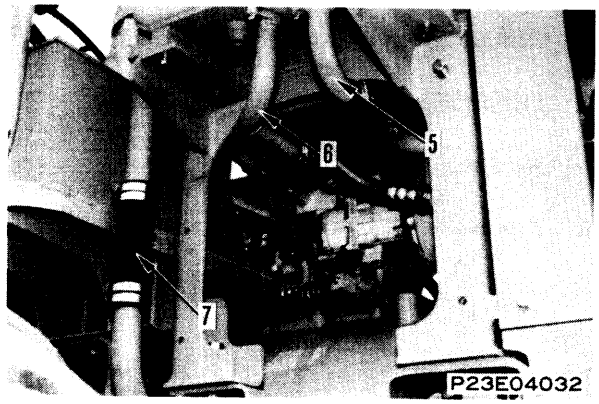
6. Connect fuel hose (13) and open fuel supply lever (12).
7. Connect transmission filter hoses (11) and (10).



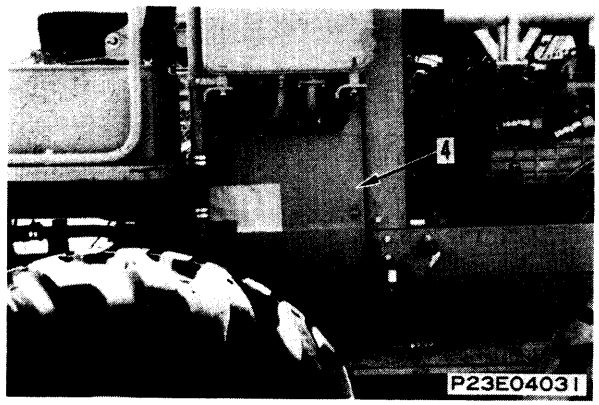
8. Install cover (9).
9. Raise hood and install.
10. Install L.H. and R.H. engine side covers.



11. Connect hose (7), and secure with clamp.
12. Fit O-rings and install tubes (6) and (5).



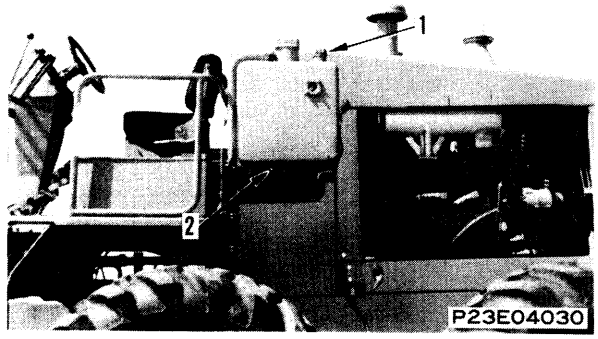
13. Install cover (4).



14. Tighten drain plug (2).
15. Add engine oil through oil filler (1) to the specified level.

Hydraulic tank: 27ℓ

★ Run the engine to circulate the oil through the system. Then check the oil level again.



REMOVAL OF FUEL TANK ASSEMBLY (incl. HYDRAULIC TANK)

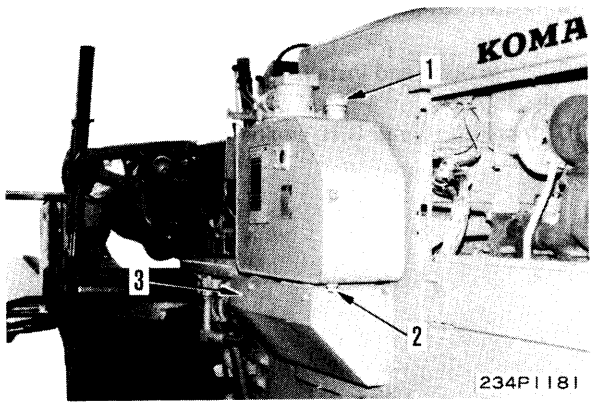
GD705A-4

⚠ Disconnect the cable from the negative (−) terminal of the battery.

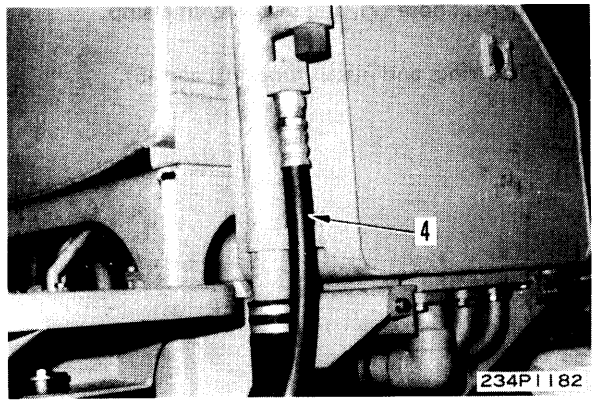
⚠ Loosen oil filler cap (1) to release pressure inside hydraulic tank.

1. Remove drain plug (2) and drain oil from hydraulic tank.

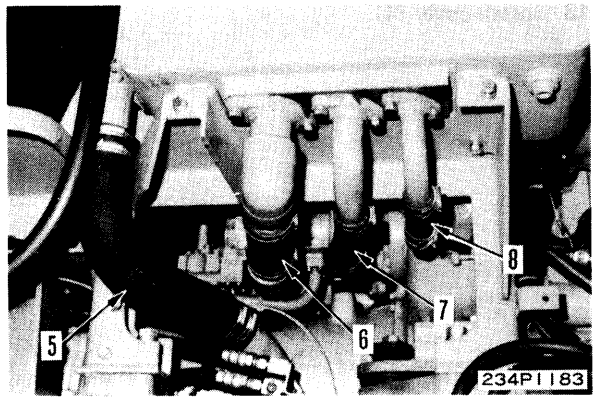
   Hydraulic tank: 70ℓ



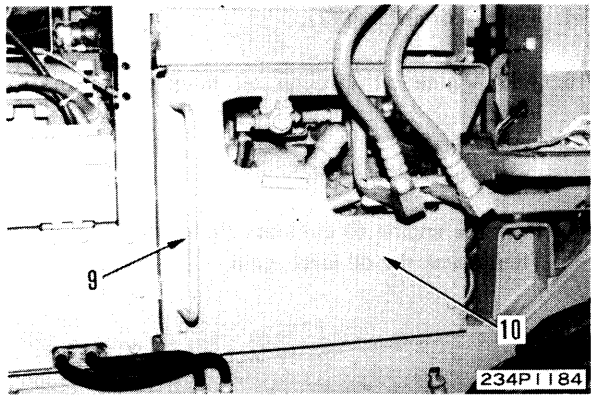
2. Remove left and right engine side covers.
3. Lift off hood.
4. Remove cover (3).
5. Disconnect hose (4).



6. Disconnect hoses (5), (6), (7) and (8).



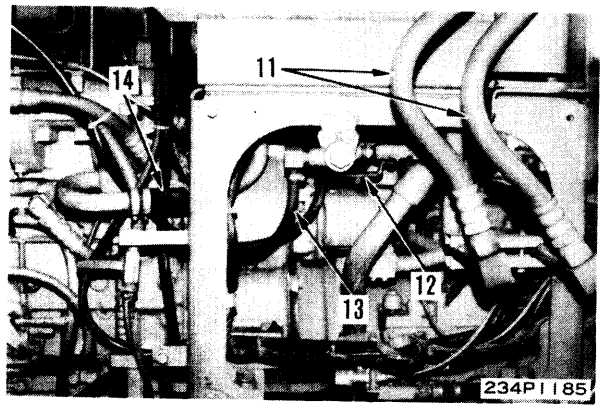
7. Remove stay (9) and cover (10).



8. Disconnect 2 transmission filter hoses (11).

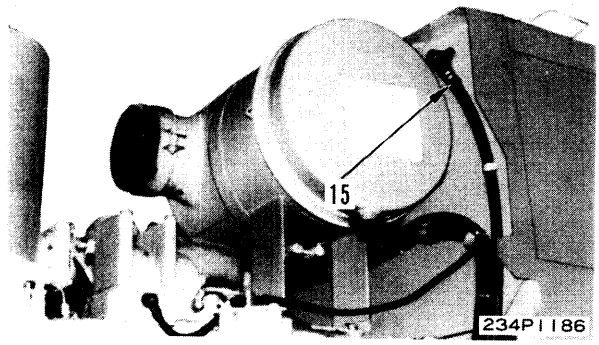
9. Close fuel supply valve (12), then disconnect fuel supply hose (13).

10. Loosen clamp, and disconnect hose (14).



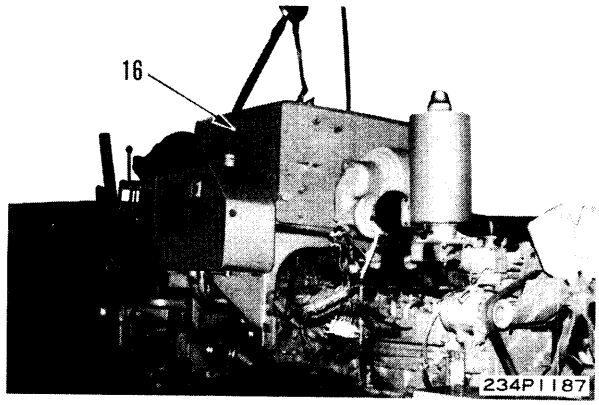
11. Disconnect fuel return hose (15).

12. Remove wiring behind fuel tank, and move it towards engine.



13. Lift off fuel tank assembly (16).

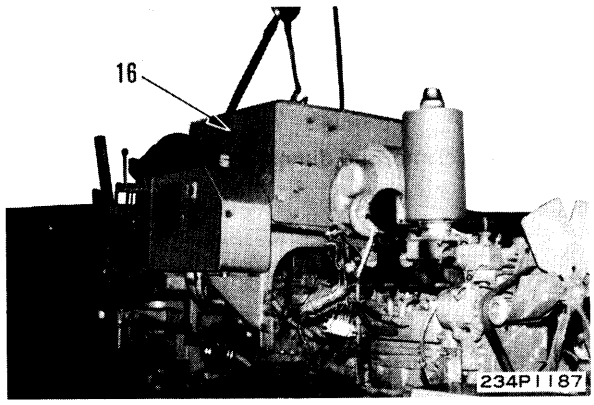
kg Fuel tank assembly (incl. hydraulic tank): 320 kg (dry weight)



INSTALLATION OF FUEL TANK ASSEMBLY (incl. HYDRAULIC TANK)

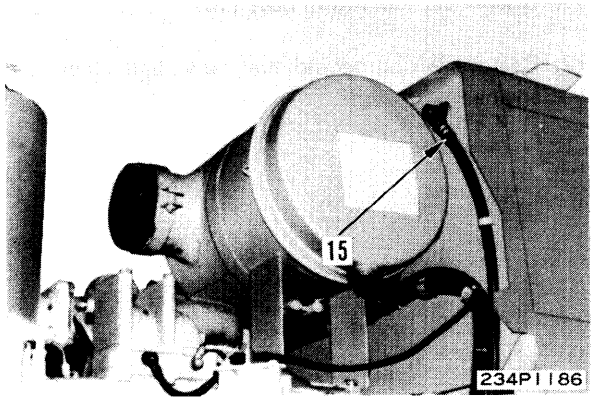
GD705A-4

1. Raise fuel tank assembly (16) and install.



2. Install wiring behind fuel tank, and connect cable to negative (–) terminal of battery.

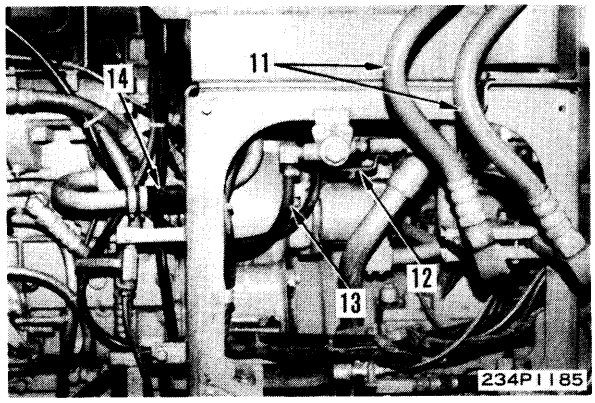
3. Connect fuel return hose (15).



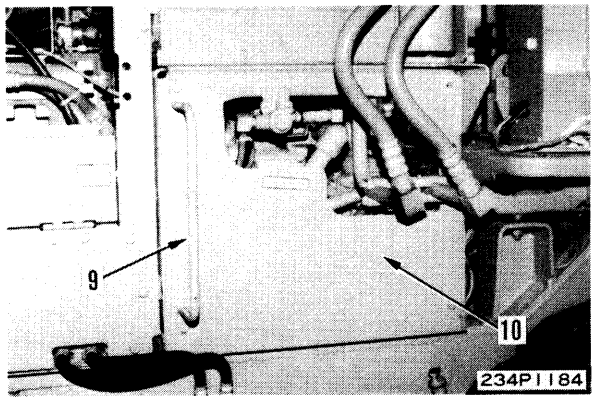
4. Connect hose (14), and secure with clamp.

5. Connect fuel supply hose (13), then open fuel supply valve (12).

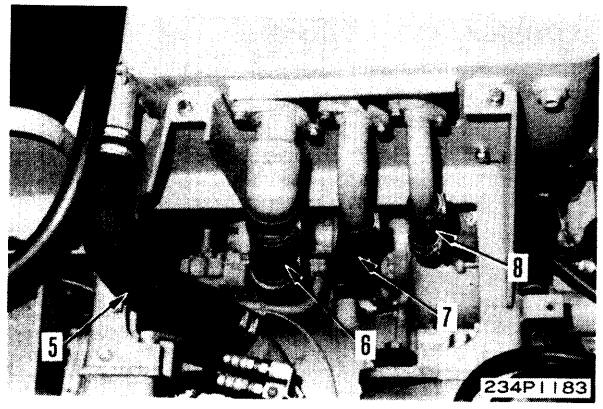
6. Connect 2 transmission filter hoses (11).



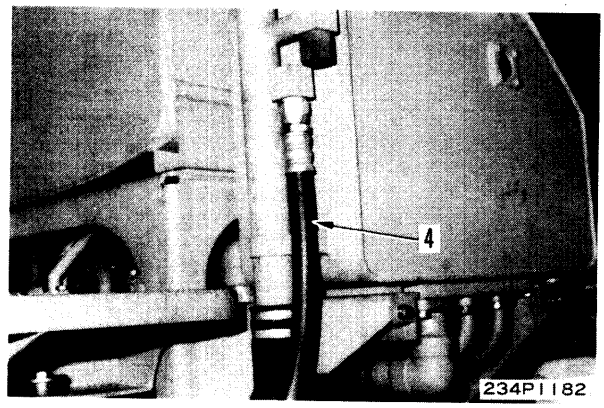
7. Install cover (10) and stay (9).



8. Connect hoses (8), (7), (6) and (5).



9. Connect hose (4).



10. Install cover (3).

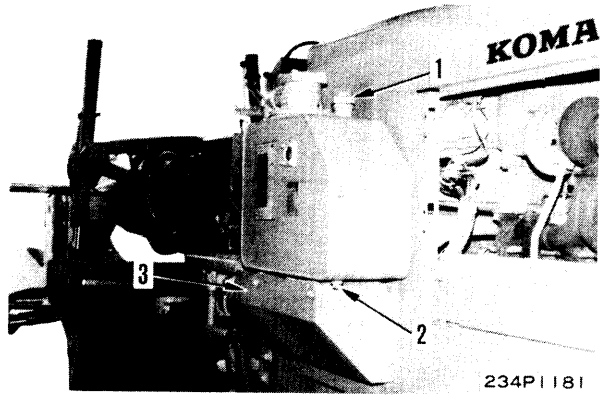
11. Raise hood and install.

12. Install left and right engine side covers.

13. Tighten drain plug (2).

14. Add engine oil through oil filler (1) to the specified level.

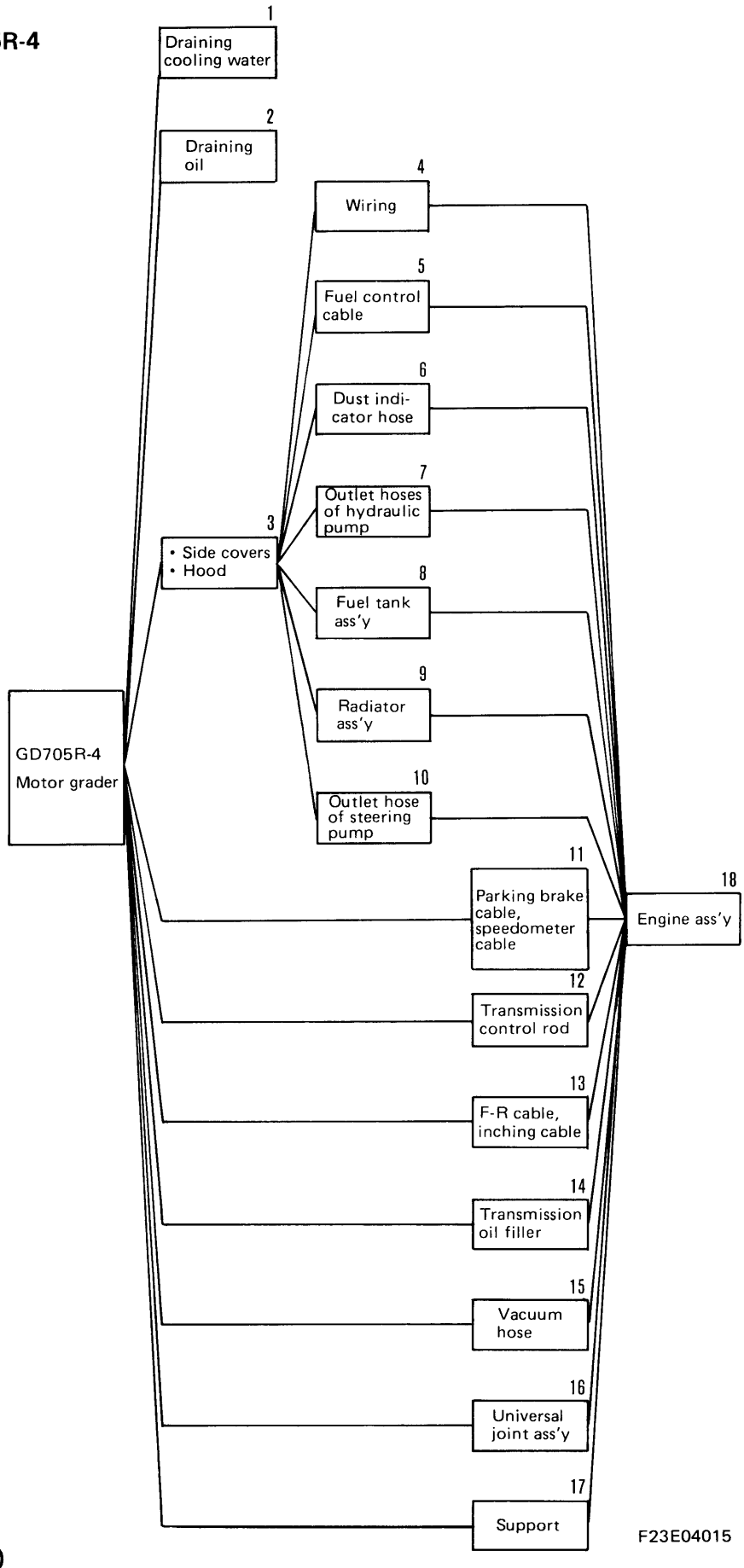
Hydraulic tank: 70ℓ



★ Run the engine to circulate the oil through the system. Then check the oil level again.

REMOVAL OF ENGINE ASSEMBLY

GD705R-4



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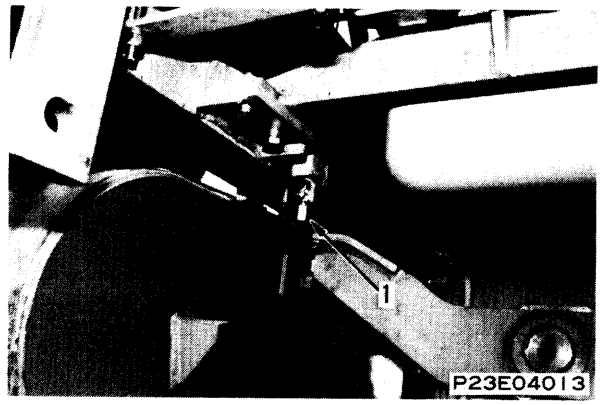
⚠ Disconnect the lead from the negative (−) terminal of the battery.

1. Draining cooling water

Loosen drain valve (1) and drain cooling water.

★ If the coolant contains antifreeze, dispose of it correctly.

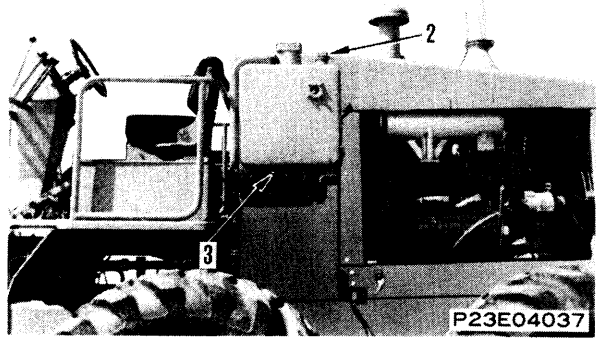


2. Draining hydraulic oil and transmission oil

Loosen oil filler cap (2) to release pressure inside hydraulic tank.

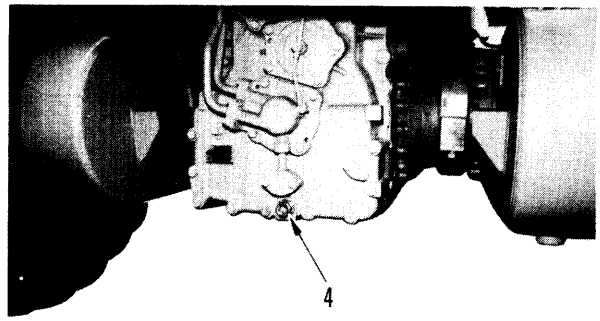
1) Remove drain plug (3) and drain oil from hydraulic tank.

Hydraulic tank: Approx. 27ℓ



2) Remove drain plug (4) and drain oil from transmission case.

Transmission case: Approx. 30ℓ



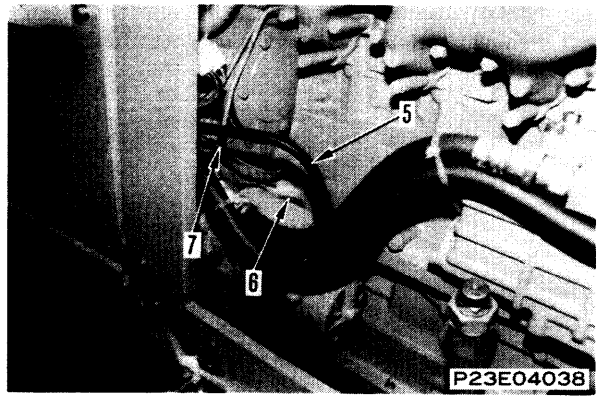
232P229

3. Side covers, hood

1) Remove L.H. and R.H. engine side covers.
2) Remove L.H. and R.H. covers under fuel tank.
3) Lift off hood.

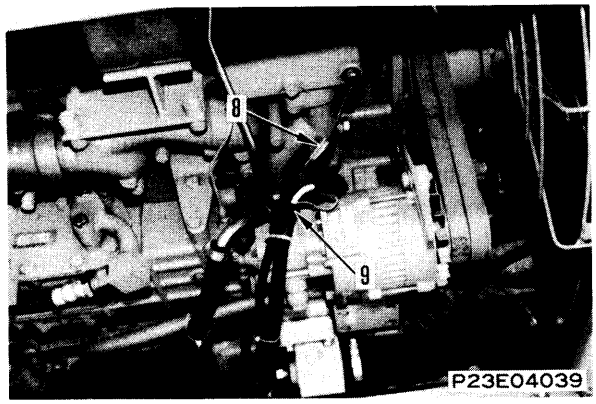
4. Wiring

1) Disconnect wires (5) and (6) of starting motor.
2) Disconnect wire (7) of oil temperature sensor.

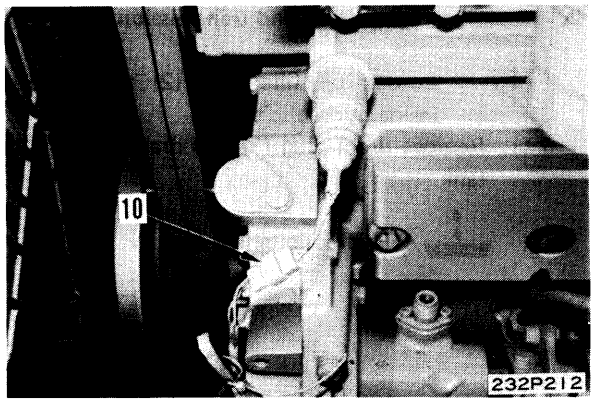


3) Disconnect wire (8) of water temperature gauge.

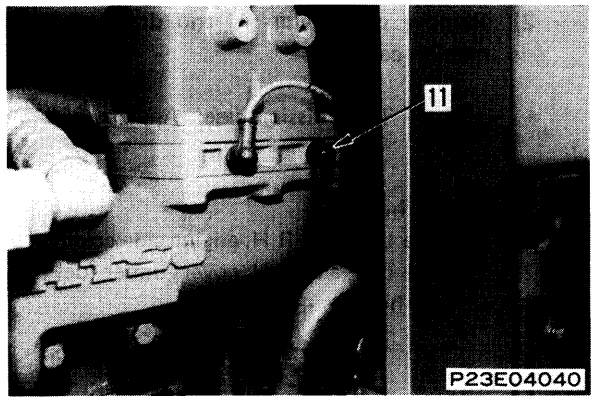
4) Disconnect wire (9) of alternator.



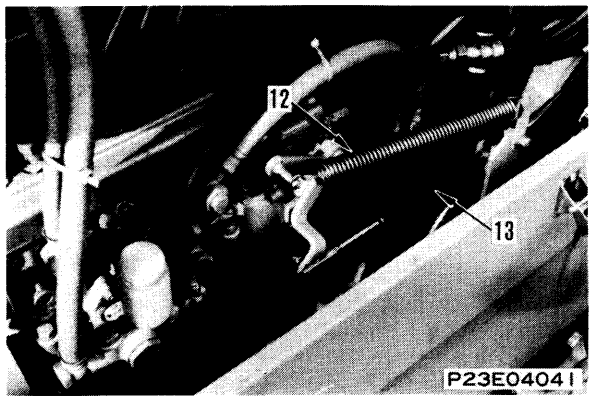
5) Disconnect wire (10) of oil pressure gauge.



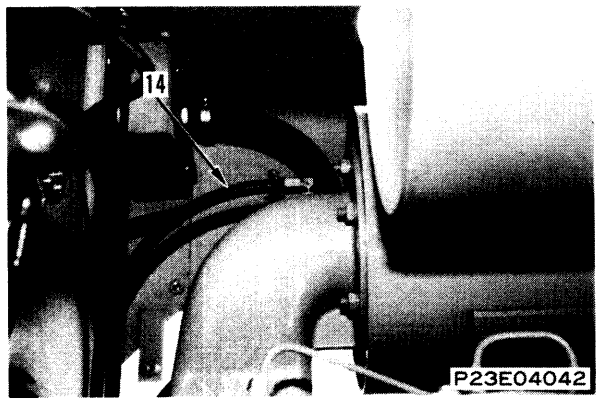
6) Disconnect wire (11) of electric heater.



5. **Fuel control cable**
Remove spring (12), then disconnect fuel control cable (13).



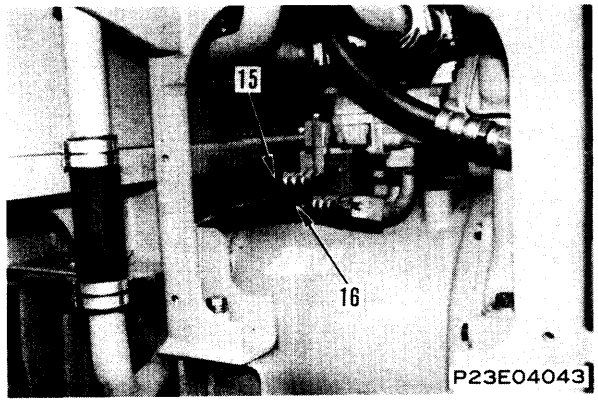
6. **Dust indicator hose**
   Disconnect dust indicator hose (14).



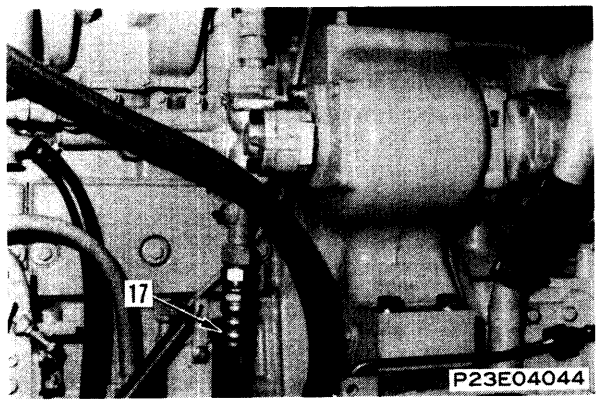
7. **Outlet hoses of hydraulic pump**
   Disconnect outlet hoses (15) and (16) of hydraulic pump.

8. **Fuel tank assembly**
   Remove fuel tank assembly.
   For details, see 13 REMOVAL OF FUEL TANK ASSEMBLY.

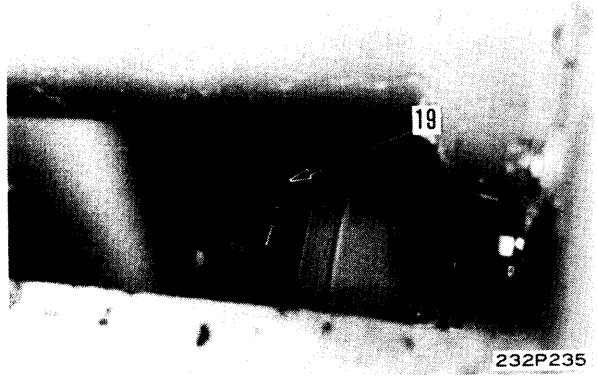
9. **Radiator assembly**
   Remove radiator assembly.
   For details, see 13 REMOVAL OF RADIATOR ASSEMBLY.



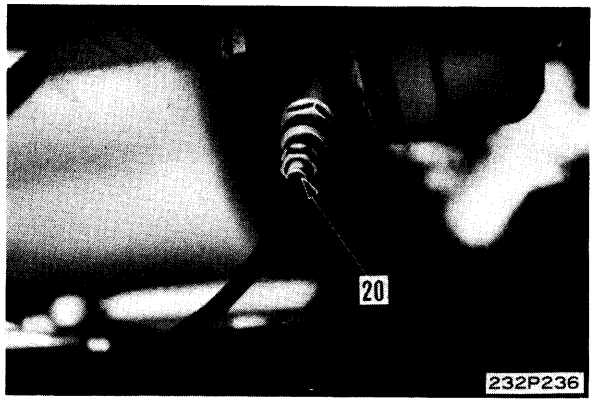
10. **Outlet hose of steering pump**
    Disconnect outlet hose (17) of steering pump.



11. **Parking brake cable, speedometer cable**
    1) Disconnect parking brake cable (19).

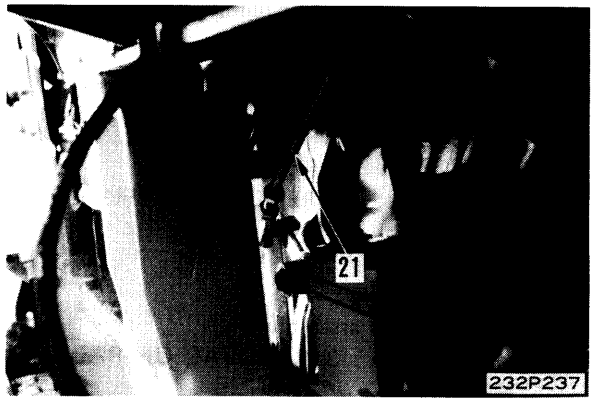


2) Disconnect speedometer (20).



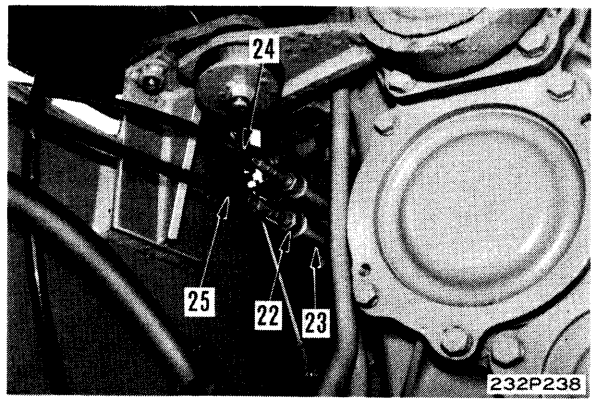
12. Transmission control rod

Disconnect transmission control rod (21).



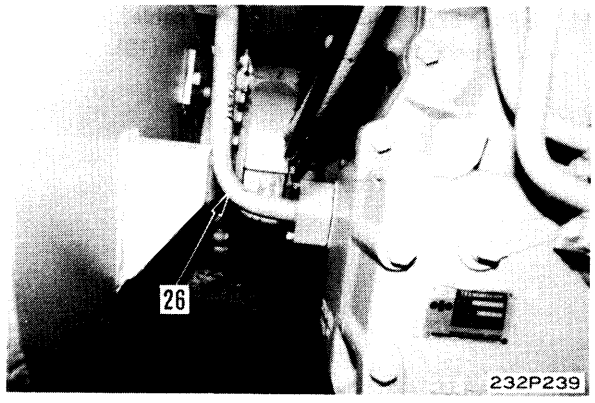
13. F-R cable, inching cable

1) Loosen locknut (22).
2) Remove coupling (23), then disconnect F-R cable (24) and inching cable (25).

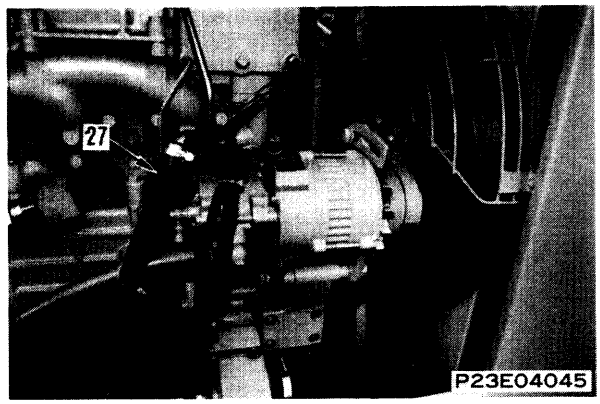


14. Transmission oil filler

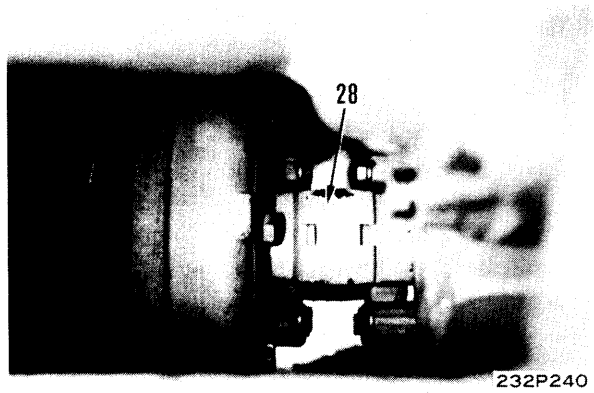
Remove transmission oil filler tube (26).



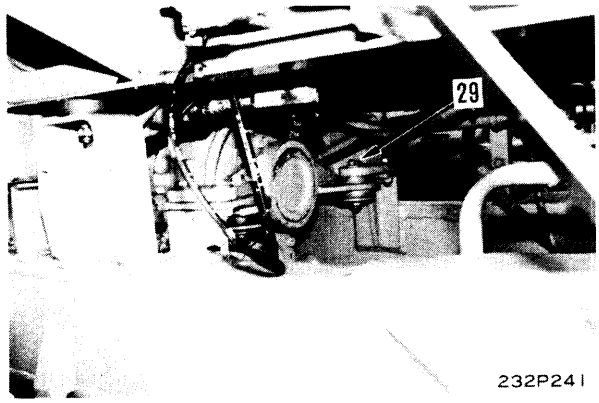
15. **Vacuum hose**
Disconnect hose (27) between vacuum pump and vacuum tank.



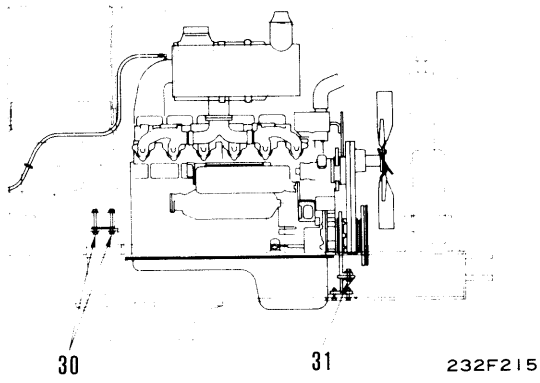
16. **Universal joint assembly**
Remove universal joint assembly (28).



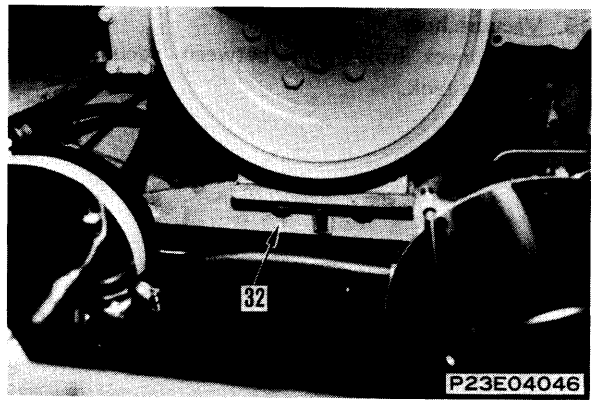
17. **Support**
Remove mounting bolts (29) of support.



18. **Engine assembly**
1) Remove 4 mounting bolts (30) and 2 mounting bolts (31).



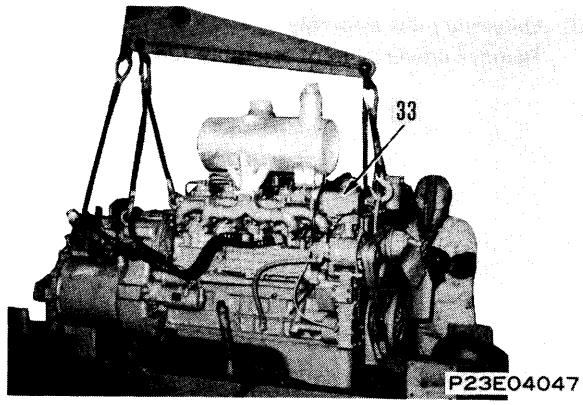
2) Sling engine assembly, then remove bracket (32).



3) Move engine assembly (33) to rear, then lift off.

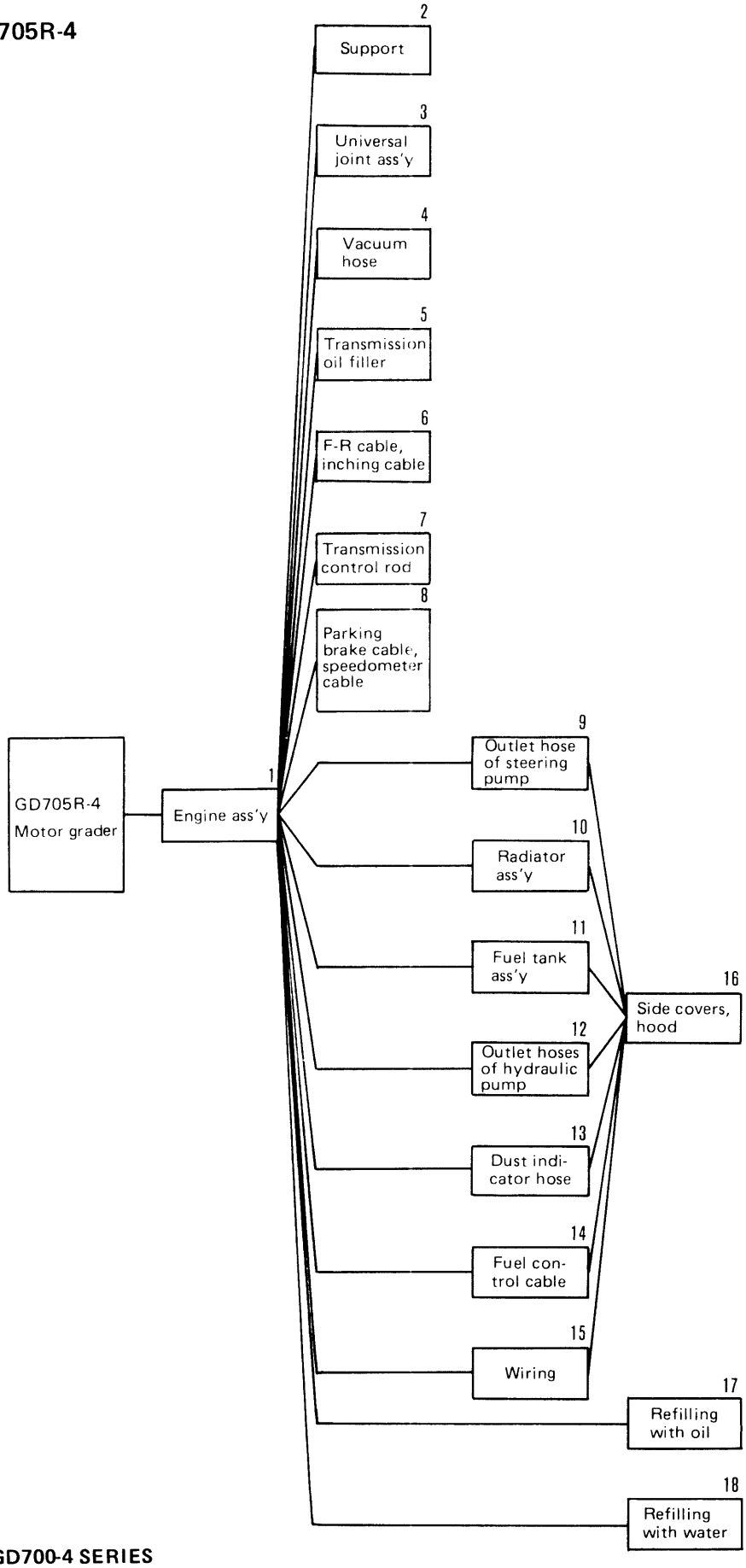
kg Engine assembly (incl. transmission): 1970 kg

★ If the hydroshift transmission assembly is to be removed from the engine assembly (which includes the transmission assembly), remove the connecting bolts of the flywheel housing, then remove the hydroshift transmission.



INSTALLATION OF ENGINE ASSEMBLY

GD705R-4



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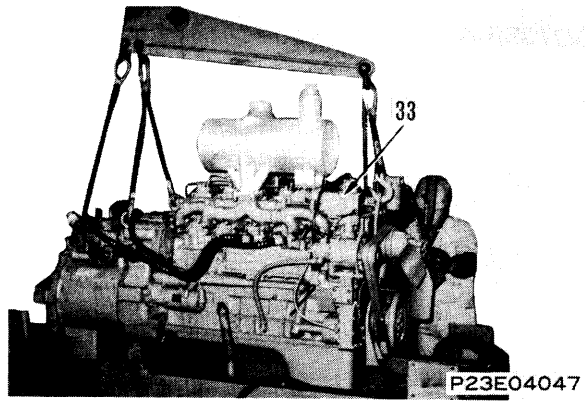
Special tool

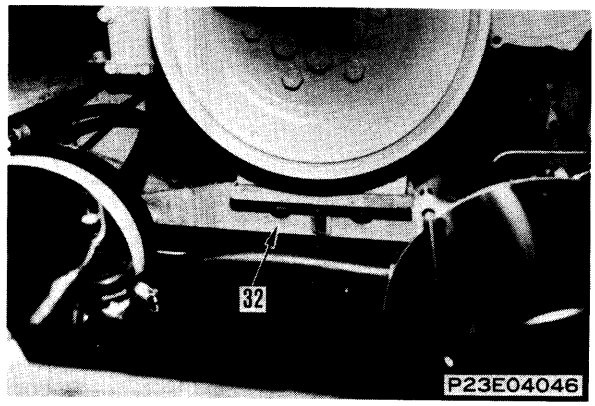
	Part number	Part name	Q'ty
A	792-271-2000	Centering tool	1



1. Engine assembly

1) Raise engine assembly (33), install bracket (32), then set on frame.

Mounting bolt of bracket: Thread tightener (LT-2)

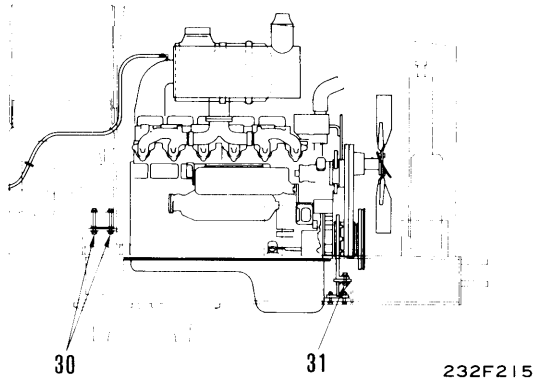


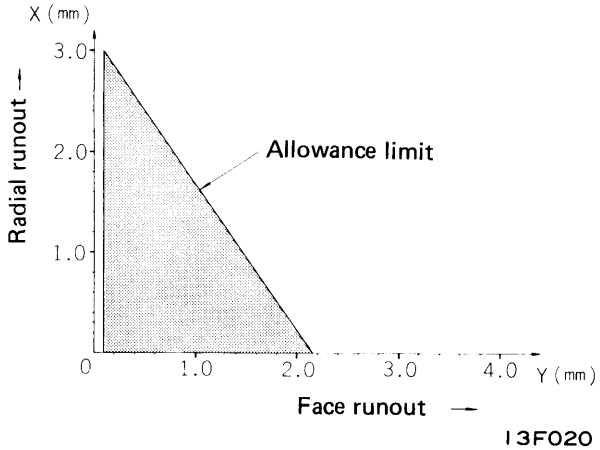
2) Tighten mounting bolts (31) and (30).
   ★ Tighten the mounting bolts fully after centering the engine.

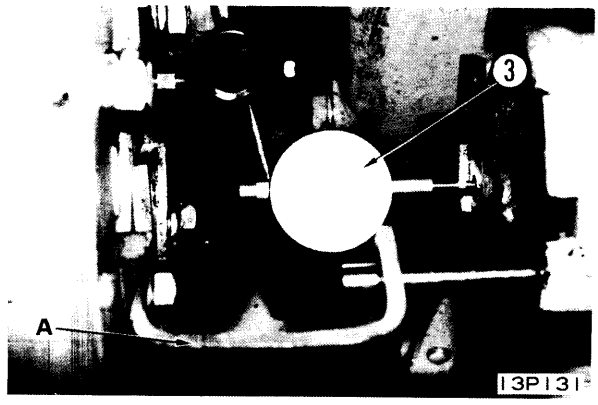
3) Measure face and radial runout of engine as follows. Install tool **A**, then set dial gauge ③ in position. Rotate tool **A**, and measure face and radial runout between engine and transmission.
   ★ Radial runout, face runout

4) Tighten mounting bolts to specified tightening torque.

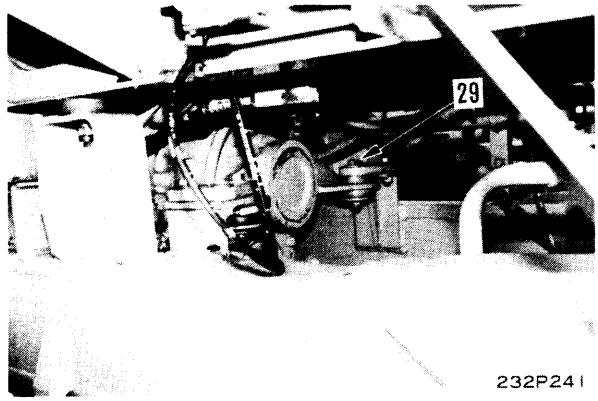
Mounting bolt: 39 ± 4 kgm



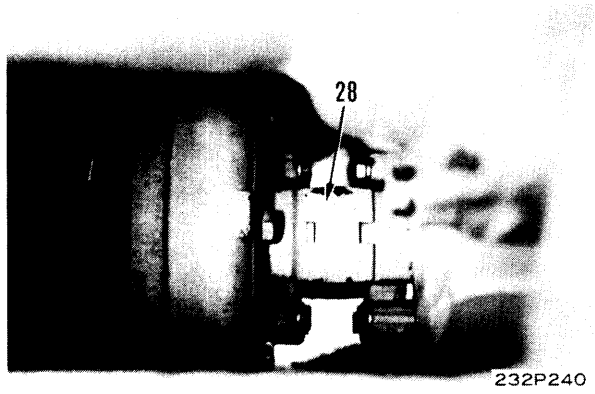




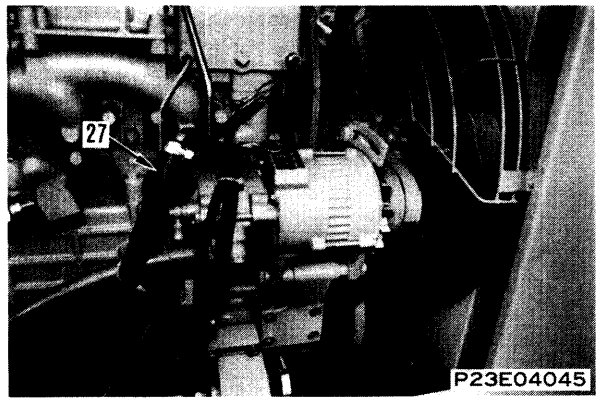
2. **Support**
Tighten mounting bolts (29) of support.



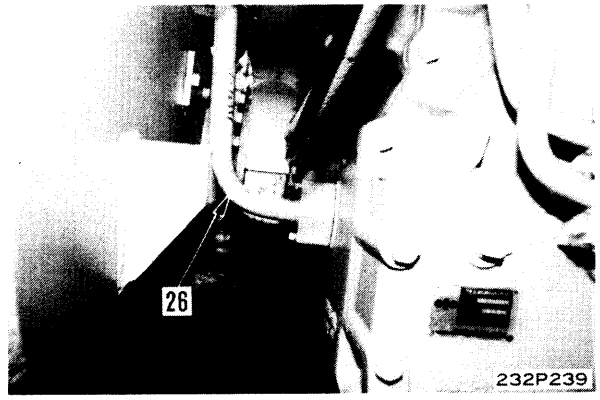
3. **Universal joint assembly**
Install universal joint (28).
kgm Mounting bolt: 10 – 12.5 kgm



4. **Vacuum hose**
Connect hose (27) between vacuum pump and vacuum tank.

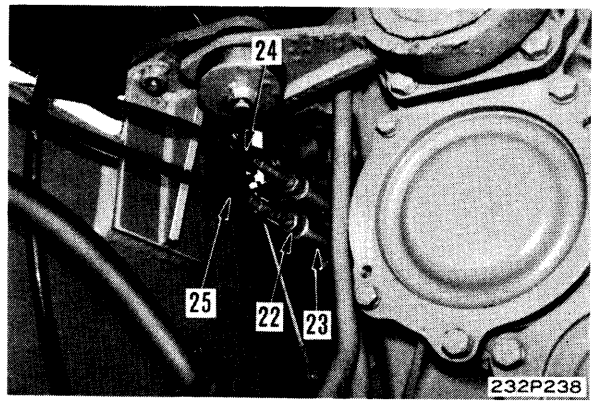


5. **Transmission oil filler**
Fit O-ring and install transmission oil filler tube (26).



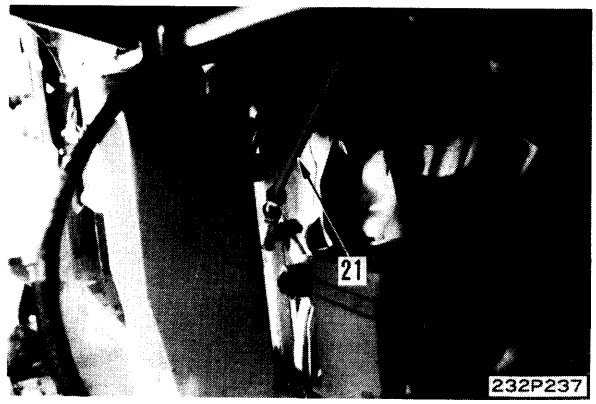
6. F-R cable, inching cable

1) Connect inching cable (25) and F-R cable (24) to spool. Fit O-ring to coupling (23), then tighten cover.
2) Secure cable with locknut (22).



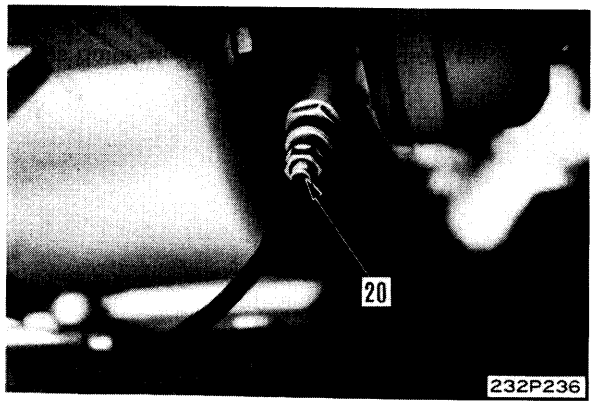
7. Transmission control rod

Connect transmission control rod (21).

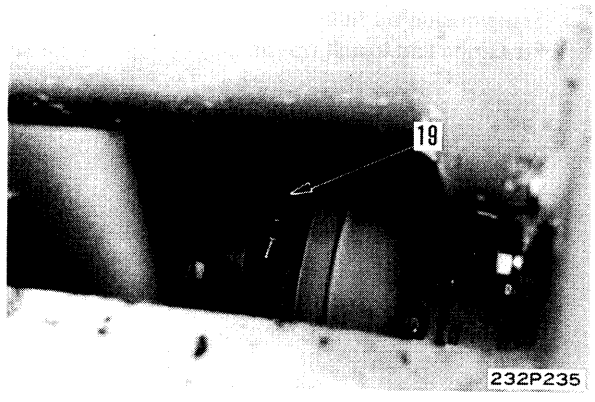


8. Parking brake cable, speedometer cable

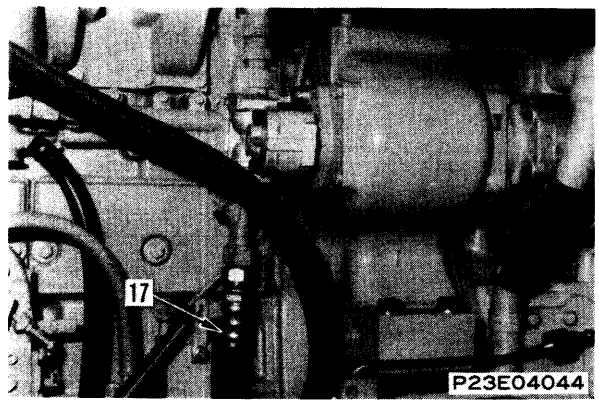
1) Connect speedometer cable (20).



2) Connect parking brake cable (19) and secure with locknut.



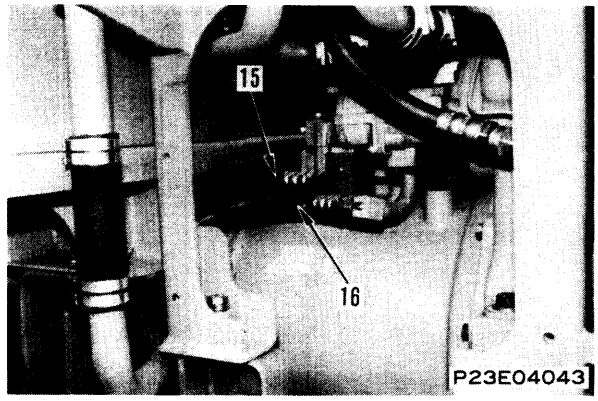
9. **Outlet hose of steering pump**
   Connect outlet hose (17) of steering pump.



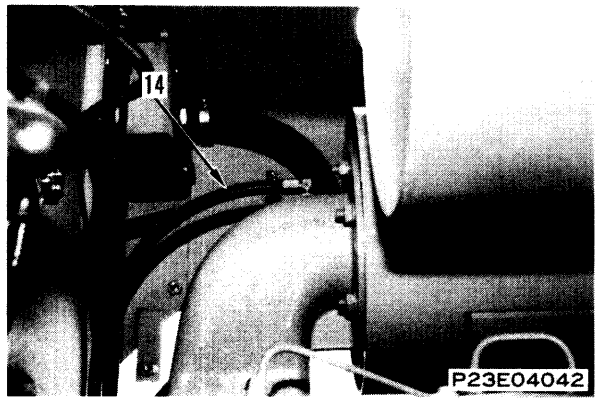
10. **Radiator assembly**
    Install radiator assembly.
    for details, see 13 INSTALLATION OF RADIATOR ASSEMBLY.

11. **Fuel tank assembly**
    Install fuel tank assembly.
    For details, see 13 INSTALLATION OF FUEL TANK ASSEMBLY.

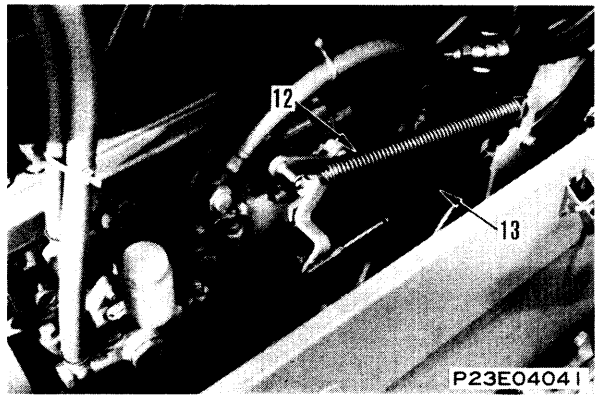
12. **Outlet hoses of hydraulic pump**
    Connect hoses (16) and (15) of hydraulic pump.



13. **Dust indicator hose**
    Connect dust indicator hose (14).

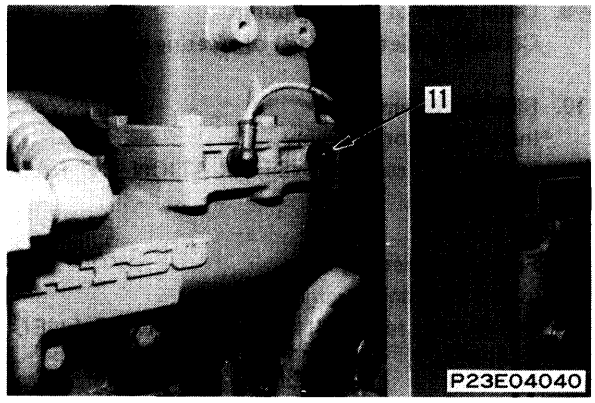


14. **Fuel control cable**
    Connect fuel control cable (13), secure with locknut, then install spring (12).

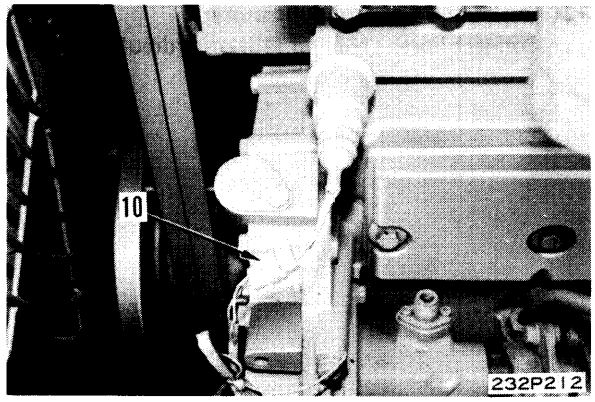


15. Wiring

1) Connect wire (11) of electric heater.

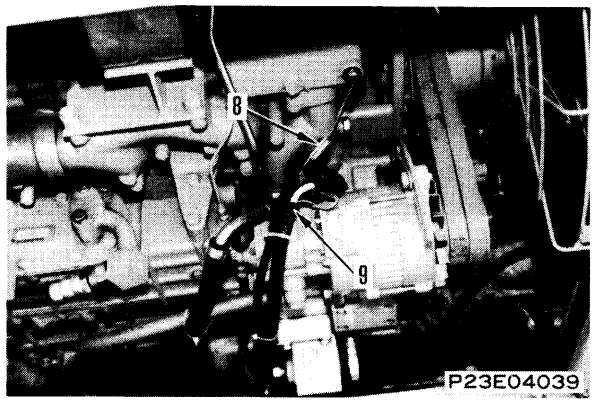


2) Connect wire (10) of oil pressure gauge.



3) Connect wire (9) of alternator.

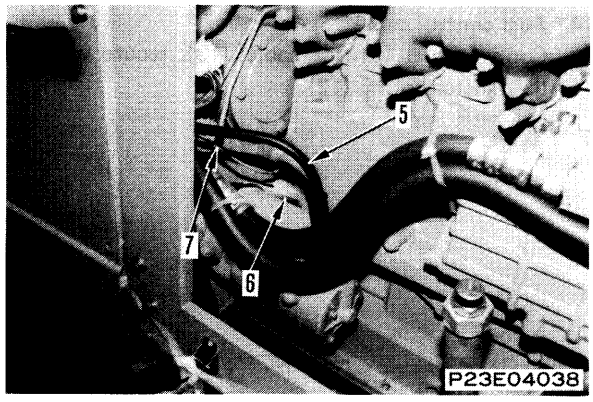
4) Connect wire (8) of water temperature gauge.



5) Connect wire (7) of oil temperature sensor.

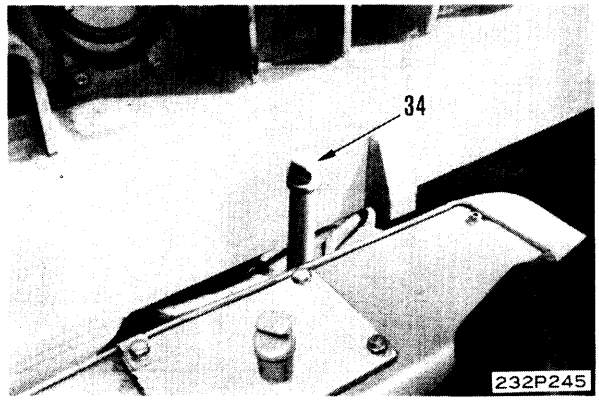
6) Connect wires (6) and (5) of starting motor.

7) Connect lead to negative (–) terminal of battery.



16. Side covers, hood

1) Raise hood and install.
2) Install L.H. and R.H. covers under fuel tank.
3) Install L.H. and R.H. engine side covers.



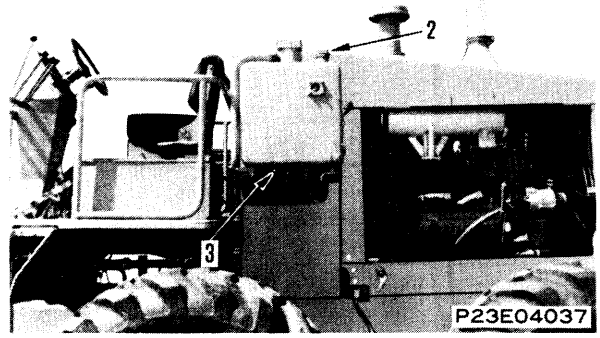
17. Refilling with hydraulic oil and transmission oil

1) Tighten drain plug of transmission, and add engine oil through oil filler (34) to the specified level.

Transmission case: Approx. 30ℓ

2) Tighten drain plug (3) and add engine oil through oil filler (2) to the specified level.

Hydraulic tank: Approx. 27ℓ

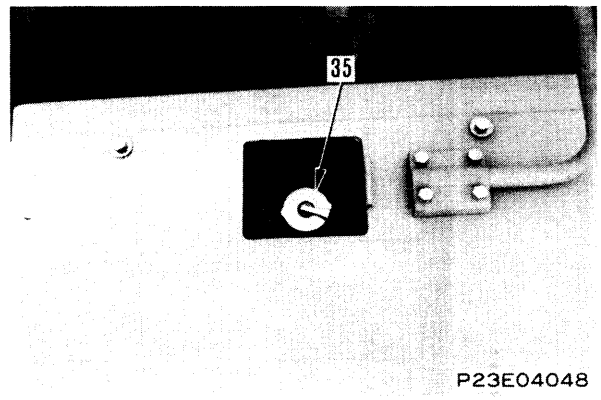


18. Refilling with water

Tighten drain valve and add cooling water through water filler (35) to the specified level.

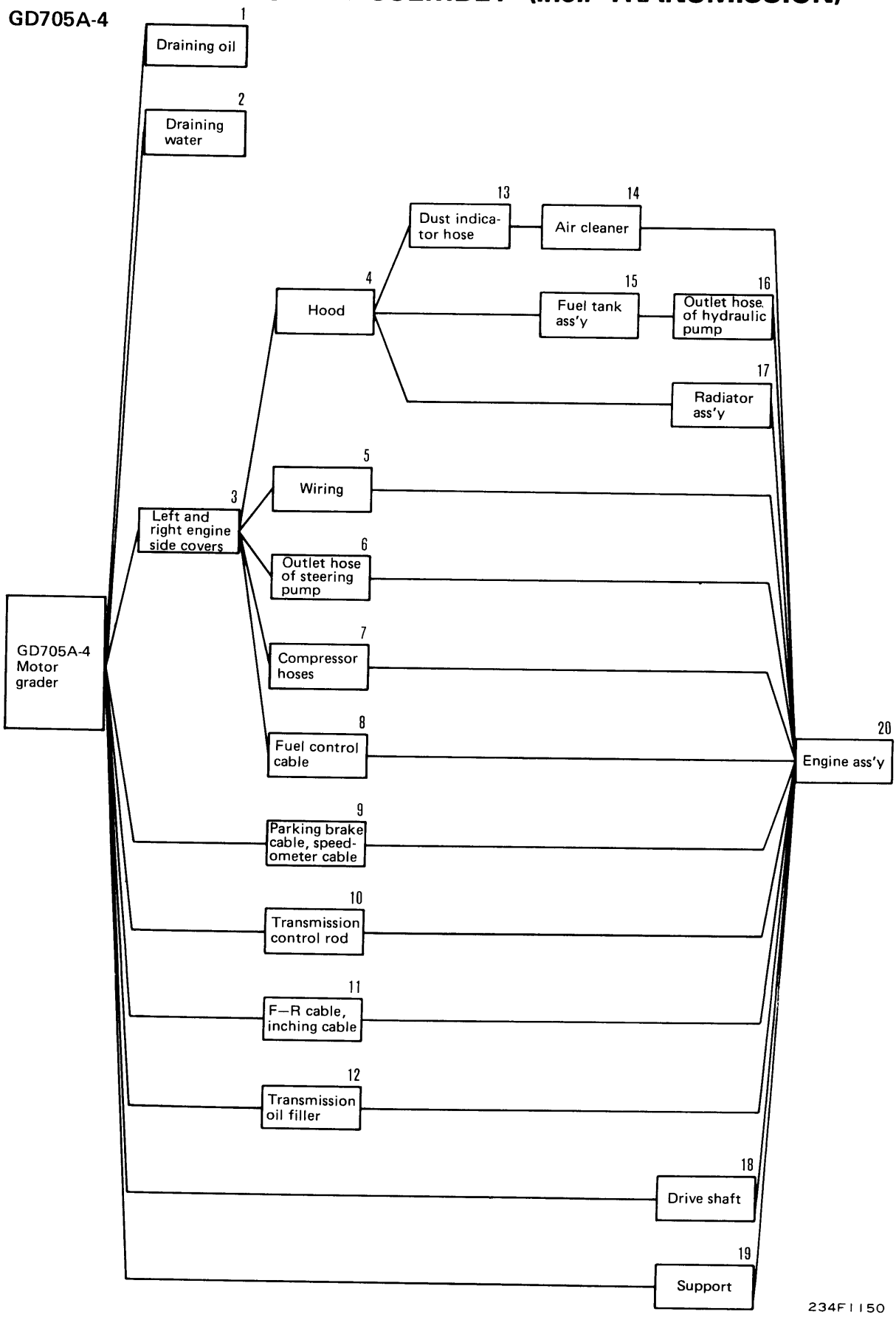
★ Run the engine to circulate the water through the system. Then check the water level again.

★ Run the engine to circulate the water and the oil through the system. Then check the water and the oil level again.



REMOVAL OF ENGINE ASSEMBLY (incl. TRANSMISSION)

GD705A-4

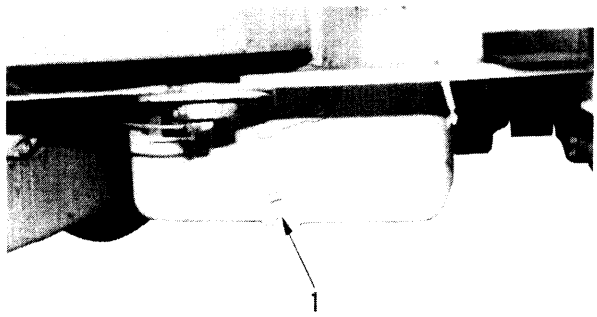


234F1150

★ When removing the hydroshift transmission assembly, remove it first together with the engine, then remove the transmission assembly.

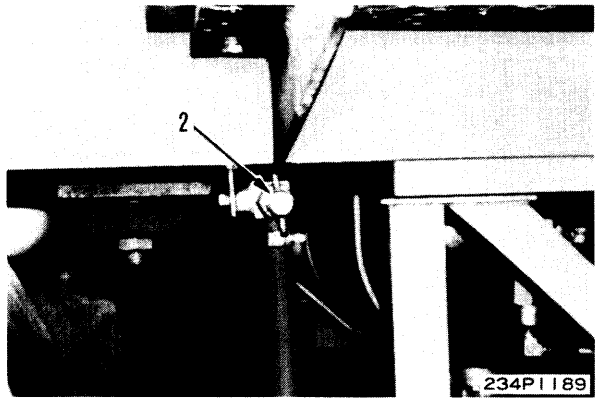
1. **Draining oil**
Remove drain plug (1) and drain oil from transmission case.

Transmission case: 48ℓ



234P1188

2. **Draining water**
Loosen drain valve (2) and drain cooling water.
★ If the coolant contains antifreeze, dispose of it correctly.



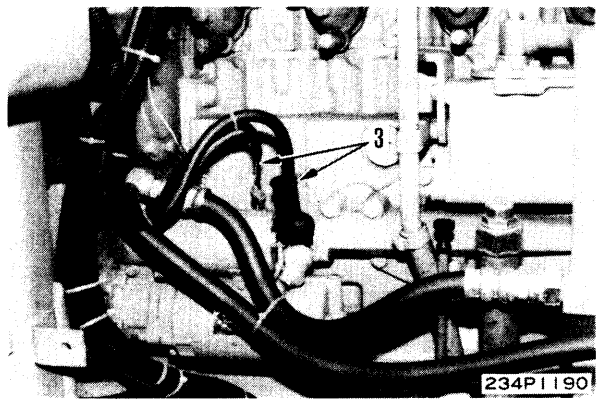
3. **Left and right engine side covers**
Remove left and right engine side covers.

4. **Hood**
Lift off hood.

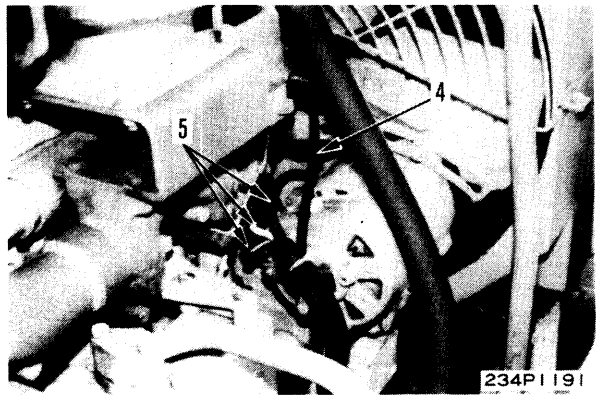
5. **Wiring**

Disconnect the cable from the negative (−) terminal of the battery.

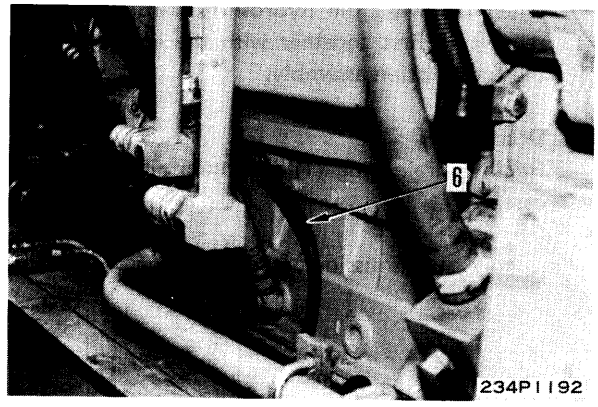
1) Disconnect wire (3) of starting motor.



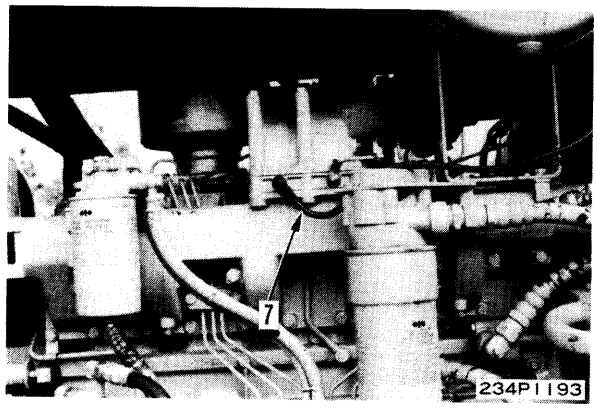
2) Disconnect wire (4) of water temperature gauge and wire (5) of alternator.



3) Disconnect ground connection (6).

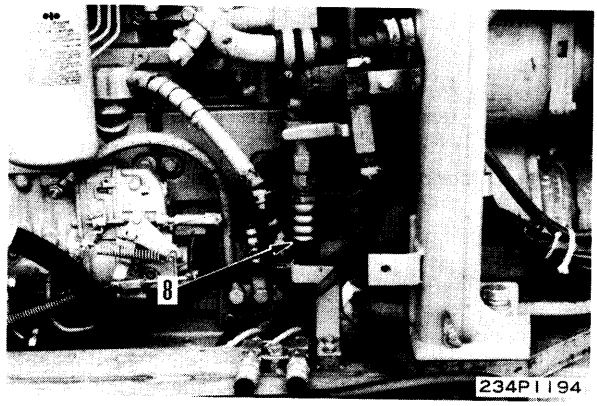


4) Disconnect wire (7) of electric heater.



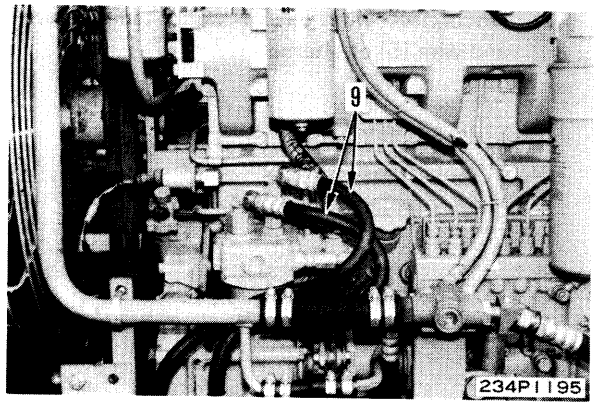
6. Outlet hose of steering pump

Disconnect outlet hose (8) of steering pump.

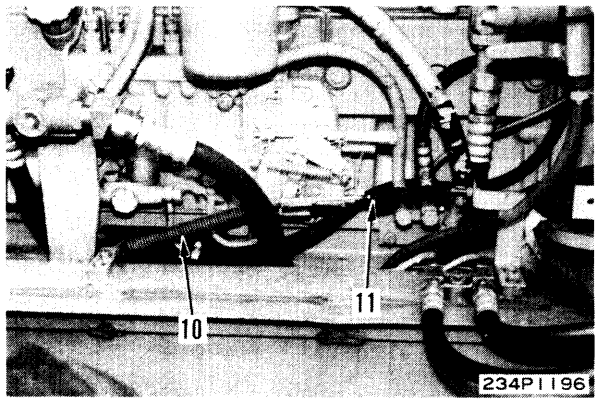


7. Compressor hoses

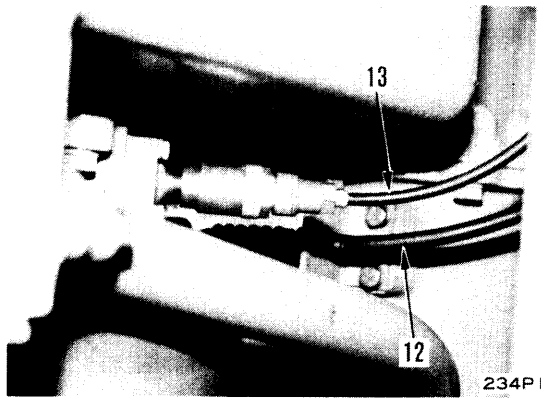
Disconnect 2 compressor hoses (9).



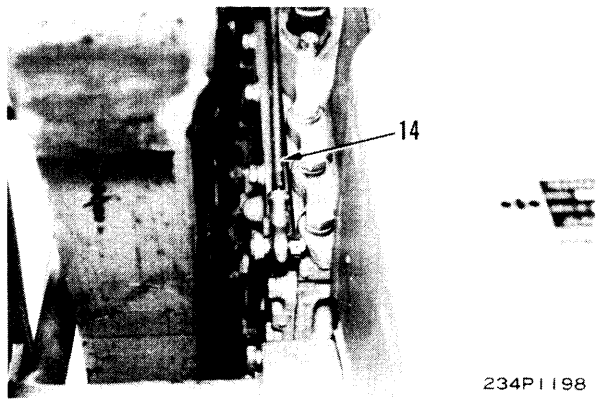
8. **Fuel control cable**
   Remove spring (10), then disconnect fuel control cable (11).



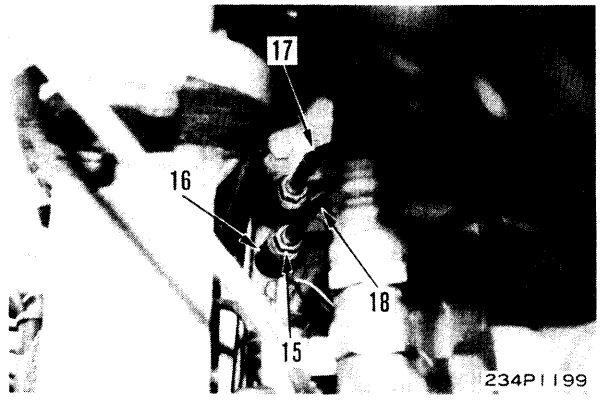
9. **Parking brake cable, speedometer cable**
   1) Disconnect parking brake cable (12).
   2) Disconnect speedometer cable (13).



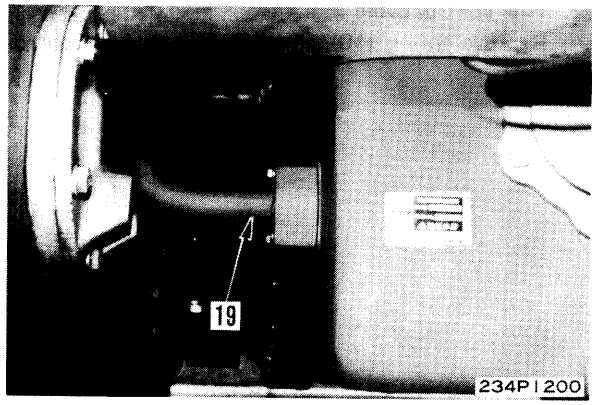
10. **Transmission control rod**
    Disconnect transmission control rod (14).



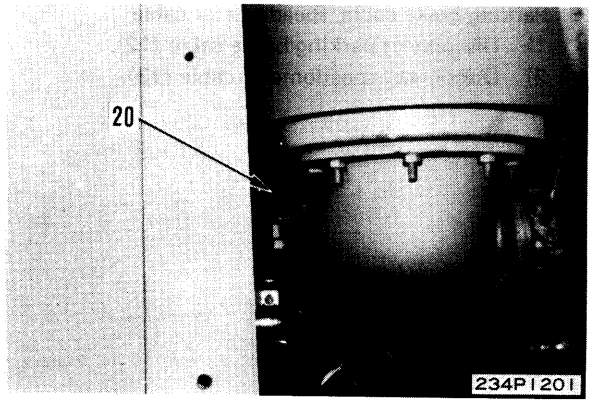
11. **F–R cable, inching cable**
    1) Loosen locknut (15).
    2) Remove coupling (16), then disconnect F–R cable (17) and inching cable (18).



12. Transmission oil filler
Remove transmission oil filler tube (19).

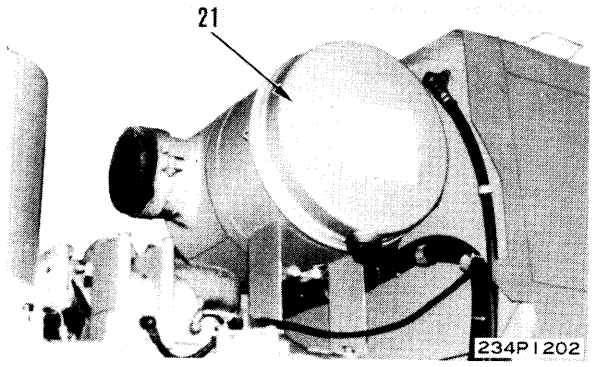


13. Dust indicator hose
Disconnect dust indicator hose (20).



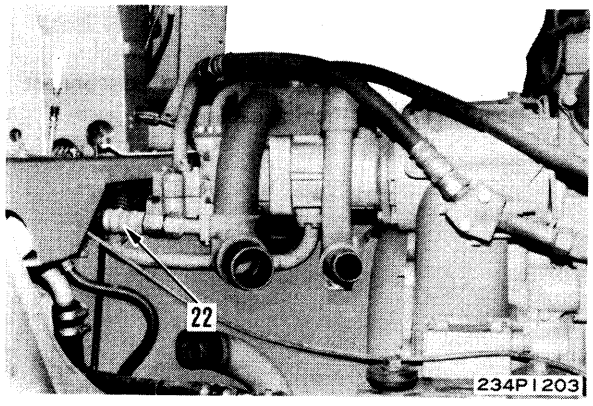
14. Air cleaner
Remove air cleaner assembly (21).

15. Fuel tank assembly
Remove fuel tank assembly.
For details, see 13 REMOVAL OF FUEL TANK ASSEMBLY.



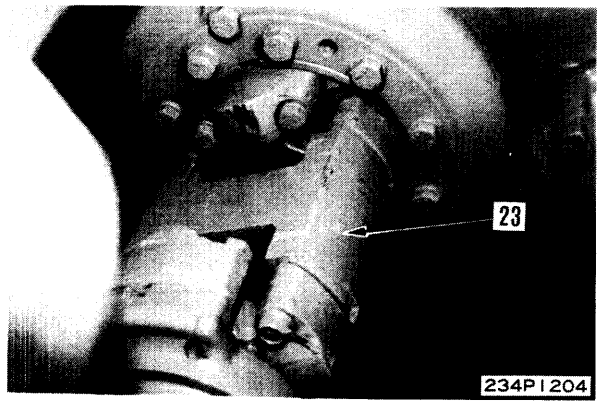
16. Outlet hose of hydraulic pump
Disconnect outlet hose (22) of hydraulic pump.

17. Radiator assembly
Remove radiator assembly.
For details, see 13 REMOVAL OF RADIATOR ASSEMBLY.



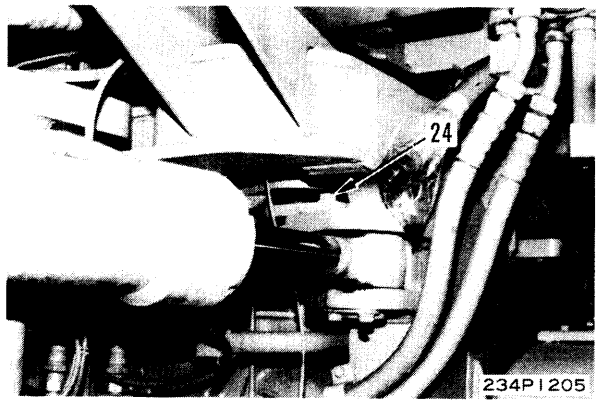
18. Drive shaft

Remove drive shaft (23).



19. Support

Remove mounting bolts (24) of support plate.

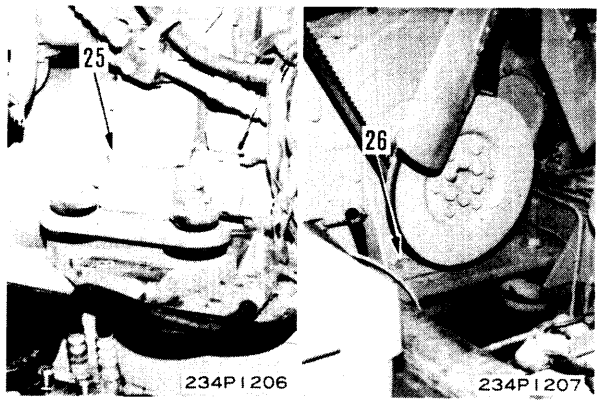


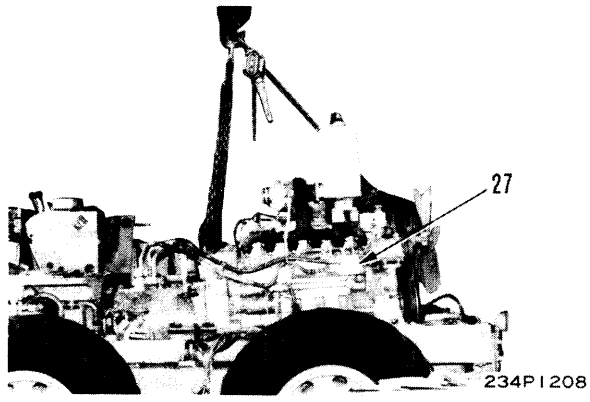
20. Engine assembly

1) Remove mounting bolts (25) and (26).
2) Lift off engine assembly (27).

kg Engine assembly (incl. transmission): 2130 kg

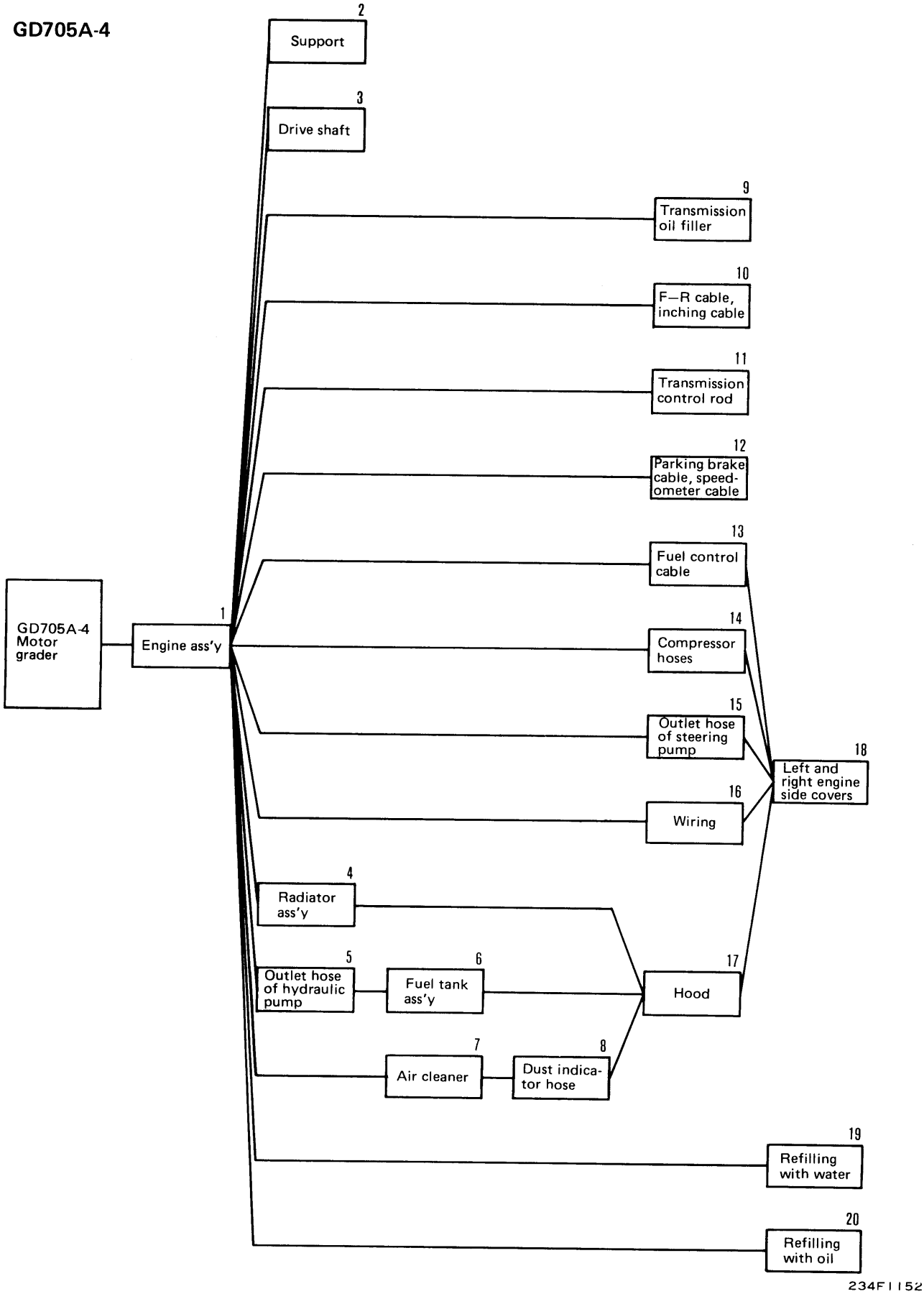
★ If the hydroshift transmission assembly is to be removed from the engine assembly (which includes the transmission assembly), remove the connecting bolts of the flywheel housing, then remove the hydroshift transmission.





INSTALLATION OF ENGINE ASSEMBLY (incl. TRANSMISSION)

GD705A-4

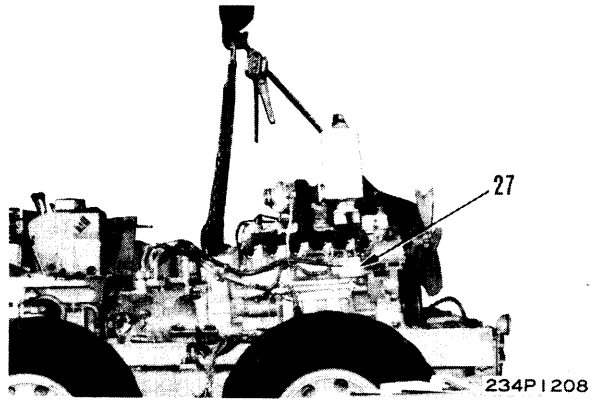


234F1152

Spedical tool

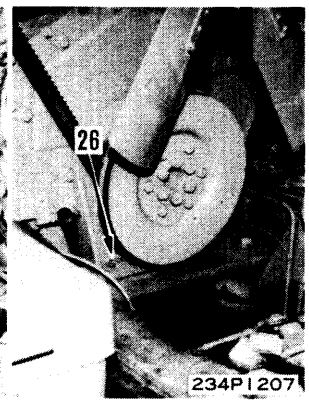
	Part No.	Part Name	Q'ty
A	792-271-2000	Centering tool	1

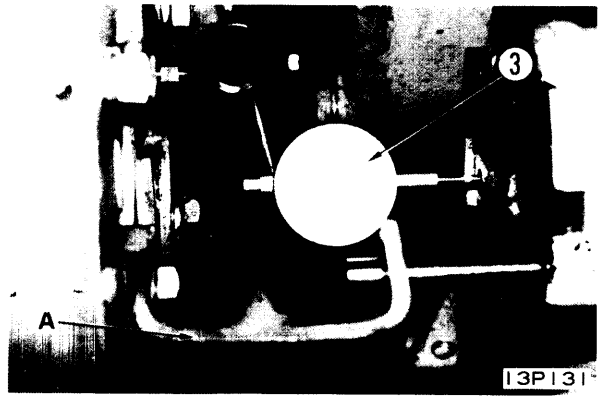
★ When installing the hydroshift transmission assembly on the machine, install the connecting bolts of the flywheel housing to install the hydroshift transmission assembly to the engine, then install on the machine together with the engine.

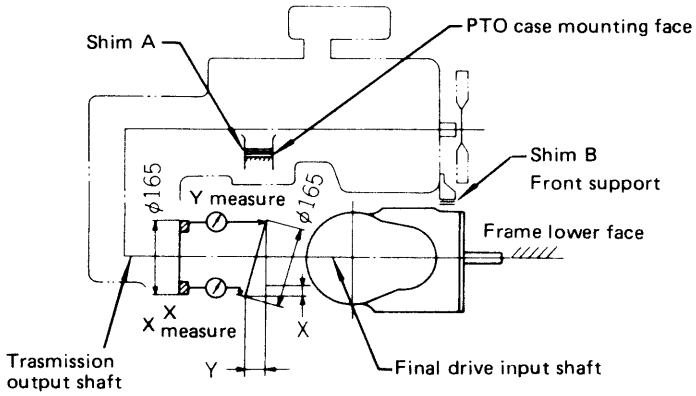


1. Engine assembly

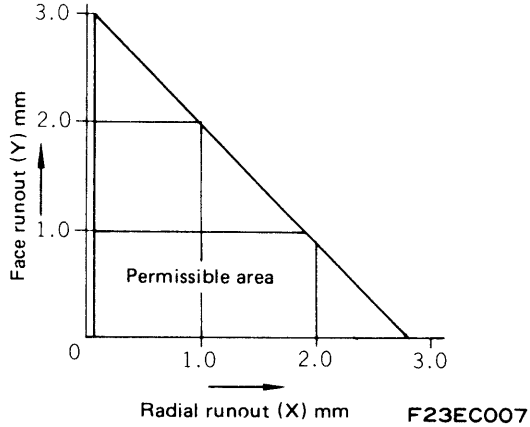
1) Lift engine assembly (27) and mount it to the frame.
2) Tighten mounting bolts (26) and (25).
   ★ Tightly fasten the mounting bolt after aligning the engine.
3) Measure face runout and radial runout as follows.
   i) Install centering tool **A** on flange of output shaft.
   ii) Set dial gauge ③ on tool **A**.
   iii) Rotate flange and measure radial runout and face runout. If the value is not within the standard, adjust the mounting position of the engine.
      ★ Radial runout: Max. See lower diagram
      ★ Face runout: Max. See lower diagram
   iv) When the value is not within the standard, adjust shim **A** and shim **B**.





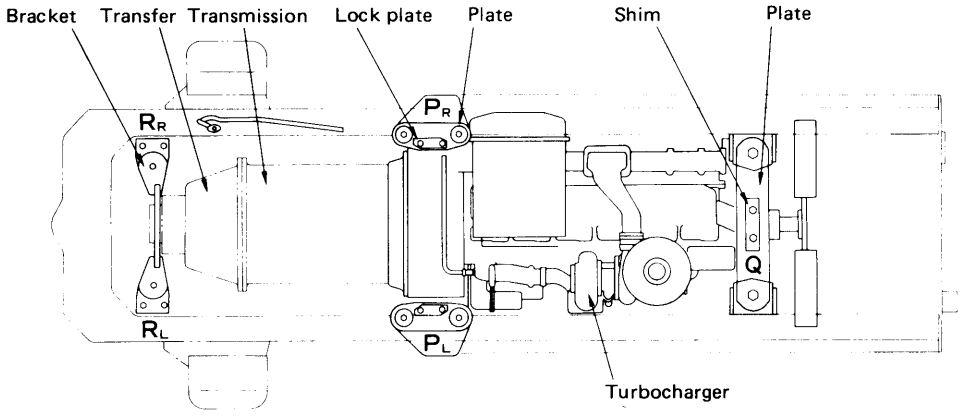


F23EC006



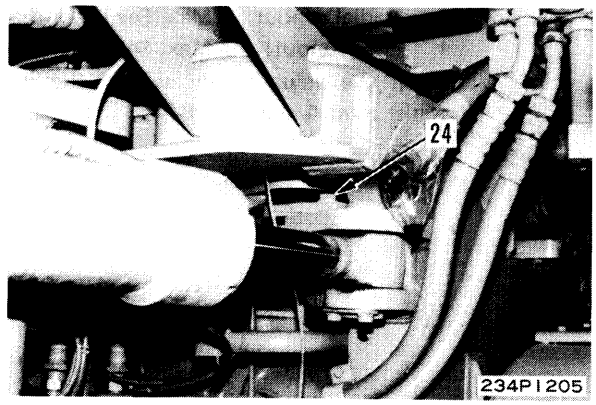
F23EC007

4) Carry out centering and shim adjustment as follows.
   i) Add shims to **P** and **Q** to adjust the three points **PL**, **PR** and **Q** so that the drive shaft of the final drive is parallel to the center line of crankshaft. When doing this, the standard shim thickness for **P** should be 2.4 mm with a minimum thickness of 0.6 mm.
   ii) Decide the shim thickness so that the clearance at **RL** and **RR** is '0'. Then add 0.7 mm of shim and assemble.
   iii) Remove 0.6 mm of shim from **PL** and **PR** and assemble.
   iv) Add 1.4 mm of shim to **Q** and assemble.



234F1151

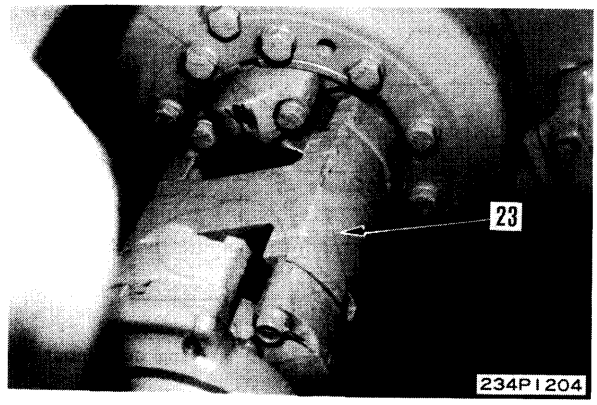
5) Tighten mounting bolt.
   kgm Mounting bolt: 39.25 ± 4.25 kgm



234P1205

2. Support
Install plate mounting bolt (24).

3. Drive shaft
Install drive shaft (23).
kgm Drive shaft: 11.25 ± 1.25 kgm

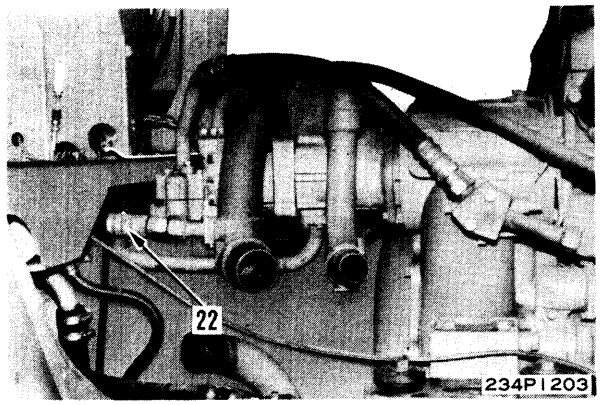


234P1204

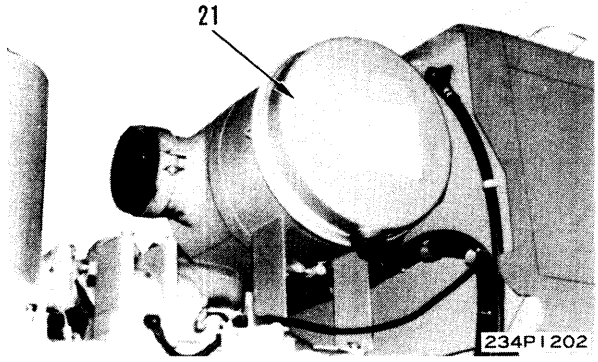
4. **Radiator assembly**
   Install radiator assembly.
   For details, see 13 INSTALLATION OF RADIATOR ASSEMBLY.

5. **Outlet hose of hydraulic pump**
   Connect hose (22) of hydraulic pump.

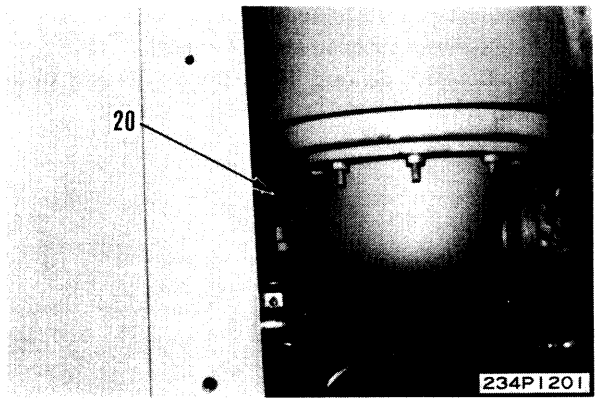
6. **Fuel tank assembly**
   Install fuel tank assembly.
   For details, see 13 INSTALLATION OF FUEL TANK ASSEMBLY.



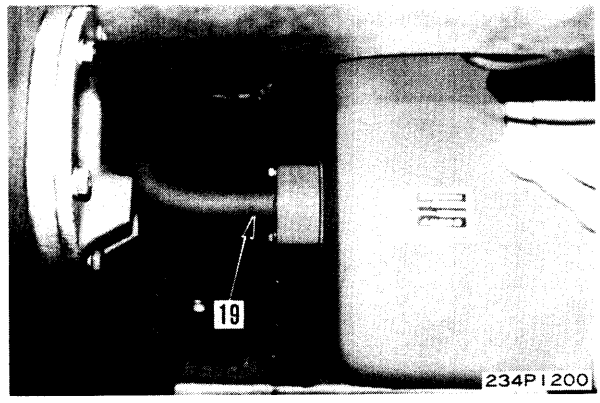
7. **Air cleaner**
   Install air cleaner assembly (21).



8. **Dust indicator hose**
   Connect dust indicator hose (20).

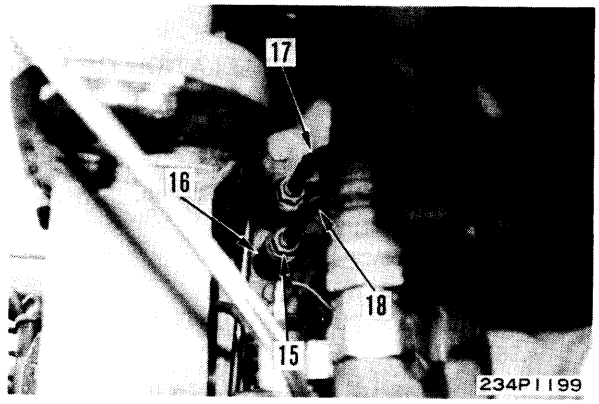


9. **Transmission oil filler**
   Fit O-ring and install transmission oil filler tube (19).



10. F–R cable, inching cable

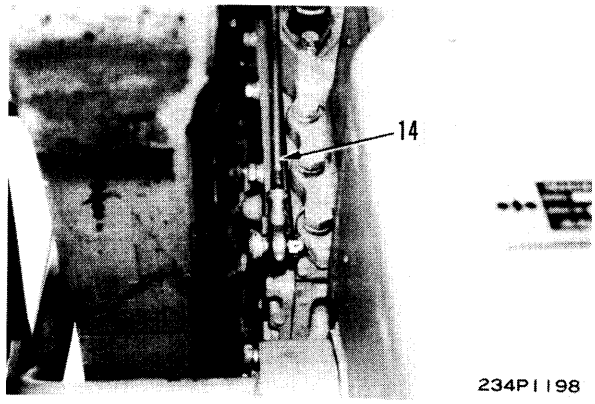
1) Connect inching cable (18) and F–R cable (17) to spool. Fit O-ring to coupling (16), then tighten cover.
2) Secure cable with locknut (15).



11. Transmission control rod

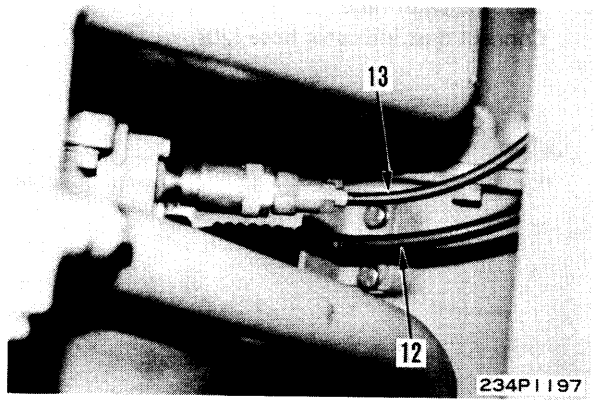
Connect transmission control rod (14).

★ Bend cotter pin securely.



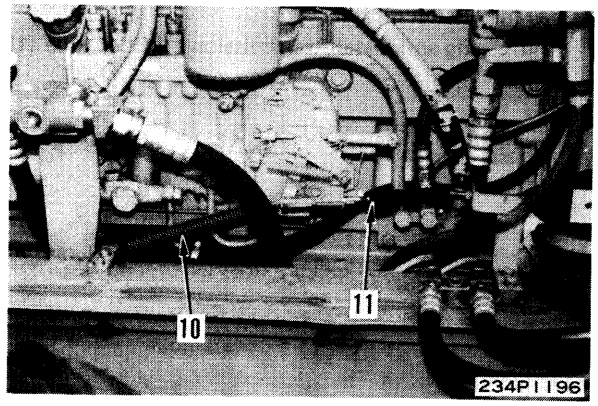
12. Parking brake cable, speedometer cable

1) Connect speedometer cable (13).
2) Connect parking brake cable (12) and secure with locknut.

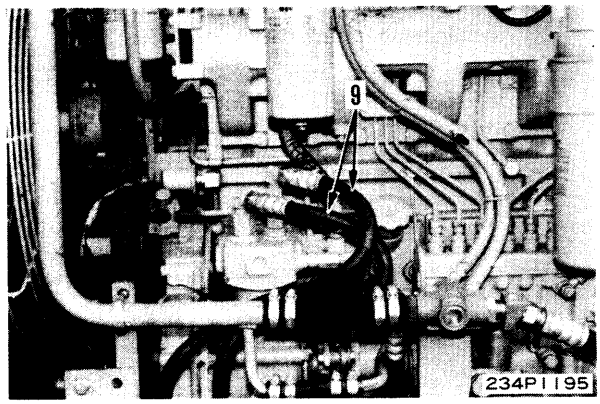


13. Fuel control cable

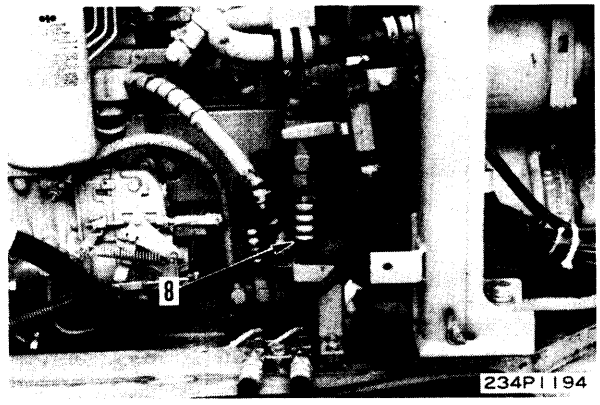
Connect fuel control cable (11), then install spring (10).



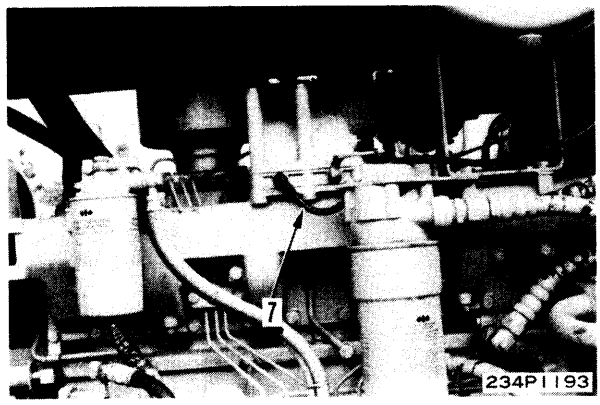
14. Compressor hoses
Connect 2 compressor hoses (9).



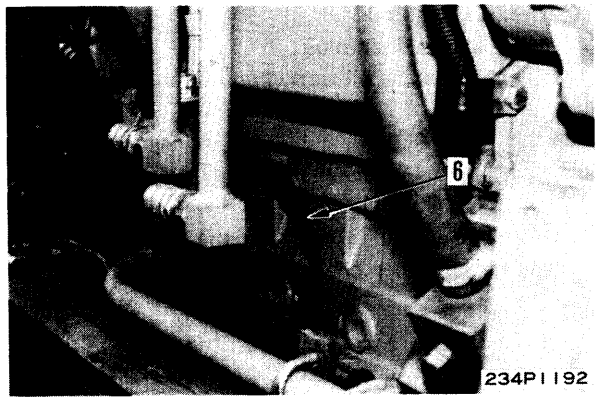
15. Outlet hose of steering pump
Connect outlet hose (8) of steering pump.



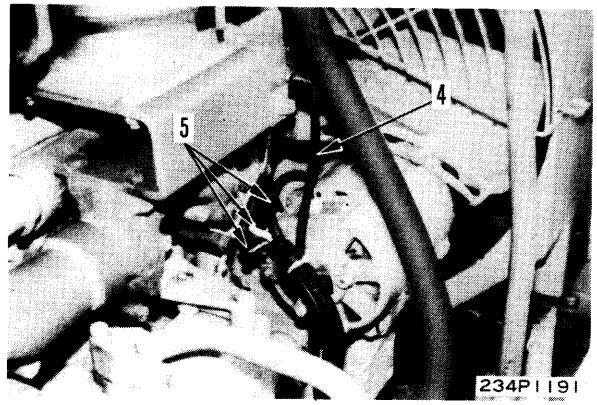
16. Wiring
1) Connect wire (7) of electric heater.



2) Connect ground connection (6).

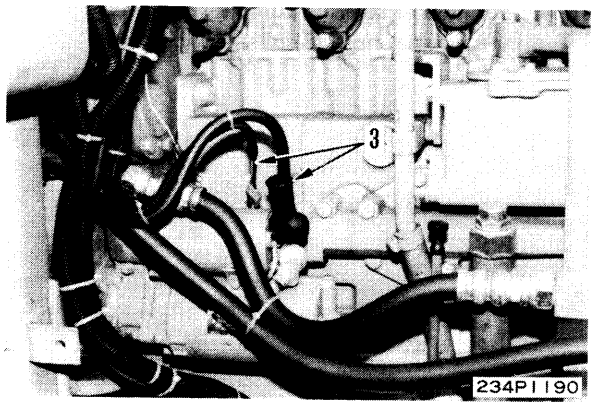


3) Connect wire (5) of alternator and wire (4) of water temperature gauge.



4) Connect wire (3) of starting motor.

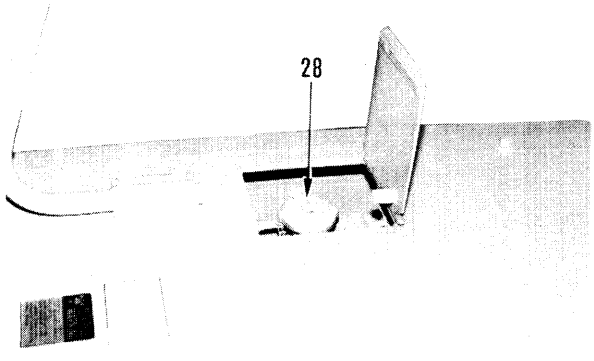
5) Connect cable to negative (−) terminal of battery.



17. Hood
Raise hood and install.

18. Left and right engine side covers
Install left and right engine side covers.

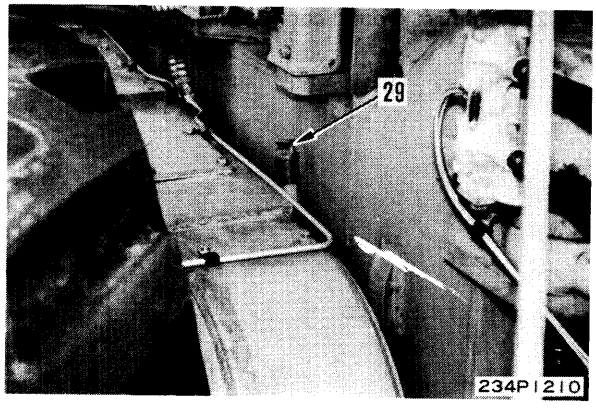
19. Refilling with water
Tighten drain valve and add water through water filler (28) to the specified level.



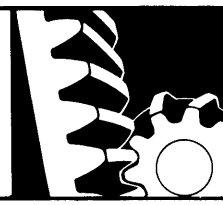
20. Refilling with oil
1) Tighten drain plug.
2) Add engine oil through oil filler (29) to the specified level.

Transmission case: 48ℓ

★ Run the engine to circulate the water and oil through the system. Then check the water and oil levels again.

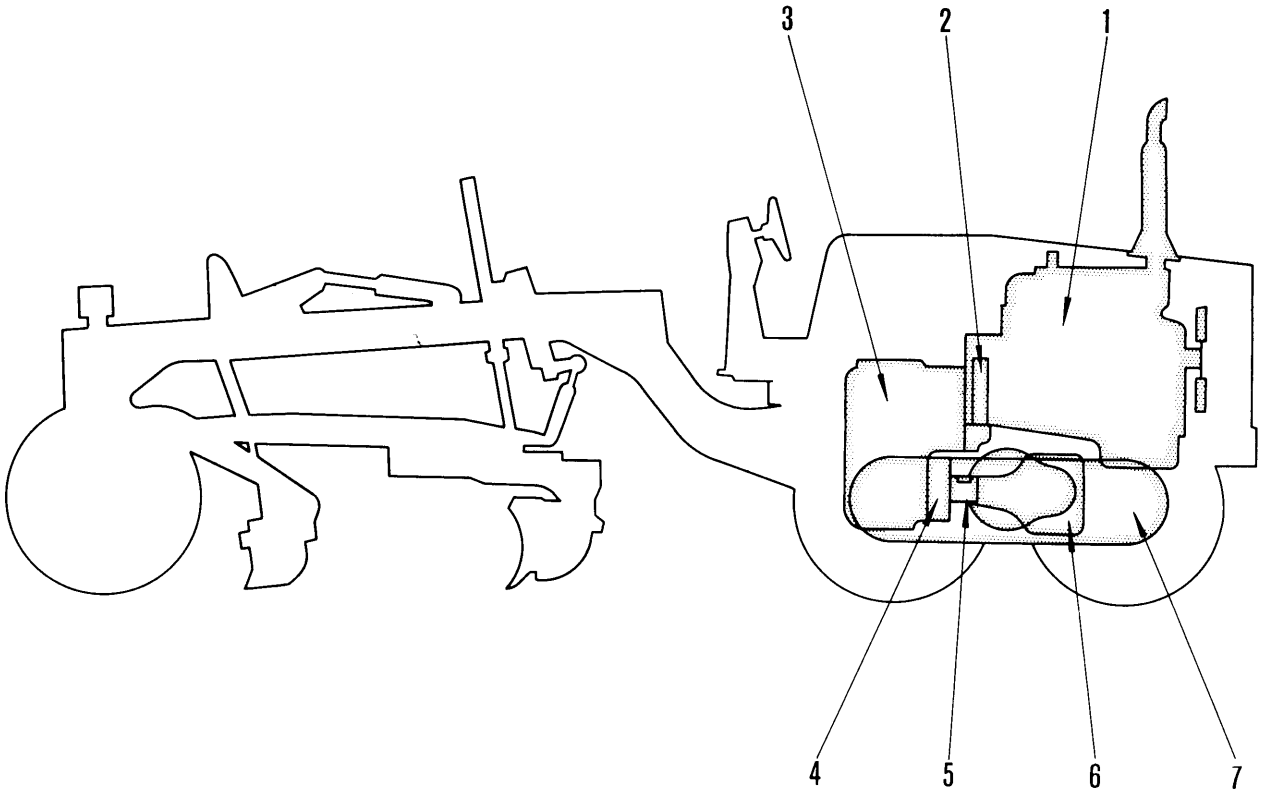


POWER TRAIN
21 STRUCTURE AND FUNCTION



GENERAL

GD705R-4

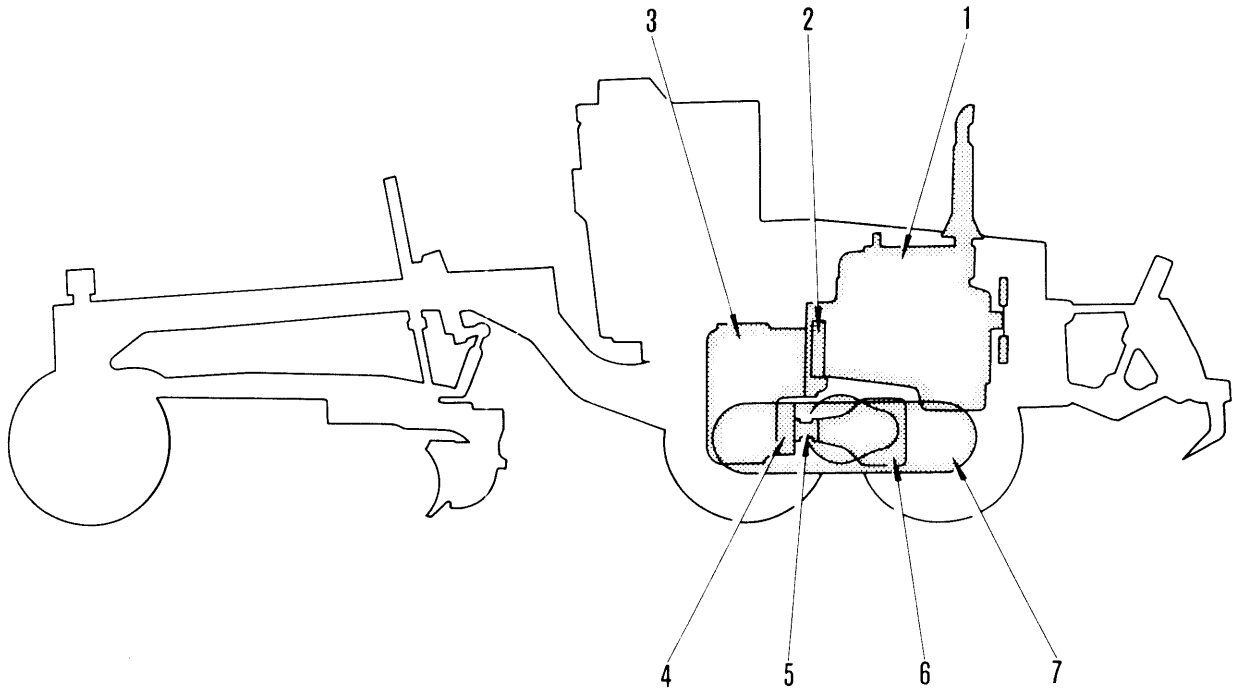


F23B008

The power from diesel engine (1) is transmitted to the HYDROSHIFT transmission (3) through the damper (2). In the HYDROSHIFT transmission, in response to the load and the forward-reverse rotation direction, the clutch is selected and the power is transmitted to the final drive (6) through the drive shaft (5).
Here, the power is separated into left and right perpendicular directions and transmitted to the tandem drive (7) through the rear axle.
The tandem drive transmits the power to the wheel by a chain and the machine travels.

1. Engine
2. Damper
3. HYDROSHIFT transmission
4. Parking brake
5. Drive shaft
6. Final drive
7. Tandem drive

GD705A-4



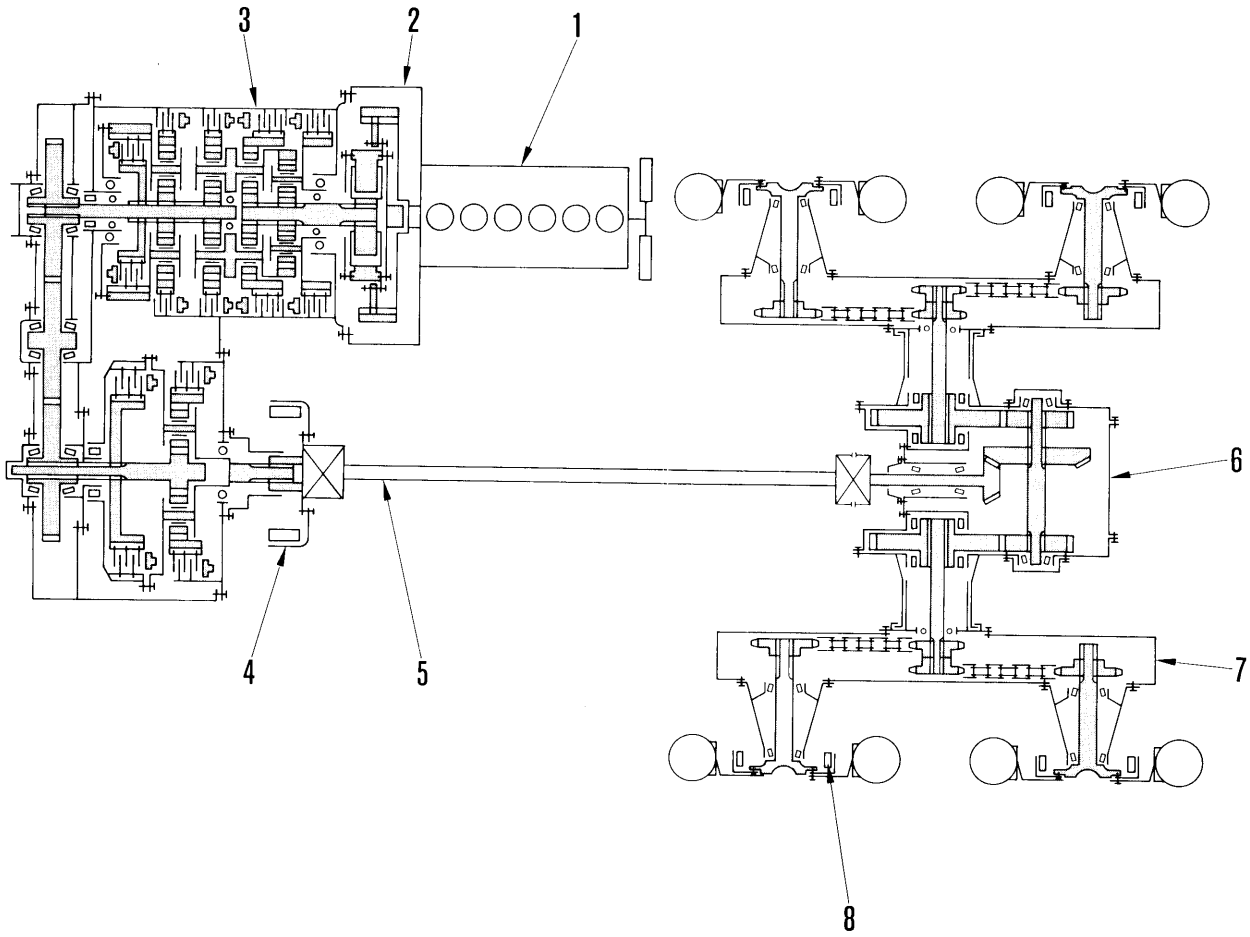
F23E005

The power from diesel engine (1) is transmitted to the HYDROSHIFT transmission (3) through the joint (2). In the HYDROSHIFT transmission in response to the load and the forward-reverse rotation direction, the clutch is selected and the power is transmitted to the final drive (6) through the drive shaft (5).
Here, the power is separated into left and right perpendicular directions and transmitted to the tandem drive (7) through the rear axle.
The tandem drive transmits the power to the wheel by a chain and the machine travels.

1. Engine
2. Joint
3. HYDROSHIFT transmission
4. Parking brake
5. Drive shaft
6. Final drive
7. Tandem drive

POWER TRAIN DIAGRAM

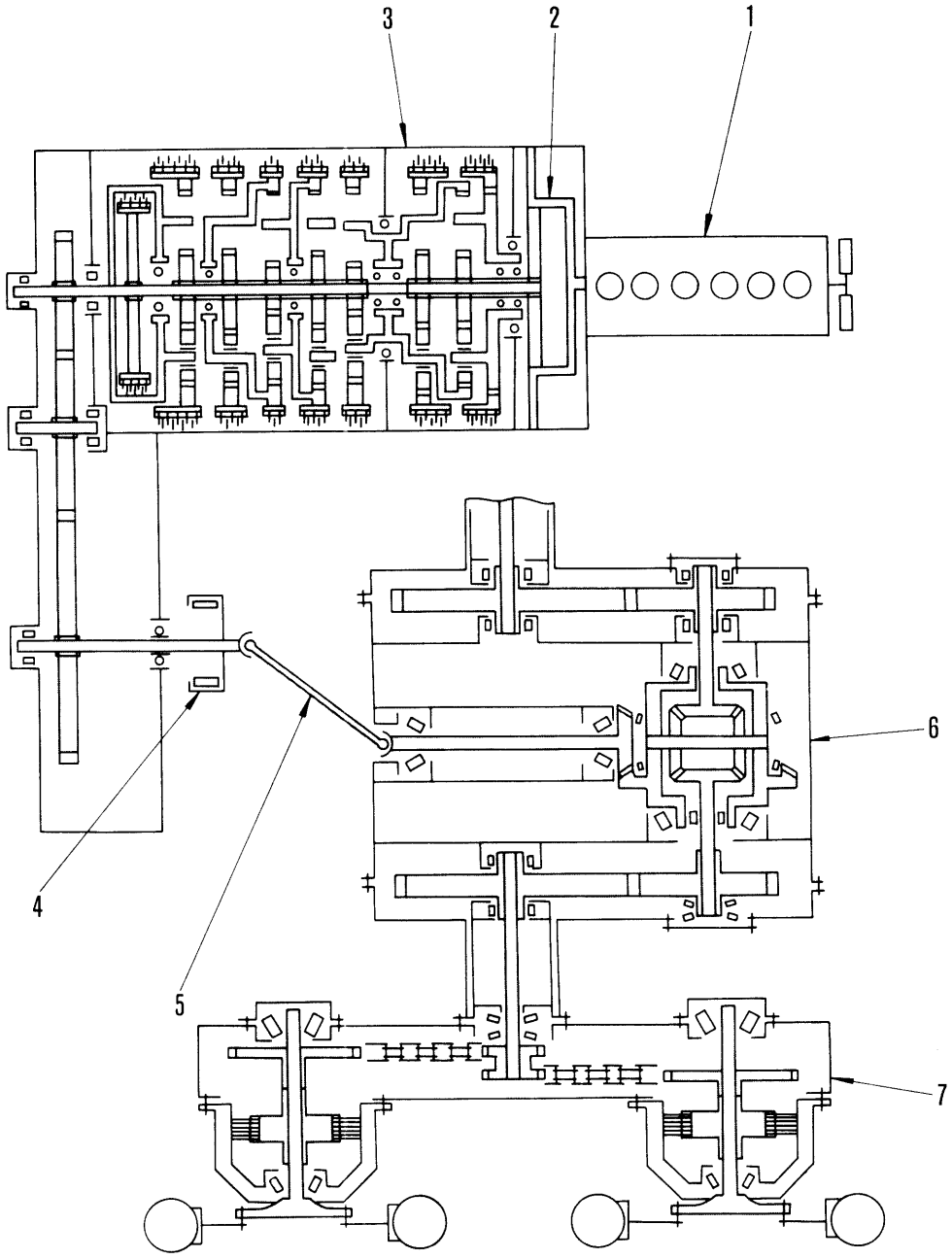
GD705R-4



F23E04017

1. Engine
2. Damper
3. HYDROSHIFT transmission
4. Parking brake
5. Drive shaft
6. Final drive
7. Tandem drive
8. Brake lining

GD705A-4

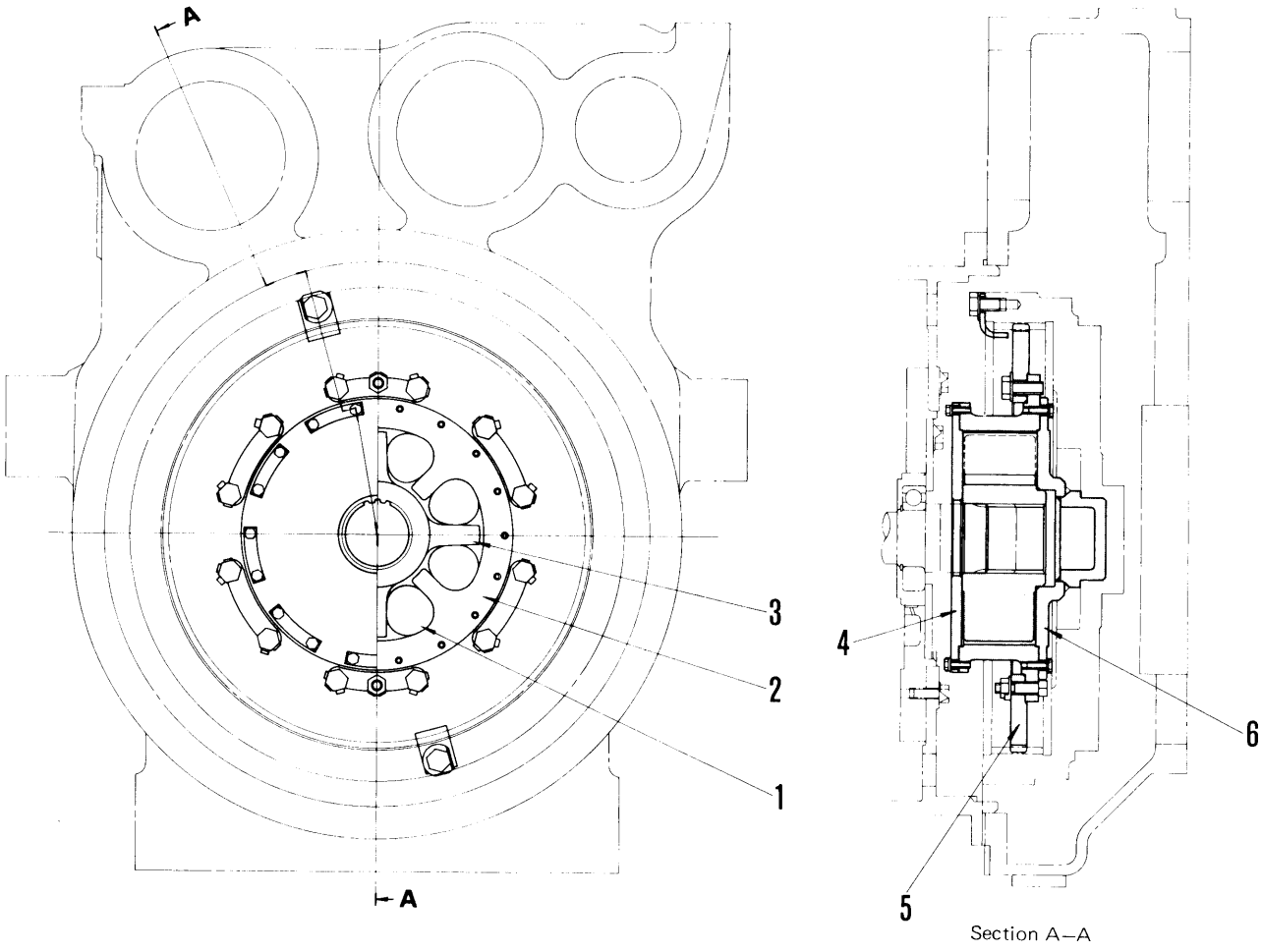


21F002-1

1. Engine
2. Joint
3. HYDROSHIFT transmission
4. Parking brake
5. Drive shaft
6. Final drive (with differential)
7. Tandem drive

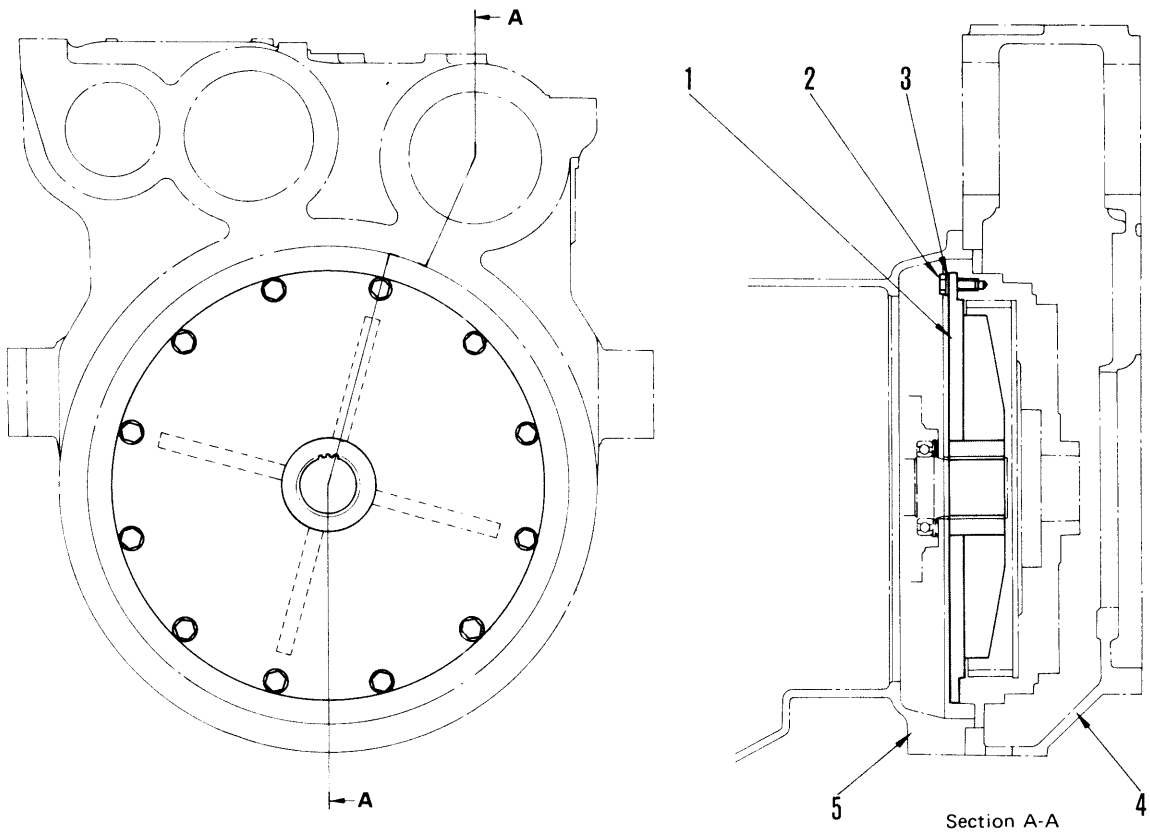
DAMPER

GD705R-4



1. Rubber
2. Body
3. Body
4. Flange
5. Gear
6. Flange

GD705A-4

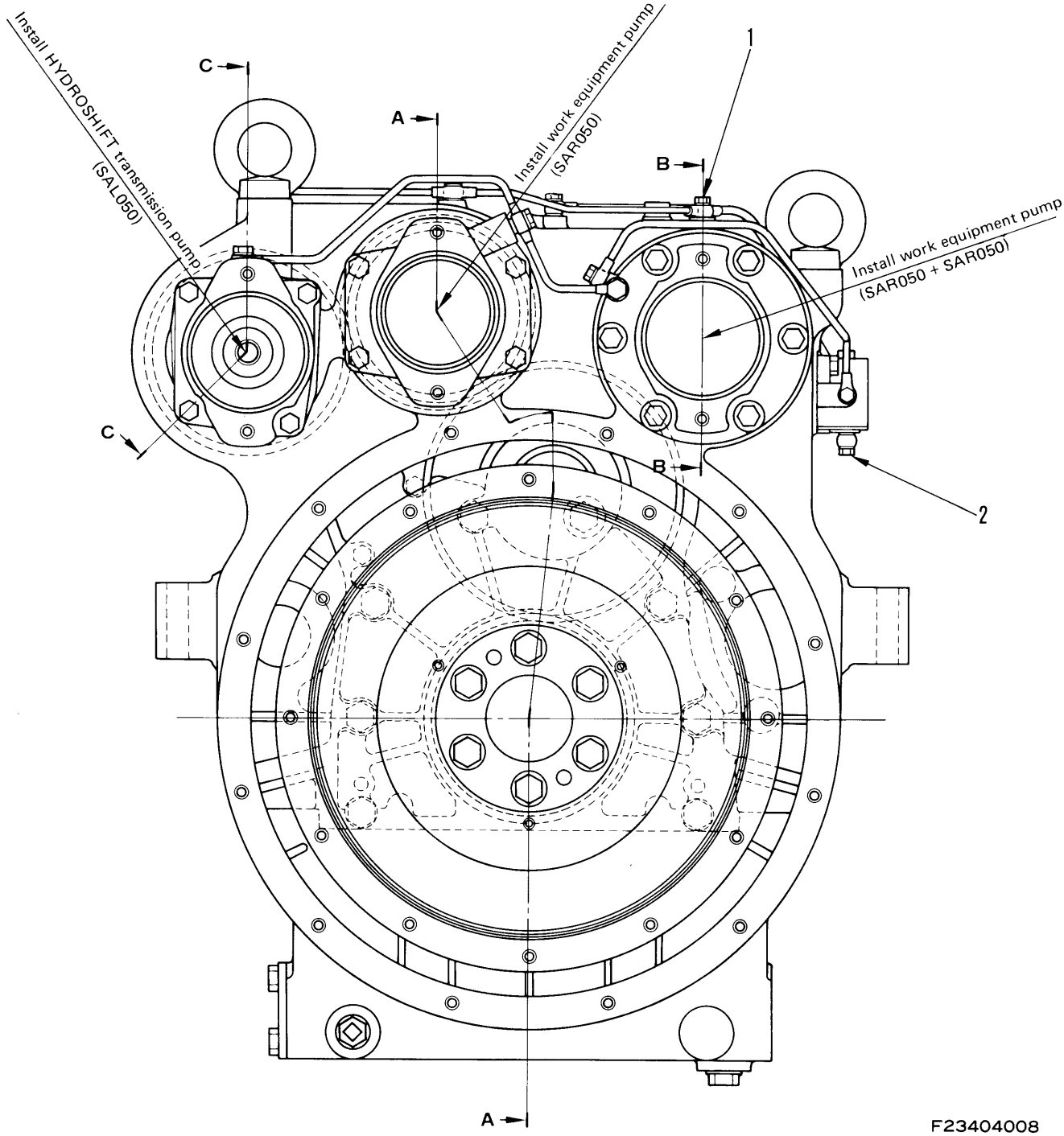


F23E006

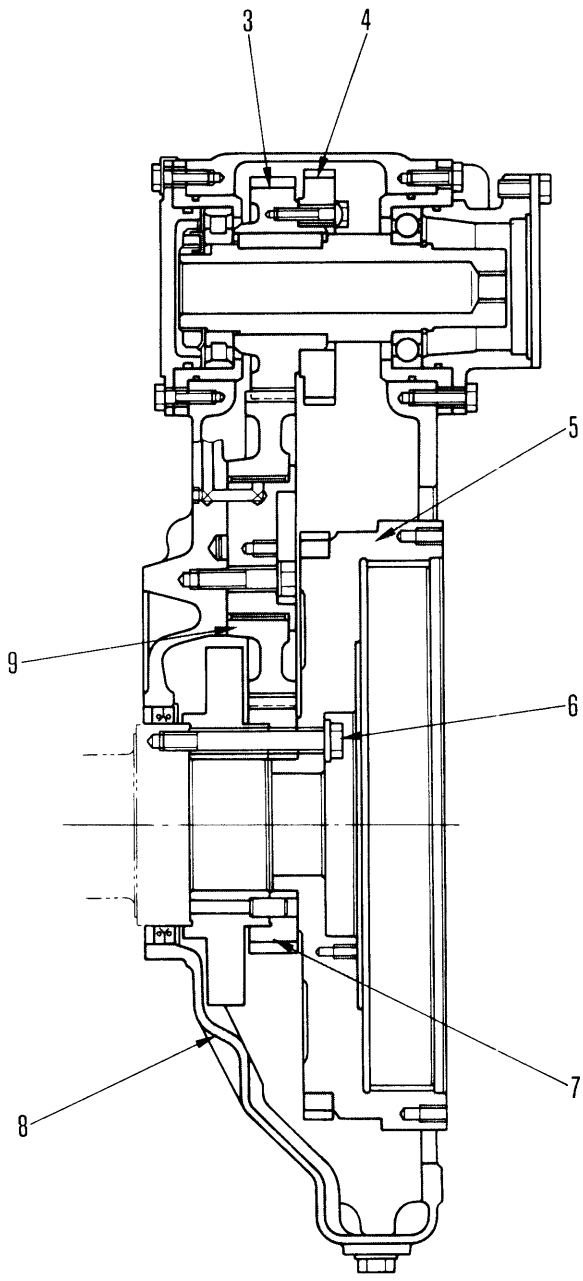
1. Disc
2. Bolt
3. Washer
4. Flywheel housing
5. HYDROSHIFT transmission case

PTO

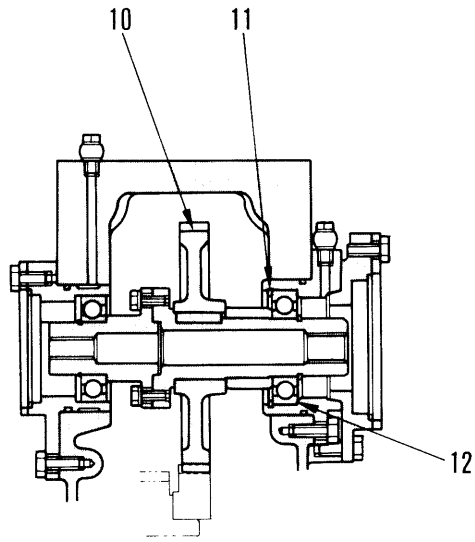
GD705A-4



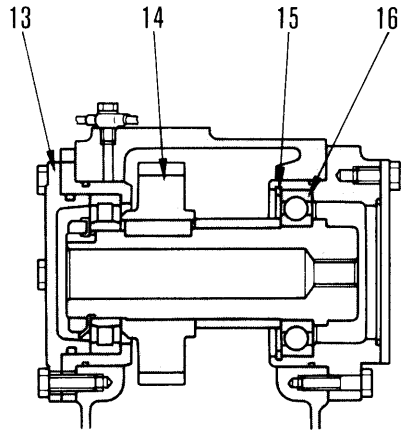
1. Joint bolt
2. Joint bolt



Section A – A



Section C – C



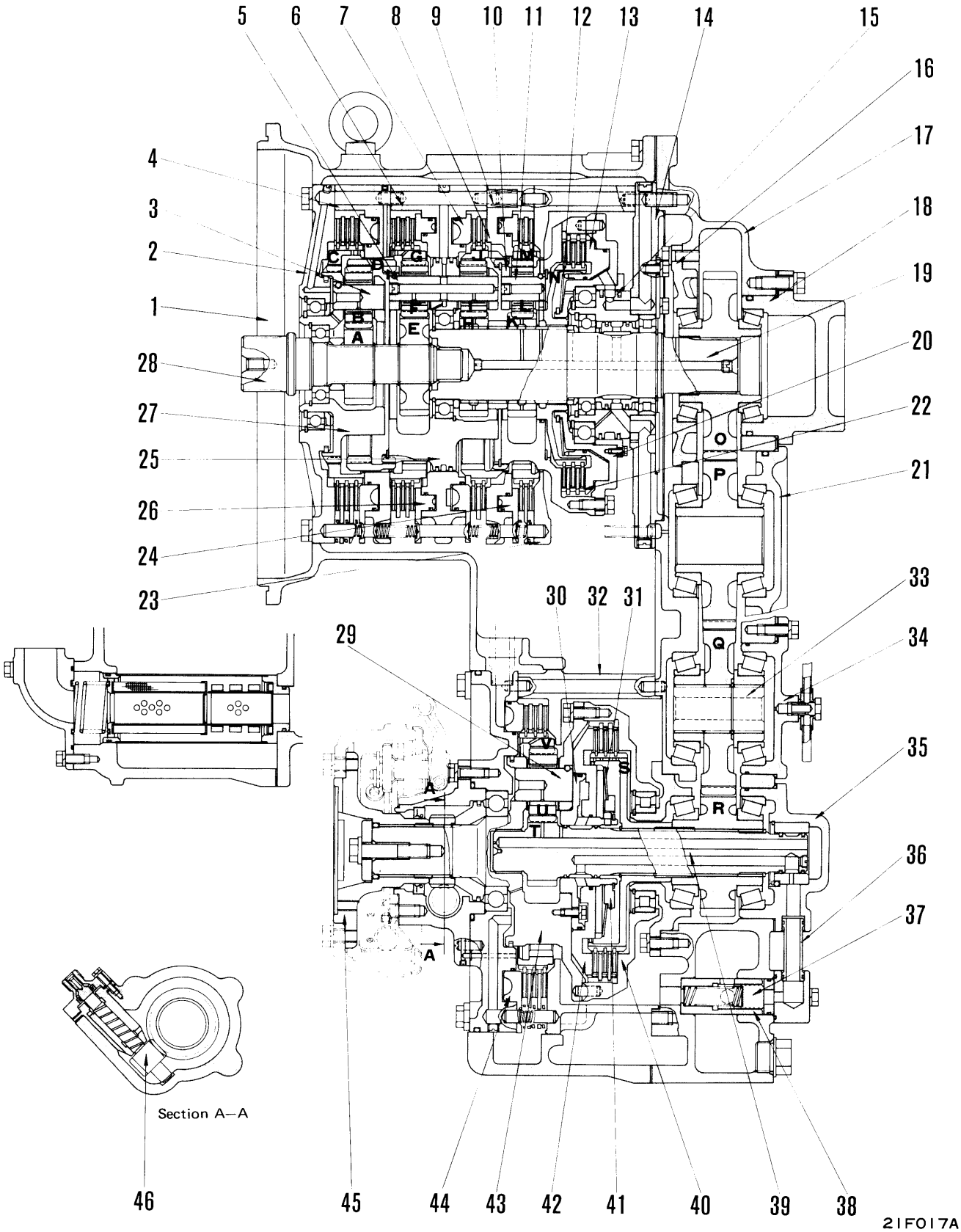
Section B – B

F23404009

3. Gear (35 teeth)
4. Gear (57 teeth)
5. Flywheel (137 teeth)
6. Bolt
7. Gear
8. Housing
9. Gear (52 teeth)
10. Gear
11. Snap ring
12. Bearing
13. Cover
14. Gear
15. Snap ring
16. Bearing

HYDROSHIFT TRANSMISSION

GD705R-4



Model GD705R-4 are equipped with planetary type transmission (F6, R6) and is a combination of planetary gear system and disc clutch.
For each revolution direction and rpm, three of 7 disc clutchs of the planetary gear system are hydraulically locked by acutating the control valve.
The R clutch is for reverse travel and F clutch for forward travel. The correspondence between clutch combinations and speeds are as follows:

Clutch		Speed	Clutch		Speed
L	1st	1st speed	H	1st	4th speed
	2nd	2nd speed		2nd	5th speed
	3rd	3rd speed		3rd	6th speed

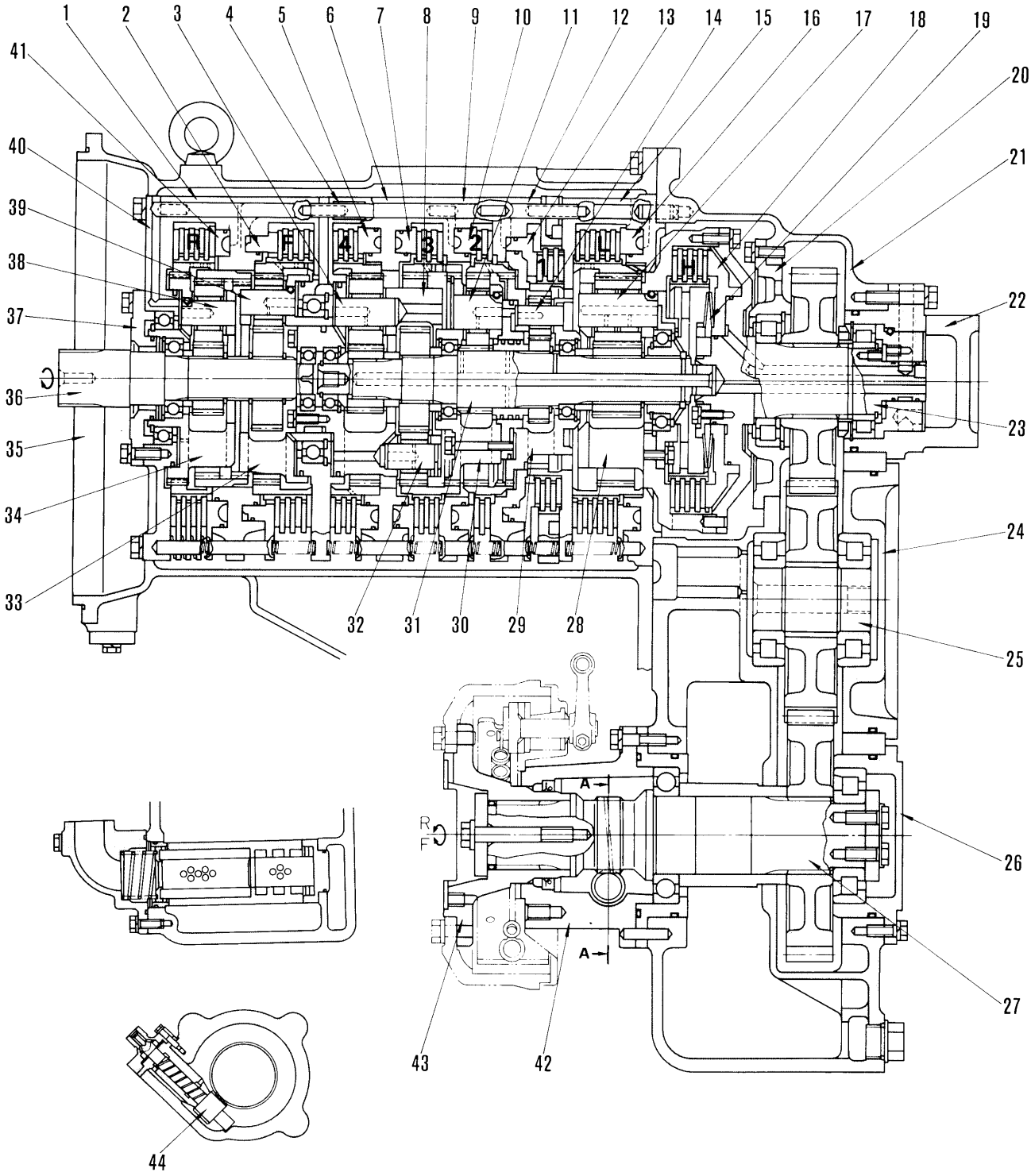
	Reduction ratio				Each speed ratio
	R.F.3.2.1	T/F	H.L	Total reduction ratio	
F1	3.000	0.688	L 4,167	8.601	1.800
F2	1.667			4.779	1.667
F3	1.000			2.867	1.389
F4	3.000		H 1,000	2.064	1.800
F5	1.667			1.147	1.667
F6	1.000			0.688	
R1	−2.536		L 4,167	−7.290	1.800
R2	−1.409			−4.039	1.667
R3	−0.845			−2.403	1.389
R4	−2.536		H 1,000	−1.745	1.800
R5	−1.409			−0.969	1.667
R6	−0.845			−0.581	

1. Case
2. Gauge
3. R. planetary pinion shaft
4. R. housing
5. F. 3rd, planetary pinion shaft
6. F, housing
7. 3rd piston
8. 2nd housing
9. Sleeve
10. 2nd carrier
11. 2nd planetary pinion shaft
12. 1st spring
13. 1st piston
14. 1st housing
15. Cage
16. Cage
17. Transfer case
18. Cage
19. Shaft
20. Cage
21. Cage
22. 1st spring
23. 1st housing
24. 2nd piston
25. 3rd, F, carrier
26. F. piston
27. R. carrier
28. Input shaft
29. L. planetary pinion shaft
30. Cage
31. Spring
32. Housing
33. Shaft
34. Cage
35. Cage
36. Sleeve
37. Valve
38. Sleeve
39. Shaft
40. H. drum
41. Cage
42. H. piston
43. L. carrier
44. L. piston
45. Coupling
46. Shaft

A. R. sun gear (28 teeth)
B. R. planetary pinion (21 teeth)
C. R. ring gear (71 teeth)
D. R. ring gear (71 teeth)
E. F. sun gear (38 teeth)
F. F. planetary pinion (17 teeth)
G. F. ring gear (76 teeth)
H. 3rd sun gear (38 teeth)
I. 3rd planetaly pinion (19 teeth)
J. 3rd ring gear (76 teeth)
K. 2nd sun gear (38 teeth)
L. 2nd planetaly pinion (19 teeth)
M. 2nd ring gear (76 teeth)
N. 1st gear (75 teeth)
O. Gear (32 teeth)
P. Gear (31 teeth)
Q. Gear (30 teeth)
R. Gear (22 teeth)
S. H. gear
T. L. sun gear
U. L planetary pinion
V. L ring gear

HYDROSHIFT TRANSMISSION

GD705A-4



F23E010

The GD705A has a planetary type transmission which combines a planetary gear mechanism and disc clutch for 8 forward speeds and 8 reverse speeds.
Out of the 8 sets of planetary gear type disc clutches, 3 clutches are fixed by oil pressure via the control valve to select one revolving direction and one revolving speed. The R clutch is for reverse travel and F clutch for forward travel. The correspondence between clutch combinations and speeds are as follows:

Clutch		Speed	Clutch		Speed
L	1st	1st speed	H	1st	5th speed
	2nd	2nd speed		2nd	6th speed
	3rd	3rd speed		3rd	7th speed
	4th	4th speed		4th	8th speed

Reduction ratio / Speed stage	Reduction ratio			Each speed ratio
	RF4321LH	T/F	Total reduction ratio	
F1	7.823	1.103 (32/29)	8.637	1.349
F2	5.798		6.398	1.465
F3	3.958		4.367	1.435
F4	2.758		3.043	1.383
F5	1.994		2.200	1.349
F6	1.478		1.631	1.465
F7	1.009		1.113	1.435
F8	0.703		0.776	
R1	7.341		8.100	1.349
R2	5.440		6.003	1.465
R3	3.714		4.098	1.435
R4	2.588		2.856	1.383
R5	1.871		2.065	1.349
R6	1.387		1.530	1.465
R7	0.947		1.045	1.435
R8	0.660		0.728	

1. F, R housing
2. F piston
3. 4th planetary pinion shaft
4. Sleeve
5. 4th piston
6. 4th, 3rd housing
7. 3rd piston
8. 3rd, 4th carrier
9. 2nd housing
10. 2nd piston
11. 2nd planetary piston shaft
12. 1st housing
13. 1st piston
14. 1st planetary pinion shaft
15. L housing
16. L piston
17. L planetary pinion shaft
18. H piston
19. Spring
20. Cage
21. Transfer case
22. Cage
23. Shaft
24. Cage
25. Shaft
26. Cage
27. Output shaft
28. L carrier
29. 1st carrier
30. 2nd carrier
31. Shaft
32. 3rd planetary pinion shaft
33. F carrier
34. R carrier
35. Housing
36. Input shaft
37. Cage
38. R planetary pinion shaft
39. F planetary pinion shaft
40. Cover
41. R piston
42. Cage
43. Coupling
44. Shaft

PLANETARY GEAR SYSTEM

Planetary gear system (structure)

The planetary gear mechanism consists of sun gear **A**, planetary pinion **B**, ring gear **C** and carrier **D**.

The planetary pinion is supported by the carrier and meshes with the sun gear and the ring gear.

When the ring gear is fixed,

The sun gear **A** revolutions are transmitted to the planetary pinions **B**.

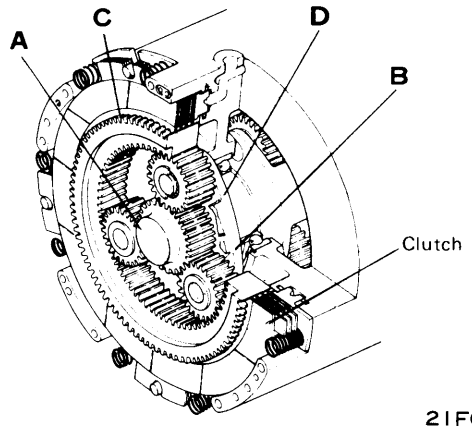
The planetary pinions are meshed with the ring gear **C**. Since the ring gear is fixed, it cannot revolve as it is. Therefore, the planetary pinions revolve on their axes while revolving around the sun gear along the ring gear. At this time the torque of the sun gear becomes carrier **D** torque and is transmitted. The direction of rotation of the carrier is the same as that of the sun gear.

When the carrier is fixed,

The sun gear **A** revolutions are transmitted to the planetary pinions **B**.

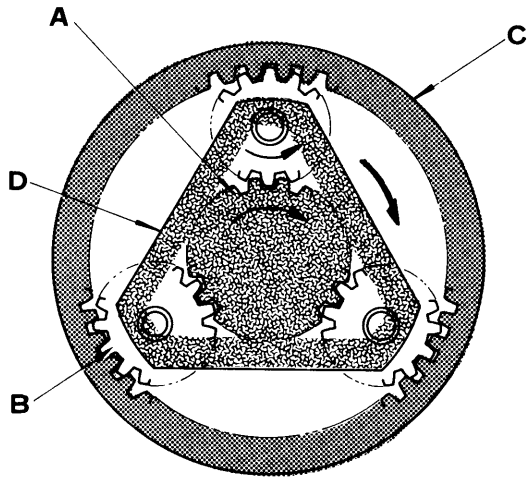
Because carrier **D** is fixed, the planetary pinions meshed with the sun gear revolve on their own axes at their positions. The ring gear **C** which is meshed with planetary pinions revolves in the opposite direction to the sun gear, and the sun gear torque becomes the torque of the ring gear and is transmitted.

Combination such as → Sun gear → Planetary pinion → Ring gear or carrier, is the structure of R.F. 3rd, 2nd, L clutches. However, for R clutch, the sun gear becomes the power source and transmits power to the ring gear, and for F, L clutch, the sun gear is the power source and transmits power to the carrier, and for 3rd and 2nd clutches the carrier is the power source and transmits power to 3rd and 2nd sun gears.

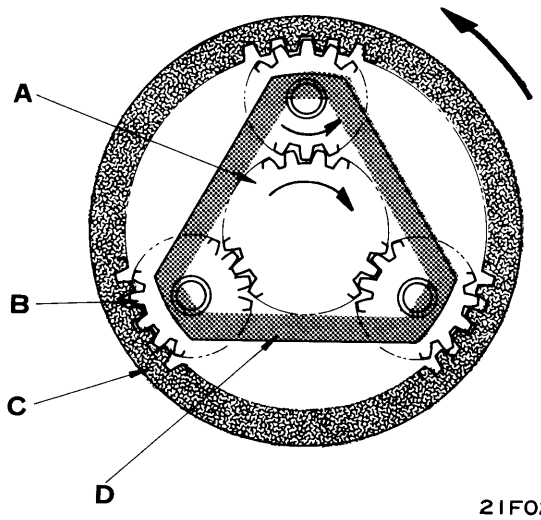


21F018

A. Sun gear
B. Planetary pinion
C. Ring gear
D. Planetary carrier



21F019



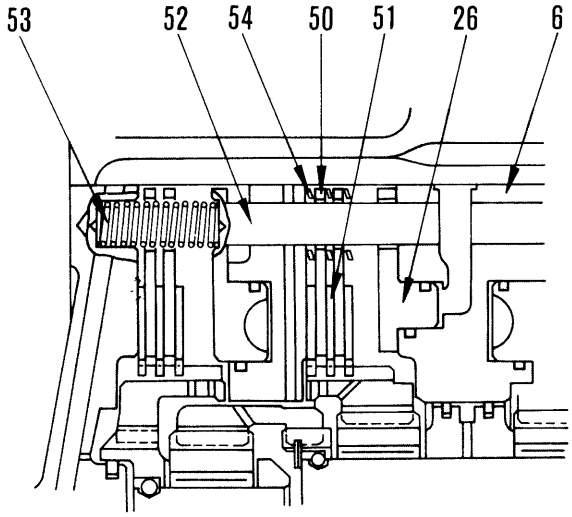
21F020

DISC CLUTCH

In order to fix the ring gear a disc clutch made up of piston (26), plate (50), disc (51), pin (52), piston return spring (53), washer spring (54), etc., is installed. The internal teeth of the disc mesh with the external teeth of the ring gear.

The plate is fixed in the direction of rotation by the meshing of the notched protrusions of the outer diameter and pins (52) fixed into the housing (6).

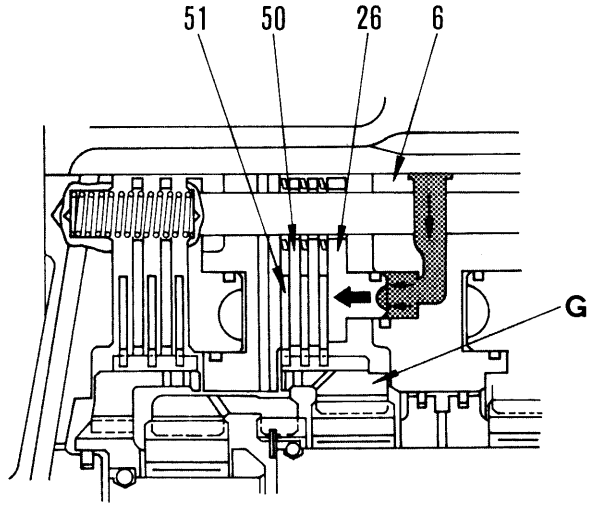
The piston is also fixed in the direction of rotation in the same way.



21F023

Clutch "**ENGAGED**" (Fixed)

Hydraulic oil from the control valve passes through the port of the housing (6) and transmits pressure to the back of the piston (26). The piston presses disc (51) and plate (50) and the friction stops the disc rotation, resulting in fixing ring gear **G** which is meshing with the interior teeth of the disc.

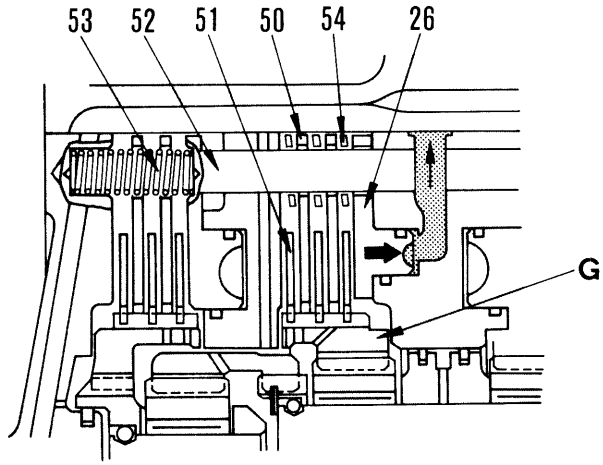


21F024

Clutch "**DISENGAGED**" (Released)

When the hydraulic oil from the control valve is interrupted, the piston return spring (53) acts to return the piston (26) to its original position, the plate (50) and disc (51) friction is released and the ring gear **G** becomes neutral.

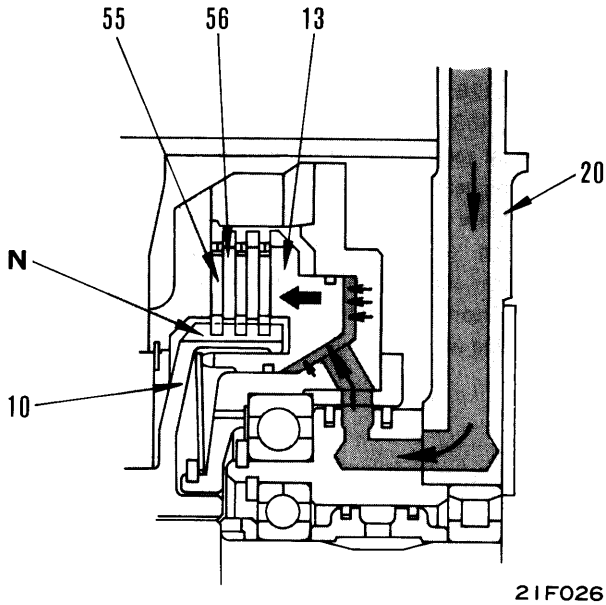
The washer spring (54) installed between the pin (52) and the plate acts to return the piston more quickly when the clutch is disengaged, improve plate and disc separation and prevent the disc drag rotation.



21F025

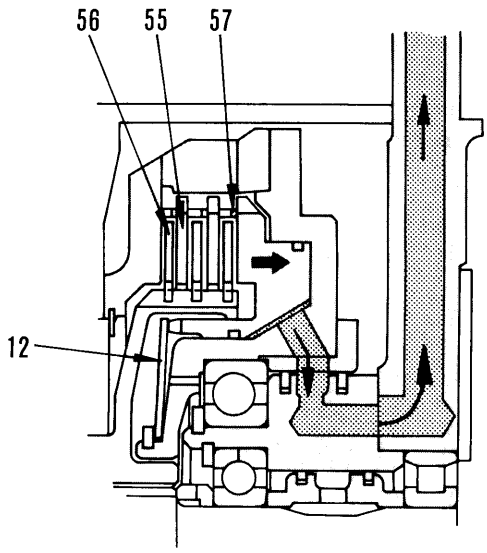
ROTARY CLUTCH

Clutch **"ENGAGED"** (Fixed)
Hydraulic oil from the control valve goes to the back of the piston (13) through the port of the cage (20).
The piston force-presses disc (55) and plate (56).
The clutch is engaged by meshing the internal teeth of the disc and the external teeth of the gear **N** and the external teeth of the plate and the internal teeth of the drum (2nd carrier, (10)).
The gear and drum become one unit and revolve.



21F026

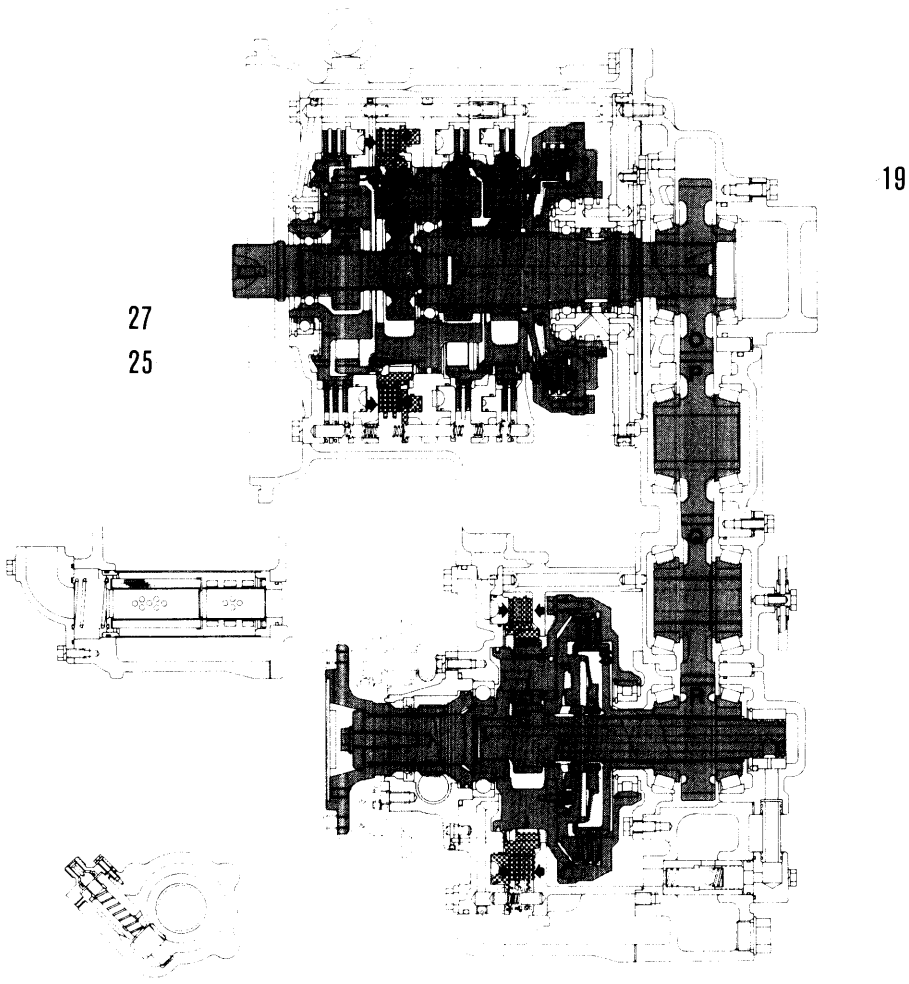
Clutch **"DISENGAGED"** (Released)
When the hydraulic oil from the control valve is interrupted the piston is returned by the disc spring (12). On the other hand, when the piston is returned to its original position, and the clutch is disengaged, the wave spring (57) between plates (56) separates plate and disc (55) completely, and prevents drag rotation.



21F027

FUNCTION (GD705R-4)

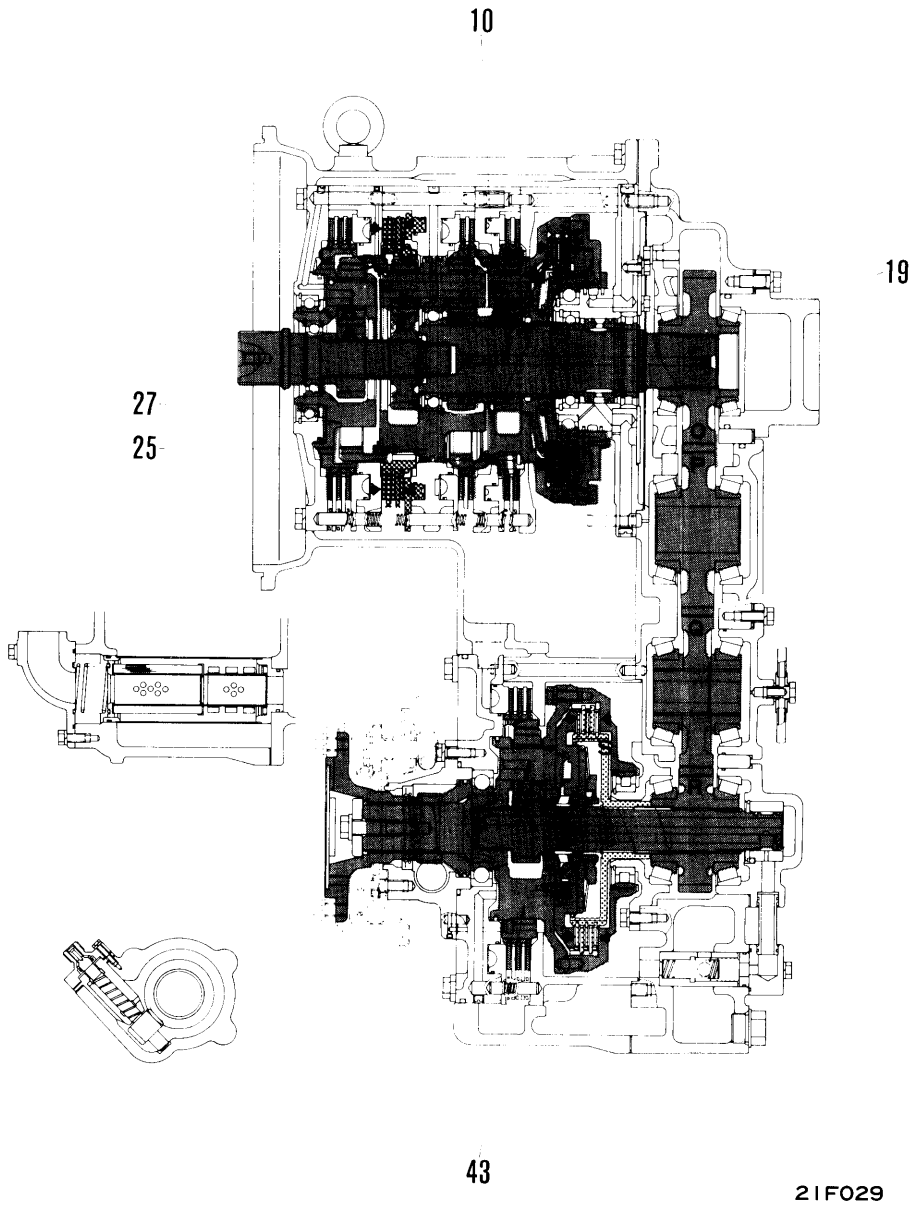
FORWARD 1st GEAR (F, 1st, L)



Power is transmitted from F sun gear **E** to F planetary pinion **F**.
Because F ring gear **G** is fixed, F planetary pinion revolves around F sun gear while revolving on its axis. F carrier (25) (one with 3rd carrier) to revolve it in the same direction as F sun gear.
Furthermore, because 1st clutch has been engaged 1st gear **N**, 2nd carrier (10) and 3rd ring gear **J** become one unit.

In this condition, F carrier (one with 3rd carrier) is revolving and 3rd sun gear **H**, 2nd sun gear **K**, 1st clutch, 2nd carrier and 3rd ring gear revolve as one unit, power is transmitted to revolve output shaft (19) in the same direction as F sun gear.
Furthermore, power is transmitted through gears **O**, **P**, **Q**, **R**, to **HL** transmission, and because L clutch is fixed, power is transmitted to the output shaft through L planetary pinion **U** and L carrier (43).

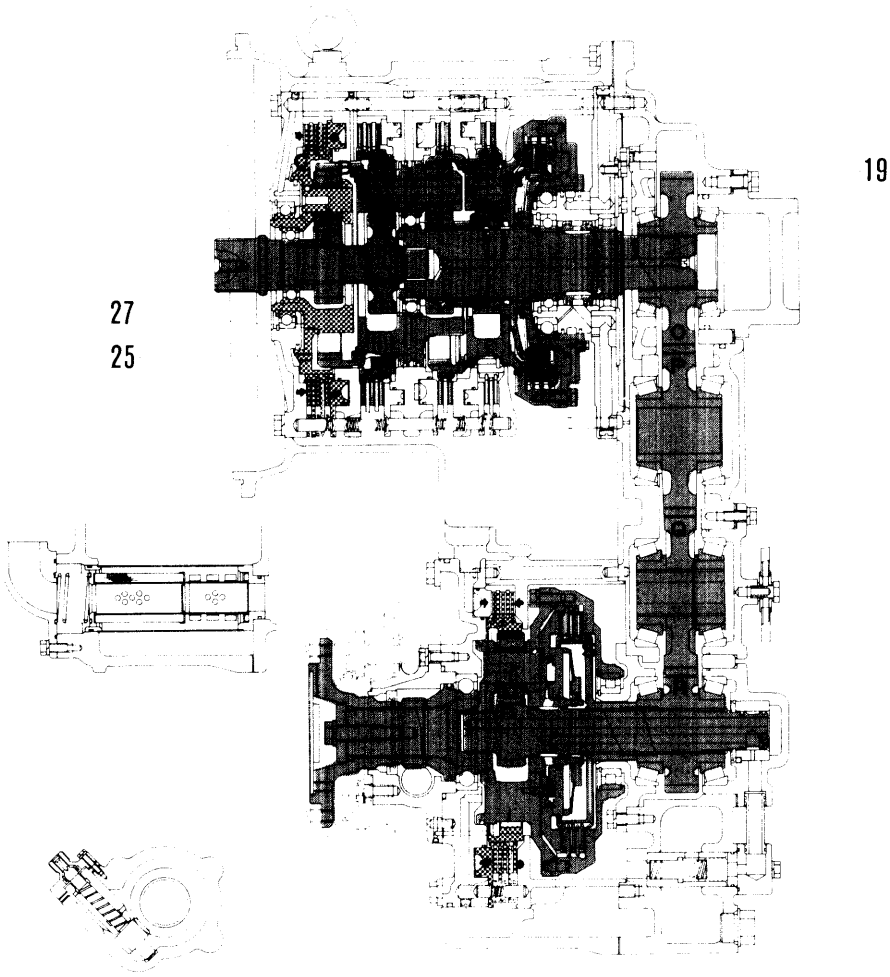
FORWARD 4th GEAR (F, 1st, H)



Transmission of power to the input shaft of H-L clutch is exactly the same as for Forward 1st gear, so see previous page.

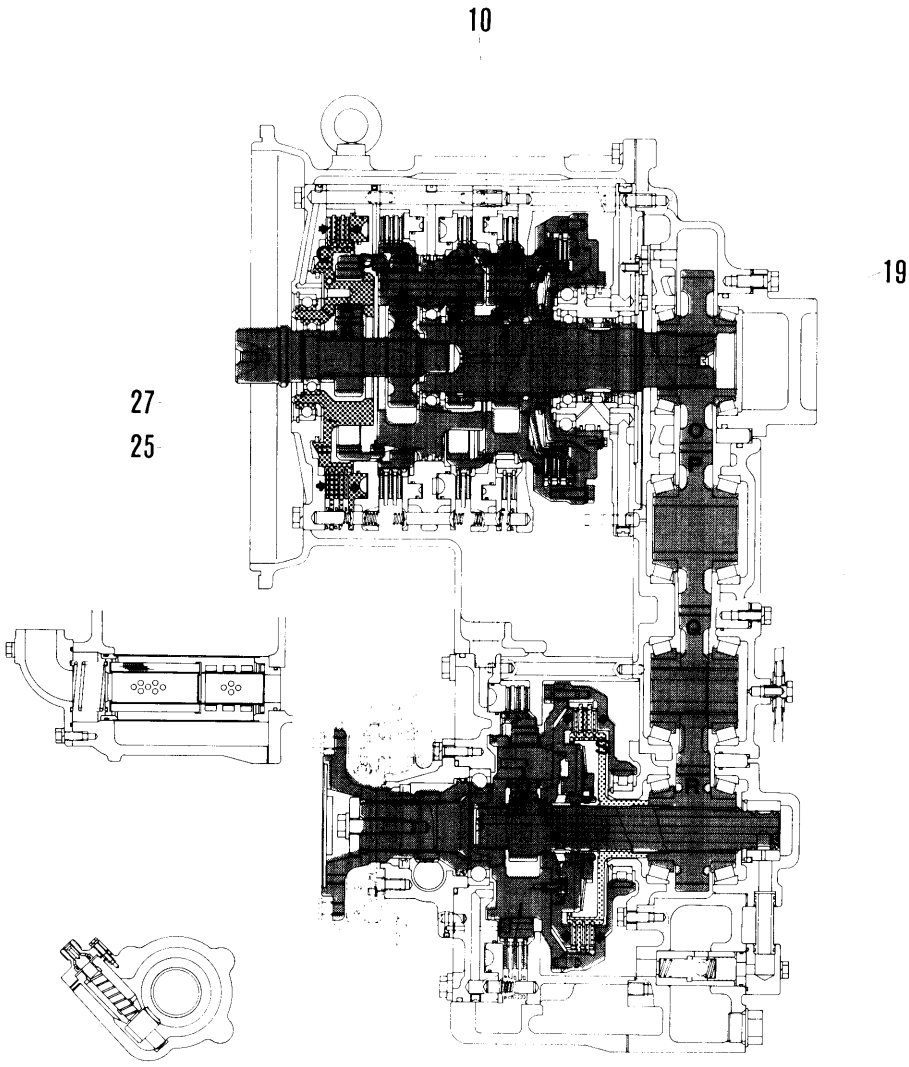
Power from the input shaft of H-L clutches is transmitted so that the output shaft revolves in the same direction and at the same speed as the input shaft, because when H clutch is engaged, L carrier, L ring gear and H clutch become one unit.

REVERSE 1st GEAR (R, 1st, L)



Power is transmitted from R sun gear **A** to R planetary pinion **B**.
Because R ring gear **C** is fixed by R clutch, R carrier (20) is also fixed.
Because of this R planetary pinion revolves on its axis. R ring gear **D** revolves in the opposite direction to R sun gear. At this time power is transmitted to revolve F carrier (25) in the opposite direction to the input shaft revolution because it is one with R ring gear.
Transmission of power after this is the same as with Forward 1st gear.

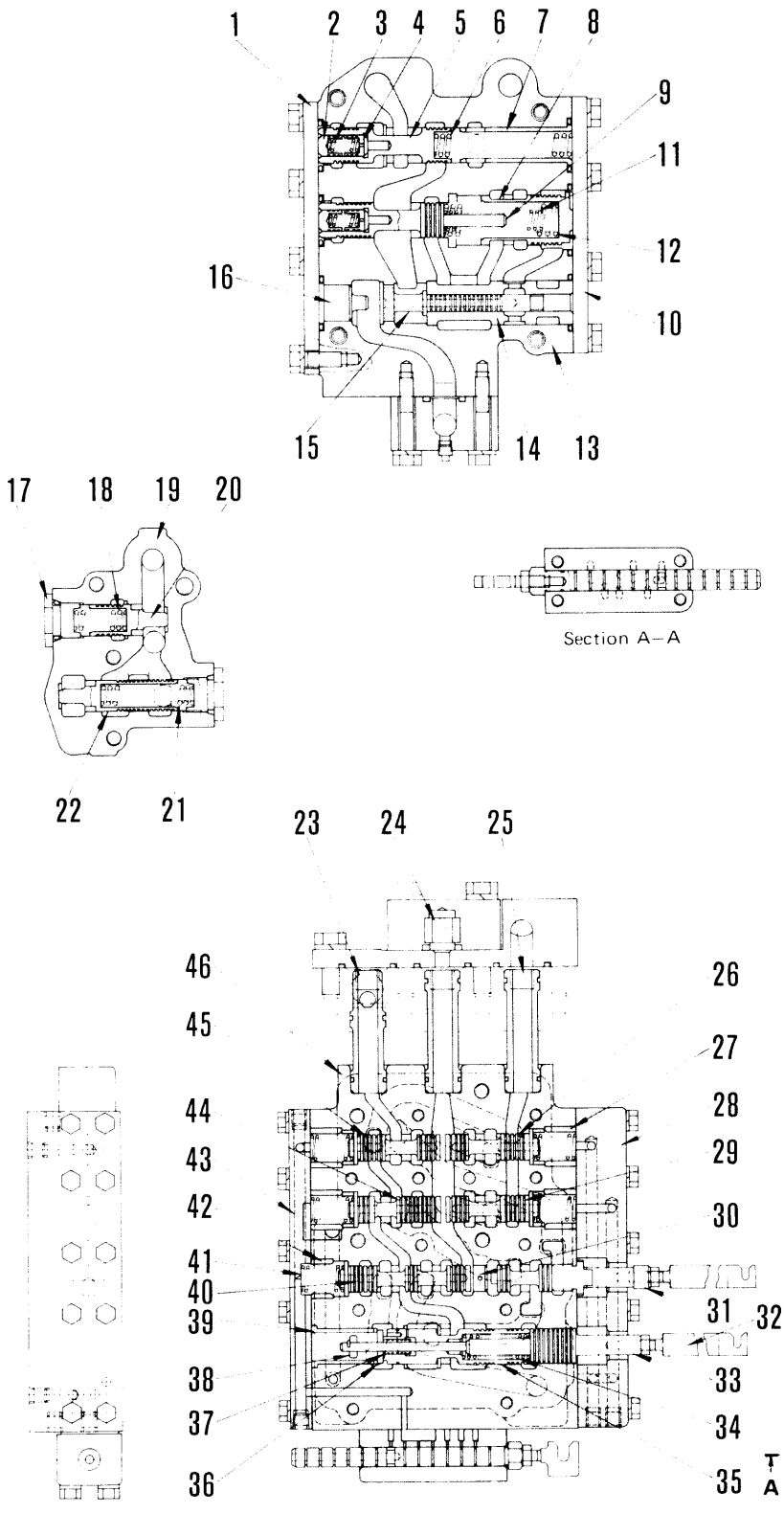
REVERSE 4th GEAR (R, 1st, H)



Power to the transfer input shaft is exactly the same as reverse 1st gear.
Furthermore, it is transmitted through the transfer to the H-L clutches. Power from the H-L clutches is transmitted to the output shaft to revolve it in the same direction and at the same speed as for forward 4th gear.

HYDROSHIFT TRANSMISSION CONTROL VALVE

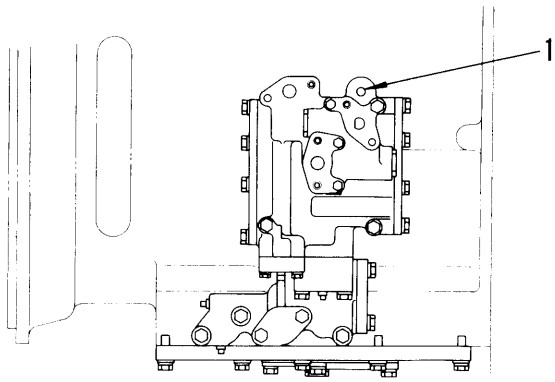
GD705R-4

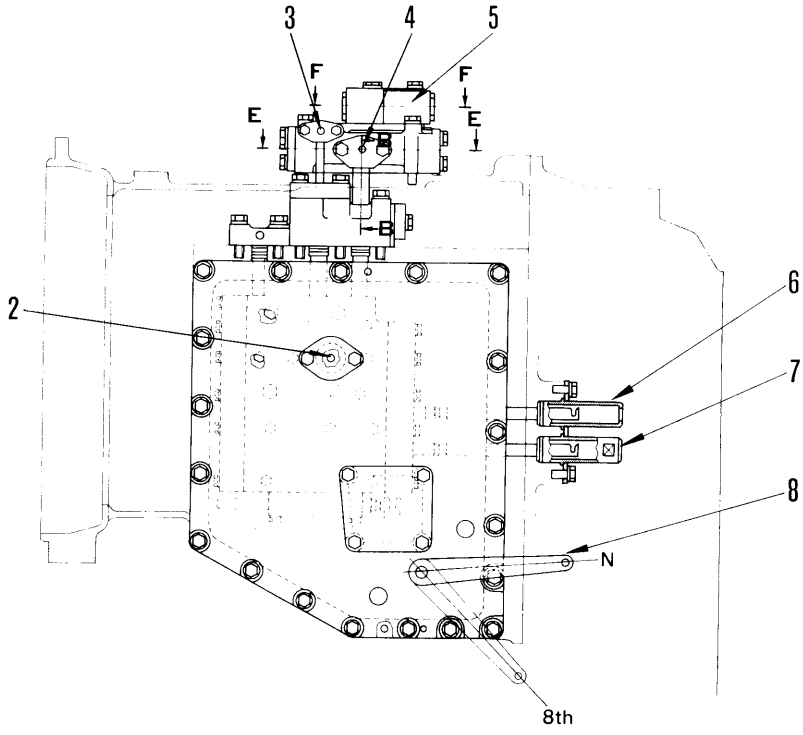


1. Cover
2. Valve
3. Spring
4. Valve
5. Priority valve
6. Spring
7. Stopper
8. Valve
9. Modulating valve
10. Cover
11. Spring
12. Spring
13. Valve body
14. Sleeve
15. Quick return valve
16. Stopper
17. Plug
18. Spring
19. Valve body
20. Lubricating valve
21. Spring
22. Cooler bypass valve
23. Sleeve
24. Strainer
25. Sleeve
26. 3rd shift valve
27. Stopper
28. Cover
29. 2nd shift valve
30. Stopper
31. F-R spool
32. Yoke
33. Inching valve spool
34. Spring
35. Inching valve
36. Washer
37. Sleeve
38. Seat
39. Stopper
40. H-L shift valve
41. Spring
42. Stopper
43. Cover
44. Cutoff valve
45. 1st shift valve
46. Valve body

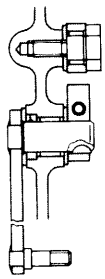
HYDROSHIFT TRANSMISSION CONTROL VALVE (1/2)

GD705A-4

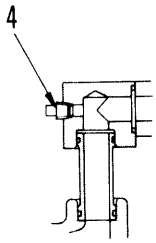




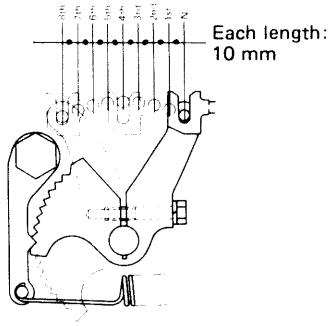
1. Lubrication oil pressure measuring plug
2. Inching oil pressure measuring plug
3. Pilot oil pressure measuring plug
4. Main oil pressure measuring plug
5. Relief valve (Lubrication and cooler by-pass)
6. Shift valve lever (for F.R)
7. Shift valve lever (for Inching)
8. Speed select control lever



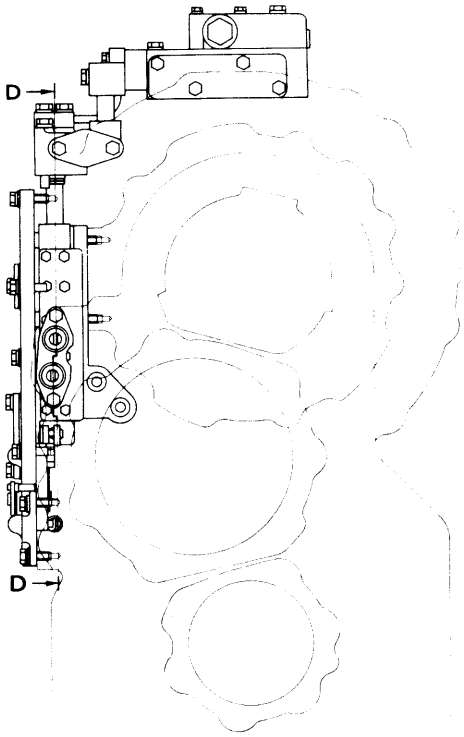
Section A-A

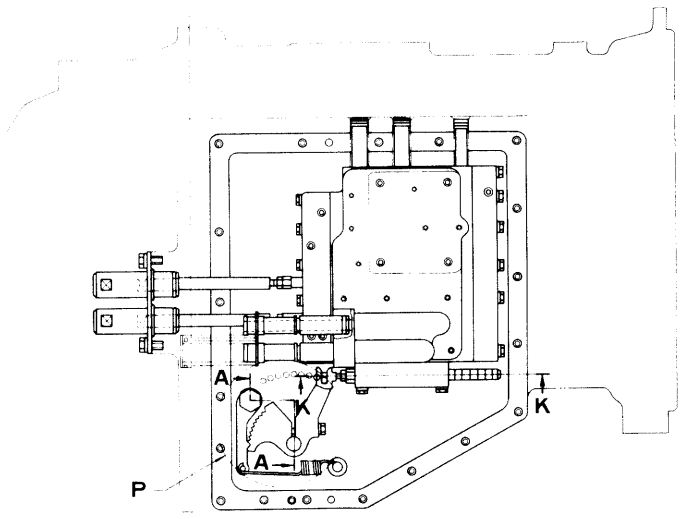


Section B-B



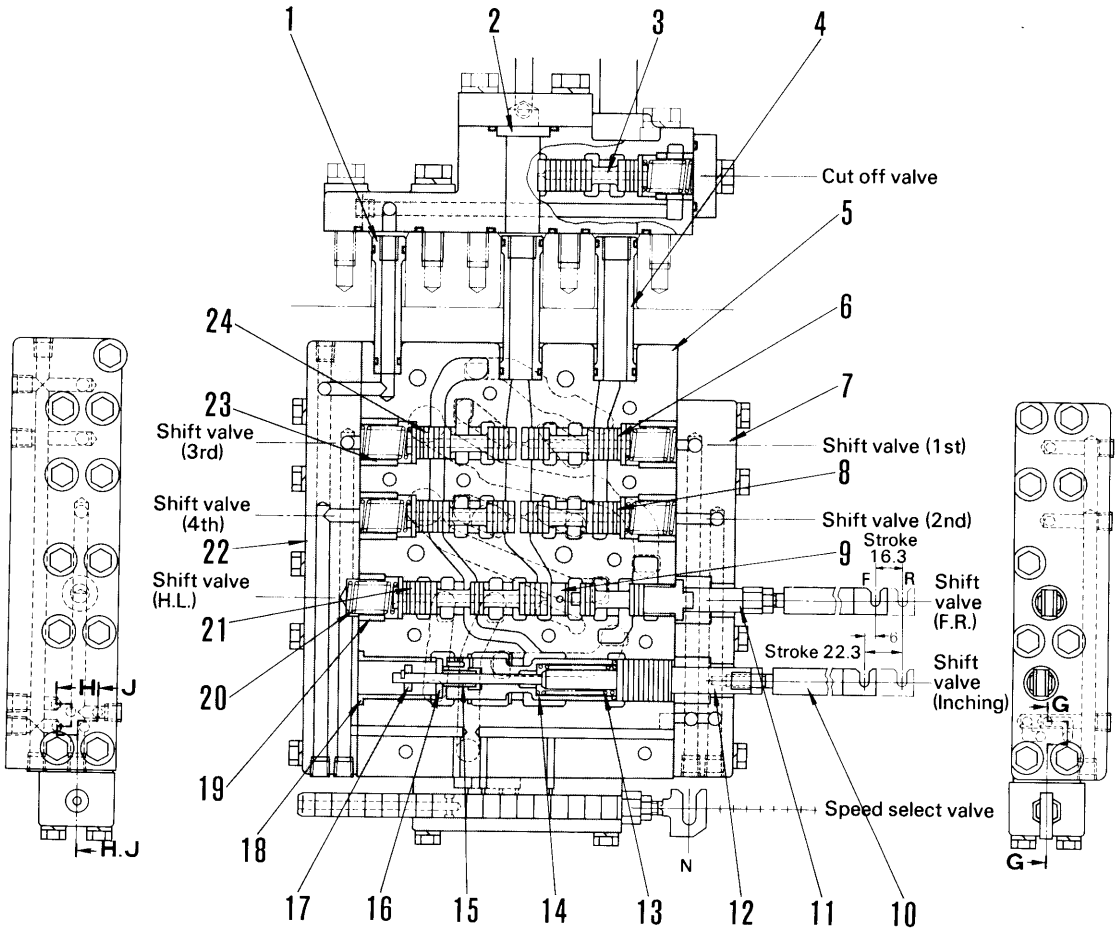
Detail P



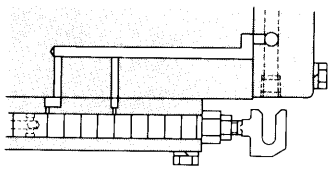


Section D-D

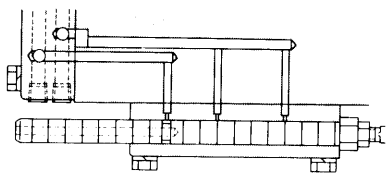
234F1107



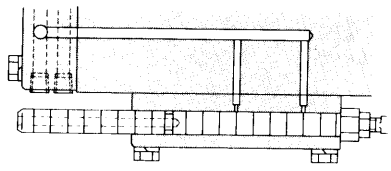
Section D-D



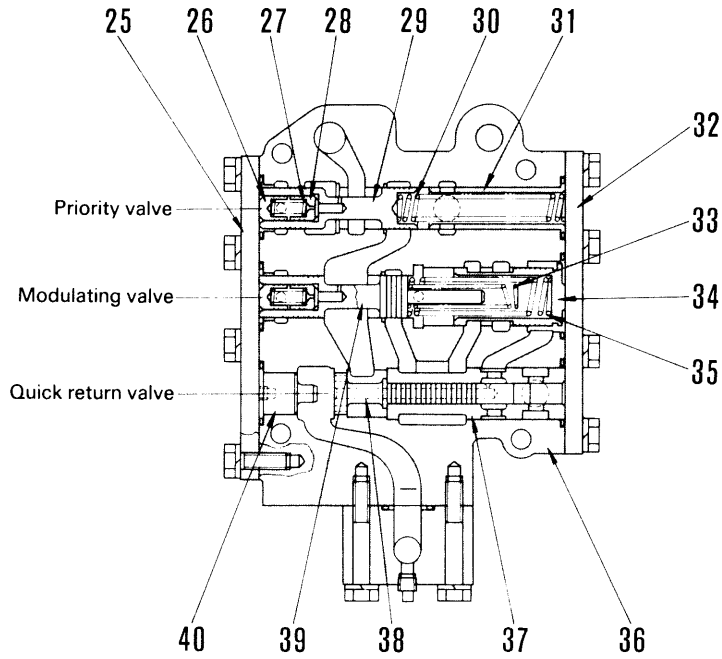
Section G-G



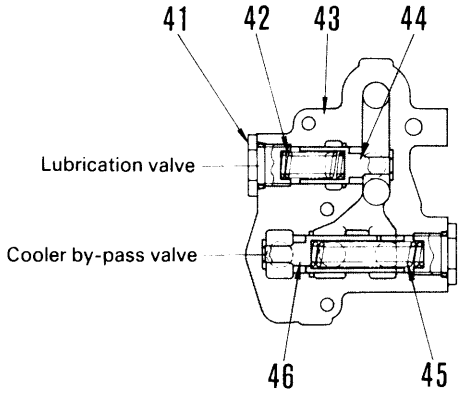
Section H-H



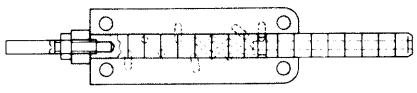
Section J-J



Section E-E



Section F-F



Section K-K

F23E016

1. Sleeve
2. Sleeve
3. Valve
4. Sleeve
5. Valve body
6. Shift valve (1st)
7. Valve body
8. Shift valve (2nd)
9. Stopper
10. Yoke
11. Shift valve (F,R)
12. Shift valve (Inching)
13. Spring
14. Valve
15. Sleeve
16. Washer
17. Stopper
18. Sleeve
19. Sleeve
20. Spring
21. Shift valve (H,L)
22. Valve body
23. Sleeve
24. Shift valve (3rd)
25. Cover
26. Valve
27. Spring
28. Valve
29. Priority valve
30. Spring
31. Sleeve
32. Cover
33. Spring
34. Valve
35. Modulating valve
36. Valve body
37. Sleeve
38. Quick return valve
39. Modulating valve
40. Stopper
41. Plug
42. Spring
43. Valve body
44. Lubrication valve
45. Spring
46. Cooler bypass valve

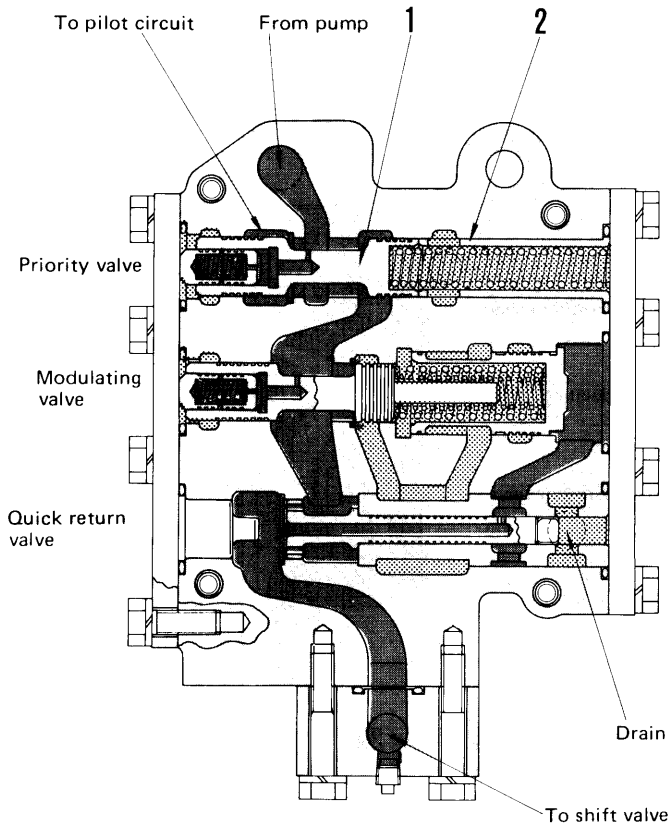
Control position	N	1st	2nd	3rd	4th	5th	6th	7th	8th
Shift valve	Cut off	L 1st	L 2nd	L 3rd	L 4th	H 1st	H 2nd	H 3rd	H 4th

PRIORITY VALVE

FUNCTION

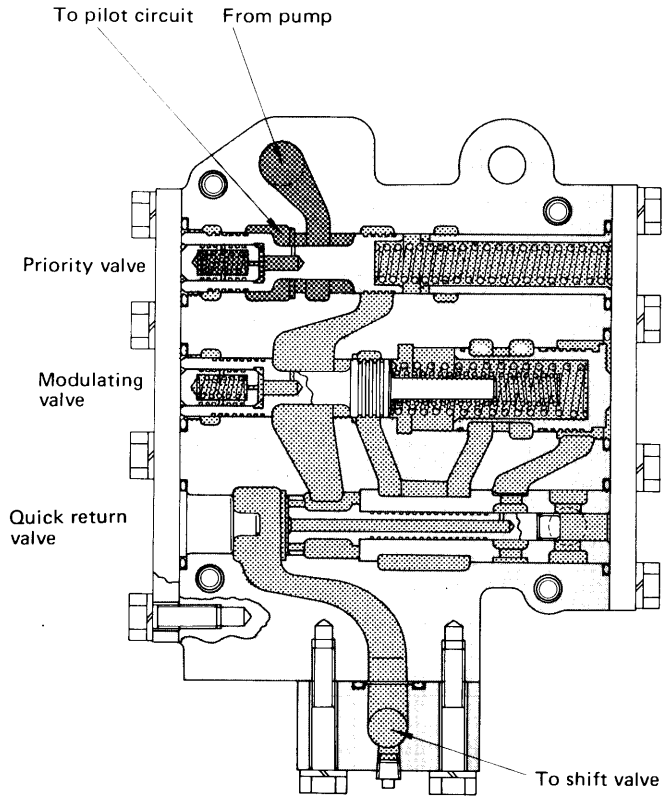
The priority valve keeps the hydraulic pressure (shift valve operation hydraulic pressure) of the pilot circuit constant at the specified pressure if the main circuit hydraulic pressure decreases, to ensure operation of the gear shift valve.

1. **When neutral**
   The priority valve (1) is a relief valve with a set pressure of 14 kg/cm^2.
   When there is no gear changing, the pilot circuit hydraulic pressure (shift valve hydraulic oil pressure) is the same as the main circuit hydraulic pressure: 25 kg/cm^2. The priority valve is in contact with the stopper.



21F033

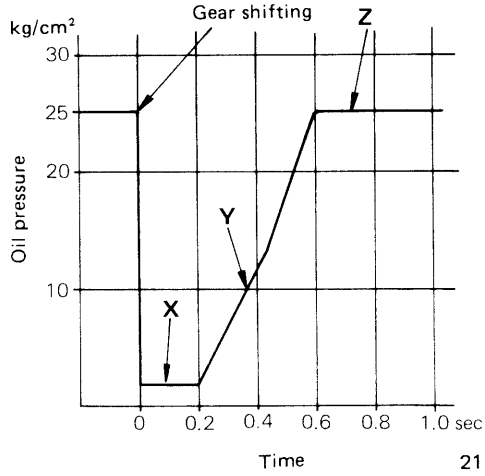
2. **During gear changing**
   When the main circuit oil pressure goes down below 14 kg/cm^2. the pilot circuit oil pressure is maintained at 14 kg/cm^2 by the priority valve and the shift valve can reliably function.



21F034

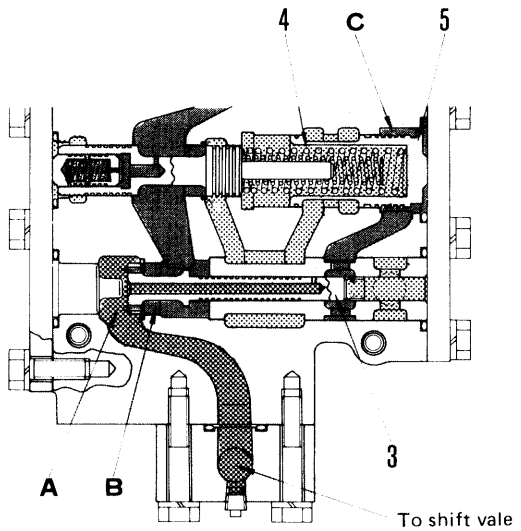
MODULATING VALVE AND QUICK RETURN VALVE

The modulating valve and the quick return valve smoothly raise the main oil pressure when gear changing. By operating the clutch, shock at driving gear changing is eliminated and the production of peak torque in the power line is prevented.



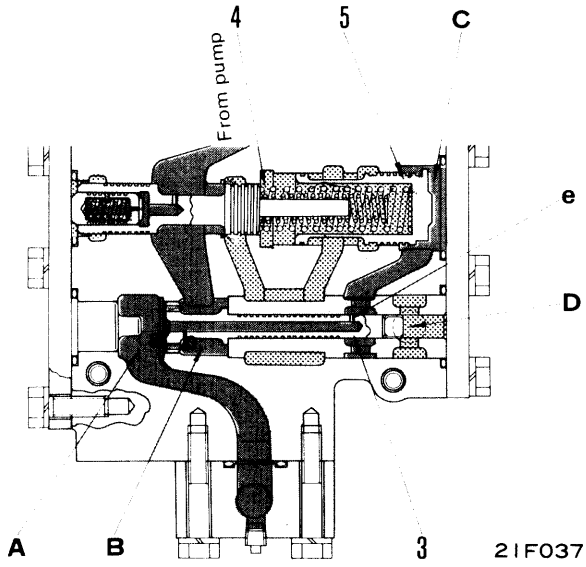
21F022A

1) **Immediately after gear changing (X point)**
Immediately after changing gears the main circuit (from the pump) oil flows into the piston of the operating clutch.
Due to the flow of oil at this time, a difference in pressure is produced in the A-chamber and the B-chamber of the quick return valve (3), and the quick return valve moves to the left. At this time, the C-chamber of the modulating valve load piston port is connected to the drain circuit. By the force of the spring (4) the modulating load piston (5), while draining the oil which has filled the C-chamber of the load piston port, returns to stroke end (right edge).



21F036

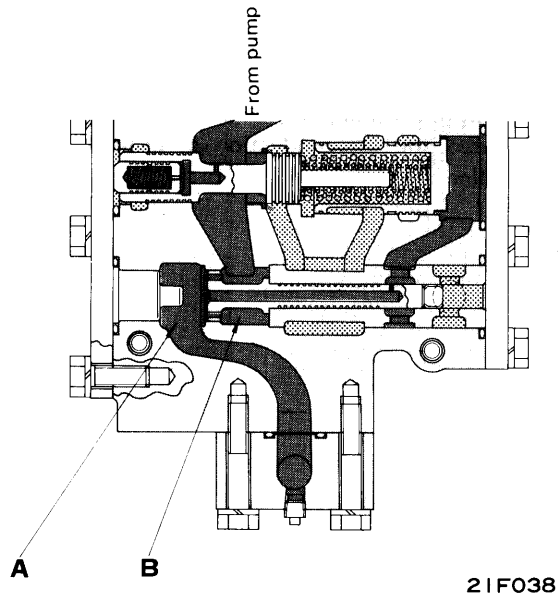
2) **While raising pressure (Y point)**
When the clutch piston fills with oil, the flow of oil almost completely stops. The pressure of the A-chamber and B-chamber of the quick return valve (3) is almost the same. Due to this, the pressure difference (a > b) on the surface and b surface of the quick return valve causes the quick return valve to return the right. The circuit to the drain port D-chamber of the modulating valve load piston closes. At the same time the oil passed through the orifice (e) of the quick return valve pushes the modulating valve load piston (5) to the left. Then, due to the movement of the load piston, the spring (4) contracts and the relief pressure of the modulating valve gradually rises.



21F037

3) At set pressure (25kg/cm^2) (Z point)

When the modulating valve load piston touches the stopper, the increase in the oil pressure ceases. At this time the relief pressure is the set pressure (25kg/cm^2) of the modulating valve.



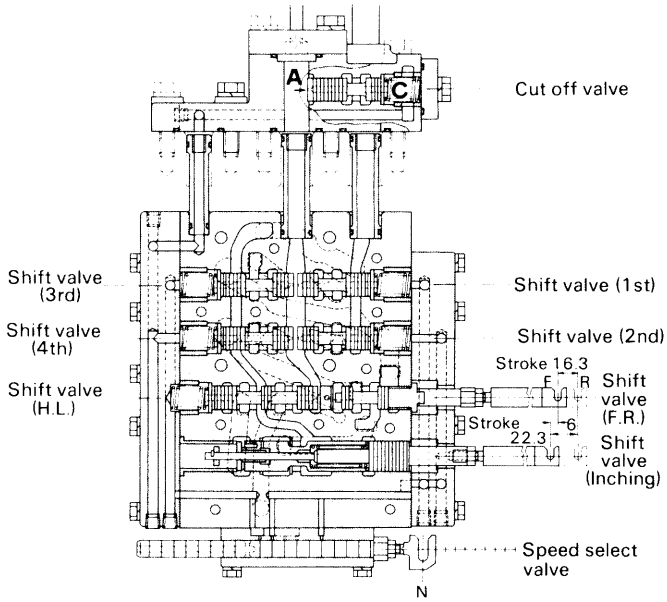
21F038

FUNCTION (GD705A-4)

SPEED STAGE CHANGING VALVE

1) At neutral

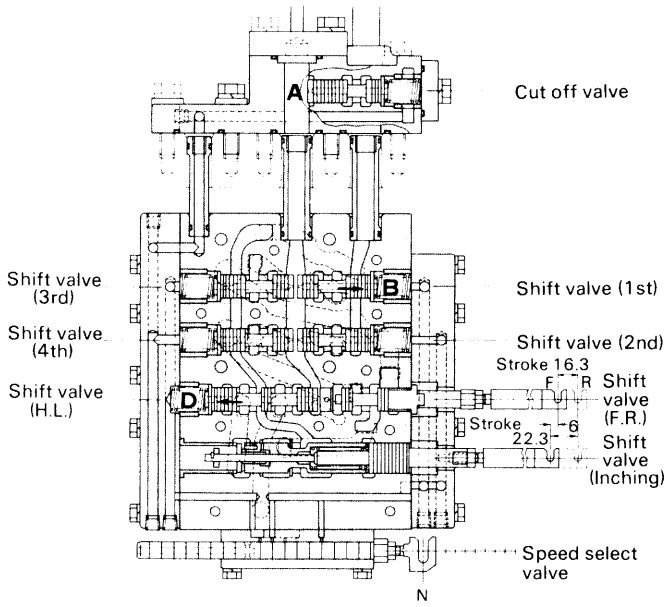
The pilot pressure applies on the A-chamber of the cutoff valve and because the C-chamber connects with the drain circuit, the spool moves to the right due to the difference in pressure between the A-chamber and the C-chamber. The oil from the pump does not operate each clutch, but lubricates the transmission and PTO, and is drained into the transmission case.



F23E017

2) At forward 1st speed

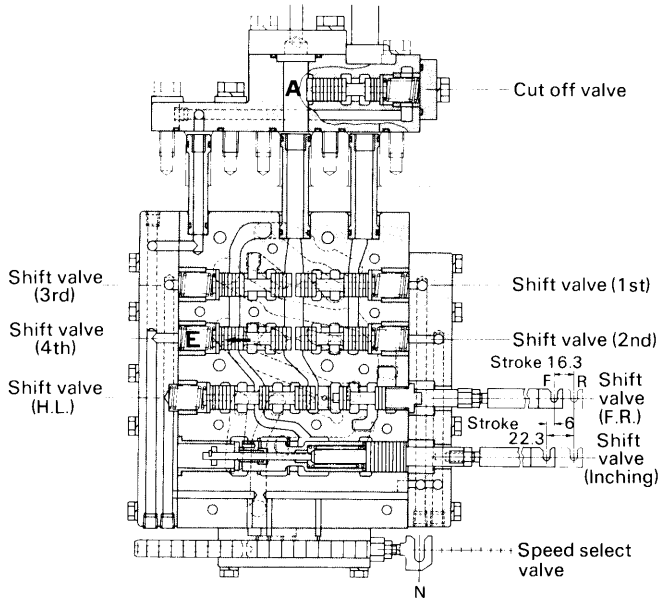
The B-chamber and D-chamber of the back pressure side of the shift valve (1st) (H.L) are each connected to the drain circuit and so a difference in pressure arises in the A-chamber and B-chamber, and the A-chamber and D-chamber. The 1st spool is pushed to the right and the H.L spool is pushed to the left and since the F.R spool is set in the F position, the oil from the pump is led to the 1st, L, F clutch.



F23E018

3) Forward 8th speed

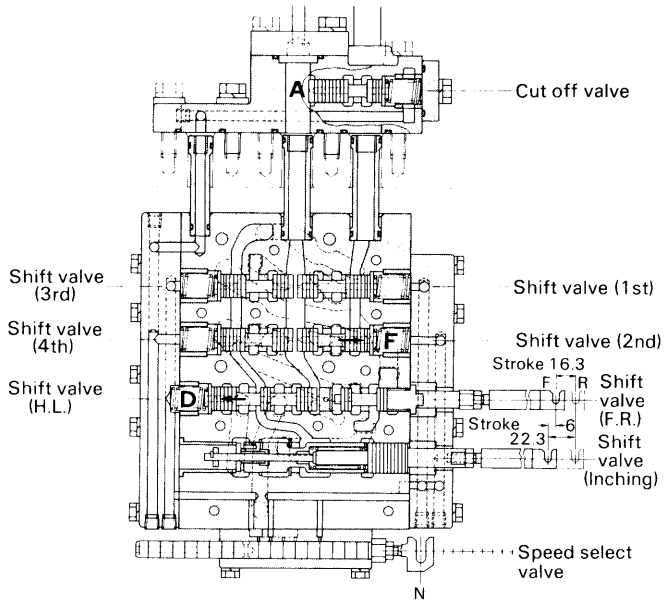
Since the E-chamber of the back pressure side of the shift valve (4th) is connected to the drain circuit, a pressure difference arises between A-chamber and E-chamber and the spool is pushed to the left. Since the F. R spool is set on the F position, the oil from the pump flows into the 4th, H, F clutch.



F23E019

4) At reverse 2nd speed

Because the back pressure side of the shift valve (2nd), (H.L) is connected to the drain circuit, a difference in pressure arises between the A-chamber and D-chamber, and the A-chamber and F-chamber. The H.L spool is pushed to the left and the 2nd spool is pushed to the right. Since the F.R spool is set in the R position, the oil from the pump is led to the 2nd, L, R clutch.



F23E020

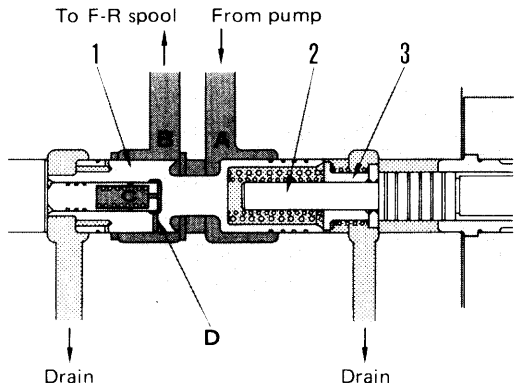
At other forward 2nd speed to 7th speed and reverse 1st speed and 3rd speed to 8th speed occur according to combinations in the above items 2 to 4. The combinations are as follows:

Forward 2nd speed:	2nd, L, F
Forward 3rd speed:	3rd, L, F
Forward 4th speed:	4th, L, F
Forward 5th speed:	1st, H, F
Forward 6th speed:	2nd, H, F
Forward 7th speed:	3rd, H, F
Forward 8th speed:	4th, H, F
Reverse 1st speed:	1st, L, R
Reverse 3rd speed:	2nd, L, R
Reverse 4th speed:	4th, L, R
Reverse 5th speed:	1st H, R
Reverse 6th speed:	2nd, H, R
Reverse 7th speed:	3rd, H, R
Reverse 8th speed:	4th, H, R

INCHING VALVE

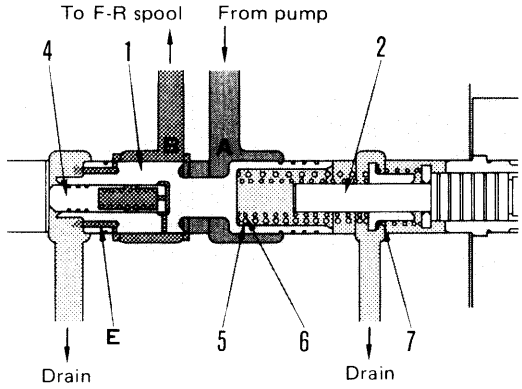
OPERATION

1. **Inching valve [OPEN]**
   The oil from the pump passes through ports **A** and **B**, and then goes from the F-R spool to the F-R clutch.
   The return spring of the inching pedal pushes valve spool (2) and collar (3), and moves valve (1) to the left. Oil passes through orifice **D** and enters chamber **C**. It acts to push valve (1) to the right, but because of the tension of the return spring, valve (1) does not move.



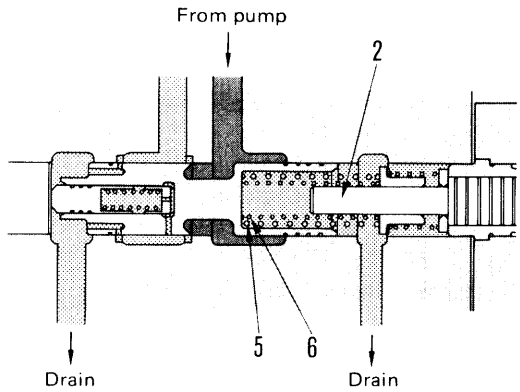
233F318

2. **Inching valve [THROTTLED]**
   When the inching pedal is depressed slightly, valve spool (2) moves to the right, so piston (4) pushes valve (1) to the right to a position where it balances the tension of springs (5), (6) and (7).
   In other words, the passage to port **B** is restricted, and orifice **E** is connected to the drain port, so the hydraulic pressure of the F-R clutch is reduced, and the clutch is partially disengaged.



233F319

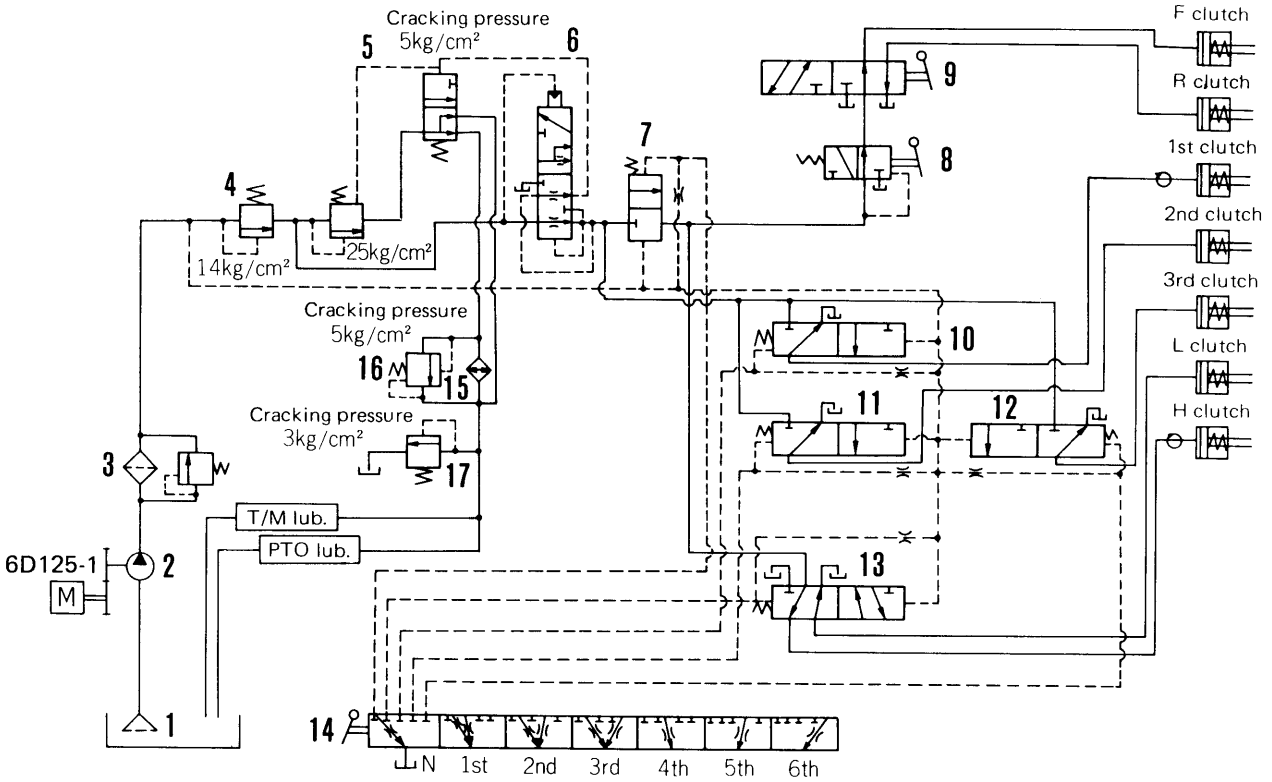
3. **Inching valve [CLOSED]**
   When the inching is depressed fully, valve spool (2) moves fully to the right, so the tension of springs (5) and (6) becomes weaker. As a result, the hydraulic pressure of the F-R clutch drops to 0.4 – 0.55 kg/cm^2, and the clutch is completely disengaged.



233F320

HYDROSHIFT TRANSMISSION CONTROL CIRCUIT DIAGRAM

GD705R-4

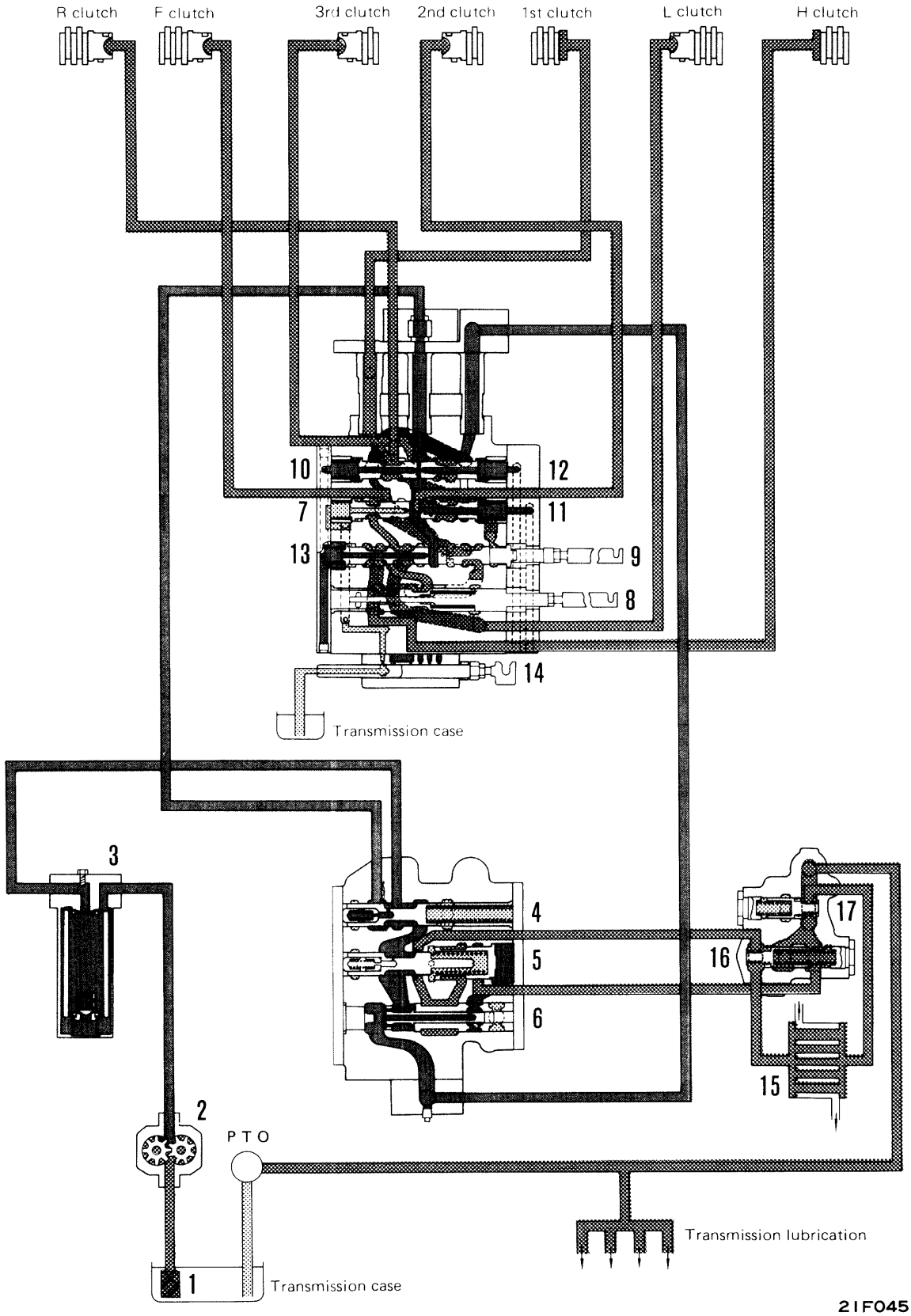


21F046

1. Strainer
2. HYDROSHIFT transmission pump (SAL 045)
3. Oil filter
4. Priority valve
5. Modulating valve
6. Quick return valve
7. Cut-off valve
8. Inching valve
9. F-R clutch valve
10. 1st clutch valve
11. 2nd clutch valve
12. 3rd clutch valve
13. H.L clutch valve
14. Speed selector valve
15. Oil cooler
16. Cooler by-pass valve
17. Lubrication relief valve

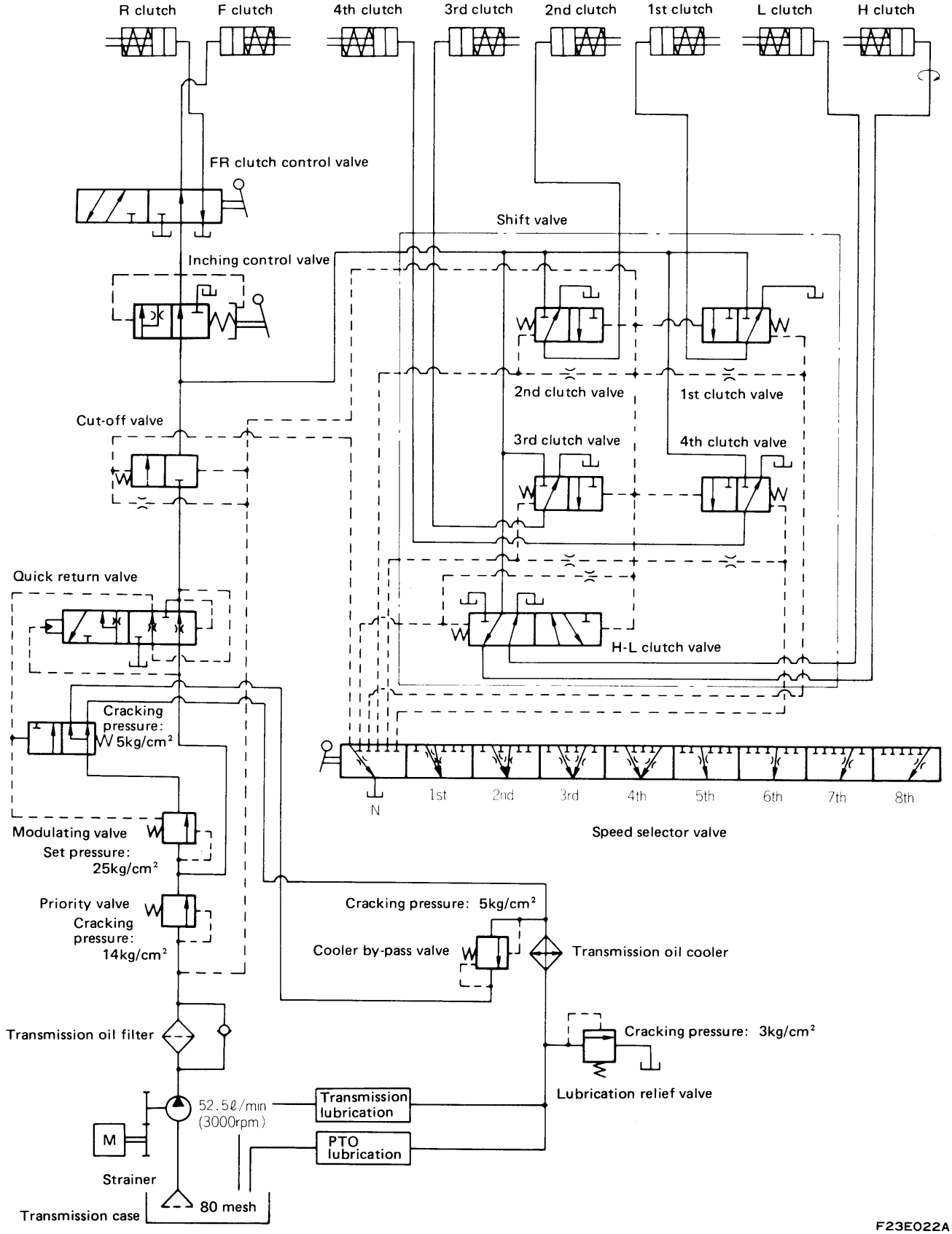
HYDROSHIFT TRANSMISSION CONTROL

GD705R-4



HYDROSHIFT TRANSMISSION CONTROL CIRCUIT DIAGRAM

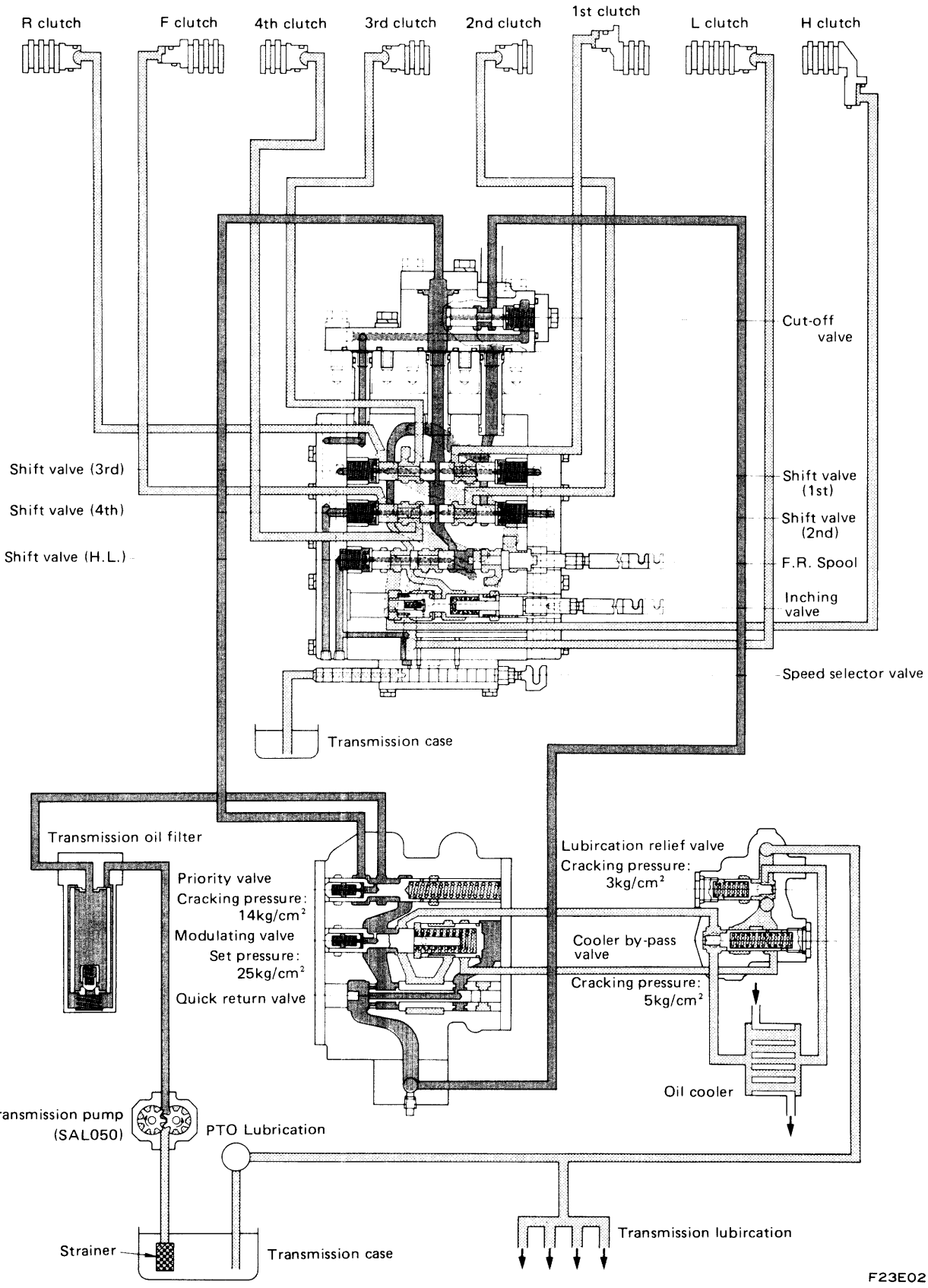
GD705A-4



F23E022A

HYDROSHIFT TRANSMISSION CONTROL

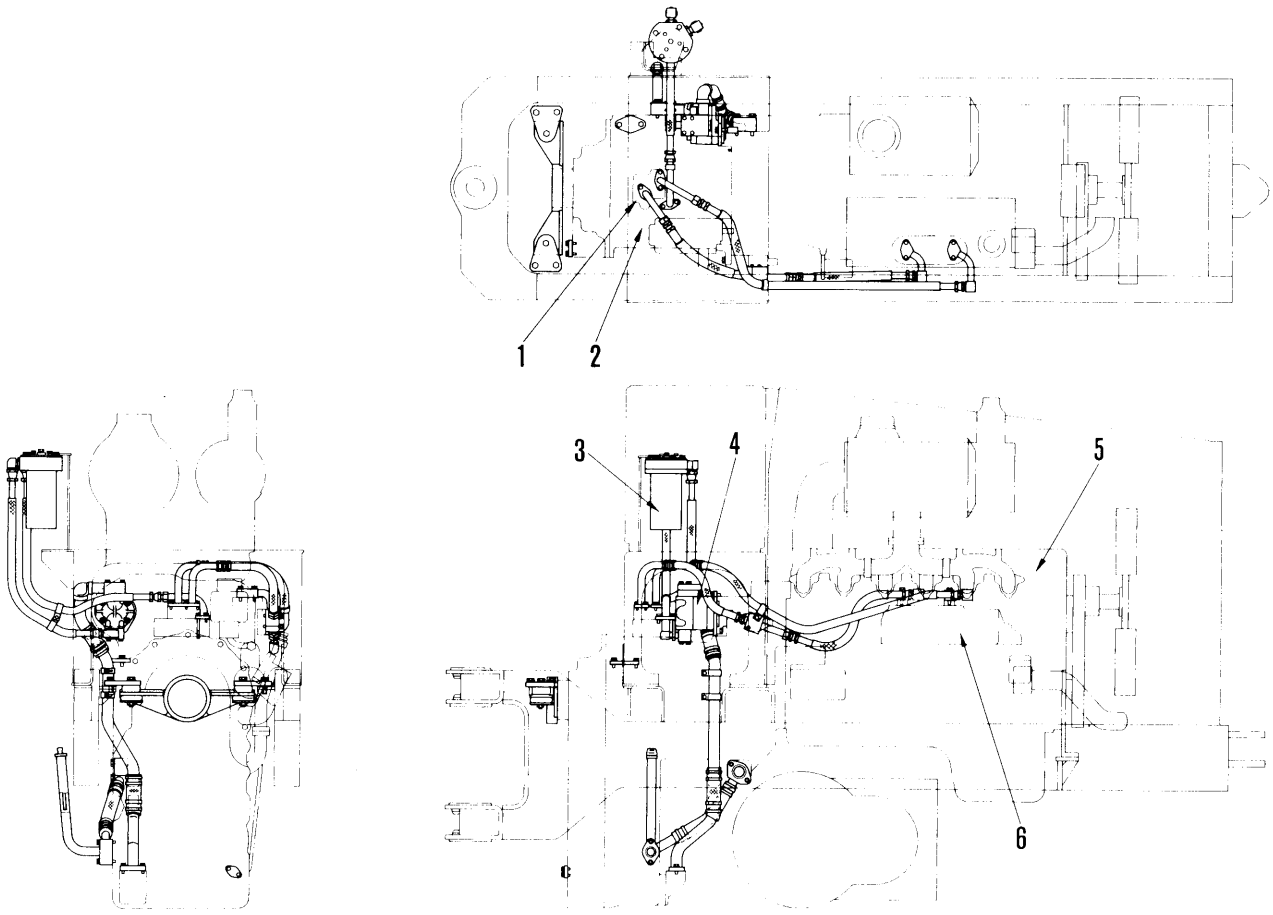
GD705A-4



F23E021A

HYDROSHIFT TRANSMISSION PIPING

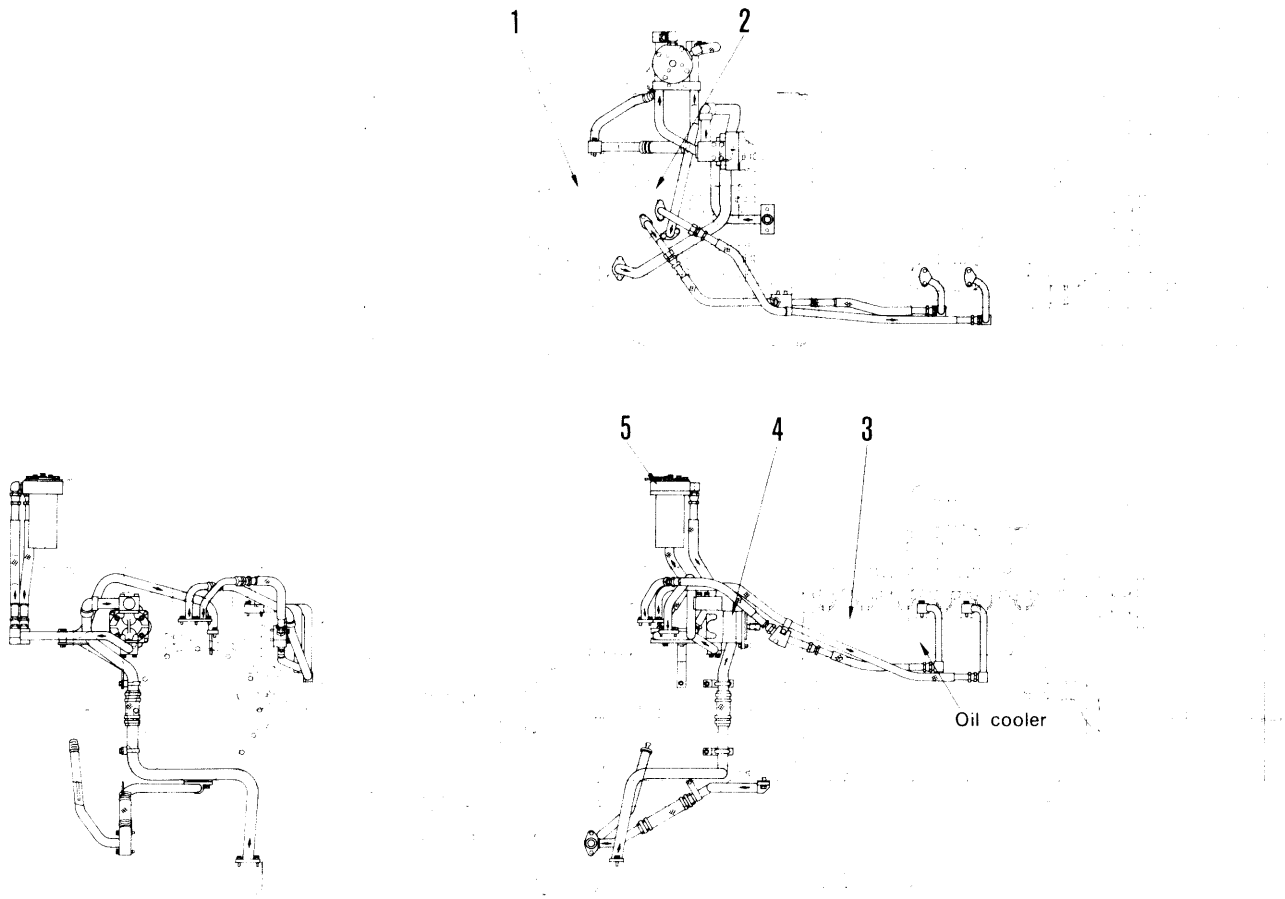
GD705R-4



232F109

1. Hydroshift transmission control valve
2. Hydroshift transmission
3. Oil filter
4. Mission pump (SAL 045)
5. Engine
6. Oil cooler

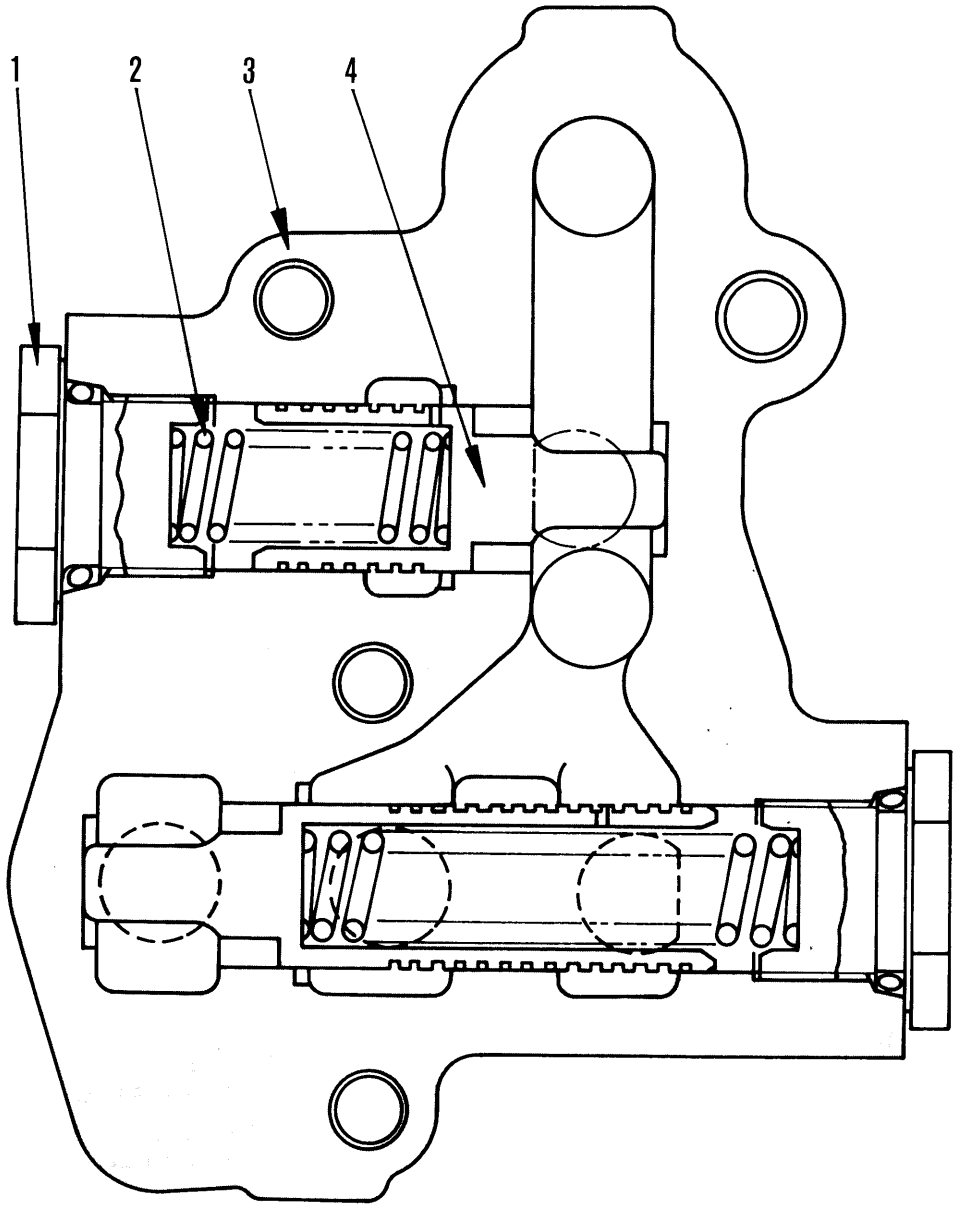
GD705A-4



F23404010

1. Transfer
2. HYDROSHIFT transmission control valve
3. Engine
4. Transmission pump (SAL 050)
5. Oil filter

LUBRICATION RELIEF VALVE

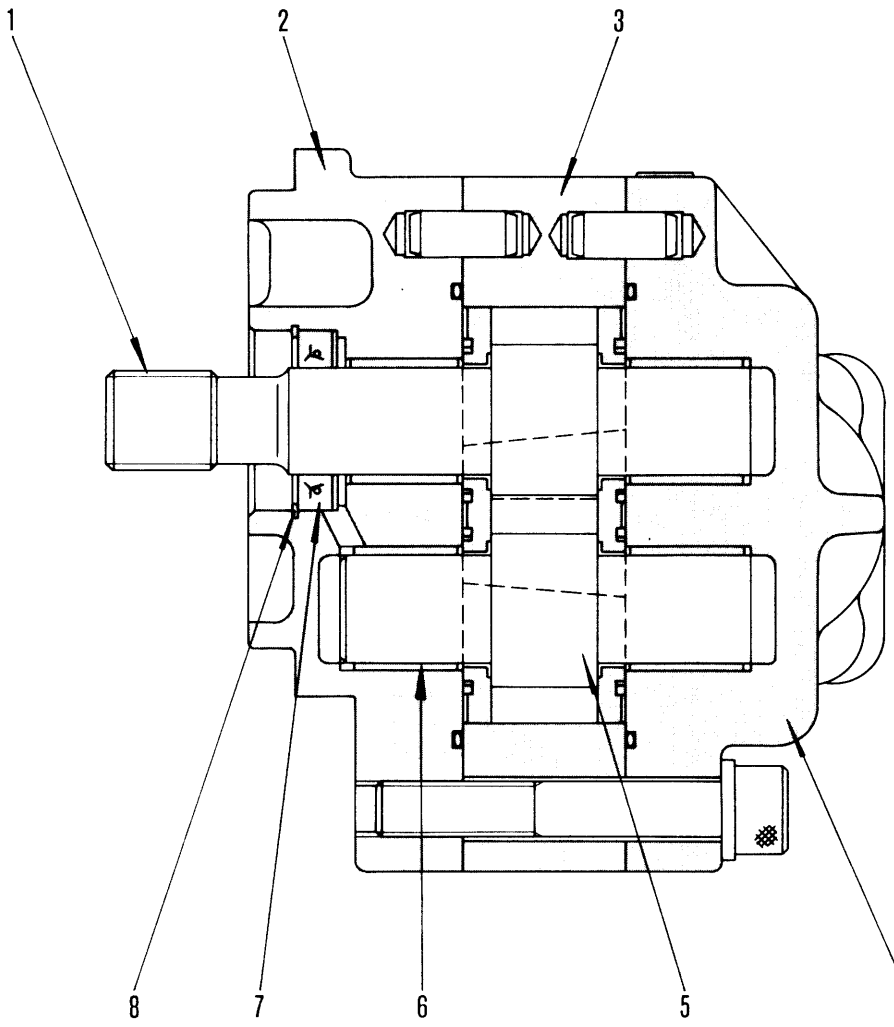


21F048

1. Plug
2. Spring
3. Body
4. Poppet

TRANSMISSION PUMP

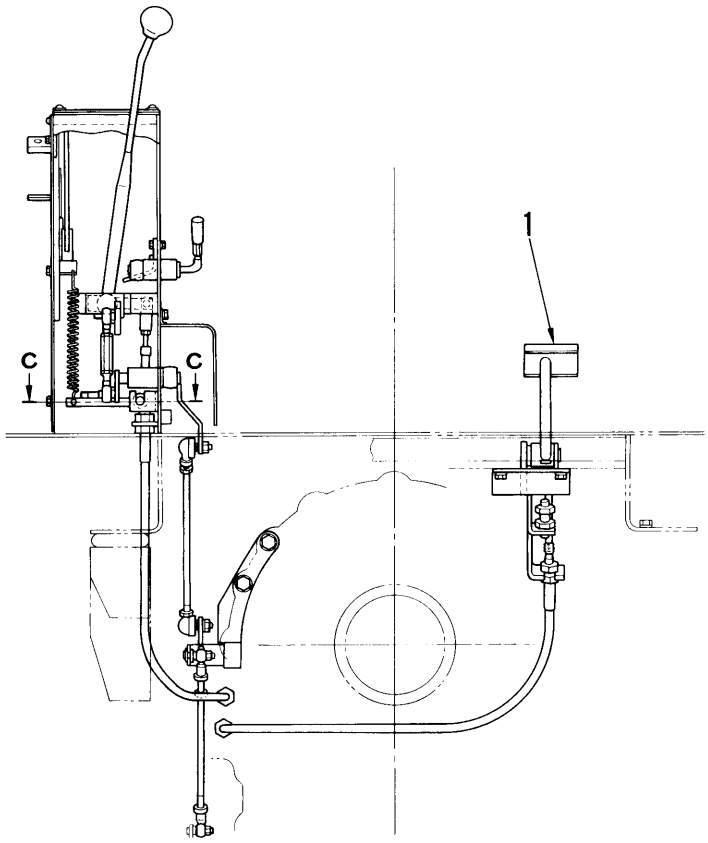
GD705R-4 (SAL045)
GD705A-4 (SAL050)

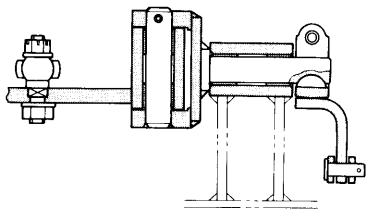


1. Drive gear
2. Bracket
3. Gear case
4. Cover
5. Driven gear
6. Bushing
7. Oil seal
8. Snap ring

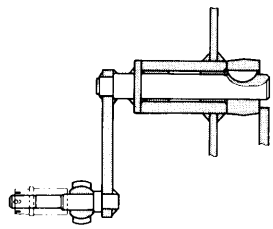
HYDROSHIFT TRANSMISSION CONTROL LINKAGE

GD705R-4

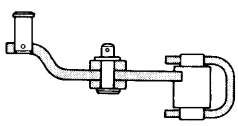




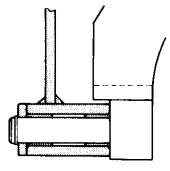
Section A – A



Section B – B

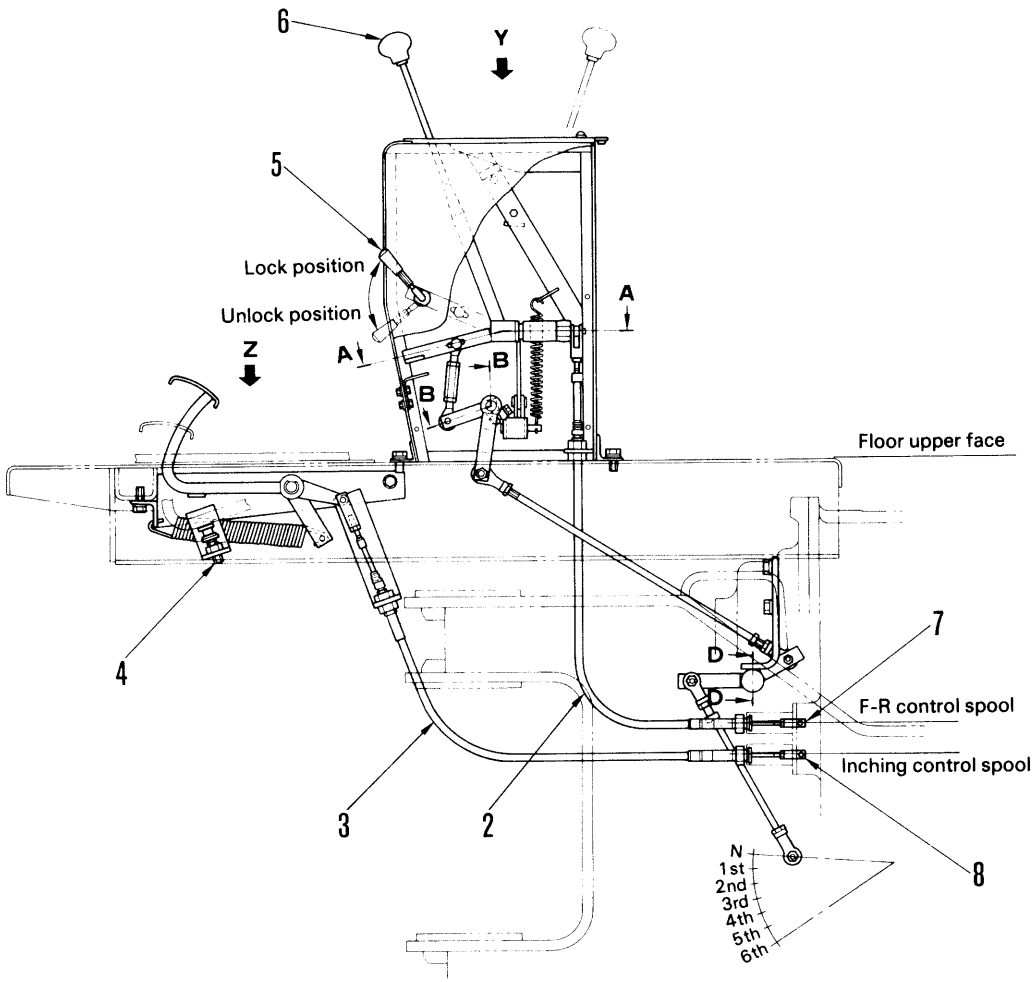


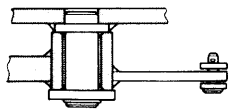
Section C – C



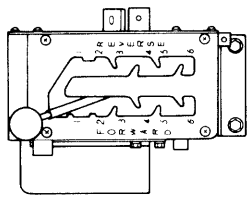
Section D – D

F23E04018

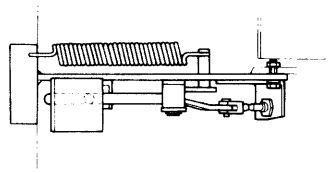




Section E – E



View Y



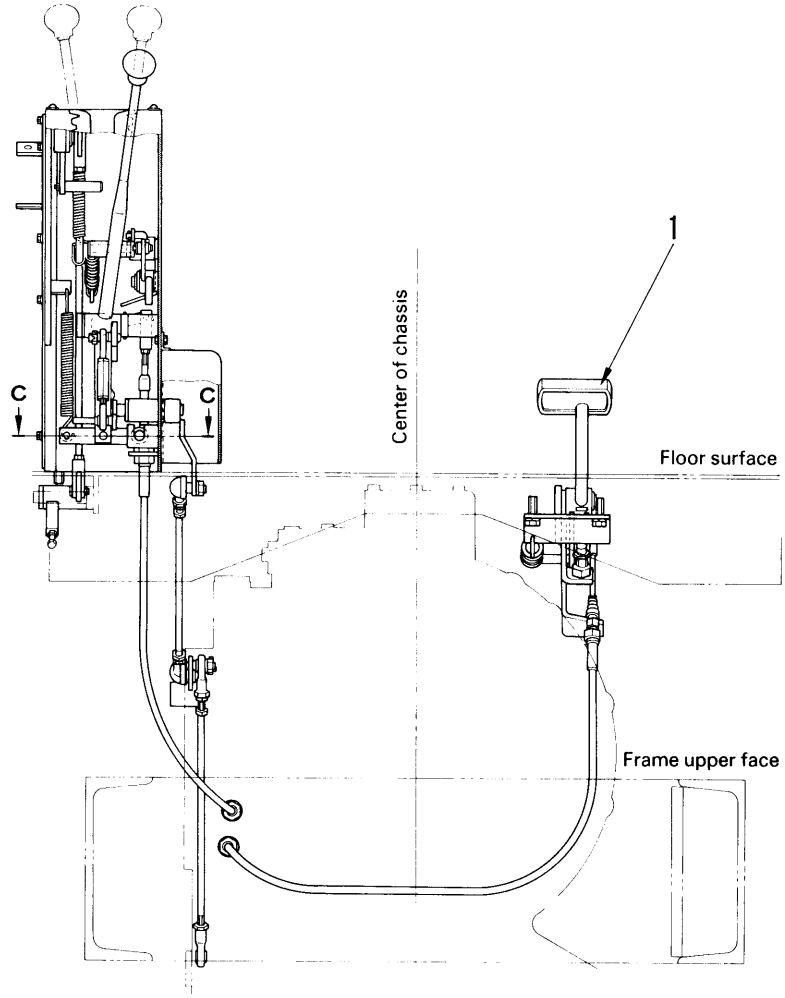
View Z

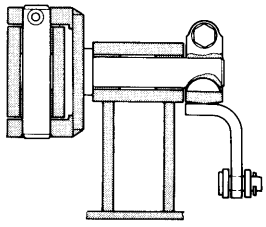
F23E04019

1. Inching pedal
2. Wire (for F.R. control)
3. Wire (for inching)
4. Stopper (for inching pedal)
5. Lock lever (for shift lever)
6. Shift lever
7. F.R. control side
8. Inching control side

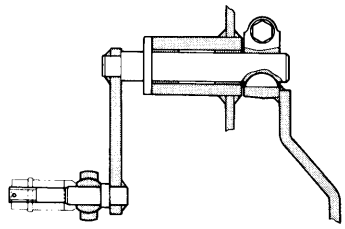
HYDROSHIFT TRANSMISSION CONTROL LINKAGE

GD705A-4

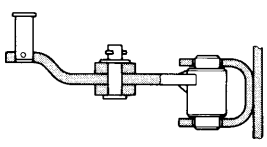




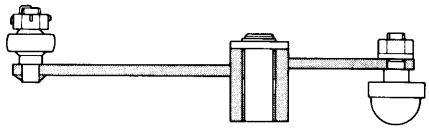
Section A – A



Section B – B

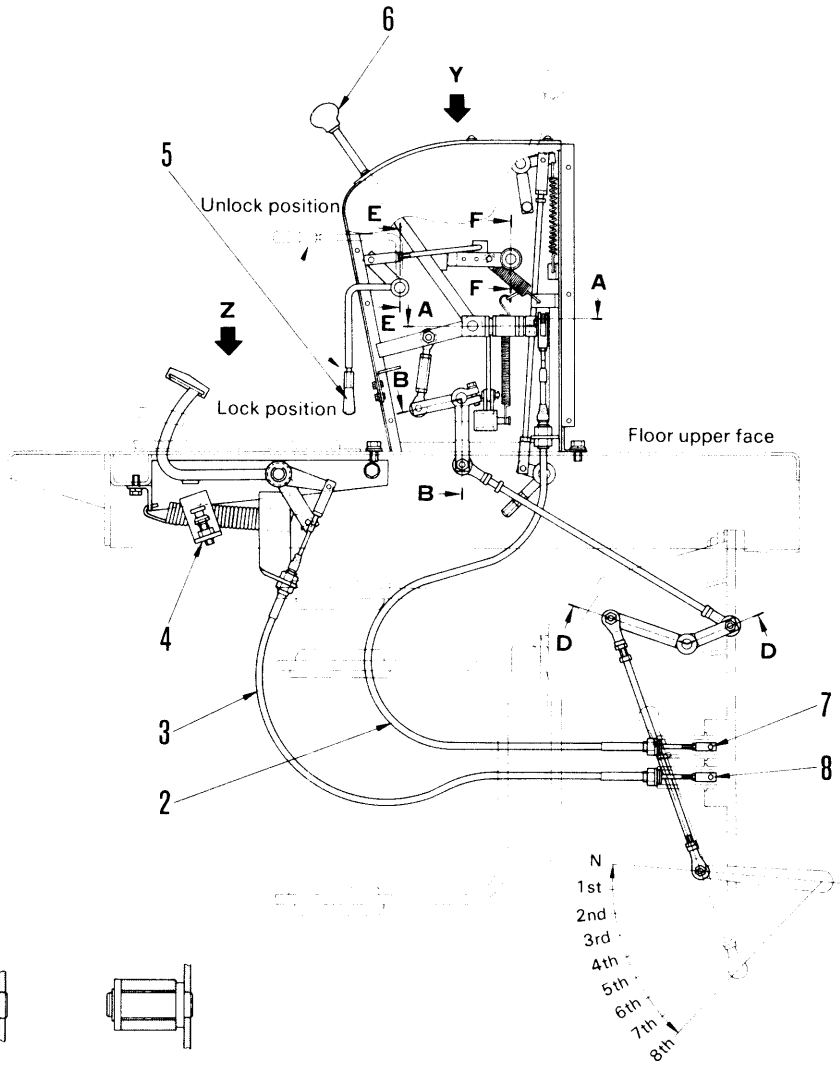


Section C – C

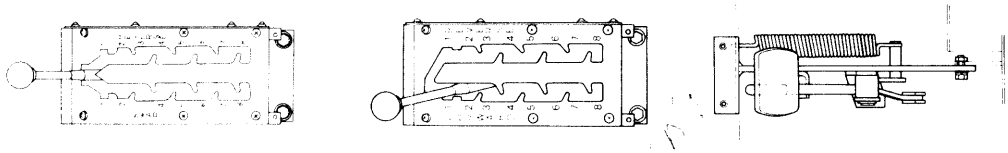


Section D – D

F23404049



Section E – E Section F – F

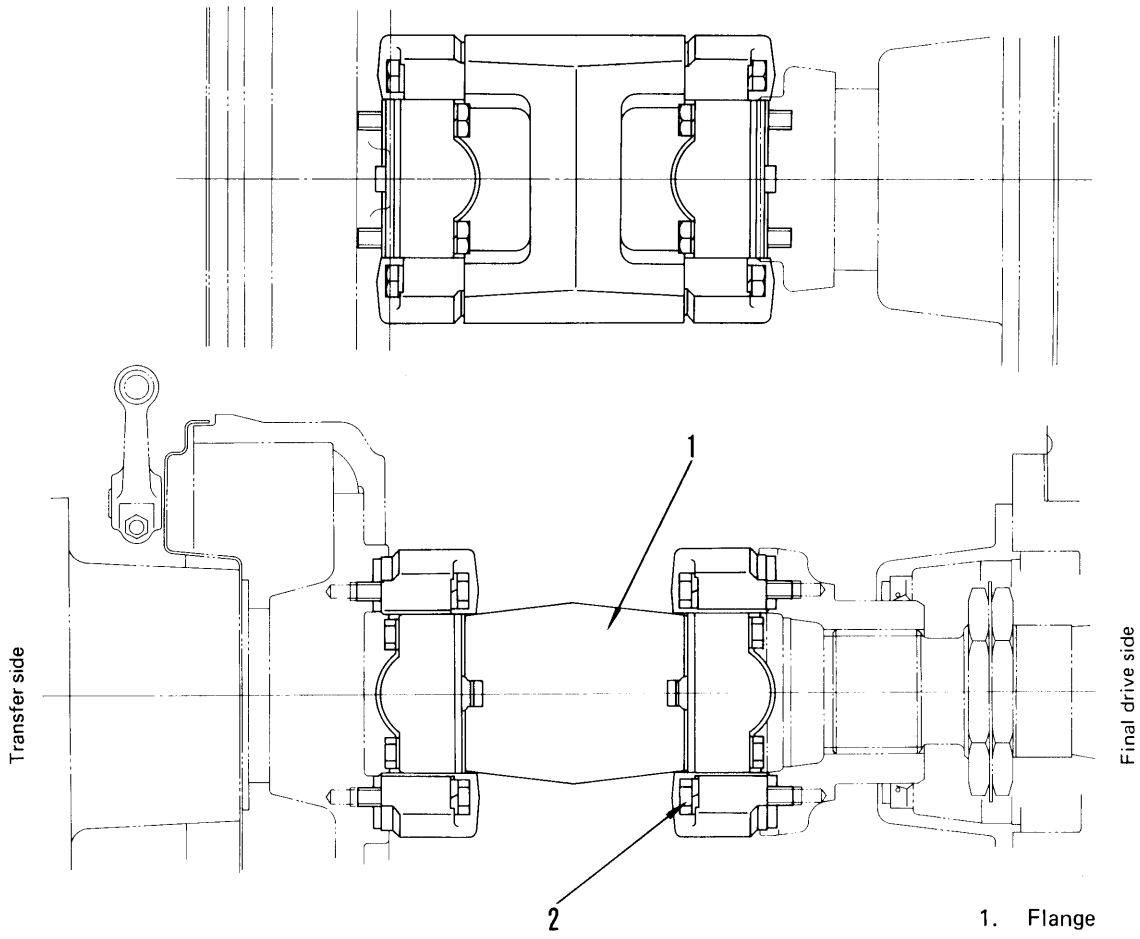


View Y View Y View Z

(Serial No. 21001 and up) **(Serial No. 31001 and up)** F23404050

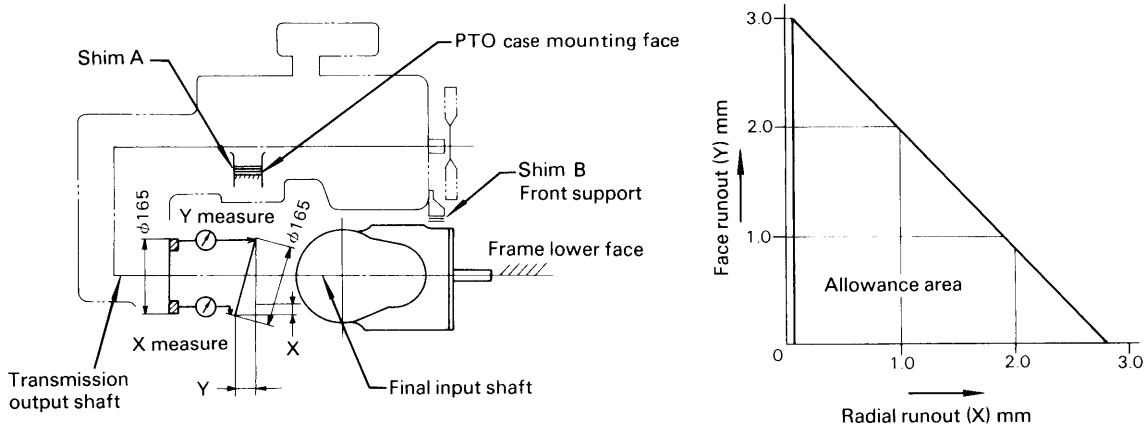
1. Inching pedal
2. Wire (for F.R control)
3. Wire (for inching)
4. Stopper (for inching pedal)
5. Lock lever (for shift lever)
6. Shift lever
7. F.R control side
8. Inching control side

DRIVE SHAFT



1. Flange
2. Bolt

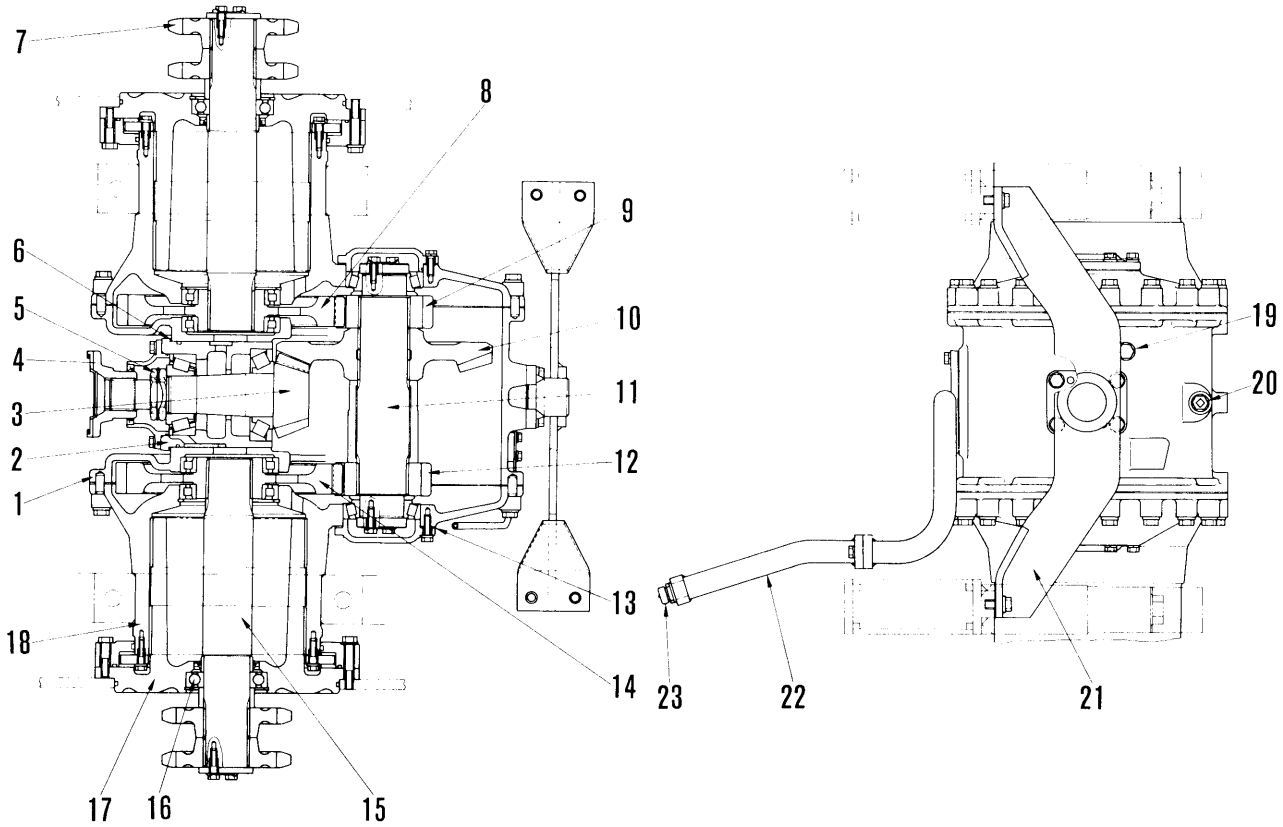
DIAGRAM OF ADJUSTING RUN OUT



F23E026

FINAL DRIVE

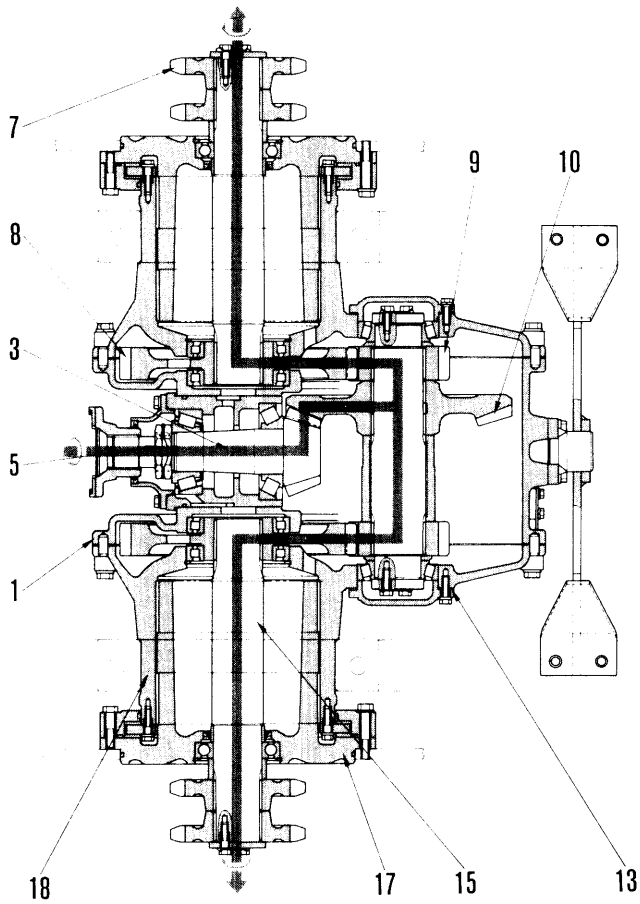
GD705R-4



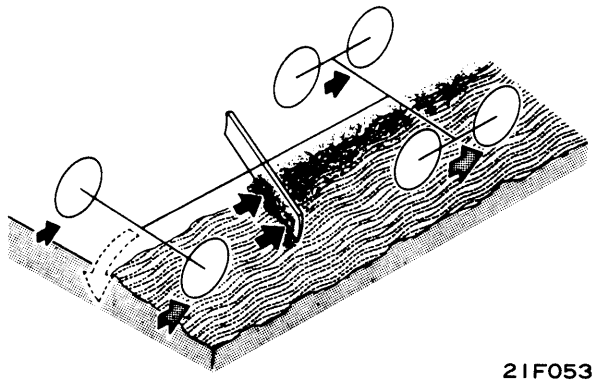
F23E04020

1. Case
2. Gage
3. Bevel pinion (13 teeth)
4. Coupling
5. Nut
6. Shim
7. Sprocket (13 teeth)
8. Gear (44 teeth)
9. Gear (17 teeth)
10. Bevel gear (38 teeth)
11. Shaft
12. Gear (17 teeth)
13. Shim
14. Gear (44 teeth)
15. Shaft
16. Bearing
17. Flange
18. Housing
19. Oil level plug
20. Oil drain plug
21. Support
22. Oil filler
23. Breather

Power transmitted from the engine to the damper and to the transmission is transmitted at right angles by meshing of the bevel pinion (3) and bevel gears (10). Then it is reduced by gear (8), (9) and transmitted to the sprocket (7).
Also, the weight of the machine is transmitted by the final drive cases (1), (18) to the tandem cases. Because this weight is directly transmitted to the tandem case by flange (17), the shaft (15) transmits the torque only. (The shaft (15) is full floating.)
Adjustment of the preload of the bevel pinion is done with nut (5) and washer. Also, adjustment of the preload of bevel gear, backlash, adjusting tooth contact of pinion is done with shim (13).
This is a device that reduces power from the transmission and transmits it to the left and right tandem drive gears. When a motor grader is operated with the blade at a propulsion angle, or the machine on a slope, it receives on its front section a side reaction force that tends to turn it sideways, either to left or right. Because it is necessary to resist this and continue to advance straight ahead, it is generally structured without a differential installed.

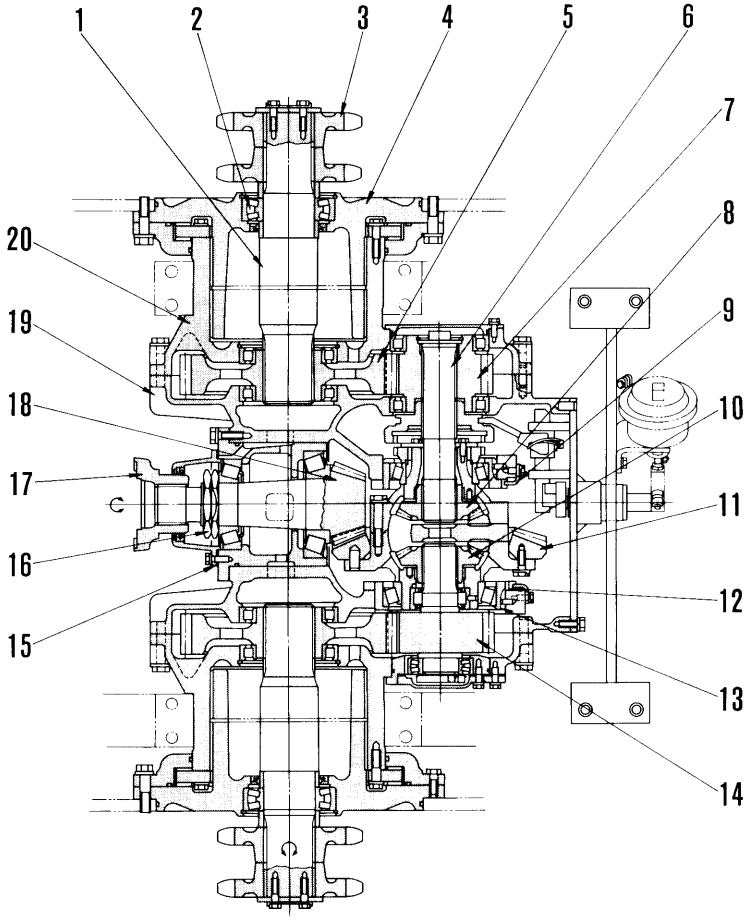


232F111

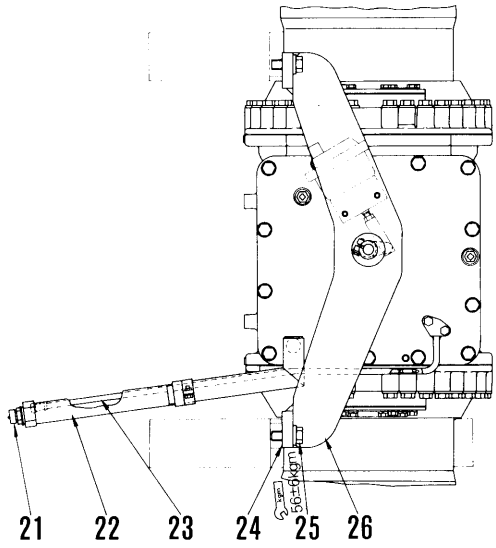

21F053

FINAL DRIVE

GD705A-4



21F044-2



F23E027

1. Shaft
2. Bearing
3. Sprocket (13 teeth)
4. Joint
5. Gear (42 teeth)
6. Shaft
7. Gear
8. Gear
9. Lock plate
10. Gear
11. Bevel gear (38 teeth)
12. Nut
13. Cage
14. Gear (17 teeth)
15. Shim
16. Nut
17. Coupling
18. Bevel pinion (13 teeth)
19. Case
20. Housing
21. Breather
22. Filler tube
23. Tube for oil level gauge
24. Shim
25. Bolt
26. Support

The final drive is a speed reduction gearing system which transmits drive power from the transmission to the right and left tandem drive gears.

When a motor grader is operated with its blade set to an angled position or with the machine body tilted, the reaction of the surface being graded will cause a lateral force to turn the front end of the machine right or left. To keep the machine traveling straight forward by resisting this turning force, ordinary motor graders are equipped with a differential.

However, since the GD705A-4 is an articulated machine, in which the rear wheels are likely to slip sideways when articulation is in effect, a differential is used to prevent early wear of the rear tires. The differential can be locked when necessary by remote control from the operator's seat.

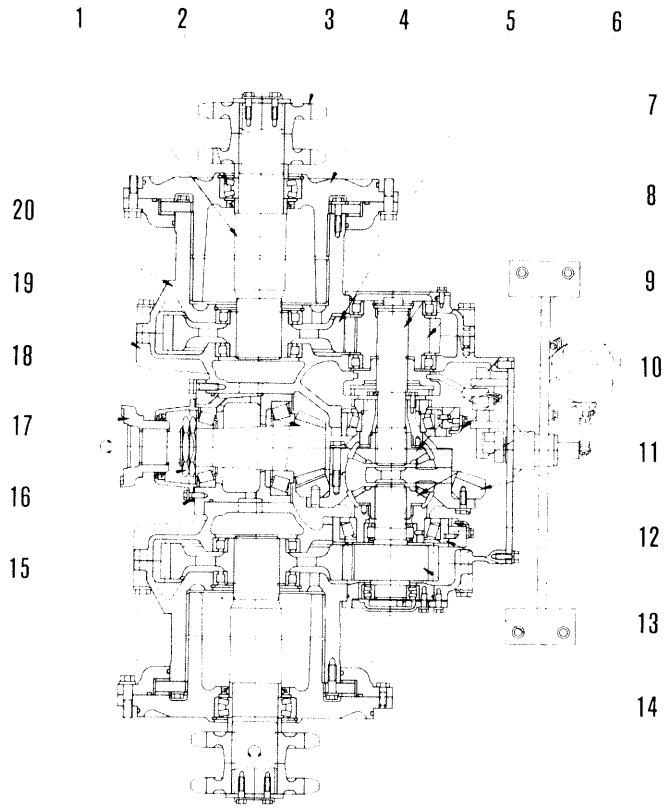
The rotation of the engine is transmitted through the damper to the transmission along the machine center line. The rotation of the transmission output shaft is then transmitted through bevel gear (11), which is in mesh with transmission output shaft bevel pinion (18), to the bevel gear shaft which is at a right angle to the machine center line. The rotation of the bevel gear shaft is in turn transmitted to sprockets (3) after it speed of rotation is decreased by gear trains (5) – (7) and (5) – (14), respectively.

The full-floating shaft (1) transmits only driving torque.

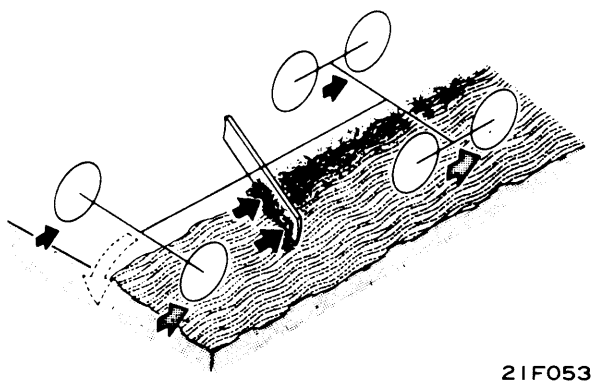
The weight of the machine is directly delivered to the tandem case from final drive case (19) and housing (20) by bearing (2) and joint (4)

The bevel pinion preload can be adjusted with nut (16). Shim (15) and nut (12) are used to adjust the tooth contact between the bevel gear and pinion, the backlash and the bevel gear preload.

Shim (24) is used to correct the step between the right and left mounting surfaces to which support (26) is fitted when mounting the case on the main frame.



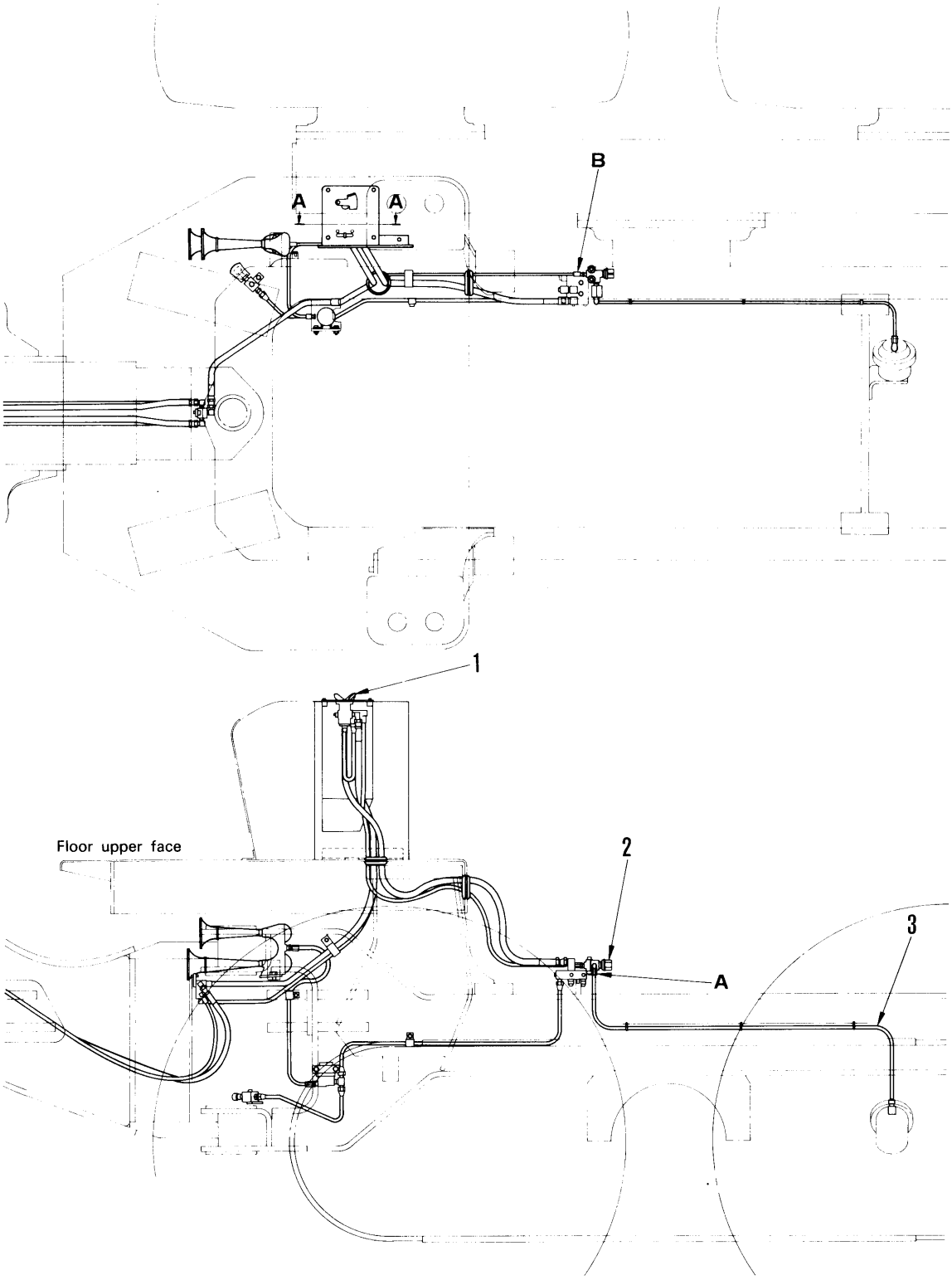
21F044-2



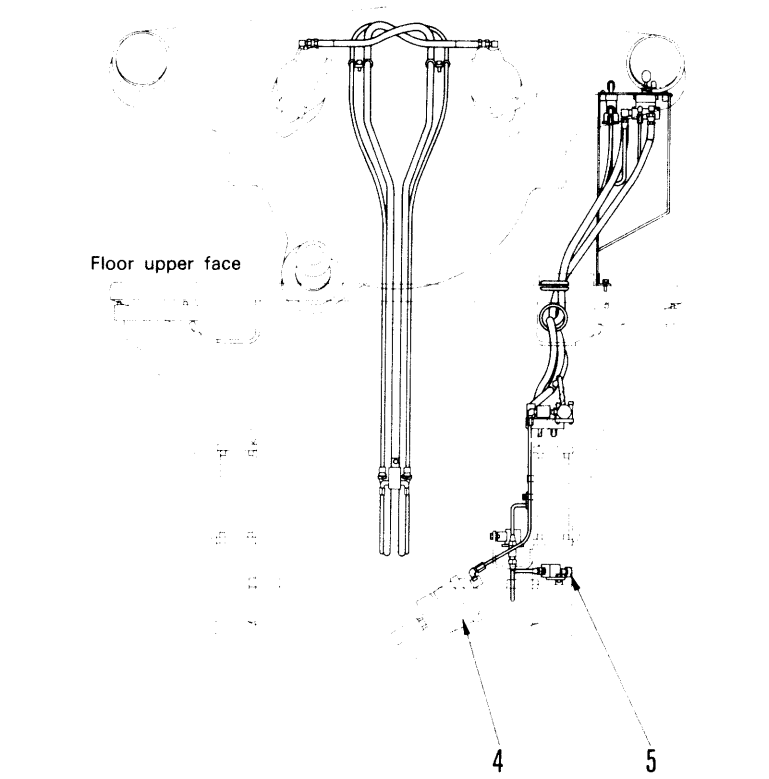
21F053

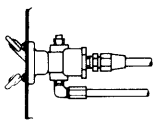
DIFFERENTIAL LOCK AND UNLOCK PIPING

GD705A-4



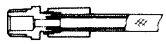
F234040I3





Section A – A

Detail A



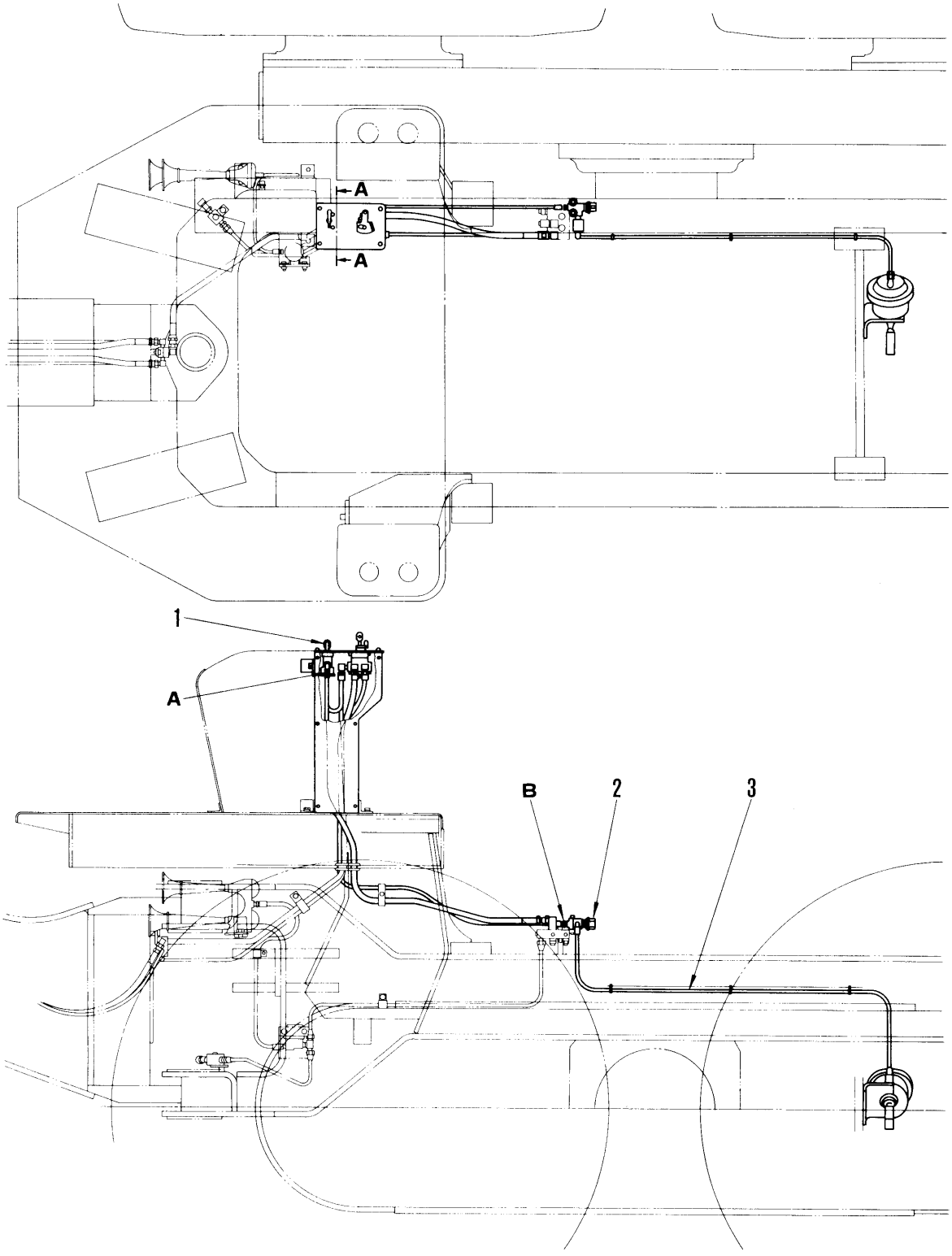
Detail B

F23404014

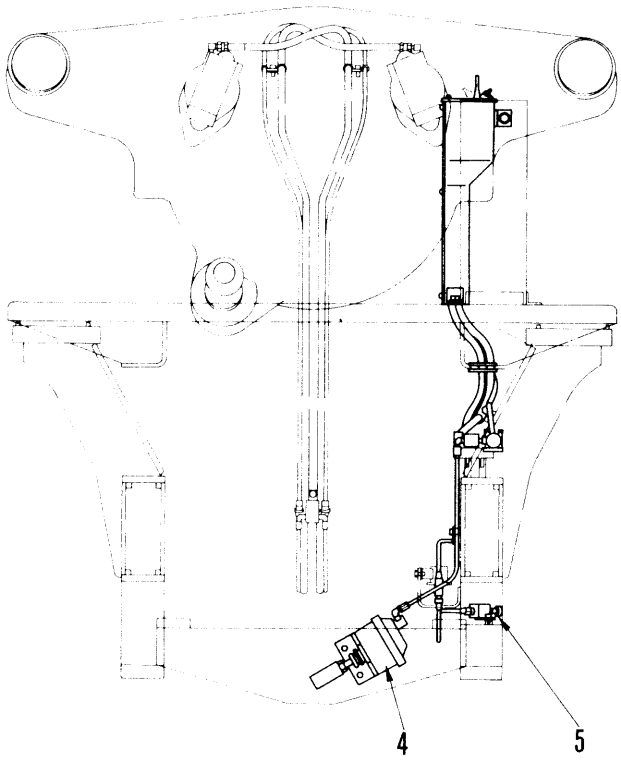
1. Lever (Differential control)
2. Air regulator valve
3. Air tube
4. Chamber
5. Air charge plug

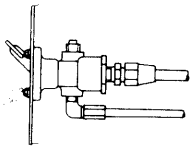
DIFFERENTIAL LOCK AND UNLOCK

GD705A-4 (Serial No. 31001 and up)



F23E092





Section A-A

Detail A

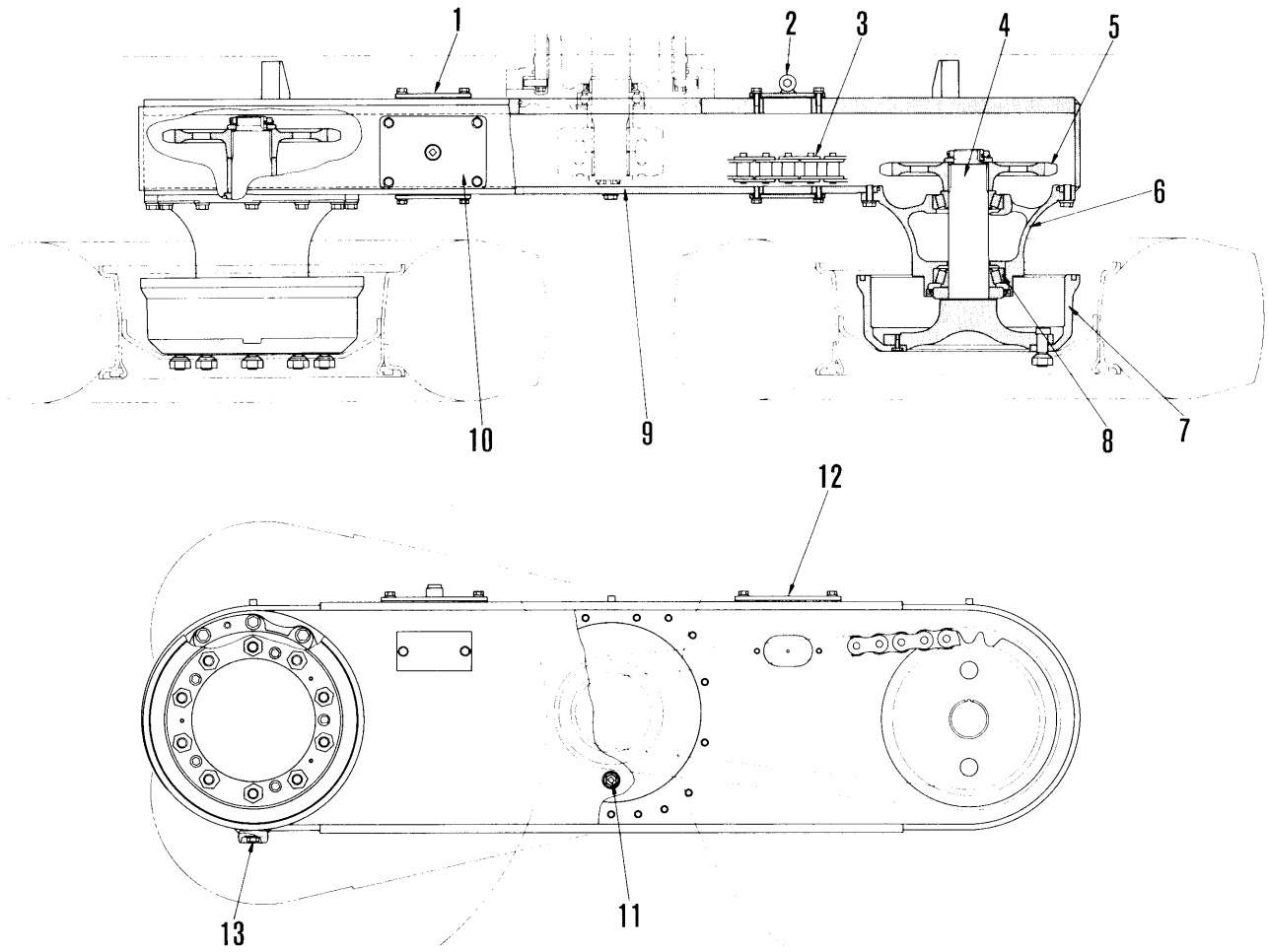
Detail B

F23E093

1. Lever (Differential control)
2. Air regulator valve
3. Air tube
4. Chamber
5. Air charge plug

TANDEM DRIVE

GD705R-4



F23E04021

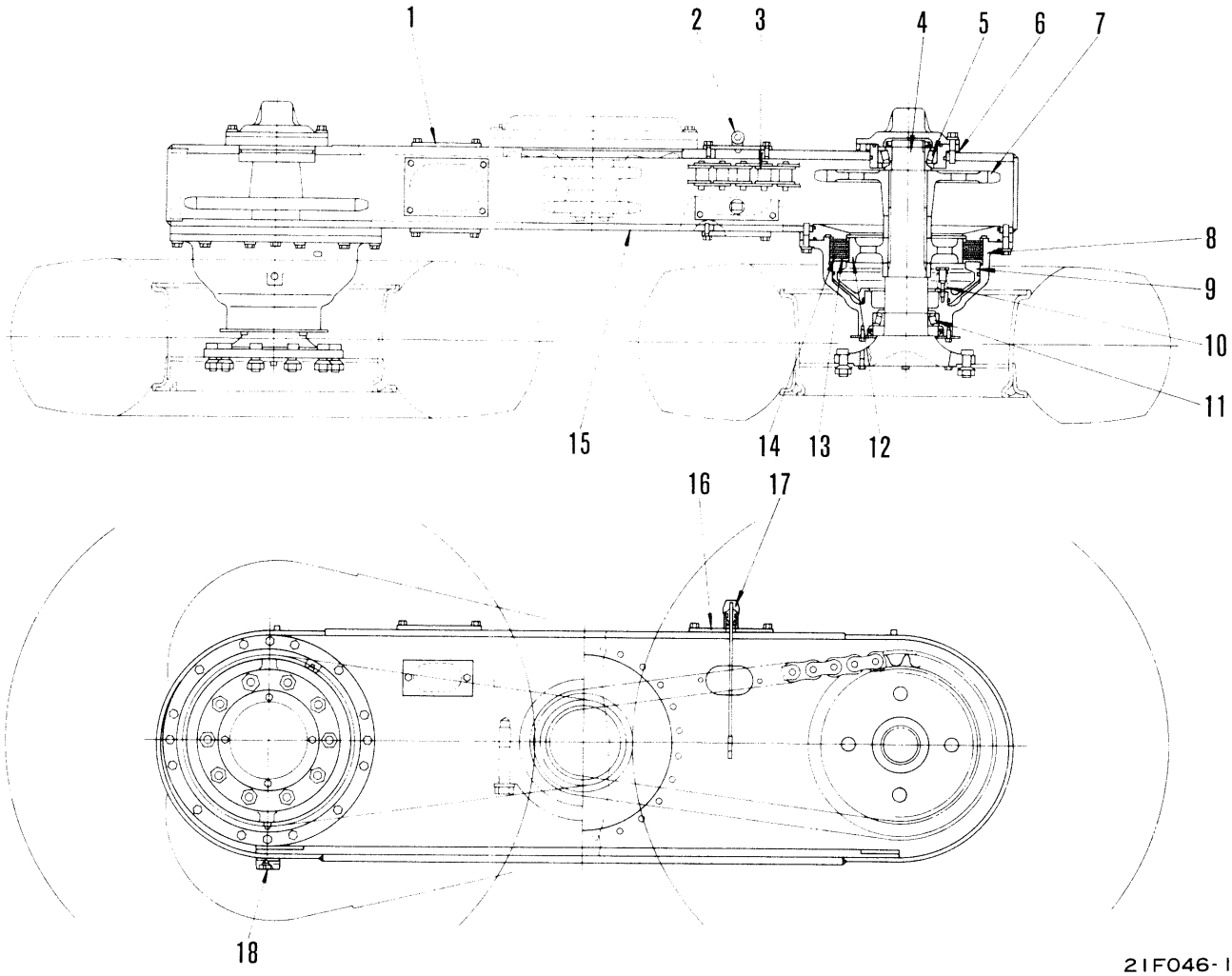
★ Above 0°C: Use engine oil CLASS-CD SAE30
Below 10°C: Use engine oil CLASS-CD SAE10W

Reduction ratio: $\frac{23}{13}$ = 1.769

Lubrication amount: 36 ℓ

1. Cover
2. Breather
3. Chain
4. Hub shaft
5. Sprocket
6. Cage
7. Brake drum
8. Bearing
9. Tandem case
10. Cover
11. Oil level plug
12. Cover
13. Oil drain plug

GD705A-4



★ Above 0°C: Use engine oil CLASS-CD SAE30
Below 10°C: Use engine oil CLASS-CD SAE10W

Reduction ratio: $\frac{26}{13} = 2.0$

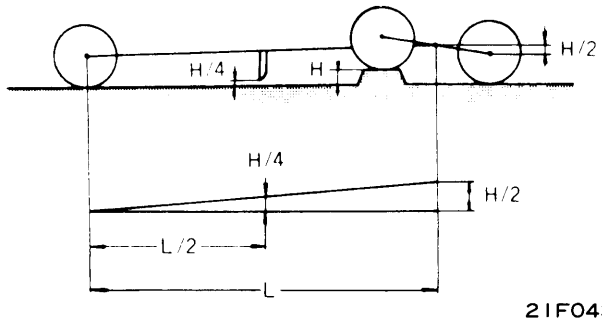
Lubrication amount: 105 ℓ

1. Cover
2. Breather
3. Chain
4. Hub shaft
5. Bearing
6. Shim
7. Sprocket (26 teeth)
8. Cage
9. Piston
10. Spring
11. Bearing
12. Gear (105 teeth)
13. Plate (138 teeth)
14. Disk
15. Tandem case
16. Cover
17. Oil level gauge
18. Drain plug

Power from the final drive is transmitted to the front and back rear wheels by chain.
The tandem cases can swing up and down 13° each. All four rear wheels are in contact with the ground even when the ground is rough restricting the up-and-down movement of the blade to a minimum.

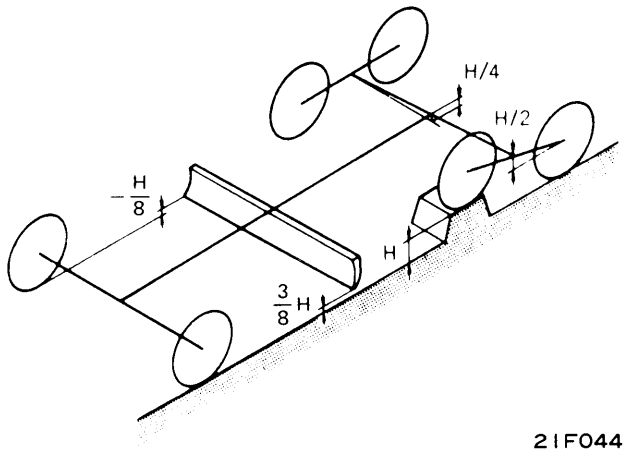
The movement of the blade of a motor grader when its rear wheels ride over an obstacle is as follows:

1. When both left and right wheels ride over on object (height: H) at the same time, the center of the rear axle rise H/2 as right figure shows, and because the blade is situated about halfway between the front and rear axles, its movement further becomes H/4.



21F043

2. When only one left rear wheel rides over an object (height: H), the rise at the center of rear axle is H/2 at its left end as right figure shows and H/4 at the center line of machine and on the real axle.
The movement of the center part of the blade is half of that, which is H/8.



21F044

POWER TRAIN
22 TESTING AND ADJUSTING

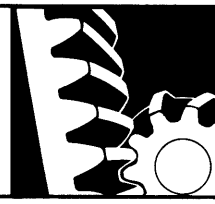


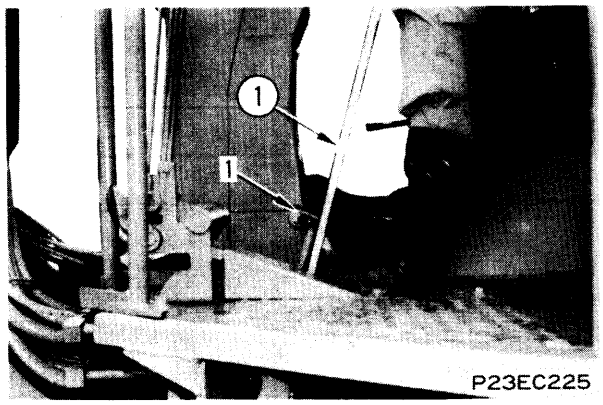
TABLE OF JUDGEMENT STANDARD VALUE

	Item		Test condition	Standard value	
				GD705R-4	GD705A-4
Stroke	Fuel control lever		Amount of movement from center of lever knob from slow to full rotation	215 ± 10 mm	150 ± 10 mm
	Accelerator pedal		Amount of movement in up-down direction	97 ± 10 mm	70 ± 10 mm
	Inching pedal		Amount of movement in up-down direction	67 ± 5 mm	105 ± 10 mm
	Parking brake lever		Ability to hold in stopped condition on 1/5 incline paved surface	Within range of 2 – 3 notches.	Within range of 2 – 3 notches.
	Gear shift lever	N → 1	Engine stopped, stroke of tip of lever	54.5 ± 5 mm	55 ± 10 mm
		1 → 2	Engine stopped, stroke of tip of lever	54.5 ± 5 mm	50 ± 10 mm
		2 → 3	Engine stopped, stroke of tip of lever	54.5 ± 5 mm	45 ± 10 mm
		3 → 4	Engine stopped, stroke of tip of lever	54.5 ± 5 mm	45 ± 10 mm
		4 → 5	Engine stopped, stroke of tip of lever	54.5 ± 5 mm	45 ± 10 mm
		5 → 6	Engine stopped, stroke of tip of lever	54.5 ± 5 mm	45 ± 10 mm
		6 → 7	Engine stopped, stroke of tip of lever	–	45 ± 10 mm
		7 → 8	Engine stopped, stroke of tip of lever	–	45 ± 10 mm
Operating force	Fuel control lever		Maximum value at tip of lever until just before stroke end	4 ± 1 kg	9 ± 2 kg
	Accelerator pedal (depression force)		Maximum value until just before stroke end	7.8 ± 1 kg	10 ± 2 kg
	Inching pedal		Maximum value until just before stroke end	12 ± 1 kg	7 ± 2 kg
	Brake pedal (depression force)		Measured with wheels completely locked	Max. 30 kg	Max. 30 kg
	Parking brake lever		Ability to hold in stopped condition on 1/5 incline paved surface	Max. 20 kg	Max. 20 kg
	Gear shift lever		Maximum value until just before stroke end	Max. 3.6 kg	Max. 5 kg
Heat balance	Engine cooling water		• Oil and water levels are normal	Max. 100°C	Max. 100°C
	Engine oil temperature		• Air temperature 40°C conversion	Max. 120°C	Max. 120°C
	Transmission oil temperature		• Performed at a continuous traction (F-2)	Max. 120°C	Max. 120°C
	Final drive oil temperature		• On a concrete road surface	Max. 120°C	Max. 120°C
	Tandem case oil temperature		• Using thermistor	Max. 120°C	Max. 120°C
	Hydraulic oil temperature		• Performed with thermostat open	Max. 120°C	Max. 120°C
Others	Height of inching pedal (when not operating)		Height from the floor to the center of the stopper mounting bolt	130 ± 2 mm	120 ± 5 mm
	Height of inching pedal (during operating)			63 ± 5 mm	15 ± 1 mm
	Inching pedal play			0 mm	0 mm
	Transmission operating		At engine full rotation, F-6, using both the parking brake and the wheel brake, the engine should stop within the ruled value when the inching pedal is released.	Within 3.0 sec.	Within 3.0 sec.

INCHING PEDAL STROKE AND OPERATING FORCE

INCHING PEDAL STROKE CHECK

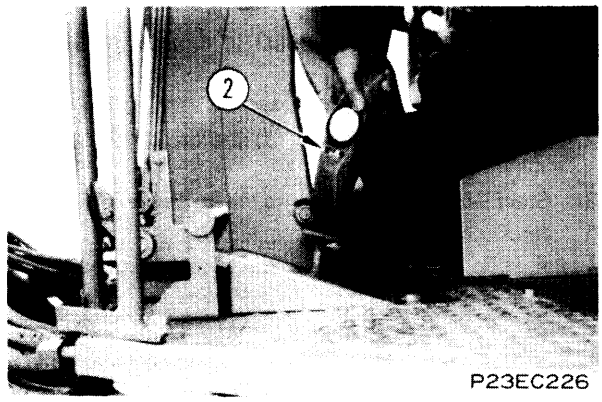
Use convex rule ① to measure the length of the movement from up to down from beginning to the end of depressing inching pedal (1).



P23EC225

INCHING PEDAL OPERATING FORCE CHECK

Use push-pull scale ② to measure the maximum value in the stroke to just before the inching pedal stroke end.



P23EC226

HYDROSHIFT TRANSMISSION

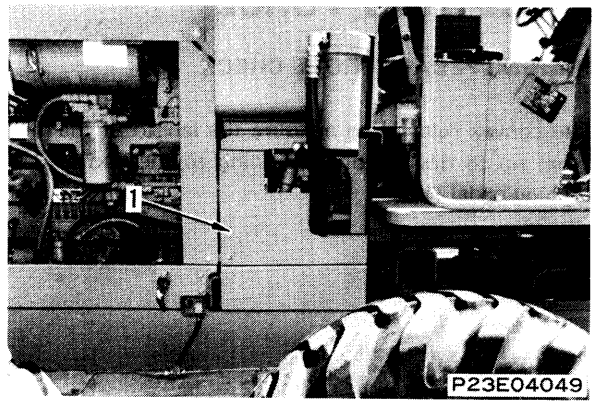
GD705R-4

Special tool

	Part No.	Part Name	Q'ty
A	790-301-1103	Hydraulic tester	1

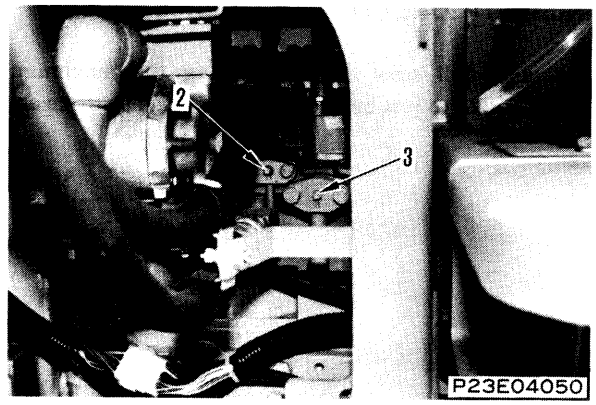
TRANSMISSION PILOT OIL PRESSURE CHECK

1. Remove side cover (1).
2. Remove measuring plug (2) and attach hydraulic gauge A (25 kg/cm^2).
3. Start engine and measure pilot oil pressure of transmission.



TRANSMISSION OIL PRESSURE CHECK (MODULATING PRESSURE)

1. Remove side cover (1).
2. Remove measuring plug (3) and attach oil pressure gauge A (70 kg/cm^2).
3. Start engine and measure oil pressure of transmission (modulating pressure).
   - ★ To confirm modulating set pressure only, it is necessary to start the engine.
   - ★ To confirm clutch pressure for each gear shift (except F and R) start engine and measure with the inching pedal depressed.

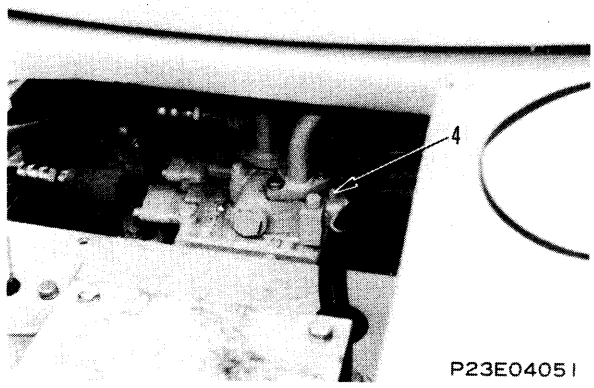


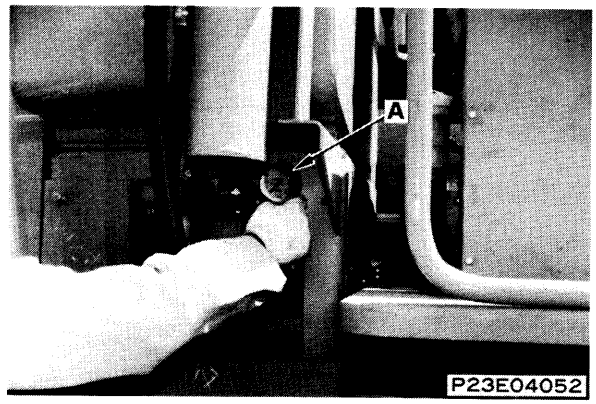
TRANSMISSION LUBRICATION PRESSURE CHECK

1. Remove measuring plug (4) and attach hydraulic gauge A (25 kg/cm^2).
2. Start engine and measure lubricating oil pressure of transmission.

Unit: kg/cm^2

	Measurement check items	Standard value
Plug (2)	Pilot oil pressure	14.5 ± 0.5
Plug (3)	Modulating pressure	25.5 ± 1.5
Plug (4)	Lubrication oil pressure	2.5 ± 1.5





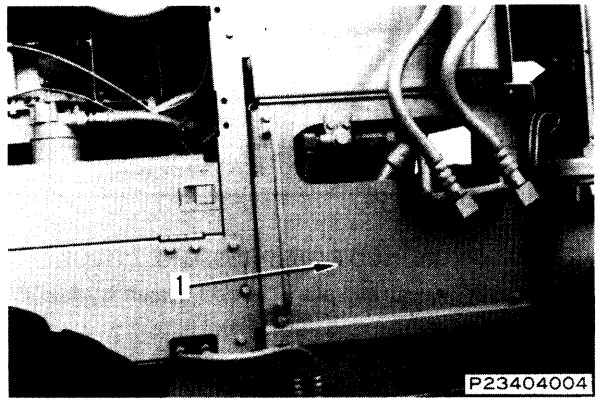
GD705A-4

Special tool

	Part No.	Part Name	Q'ty
A	790-301-1103	Hydraulic tester	1

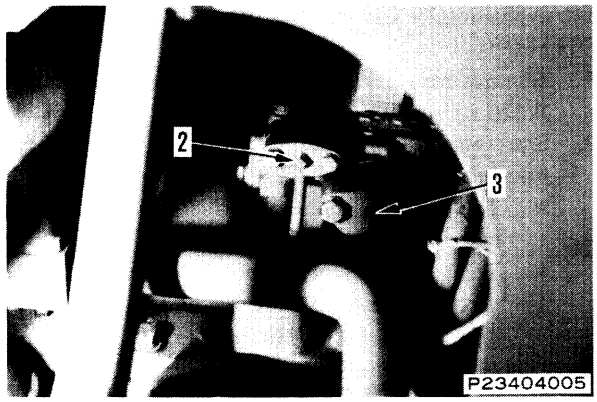
TRANSMISSION PILOT OIL PRESSURE CHECK

1. Remove side cover (1).
2. Remove measuring plug (2) and attach hydraulic gauge A (25 kg/cm^2).
3. Start engine and measure pilot oil pressure of transmission.



TRANSMISSION OIL PRESSURE CHECK (MODULATING PRESSURE)

1. Remove side cover (1).
2. Remove measuring plug (3) and attach oil pressure gauge A (70 kg/cm^2).
3. Start engine and measure oil pressure of transmission (modulating pressure).
   - ★ To confirm modulating set pressure only, it is necessary to start the engine.
   - ★ To confirm clutch pressure for each gear shift (except F and R) start engine and measure with the inching pedal depressed.

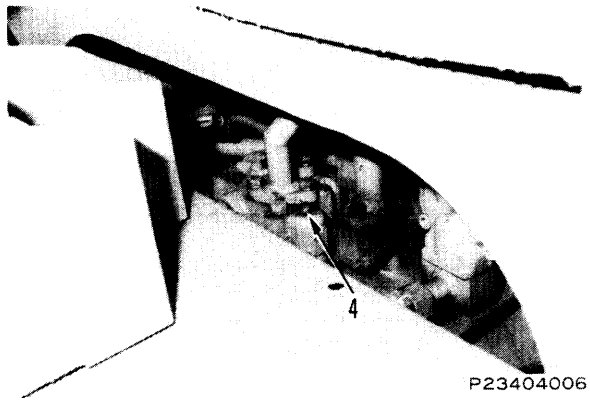


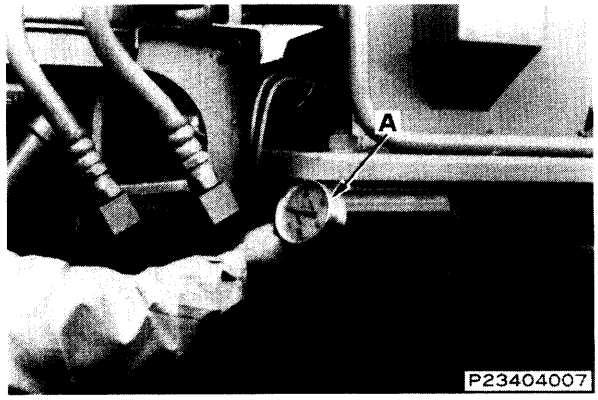
TRANSMISSION LUBRICATION PRESSURE CHECK

1. Remove measuring plug (4) and attach hydraulic gauge A (25 kg/cm^2).
2. Start engine and measure lubricating oil pressure of transmission.

Unit: kg/cm^2

	Measurement check items	Standard value
Plug (2)	Pilot oil pressure	14.5 ± 0.5
Plug (3)	Main oil pressure	25.5 ± 1.5
Plug (4)	Lubrication oil pressure	2.5 ± 1.5



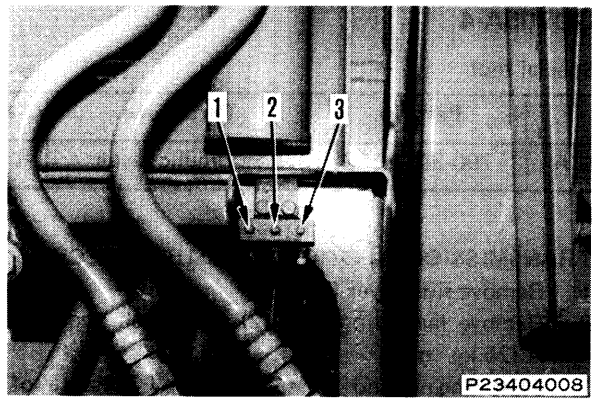


HYDROSHIFT TRANSMISSION

GD705A-4 (Serial No. 31001 and up)

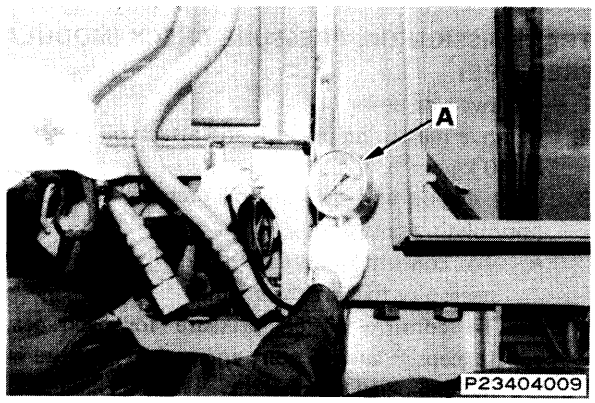
Special tool

	Part No.	Part Name	Q'ty
A	790-301-1103	Hydraulic tester	1



TRANSMISSION PILOT OIL PRESSURE CHECK

1. Remove measuring plug (2) and attach hydraulic gauge A (25 kg/cm^2).
2. Start engine and measure pilot oil pressure of transmission.



TRANSMISSION OIL PRESSURE CHECK (MODULATING PRESSURE)

1. Remove measuring plug (3) and attach oil pressure gauge A (70 kg/cm^2).
2. Start engine and measure oil pressure of transmission (modulating pressure).
   - ★ To confirm modulating set pressure only, it is necessary to start the engine.
   - ★ To confirm clutch pressure for each gear shift (except F and R) start engine and measure with the inching pedal depressed.

TRANSMISSION LUBRICATION PRESSURE CHECK

1. Remove measuring plug (1) and attach hydraulic gauge A (25 kg/cm^2).
2. Start engine and measure lubricating oil pressure of transmission.

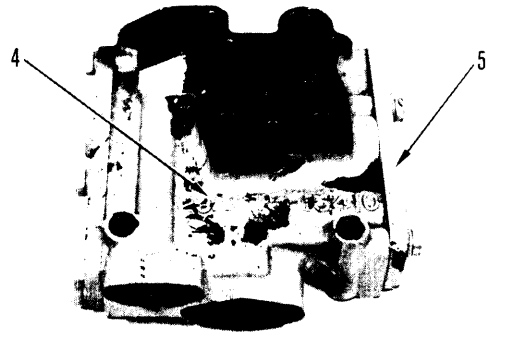
Unit: kg/cm^2

	Measurement check items	Standard value
Plug (2)	Pilot oil pressure	14.5 ± 0.5
Plug (3)	Modulating pressure	25.5 ± 1.5
Plug (1)	Lubrication oil pressure	2.5 ± 1.5

TRANSMISSION OIL PRESSURE ADJUSTMENT (MODULATING PRESSURE)

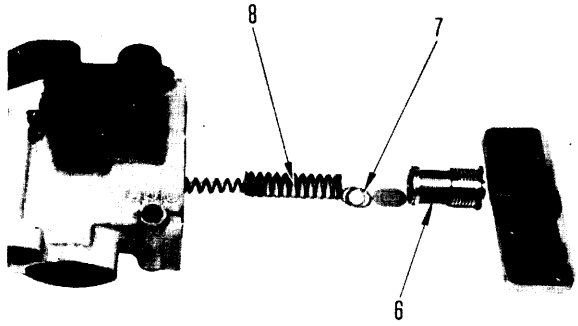
★ If oil pressure is outside standard value, adjust according to following procedure.

1. Remove transmission control valve assembly (4).



22P014

2. Remove cover (5) and remove valve (6).
3. Increase or decrease shims (7) and adjust tension of spring (8).
   - ★ Increase shims and oil pressure rises.
     Decrease shims and oil pressure falls.
   - ★ Standard shim thickness: 1.0 mm
   - ★ Kind of shim: 0.5 mm
4. After adjustment, confirm that transmission oil pressure (modulating pressure) is within standard value, following procedure of TRANSMISSION OIL PRESSURE CHECK (MODULATING PRESSURE).



22P015

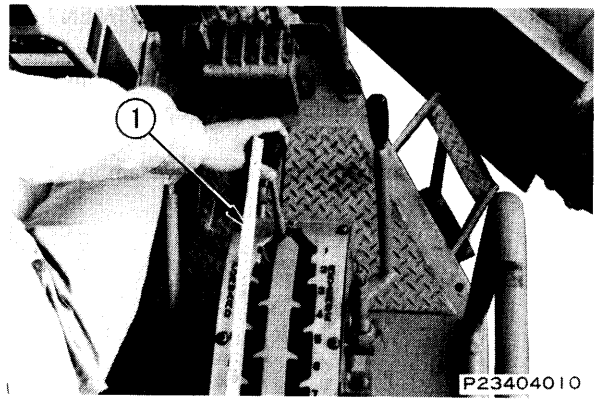
TRANSMISSION CONTROL LEVER STROKE AND OPERATING FORCE

STROKE CHECK AND ADJUSTMENT

Use convex rule ① to measure the stroke of the gear shift lever at the tip of each lever between each gear shift.

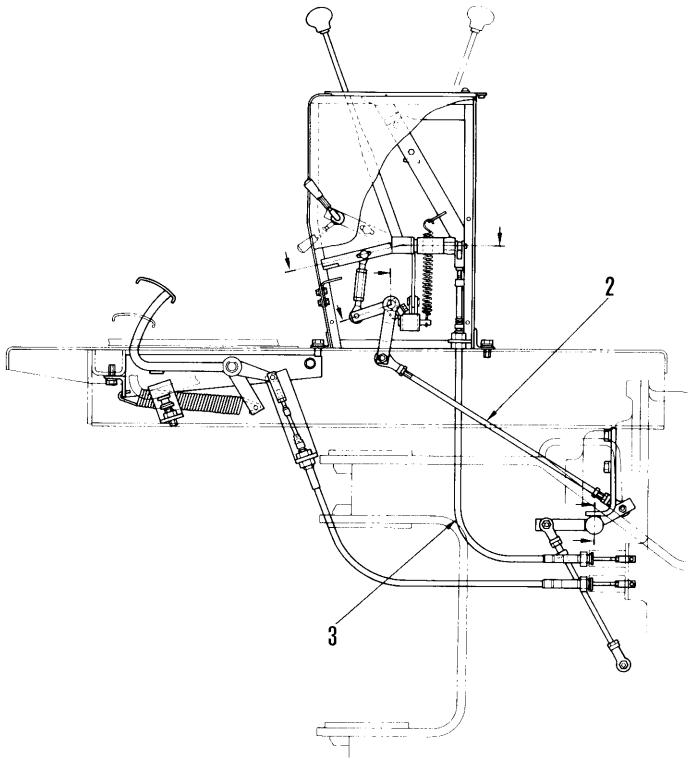
★ Measure with engine stopped.

★ The stroke of gear shift lever is determined by the working distance of the lever notch on the transmission side. However, the neutral position of the gear shift lever is determined by adjusting rod (2) and cable (3) without removing the gear shift lever guide.



GD705A-4

GD705R-4



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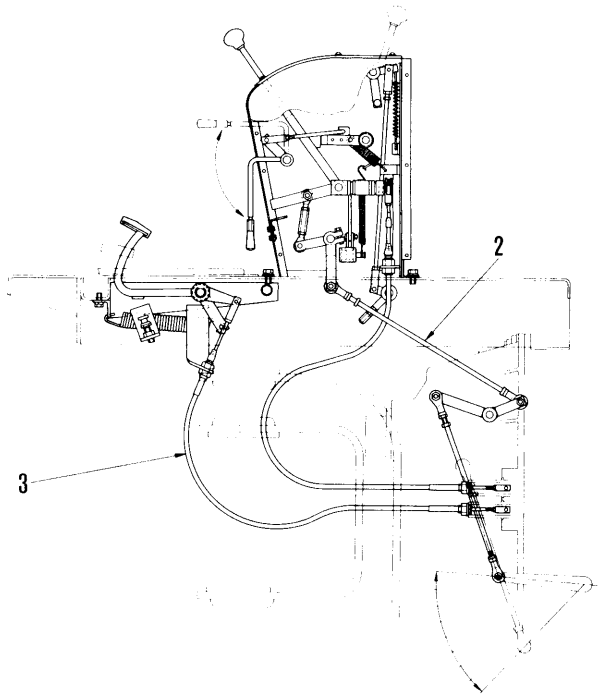

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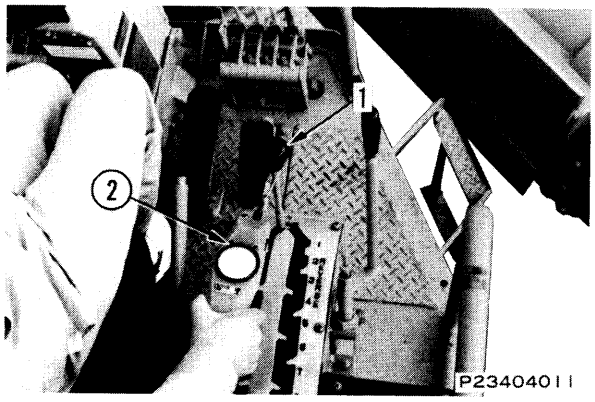
OPERATING FORCE CHECK AND ADJUSTMENT

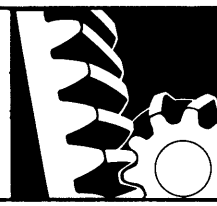
Use push-pull scale ② to measure maximum value in the stroke to just before the stroke end of each gear at the gear shift lever (1) tip.

★ Measure with engine stopped.

★ The operating force of the gear shift lever is determined on transmission side. However, when the operating force is above standard value, check the movement of connecting rod. If it is normal, disassemble the transmission side and check the operating condition of the movement of the spool.



POWER TRAIN
23 DISASSEMBLY AND ASSEMBLY



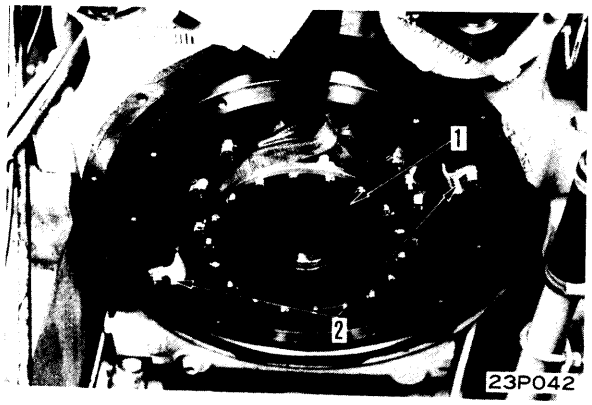
REMOVAL OF DAMPER

GD705R-4

1. Remove HYDROSHIFT transmission.
   Refer to "REMOVAL OF HYDROSHIFT TRANSMISSION" section.

2. Temporarily sling damper (1).

3. Remove stopper (2). Sling up and remove damper (1).
   kg Damper: Approx. 35 kg



INSTALLATION OF DAMPER

GD705R-4

1. Sling damper (1) into flywheel.

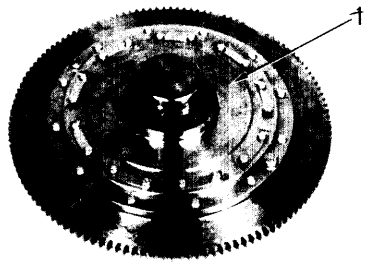
2. Install stopper (2).
   ★ Bend down lock plate firmly.

3. Install HYDROSHIFT transmission.
   Refer to "INSTALLATION OF HYDROSHIFT TRANSMISSION" section.

DISASSEMBLY OF DAMPER

GD705R-4

1. Remove flange (1).
2. Turn over damper and remove flange (2).
3. Pull out body (4) and rubber (5) from body (3).
4. Remove gear (6) from body (3).

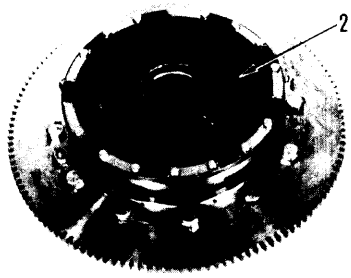


23P043

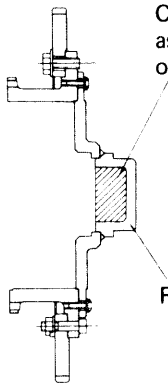
ASSEMBLY OF DAMPER

GD705R-4

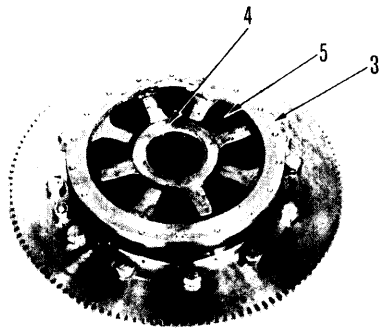
1. Install gear (6) on body (3).
   ★ Bend down lock plate firmly.
2. Install flange (1).
   ★ Bend down lock plate firmly.
   ★ Charge grease (G2-LI) to flange pilot as much as one fifth of its capacity.



23P044

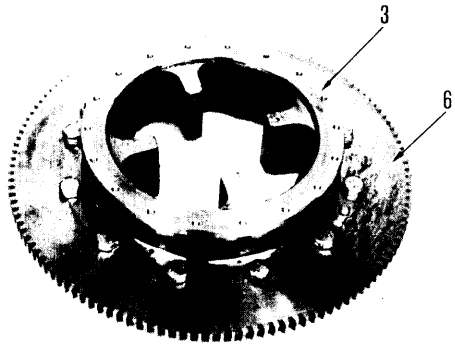


23F008



23P045

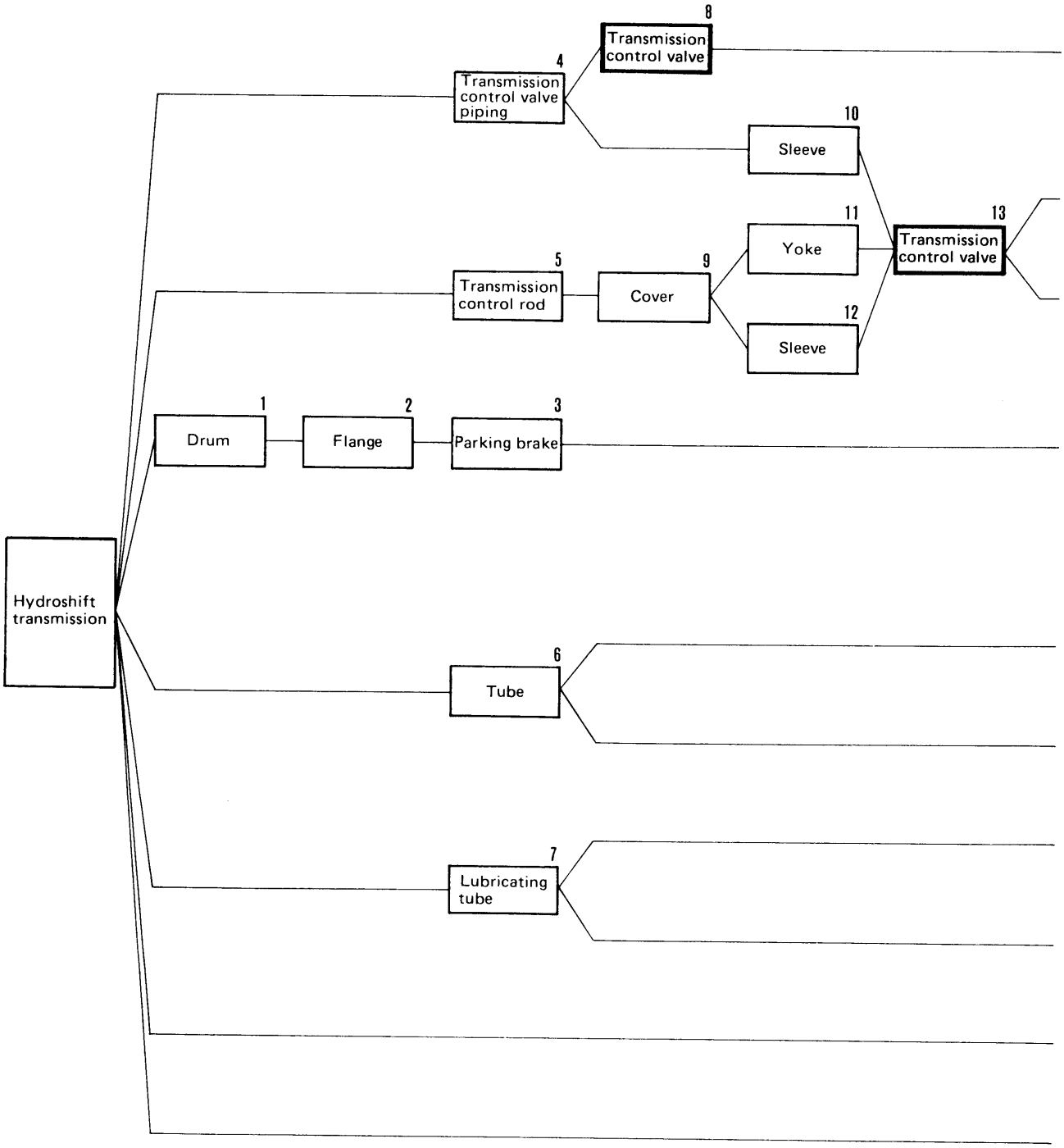
3. Install body (4) and rubber (5) on body (3).
   Rubber: Grease (G2-LI)
4. Install flange (2).
   ★ Bend down lock plate firmly.

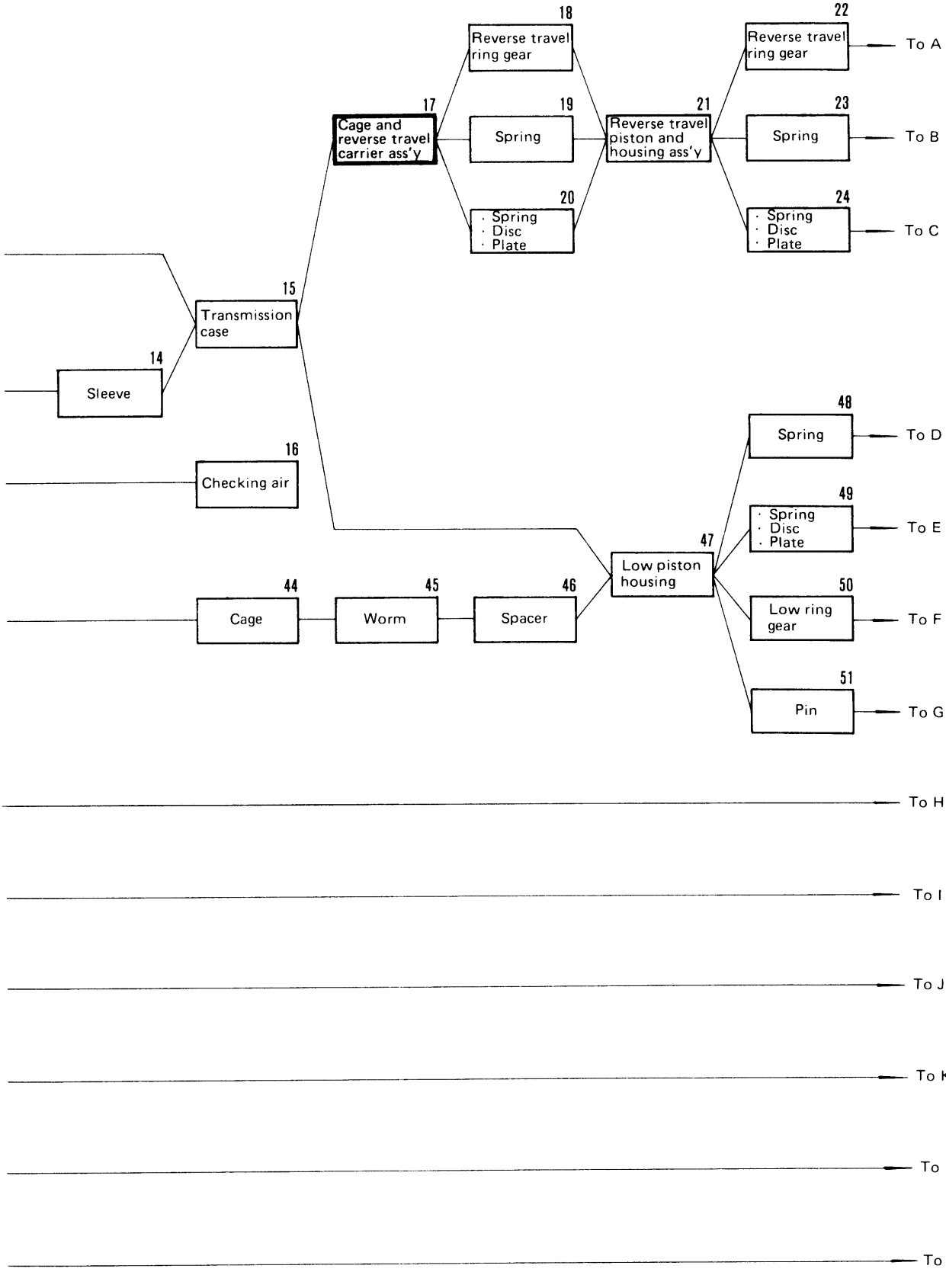


23P046

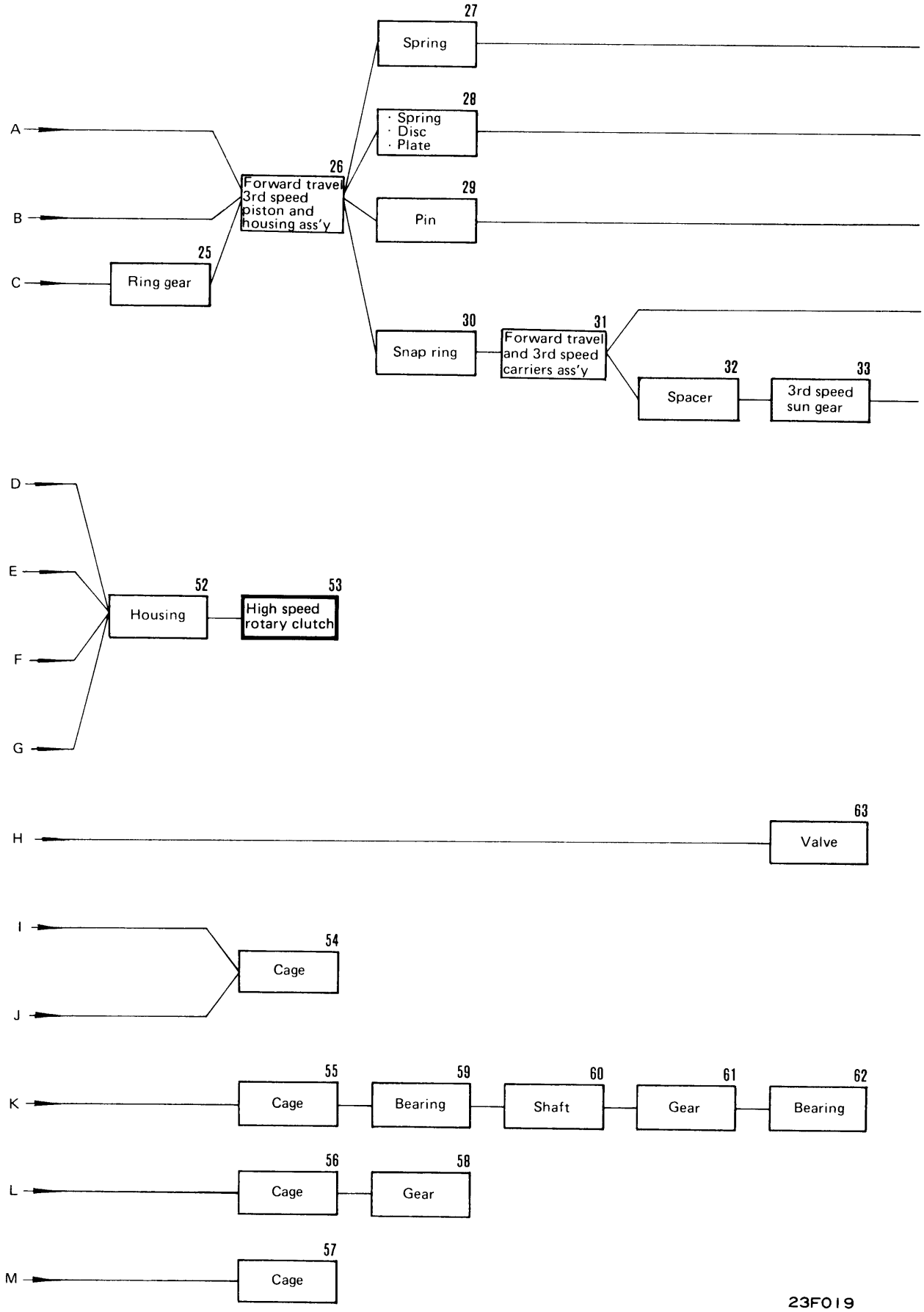
DISASSEMBLY OF HYDROSHIFT TRANSMISSION

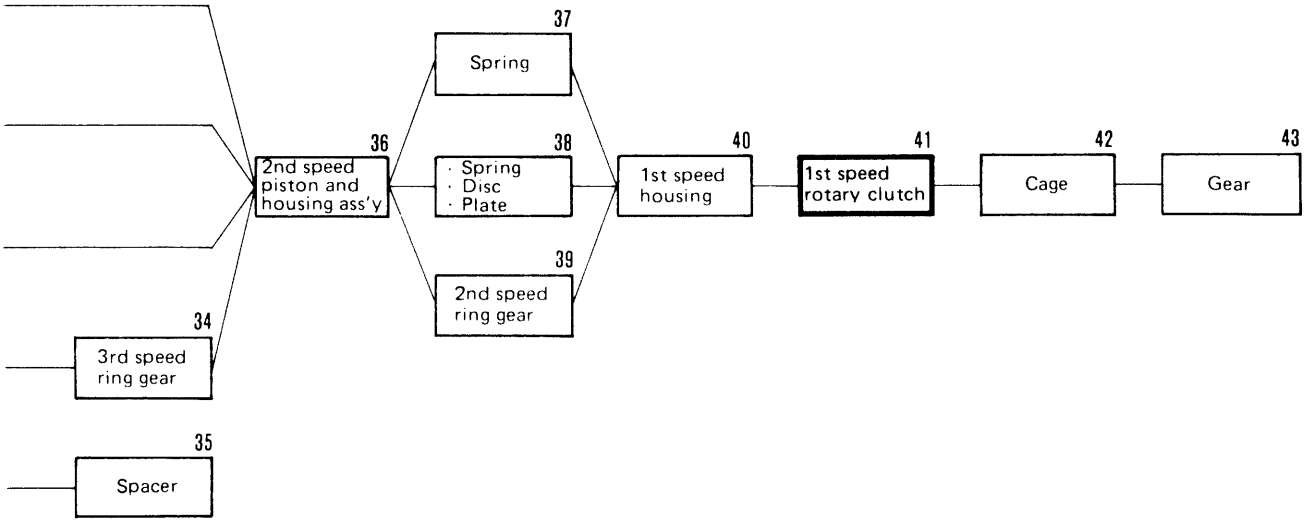
GD705R-4




18
Reverse travel ring gear
22
Reverse travel ring gear
To A
17
Cage and reverse travel carrier ass'y
19
Spring
21
Reverse travel piston and housing ass'y
23
Spring
To B
20
· Spring
· Disc
· Plate
24
· Spring
· Disc
· Plate
To C
15
Transmission case
14
Sleeve
48
Spring
To D
16
Checking air
49
· Spring
· Disc
· Plate
To E
47
Low piston housing
44
Cage
45
Worm
46
Spacer
50
Low ring gear
To F
51
Pin
To G
To H
To I
To J
To K
To L
To M

23F018

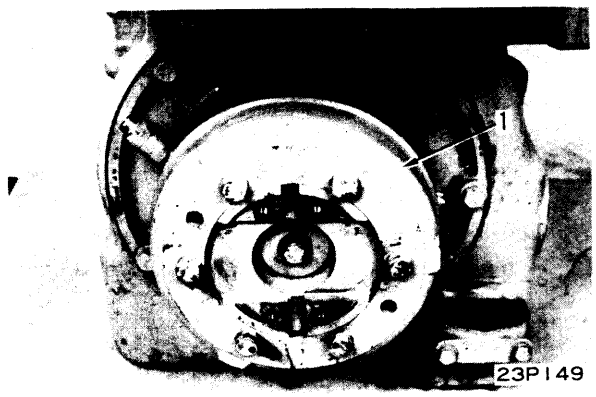

27
Spring
28
· Spring
· Disc
· Plate
A
26
Forward travel 3rd speed piston and housing ass'y
29
Pin
B
25
C
Ring gear
30
Snap ring
31
Forward travel and 3rd speed carriers ass'y
32
Spacer
33
3rd speed sun gear
D
E
52
Housing
53
High speed rotary clutch
F
G
63
H
Valve
I
54
Cage
J
55
59
60
61
62
K
Cage
Bearing
Shaft
Gear
Bearing
56
58
L
Cage
Gear
57
M
Cage
23F019



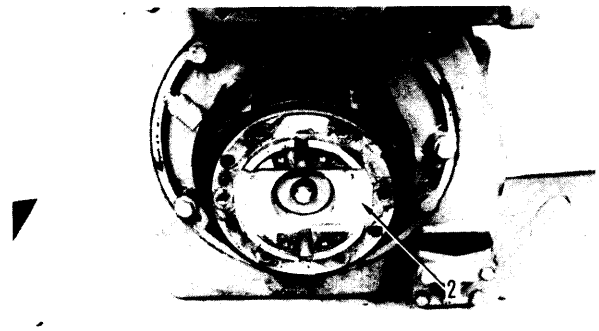
Special tool

	Part number	Part name	Q'ty
A	799-301-1300	Air checker	1

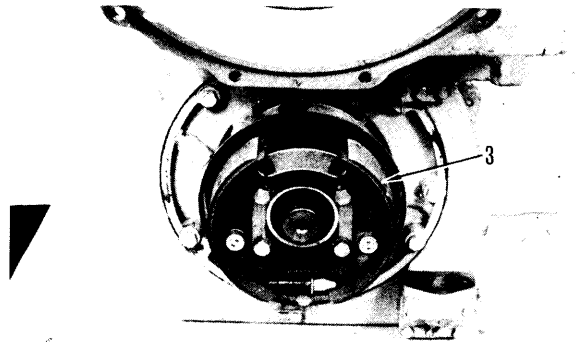
1. **Drum**
   Remove brake drum (1).



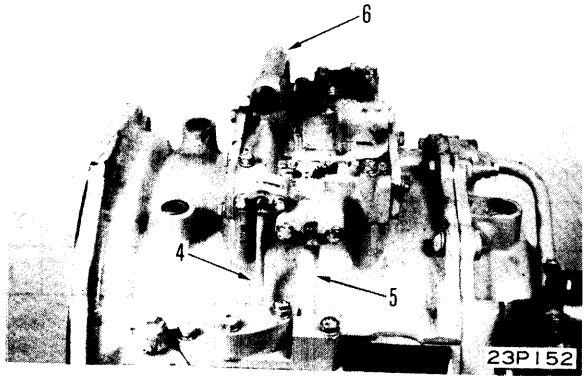
2. **Flange**
   Remove center bolt, remove flange (2).



3. **Parking brake**
Remove parking brake assembly (3).



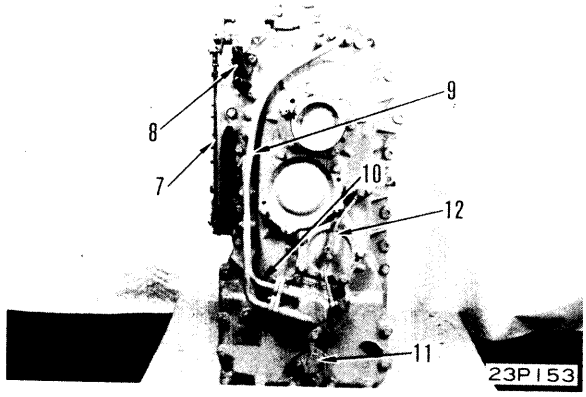
4. **Transmission control valve piping**
Remove transmission control valve tubes (4), (5) and (6).
★ Care should be taken not to let strainer to come out from the tube (4).



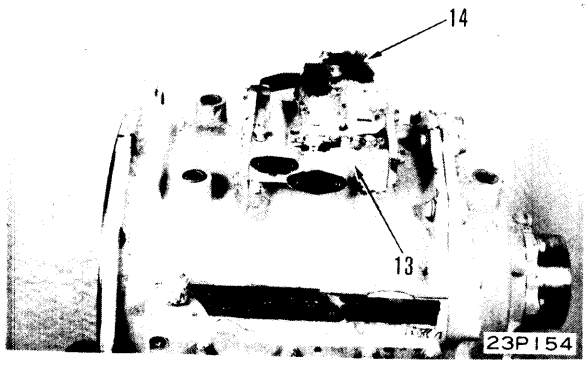
5. **Transmission control rod**
Disconnect transmission control rod (7) from lever and remove it together with bracket (8) as an assembly.

6. **Tube**
Remove tubes (9), (10) and (11).

7. **Lubricating tube**
Remove lubricating tube (12).

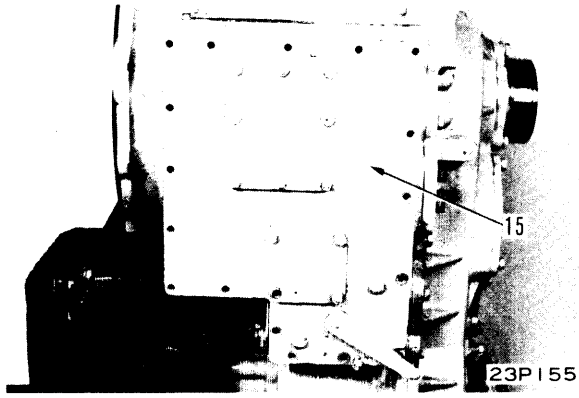


8. **Transmission control valve**
Remove transmission control valve (13) together with cooler bypass valve (14) as an assembly.



9. Cover

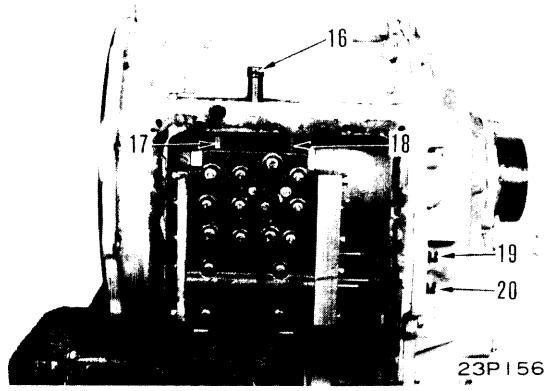
Screw in jack bolt and remove cover (15).



10. Sleeve

Screw in jack bolts (Thread dia. = 16 mm, Pitch = 2.0 mm) and remove sleeves (16), (17) and (18).

★ Since there are two kinds of sleeves, confirm their location before removal.

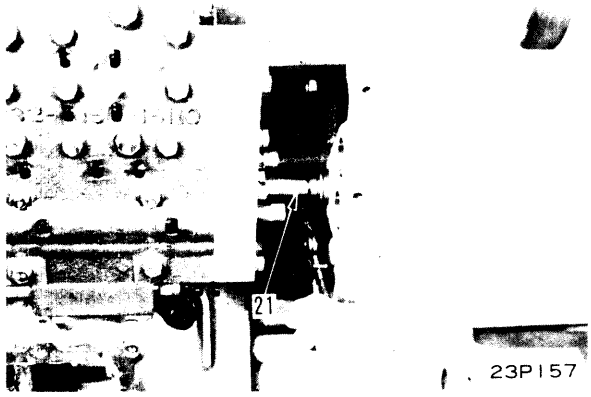


11. Yoke

Loosen lock nut and remove F–R yoke (19) and inching yoke (20) from spool.

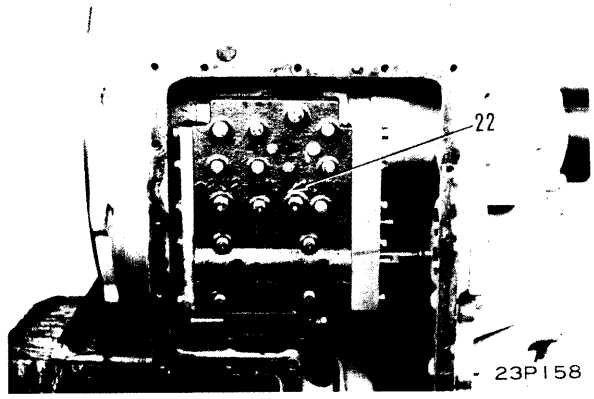
12. Sleeve

Remove snap ring and move sleeve (21) to the right side to disconnect from control valve.



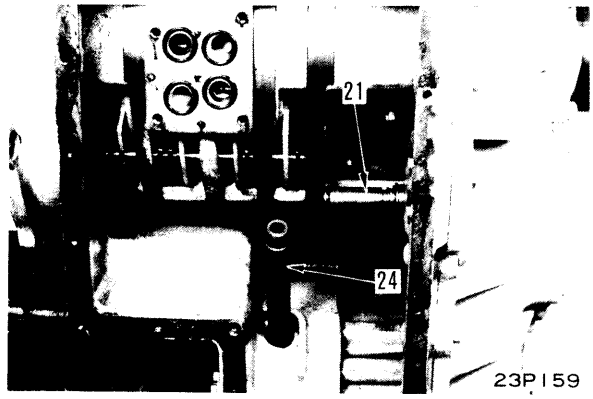
13. Transmission control valve

Remove four mounting bolts (Thread dia. = 10 mm) and lift transmission control valve (22) to remove.



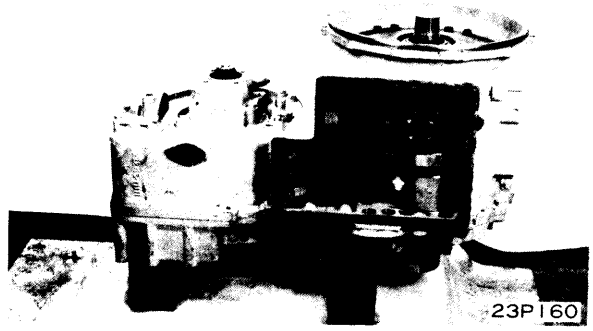
14. Sleeve

Remove sleeves (21) and (24).

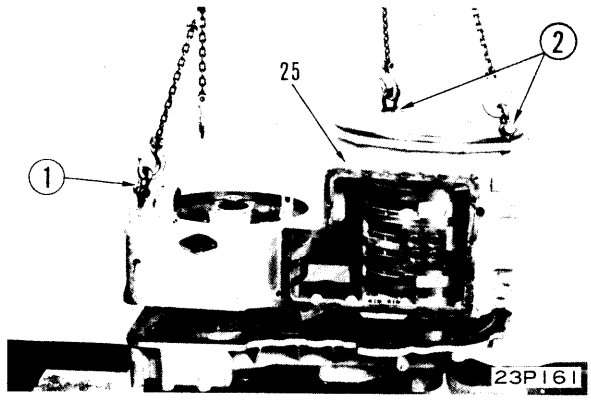


15. Transmission case

1) Set transmission in place with its transfer case faced down.
   ★ Before setting in place, remove mounting bolts tightened from transfer case side.



2) Install eye bolts ① (Thread dia. = 10 mm, Pitch = 1.75 mm) and ② (Thread dia. = 12 mm, Pitch = 1.75 mm). Sling and remove transmission case (25).
   ★ Slowly sling transmission case horizontally.
   kg Transmission case: Approx. 130kg

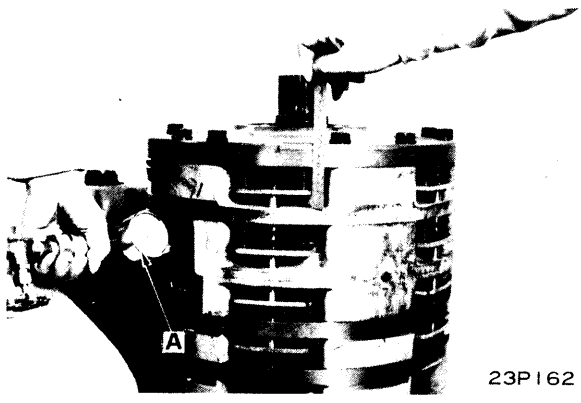


16. Checking air

Using tool **A**, measure piston stroke at each speed stage (F, R, 3rd, 2nd and L) as well as check their function.
★ Air pressure: 5kg/cm^2 min.
★ Pistn stroke

(Unit: mm)

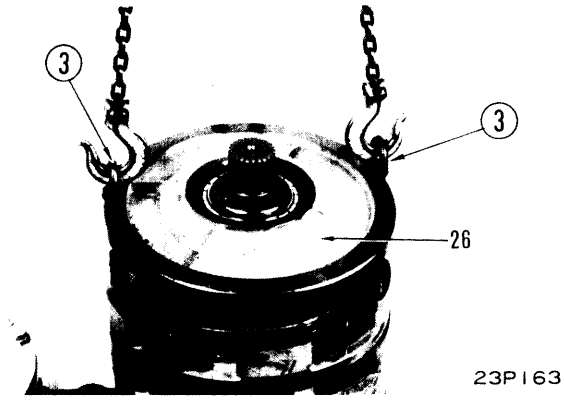
Speed stage	F	R	3rd	2nd	L
Stroke	3.5	3.5	2.5	2.5	3.5



17. Cage and reverse travel carrier assembly

1) Remove tie bolt.
2) Install eye bolts ③ (Thread dia. = 14 mm, Pitch = 2.0 mm). Sling and remove cage and reverse travel carrier assembly (26).

kg Cage and reverse travel carrier assembly: Approx. 35kg



18. Reverse travel ring gear

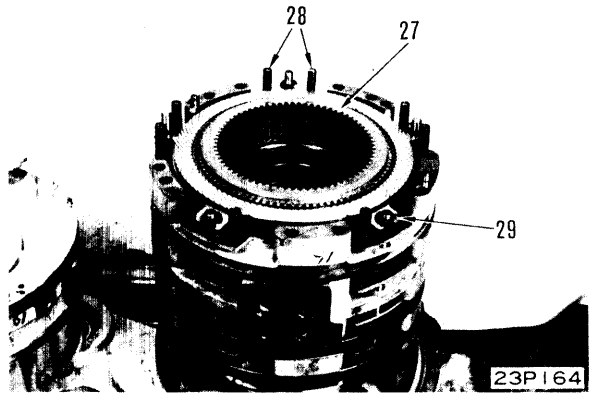
Remove ring gear (27).

19. Spring

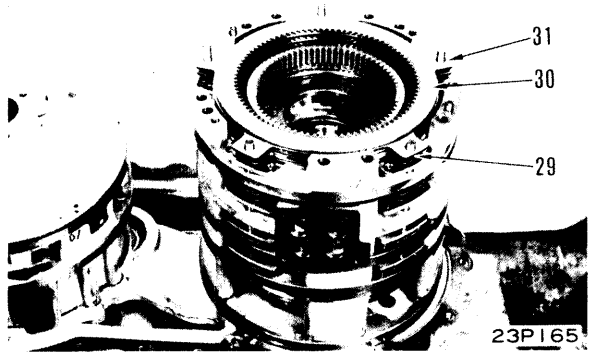
Remove spring (28).

20. Spring, Disc, Plate

1) Remove spring (29).

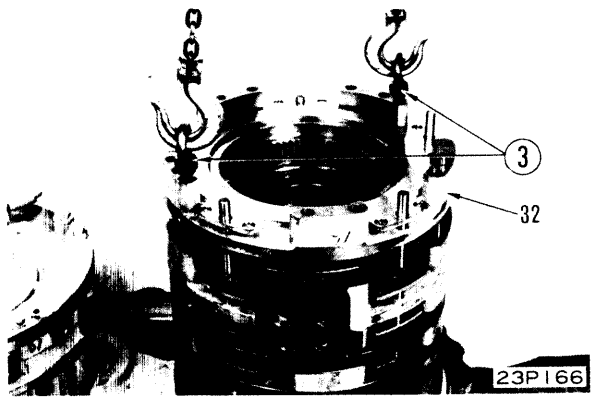


2) Remove discs (30), plates (31) and spring (29) in order.
   ★ Disc: 3 pcs. Plate: 2 pcs.



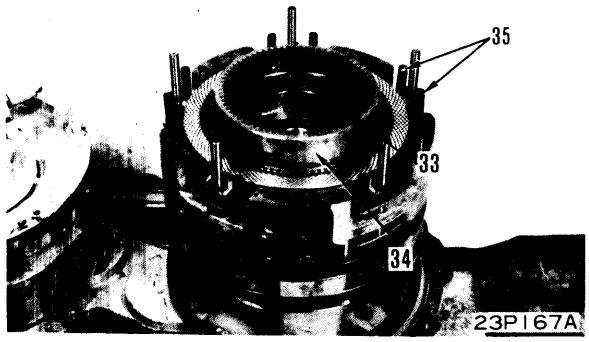
21. Reverse travel piston and housing assembly

Install eye bolts ③ (Thread dia. = 14 mm, Pitch = 2.0 mm). Sling and remove reverse travel piston and housing assembly (32).

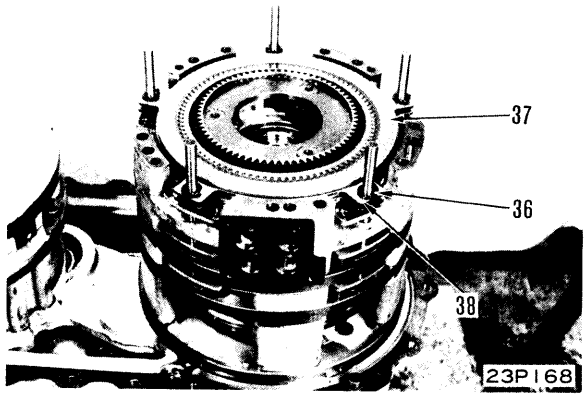


22. **Reverse travel ring gear**
Remove snap ring (33), remove ring gear (34).

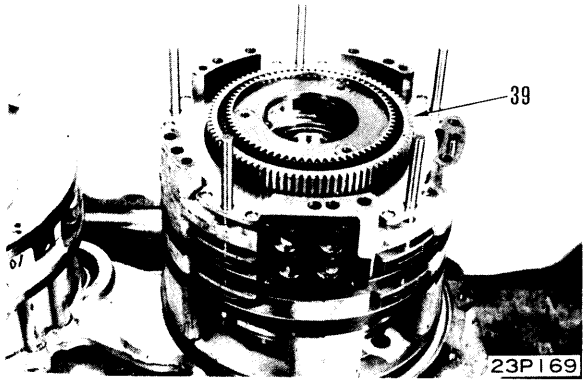
23. **Spring**
Remove spring (35).



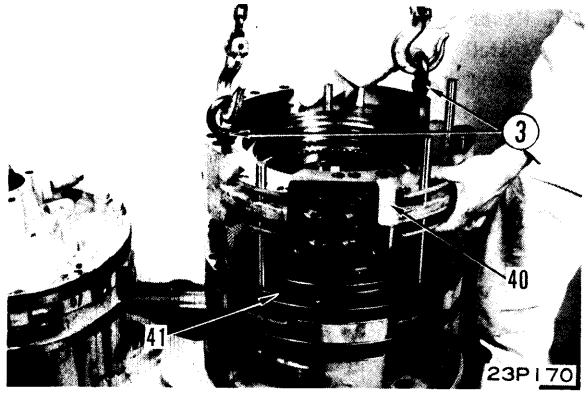
24. **Spring, Disc, Plate**
Remove spring (36), discs (37) and plates (38).
★ Disc: 3 pcs. Plate: 2 pcs.



25. **Ring gear**
Remove ring gear (39).
★ Confirm installing direction of ring gear before removal.



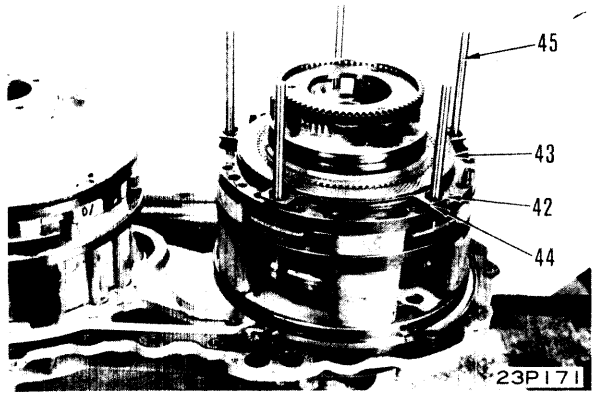
26. **Forward travel and 3rd speed pistons and housing assembly**
Install eye bolts ③ (Thread dia. = 14 mm, Pitch = 2.0 mm). Sling and remove forward travel and 3rd speed pistons and housings assembly (40).
★ Hold 3rd speed piston by the hand to prevent falling.
kg Forward and 3rd speed pistons and housings assembly: Approx. 35kg



27. **Spring**
Remove spring (41).

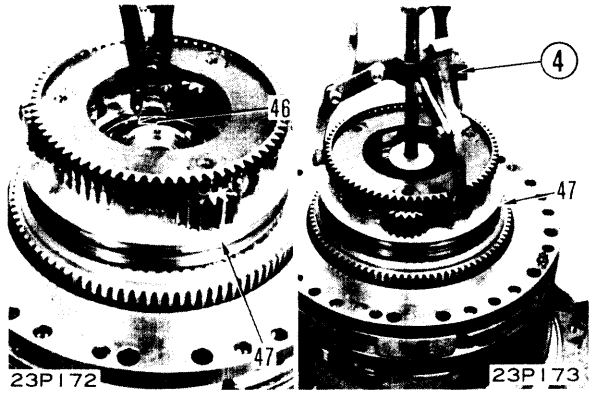
28. Spring, Disc, Plate
Remove spring (42), discs (43) and plate (44) in order.
★ Disc: 2 pcs. Plate: 1 pc.

29. Pin
Remove pin (45).



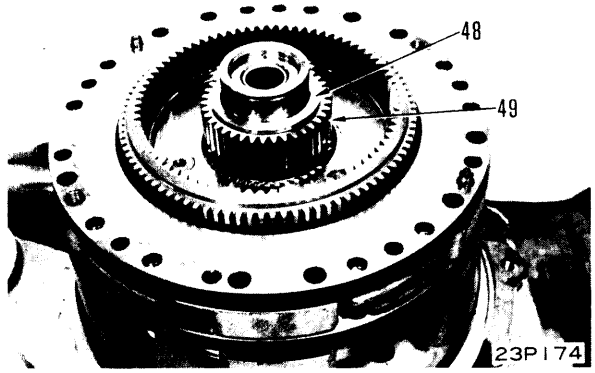
30. Snap ring
Remove snap ring (46).

31. Forward travel and 3rd speed carriers assembly
Using gear puller ④ (φ219) pull out forward and 3rd speed carriers assembly (47).



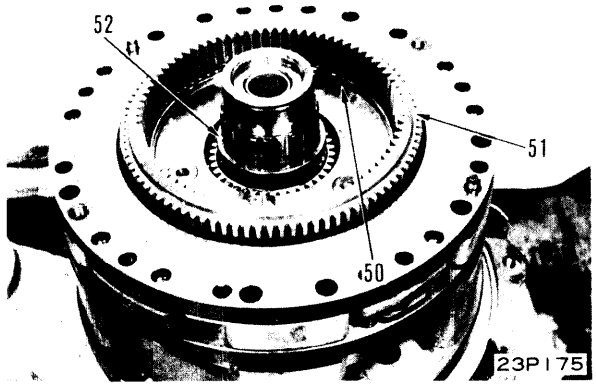
32. Spacer
Remove spacer (48).

33. 3rd speed sun gear
Remove 3rd speed sun gear (49).



34. 3rd speed ring gear
Remove snap ring (50), remove 3rd speed ring gear (51).

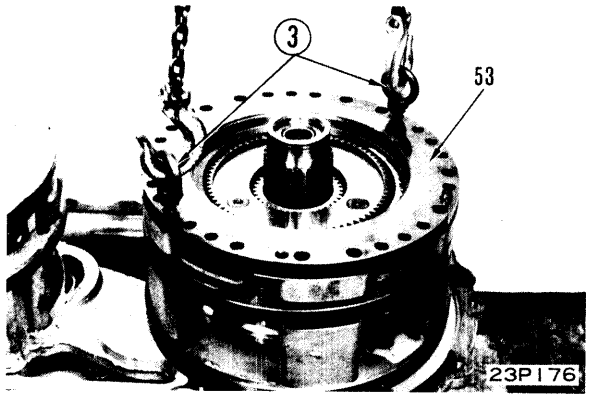
35. Spacer
Remove spacer (52).



36. 2nd speed piston and housing assembly

Install eye bolts ③ (Thread dia. = 14 mm, Pitch = 2.0 mm). Sling and remove 2nd speed piston and housing assembly (53).

★ Hold piston by the hand to prevent falling.



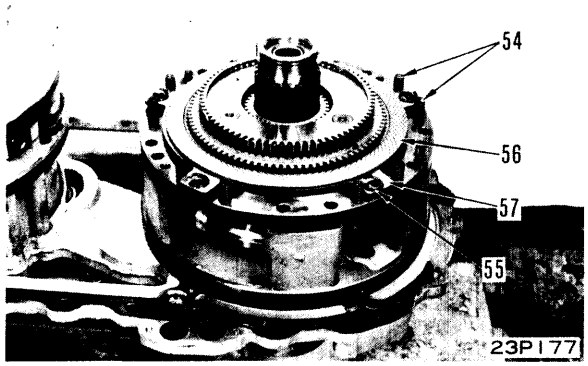
37. Spring

Remove spring (54).

38. Spring, Disc, Plate

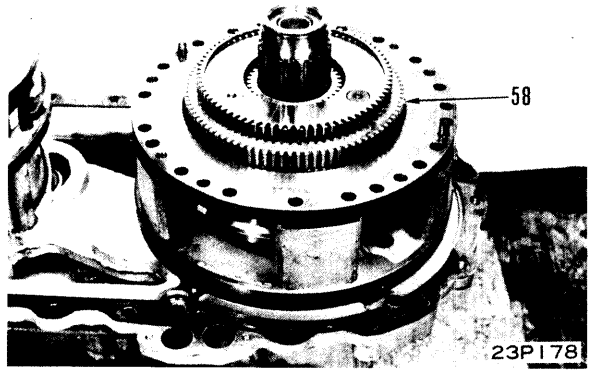
Remove spring (55), discs (56) and plate (57).

★ Disc: 2 pcs. Plate: 1 pc.



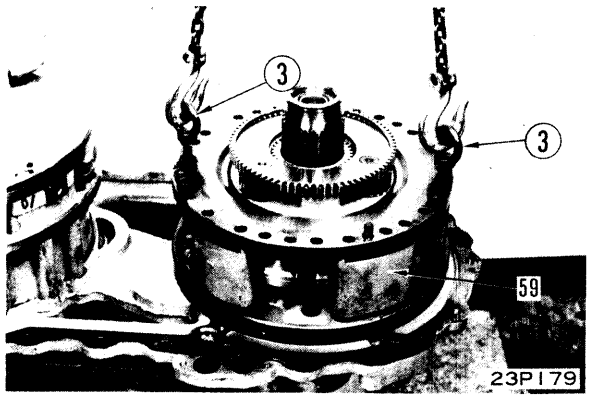
39. 2nd speed ring gear

Remove 2nd speed ring gear (58).



40. 1st speed housing

Install eye bolts ③ (Thread dia. = 14 mm, Pitch = 2.0 mm). Sling and remove 1st speed housing (59).

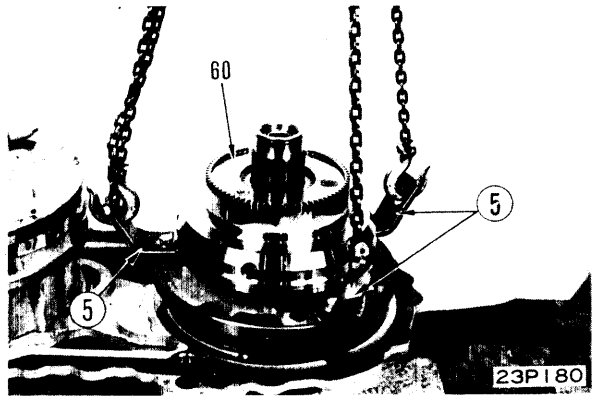


41. 1st speed rotary clutch

Install sling plate ⑤ . Sling and remove 1st speed clutch (60).

kg 1st speed clutch: Approx. 85kg

★ Sling plate mounting bolt:
Thread dia. = 14 mm, Pitch = 2.0

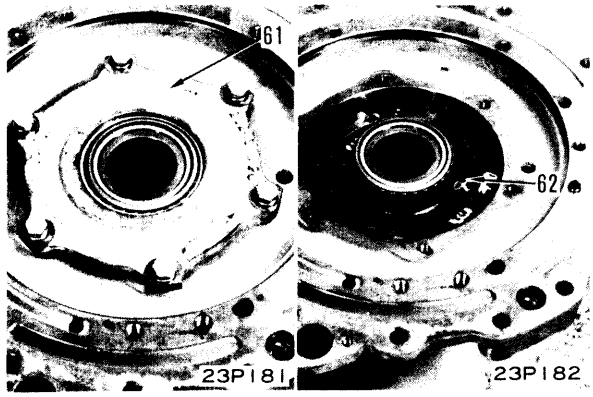


42. Cage

Remove cage (61).

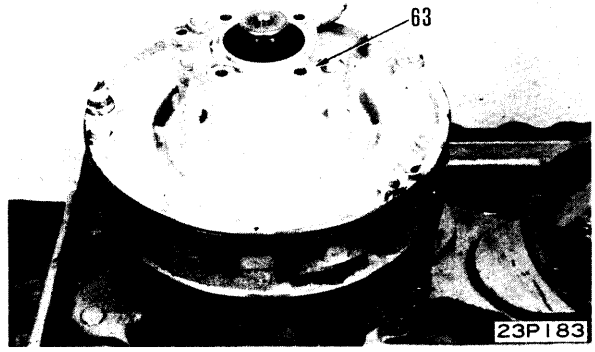
43. No. 1 gear

Remove No. 1 gear (62).



44. Cage

Remove cage (63).

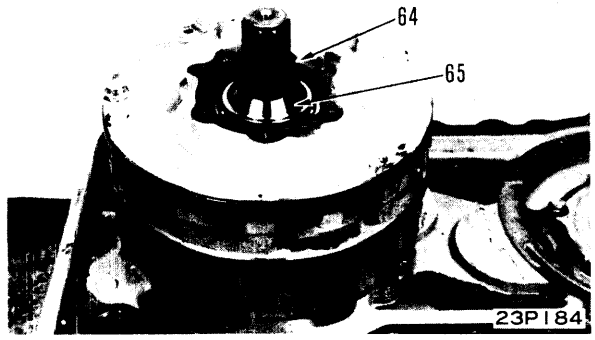


45. Worm

Remove worm (64).

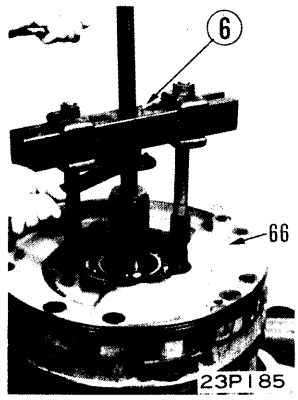
46. Spacer

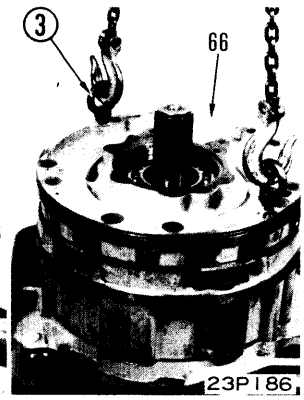
Remove spacer (65).



47. Low piston housing

1) Remove tie bolt.
2) Using push puller ⑥ pull out low piston housing (66) from shaft.
3) Install eye bolts ③ (Thread dia. = 14 mm, Pitch = 2.0 mm). Sling and remove low piston housing.
   ★ Hold piston with the hand to prevent falling.



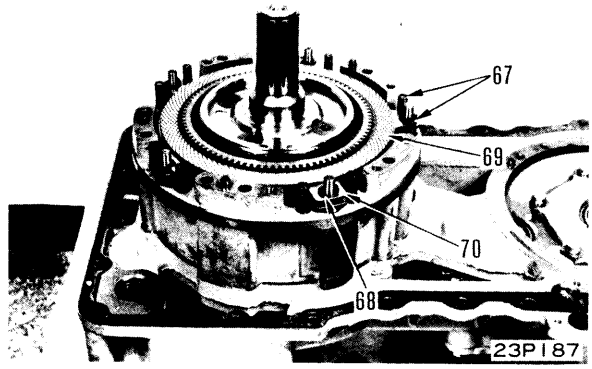


48. Spring

Remove spring (67).

49. Spring, Disc, Plate

Remove spring (68), discs (69) and plates (70) in order.
★ Disc: 3 pcs. Plate: 2 pcs.

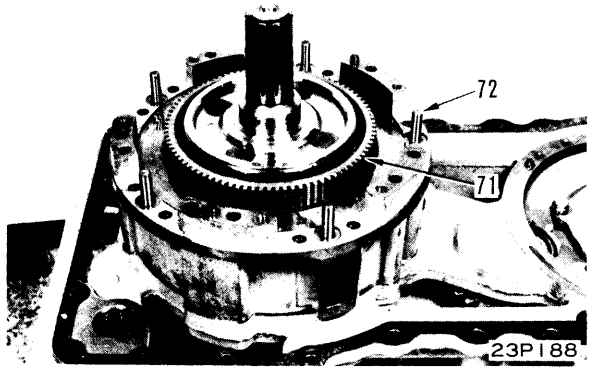


50. Low ring gear

Remove low ring gear (71).

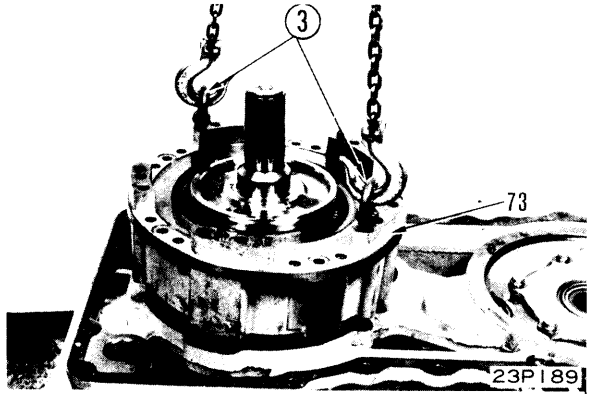
51. Pin

Remove pin (72).



52. Housing

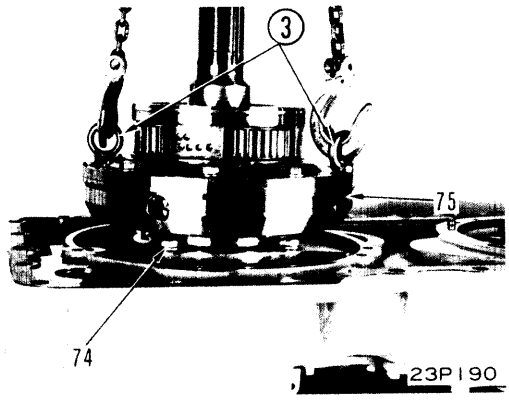
Install eye bolts ③ (Thread dia. = 14 mm, Pitch = 2.0 mm). Sling and remove housing (73).



53. High speed rotary clutch

1) Remove four cage mounting bolts (74).
2) Install eye bolts ③ (Thread dia. = 14 mm, Pitch = 2.0 mm). Sling and remove high speed rotary clutch (75).

kg High speed rotary clutch: Approx. 75kg



54. Cage

1) Place transfer in place with its mounting face down.
2) Screw in jack bolt and remove cage (76).
   ★ Keep shims identified their location.

55. Cage

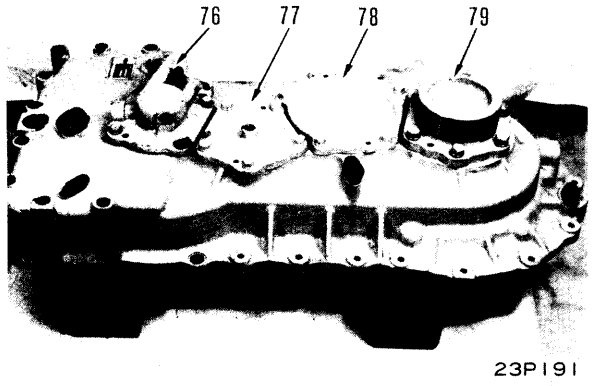
Screw in jack bolt and remove cage (77).

★ Keep shims identified their location.

56. Cage

Screw in jack bolt and remove cage (78).

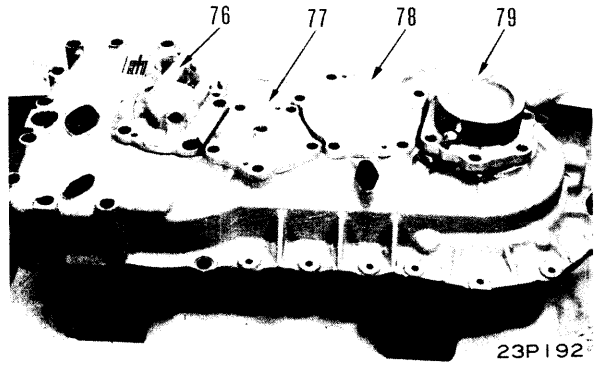
★ Keep shims identified their location.



57. Cage

Screw in jack bolt and remove cage (79).

★ Keep shims identified their location.

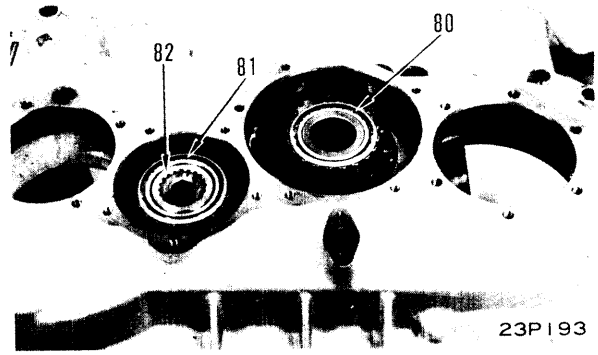


58. No. 2 gear

Remove gear (80).

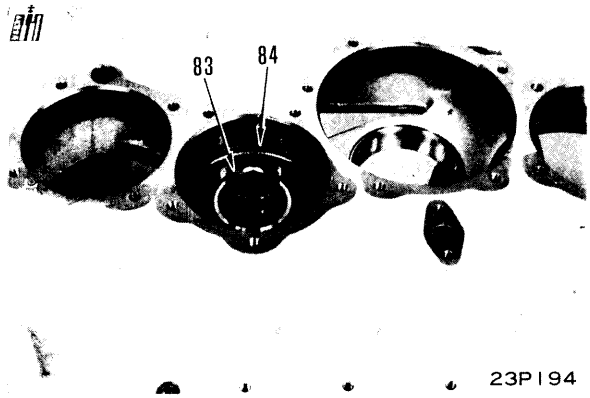
59. Bearing

Remove bearing (81) together with collar (82) as an assembly.

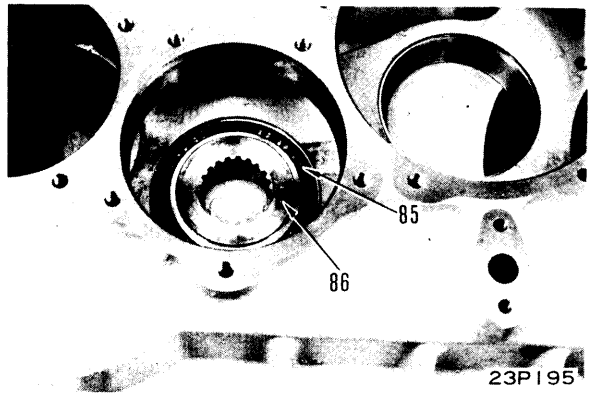


60. Shaft
Remove shaft (83).

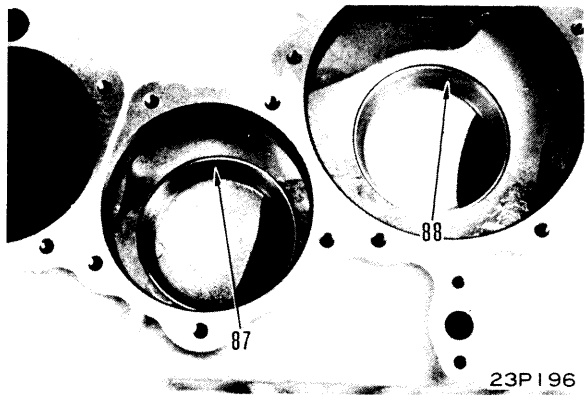
61. No. 3 gear
Remove gear (84).



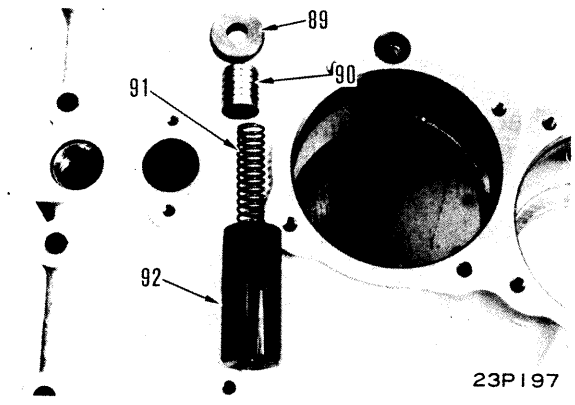
62. Bearing
1) Remove bearing (85) together with collar (86) as an assembly.



2) Remove bearing outer races (87) and (88) from transfer case.

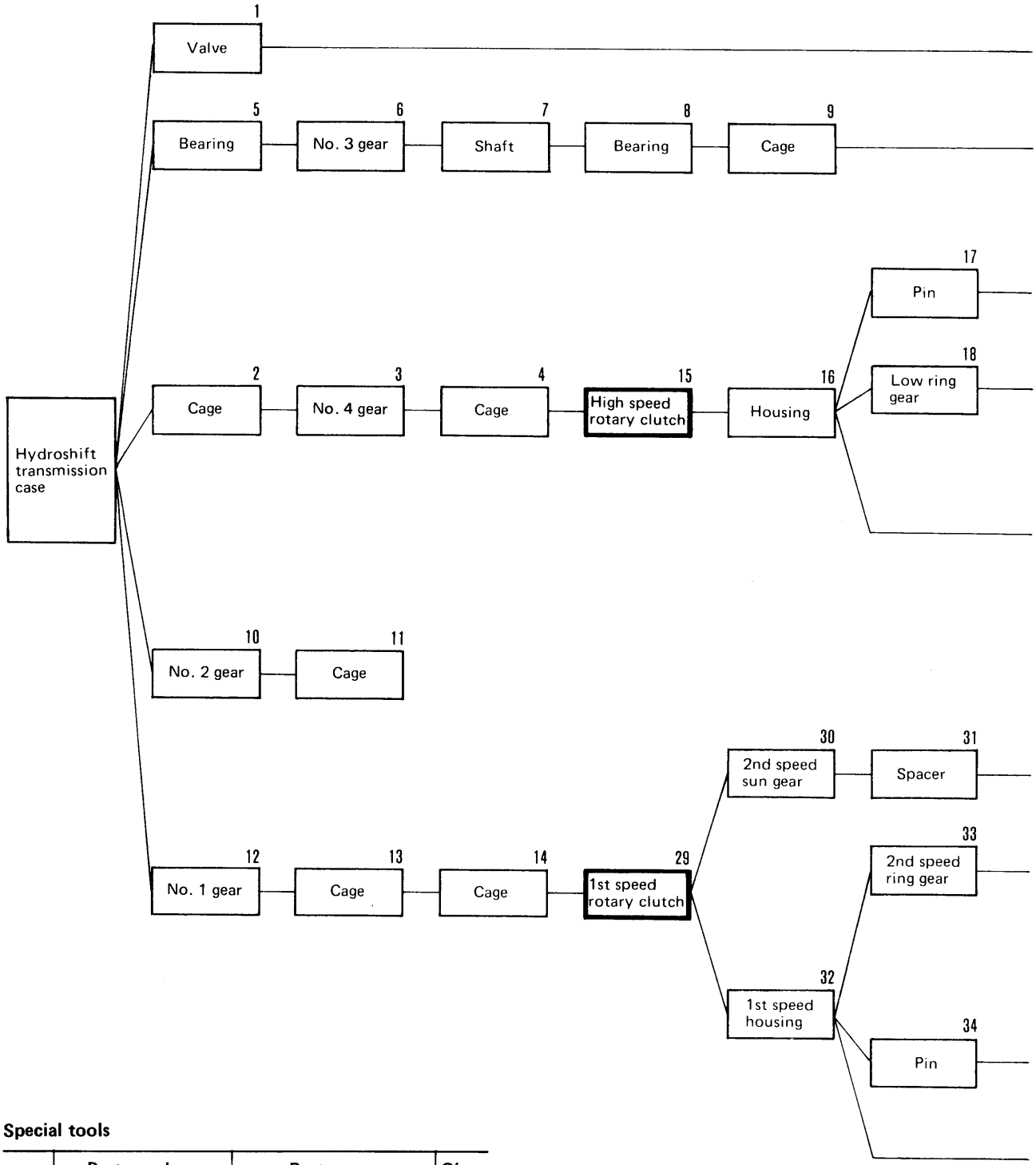


63. Valve
Remove plate (89), remove valve (90), spring (91) and sleeve (92).



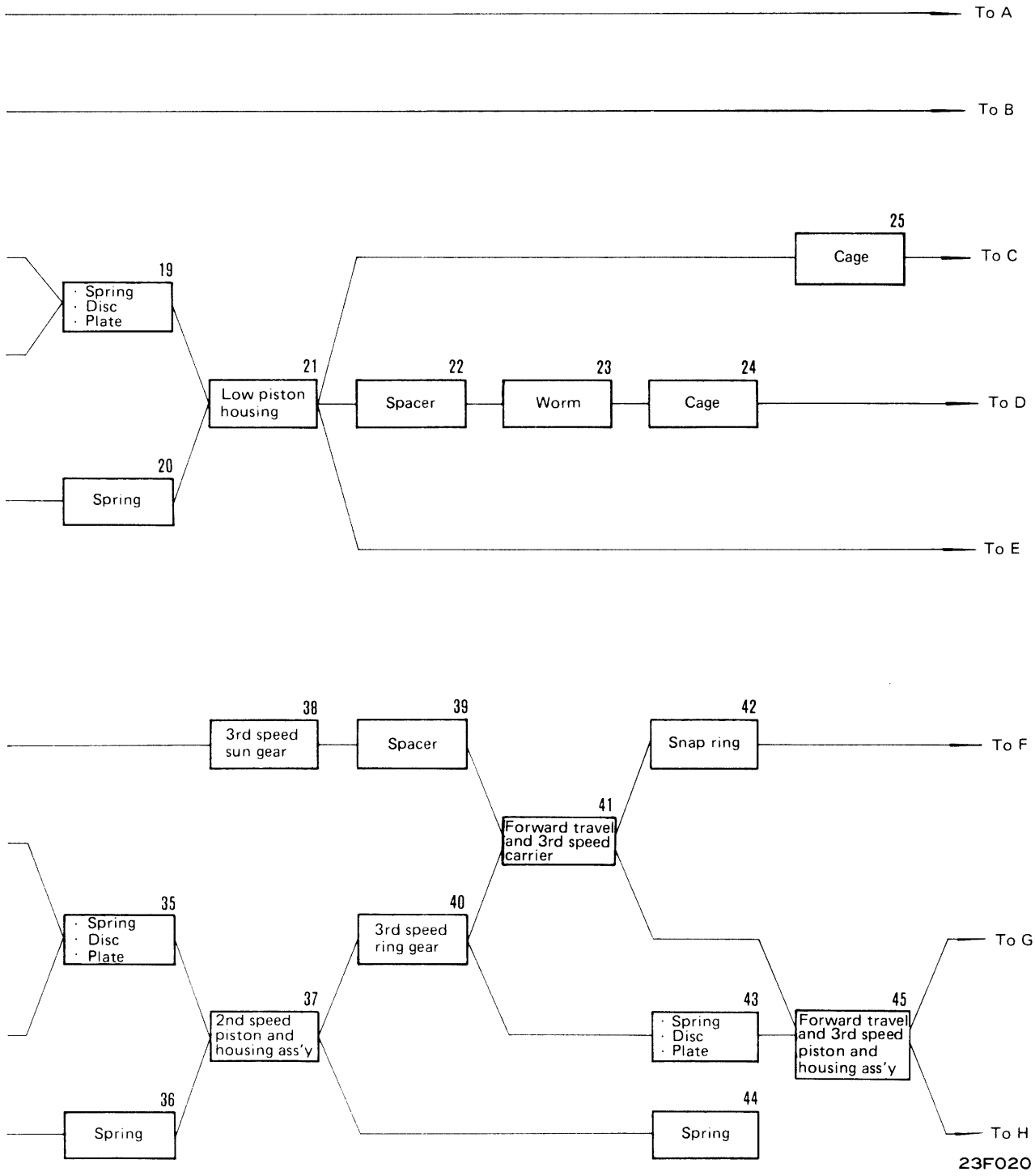
ASSEMBLY OF HYDROSHIFT TRANSMISSION

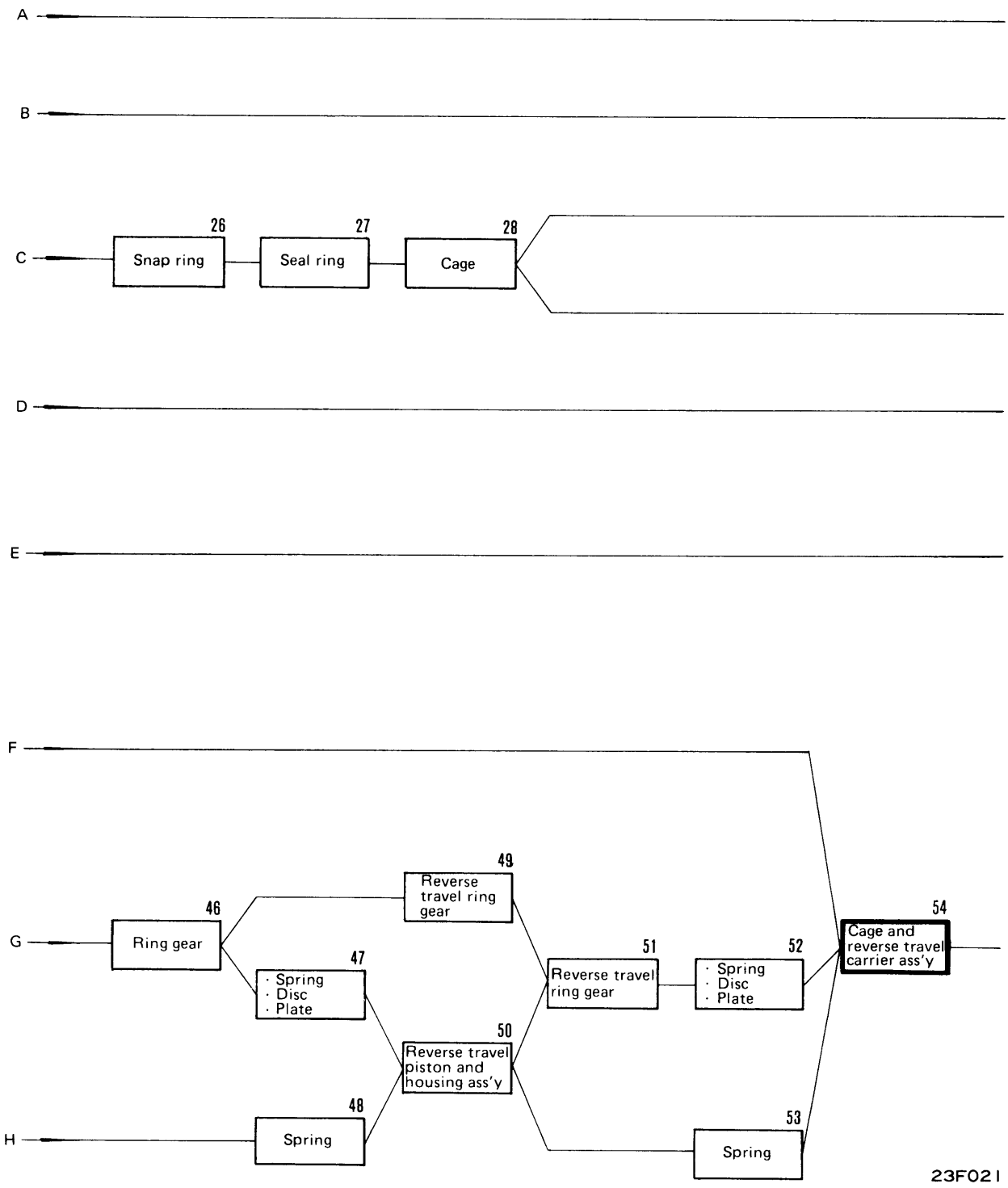
GD705R-4

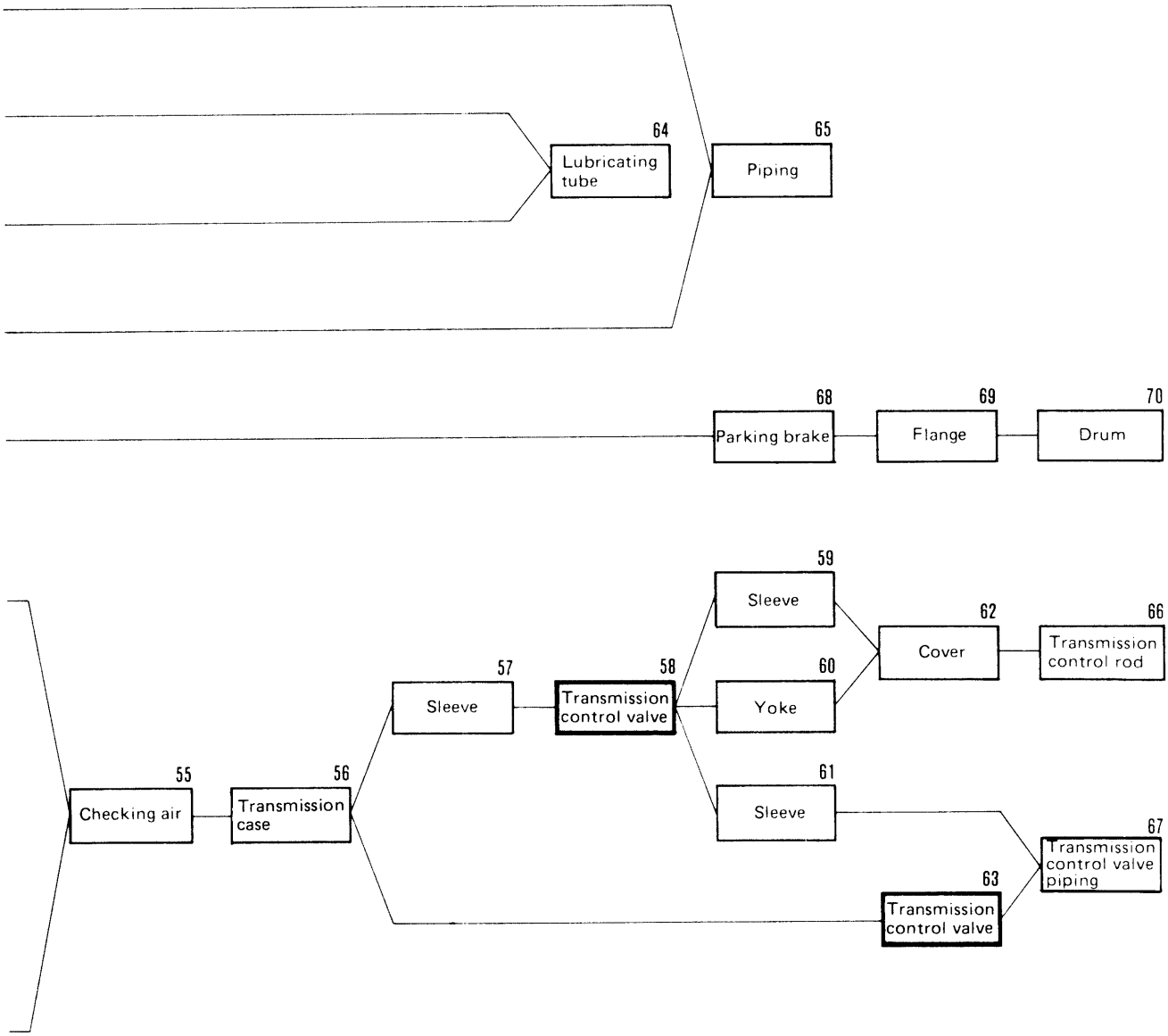


Special tools

	Part number	Part name	Q'ty
A	799-301-1300	Air checker	1
B	792-371-1500	Spline shaft	1
	795-630-1830	Adaptor	1
	795-630-1810	Torque wrench	1

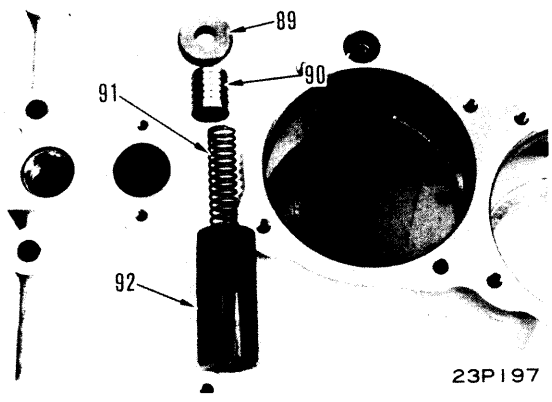

To A
To B
25
Cage
To C
19
· Spring
· Disc
· Plate
21
Low piston housing
22
Spacer
23
Worm
24
Cage
To D
20
Spring
To E
38
3rd speed sun gear
39
Spacer
42
Snap ring
To F
41
Forward travel and 3rd speed carrier
35
· Spring
· Disc
· Plate
40
3rd speed ring gear
To G
37
2nd speed piston and housing ass'y
43
· Spring
· Disc
· Plate
45
Forward travel and 3rd speed piston and housing ass'y
36
Spring
44
Spring
To H
23F020


A
B
C
26
Snap ring
27
Seal ring
28
Cage
D
E
F
G
H
46
Ring gear
47
· Spring
· Disc
· Plate
48
Spring
49
Reverse travel ring gear
50
Reverse travel piston and housing ass'y
51
Reverse travel ring gear
52
· Spring
· Disc
· Plate
53
Spring
54
Cage and reverse travel carrier ass'y
23F021

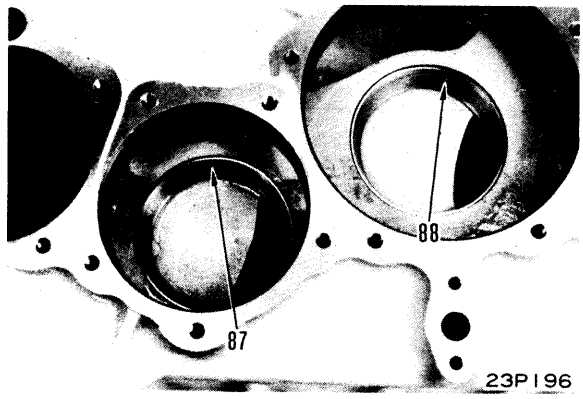


★ **Apply engine oil to sliding portion of each part before installing.**

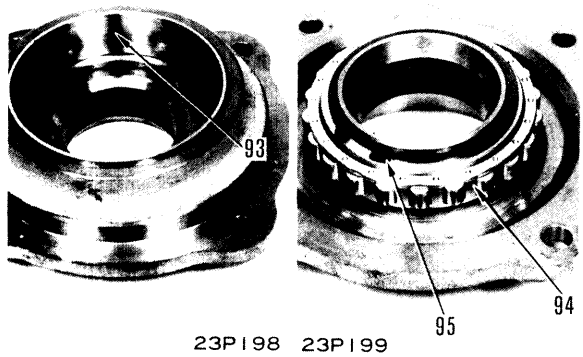
1. **Valve**
   1) Fix transfer case with its mounting face down.
   2) Install sleeve (92), install spring (91), valve (90) and plate (89).



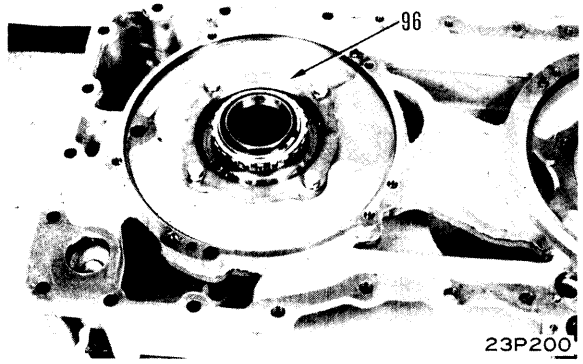
2. **Cage**
   1) Using push tool (φ130) press-fit bearing outer races (87) and (88).



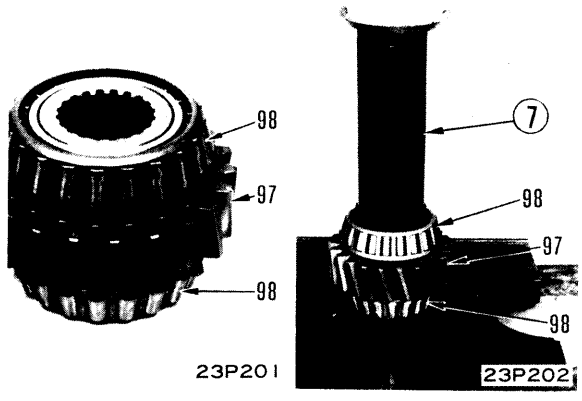
   2) Using push tool (φ130) press-fit bearing outer race (93).
   3) Using push tool (φ90) press-fit bearing (94) and install snap ring (95) to lock bearing.



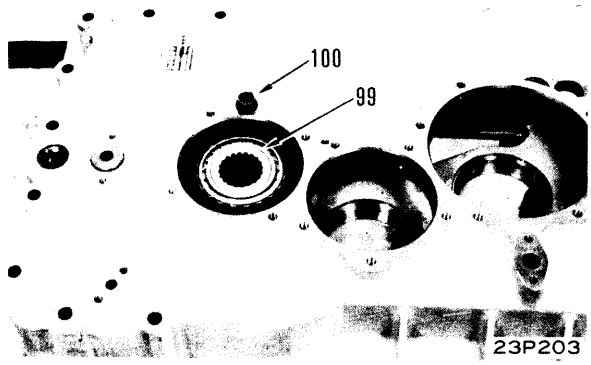
   4) Fix transfer case with its mounting face up.
   5) Install cage (96).



3. **No. 4 gear**
   1) Using press-fitting tool ⑦ (φ75) press-fit bearing (98) to gear (97).

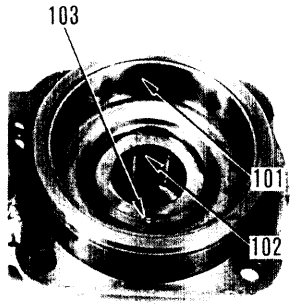


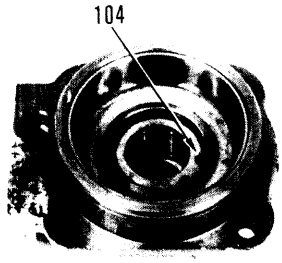
2) Fix transfer case with its mounting face down.
3) Install No. 4 gear (99).
   ★ Number of teeth: Z = 22
4) Fit O-ring and install sleeve (100).



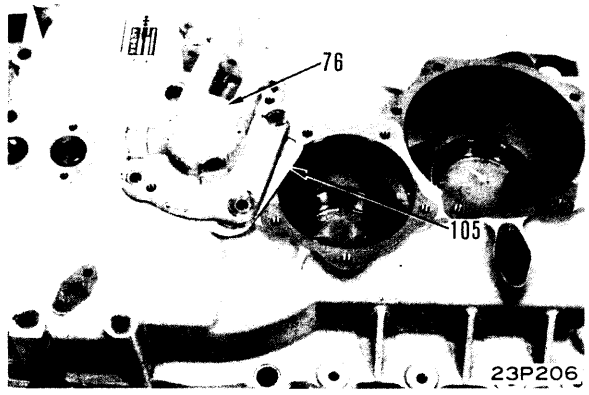
4. Cage

1) Using press-fitting tool (ϕ130) press-fit bearing outer race (101).
2) Using press-fitting tool (ϕ70) press-fit collar (102) aligning mounting position and install ball (103).
   ★ If mounting position is not aligned, ball cannot be installed.
3) Install snap ring (104) to press ball.

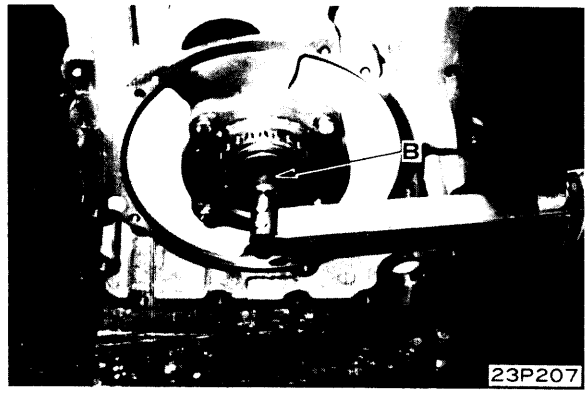




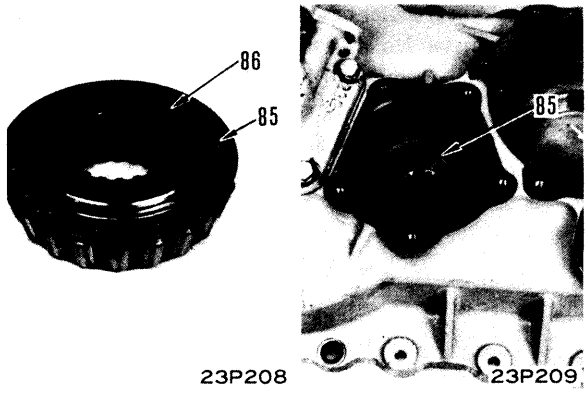
4) Insert shims (105) into mounting portion and install cage (76).
   ★ Use removed shims, the same amount at upper and lower sides.
   kgm Mounting bolt: 11 ± 1.5kgm



5) Adjusting bearing preload
   ★ Transfer gears are No. 1, No. 2 and No. 4 from input side.
   i) Fix transfer case with its mounting face directed frontward.
   ii) Install tool **B** to measure starting torque of No. 4 gear alone and confirm that it is within standard. Adjustment can be accomplished by increasing or decreasing shims.
      ★ Starting torque: 1 to 10 kgcm
      ★ Measure starting torque after racing gear 4 or 5 turns and use the minimum value.

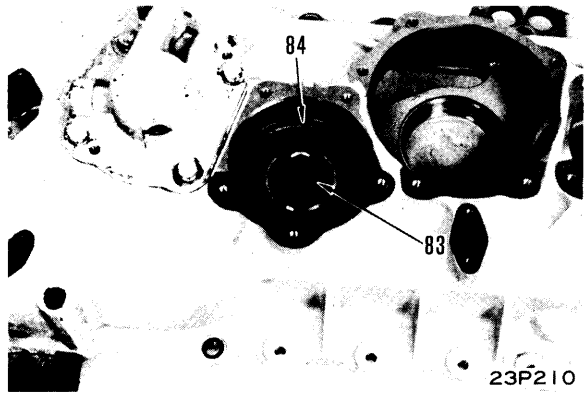


5. **Bearing**
   1) Fix transfer case with its mounting face down.
   2) Press-fit bearing (85) into collar (86) and install it on transfer case.

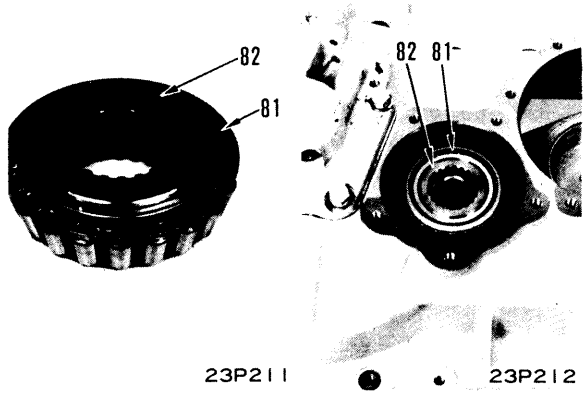


6. **No. 3 gear**
   Install No. 3 gear (84).
   ★ Number of teeth: Z = 30
   ★ Gear has proper installing direction and install it with its spot faced boss faced up.

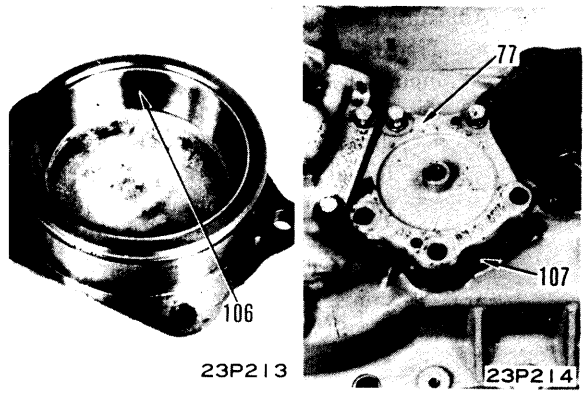
7. **Shaft**
   Install snap ring and install shaft (83).



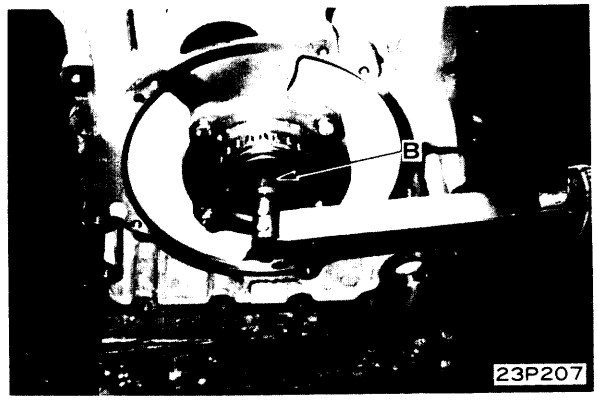
8. **Bearing**
   Press-fit bearing (81) to collar (82) and install it on shaft.



9. **Cage**
   1) Using press-fitting tool (ϕ130) press-fit bearing outer race (106).
   2) Fit O-ring and install cage (77) with shims (107) inserted into mounting portion.
      ★ Use removed shims as they are, the same amount at right and left sides.
      kgm Mounting bolt: 11 ± 1.5kgm

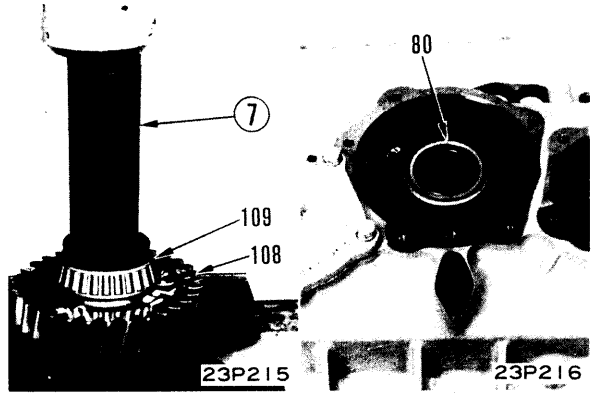


3) Adjusting bearing preload
   i) Fix transfer case with its mounting face directed frontward.
   ii) Install tool **B** and measure starting torque with No. 4 gear (total starting torque of No. 4 and No. 3 gears) and confirm that it is within standard. Adjustment can be accomplished by increasing or decreasing shims.
   - ★ Starting torque: 2 to 17 kgcm
   - ★ Measure starting torque after racing gear 4 or 5 turns and use the minimum value.
   - ★ Adjust preload so that starting torque increases more than 1kgcm and less than 10kgcm as gear is added one each.



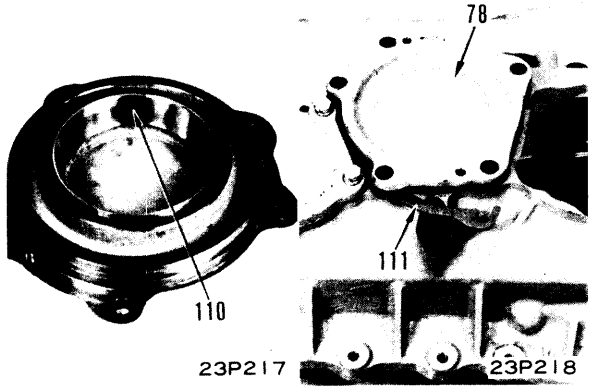
10. No. 2 gear

1) Using press-fitting tool ⑦ (ϕ75) press-fit bearings (109) to both ends of gear (108).
2) Install gear (80).
   - ★ Number of teeth: Z = 31

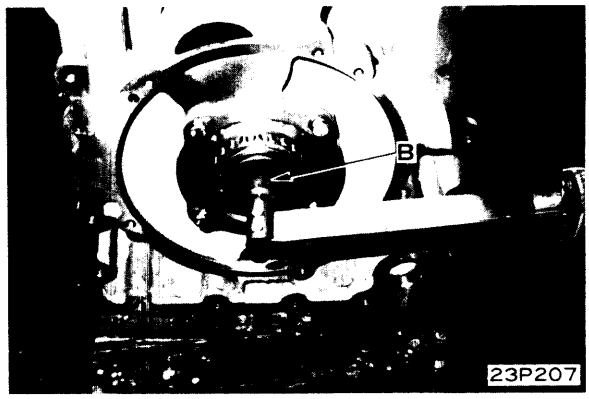


11. Cage

1) Using press-fitting tool (ϕ130) press-fit bearing outer race (110).
2) Fit O-ring, inserted shims (111) to mounting portion, install cage (78).
   Use removed shims as they are, the same amount at right and left sides.
   - kgm Mounting bolt: 11 ± 1.5kgm

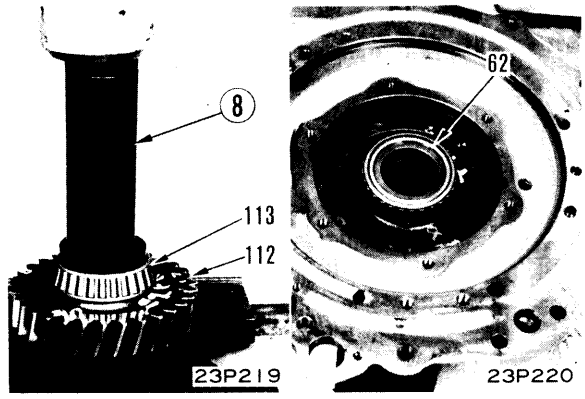


3) Adjusting bearing preload
   Install tool **B** in the same manner described in 9-3) section, measure starting torque with No. 4 gear (total starting torque of No. 4, No. 3 and No. 2 gears) and confirm that it is within standard. Adjustment can be accomplished by increasing or decreasing shims.
   - ★ Starting torque: 3 to 24 kgcm
   - ★ Other instructions are subject to those described in 9-3) section.



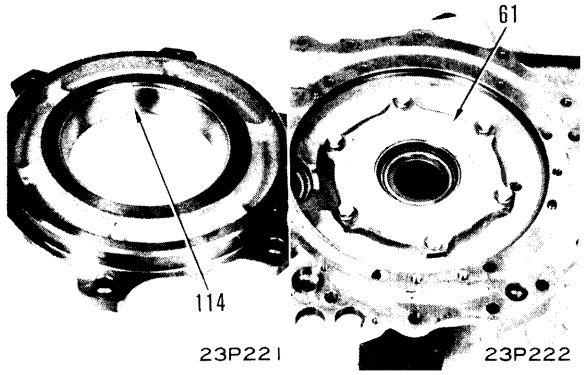
12. No. 1 gear

1) Fix transfer case with its mounting face up.
2) Using press-fitting tool ⑧ (φ85) press-fit bearings (113) to both ends of gear (112).
3) Install No. 1 gear (62).
   ★ Number of teeth: Z = 32



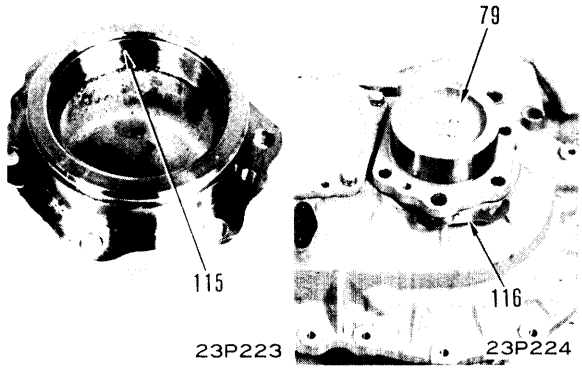
13. Cage

1) Using press-fitting tool (φ130) press-fit bearing outer race (114).
2) Install cage (61).

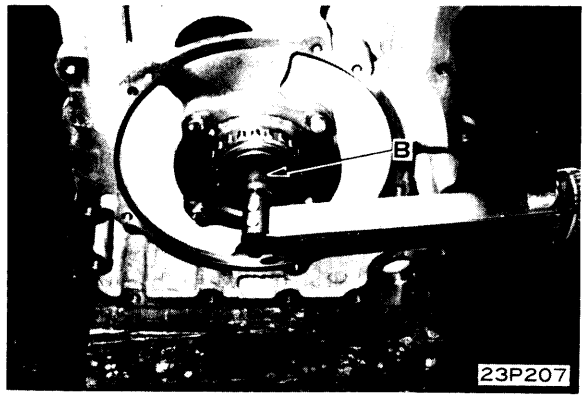


14. Cage

1) Fix transfer case with its mounting face down.
2) Using press-fitting tool (φ130) press-fit bearing outer race (115).
3) Fit O-ring, insert shims (116) to mounting portion, install cage (79).
   kgm Mountng bolt: 17 ± 1kgm



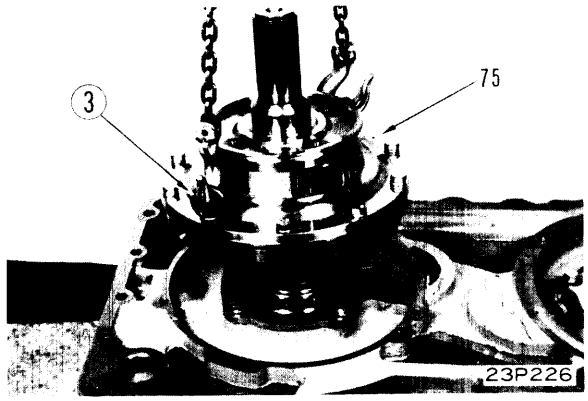
4) Adjusting bearing preload
   Install tool **B** in the same manner as described in 9-3) section, measure starting torque with No. 4 gear (total starting torque of No. 4, No. 3, No. 2 and No. 1 gears), confirm that it is within standard. Adjustment can be accomplished by increasing or decreasing shims.
   ★ Starting torque: 3.5 to 30.5 kgcm
   ★ Other instructions are subject to those described in 9-3) section.



15. High speed rotary clutch

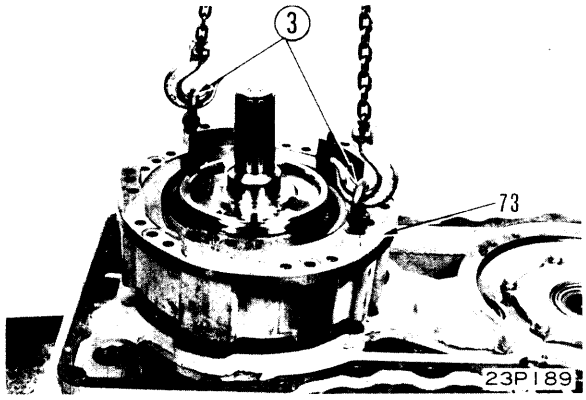
1) Fix transfer case with its mounting face up.
2) Install eye bolts ③ (Thread dia. = 14 mm, Pitch = 2.0 mm). Sling and remove high speed rotary clutch (75).

kg High rotary clutch: Approx. 70kg



16. Housing

Install eye bolts ③ (Thread dia. = 14 mm, Pitch = 2.0 mm). Sling and install housing (73).



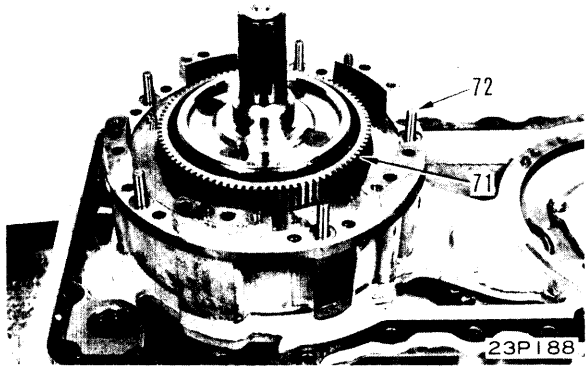
17. Pin

Install pin (72).

18. Low ring gear

Install low ring gear (71).

★ Install ring gear with its recessed inner teeth side up.



19. Spring, Disc, Plate

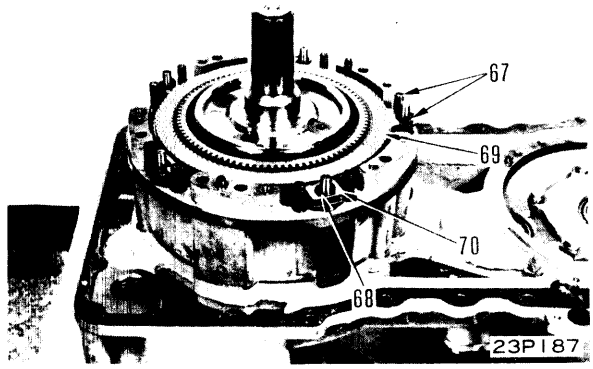
Install spring (68), discs (69) and plates (70).

★ Install discs aligning their notches in the same position.

★ Disc: 3 pcs. Plate: 2 pcs.

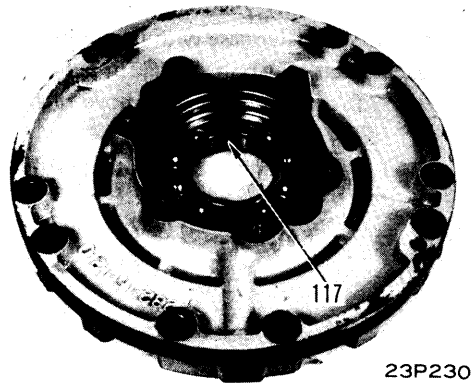
20. Spring

Install spring (67).

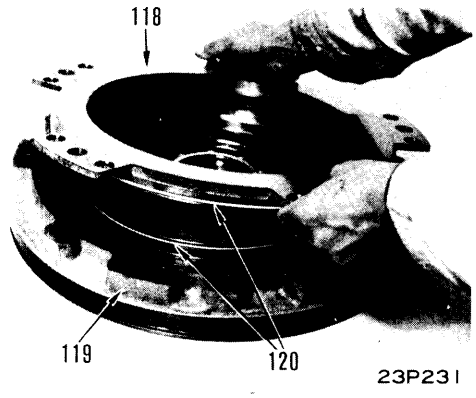


21. Low piston housing

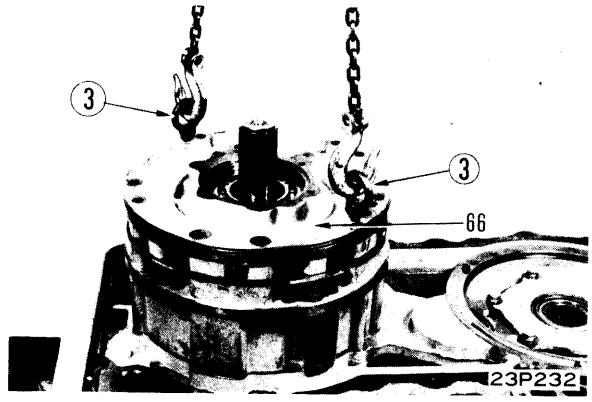
1) Using press-fitting tool (ϕ140) press-fit bearing (117).



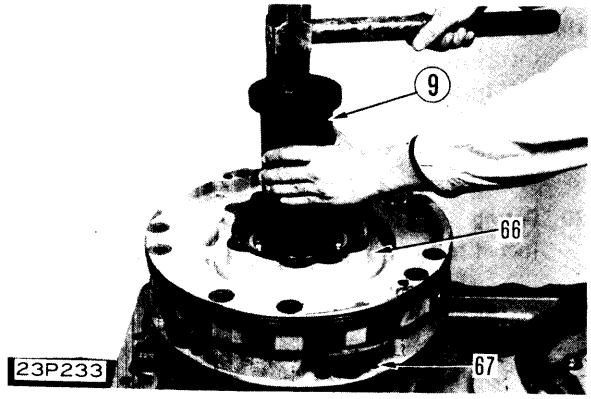
2) Install seal rings (120) on piston (118) and housing (119) and install piston in housing.
   ★ Install seal ring with care to avoid twisting.



3) Fit O-ring, install eye bolts ③ (Thread dia. 14 mm, Pitch = 2.0 mm). Sling and install low piston housing (66).
   ★ Hold piston by the hand to prevent falling off.

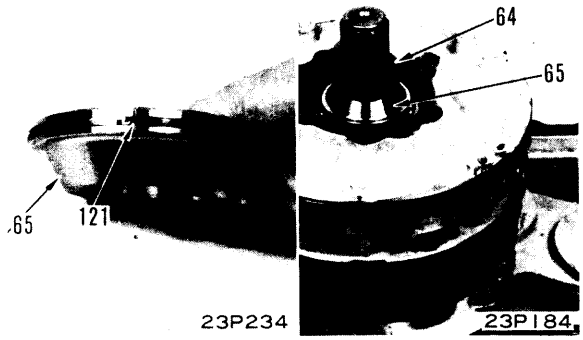


4) Using push tool ⑨ (ϕ80) install low piston housing (66).
   ★ Install housing with care not to damage planetary carrier seal ring.
5) Tighten tie bolt.
   kgm Tie bolt: 17 ± 1kgm
   ★ Confirm that spring (67) is firmly installed in housing and piston groove.

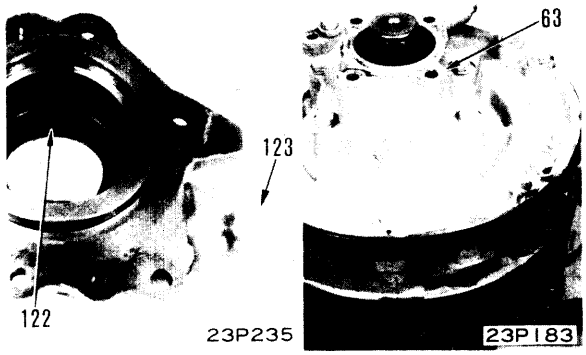


22. Spacer
Install seal ring (121) and install spacer (65).

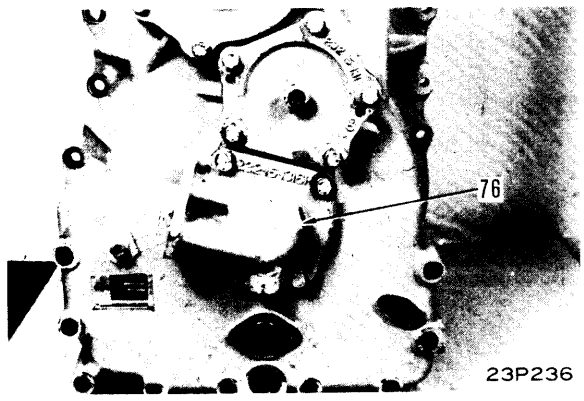
23. Worm
Install worm (64).



24. Cage
1) Using push tool (ϕ97) install oil seal (122) and install speedometer shaft (123).
   ★ Charge grease (G2-LI) to oil seal lip groove to fill up 40 to 60%.
2) Fit O-rings (two) and install cage (63).
   kgm Mounting bolt: 11 ± 1.5kgm

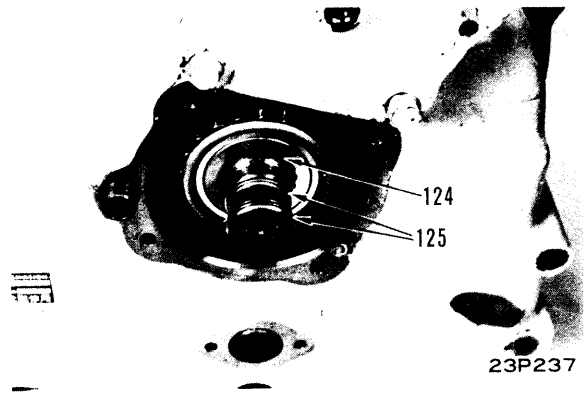


25. Cage
1) Fix transfer case with its mounting face directed to the other side.
2) Screw in jack bolt and remove cage (76).
   ★ Keep removed shims identified their location.



26. Snap ring
Install snap ring (124).

27. Seal ring
Install seal ring (125).
★ Install seal rings not aligning their slits.



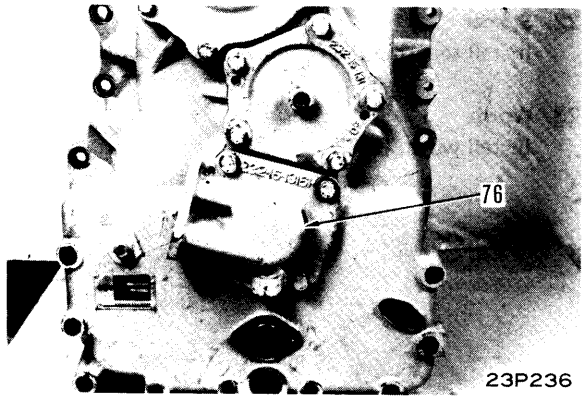
28. Cage

Fit O-ring, insert shims in mounting portion and install cage (76).

★ Install cage with care not to damage seal ring.

★ Install removed shims as they are.

kgm Mounting bolt: 11 ± 1.5kgm

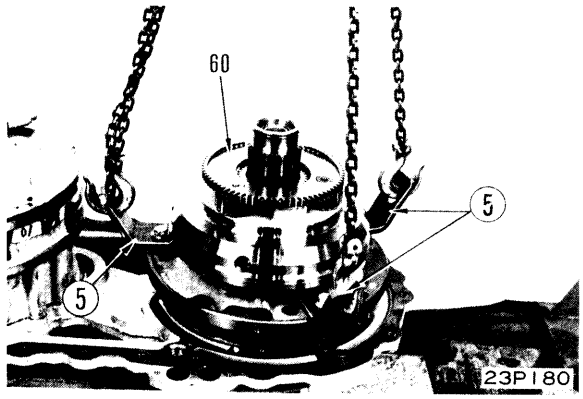


29. 1st speed rotary clutch

1) Fix transfer case with its mounting face up.

2) Install sling plates ⑤. Sling and install 1st speed rotary clutch (60).

kg 1st speed rotary clutch: Approx. 85kg



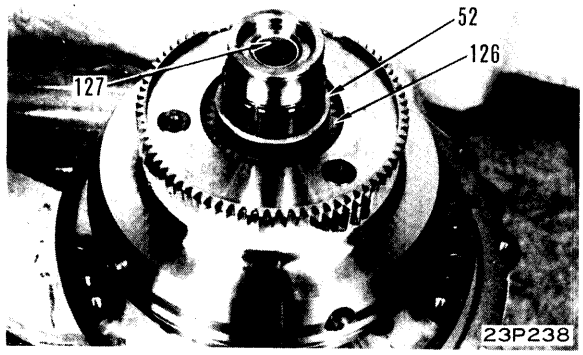
30. 2nd speed sun gear

Install 2nd speed sun gear (126).

31. Spacer

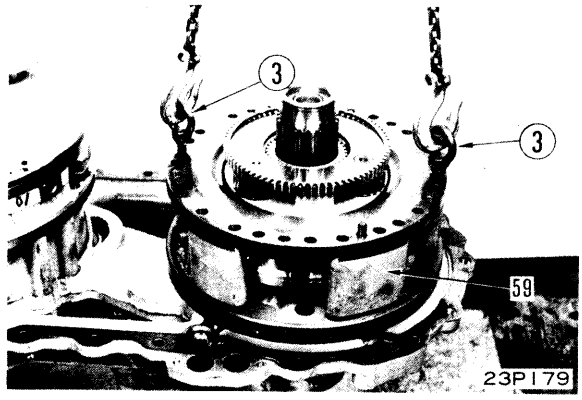
Install spacer (52).

Inside surface of bushing: Grease (G2-LI)



32. 1st speed housing

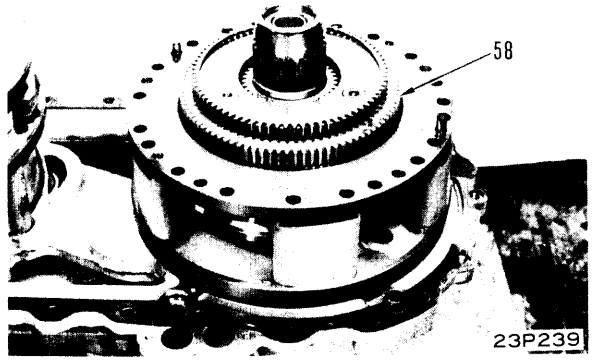
Install eye bolts ③ (Thread dia. = 14 mm, Pitch = 2.0 mm). Sling and install 1st speed housing (59).



33. 2nd speed ring gear

Install 2nd speed ring gear (58).

★ Install ring gear with its recessed inner teeth side down.



34. Pin

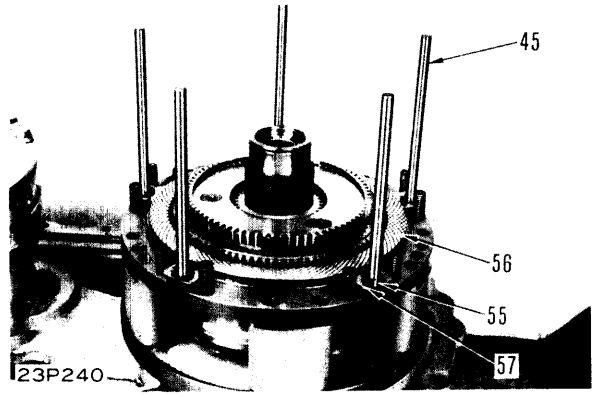
Install pin (45).

35. Spring, Disc, Plate

Install spring (55), discs (56) and plate (57) in order.

★ Install discs aligning notches of inner teeth in the same position.

★ Disc: 2 pcs. Plate: 1 pc.

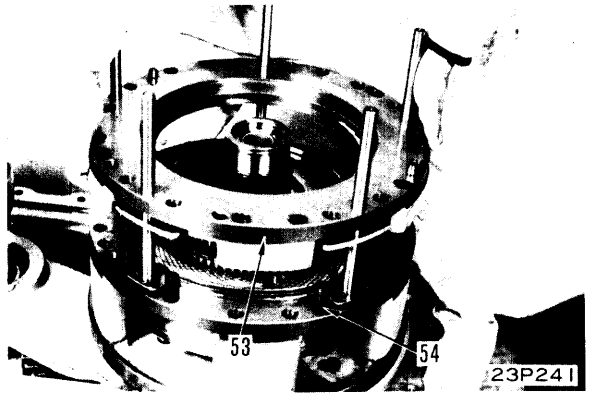


36. Spring

Install spring (54).

37. 2nd speed piston and housing assembly

1) Install seal ring and install piston in housing.
2) Install 2nd speed piston and housing assembly (53).
   ★ Hold piston by the hand to prevent falling off.
   ★ Confirm that spring (54) is firmly installed in housing and piston groove.

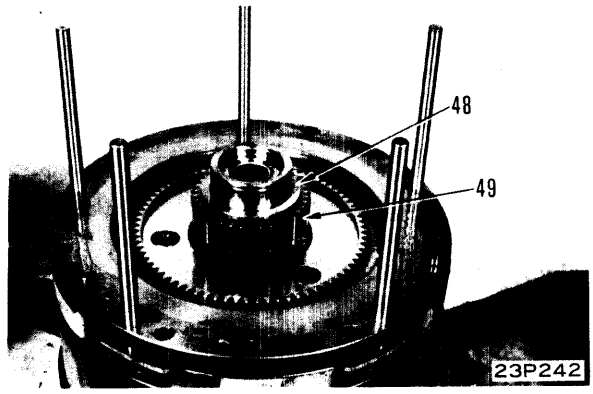


38. 3rd speed sun gear

Install 3rd speed sun gear (49).

39. Spacer

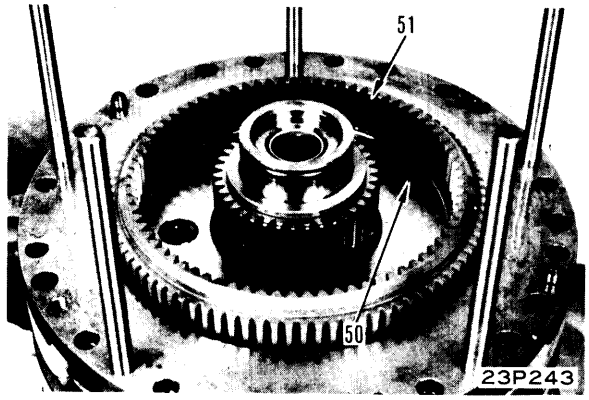
Install spacer (48).



40. 3rd speed ring gear

Install 3rd speed ring gear (51) and fix it with snap ring (50).

★ Confirm that ring gear is firmly installed on planetary carrier.

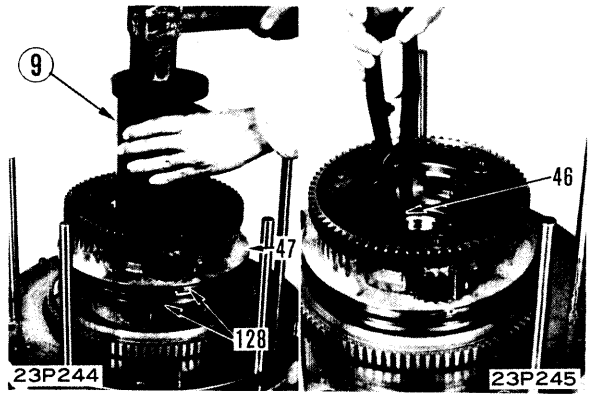


41. Forward travel and 3rd speed carriers assembly

1) Install seal ring (128) and planetary gear.
   ★ Refer to "INSTALLATION OF PLANETARY GEAR" section.
2) Using push tool ⑨ (ϕ80) install forward travel and 3rd speed carriers assembly (47).

42. Snap ring

Install snap ring (46).

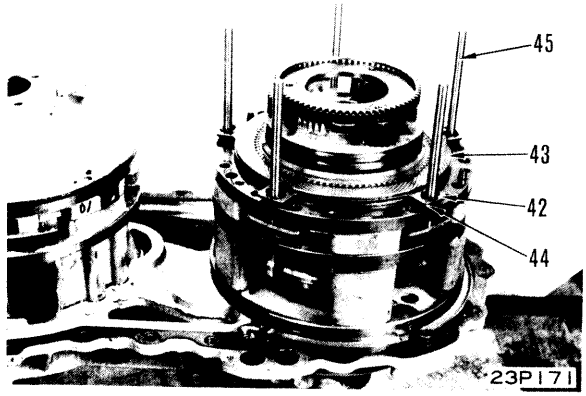


43. Spring, Disc, Plate

Install spring (42), discs (43) and plate (44) in order.

★ Install discs aligning their notches in the same position.

★ Disc: 2 pcs. Plate: 1 pc.



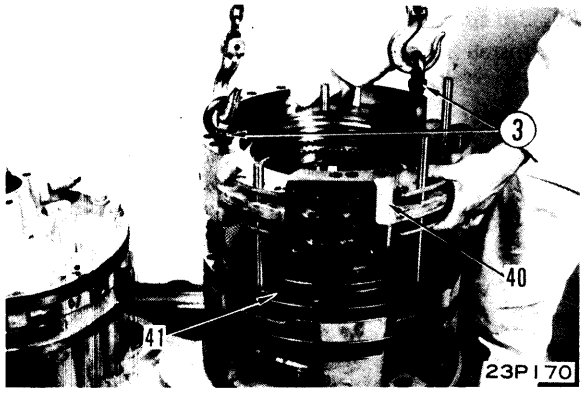
44. Spring

Install spring (41).

45. Forward travel and 3rd speed piston and housing assembly

1) Install seal ring and install piston in housing.
2) Install eye bolts ③ (Thread dia. = 14 mm, Pitch = 2.0 mm). Sling and install forward travel and 3rd speed pistons and housing assembly (40).
   ★ Hold pistons by the hand to prevent falling off and confirm that springs are installed firmly in housings and piston groove.

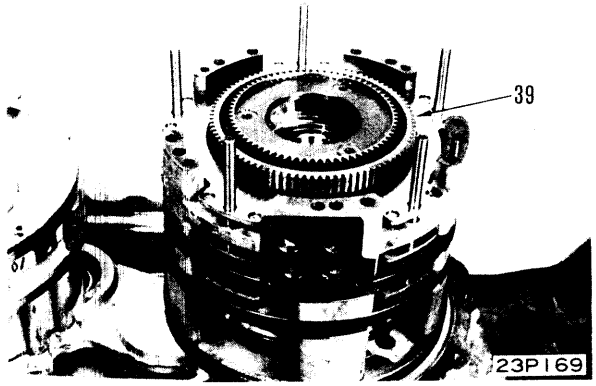
kg Forward and 3rd speed piston and housing assembly: Approx. 35kg



46. Ring gear

Install ring gear (39).

★ Install ring gear with recessed inner teeth up.

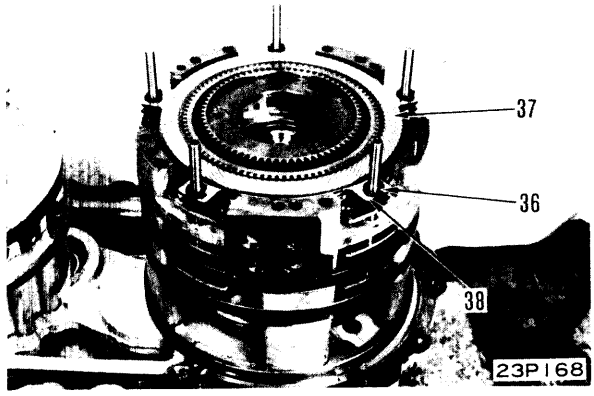


47. Spring, Disc, Plate

Install spring (36), discs (37) and plate (38) in order.

★ Install discs aligning notches of inner teeth in the same position.

★ Disc: 3 pcs. Plate: 2 pcs.



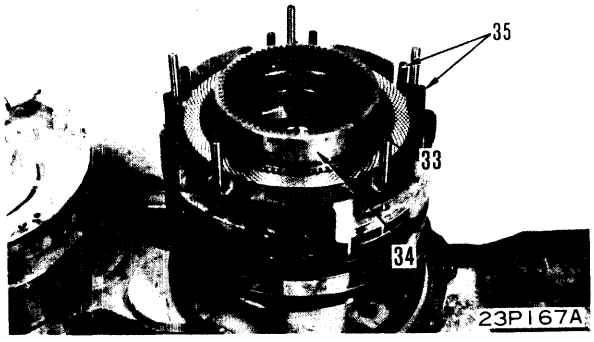
48. Spring

Install spring (35).

49. Reverse travel ring gear

Install reverse travel ring gear (34) and fix it with snap ring (33).

★ Confirm that ring gear is firmly installed on planetary carrier.

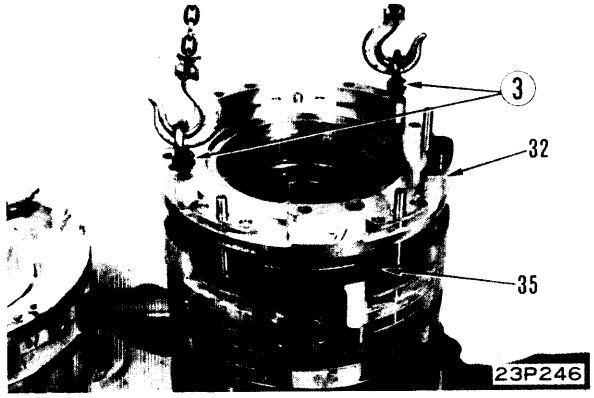


50. Reverse travel piston and housing assembly

1) Install seal ring and install piston on housing.

2) Install eye bolts ③ (Thread dia. = 14 mm, Pitch = 2.0 mm). Sling and install reverse travel piston and housing assembly (32).

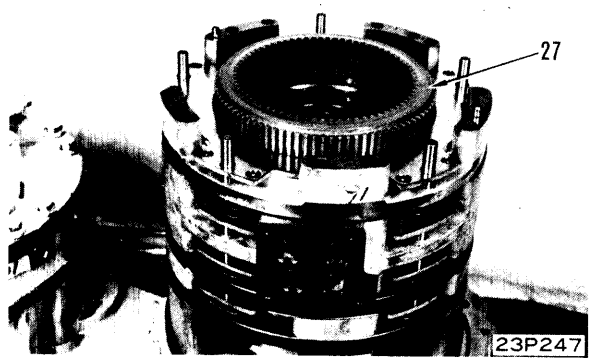
★ Confirm that spring (35) is firmly installed in housing and piston groove.



51. Reverse travel ring gear

Install reverse travel ring gear (27).

★ Install ring gear with its ring gear inner teeth up.



52. Spring, Disc, Plate

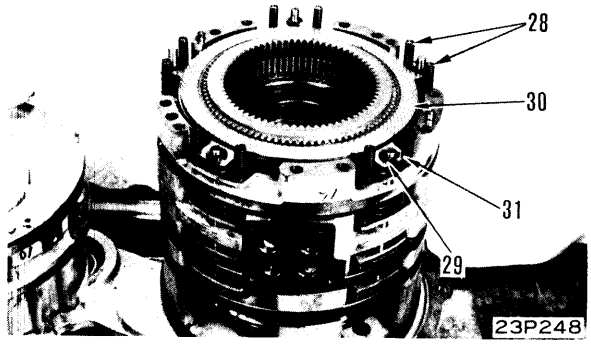
Install spring (29), discs (30) and plates (31) in order.

★ Install discs aligning notches of inner teeth in the same position.

★ Disc: 3 pcs. Plate: 2 pcs.

53. Spring

Install spring (28).



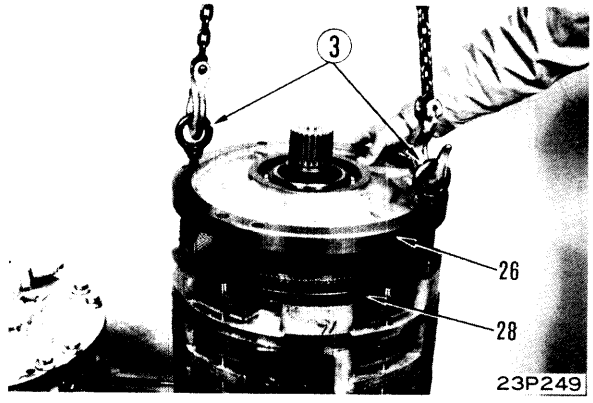
54. Cage and reverse travel carrier assembly

1) Install eye bolts ③ (Thread dia. = 14 mm, Pitch = 2.0 mm). Sling and install cage and reverse travel carrier assembly (26).

2) Tighten tie bolt.

kgm Tie bolt: 17 ± 1kgm

★ Confirm that spring (28) is firmly installed in housing and piston groove.



55. Checking air

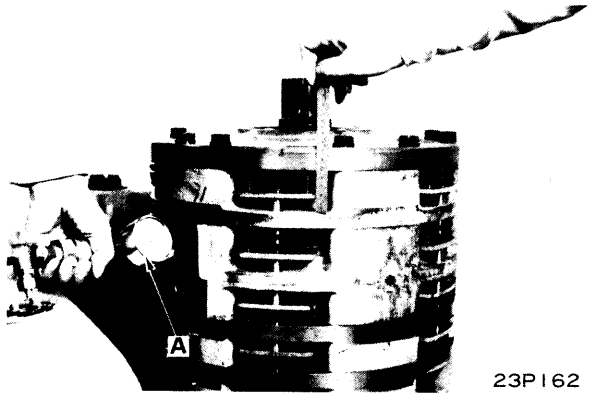
Using tool **A** check function of piston at each speed stage (F, R, 3rd, 2nd and L). Measure piston stroke and confirm that it is within standard.

★ Air pressure: 5kg/cm^2 min.

★ Piston stroke

(Unit: mm)

Speed stage	F	R	3rd	2nd	L
Stroke	3.5	3.5	2.5	2.5	3.5



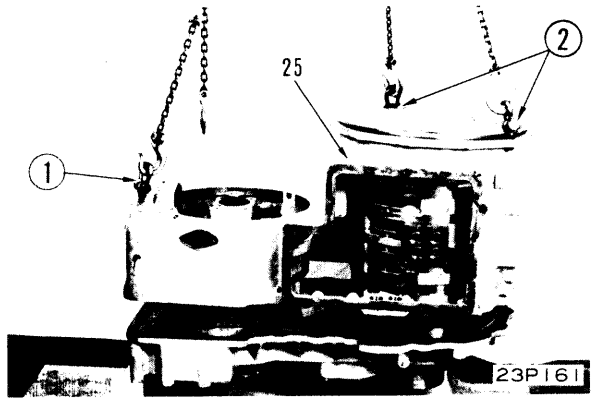
56. Transmission case

Attach gasket to mounting face, install eye bolts ① (Thread dia. = 10 mm, Pitch = 1.5 mm) and ② (Thread dia. = 12 mm, Pitch = 1.75 mm). Sling and install transmission case (25).

Gasket: Gasket sealant (LG-1)

Mounting bolt: 18 ± 2kgm

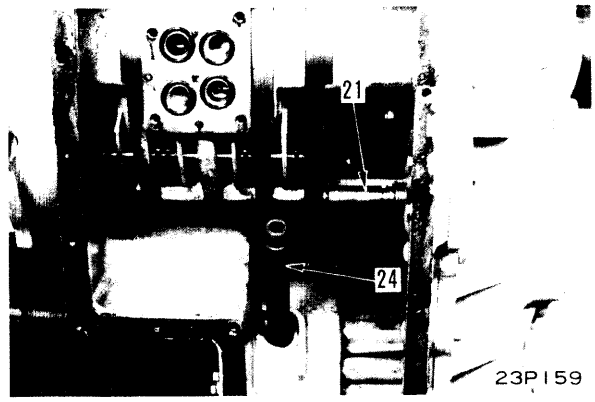
Transmission case: Approx. 130kg



57. Sleeve

1) Raise up transmission and fix it with transmission control valve mounting face directed frontward.
2) Fit O-rings to both ends and install sleeves (21) and (24).

O-ring: Grease (G2-LI)

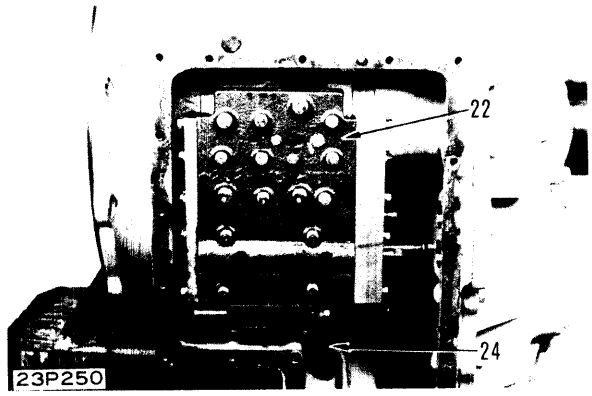


58. Transmission control valve

Attach O-ring to mounting surface, insert transmission control valve (22) into sleeve (24) and install.

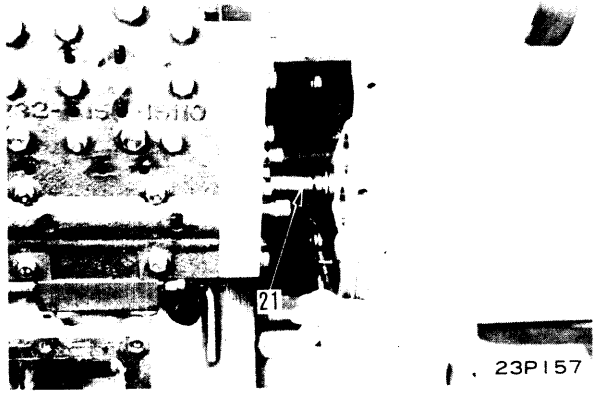
★ When inserting transmission control valve into sleeve, be careful not to damage O-ring of sleeve.

Mounting bolt: 3.5 ± 0.5kgm



59. Sleeve

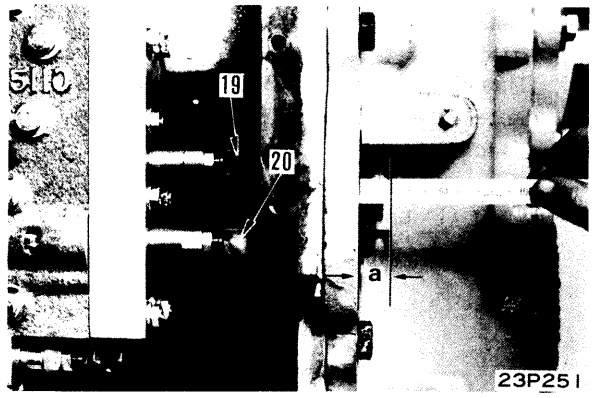
Move sleeve (21) to the left side to connect to control valve, install snap ring to fix sleeve.



60. Yoke

Install F–R yoke (19) and inching yoke (20) setting distance "a" at the standard at the state where spool is pulled and tighten lock nut to fix them on spool.

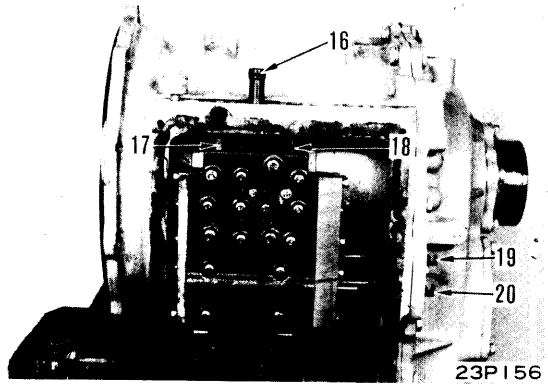
★ Distance "a": 19mm



61. Sleeve

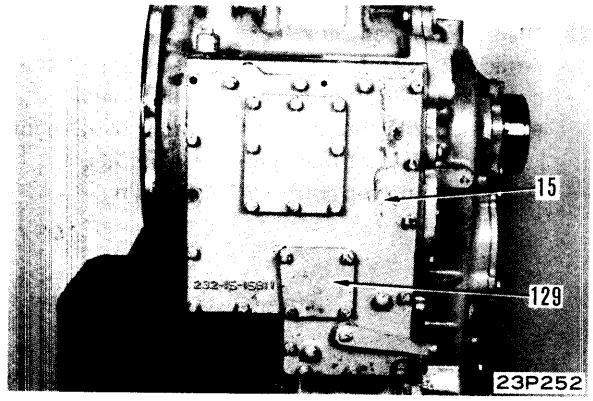
Fit O-rings to both ends and install sleeves (16), (17) and (18).

O-ring: Grease (G2-LI)



62. Cover

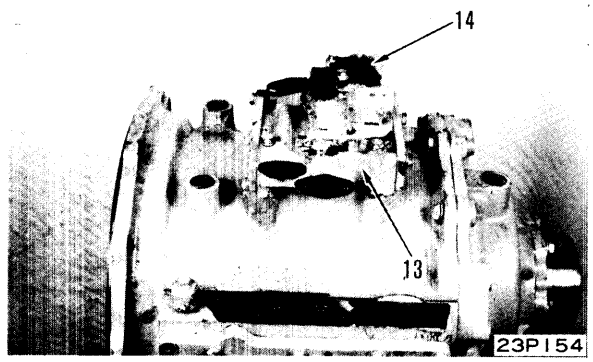
1) Attach gasket, connect speed selector lever to spool yoke, install cover (15).
   - Gasket: Gasket sealant (LG-1)
   - kgm Mounting bolt: 7 ± 0.5kgm
2) Remove cover (129) to confirm whether speed selector lever is firmly connected to spool and install cover with gasket attached.
   - Gasket: Gasket sealant (LG-1)
   - Mounting bolt: Gasket sealant (LG-1)
   - kgm Mounting bolt: 3.5 ± 0.5kgm



63. Transmission control valve

Fit O-ring to mounting portion and install transmission control valve (13) together with cooler bypass valve (14) as an assembly.

kgm Mounting bolt: 4.5 ± 1kgm



64. Lubricating tube

Attach gaskets to both ends and install lubricating tube (12).

kgm Joint bolt: 11.5 ± 2.5kgm

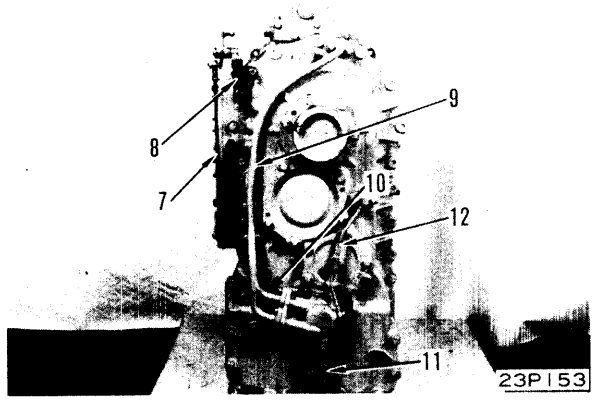
65. Piping

Fit O-rings to both ends and install tubes (9), (10) and (11).

66. Transmission control rod

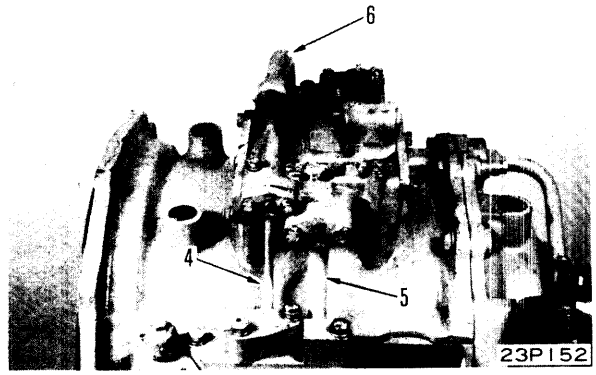
Fit bracket (8) and connect the transmission control rod (7) on lever (control valve side).

★ Bend down cotter pin firmly.



67. Transmission control valve piping

1) Fit O-rings to both ends and install control valve tubes (4) and (5).
   ★ Install strainer in tube (4).
2) Fit O-ring and install control valve tube (6).
   kgm Control valve common tightening bolt: 4.5 ± 1kgm



68. Parking brake

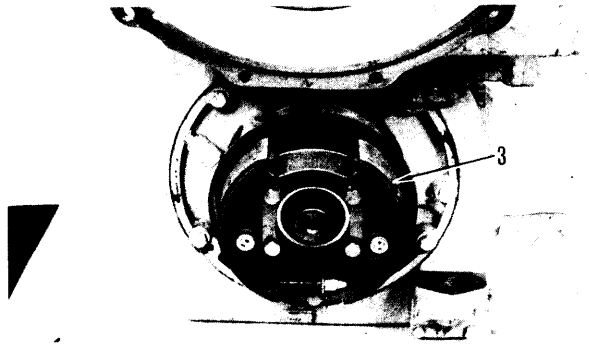
Install parking brake assembly (3).

kgm Mounting bolt: 18 ± 2kgm

★ Bend down lock plate firmly.

69. Flange

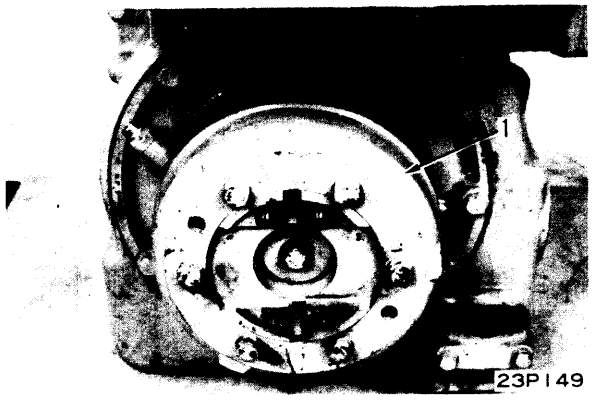
1) Install flange (2) on shaft.
2) Fit O-ring and install holder (130) and tighten center bolt.
   Center bolt: Thread tightener (LT-2)
   kgm Center bolt: 23.5 ± 2.5kgm

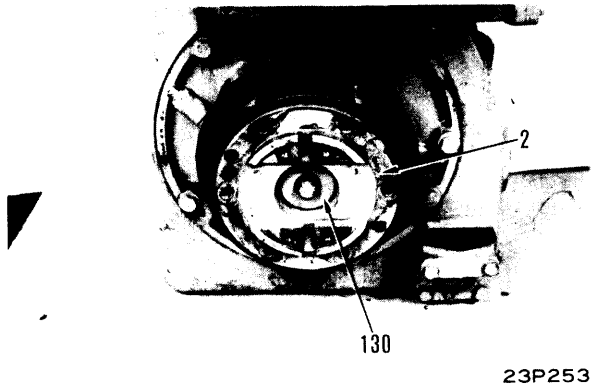


70. Drum

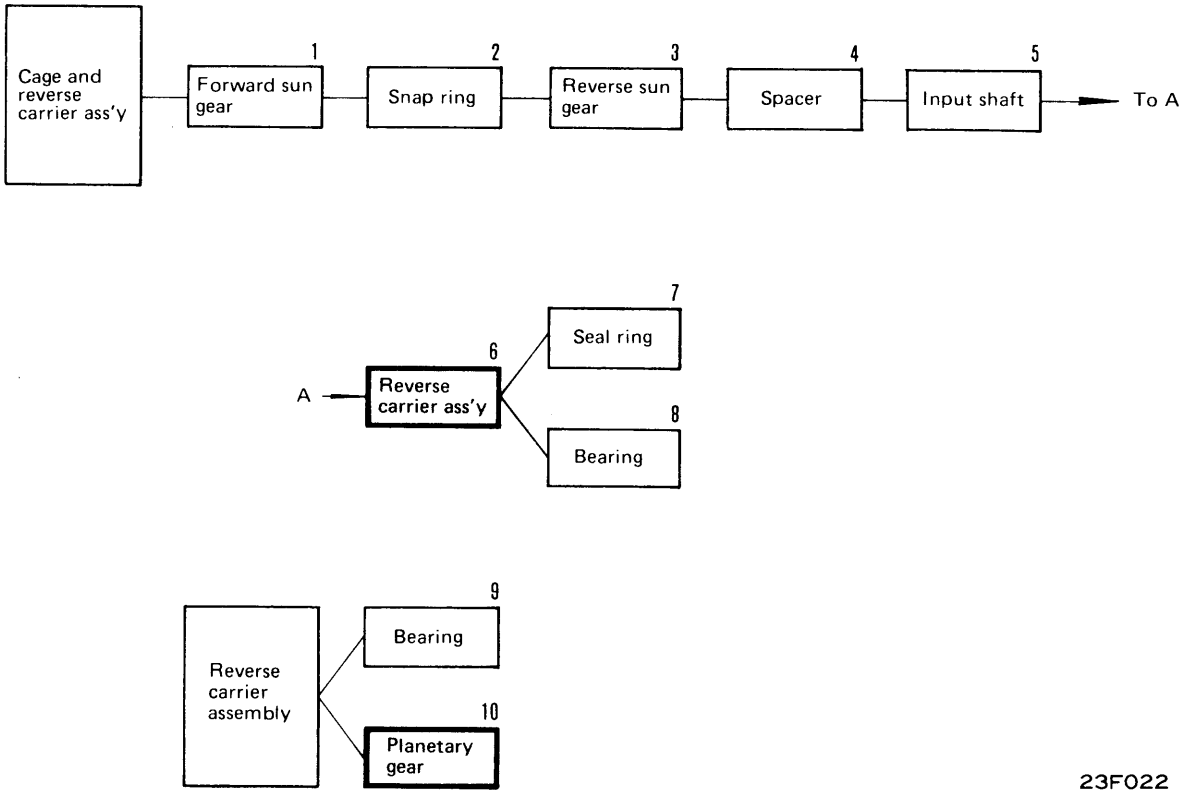
Install brake drum (1).

kgm Mounting bolt: 18 ± 2kgm



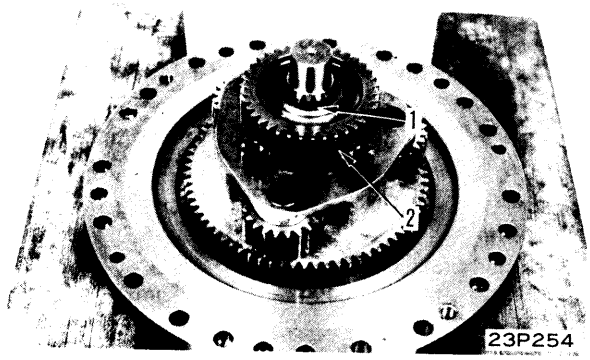


DISASSEMBLY OF CAGE AND REVERSE CARRIER ASSEMBLY
GD705R-4



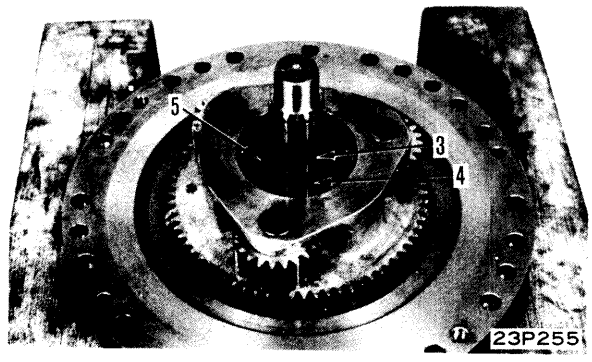
23F022

1. **Forward sun gear**
   Remove snap ring (1) and remove forward sun gear (2).

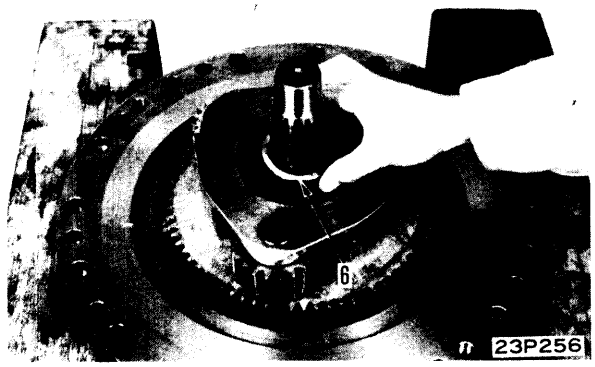


2. **Snap ring**
   Remove snap ring (3).

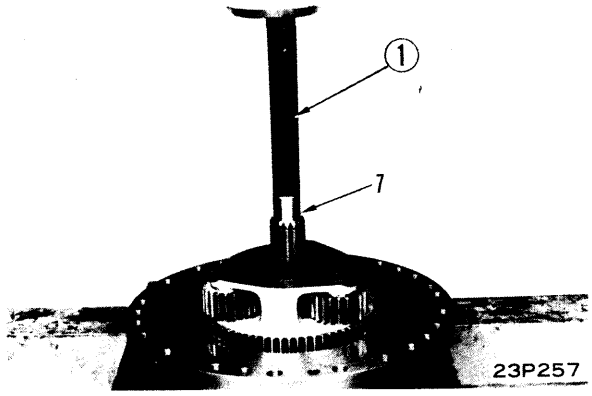
3. **Reverse sun gear**
   Remove snap ring (4) and remove reverse sun gear (5).



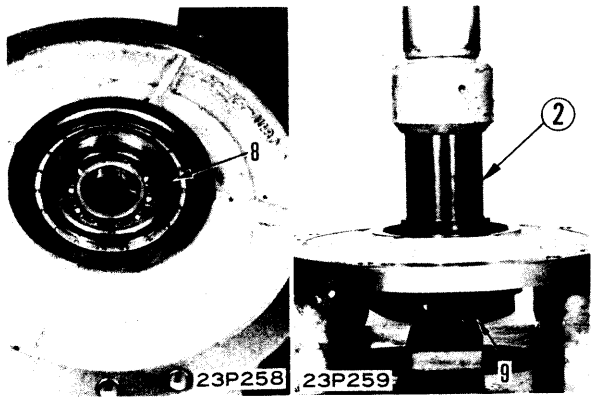
4. **Spacer**
   Remove spacer (6).



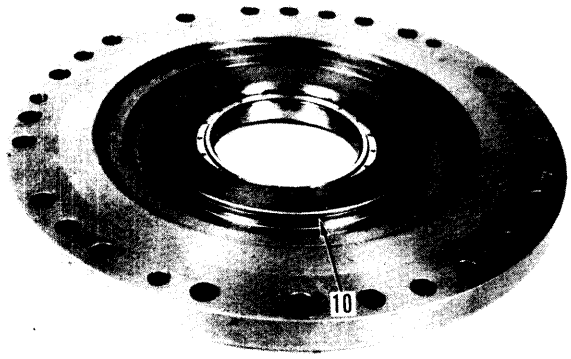
5. **Input shaft**
   Using press-fitting tool ① pull out input shaft (7).



6. **Reverse carrier assembly**
   1) Remove snap ring (8).
   2) Using press-fitting tool ② (φ108) pull out reverse carrier (9).

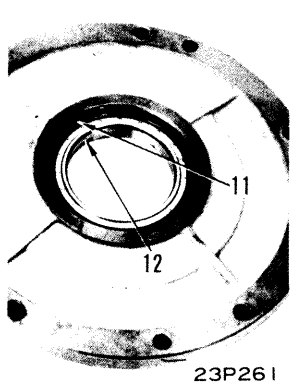


7. **Seal ring**
   Remove seal ring (10).

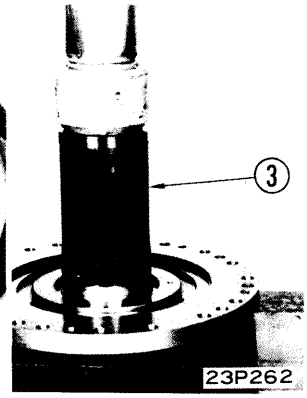


23P260

8. **Bearing**
   1) Remove snap ring (11).
   2) Using press-fitting tool ③ (φ139) pull out bearing (12).

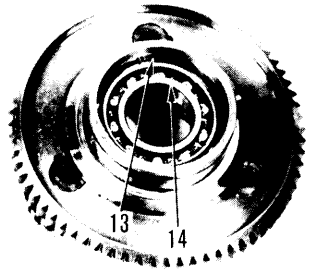


23P261

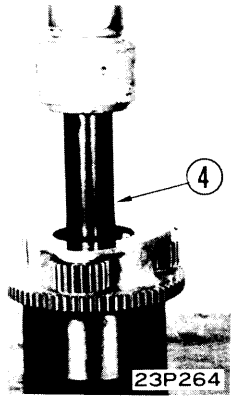


23P262

9. **Bearing**
   1) Remove snap ring (13).
   2) Using press-fitting tool ④ (φ79) pull out bearing (14).



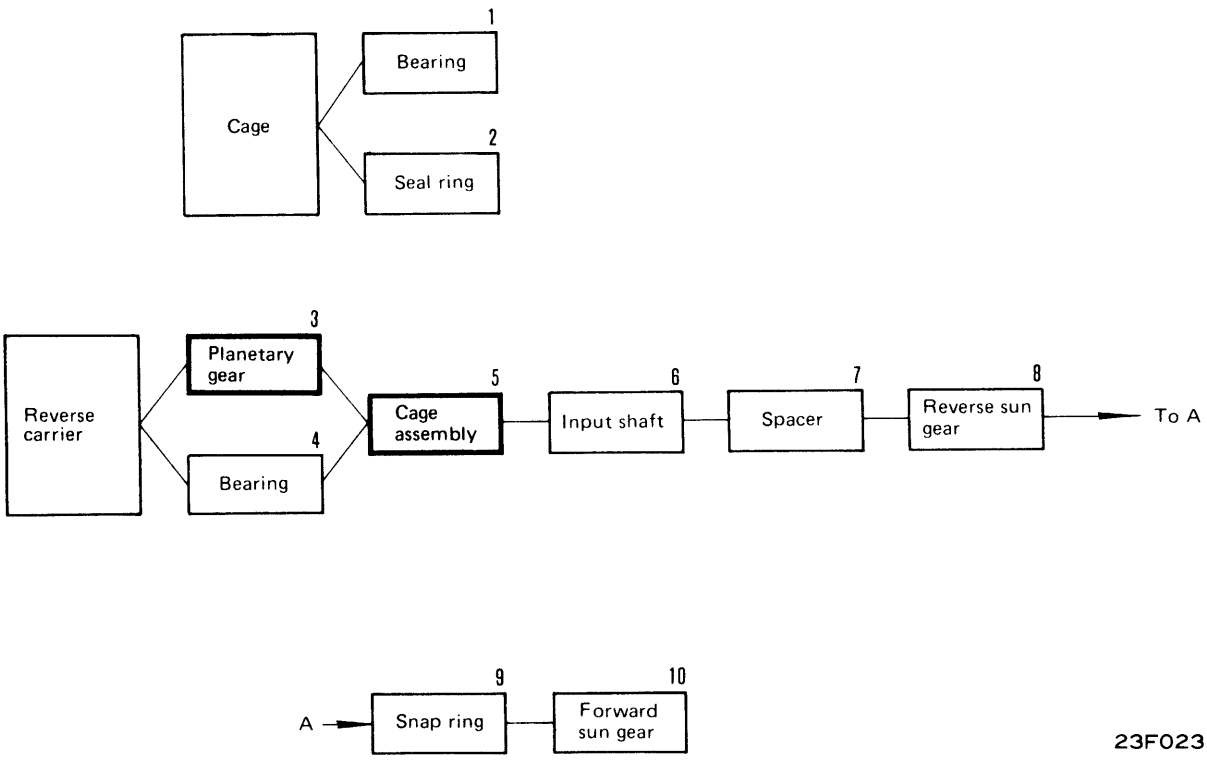
23P263



23P264

10. **Planetary gear**
    Refer to "DISASSEMBLY OF PLANETARY GEAR" section.

ASSEMBLY OF CAGE AND REVERSE CARRIER ASSEMBLY
GD705R-4

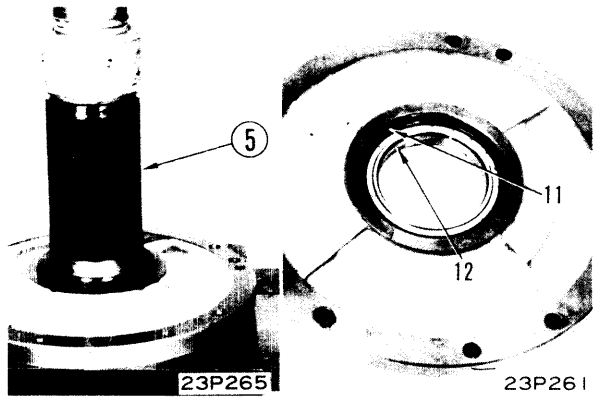


23F023

★ **Coat sliding portion of each part with engine oil before installing.**

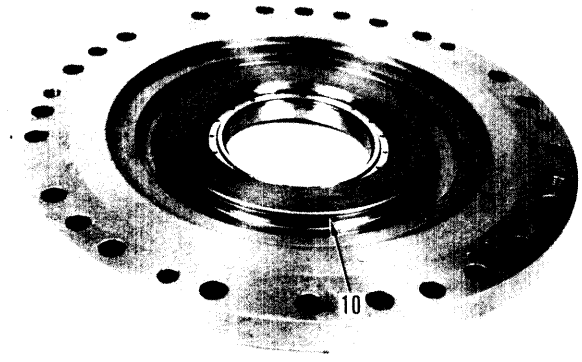
1. Bearing

1) Using press-fitting tool ⑤ (φ160) press-fit bearing (12).
2) Install snap ring (11).



2. Seal ring

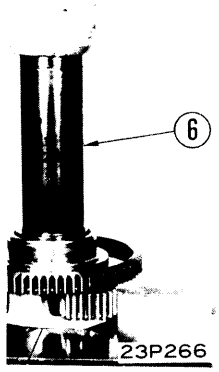
Install seal ring (10).

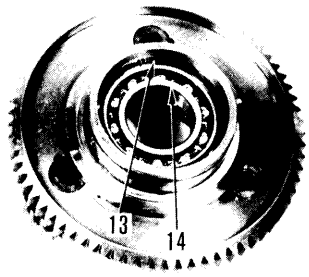


23P260

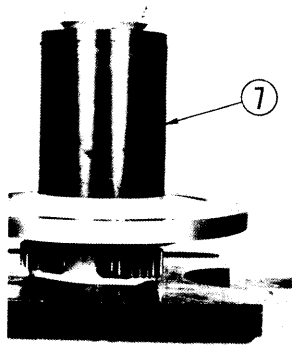
3. **Planetary gear**
   Refer to "ASSEMBLY OF PLANETARY GEAR" section.

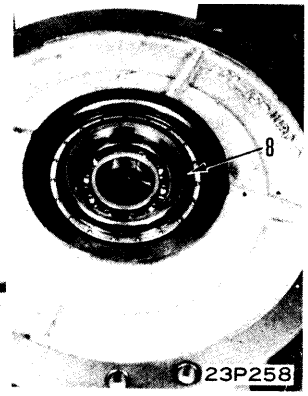
4. **Bearing**
   1) Using press-fitting tool ⑥ (φ90) press-fit bearing (14).
   2) Install snap ring (13).



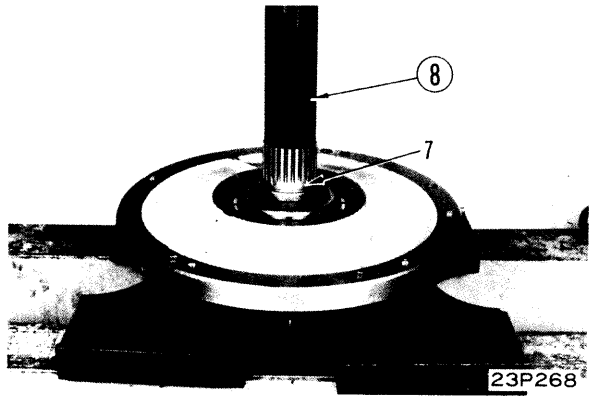


5. **Cage assembly**
   1) Using press-fitting tool ⑦ press-fit cage assembly.
      ★ Press-fit cage using care not to damage its seal ring.
   2) Install snap ring (8).

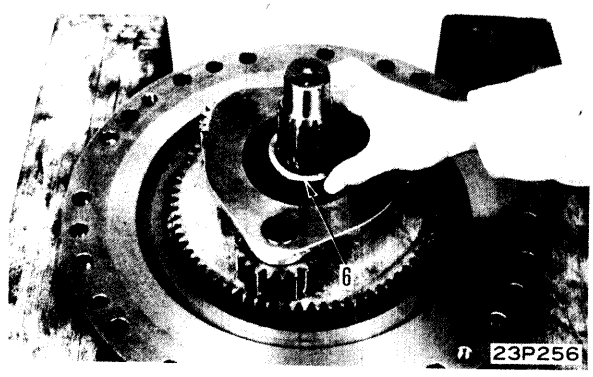




6. **Input shaft**
   Using press-fitting tool ⑧ press-fit input shaft (7).

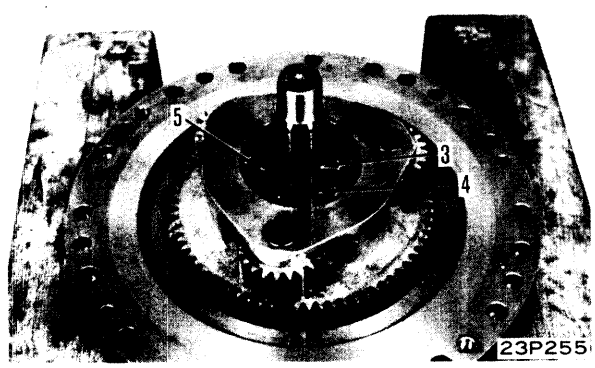


7. **Spacer**
   Install spacer (6).

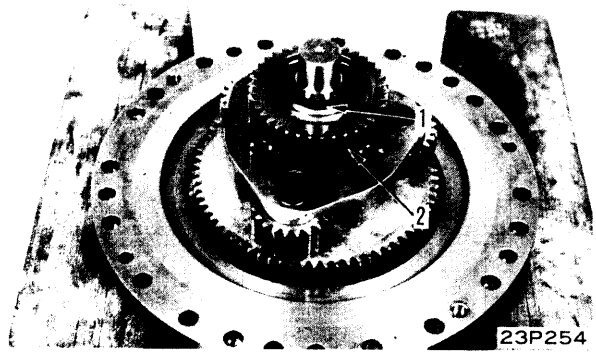


8. **Reverse sun gear**
   Install reverse sun gear (5) and install snap ring (4).

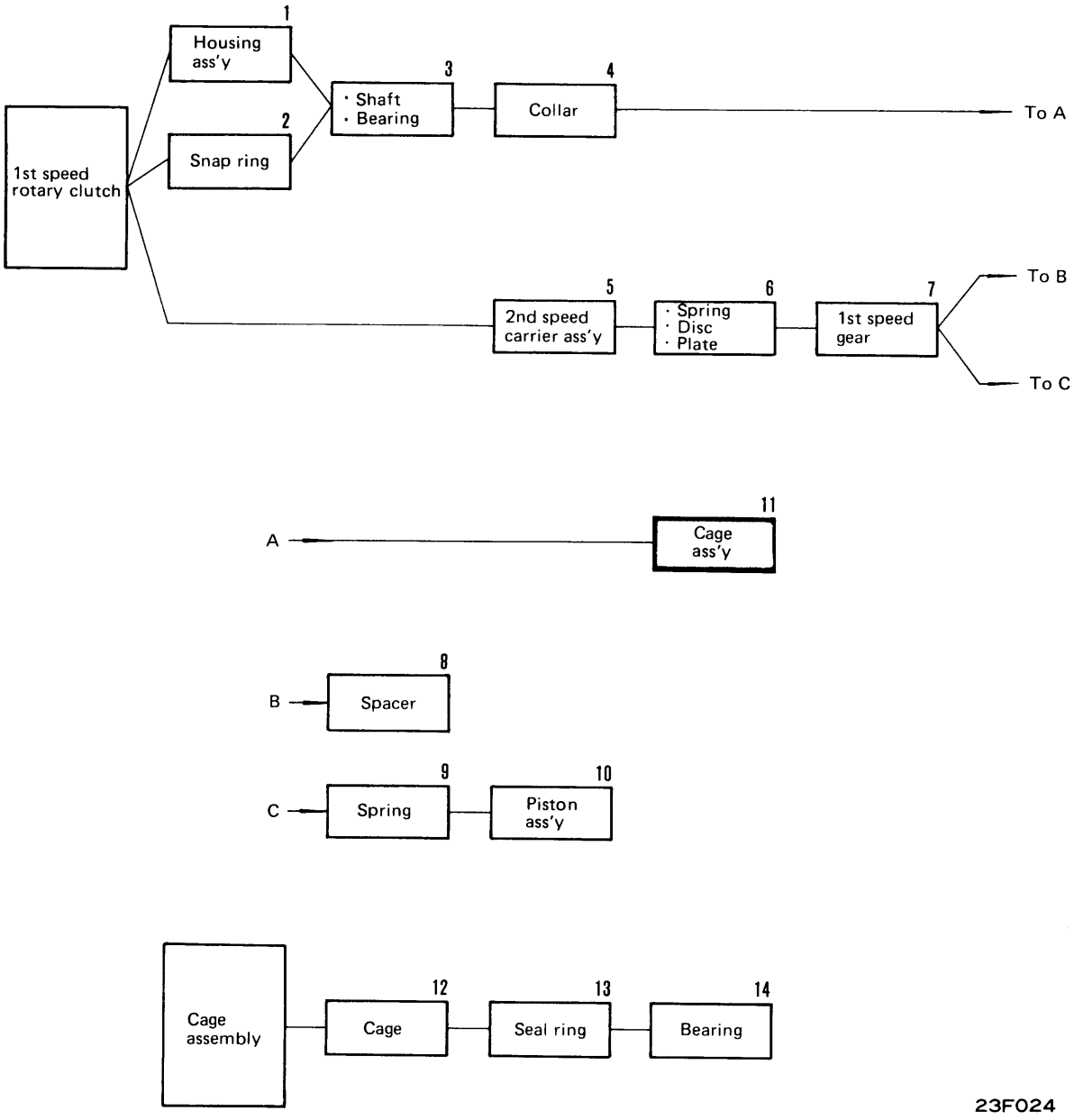
9. **Snap ring**
   Install snap ring (3).



10. **Forward sun gear**
    Install forward sun gear (2) and install snap ring (1).



DISASSEMBLY OF 1ST SPEED ROTARY CLUTCH
GD705R-4

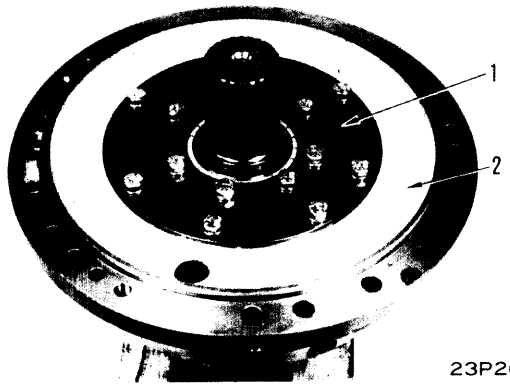


23F024

Special tools

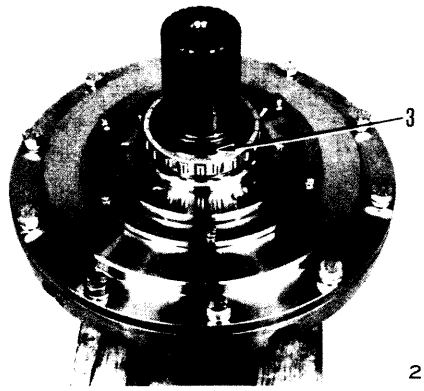
	Part number	Part name	Q'ty
A	792-371-1300	Plate	1
	790-201-2350	Push tool	1

1. **Housing assembly**
   1) Remove plate (1).
   2) Remove housing (2).



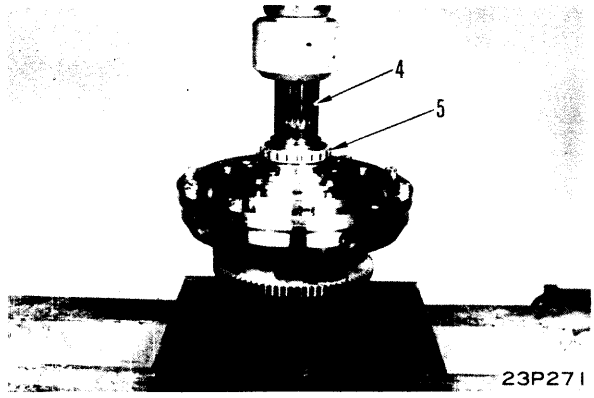
23P269

2. **Snap ring**
   Remove snap ring (3).



23P270

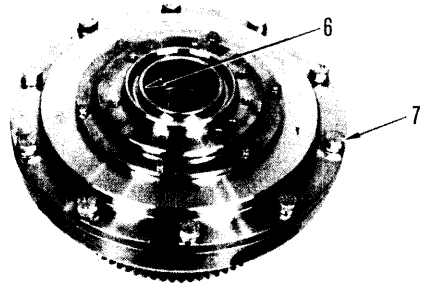
3. **Shaft, Bearing**
   Set shaft (4) and bearing (5) in press and pull out them.



23P271

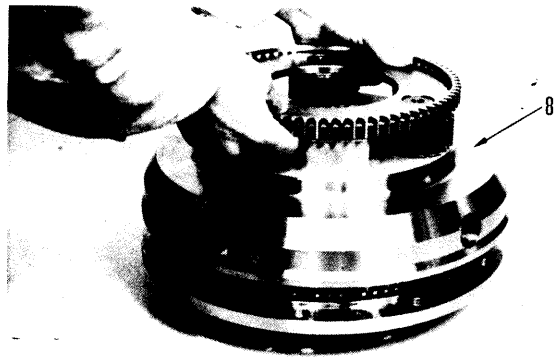
4. **Collar**
   Pull out collar (6).

5. **2nd speed carrier assembly**
   1) Remove mounting bolts (7) leaving two bolts unremoved.



23P272

2) Fix carrier faced up.
3) Remove remaining bolts and remove 2nd carrier assembly (8).

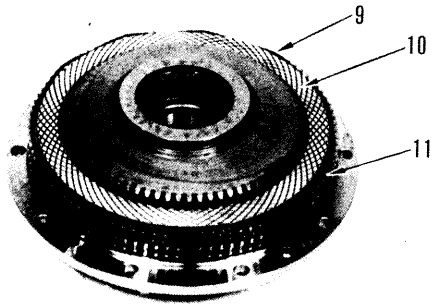


23P273

6. Spring, Disc, Plate

Remove spring (9), discs (10) and plates (11) in order.

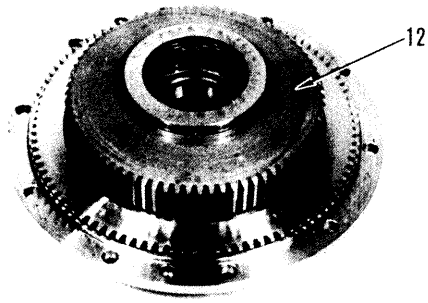
★ Disc: 3 pcs. Plate: 2 pcs.



23P274

7. 1st speed gear

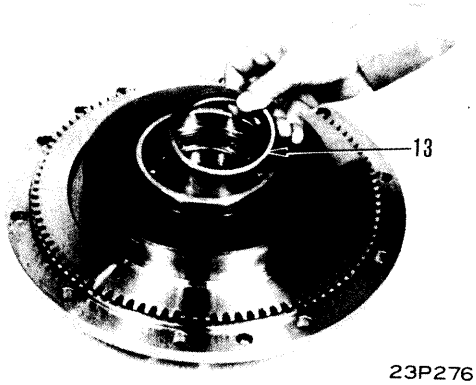
Remove gear (12).



23P275

8. Spacer

Remove spacer (13).

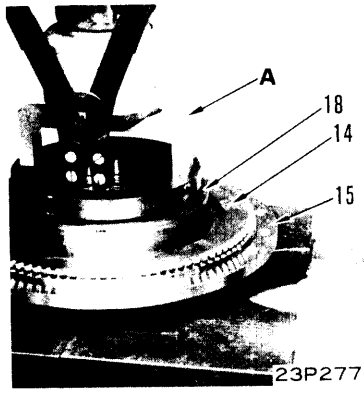


23P276

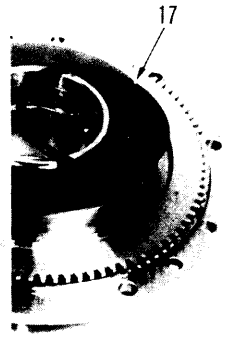
9. **Spring**

⚠ Be careful since spring is applied tension.

1) Put match marks on piston (14) and cage (15).
2) Using tool **A** compress spring with press and remove snap ring (17).
3) Remove snap ring (18).



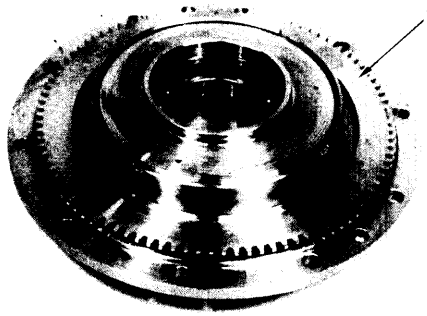
23P277



23P278

10. **Piston assembly**

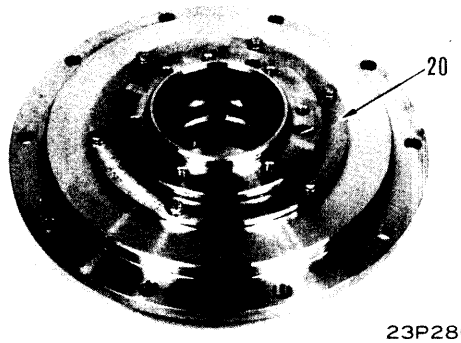
Remove piston assembly (19).



23P279

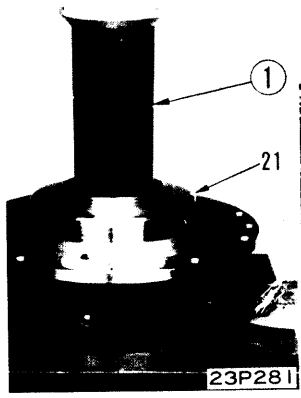
11. **Cage assembly**

1) Remove bolts mounting cage (20).

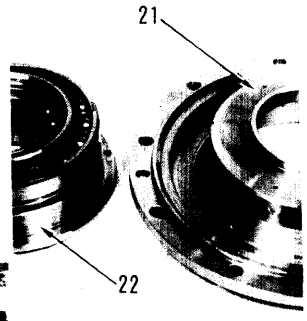


23P280

2) Using press-fitting tool ① (φ90) pull out cage assembly (22) from cage (21).



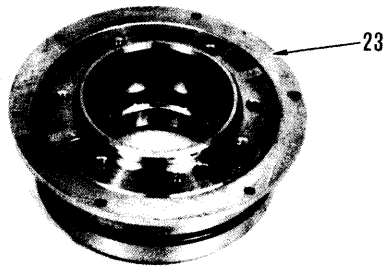
23P281



23P282

12. Cage

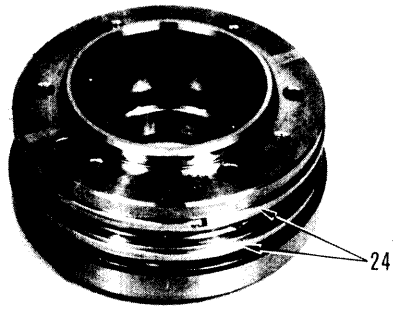
Remove cage (23).



23P283

13. Seal ring

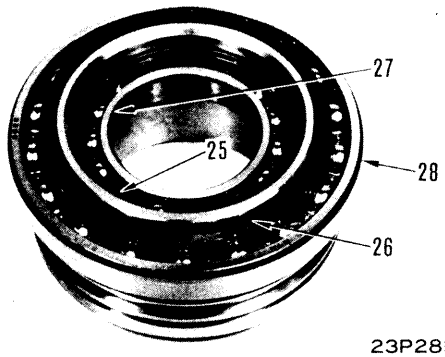
Remove seal ring (24).



23P284

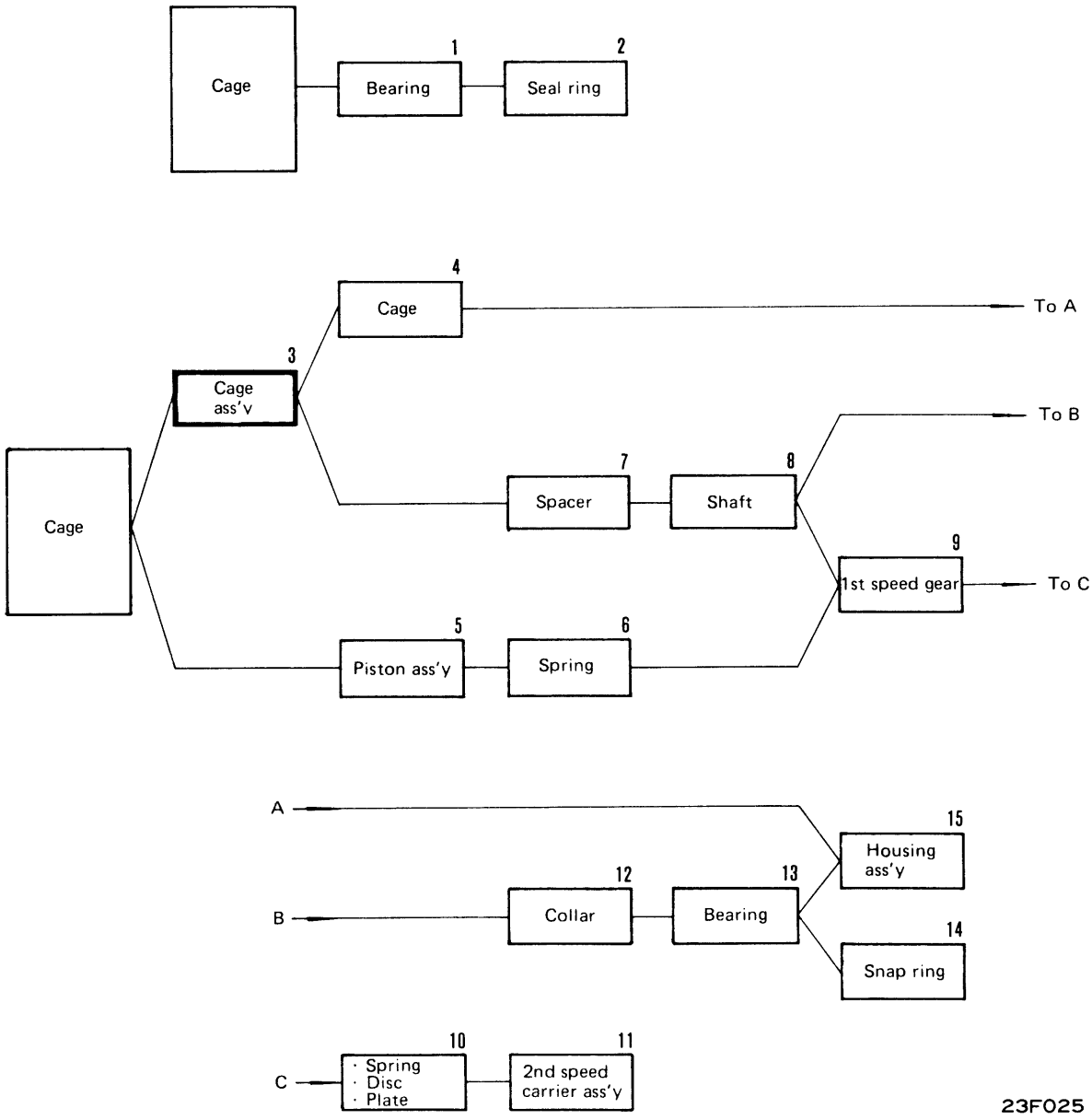
14. Bearing

Remove snap rings (25) and (26) and pull out bearings (27) and (28).



23P285

ASSEMBLY OF 1ST SPEED ROTARY CLUTCH
GD705R-4



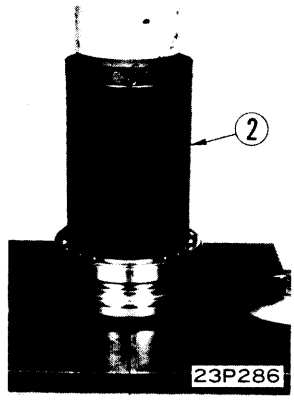
Special tools

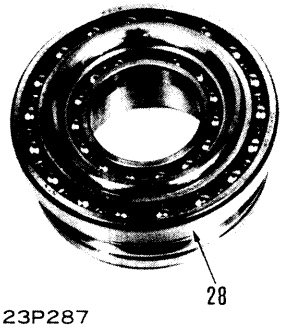
	Part number	Part name	Q'ty
A	792-371-1300	Plate	1
	790-201-2350	Push tool	1

★ **Coat sliding portion of each part with engine oil before installing.**

1. Bearing

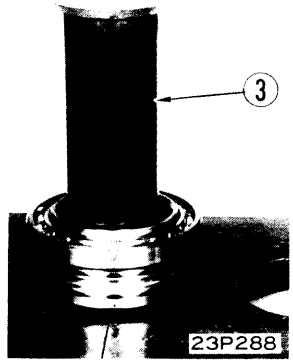
1) Using press-fitting tool ② (ϕ130) press-fit bearing (28).

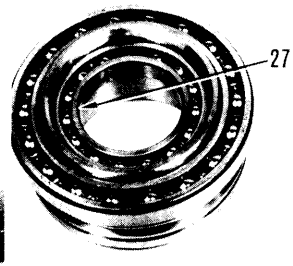




23P287

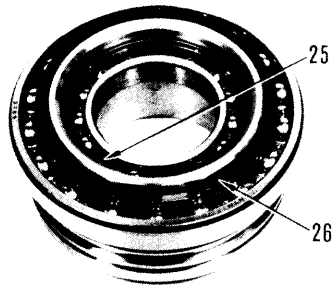
2) Using press-fitting tool ③ (ϕ75) press-fit bearing (27).





23P289

3) Install snap rings (25) and (26).

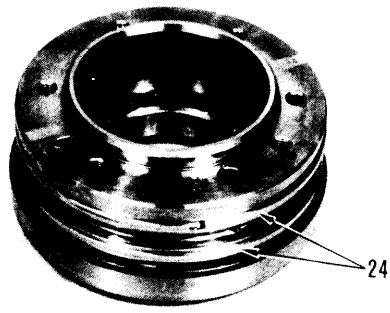


23P290

2. Seal ring

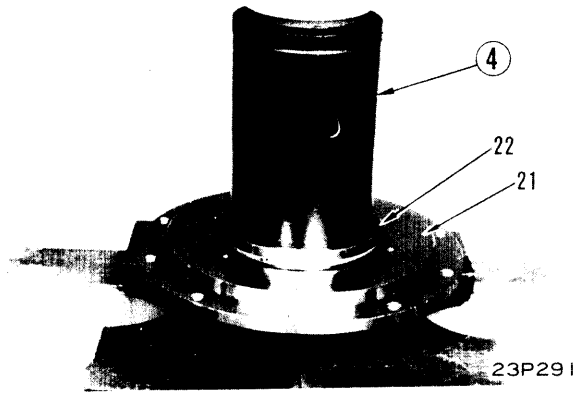
Install seal rings (24).

★ Install rings not aligning their slits.

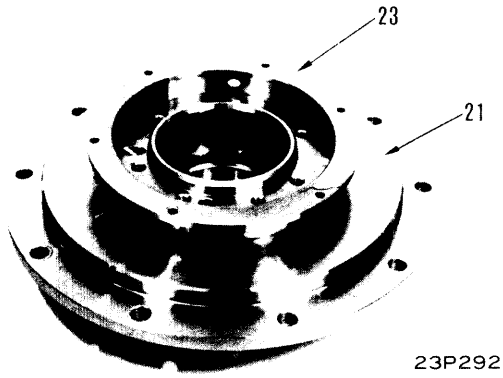


23P284

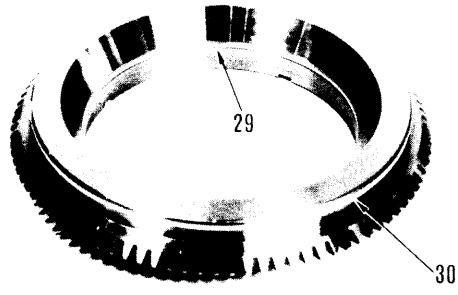
3. **Cage assembly**
Using press-fitting tool ④ (φ115) press-fit cage assembly (22) to cage (21).



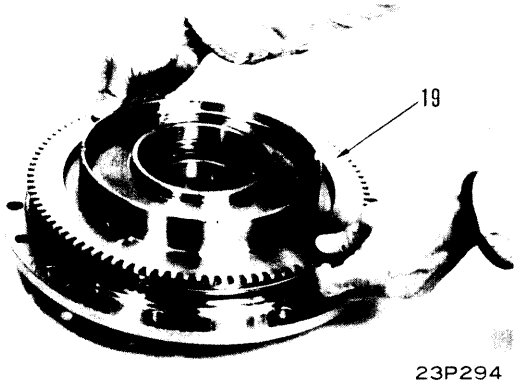
4. **Cage**
Install cage (23) aligning its oil vent with that on cage (21).
★ Install cage using care not to damage seal ring.
Mounting bolt: Thread tightener (LT-2)
kgm Mounting bolt: 1.35 ± 0.15kgm



5. **Piston assembly**
1) Install seal rings (29) and (30) on piston.
★ Install seal rings using care to avoid twisting.



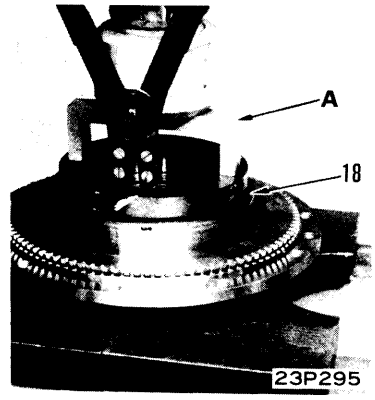
2) Install piston assembly (19) aligned with match mark put when disassembled.



6. Spring

1) Install spring (18).
2) Be sure to align match marks on piston and cage and install snap ring (17) compressing spring with press using tool **A**.
   ★ Secure snap ring firmly.

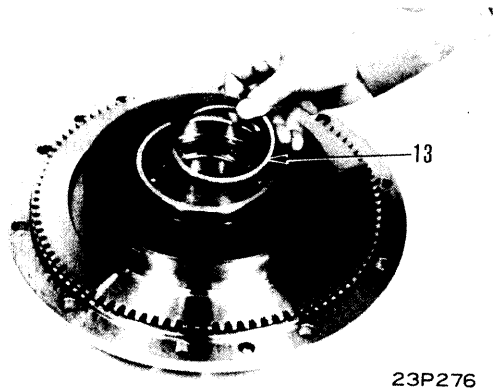
23P278



23P295

7. Spacer

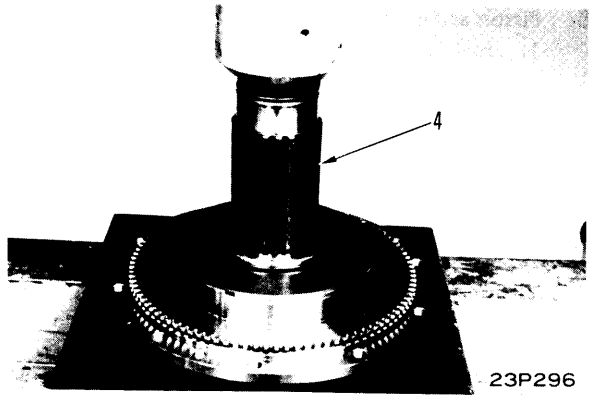
Install spacer (13).



23P276

8. Shaft

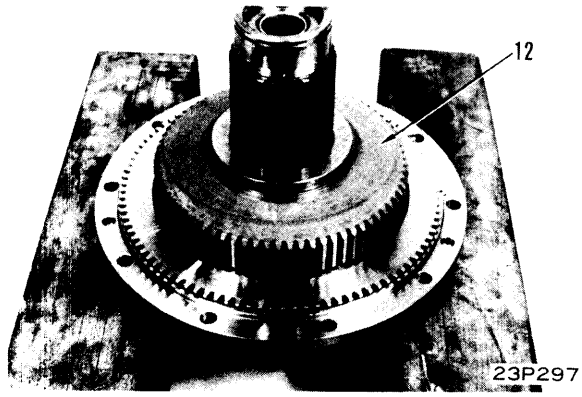
Press-fit shaft (4).



23P296

9. 1st speed gear

Install gear (12).



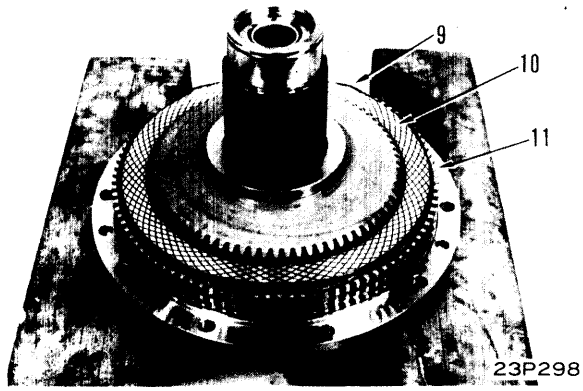
23P297

10. Spring, Disc, Plate

Install spring (9), discs (10) and plates (11) in order.

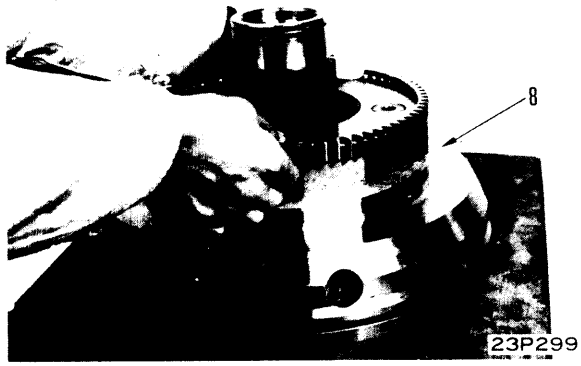
★ Disc: 3 pcs. Plate: 2 pcs.

★ Align plate internal teeth with piston external teeth.



11. 2nd speed carrier assembly

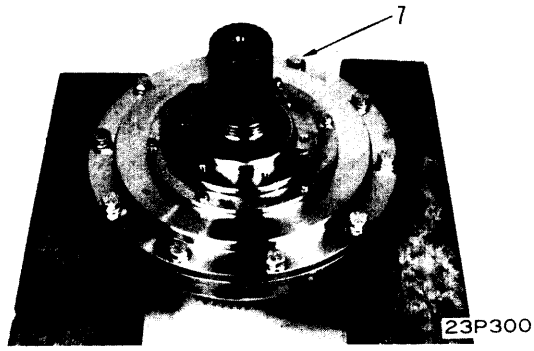
1) Align mounting bolt holes and install 2nd speed carrier assembly (8).



2) Fix cage faced up and tighten mounting bolts (7).

Mounting bolt: Thread tightener (LT-2)

Mounting bolt: 11 ± 1.5kgm



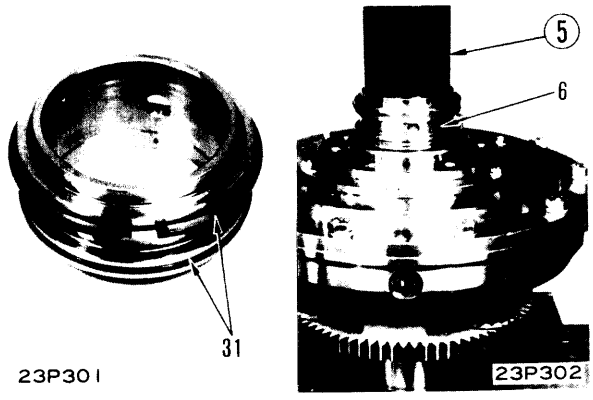
12. Collar

1) Install seal rings (31) on collar.

★ Install seal rings not aligning their slits.

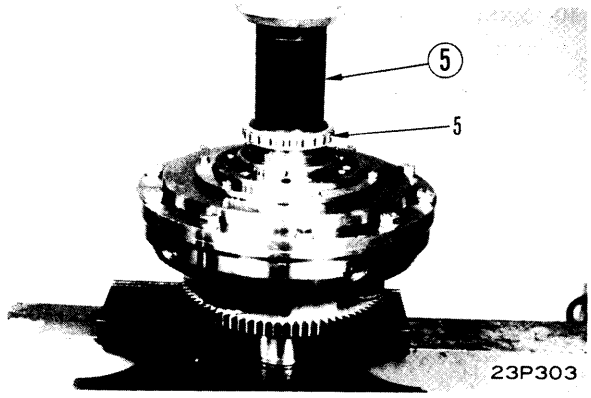
2) Using press-fitting tool ⑤ (φ76) press-fit collar (6).

★ Press-fit collar using care not to damage seal ring.



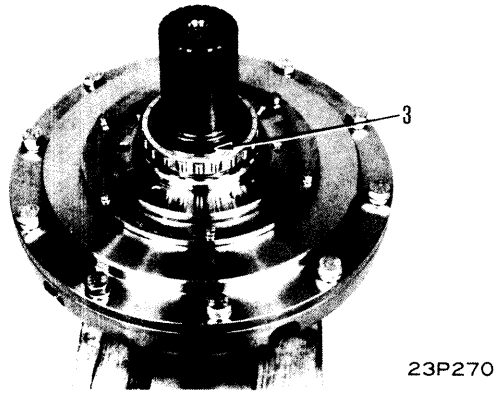
13. Bearing

Using press-fitting tool ⑤ (φ76) press-fit bearing (5).



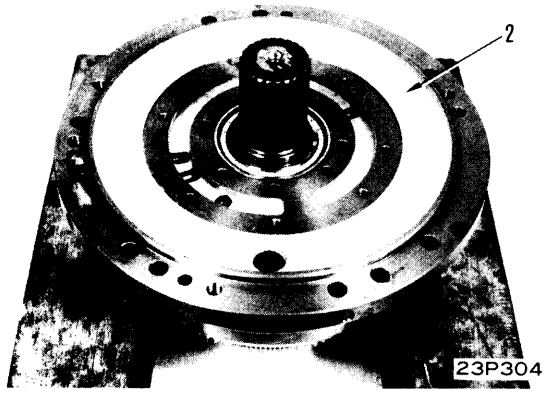
14. Snap ring

Install snap ring (3).



15. Housing assembly

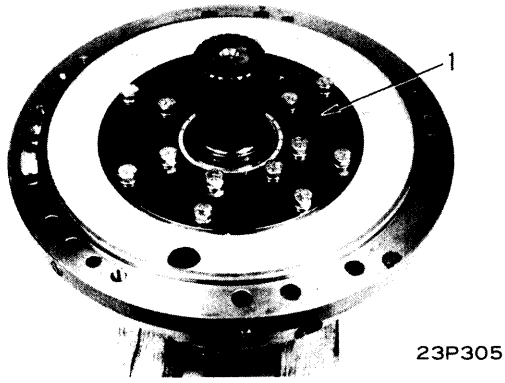
1) Install housing assembly (2).



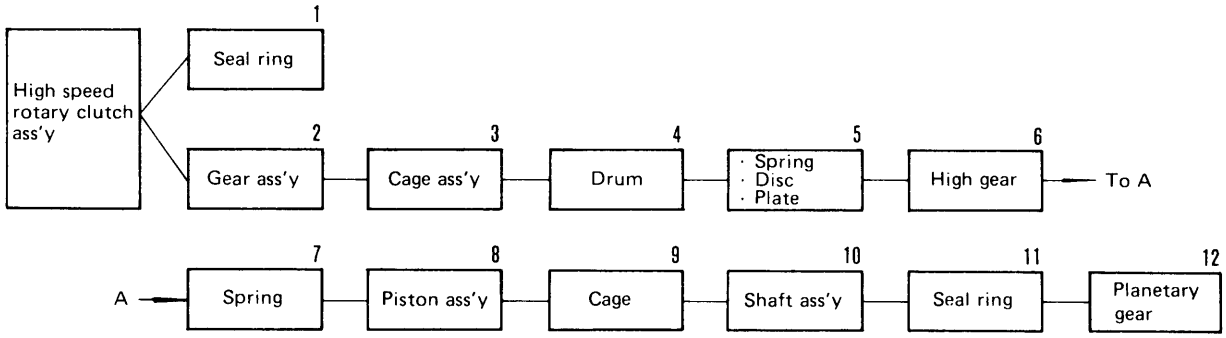
2) Install plate (1).

Mounting bolt: Thread tightener (LT-2)

kgm Mounting bolt: 6.5 ± 1.0kgm



DISASSEMBLY OF HIGH SPEED ROTARY CLUTCH
GD705R-4

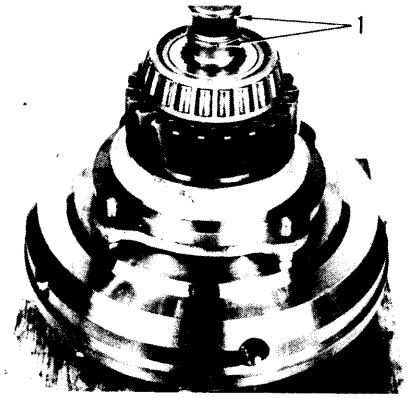


23F026

Special tools

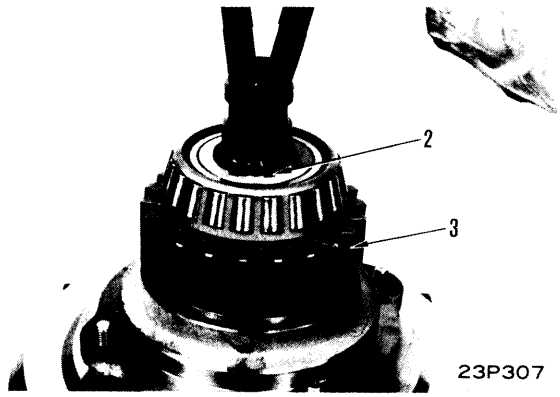
	Part number	Part name	Q'ty
A	792-371-1400	Sleeve	1
	790-201-2660	Push tool	1
	790-201-2760	Push tool	1

1. **Seal ring**
   Remove seal ring (1).



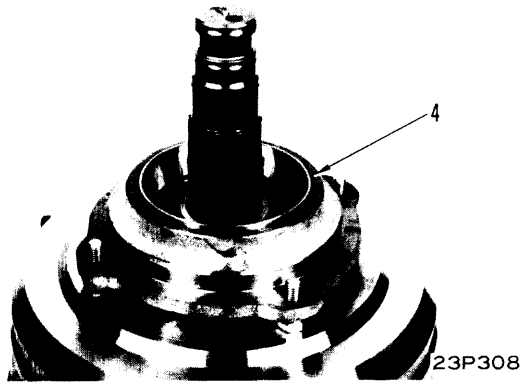
23P306

2. **Gear assembly**
   1) Remove snap ring (2).
   2) Remove gear assembly (3).

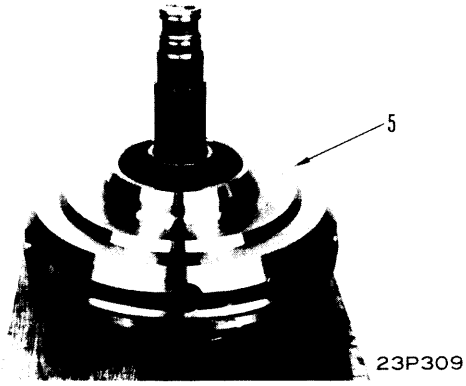


23P307

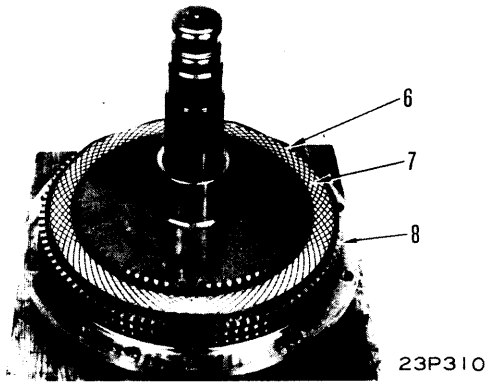
3. **Cage assembly**
   Remove cage assembly (4).



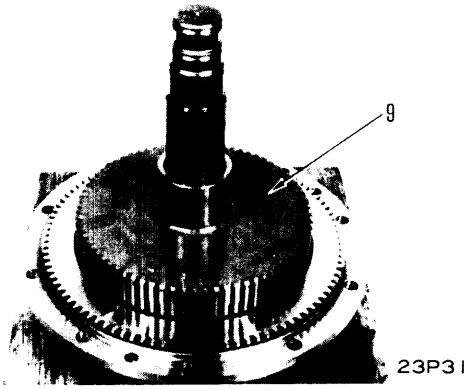
4. **Drum**
   Remove mounting bolts and remove drum (5).



5. **Spring, Disc, Plate**
   Remove spring (6), discs (7) and plates (8) in order.
   ★ Disc: 3 pcs. Plate: 2 pcs.



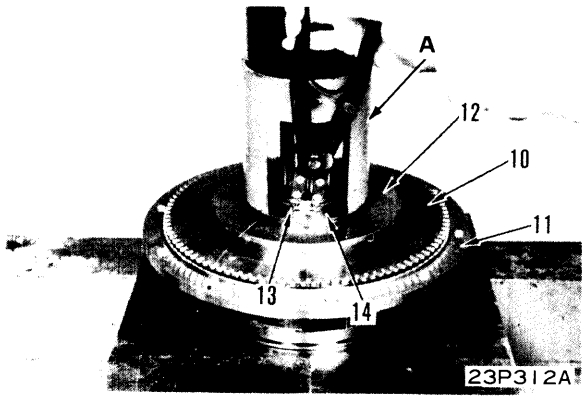
6. **High gear**
   Remove gear (9).



7. Spring

⚠ Be careful since spring is applied tension.

1) Put match marks on piston (10) and carrier (11).
2) Using tool **A** compress spring (12) with press and remove snap ring (13).
3) Remove cage (14) and remove spring (12).

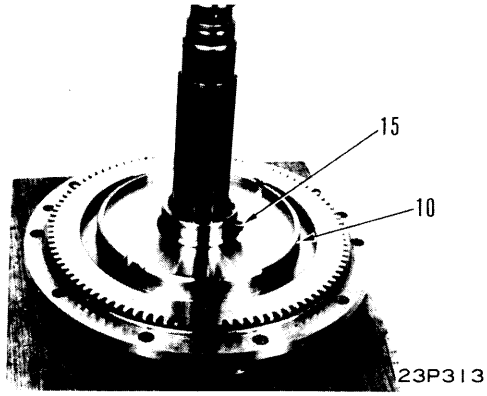


8. Piston assembly

1) Remove pin (15) and remove piston assembly (10).

9. Cage

1) Remove snap ring (16).
2) Remove cage (17).



10. Shaft assembly

1) Remove shaft (18).
2) Remove bushing (19) and seal ring (20) from shaft assembly.

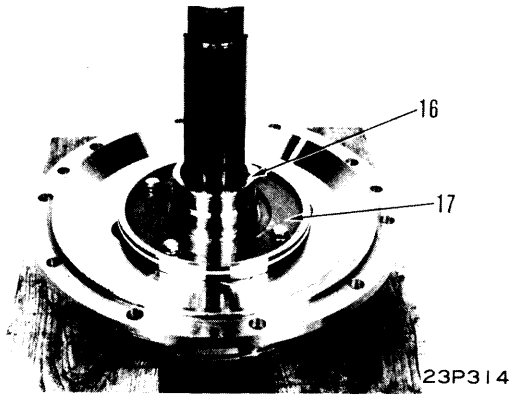
11. Seal ring

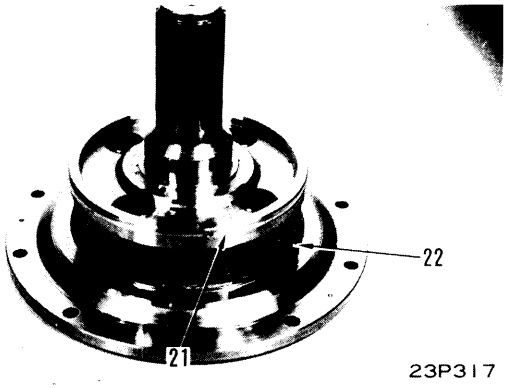
Remove seal ring (21).

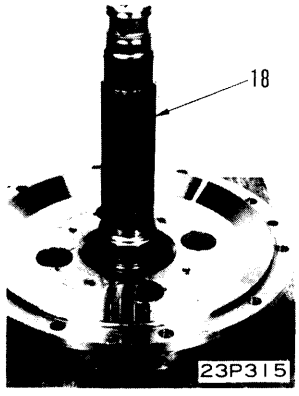
12. Planetary gear

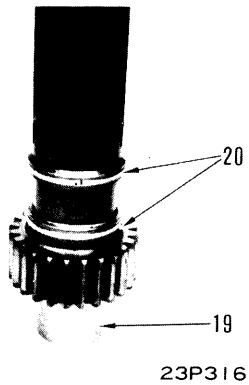
Remove planetary gear (22).

★ Refer to "DISASSEMBLY OF PLANETARY GEAR" section for removal of planetary gear.

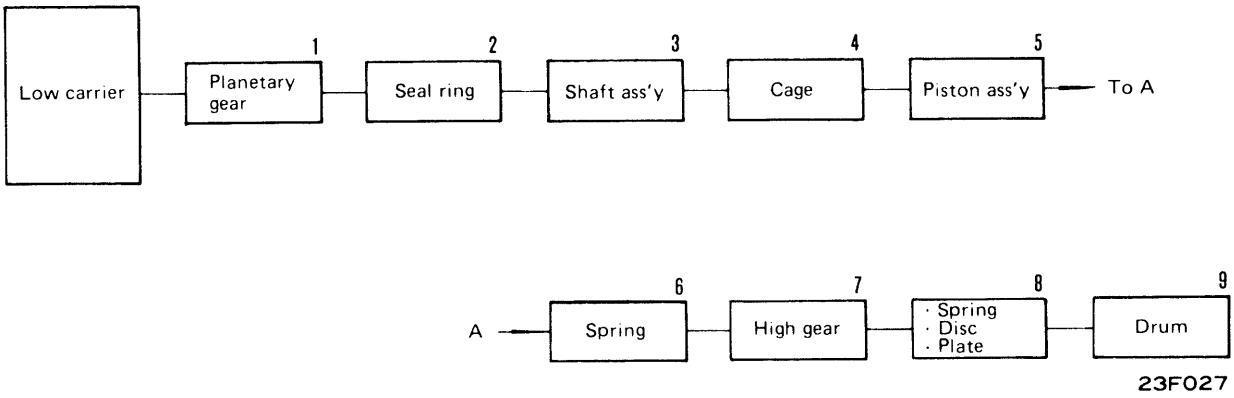








ASSEMBLY OF HIGH SPEED ROTARY CLUTCH
GD705R-4



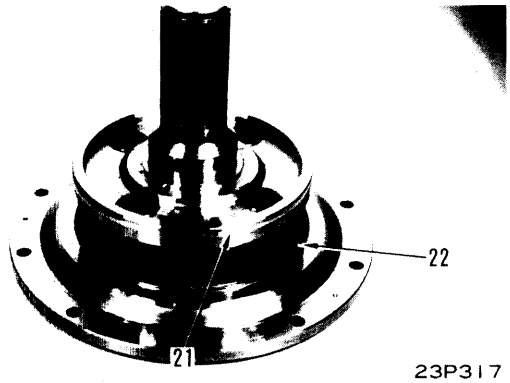
Special tools

	Part number	Part name	Q'ty
A	792-371-1400	Sleeve	1
	790-201-2660	Push tool	1
	790-201-2760	Push tool	1

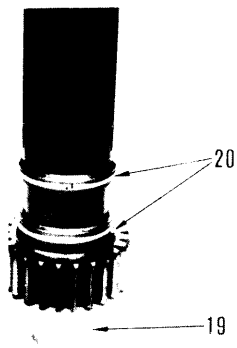
★ **Coat sliding portion of each part with engine oil before installing.**

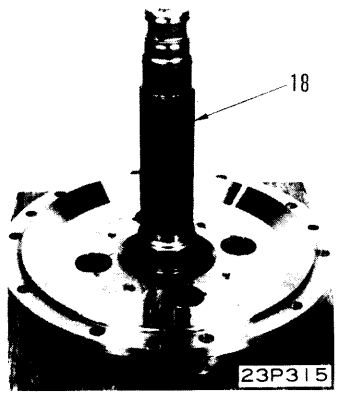
1. **Planetary gear**
   Install planetary gear (22).
   ★ Refer to "ASSEMBLY OF PLANETARY GEAR" section for installing planetary gear.

2. **Seal ring**
   Install seal ring (21).



3. **Shaft assembly**
   1) Press-fit bushing (19) to shaft and install seal rings (20).
      ★ Install seal rings not aligning their slits.
   2) Install shaft assembly (18) on carrier assembly.





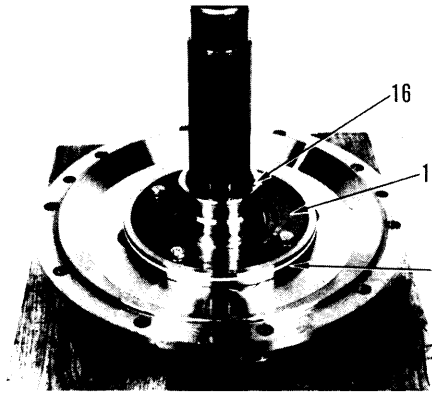
4. Cage

1) Instll seal ring (23) and install cage (17).

Mounting bolt: Thread tightener (LT-2)

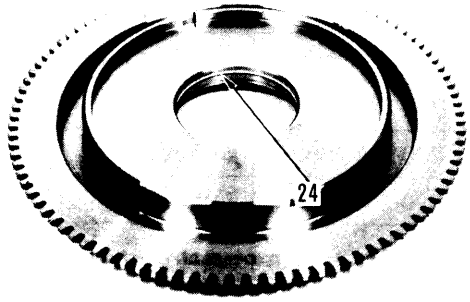
Mounting bolt: 3 ± 0.5kgm

2) Install snap ring (16).

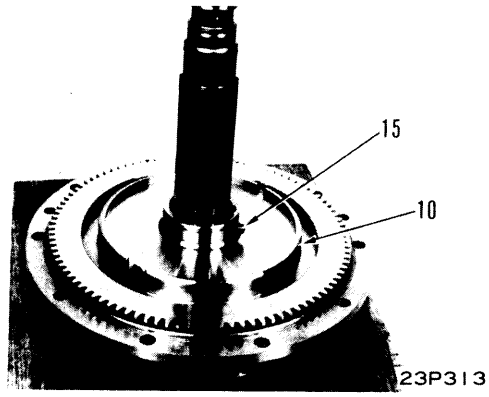


5. Piston assembly

1) Install seal ring (24) on piston.

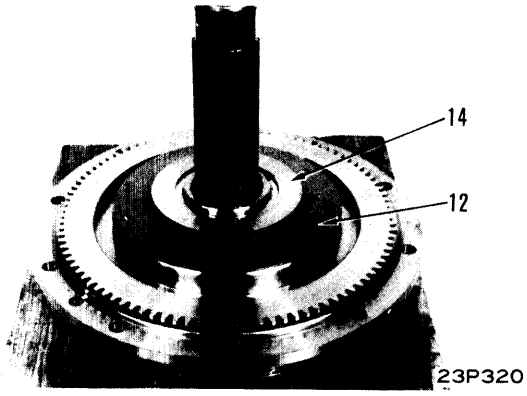


2) Install piston assembly (10) aligning match marks put when disassembled and install pin (15).



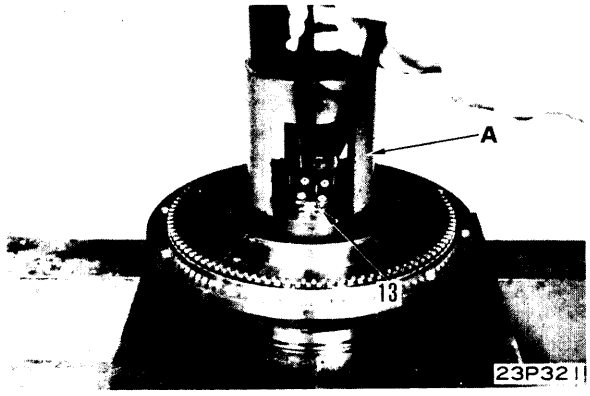
6. Spring

1) Install spring (12) and cage (14).



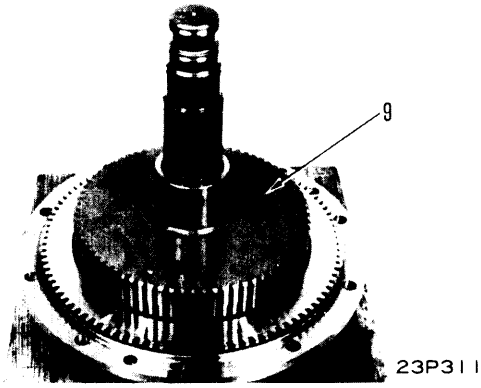
2) Confirm that match marks on piston and carrier are aligned and install snap ring (13) by compressing spring with press, using tool **A**.

★ Secure snap ring firmly.



7 High gear

Install gear (9).

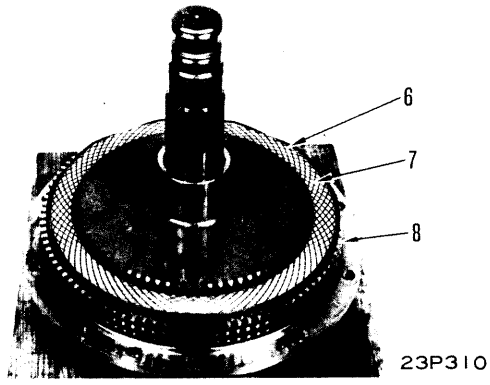


8. Spring, Disc, Plate

Install spring (6), discs (7) and paltes (8) in order.

★ Disc: 3 pcs. Plate: 2 pcs.

★ Align plate internal teeth with piston external teeth.

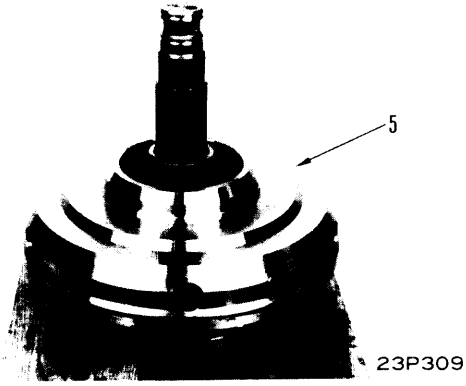


9. Drum

1) Press-fit bearing outer race to drum.

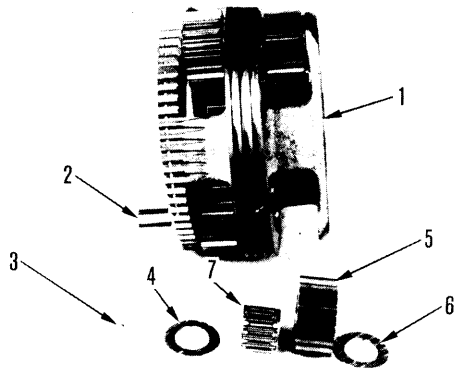
2) Install drum (5) aligning mounting bolt holes.

kgm Mounting bolt: 11 ± 1.5kgm



DISASSEMBLY OF PLANETARY GEAR GD705R-4

1. Pull out shaft (2) from planetary carrier assembly (1) to remove ball (3), and remove thrust washer (4), gear (5) and thrust washer (6) in that order.
2. Pull out bearing (7) from gear (5).

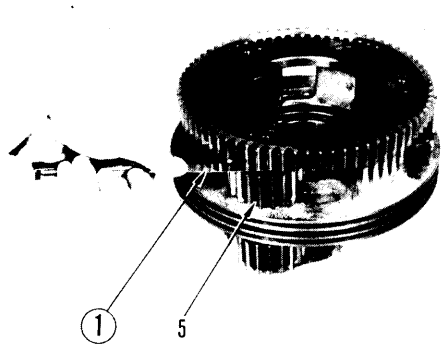


23P322

ASSEMBLY OF PLANETARY GEAR GD705R-4

★ **Coat sliding portion of each part with engine oil before installing.**

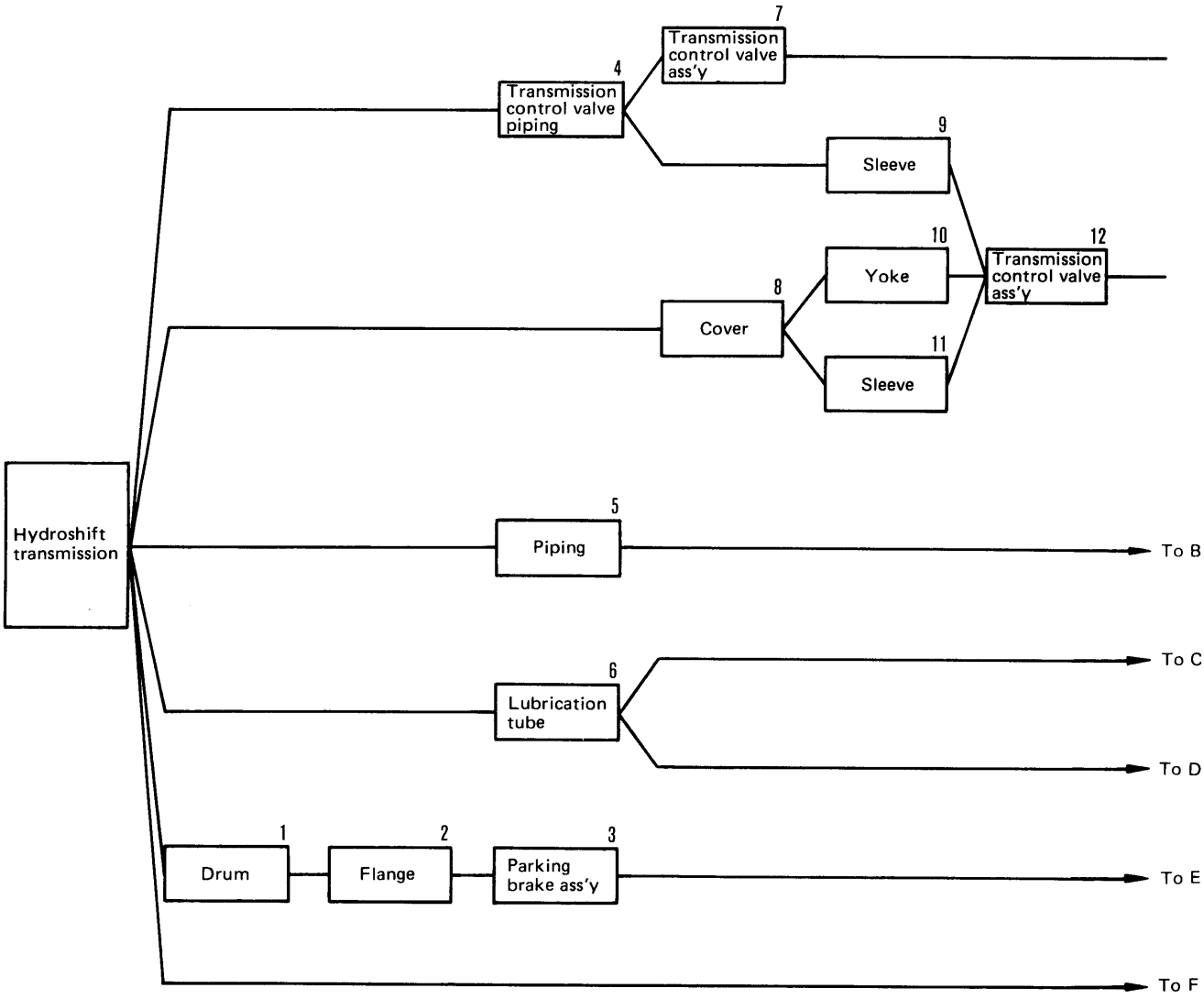
1. Install bearing (7) on gear (5).
2. While inserting carrier into shaft (2), install thrust washer (6), gear (5) and thrust washer (4), and at last fix shaft with ball (3).
   ★ If shaft comes out, calk slightly carrier ball groove.
3. After assembling, measuer side clearance of planetary gear (5) with feeler gauge ① and confirm that it is within standard.
   ★ Side clearace: 0.35 – 0.8 mm

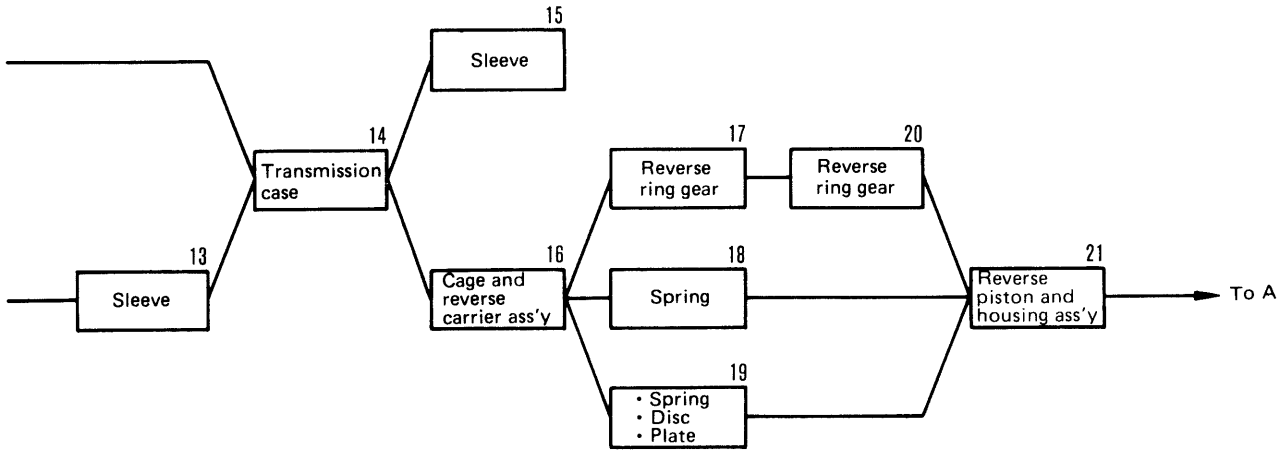


23P323

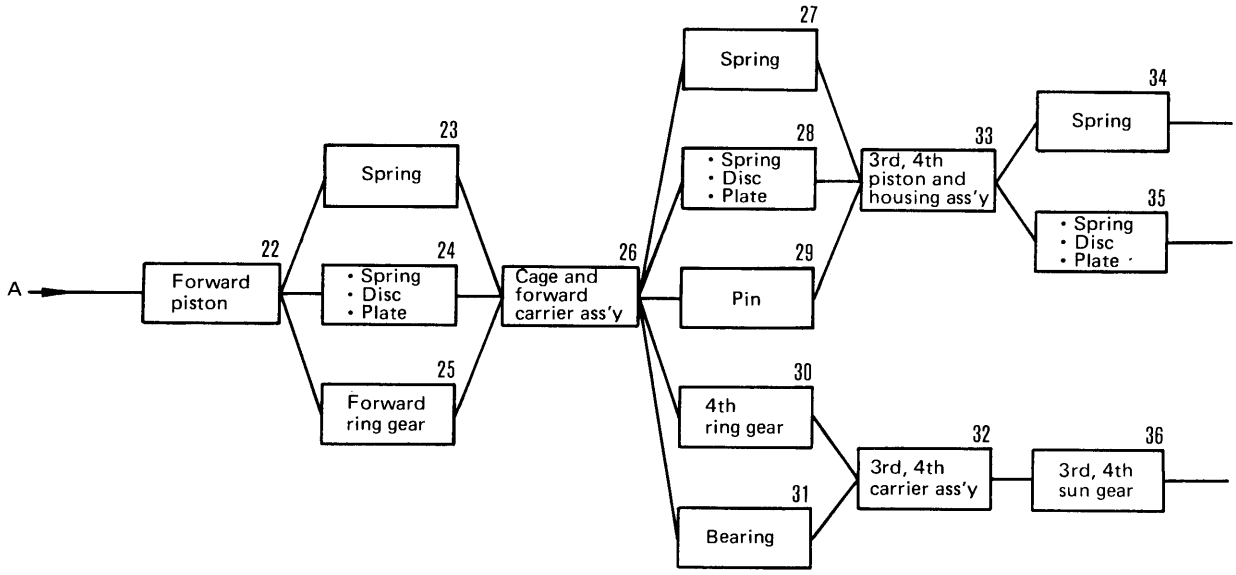
DISASSEMBLY OF HYDROSHIFT TRANSMISSION ASSEMBLY

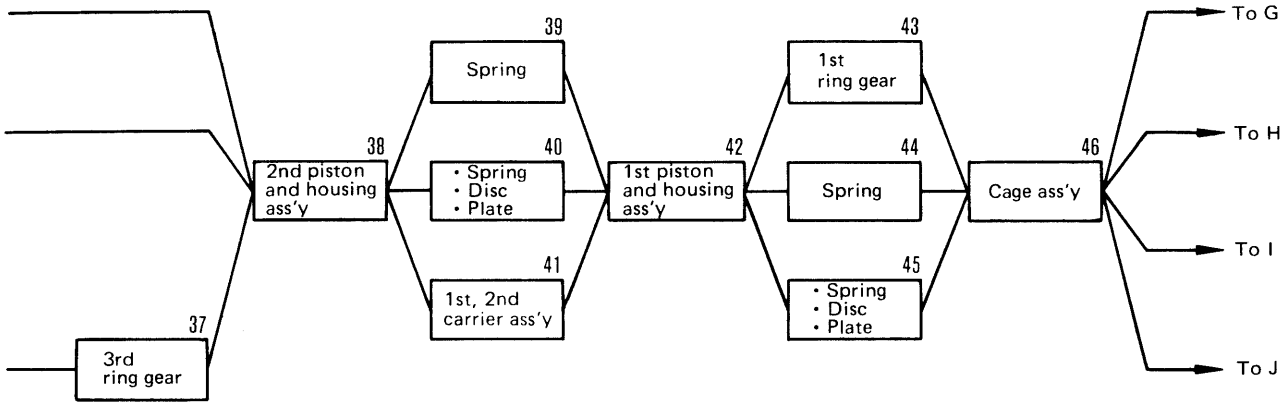
GD705A-4



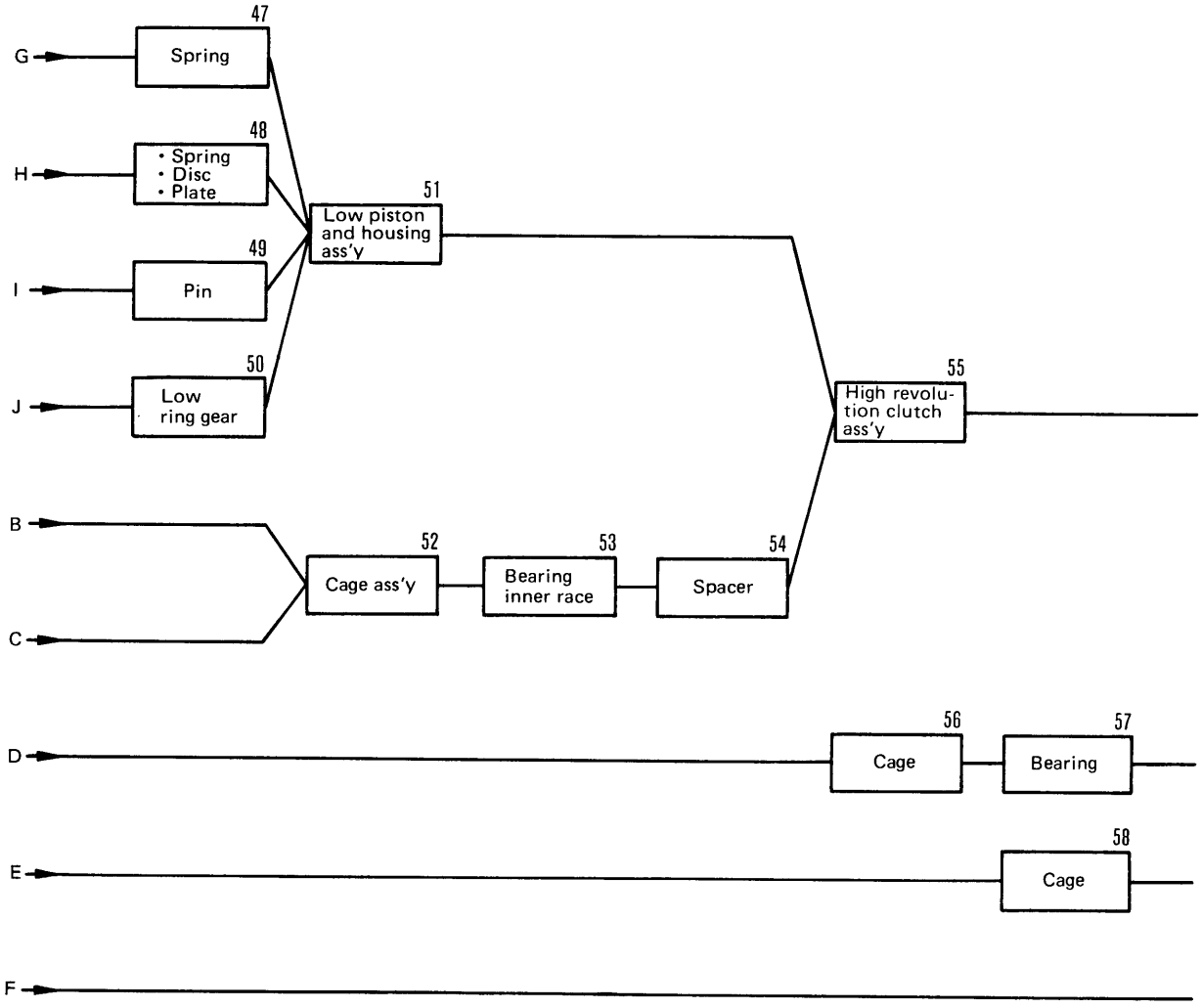

15
Sleeve
14
Transmission case
17
Reverse ring gear
20
Reverse ring gear
13
Sleeve
16
Cage and reverse carrier ass'y
18
Spring
21
Reverse piston and housing ass'y
To A
19
• Spring
• Disc
• Plate

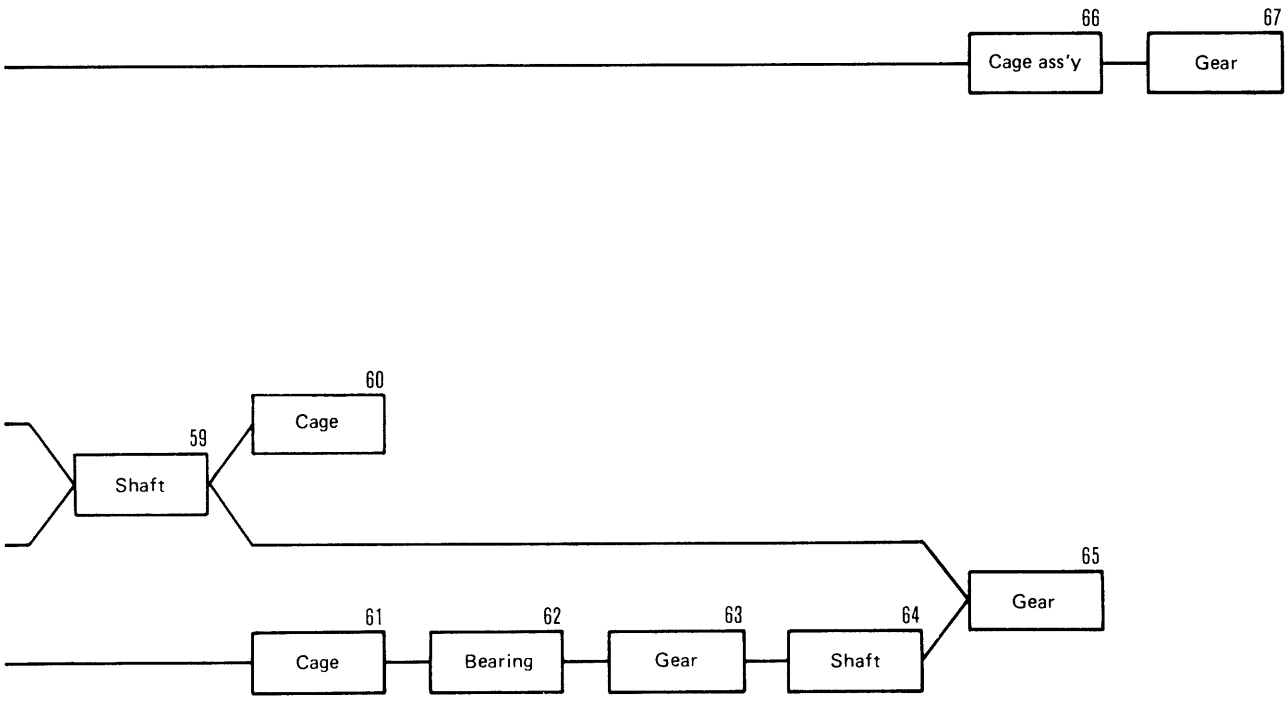
F23EC010


A
22
Forward piston
23
Spring
24
• Spring
• Disc
• Plate
25
Forward ring gear
26
Cage and forward carrier ass'y
27
Spring
28
• Spring
• Disc
• Plate
29
Pin
30
4th ring gear
31
Bearing
32
3rd, 4th carrier ass'y
33
3rd, 4th piston and housing ass'y
34
Spring
35
• Spring
• Disc
• Plate
36
3rd, 4th sun gear


37
3rd ring gear
38
2nd piston and housing ass'y
39
Spring
40
• Spring
• Disc
• Plate
41
1st, 2nd carrier ass'y
42
1st piston and housing ass'y
43
1st ring gear
44
Spring
45
• Spring
• Disc
• Plate
46
Cage ass'y
To G
To H
To I
To J

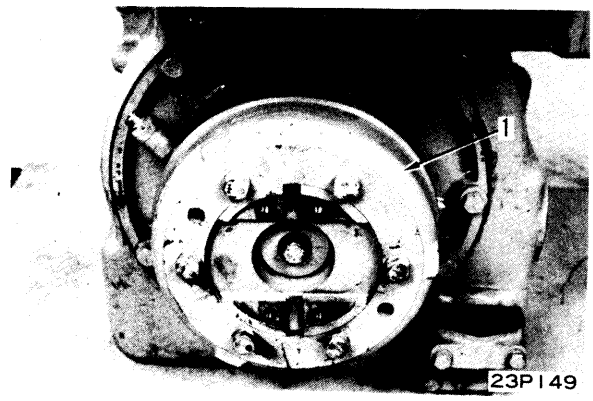
F23EC011


47
Spring
G
48
• Spring
• Disc
• Plate
H
51
Low piston and housing ass'y
49
Pin
I
50
Low ring gear
J
55
High revolution clutch ass'y
B
C
52
Cage ass'y
53
Bearing inner race
54
Spacer
56
Cage
57
Bearing
D
58
Cage
E
F

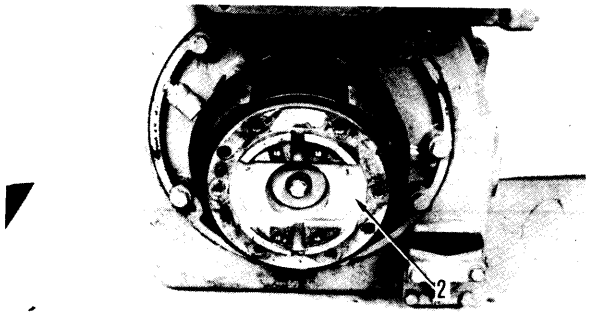

66
Cage ass'y
67
Gear
60
Cage
59
Shaft
65
Gear
61
Cage
62
Bearing
63
Gear
64
Shaft

F23EC012

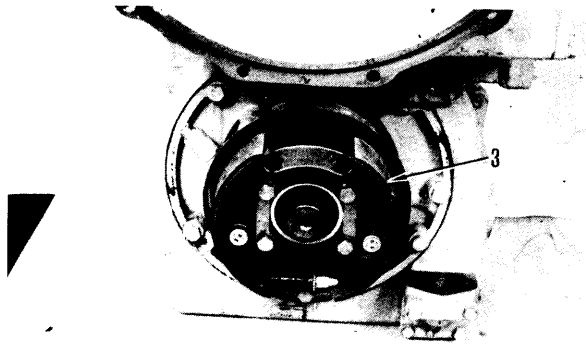
1. **Drum**
   Remove brake drum (1).



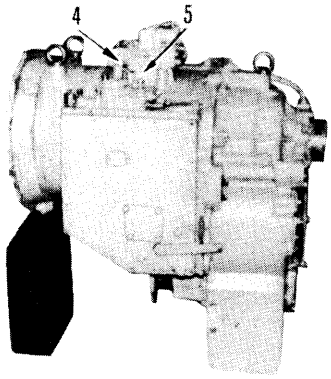
2. **Flange**
   Remove center bolt and dismount flange (2).



3. **Parking brake assembly**
   Remove parking brake assembly (3).

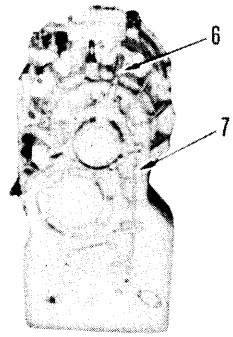


4. **Transmission control valve piping**
   Remove transmission control valve tubes (4), (5).



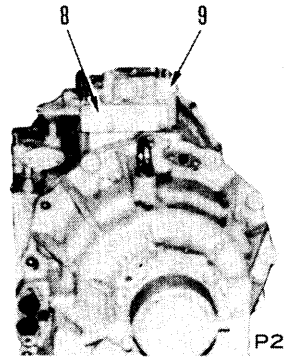
5. **Piping**
   Remove tube (6).

6. **Lubrication tube**
   Remove lubrication tube (7).



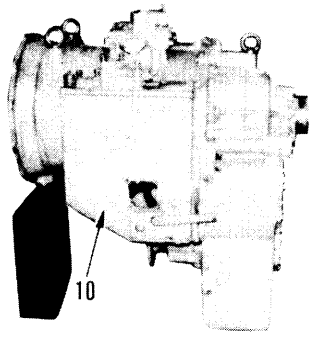
P23EC109

7. **Transmission control valve assembly**
   Remove transmission control valve assembly (8) together with cooler by-pass valve assembly (9).



P23EC110

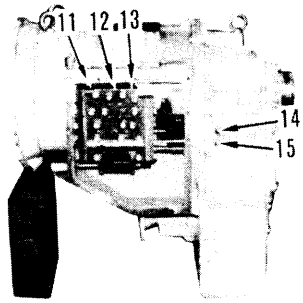
8. **Cover**
   Screw in jack bolt and remove cover (10).



P23EC111

9. **Sleeve**
   Screw in jack bolt (Thread dia. = 10 mm, Pitch = 1.5 mm), (Thread dia. = 16 mm, Pitch = 2.0 mm) and remove sleeves (11), (12) and (13).
   ★ As there are two kinds of sleeves, check the mounting position at removal.

10. **Yoke**
    Loosen lock nut, remove F • R yokes (14) and yoke (15) for inching from spool.



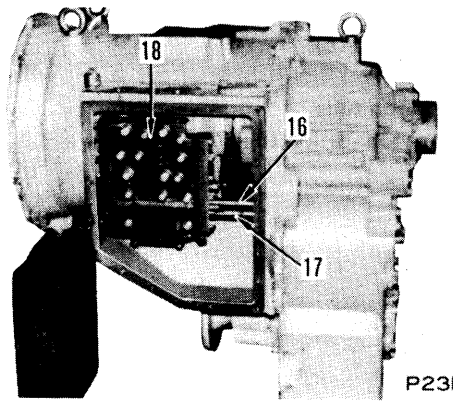
P23EC112

11. Sleeve

Remove snap rings, shift sleeves (16), (17) to right side and disconnect it from control valve.

12. Transmission control valve assembly

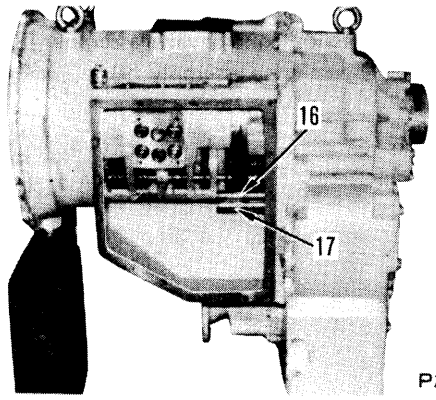
Remove four mounting bolts (Thread dia. = 10 mm), lift up control valve assembly (18) and dismount it.



P23EC113

13. Sleeve

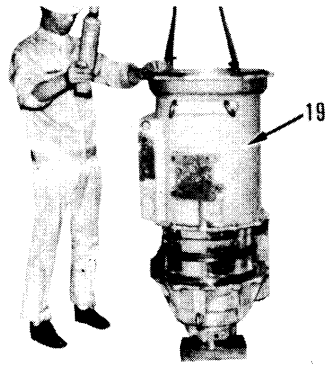
Remove sleeves (16), (17).



P23EC114

14. Transmission case

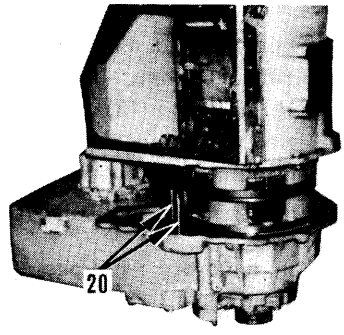
1) Set transmission in place with its transfer case facing down.
   ★ Before setting in place, remove mounting bolts from transfer case side.
2) Install eye bolt, lift transmission case (19) and dismount it.
   ★ Slowly sling transmission case horizontally.



P23EC115

15. Sleeve

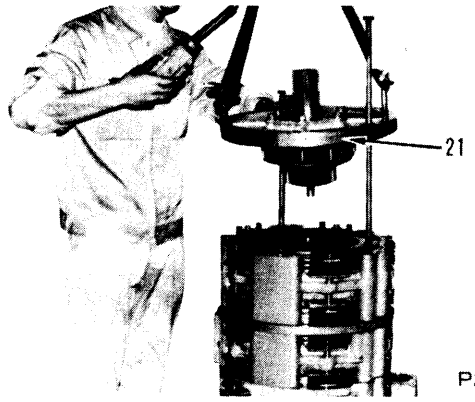
Remove sleeve (20).



P23EC116

16. Cage and reverse carrier assembly

1) Remove tie bolt.
2) Install eye bolts, sling cage and reverse carrier assembly (21) and remove it.



P23EC117

17. Reverse ring gear

Remove ring gear (22).

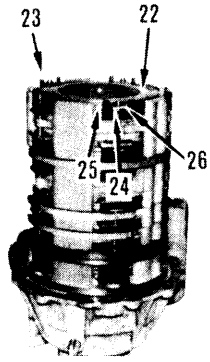
18. Spring

Remove spring (23).

19. Spring, Disc, Plate

Remove spring (24), disc (25) and plate (26) in order.

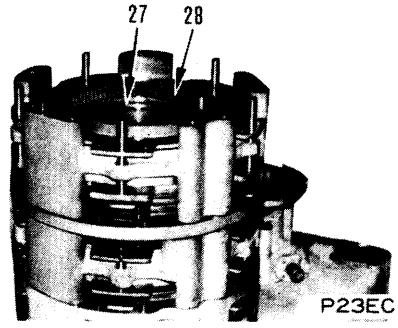
★ Disc: 4 pcs Plate: 3 pcs



P23EC118

20. Reverse ring gear

Remove snap ring (27) and remove ring gear (28).



P23EC119

21. Reverse piston and housing assembly

Install eye bolts, sling reverse piston and housing assembly (29) and remove them.

22. Forward piston

Remove forward piston (30).

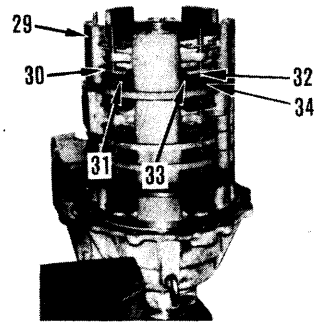
23. Spring

Remove spring (31).

24. Spring, Disc, Plate

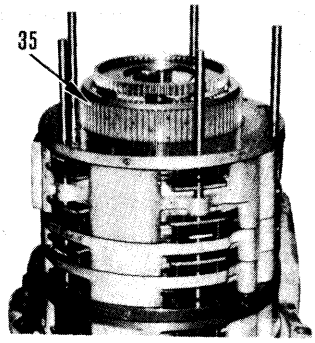
Remove spring (32), disc (33), plate (34) in order.

★ Disc: 4 pcs Plate: 3 pcs



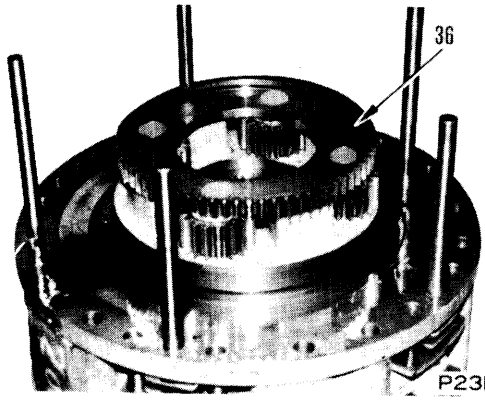
P23EC120

25. Forward ring gear
Remove ring gear (35).



P23EC121

26. Cage and forward carrier assembly
Install eye bolt, sling cage and forward carrier assembly (36) and remove them.

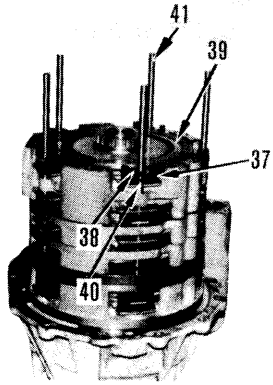


P23EC122

27. Spring
Remove spring (37).

28. Spring, Disc, Plate
Remove spring (38), disc (39) and plate (40) in order.
★ Disc: 3 pcs, Plate: 2 pcs

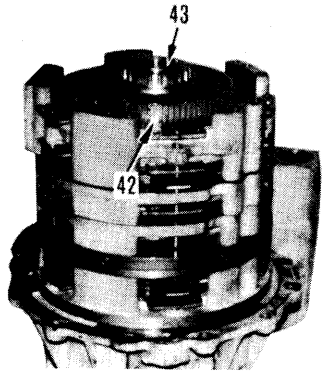
29. Pin
Remove pin (41).



P23EC123

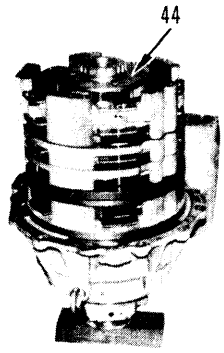
30. 4th ring gear
Remove ring gear (42).

31. Bearing
Remove holder and remove bearing (43).



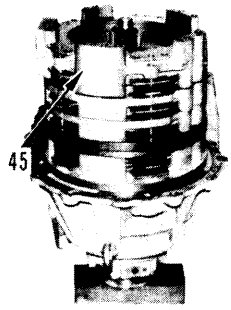
P23EC124

32. 3rd and 4th carrier assembly
Remove 3rd and 4th carrier assembly (44).



P23EC125

33. 3rd, 4th piston and housing assembly
Remove 3rd, 4th piston and housing assembly (45).
★ Hold 3rd speed piston by hand to prevent falling.

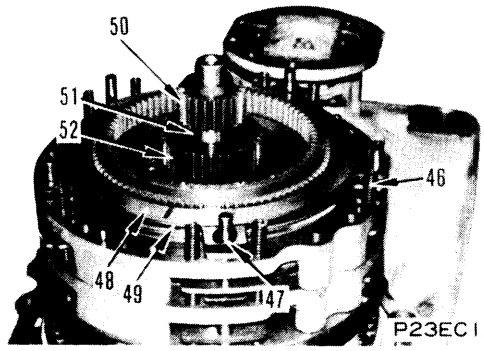


P23EC126

34. Spring
Remove spring (46).

35. Spring, Disc, Plate
Remove spring (47), disc (48), plate (49) in order.
★ Disc: 3 pcs, Plate: 2 pcs

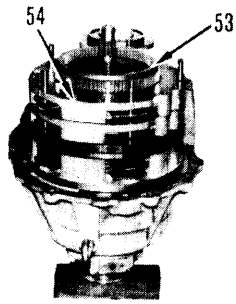
36. 3rd and 4th sun gear
Remove 4th sun gear (50), speacer (51) and 3rd sun gear (52).



P23EC127

37. 3rd ring gear
Remove snap ring and remove ring gear (53).

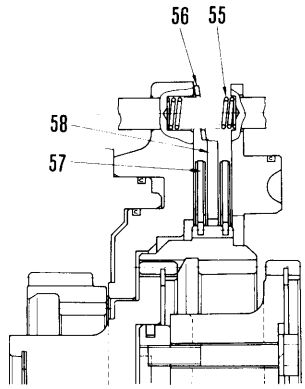
38. 2nd piston and housing assembly
Remove 2nd piston and housing assembly (54).
★ Hold piston by hand to prevent falling.



P23EC128

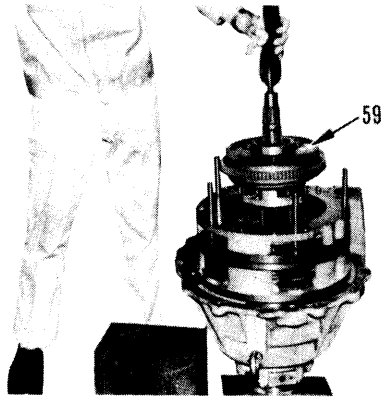
39. Spring
Remove spring (55).

40. Spring, Disc, Plate
Remove spring (56), disc (57) and plate (58) in order.
★ Disc: 2 pcs, Plate: 1 pc



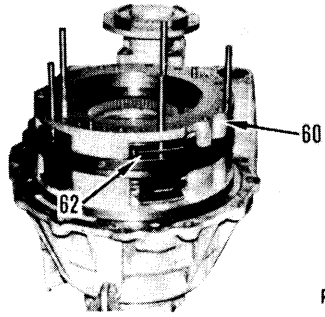
F23EC013

41. 1st, 2nd carrier assembly
Install eye bolts, sling 1st and 2nd carrier assembly (59) then remove them.



P23EC129

42. 1st piston and housing assembly
Remove 1st piston and housing assembly (60).
★ Hold piston by hand to prevent falling.

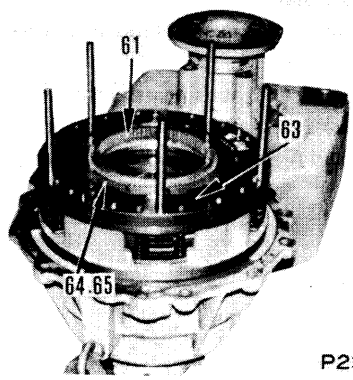


P23EC130

43. 1st ring gear
Remove ring gear (61).

44. Spring
Remove spring (62).

45. Spring, Disc, Plate
Remove wave spring (63), disc (64) and plate (65) in order.
★ Wave spring: 3 pcs, Disc: 3 pcs, Plate: 2 pcs.

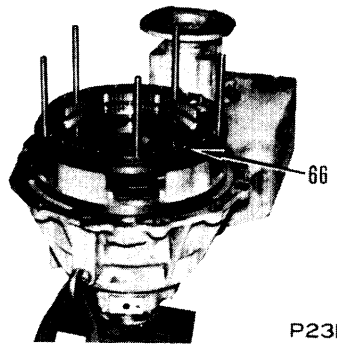


P23EC131

46. Cage assembly

Remove cage assembly (66).

★ Align pin and hole and confirm the position.



P23EC132

47. Spring

Remove spring (67).

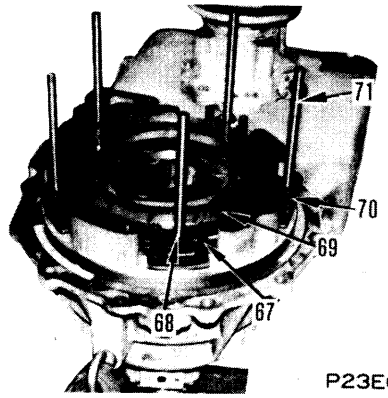
48. Spring, Disc, Plate

Remove spring (68), disc (69) and plate (70) in order.

★ Disc: 5 pcs, Plate: 4 pcs

49. Pin

Remove pin (71).



P23EC133

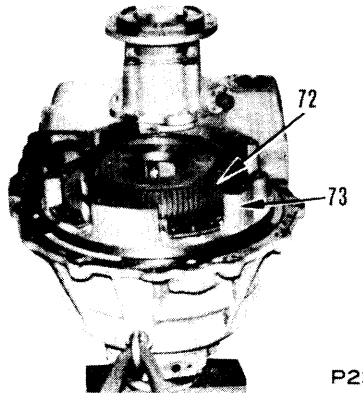
50. Low ring gear

Remove ring gear (72).

51. Low piston and housing assembly

Remove low piston and housing assembly (73).

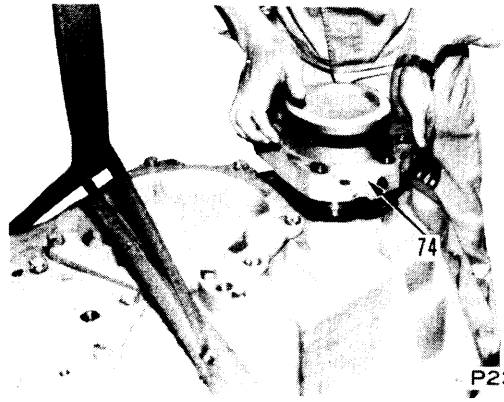
★ Align hole of housing and pin of transfer case and confirm the position.



P23EC134

52. Cage assembly

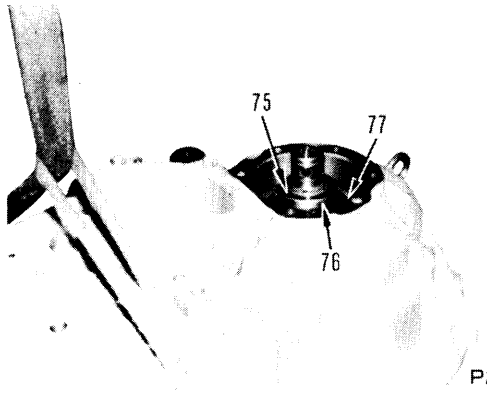
1) Face transfer case side up and insert block to prevent high revolution clutch assembly from falling.
2) Screw in jack bolt and remove cage assembly (74).



P23EC135

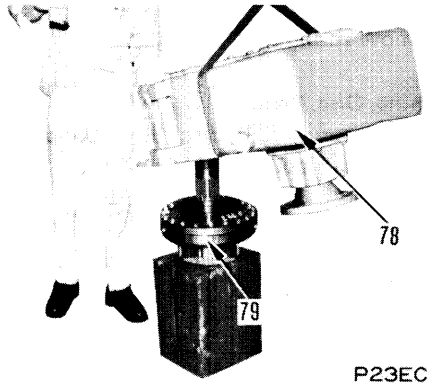
53. Bearing inner race
Remove snap ring (75) and remove bearing inner race (76).

54. Spacer
Remove spacer (77).



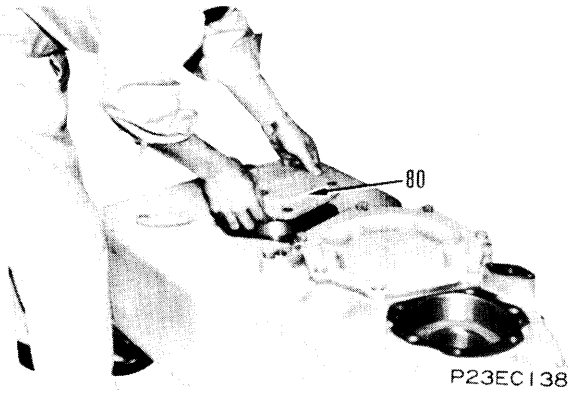
P23EC136

55. High revolution clutch assembly
Lift transfer case (78) and remove high revolution clutch (79).
★ Slowly sling transfer case horizontally.



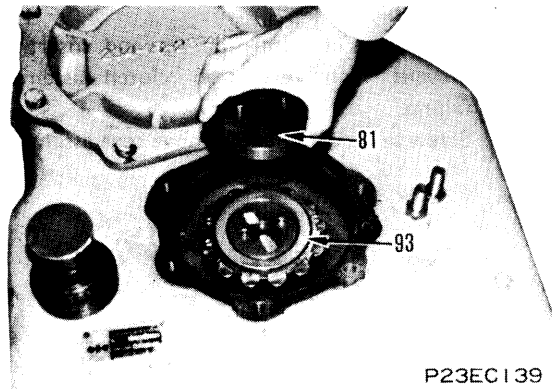
P23EC137

56. Cage
Screw in jack bolt and remove cage (80) together with bearing outer race.



P23EC138

57. Bearing
Remove holder (81) and remove bearing inner race (93).



P23EC139

58. Cage
Remove cage (82).

59. Shaft
Remove shaft (83) together with bearing (84).

60. Cage
Screw in jack bolt and remove cage (85).

61. Cage
Screw in jack bolt and remove cage (86) together with bearing outer race.

62. Bearing
Remove bearing inner race (87).

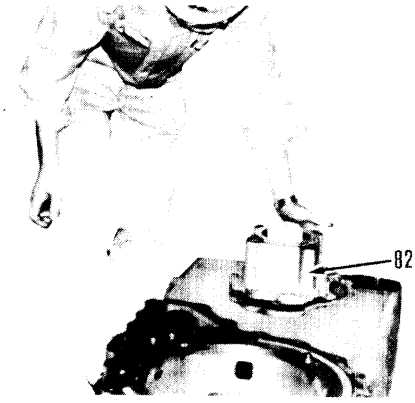
63. Gear
Remove gear (88).

64. Shaft
Remove shaft (89) together with bearing inner race.

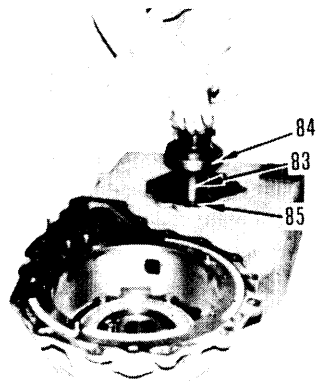
65. Gear
Shift gear (90) to hole of neighbor and pull it out.

66. Cage assembly
Screw in jack bolt and remove cage (91) together with bearing outer race.

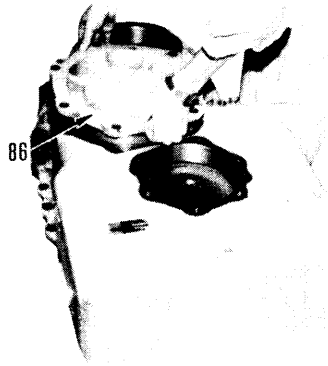
67. Gear
Remove gear (92).
★ Confirm installation direction.



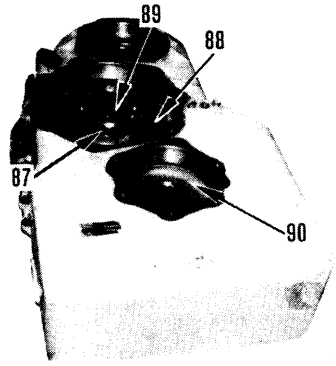
P23EC140



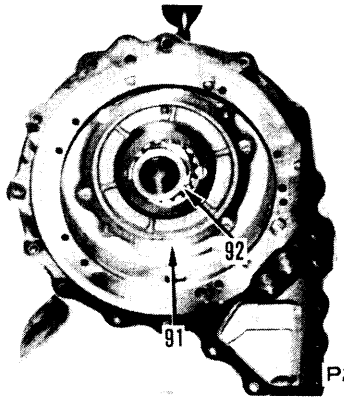
P23EC141



P23EC142



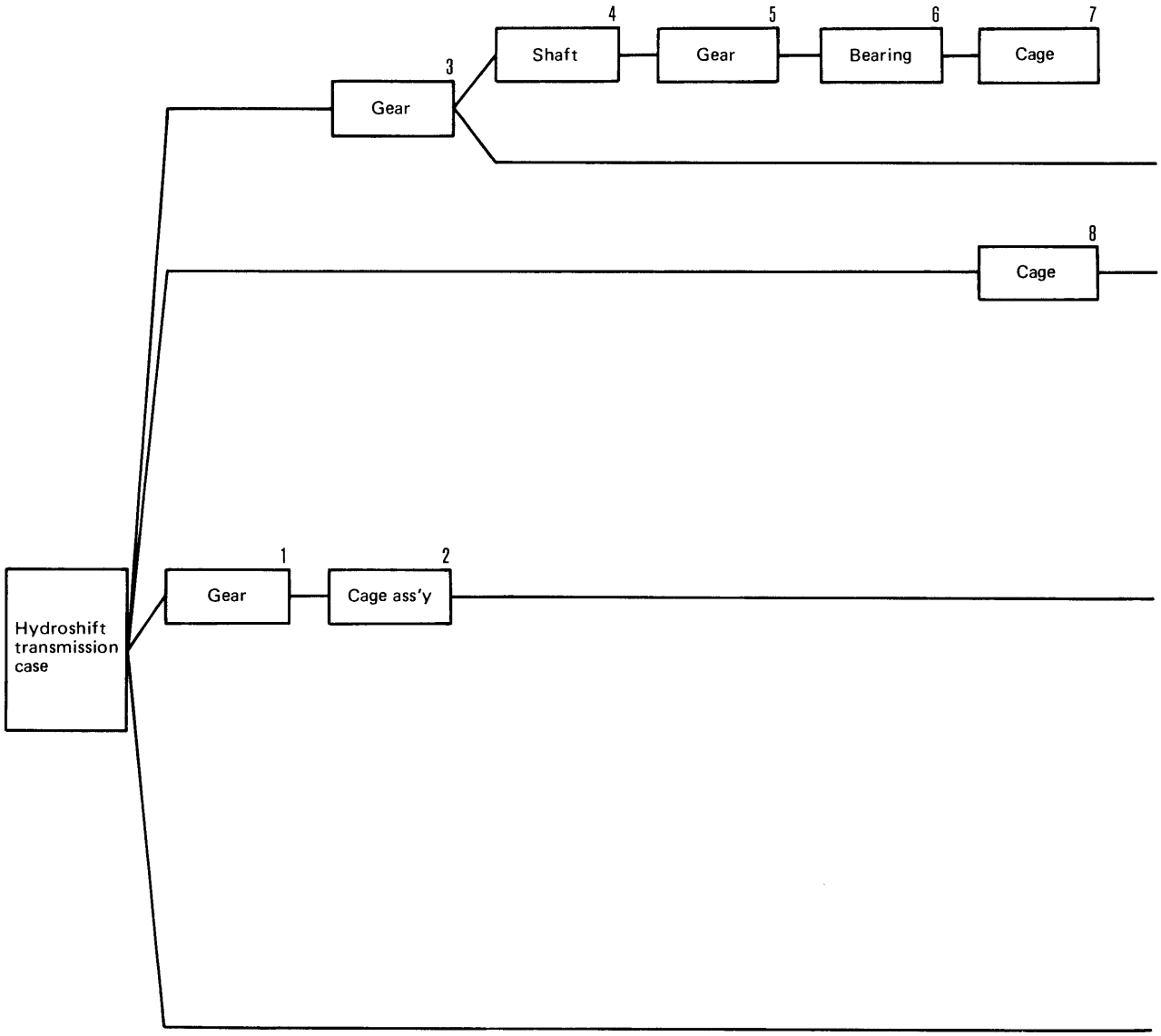
P23EC143

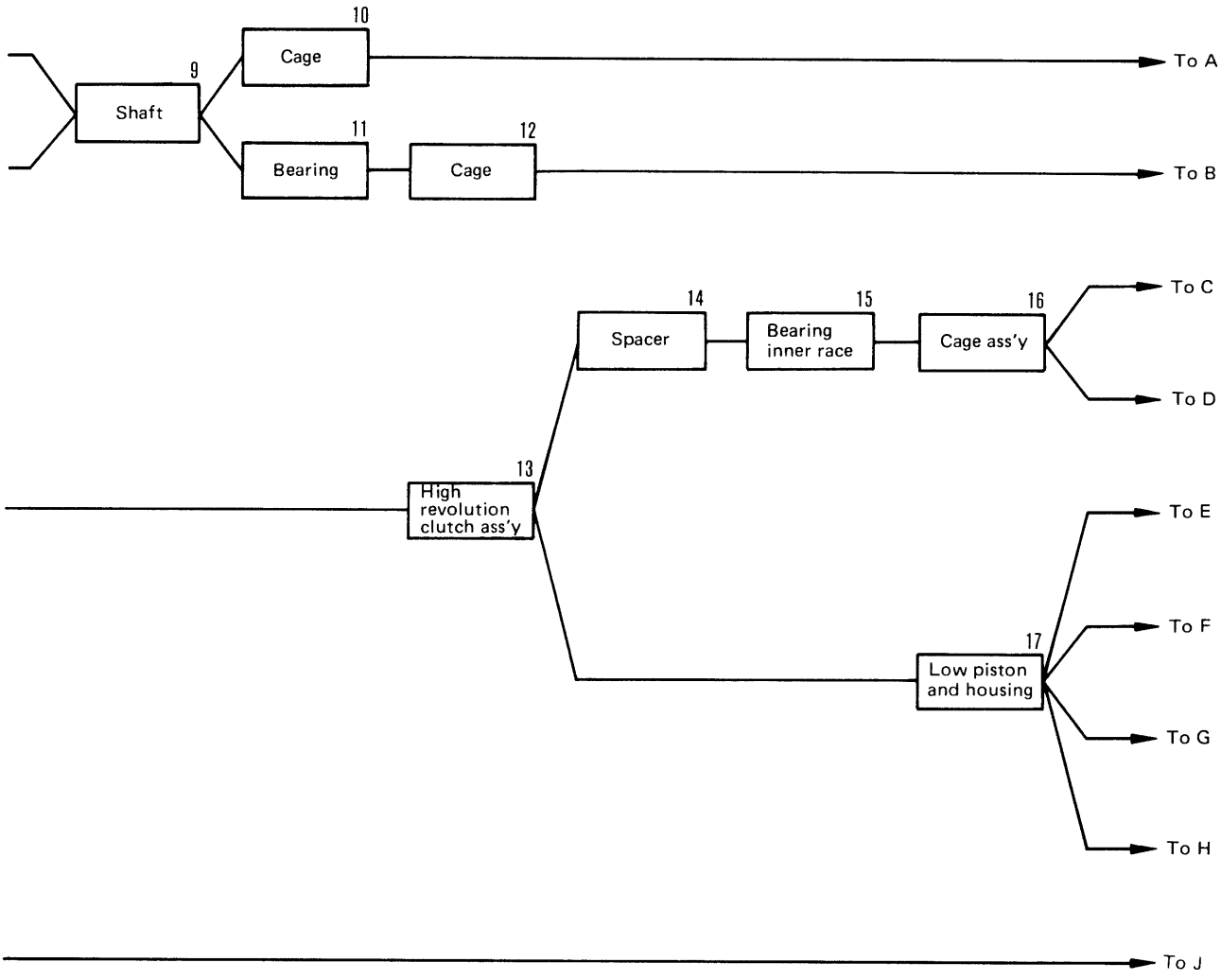


P23EC144

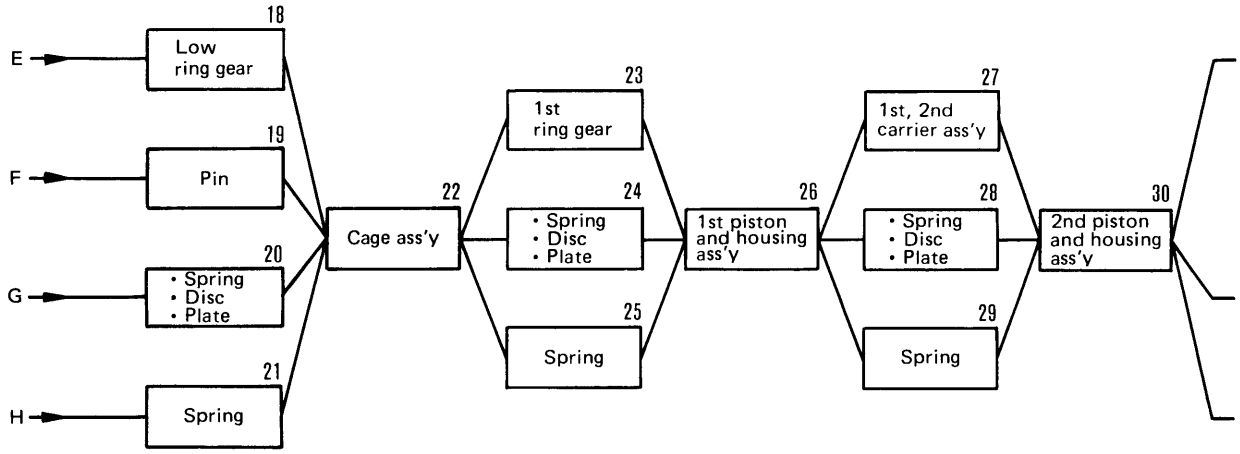
ASSEMBLY OF HYDROSHIFT TRANSMISSION ASSEMBLY

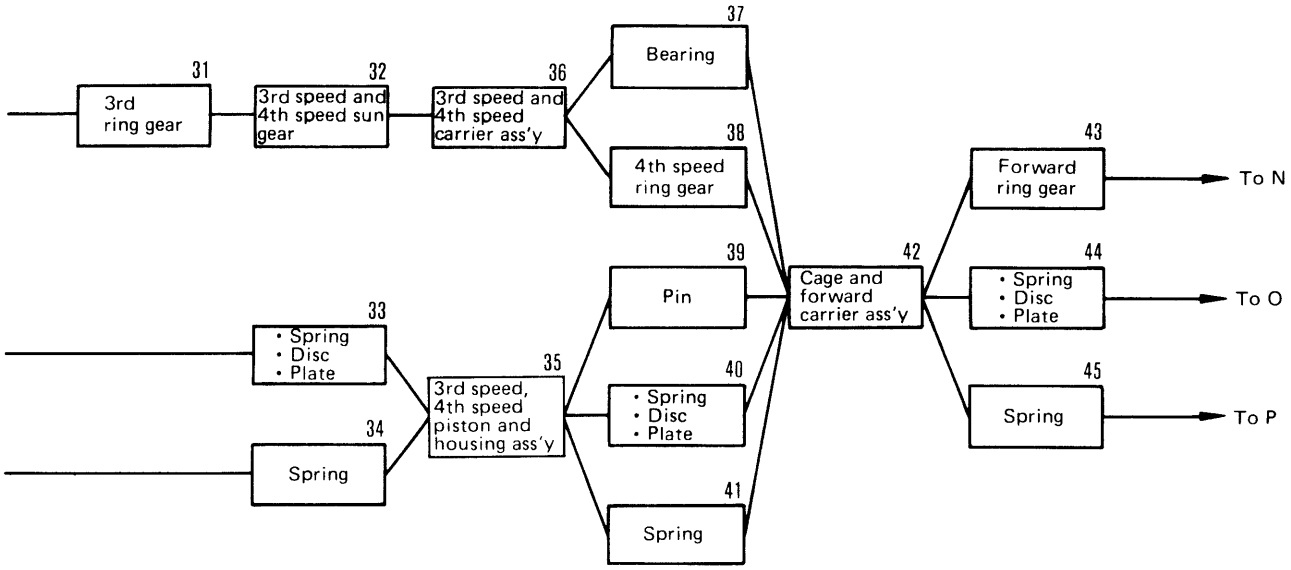
GD705A-4



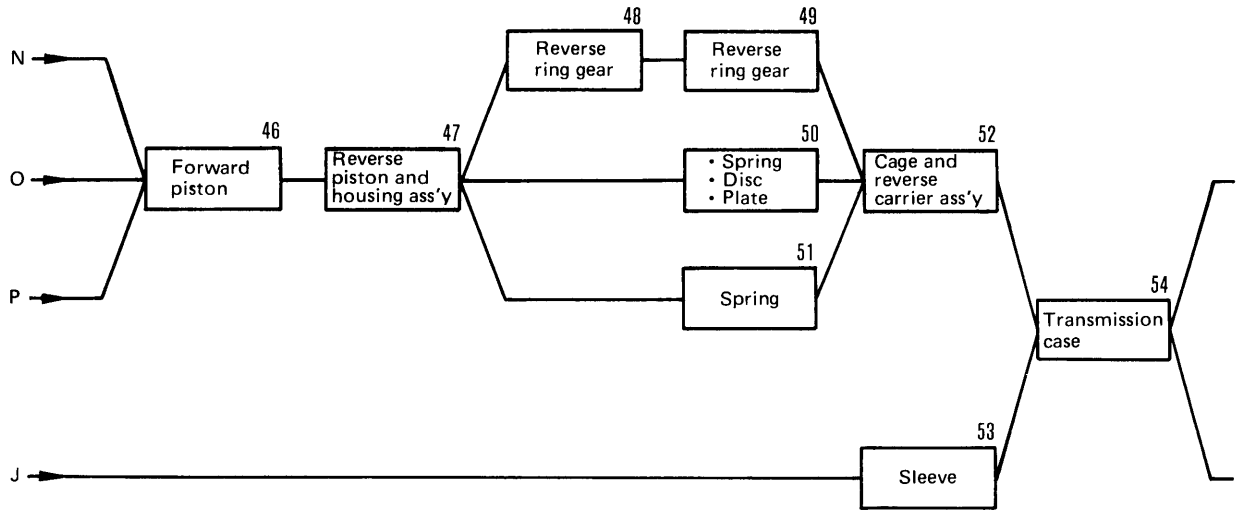

10
Cage
9
Shaft
11
Bearing
12
Cage
To A
To B
14
Spacer
15
Bearing inner race
16
Cage ass'y
To C
To D
13
High revolution clutch ass'y
To E
To F
17
Low piston and housing
To G
To H
To J

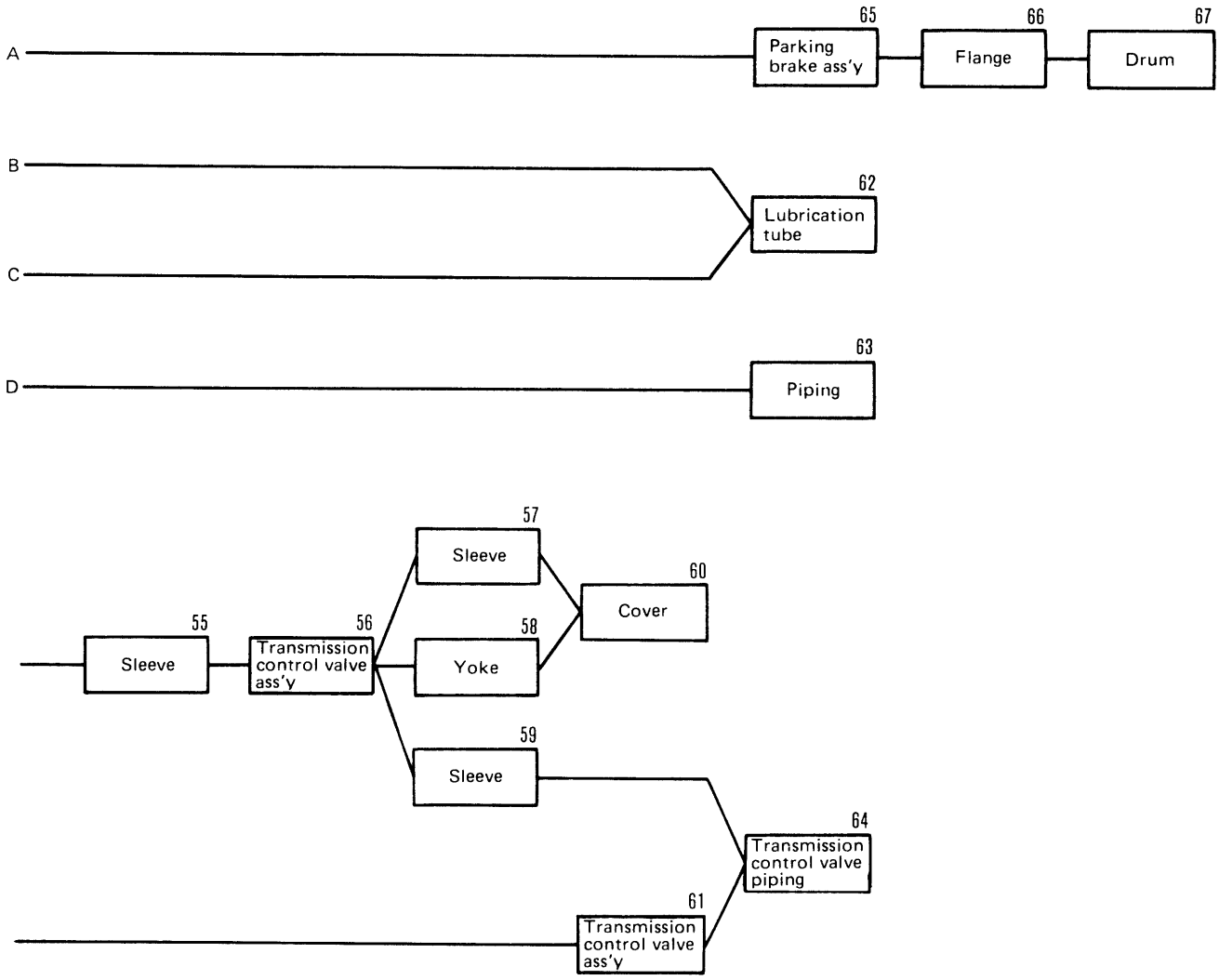
F23EC014


E
F
G
H
18
Low ring gear
19
Pin
20
• Spring
• Disc
• Plate
21
Spring
22
Cage ass'y
23
1st ring gear
24
• Spring
• Disc
• Plate
25
Spring
26
1st piston and housing ass'y
27
1st, 2nd carrier ass'y
28
• Spring
• Disc
• Plate
29
Spring
30
2nd piston and housing ass'y


31
3rd ring gear
32
3rd speed and 4th speed sun gear
36
3rd speed and 4th speed carrier ass'y
37
Bearing
38
4th speed ring gear
39
Pin
40
• Spring
• Disc
• Plate
41
Spring
33
• Spring
• Disc
• Plate
34
Spring
35
3rd speed, 4th speed piston and housing ass'y
42
Cage and forward carrier ass'y
43
Forward ring gear
44
• Spring
• Disc
• Plate
45
Spring
To N
To O
To P

F23EC015


N
O
P
J
46
Forward piston
47
Reverse piston and housing ass'y
48
Reverse ring gear
49
Reverse ring gear
50
• Spring
• Disc
• Plate
51
Spring
52
Cage and reverse carrier ass'y
53
Sleeve
54
Transmission case

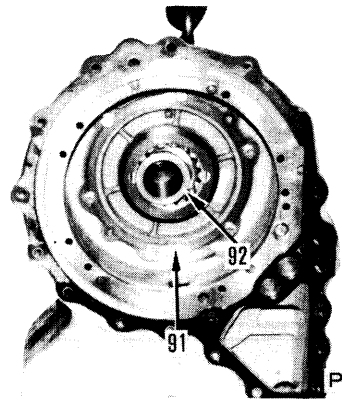

A
65
Parking brake ass'y
66
Flange
67
Drum
B
C
62
Lubrication tube
D
63
Piping
55
Sleeve
56
Transmission control valve ass'y
57
Sleeve
58
Yoke
59
Sleeve
60
Cover
61
Transmission control valve ass'y
64
Transmission control valve piping

F23EC016

★ Apply engine oil to sliding portion of each part before installation.

1. **Gear**
   Install gear (92).
   ★ Confirm installation direction of gear.

2. **Cage assembly**
   Insert bearing outer race to cage (91), fix snap ring and mount it to transfer case.

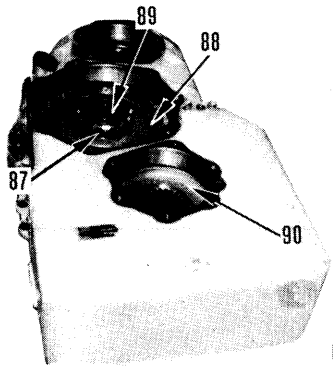


P23EC144

3. **Gear**
   Insert gear (90) from center hole and shift it to the hole of out put shaft side.

4. **Shaft**
   1) Press-fit bearing outer race to transfer case.
   2) Press-fit bearing inner race to shaft (89).
   3) Mount shaft.
      ★ Confirm installing direction of shaft.

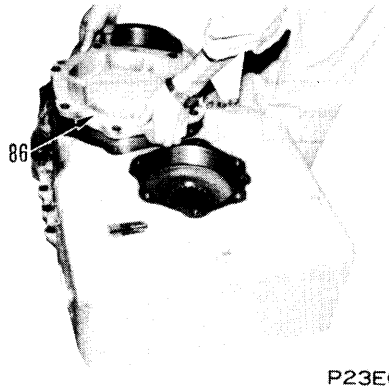
5. **Gear**
   Install gear (88).



P23EC143

6. **Bearing**
   Using press-fitting tool, press-fit bearing (87).

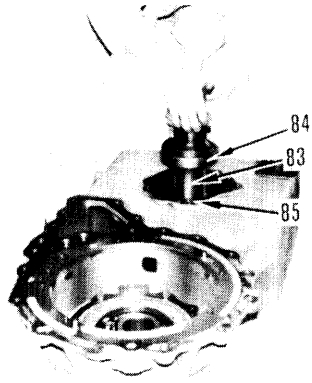
7. **Cage**
   1) Press-fit bearing outer race to cage (86).
   2) Fit O-ring and install cage (86).



P23EC142

8. **Cage**
   Fit O-ring and install cage (85).

9. **Shaft**
   Press-fit bearing (84) to shaft (83) and install shaft (83).

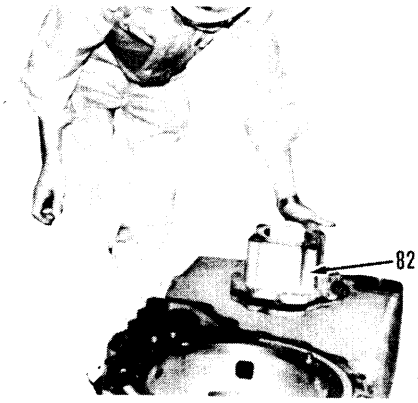


P23EC141

10. Cage

1) Use push tool to install oil seal.
   - ★ Charge grease (G2-LI) to oil seal lip groove to fill it up to 40 to 60%.
   - ★ Coat fluid gasket to press-fit face of oil seal.
2) Fit O-ring to mounting face and install cage (82).

   kgm Mounting bolt: 11.25 ± 1.25 kgm



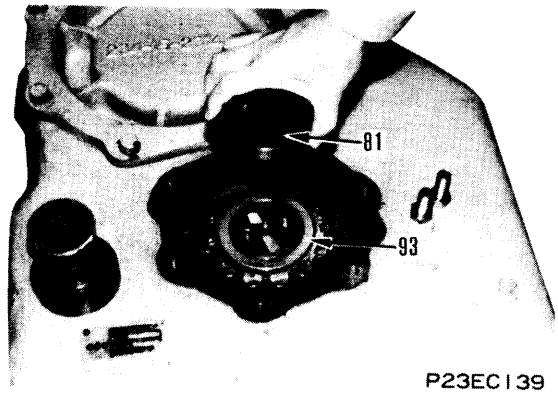
P23EC140

11. Bearing

Using press-fit tool, press-fit bearing (93) and install holder (81).

Mounting bolt: Thread tightener (LT-2)

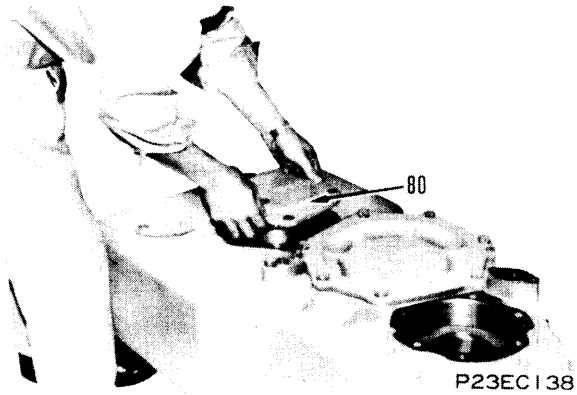
kgm Mounting bolt: 18 ± 2 kgm



P23EC139

12. Cage

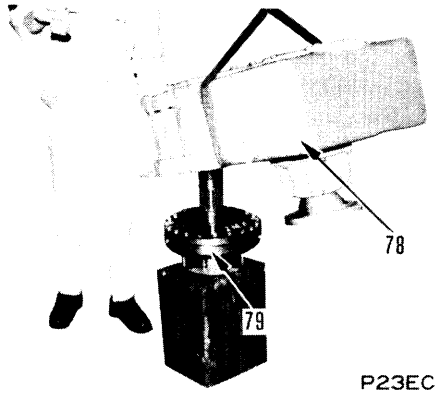
Press-fit bearing outer race to cage (80), fit O-ring to cage and install it.



P23EC138

13. High revolution clutch assembly

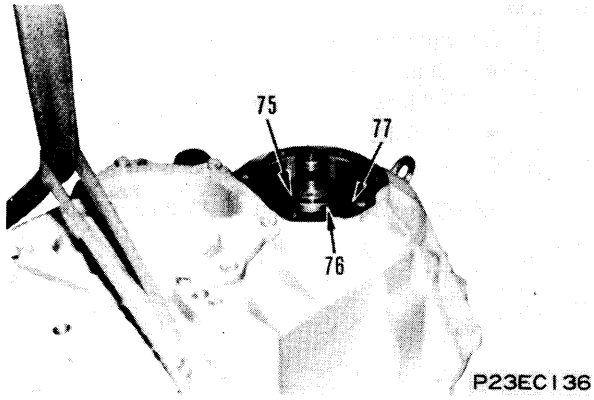
1) Put high revolution clutch assembly (79) on the block.
2) Lift transfer case (78) and put it on the high revolution clutch assembly.
   - ★ Slowly put horizontally on transfer case.



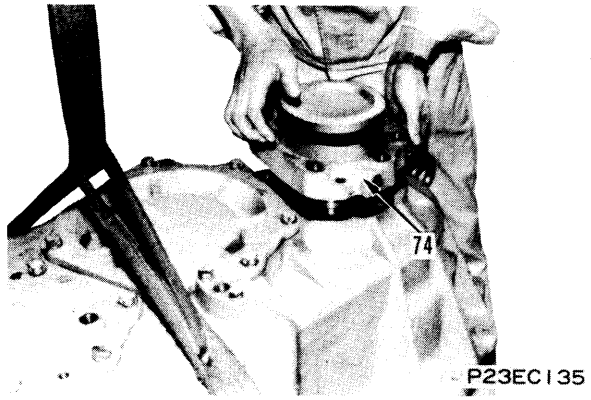
P23EC137

14. Spacer
Install spacer (77).

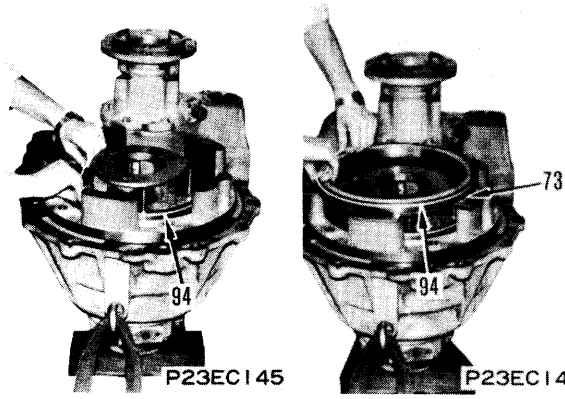
15. Bearing inner race
Press-fit bearing inner race (76) and fix it with snap ring (75).



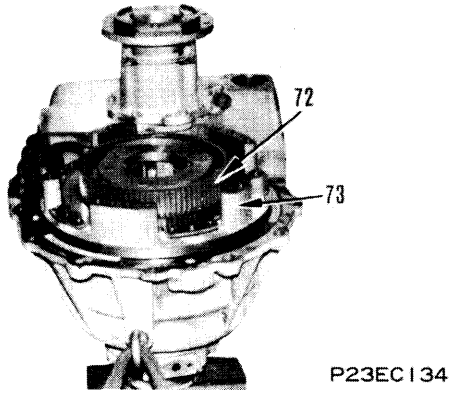
16. Cage assembly
Fix O-ring and install cage assembly (74).
kgm Mounting bolt: 17 ± 1 kgm



17. Low piston and housing assembly
1) Install ring (94) to piston and housing.
★ Install ring without twisting.
2) Install low piston and housing assembly (73).
★ Be careful about align position of pin.



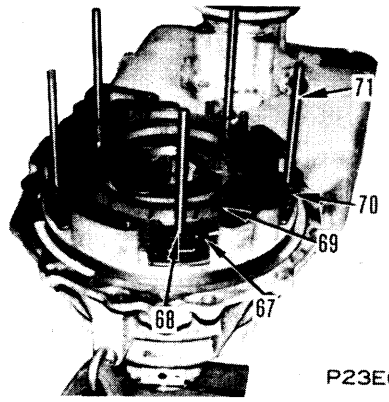
18. Low ring gear
Install ring gear (72).
★ Confirm that ring gear is firmly installed on planetary carrier.



19. Pin
Install pin (71).

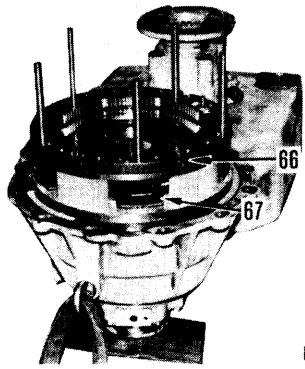
20. Spring, Disc, Plate
Spring (68), disc (69) and plate (70) in order.
★ Disc: 5 pcs, Plate: 4 pcs

21. Spring
Install spring (67).



P23EC133

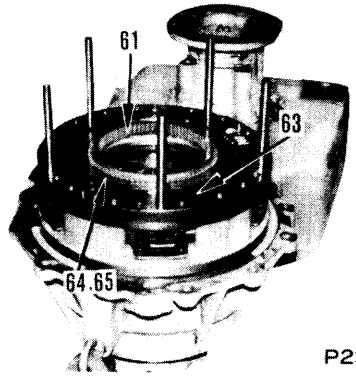
22. Cage assembly
Install cage assembly (66).
★ Be careful align position of pin.
★ Confirm that spring (67) is firmly installed in piston and groove of plate.



P23EC147

23. 1st ring gear
Install ring gear (61).
★ Install ring gear with its recessed inner teeth side down.

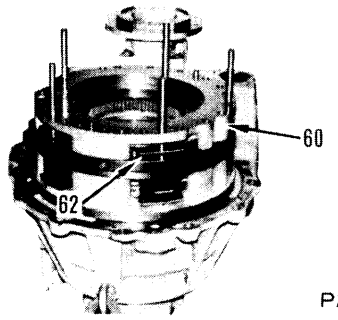
24. Spring, Disc, Plate
Install spring (63), disc (64) and plate (65) in order.
★ Wave spring: 3 pcs, Disc: 3 pcs, Plate: 2 pcs



P23EC131

25. Spring
Install spring (62).

26. 1st piston and housing assembly
1) Install piston and ring to housing.
2) Install 1st piston and housing assembly (60).
★ Hold piston by hand to prevent falling.
★ Confirm that spring (62) is firmly installed in cage and groove of piston.

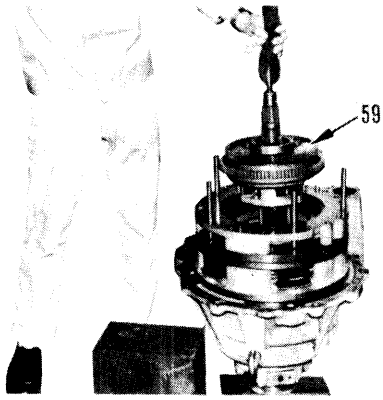


P23EC130

27. 1st and 2nd carrier assembly

Install eye bolt, lift carrier assembly (59) and install it.

★ Confirm that sun gear and ring gear are firmly installed to planetary carrier.



P23EC129

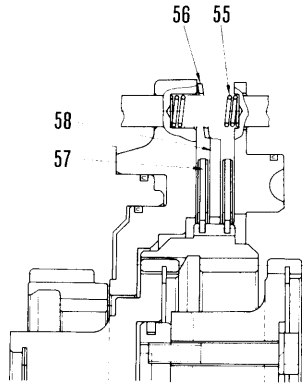
28. Spring, Disc, Plate

Install spring (56), disc (57) and plate (58) in order.

★ Disc: 2 pcs, Plate: 1 pc

29. Spring

Install spring (55).



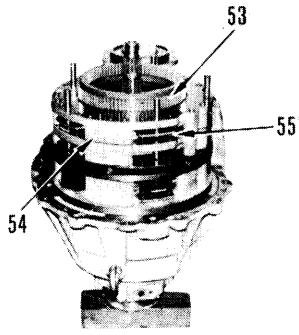
F23EC013

30. 2nd piston and housing assembly

1) Install ring to piston and housing
   ★ Install ring without twisting.
2) Install 2nd piston and housing assembly (54).
   ★ Hold piston by hand to prevent falling.
   ★ Confirm that spring (55) is firmly installed in housing and groove of piston.

31. 3rd ring gear

Install ring gear (53) and fix it with snap ring.



P23EC148

32. 3rd speed and 4th speed sun gear

Install spacer (51), 3rd speed sun gear (52) and 4th speed sun gear (50).

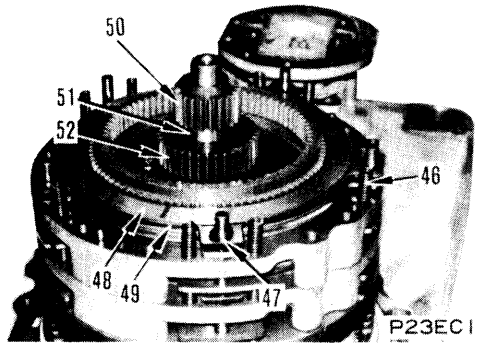
33. Spring, Disc, Plate

Spring (47), disc (48) and plate (49) in order.

★ Disc: 3 pcs, Plate: 2 pcs.

34. Spring

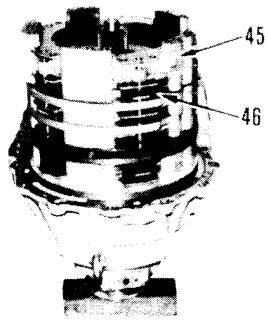
Install spring (46).



P23EC127

35. 3rd speed and 4th speed piston and housing assembly

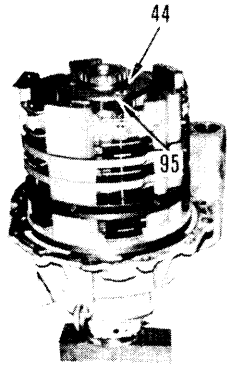
1) Install ring to piston and housing.
   - ★ Install ring without twisting.
2) Install piston and housing assembly (45).
   - ★ Hold 3rd speed piston by hand to prevent falling.
   - ★ Confirm that spring (46) is firmly installed in housing and groove of piston.



P23EC149

36. 3rd speed and 4th speed carrier assembly

Install seal ring (95) to carrier assembly (44).
- ★ Confirm that ring gear and planetary gear are firmly engaged.



P23EC150

37. Bearing

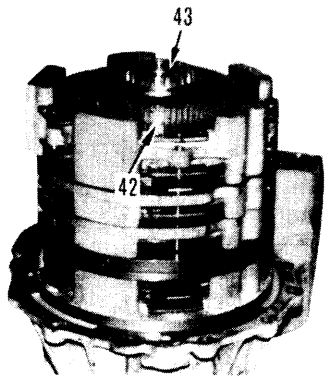
Press-fit bearing (43) and install holder.

Mounting bolt: Thread tightener (LT-2)

kgm Mounting bolt: 6.75 ± 0.75 kgm

38. 4th speed ring gear

Install ring gear (42).
- ★ Confirm that ring gear is firmly installed on planetary carrier.



P23EC124

39. Pin

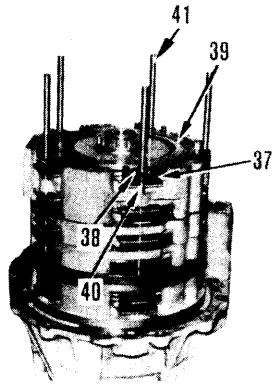
Install pin (41).

40. Spring, Disc, Plate

Install spring (38), disc (39) and plate (40) in order.
- ★ Disc: 3 pcs, Plate: 3pcs

41. Spring

Install spring (37).

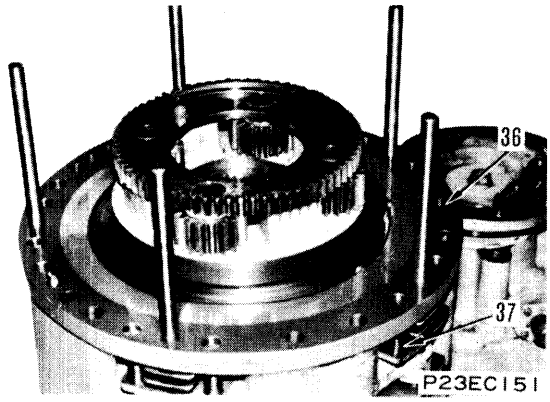


P23EC123

42. Cage and forward carrier assembly

Install eye bolt, sling cage and forward carrier assembly (36) and install it.

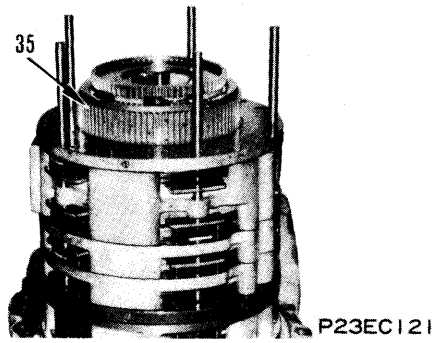
★ Comfirm that spring (37) is firmly installed in piston and groove of cage.



43. Forward ring gear

Install ring gear (35).

★ Confirm that ring gear is firmly installed on planetary carrier.



44. Spring, Disc, Plate

Install spring (32), disc (33) and plate (34) in order.

★ Disc: 4 pcs, Plate: 3 pcs

45. Spring

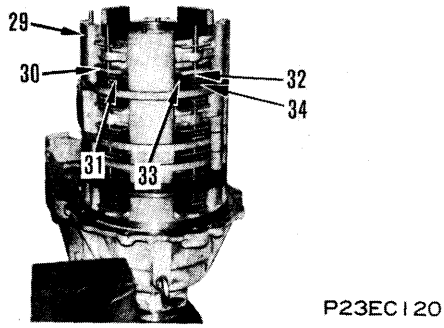
Install spring (31).

46. Forward piston

Install teflon ring and install piston (30).

★ Install teflon ring without twisting.

★ Confirm that spring (31) is firmly installed in cage and groove of piston.

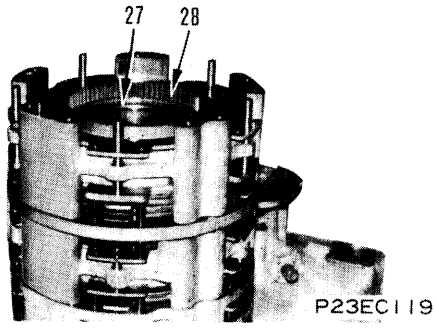


47. Reverse piston and housing assembly

1) Install teflon ring to piston and housing.
   ★ Install ring without twisting.
2) Install eye bolt, lift reverse piston and housing assembly (29) and install it.

48. Reverse ring gear

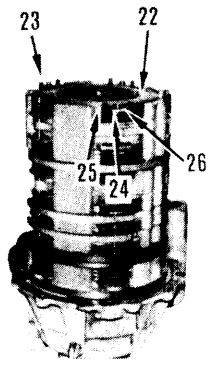
Install ring gear (28) and fix it with snap ring (27).



49. Reverse ring gear
Install ring gear (22).

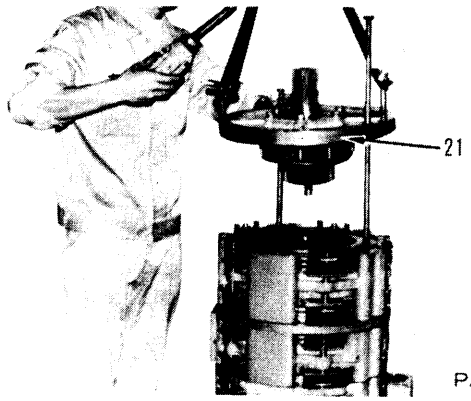
50. Spring, Disc, Plate
Install spring (24), disc (25) and plate (26) in order.
★ Disc: 4 pcs, Plate: 3 pcs

51. Spring
Install spring (23).



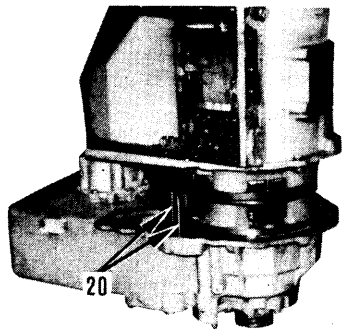
P23EC118

52. Cage and reverse carrier assembly
1) Install eye bolt, lift cage and reverse carrier assembly (21) and then install it.
2) Tighten tie bolt.
kgm Tie bolt: 17 ± 1 kgm
★ Confirm that spring is firmly installed in piston and groove of cage.



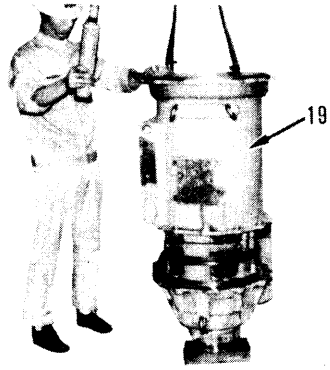
P23EC117

53. Sleeve
Fix O-ring and install sleeve (20).



P23EC116

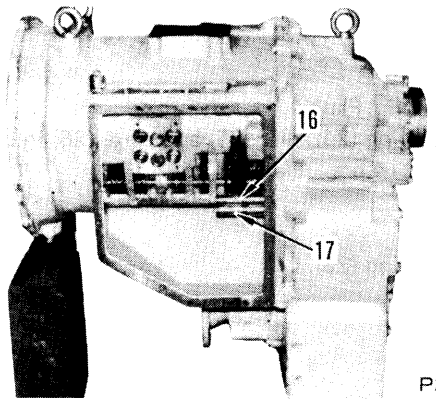
54. Transmission case
Attach gasket to mounting face, install eye bolt, lift transmission case (19) and mount it.
Gasket: Liquid gasket (LG-1)



P23EC115

55. Sleeve

Fix O-ring to each side end and install sleeves (16), (17).



P23EC114

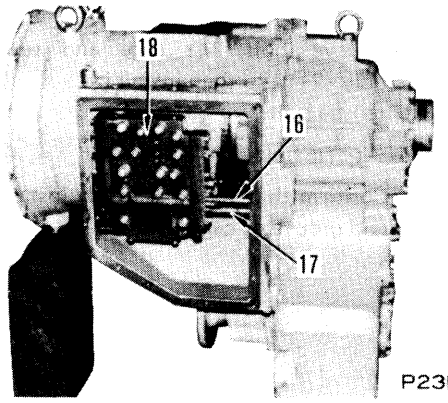
56. Transmission control valve assembly

Fix O-ring and install transmission control valve assembly (18).

kgm Mounting bolt: 3.5 ± 0.5 kgm

57. Sleeve

Shift sleeves (16), (17) to left side and connect them to control valve. Fix control valve with snap ring.



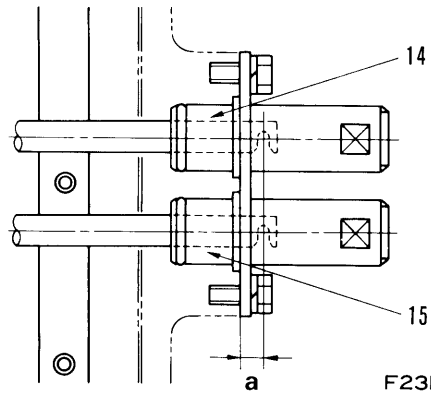
P23EC113

58. Yoke

Pull out spool and set to specified length.

Install F • R yokes (14) and yoke (15) for inching, then tighten their lock nuts.

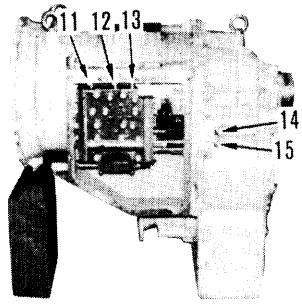
★ a length: 12 mm



F23EC017

59. Sleeve

Fix O-ring on each side end and install sleeves (11), (12), (13).



P23EC112

60. Cover

1) Attach gasket, connect speed selector lever to yoke of spool and install cover (10).

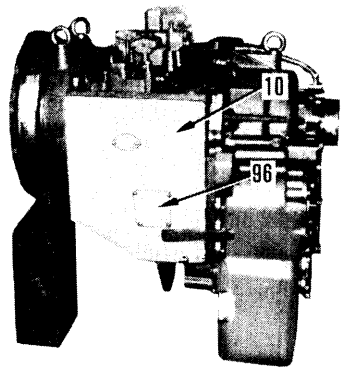
   Gasket: Liquid gasket (LG-1)

2) Remove cover (96) and confirm that speed selector lever is connected firmly then attach gasket and install cover.

   Gasket: Liquid gasket (LG-1)

   Mounitng bolt: Liquid gasket (LG-1)

   kgm Mounting bolt: 3.5 ± 0.5 kgm

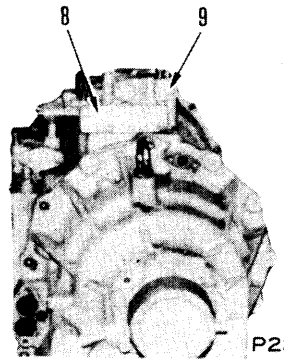


P23EC152

61. Transmission control valve assembly

Fix O-ring to mounting face and install transmission control valve assembly (8) together with cooler by-pass valve assembly (9).

kgm Mounting bolt: 4.25 ± 1.25 kgm



P23EC110

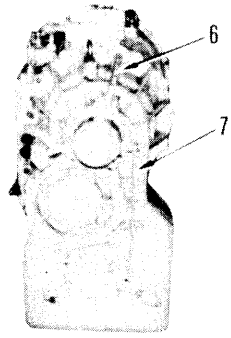
62. Lubrication tube

Install tube (7).

kgm Joint bolt: 3.0 ± 0.5 kgm

63. Piping

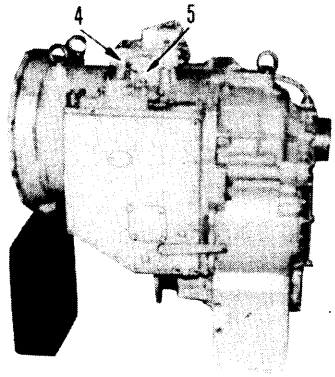
Fix O-ring to each side and install tube (6).



P23EC109

64. Transmission control valve piping

Fix O-ring and install tube (4), (5).



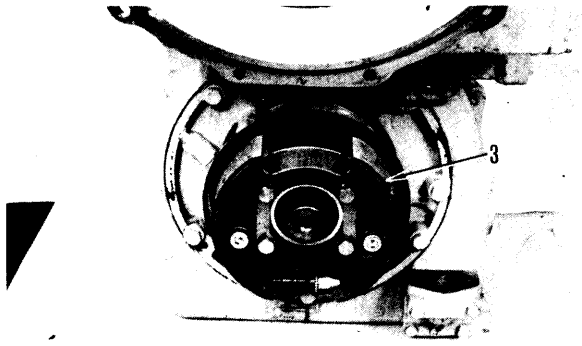
P23EC108

65. Parking brake assembly

Install parking brake assembly (3).

kgm Mounting bolt: 28.25 ± 3.25 kgm

★ Bend cotter pin securely.



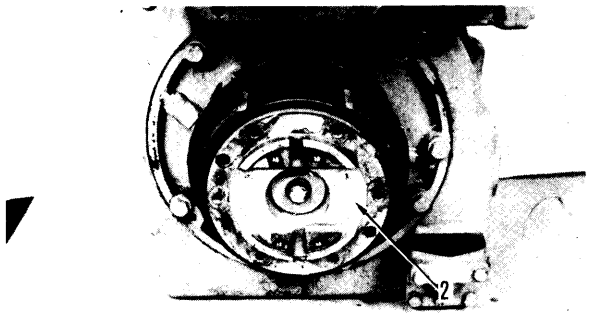
23P151

66. Flange

1) Install flange (2) to shaft.
2) Fix O-ring, install holder and tighten center bolt.

Center bolt: Thread tightener (LT-2)

kgm Center bolt: 23.5 ± 2.5 kgm

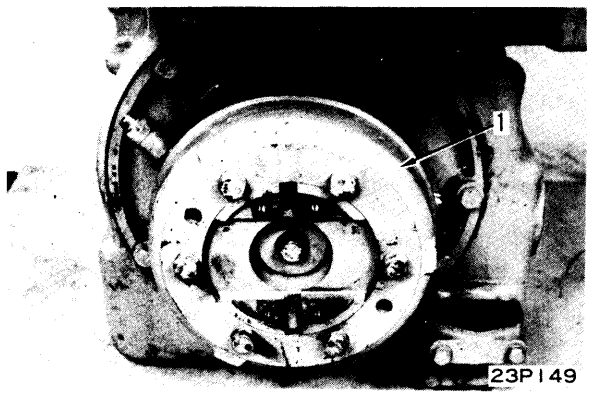


23P150

67. Drum

Install brake drum (1).

kgm Mounting bolt: 18 ± 2 kgm



23P149

DISASSEMBLY OF CAGE AND REVERSE CARRIER ASSEMBLY

GD705A-4

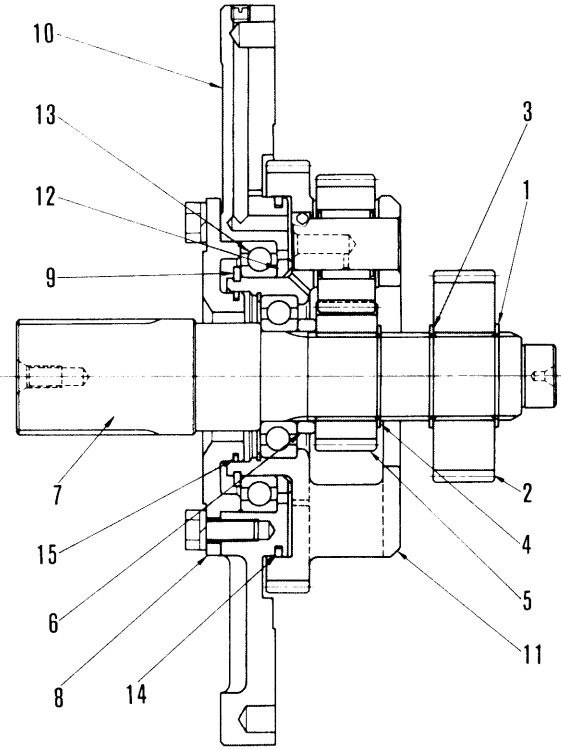
1. **Forward sun gear**
   1) Remove snap ring (1) and remove sun gear (2).
   2) Remove snap ring (3).

2. **Reverse sun gear**
   1) Remove snap ring (4) and remove sun gear (5).
   2) Remove spacer (6).

3. **Shaft**
   Remove shaft (7).

4. **Cage**
   Remove cage (8).

5. **Cage assembly**
   1) Remove snap ring (9).
   2) Remove cage assembly (10).



F23EC018

ASSEMBLY OF CAGE AND REVERSE CARRIER ASSEMBLY

GD705A-4

★ Coat sliding portion of each part with engine oil before installing.

1. **Cage assembly**
   1) Install spacer (12) to reverse carrier assembly (11).
   2) Press-fit bearing (13) to cage assembly (10).
   3) Install seal ring (14), install cage assembly (10) and fix it with snap ring (9).

2. **Cage**
   Install seal ring (15) and install cage (8).

3. **Shaft**
   Install shaft (7).

4. **Reverse sun gear**
   1) Install spacer (6).
   2) Install sun gear (5) and fix it with snap ring (4).
      ★ Confirm that sun gear is firmly engaged in planetary gear.

5. **Forward sun gear**
   1) Install snap ring (3).
   2) Install sun gear (2) and fix it with snap ring (1).

DISASSEMBLY 1ST SPEED AND 2ND SPEED CARRIER ASSEMBLY

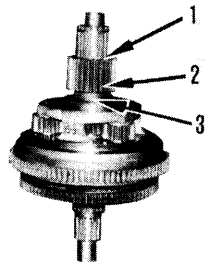
GD705A-4

1. **Low sun gear**
   1) Remove snap ring (1) and remove sun gear (2).
   2) Remove spacer (3).

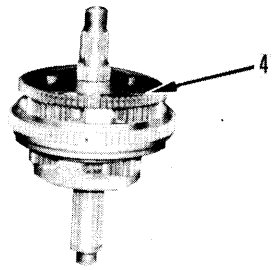
2. **2nd speed carrier assembly**
   1) Remove 2nd speed carrier assembly (4).
   2) Remove mounting bolt and remove cage (5).

3. **2nd speed ring gear and 1st speed carrier assembly**
   1) Remove 2nd speed ring gear and 1st speed carrier assembly (6) from shaft.
   2) Remove snap ring (7) and remove ring gear (8).

4. **Shaft assembly**
   1) Remove snap ring (10) from shaft (9) and remove 1st speed sun gear (11).
   2) Remove spacer (12).



P23EC153



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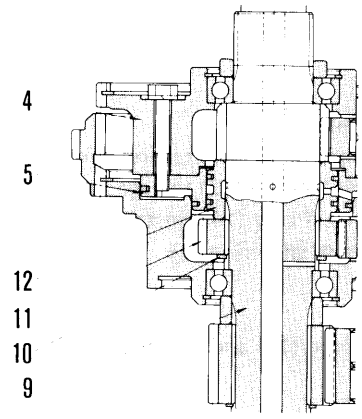

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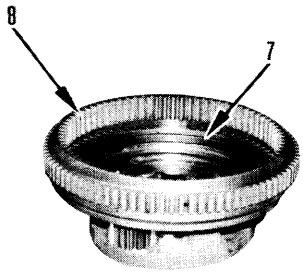

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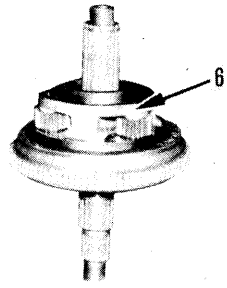


P23EC155

ASSEMBLY 1ST SPEED AND 2ND SPEED CARRIER ASSEMBLY

GD705A-4

★ Coat sliding portion of each part with engine oil before installing.

1. Shaft assembly

1) Install spacer (12) to shaft (9).
2) Install 1st speed sun gear (11) and fix it with snap ring (10).
3) Install seal ring (13) to spacer (12).

2. 2nd speed ring gear and 1st speed carrier assembly

1) Press-fit bearing (15) to 1st speed carrier assembly (14) and fix it with snap ring (16).
2) Install 2nd speed ring gear (8) and fix it with snap ring (7).
3) Install 2nd speed ring gear and 1st carrier assembly (6) on shaft.

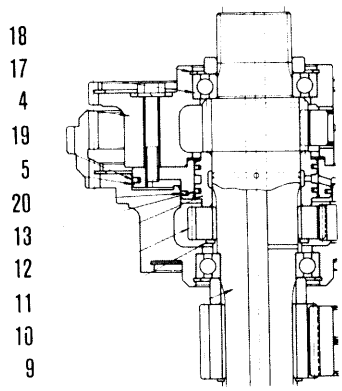
3. 2nd speed carrier assembly

1) Press-fit bearing (17) to 2nd speed carrier assembly and fix it with snap ring (18).
2) Install cage (5).

   Mounting bolt: Thread tightener (LT-2)
3) Install seal rings (19), (20). Using press-fit tool ① install 2nd speed carrier assembly (4).
   ★ Confirm that ring gear is firmly installed on planetary carrier.

4. Low sun gear

1) Install spacer (3).
2) Install sun gear (2) and fix it with snap ring (1).



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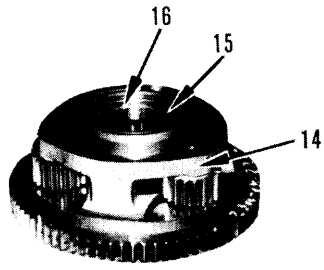

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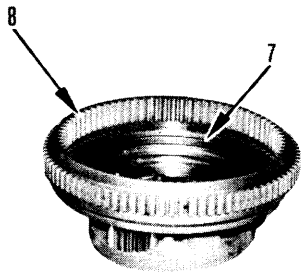

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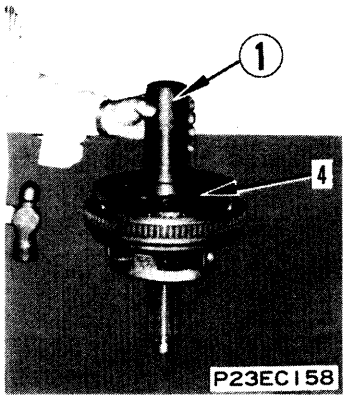

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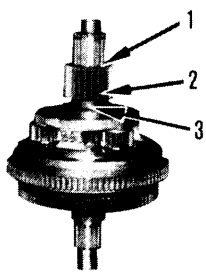

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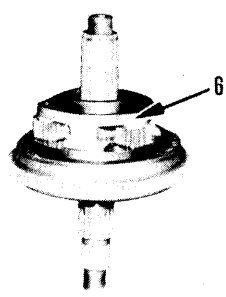


P23EC155

DISASSEMBLY OF HIGH ROTARY CLUTCH ASSEMBLY
GD705A-4

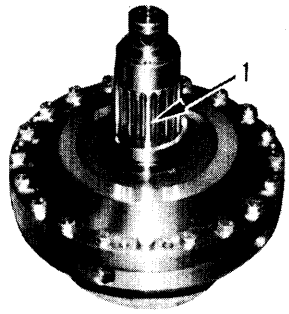
1. **Shaft assembly**
   Remove mounting bolt and remove shaft assembly (1).

2. **Spring, Disc, Plate**
   Remove wave spring (2), disc (3), plate (4) in order.
   ★ Spring: 4 pcs., Disc: 4 pcs., Plate: 3 pcs.

3. **Sun gear**
   1) Remove snap ring (5).
   2) Remove sun gear (6).

4. **Cage assembly**
   1) Put punch mark on cage (7) and carrier (8).
   2) Remove bearing (9) together with cage.

5. **Planetary gear**
   Remove planetary gear (10).
   ★ For details, see 23 DISASSEMBLY OF PLANETARY GEAR.



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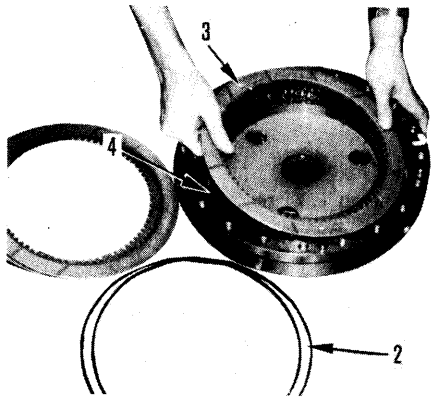

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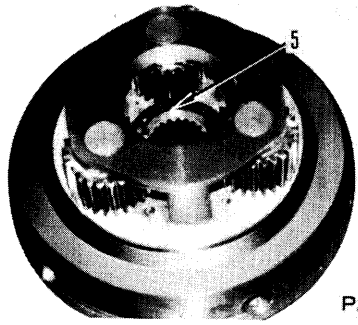

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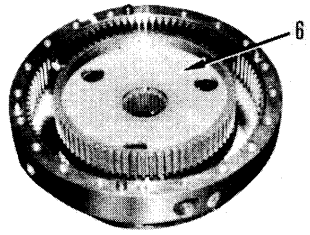


P23EC162

ASSEMBLY OF HIGH ROTARY CLUTCH ASSEMBLY GD705A-4

★ Coat sliding portion of each part with engine oil before installing.

1. Planetary gear
Install planetary gear (10).
★ For detail, see ASSEMBLY OF PLANETARY GEAR.

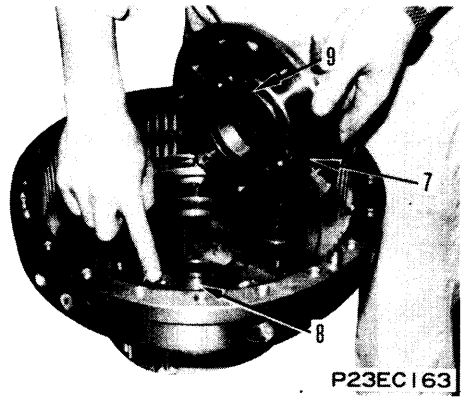
2. Cage assembly
1) Press-fit bearing (9) to cage (7).
2) Align the punch mark stamped during disassembly and install cage assembly (8).

Mounting bolt: Thread tightener (LT-2)

3. Sun gear
1) Install sun gear (6).
2) Turn carrier assembly over and fix it with snap ring (5).

4. Spring, Disc, Plate
Install wave spring (2), disc (3) and plate (4) in order.
★ Spring: 4 pcs., Disc: 4 pcs., Plate: 3 pcs.

5. Shaft assembly
Install shaft assembly (1).



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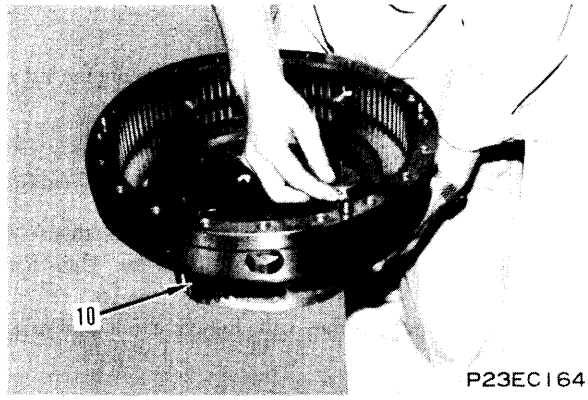
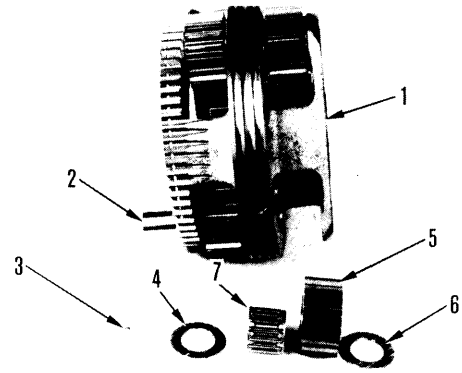


P23EC164

DISASSEMBLY OF PLANETARY GEAR GD705A-4

1. Pull out shaft (2) from planetary carrier assembly (1) and remove ball (3). Then remove thrust washer (4), gear (5), thrust washer (6) in order.
2. Pull out bearing (7) from gear (5).

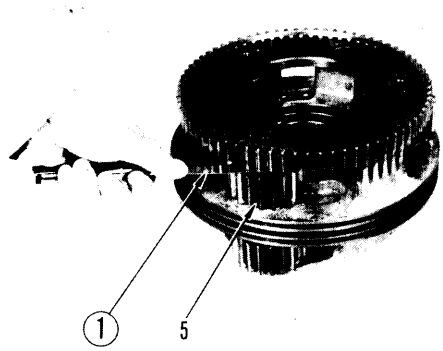


23P322

ASSEMBLY OF PLANETARY GEAR GD705A-4

★ Coat sliding portion of each part with engine oil before installing.

1. Install bearing (7) in gear (5).
2. Inserting shaft (2) into carrier and install thrust washer (6), gear (5), thrust washer (4) in order. Then fix shaft with ball (3).
   ★ When shaft comes out, lightly caulk ball groove of carrier.
3. After assembly, measure side clearance of planetary gear (5) with feeler gauge ① and confirm measured internal clearance within standard.
   ★ Side clearance: 0.3 to 0.8 kgm



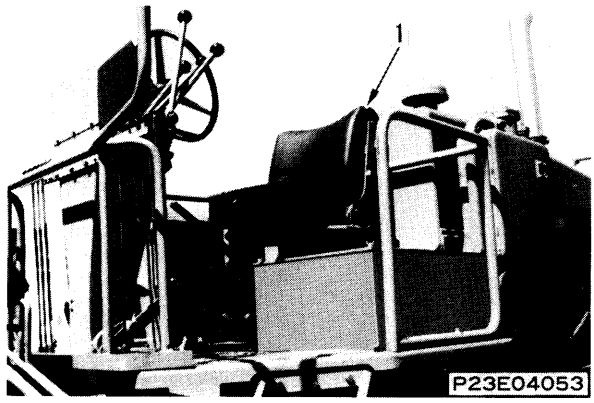
23P323

REMOVAL OF HYDROSHIFT TRANSMISSION CONTROL VALVE

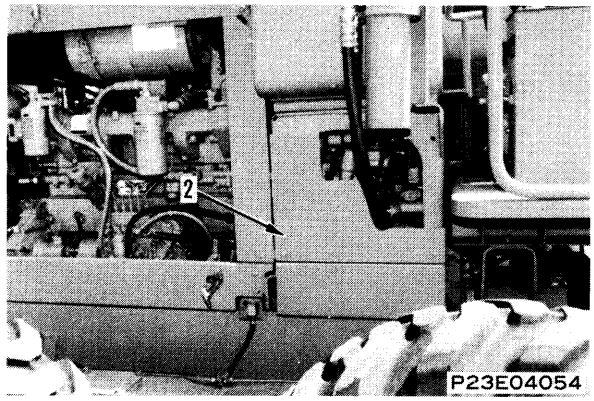
GD705R-4

1. **Operator's seat ass'y**
   Sling and remove operator's seat assembly (1).

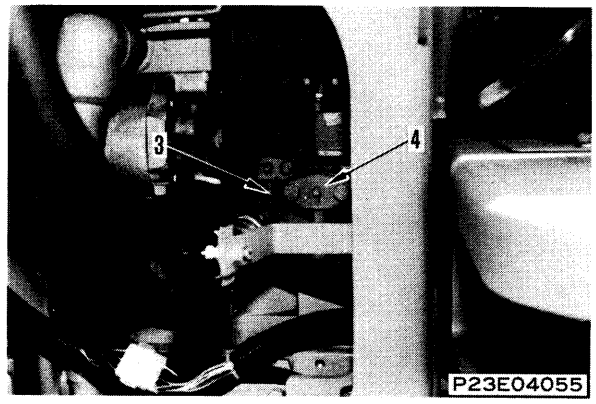
   kg Operator's seat assembly: Approx. 32 kg



2. **Cover**
   Remove cover (2).



3. **Control valve piping**
   1) Remove control valve tube (3).
      ★ Care should be taken not to allow strainer to fall off, which is installed in tube.
   2) Remove control valve tube (4).

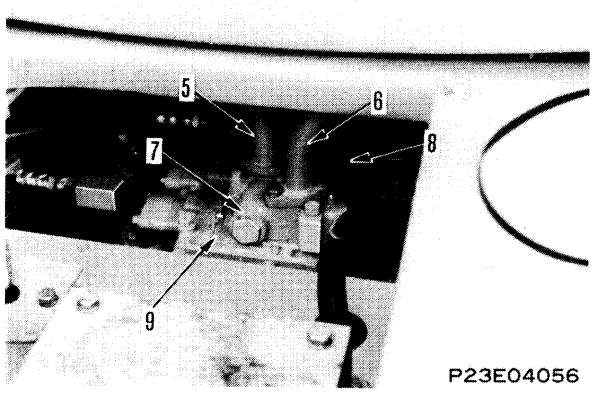


4. **Cooler piping**
   Disconnect cooler bypass valve outlet tube (5) and cooler bypass valve inlet tube (6) from cooler bypass valve.

5. **Cooler bypass valve assembly**
   Remove cooler bypass valve assembly (7).

6. **Control valve inlet tube**
   Disconnect control valve inlet tube (8) from control valve assembly.

7. **Transmission control valve assembly**
   Remove transmission control valve assembly (9).



INSTALLATION OF HYDROSHIFT TRANSMISSION CONTROL VALVE

GD705R-4

1. **Transmission control valve assembly**
   Fit O-ring to mounting face and install transmission control valve assembly (9).
   kgm Mounting bolt: 4.5 ± 1 kgm

2. **Control valve inlet tube**
   Fit O-ring and connect control valve inlet tube (8) to control valve assembly.
   kgm Bolt mounting control valve together: 4.5 ± 1 kgm
   ★ Fit O-ring in groove closely.

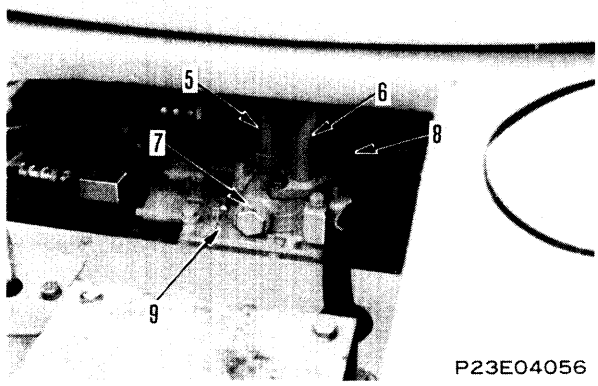
3. **Cooler bypass valve assembly**
   Fit O-ring to mounting face and install cooler bypass valve assembly (7).
   kgm Mounting bolt: 10 mm 4.5 ± 1 kgm
   8 mm 2.5 ± 1 kgm

4. **Cooler piping**
   Fit O-ring and connect cooler bypass valve outlet tube (5) and cooler bypass valve inlet tube (6) to cooler bypass valve assembly.

5. **Control valve piping**
   1) Fit O-ring and install control valve tube (4).
   2) Fit strainer and O-ring, and install control valve tube (3).
      ★ Fit O-ring in groove closely.

6. **Cover**
   Install cover (2).

7. **Operator's seat assembly**
   Sling and install operator's seat assembly (1).



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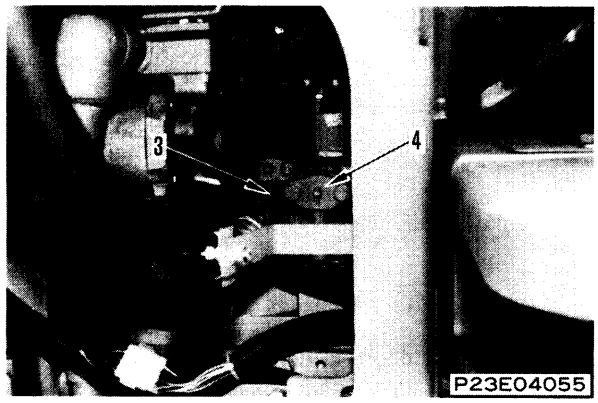

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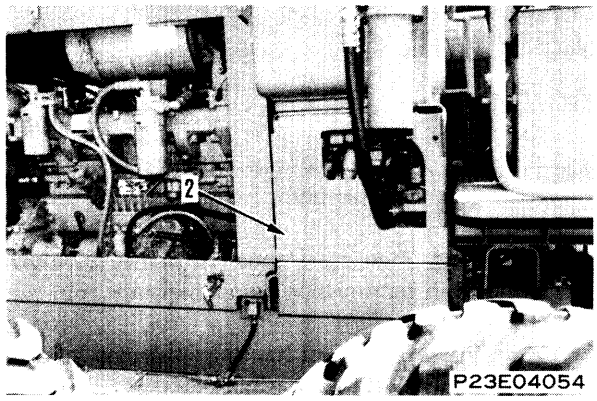

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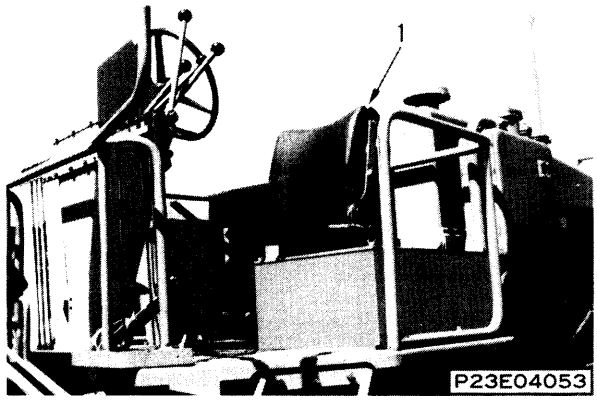
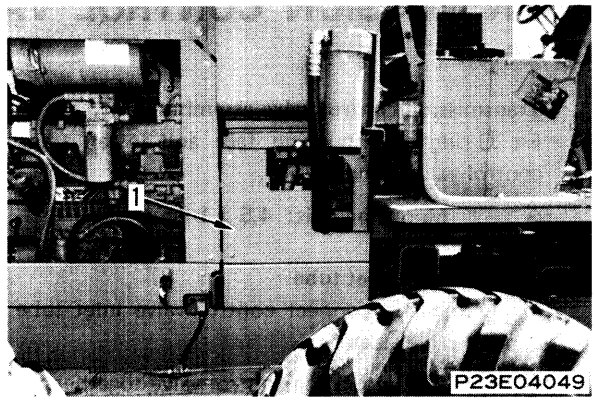


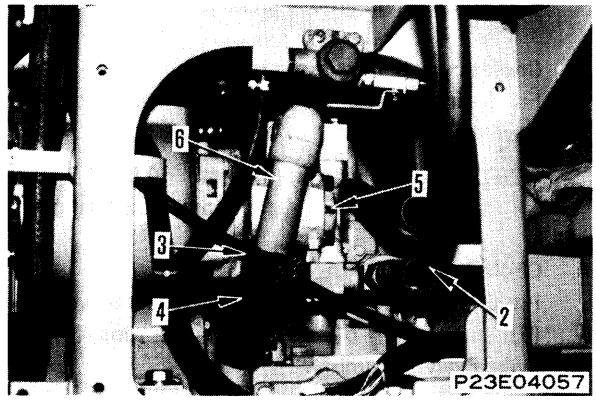
P23E04053

REMOVAL OF HYDROSHIFT TRANSMISSION PUMP ASSEMBLY

GD705R-4

1. Remove cover (1).
2. Remove transmission pump outlet hose (2).
3. Loosen clamp (3), slide hose (4) and disconnect it.
4. Dismount transmission pump assembly (5) together with transmission pump inlet tube (6).
5. Remove transmission pump inlet tube from transmission pump assembly.





INSTALLATION OF HYDROSHIFT TRANSMISSION PUMP ASSEMBLY

GD705R-4

1. Fit O-ring, install transmission pump inlet tube on transmission pump assembly.
2. Fit O-ring, mount transmission pump assembly (5) together with transmission pump inlet tube (6).
3. Slide hose (4), connect transmission pump inlet tube, then tighten them with clamp (3).
4. Connect transmission pump outlet hose (2).
5. Install cover (1).

★ Run the engine to circulate engine oil through the system. Then check the oil level again.

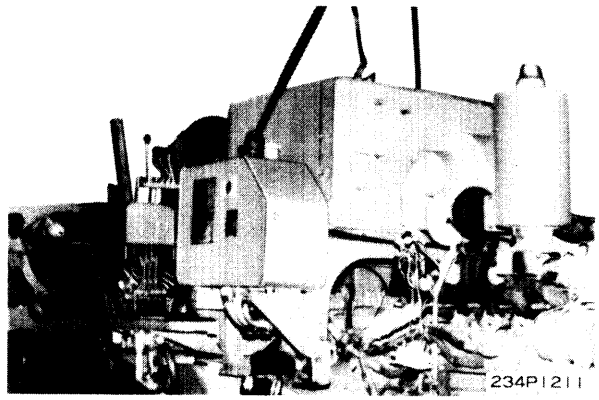
REMOVAL OF HYDROSHIFT TRANSMISSION PUMP ASSEMBLY

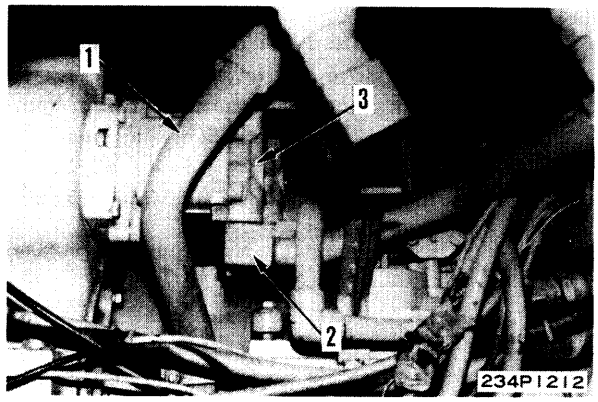
GD705A-4

⚠ Lower the work equipment completely to the ground and stop the engine.

1. Remove fuel tank assembly (incl. hydraulic tank).
   For details, see 13 REMOVAL OF FUEL TANK ASSEMBLY (incl. HYDRAULIC TANK).
2. Remove inlet and outlet tubes (1) and (2) of transmission pump from transmission pump.
3. Remove transmission pump assembly (3).

   kg Transmission pump assembly: Approx. 6 kg





INSTALLATION OF HYDROSHIFT TRANSMISSION PUMP ASSEMBLY

GD705A-4

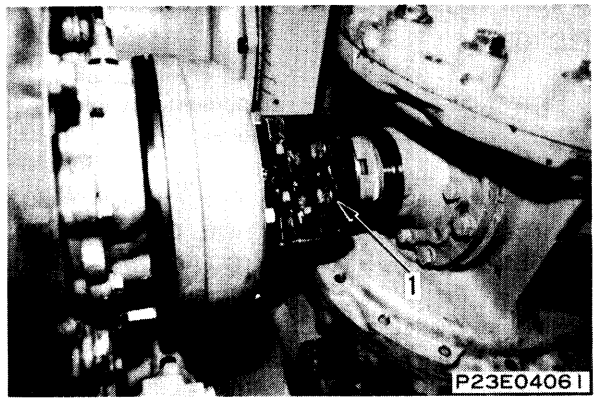
1. Fit O-ring and install transmission pump assembly (3).
2. Fit O-rings and install inlet and outlet tubes (1) and (2) of transmission pump to transmission pump.
3. Install fuel tank assembly.
   For details, see 13 INSTALLATION OF FUEL TANK ASSEMBLY (incl. HYDRAULIC TANK).

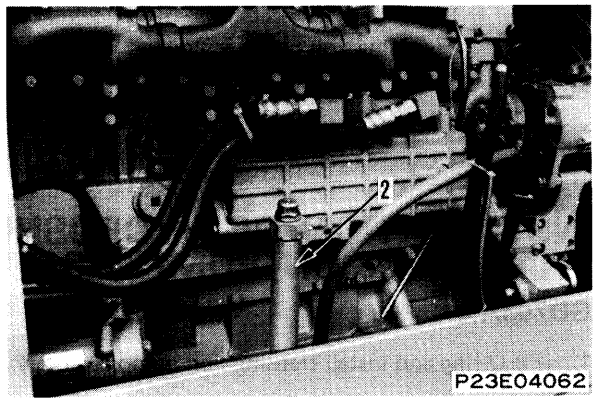
REMOVAL OF TANDEM AND FINAL DRIVE ASSEMBLY

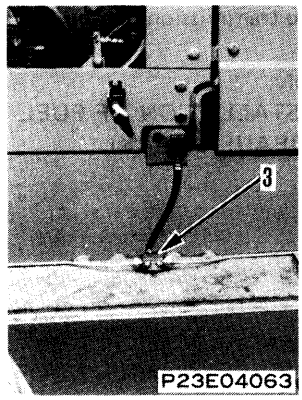
GD705R-4

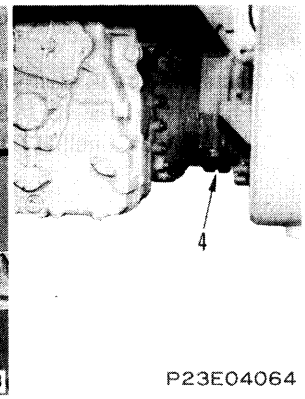
1. Disconnect drive shaft (1) from final case side.
2. Remove filler tube (2).
3. Remove L.H. and R.H. brake oil joint (3).
4. Remove L.H. and R.H. cap (4).

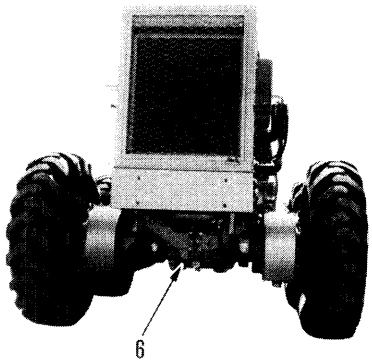
   kg Cap (each): Approx. 16 kg
5. Remove bolt, and remove support (5) from frame.
6. Dismount tandem and final drive assembly
   1) Hold final drive case lower part with jack and raise body with crane, then dismount it from frame.
   2) Turn wheel to pull tandem and final drive case assembly (6) out in the rear direction.
   3) After pulling out tandem and final drive assembly, support body with block.

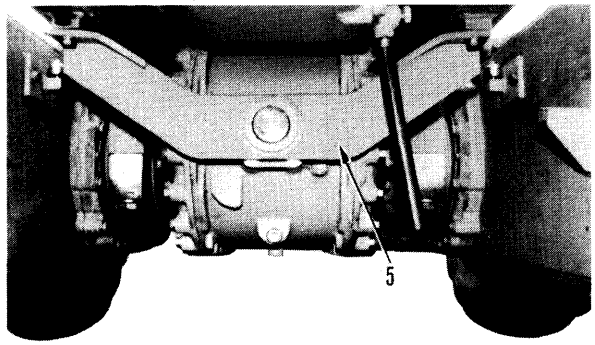








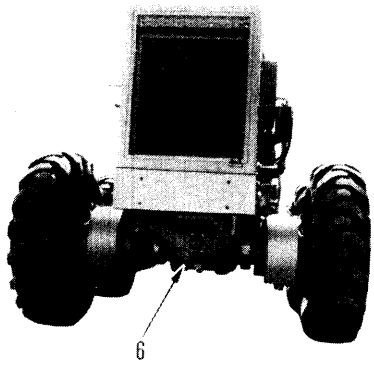




INSTALLATION OF TANDEM AND FINAL DRIVE ASSEMBLY

GD705R-4

1. Mount tandem and final drive assembly
   1) Raise tandem and final drive assembly (6) with a crane, extend center of body, and set at rear of body. Then support final case lower part with a jack.
   2) Raise body with a crane and pull out the block. While turning the wheel set the tandem and final drive assembly to the lower part of the body.
   3) Lower the body slowly, and connect the tandem and final drive assembly while moving it.



P23E04066

2. Install support (5) on frame.

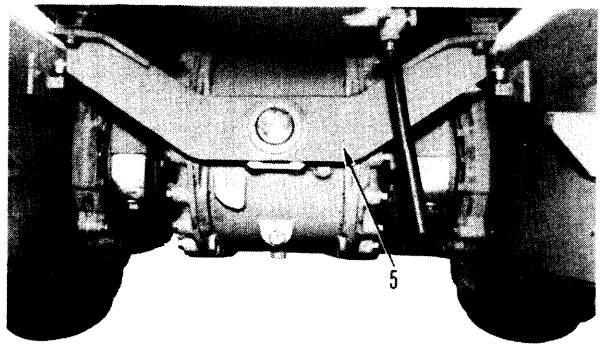
3. Install L.H. and R.H. cap (4).

4. Install L.H. and R.H. brake oil joint (3).

5. Install filler tube (2).

6. Connect drive shaft (1).

7. Adjusting brake
   For detail, see CHECK AND ADJUSTING OF BRAKE SYSTEM.



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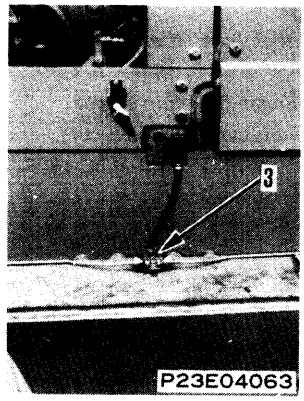
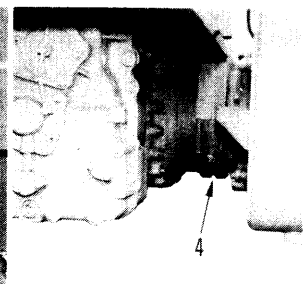
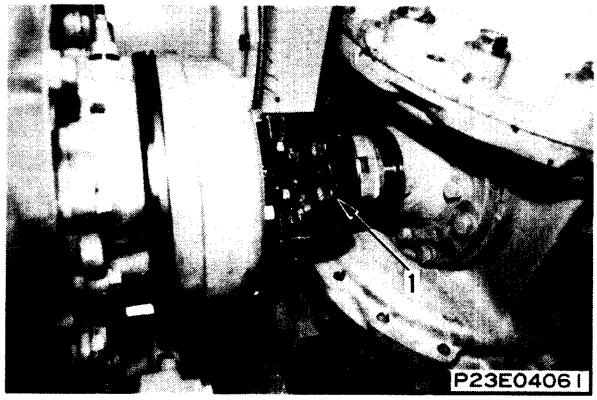
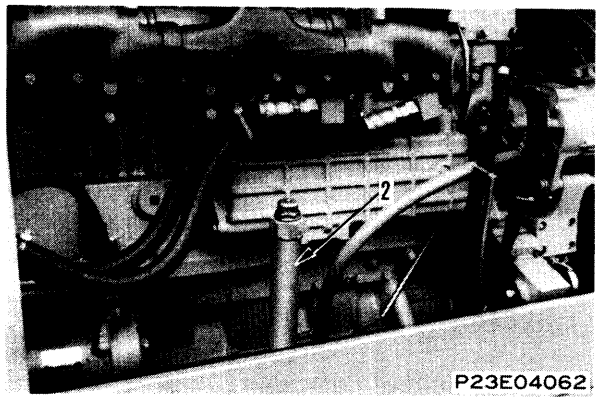




P23E04064

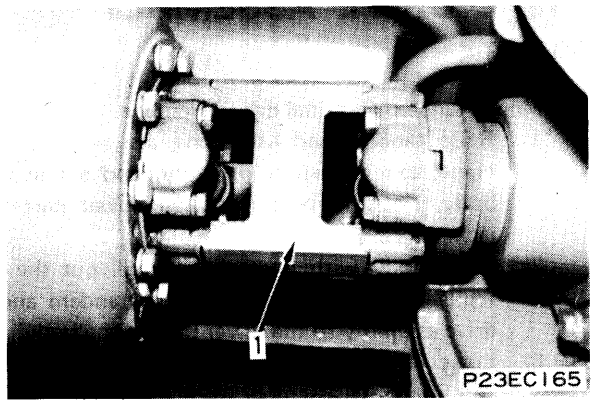




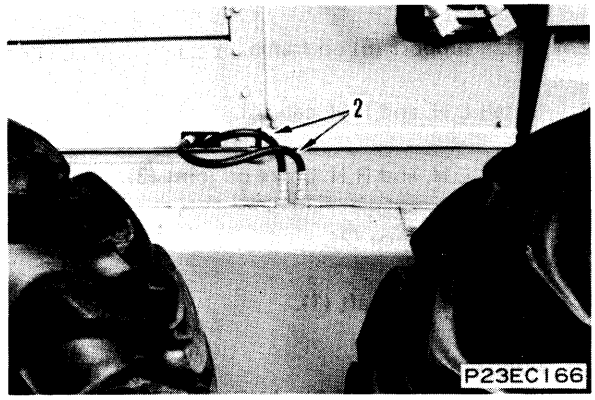
REMOVAL OF TANDEM AND FINAL DRIVE ASSEMBLY

GD705A-4

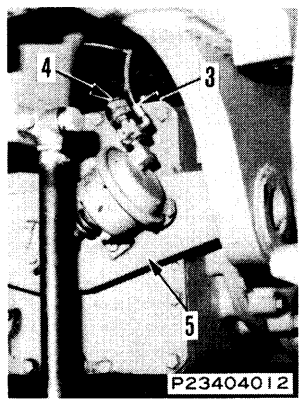
1. **Drive shaft**
   Remove drive shaft (1).

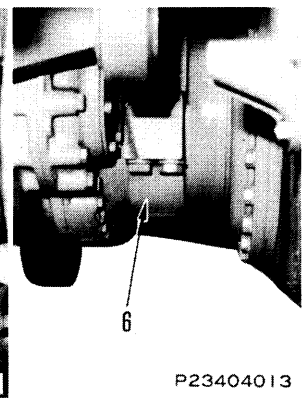


2. **L.H. and R.H. brake piping joint**
   Remove L.H. and R.H. brake piping joints (2).

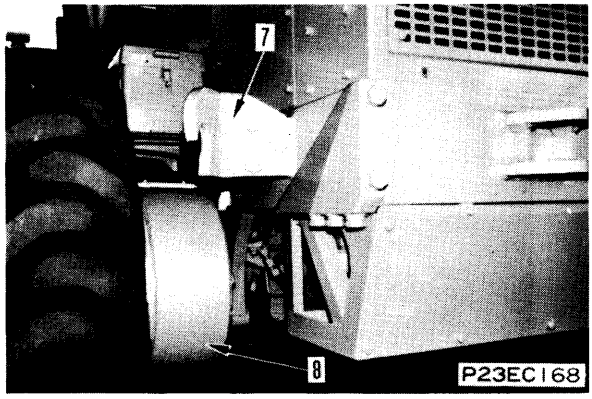


3. **L.H. and R.H. cap, hanger**
   1) Disconnect differential lock chamber connect tube (3) and wiring (4).
   2) Remove bolt and hanger (5) from frame.
   3) Remove L.H. and R.H. cap (6).
      ★ Distinguish between L.H. and R.H. caps.





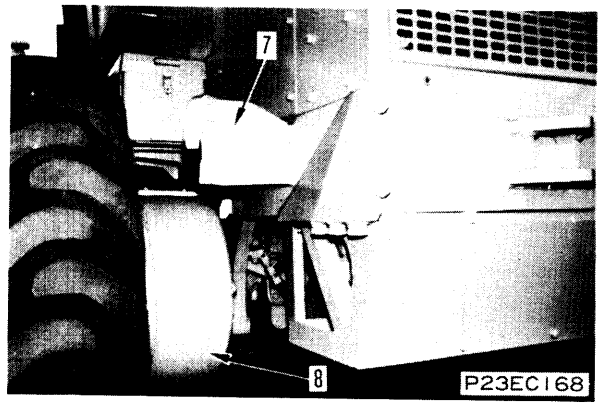
4. **Tandem · Final drive assembly**
   1) Using hook (7) lift up the chassis.
   2) Turning wheel, pull out tandem and final drive assembly (8) to rear.



INSTALLATION OF TANDEM AND FINAL DRIVE ASSEMBLY

GD705A-4

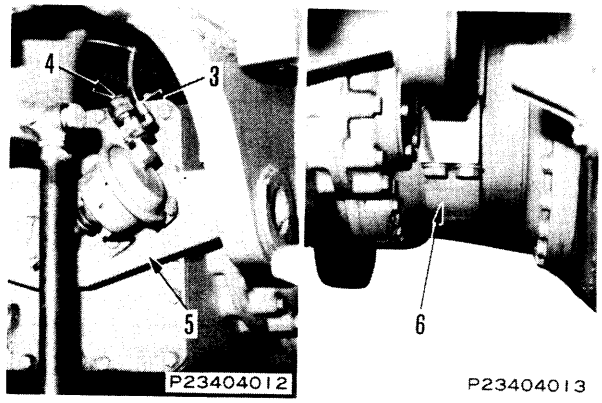
1. **Tandem and final drive assembly**
   1) Using hook (7), raise the chassis. Turning the wheel, set tandem and final drive assembly (8) under the chassis.
   2) Slowly lower the chassis and connect tandem and final drive assembly while moving them.



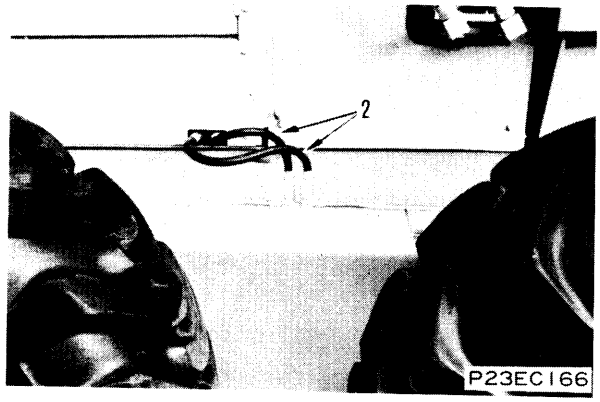
2. **L.H. and R.H. cap, hanger**
   1) Install L.H. and R.H. caps (6).
      ★ Be careful not to confuse L.H. and R.H. caps.
   2) Install hanger (5) on frame.
   3) Connect differential lock chamber connect tube (3) and wiring (4).

      Hanger mounting bolt: Thread tightener (LT-2)

      kgm Hanger mounting bolt: 56 ± 6 kgm

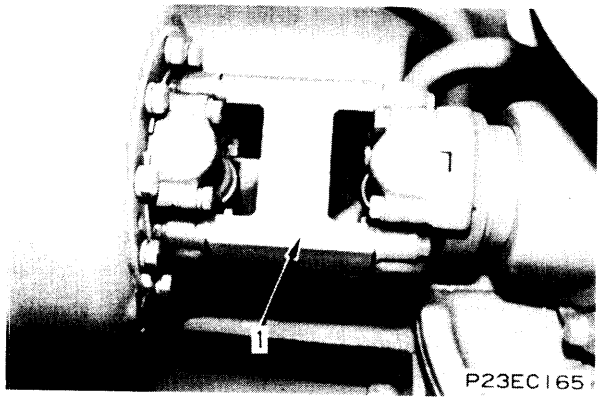


3. **L.H. and R.H. brake piping joint**
   Install L.H. and R.H. piping joints (2).



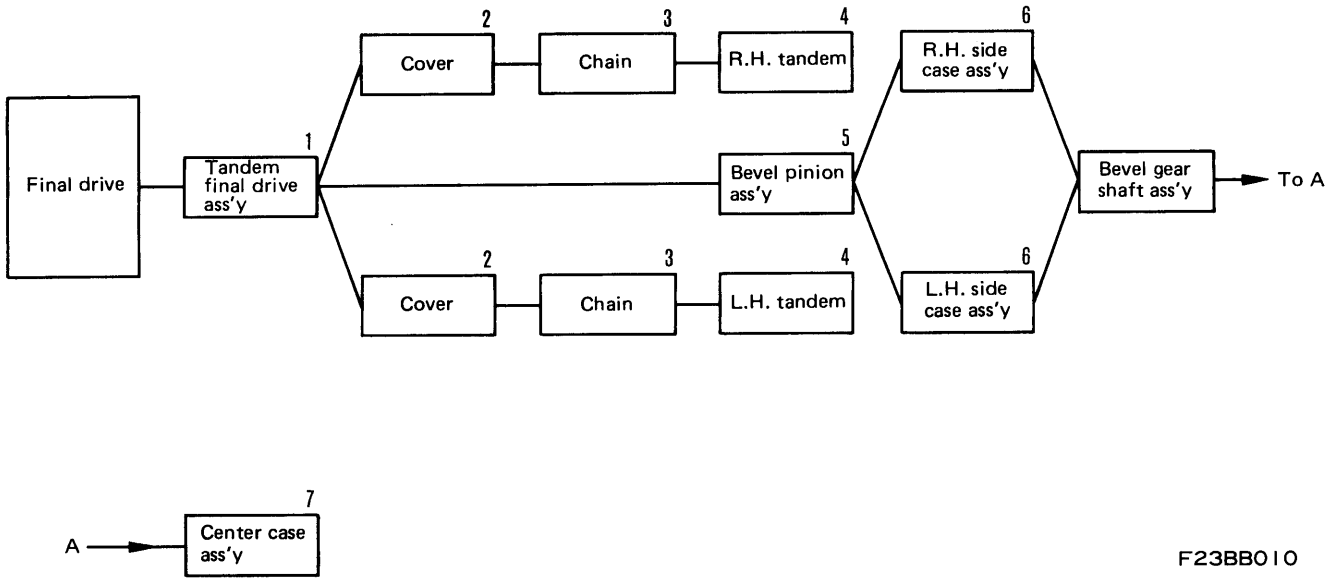
4. **Drive shaft**
   Install drive shaft (1).

   kgm Mounting bolt: 11.25 ± 1.25 kgm



DISASSEMBLY OF FINAL DRIVE ASSEMBLY

GD705R-4



F23BB010

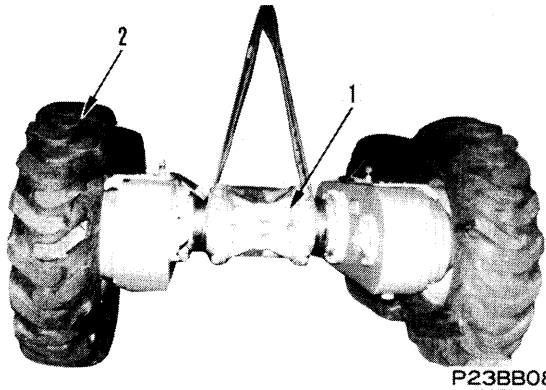
Special tool

	Part number	Part name	Q'ty
A	792-571-1600	Chain puller	1

1. Tandem, final drive assembly

1) For details, see "REMOVAL OF TANDEM AND FINAL DRIVE ASSEMBLY".
2) Raise tandem, final assembly (1) with crane, and remove wheel (2).

kg Tandem, final drive assembly: 3 ton



P23BB086

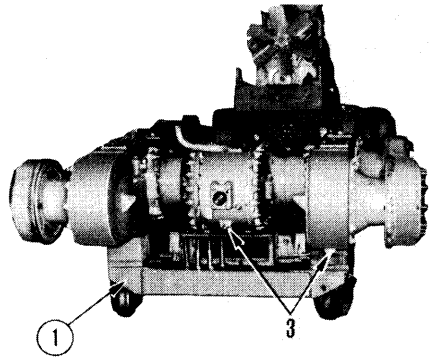
3) Set tandem, final drive assembly on block ① and remove drain plug (3), then drain oil from tandem case.

Tandem case (each side): Approx. 36ℓ

4) Remove drain plug and drain from final drive case.

Final drive case: Approx. 24ℓ

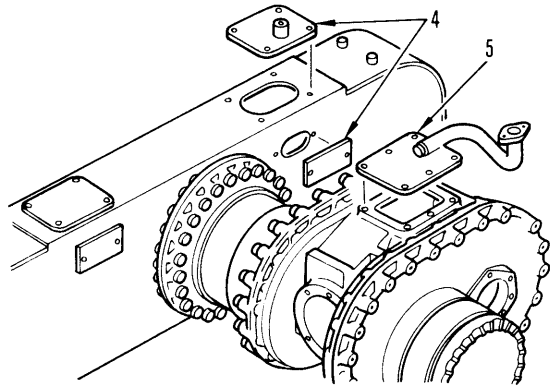
★ Set blocks in three places under the L.H. and R.H. tandem case and final drive case.



P23E04067

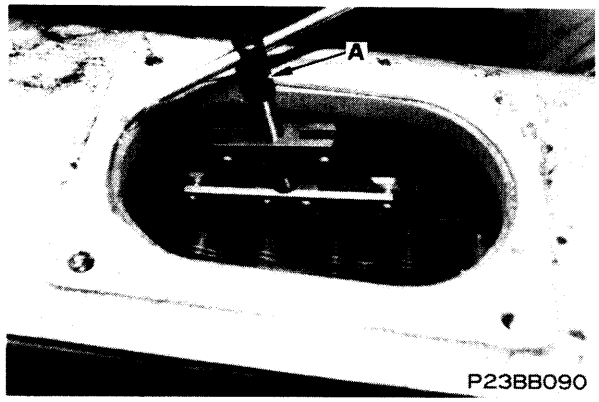
2. Cover (tandem final)

Remove covers (4) (tandem side, F, R, 6 pcs.), cover (5) (final side 1 pc.).

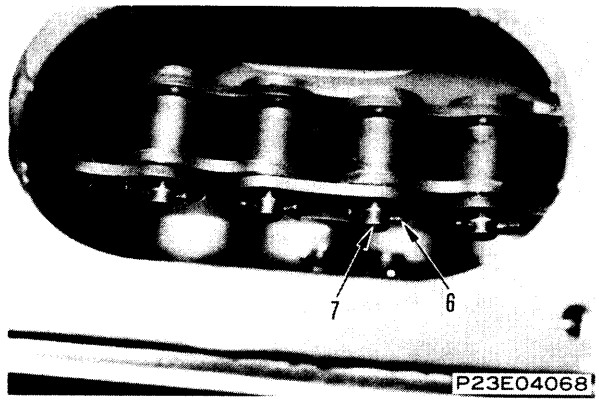


3. Chain

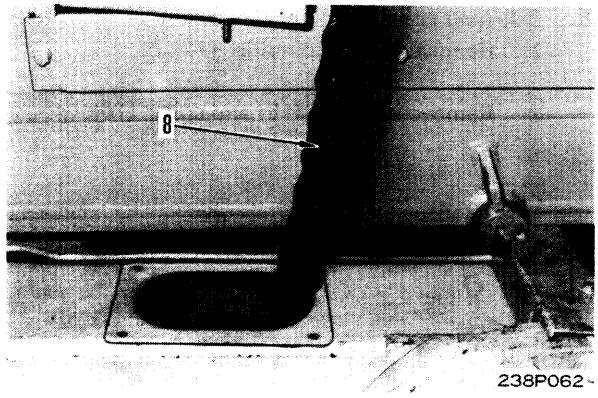
1) Rotate the pinion to bring the connecting port of the chain into line with the inspection window.



2) Using tool **A**, tighten the chain, then remove lock pin (6) and pin (7).

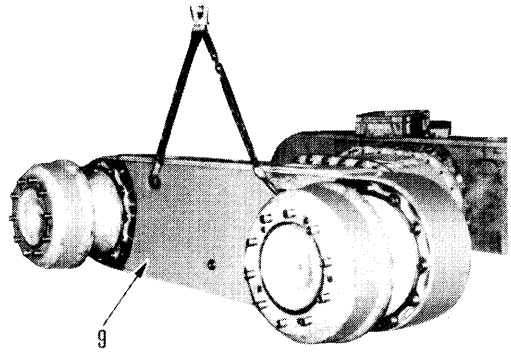


3) Remove chain (8).



4. Tandem case assembly

1) Suspend tandem case assembly (9).



P23E04069

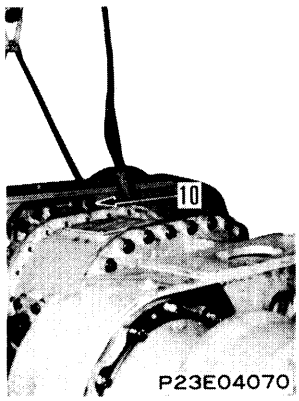
2) i) Remove mounting bolts (10) and dismount the tandem case assembly.

kg Tandem case assembly: Approx. 920 kg (one side)

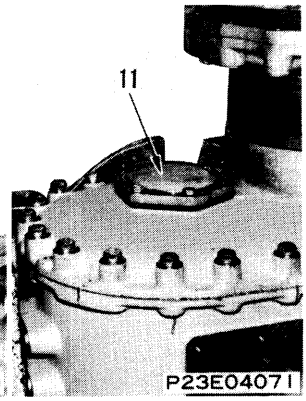
★ When dismounting the tandem case assembly, be careful to maintain it in a balanced condition in order to prevent the contact face of the O-ring on the case side from being damaged.

ii) Dismount cover (11).

★ Keep shims on one side so they don't get mixed up.



P23E04070



P23E04071

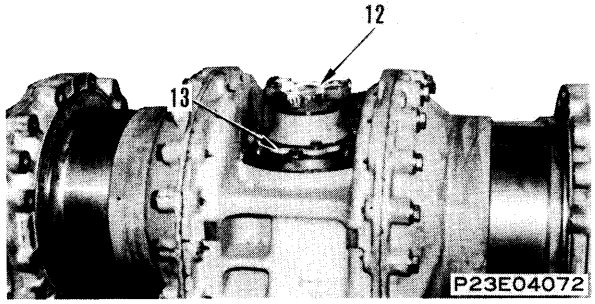
5. Bevel pinion assembly

1) Dismount coupling (12).

2) Remove the mounting bolts, then dismount bevel pinion assembly (13).

kg Bevel pinion assembly: Approx. 50 kg

★ Check the number and positions of the shims which were removed.

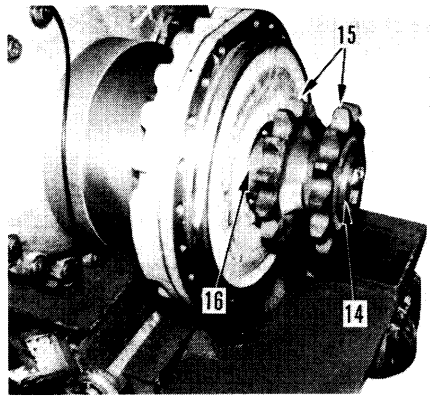


P23E04072

6. Side case assembly

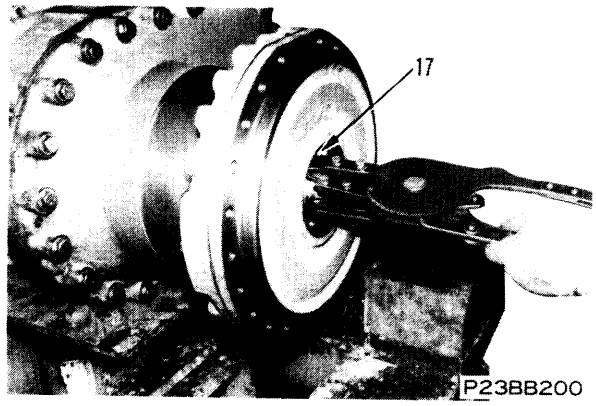
1) Remove shaft end holder (14).

2) Remove sprocket (15) and collar (16).



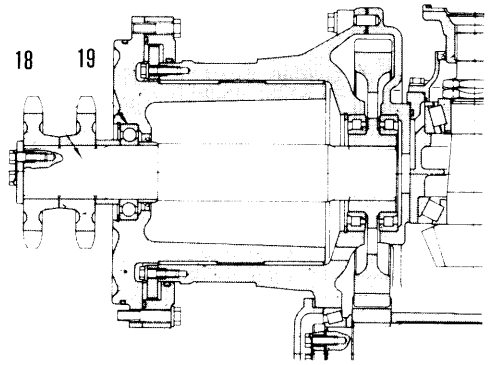
P23BB199

3) Remove snap ring (17).



P23BB200

4) Pull out shaft (18) together with bearing (19).

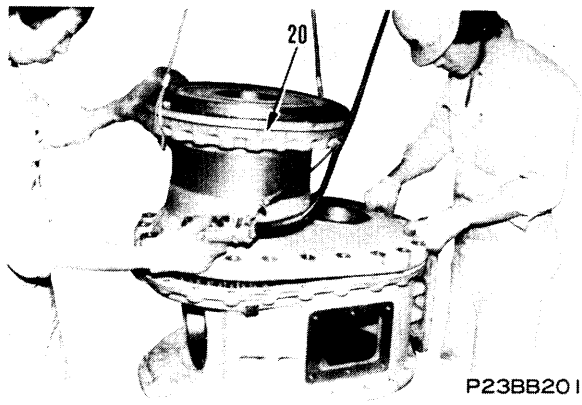


F23BB012

5) Remove mounting bolt and disconnect side case assembly (20) from center case.

kg Side case assembly: Approx. 240 kg

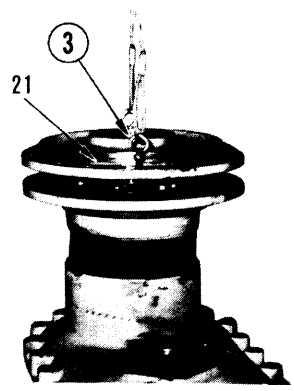
⚠ Be careful to prevent inside gear from falling out.



P23BB201

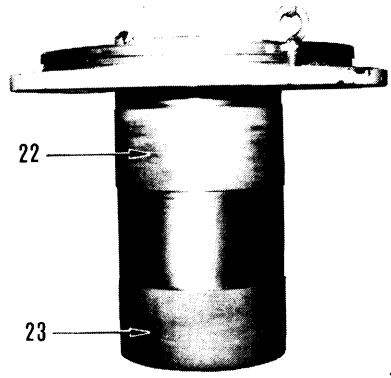
6) Remove mounting bolts, then fit eye bolts 3 (Thread dia. = 12 mm, Pitch = 1.75 mm) and dismount joint assembly (21).

kg Joint: 100 kg



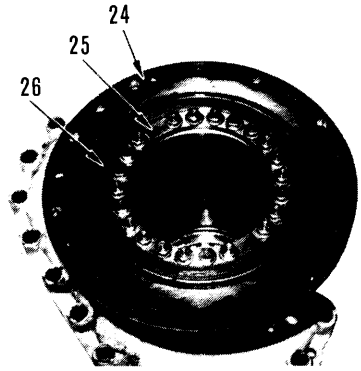
23P164A

7) Remove bushings (22) and (23) from the joint assembly.



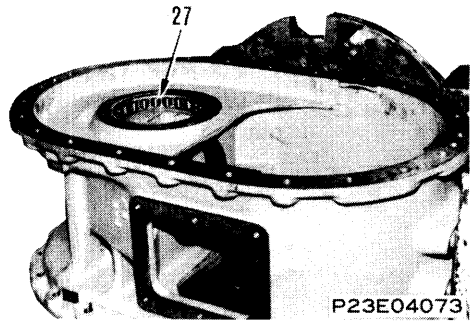
23P165A

8) i) Remove the mounting bolts and dismount cage (24).
ii) In a similar manner, remove top and bottom plates (25) and washers (26).



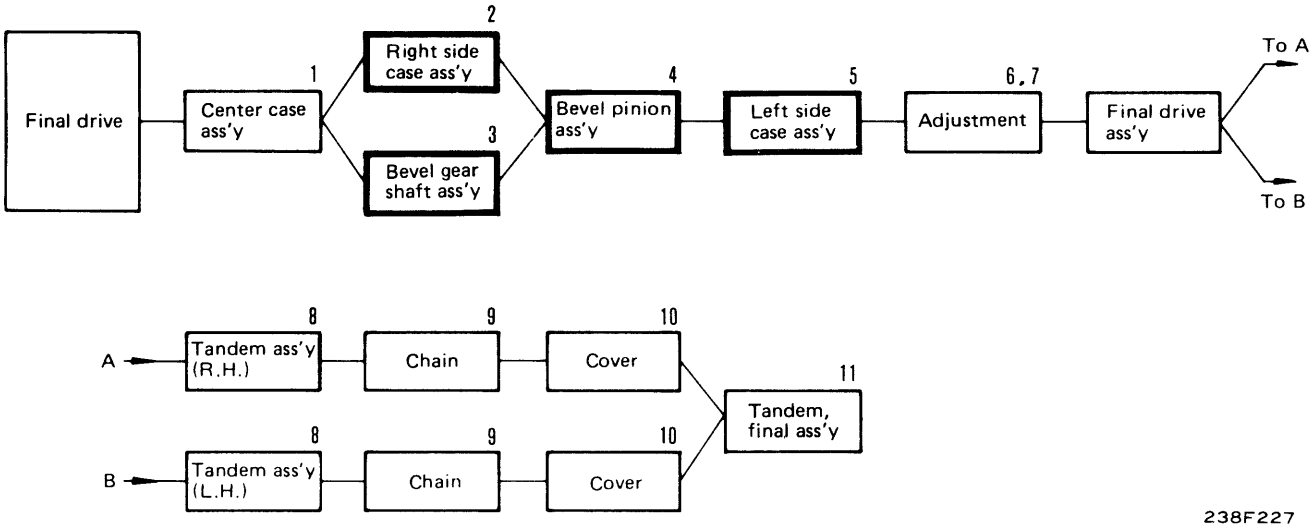
23P166A

7. Center case assembly
Dismount bearing (27).



ASSEMBLY OF FINAL DRIVE ASSEMBLY

GD705R-4

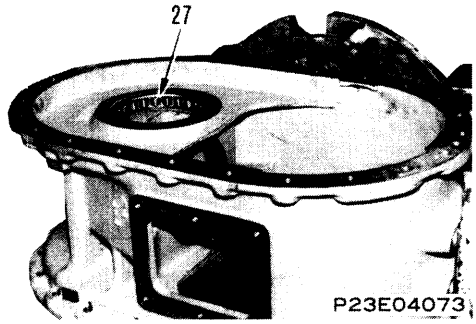


238F227

Special tool

	Part number	Part name	Q'ty
A	792-571-1600	Chain puller	1

1. **Center case ass'y**
   Mount bearing (27).



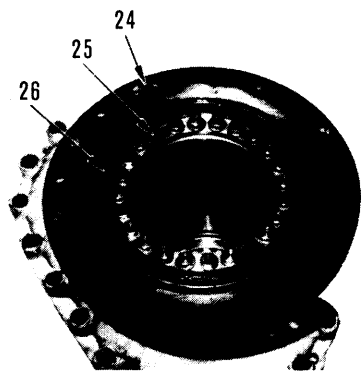
P23E04073

2. **Side case ass'y**
   1) Fit cage (24) on the side case.
   Fit washer (26), plate (25) and washer (26) in that order, and tighten the bolt.

   Washers: Grease (G2-LI) (both sides)

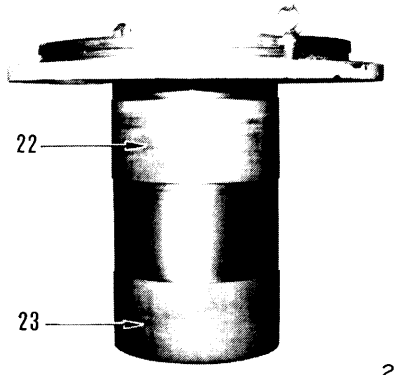
   Bolt: Liquid gasket (LG-1)

   kgm Bolt: 9 kgm



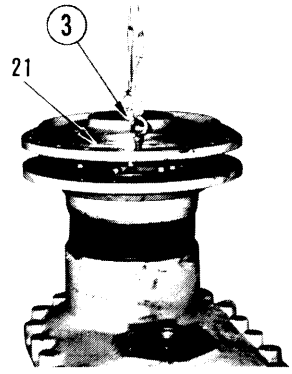
23P166A

2) Fit bushings (22) and (23) on the joint.
★ Arrange the slit of the bushings as follows:
Arrange the slit of bushing (22) so that it is at the bottom of the machine body.
Arrange the slit of bushing (23) so that it is at the top of the machine body.
Bushing: Engine oil (both side)



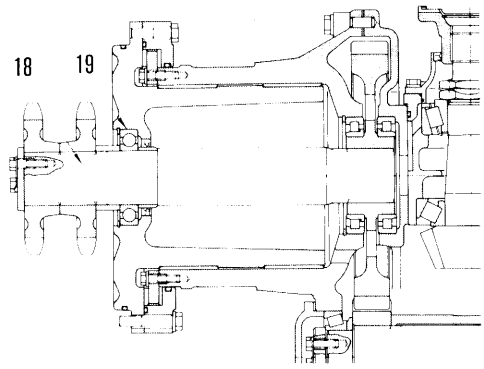
23P165A

3) Fit eye bolts 3 (Thered dia. = 12 mm, Pitch = 1.75 mm) to joint assembly (21), then lift the joint assembly and mount it on the side case.



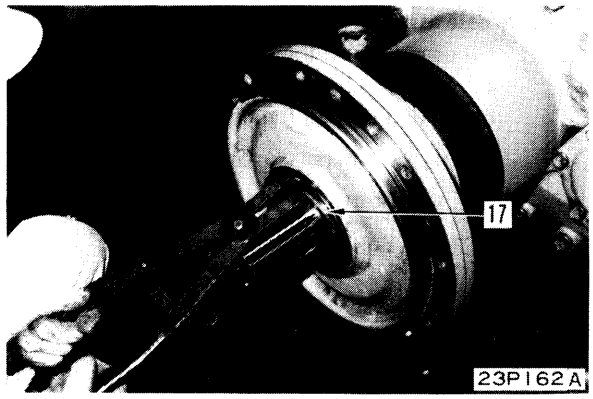
23P164A

4) Mount shaft (18) and the bearing (19) as single assembly.



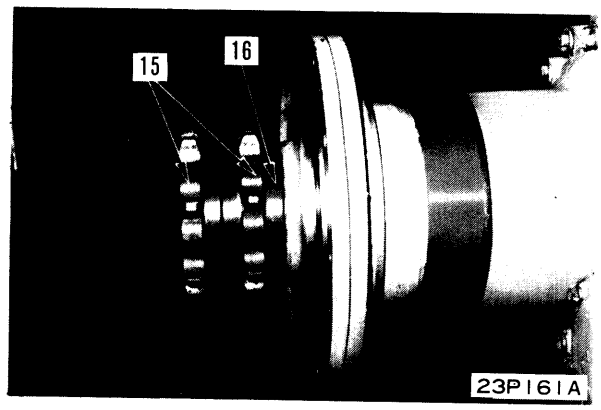
F23BB012

5) Fit snap ring (17).

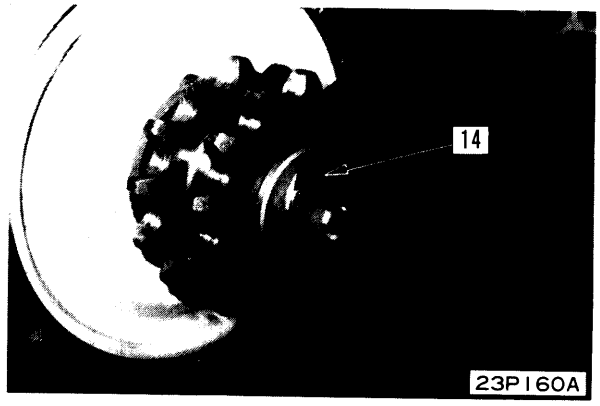


23P162A

6) Fit sprocket (15) and (16).

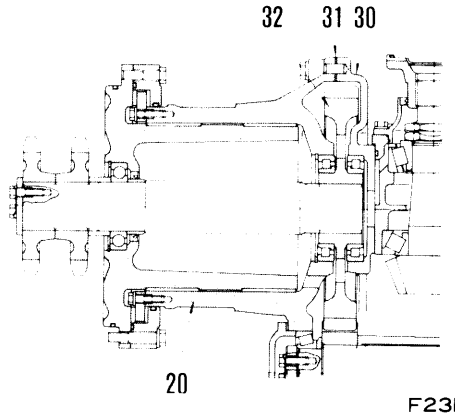


7) Mount shaft end holder (14).
★ Bend lock plates securely.



8) Fit gasket (31) and gear (32) to center case (30), then mount right side case assembly (20).

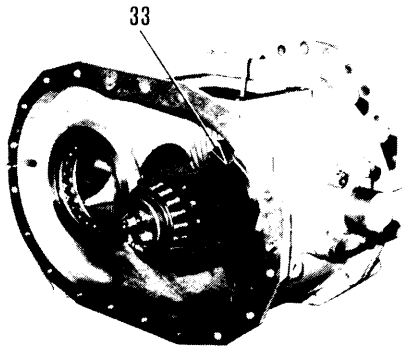
Gasket: Gasket sealant (LG-1)
kgm Mounting bolt: 23.5 kgm



F23BB013

3. Bevel gear shaft assembly

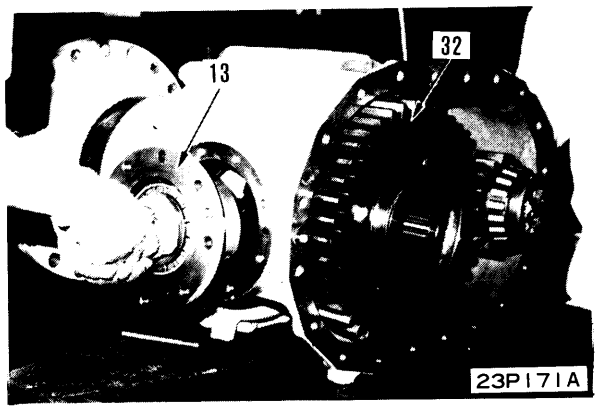
Suspend bevel gear shaft assembly (33) in the middle of center case (30), then mount it on right side bearing.



23P170A

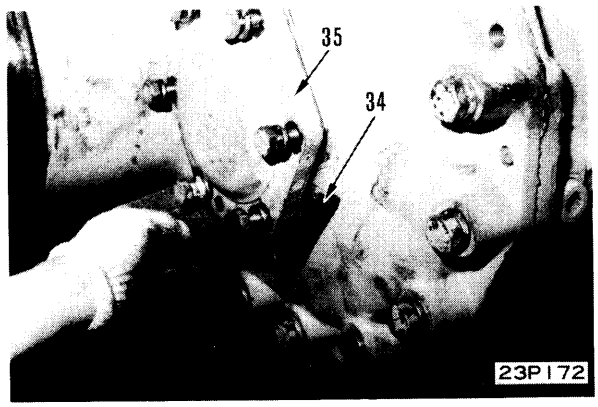
4. **Bevel pinion ass'y**
   1) Mount gear (32) and engage it with the gear on the bevel gear shaft ass'y side.
   2) Mount bevel pinion ass'y (13) and engage it with the bevel gear.

   ★ Backlash adjusting shims
      i) Insert adjusting shims of the same thickness as those which were removed during disassembly.
      ii) Standard shim thickness; 2.0mm
      iii) Types of shims: t = 0.1mm
      t = 0.3mm
      t = 1.0mm

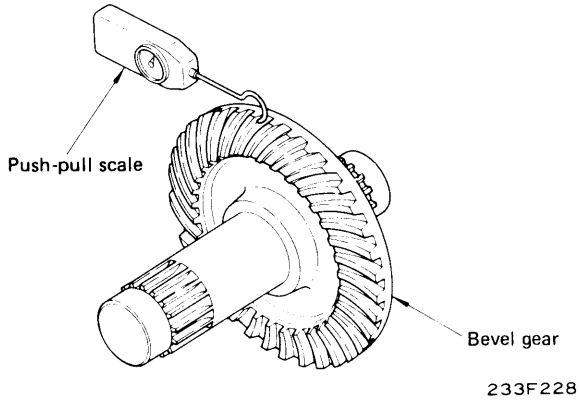


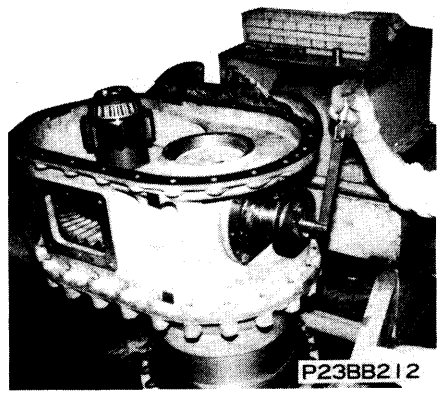
5. **Side case ass'y**
   Mount the left side case ass'y in similar manner to item 2.

6. **Pre-pressure adjustment**
   Adjust the overall thickness of shims (34), then tighten cover (35) and measure the starting torque.
   ★ Adjust the shim thickness so that the starting torque at the bevel pinion increases by about 0.3 to 0.4
   ★ Standard shim thickness: 2.0mm
   Types of shims: t = 0.1 mm, 0.3 mm, 1.0 mm



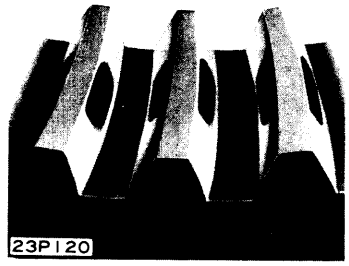
7. **Adjustment of backlash and tooth contact of bevel gear**
   ★ Fit the shims which were removed during disassembly of the bevel pinion ass'y in their initial positions.
   ★ Perform pre-pressure adjustment, backlash adjustment and tooth contact adjust at the same time.
   ★ Measure the rotating torque of the bevel gear and shaft ass'y with the bevel gear and bevel pinion engaged.
   ★ When adjusting the bearing pre-pressure, tighten the adjusting shims while rotating the bevel gear. Adjust the rotating torque on the bevel gear to about 4.5 to 6kg.
   1) Backlash measurement
      Fix dial gauge to the case in such a way that its tip touches the tooth face of the bevel gear at right angles.
      ★ Fix the bevel pinion and measure the backlash of the bevel gear. (Perform measurements at minimum of 3 points.)
      ★ Backlash should be between 0.3 to 0.4mm.





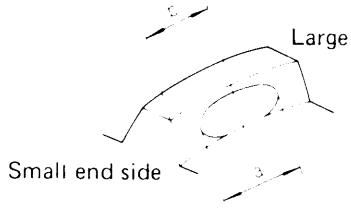
3) Adjusting tooth contact
Coat the tooth face of the bevel pinion lightly with red lead (minimum). Rotate the bevel gear forward and backward and inspect the pattern left on the teeth.

★ Tooth contact should be checked with no load on the bevel pinion. The tooth contact pattern should be located 20 to 40% from the small end. It should be in the center of the tooth height. If the gears are adjusted to this pattern, the tooth contact will be correct when load is applied.



If the result of the inspection shows that the correct tooth contact is not being obtained, adjust again as follows.

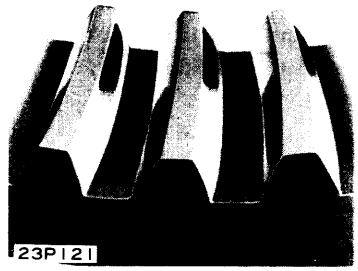
★ Tooth contact a . . . . . Tooth contact width 30 to 50%
b . . . . . Tooth contact center 20 to 40%

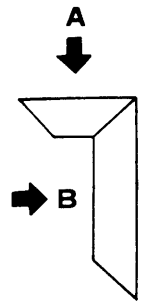


23F032

i) If bevel pinion is too far from center line of bevel gear. Contact is at the small end of the convex tooth face of the bevel gear and at the big end of the concave tooth face.

★ Procedure for adjustment
Reduce the thickness of the shims at the mount of the bevel pinion assembly to move the pinion shaft in direction A, nearer to the bevel gear. Increase the thickness of shims at the right and left cage mounts to move the bevel gear in direction B by the same amount that the bevel pinion has moved in direction A. Check the tooth contact pattern and backlash.



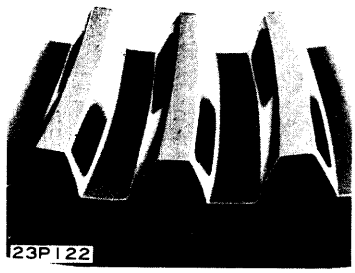


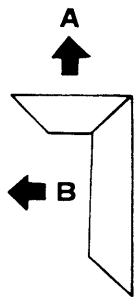
23F058

ii) If bevel pinion is too close to center line of bevel gear. Contact is at the small end of the concave tooth face of the bevel gear and the big end of the convex tooth face.

★ Procedure for adjustment
Increase the thickness of the shims at the mount of the bevel pinion assembly to move the pinion shaft in direction A, away from the bevel gear. Reduce the thickness of shims at the right and left cage mounts to move the bevel gear in direction B by the same amount that the bevel pinion has moved in direction A. Check the tooth contact pattern and backlash.

★ When adjusting the bevel gear to the right or left, do not change the preload of the bearing. Adjust by moving shims between the bevel gear and the bevel pinion. Always keep the same total thickness of shims.



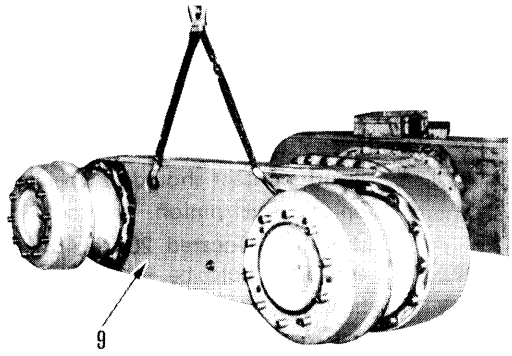


23F059

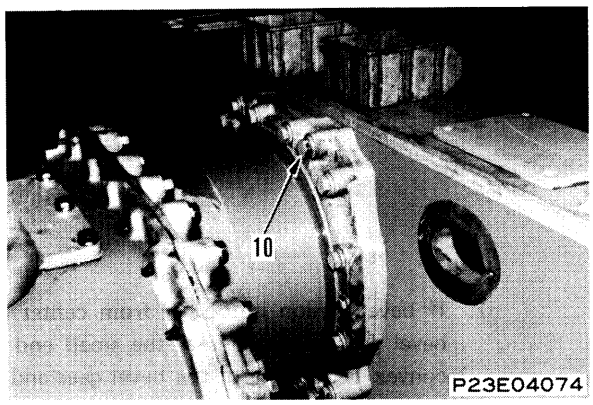
8. Tandem case ass'y

1) Suspend tandem case ass'y (9) and mount it on the final drive case.
2) Tighten mounting bolts (10).

	Mounting bolts:	Thread tightener (LT-2)
	Case:	Gasket sealant (LG-1)
kgm	Mounting bolts:	23.5 kgm



P23E04069



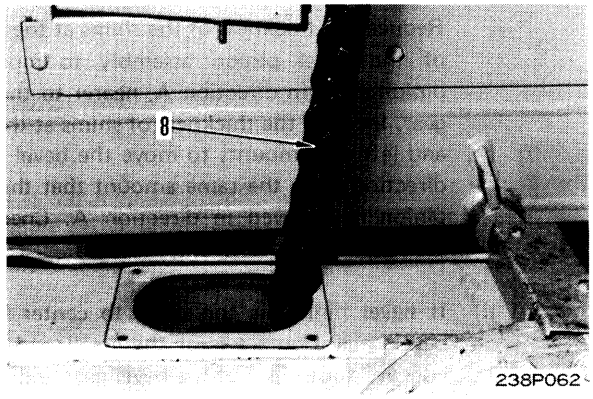
P23E04074

9. Chain

1) Fit chain (8) on the sprocket while rotating the wheel hub.

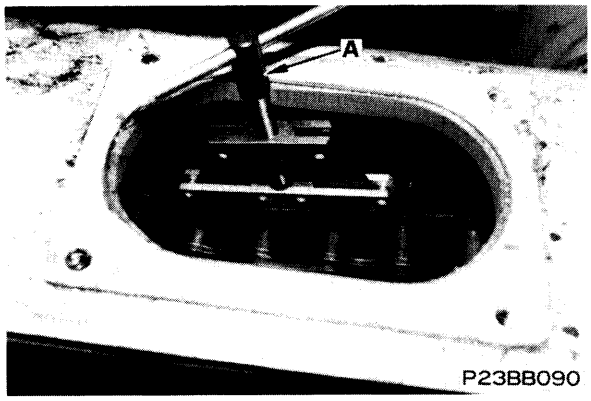
★ It is relatively easy to fit the chain from the driven side sprocket.

★ Fit the chain towards the inside at the front of the machine body and towards the outside at the rear of the machine body.



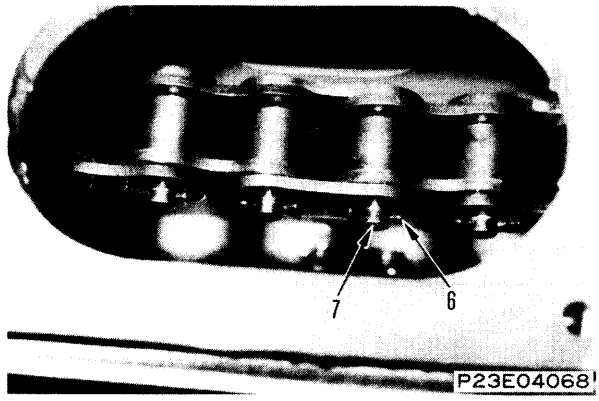
238P062

2) Using tool **A**, connect the chain and align it with the pin.



P23BB090

3) Fit pin (7) and bend lock pin (6).
★ Bend lock pin securely.

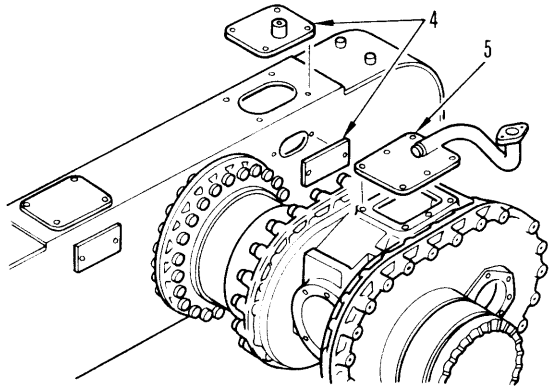


10. Cover (tandem and final)

Install covers (4) (six covers) front and rear at the tandem side and cover (5) (one cover) at the final side after fitting gaskets to them.

Gasket and bolt: Gasket sealant (LG-1)

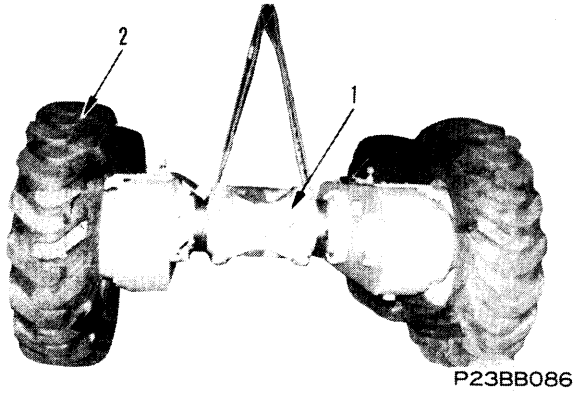
★ Install the tandem cover with the oil filler at the front of the machine body, and the cover with the breather at the rear inner side.



11. Tandem, final ass'y

1) Mount wheel (2), then raise the tandem, final ass'y (1) and remove the block.
2) Screw tandem case drain plug, then pour in engine oil from the oil filler to the specified level.

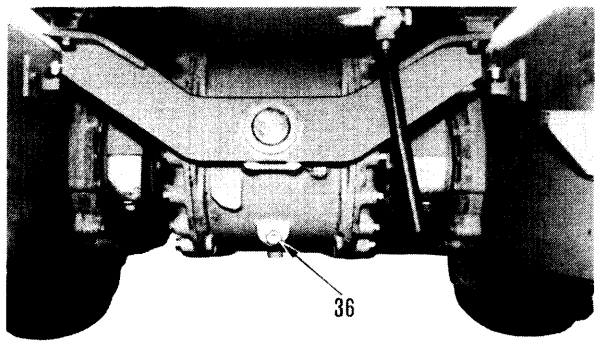
Tandem case (one side): 36ℓ



3) Screw final case drain plug (36), then pour in gear oil from the oil filler to the specified level.

Final case: 24ℓ

★ Start and run engine to let oil circulate in hydraulic system. Check oil level again.



DISASSEMBLY OF FINAL DRIVE ASSEMBLY

GD705A-4

Special tools

	Part number	Part name	Q'ty
A	792-571-1600	Chain puller	1
B	792-571-1400	Wrench (for L.H. nut)	1
C	792-571-1500	Wrench (for R.H. nut)	1

1. Tandem and final drive assembly

1) For detail see DISMOUNTING TANDEM DRIVE AND FINAL DRIVE ASS'Y.
2) Sling tandem and final drive assembly (1) and remove wheel (2).

kg Tandem and final drive assembly: 4.0 ton

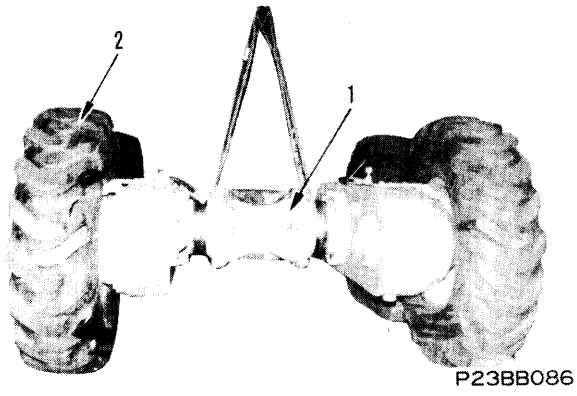
3) Set tandem and final drive assembly on block ①, remove drain plug (3) and drain tandem case oil.

Tandem case (each): Approx. 105ℓ

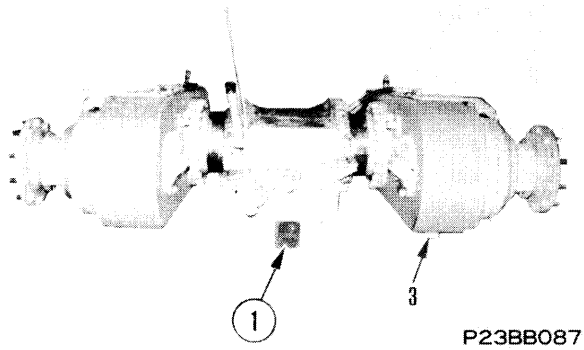
4) Remove drain plug and drain final drive case oil.

Final drive case: Approx. 40ℓ

★ Set block with three places under the L.H. and R.H. tandem case and final drive.



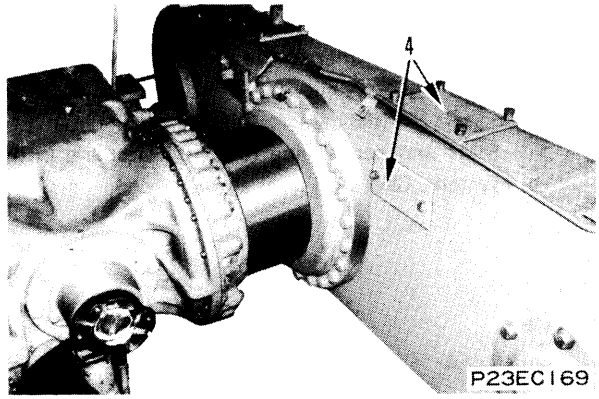
P23BB086



P23BB087

2. Cover

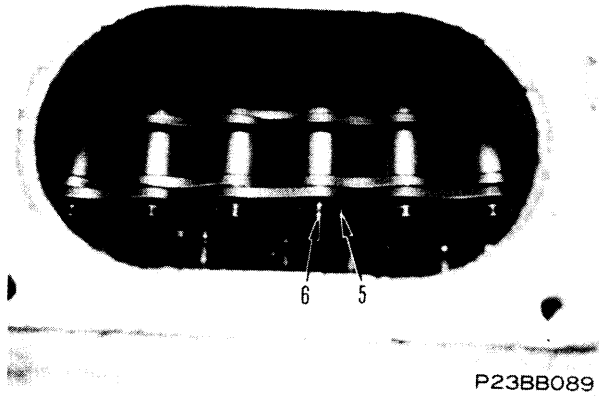
Remove covers (4) (Front and rear: 6 pcs.)



P23EC169

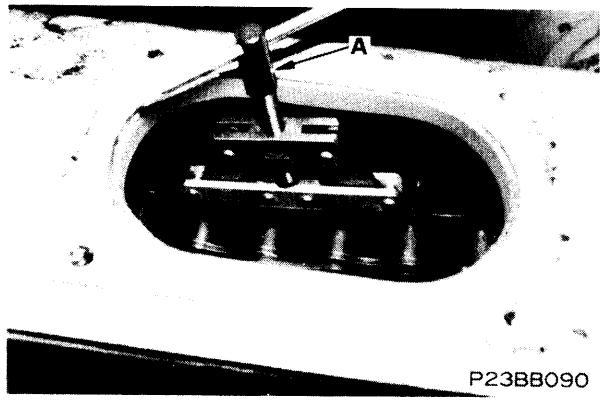
3. Chain

1) Turn the pinion and align connection part of chain to check port position.



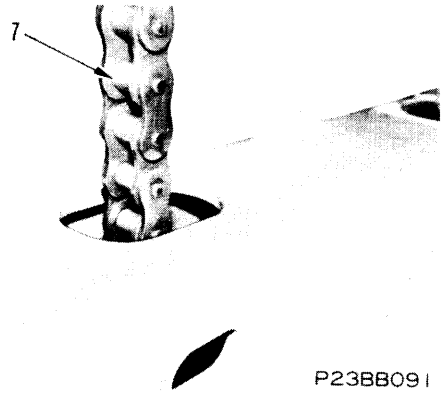
P23BB089

2) Using tool **A** squeeze the chain, remove lock pin (5) and pull out connection pin (6).



P23BB090

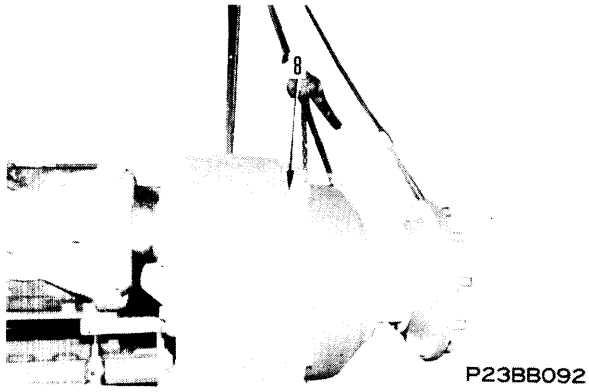
3) Remove chain (7).



P23BB091

4. Tandem case assembly

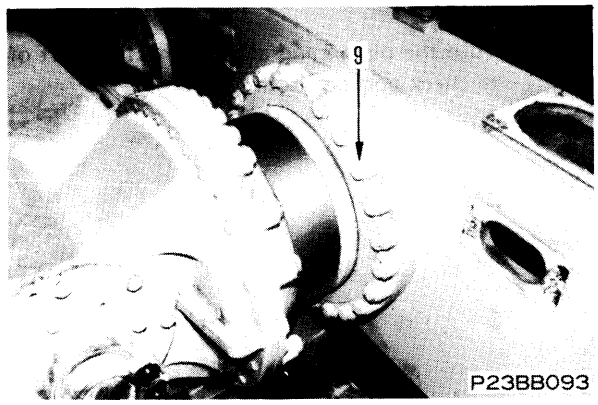
1) Sling tandem case assembly (8).



P23BB092

2) Remove mounting bolt (9) and dismount tandem case assembly.

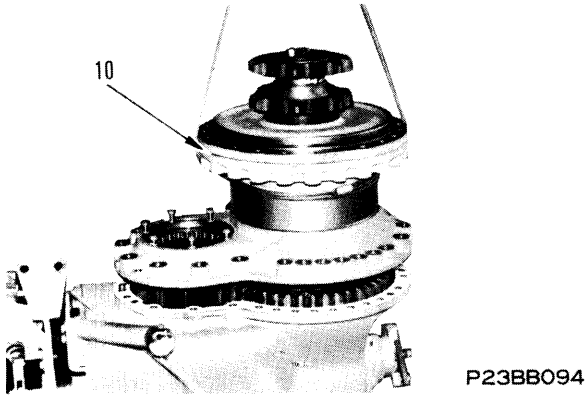
kg Tandem case assembly: Approx. 1030 kg



5. Dismounting side case assembly

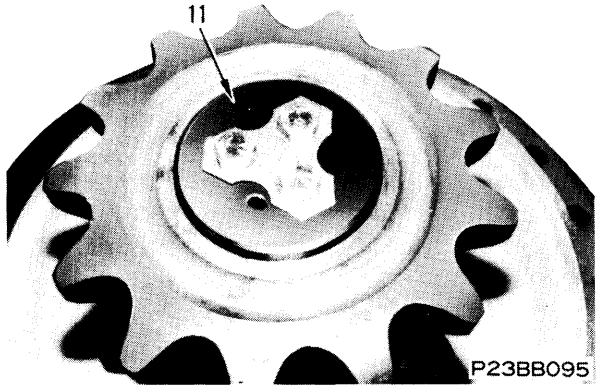
Remove mounting bolt and disconnect side case assembly (10) from center case.

kg Side case assembly: Approx. 240 kg

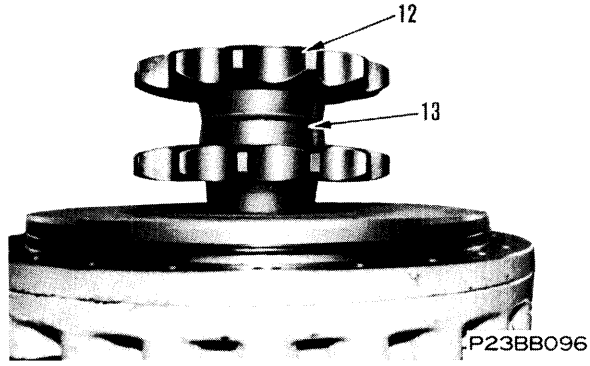


6. Disassembly side case assembly

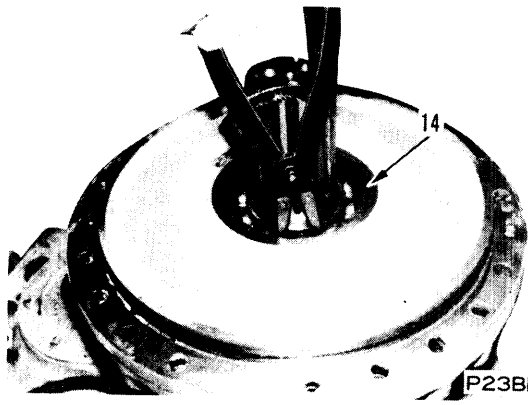
1) Remove holder (11) of shaft end.



2) Remove sprocket (12), coller (13).

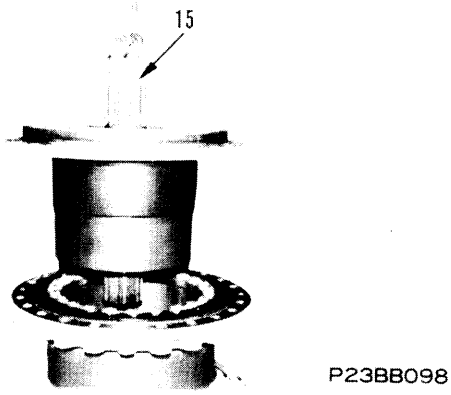


3) Remove snap ring (14)

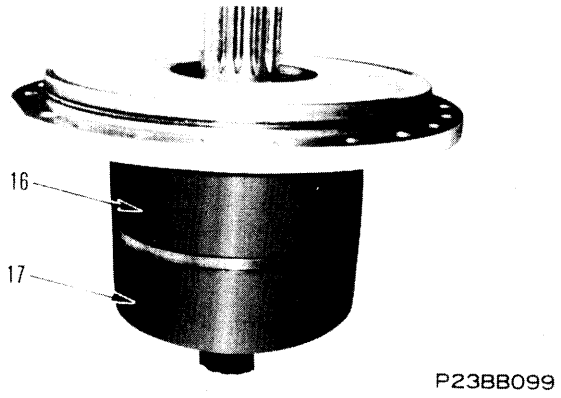


4) Install eye bolt, sling shaft and joint assembly (15) and remove it.

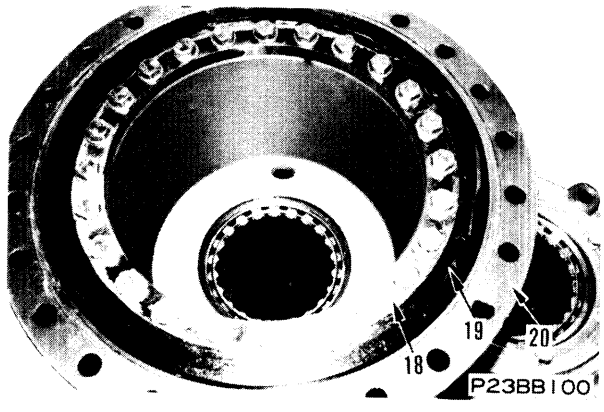
kg Shaft and joint assembly: Approx. 150 kg



5) Remove bushing (16), (17) from joint assembly.

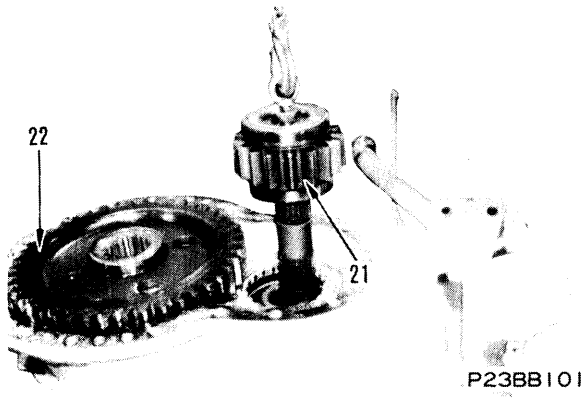


6) Remove plate (18), upper and lower washer (19) and cage (20).

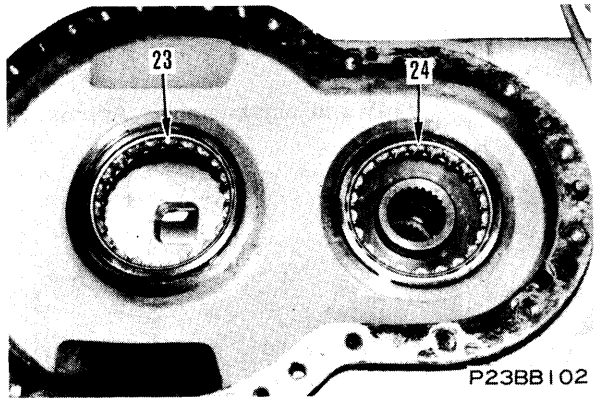


7. **Gear and shaft assembly**
   Remove gear and shaft assembly (21).

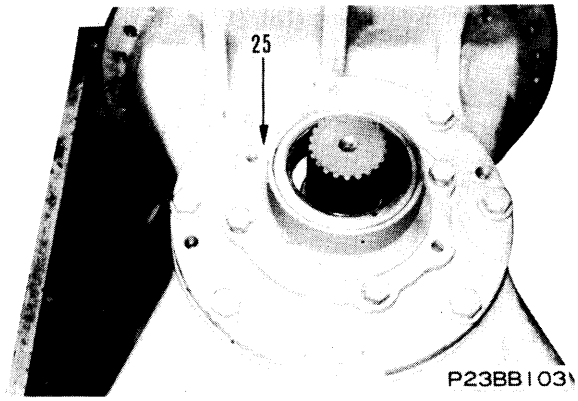
8. **Gear**
   Remove gear (22).



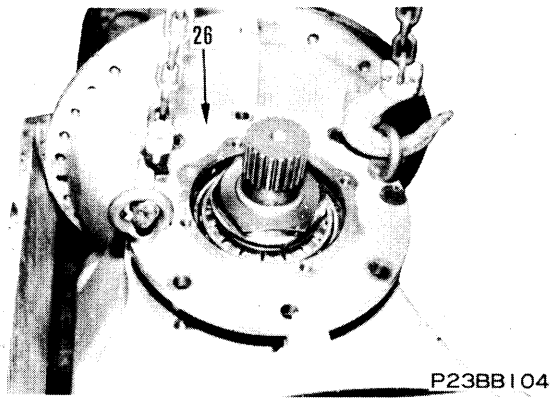
9. **Bearing**
   Remove bearings (23), (24).



10. **Bevel pinion assembly**
    1) Screw in jack bolt and remove cover (25).

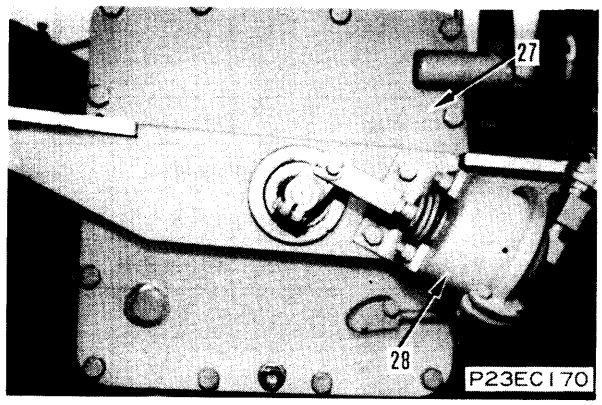


    2) Install eye bolt and remove bevel pinion assembly (26).



11. Cover

Screw in jack bolt and remove differential lock chamber (28) together with cover (27).



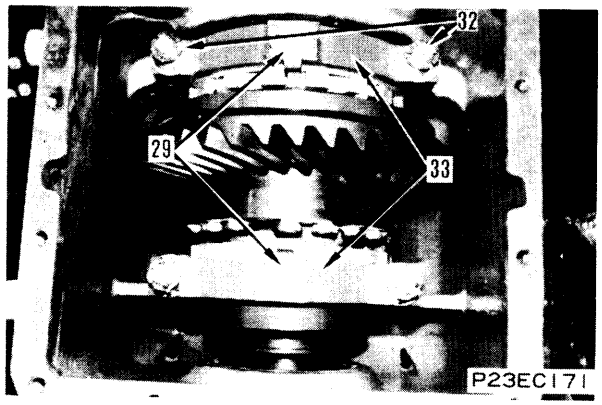
12. Bevel gear assembly

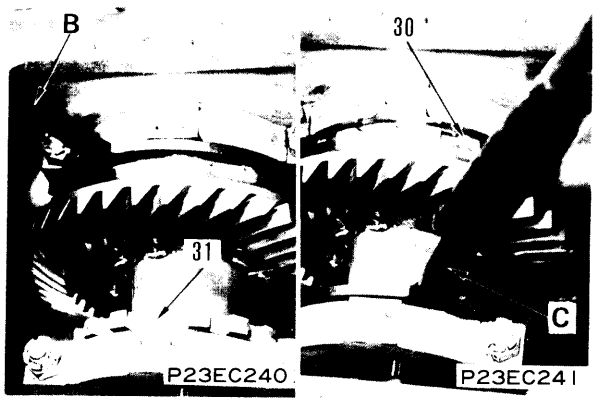
1) Remove lock (29) of L.H. and R.H. adjusting nuts.

2) Using tool **B**, loosen L.H. nut (30).

3) Using tool **C**, loosen R.H. nut (31).

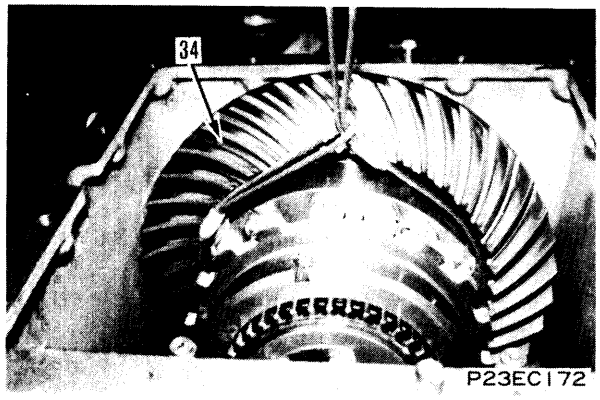
4) Remove L.H. and R.H. nuts (32) and cap (33).





5) Remove bevel gear assembly (34).

kg Bevel gear assembly: Approx. 90 kg



ASSEMBLY OF FINAL DRIVE ASSEMBLY

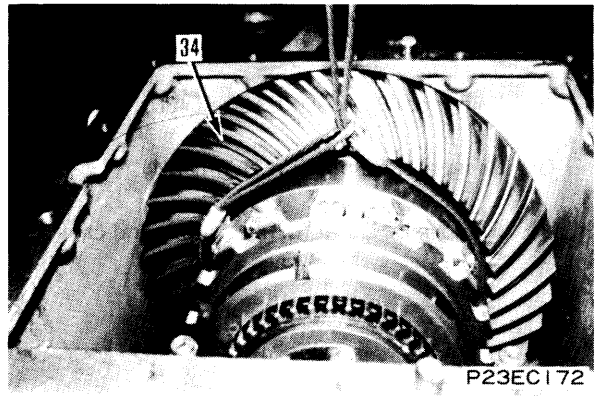
GD705A-4

Special tools

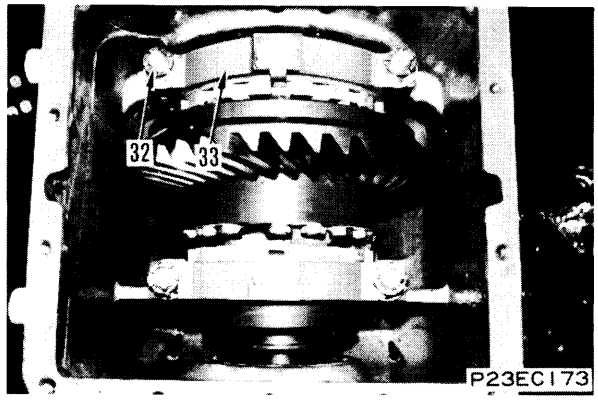
	Part number	Part name	Q'ty
A	792-571-1600	Chain puller	1
B	792-571-1400	Wrench (for L.H. nut)	1
C	792-571-1500	Wrench (for R.H. nut)	1

1. Bevel gear assembly

1) Sling bevel gear assembly (34) and install case.
   ★ When install, upper set dowel pin connection notch of cap.

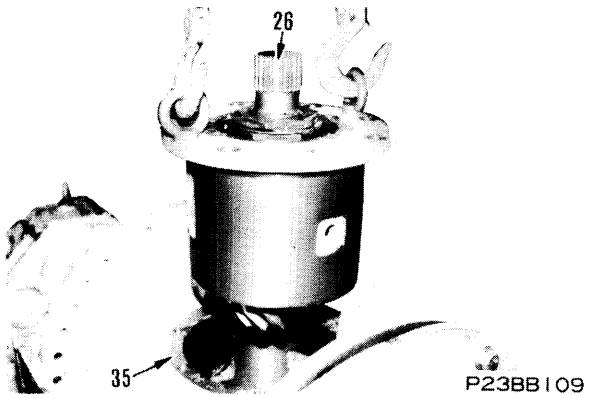


2) i) Align dowel pin part and install cap (33).
   ii) Temporarily tighten nut (32).
   ★ When tightening adjusting nut, bevel gear assembly is reduced to move on both sides.
   ★ When installing cap, case inner side and cap are reduced to as the same face.



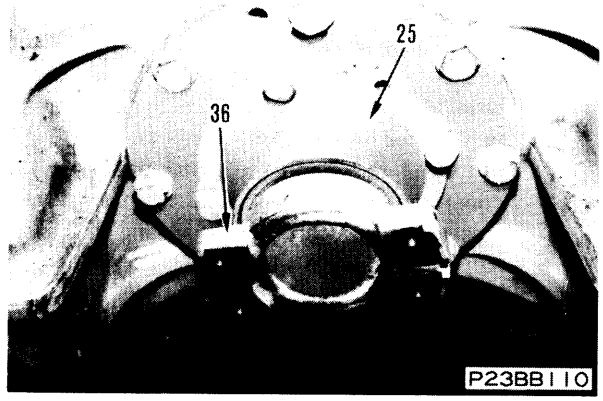
2. Bevel pinion assembly

1) Fix O-ring, install bevel pinion assembly (26) and it is engaged in bevel gear.
   ★ Backlash adjusting shims
      i) Insert adjusting shims (35) of the same thickness as those which were removed during disassembly.
      ii) Standard shim thickness: 2.0 mm
      iii) Typs of shims
      t = 0.1 mm t = 0.2 mm t = 0.5 mm



2) Attach gasket and install cover (25).
   Cover side: Liquid gasket (LG-1)

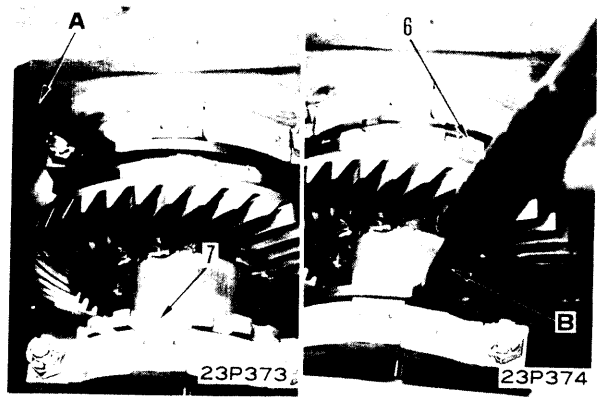
3) Install coupling (36).



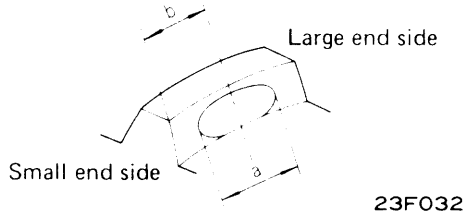
3. Checking and adjusting

Adjust preload to taper roller bearing, backlash and tooth contact of bevel gear and bevel pinion by tightening R.H. nut (6) with tool **A** and L.H. nut (7) with tool **B**.

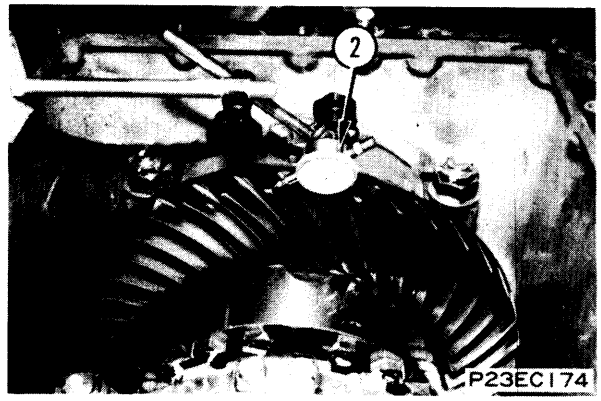
- ★ Adjust bevel pinion assembly for starting force of 7.5 to 10.5 kg as a single assembly.
- ★ Install bevel pinion assembly on case with the same shims as those before removal.
- ★ Perform adjustment of preload, backlash and tooth contact in parallel.
- ★ Measure starting torque of bevel gear assembly while bevel gear is in mesh with bevel pinion.
- ★ When adjusting preload to bearing, adjust it by tightening adjustment nut while adjusting play of L.H. and R.H. bearings by rotating bevel gear.



★ Tooth contact
a . . . . . Tooth contact width 30 to 50%
b . . . . . Tooth contact center 20 to 40%

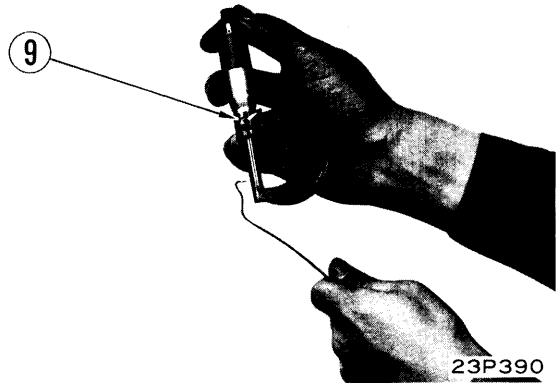


1) Backlash measurement
   Fix dial gauge ② to the case in such a way that its tip touches the tooth face of the bevel gear at a right angle.
   - ★ Fix the bevel pinion and measure the backlash of the bevel gear.
     (Measurements at least 3 points)



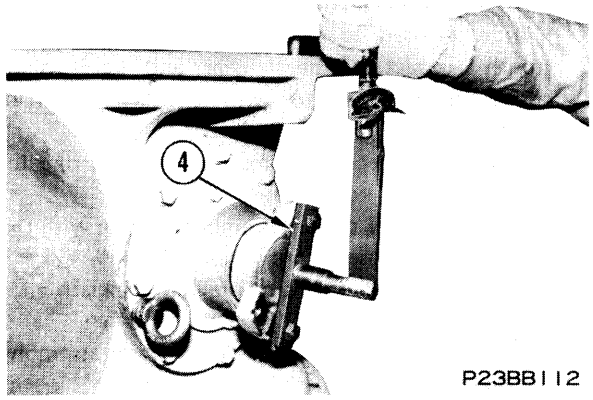
- Measuring with fuse wire
  Put a fuse wire (approx. ϕ1.5 mm) between the teeth of the bevel gear and bevel pinion. Rotate the bevel gear and then measure the thickness of the wire with a micrometer ⑨ .
  Put the fuse wire in the center of the bevel pinion contact pattern (about 30% from small end) and measure at least three points around the gears.

★ Adjust the backlash to the standard value by adjusting the shim thickness at the right and left cage mounts.
  Standard value for backlash: 0.3 to 0.4 kgm

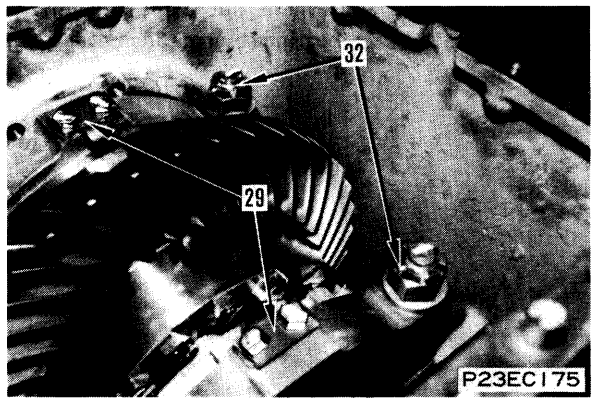


2) Adjusting preload of bevel gear shaft bearing
   i) Measure starting torque of bevel pinion with torque wrench ④ . Adjust the starting torque to the standard value by adjusting the shim thickness at the right and left cage mounts.
      Starting torque: 0.3 to 0.4 mm
   ii) After adjusitng preload, check backlash between bevel pinion and bevel gear.

3) Adjusting tooth contact.
   Refer to page 23-150.

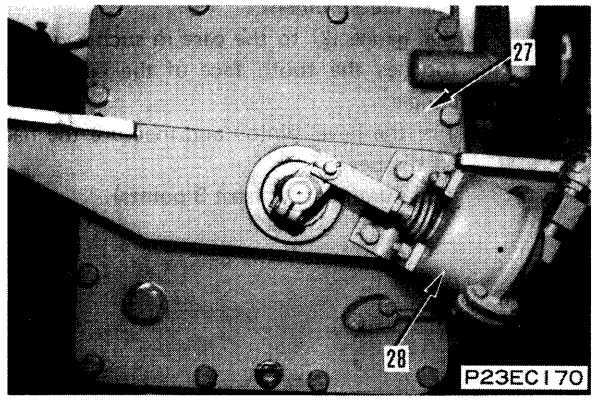


4. Nut
Tighten L.H. and R.H. nuts (32), and align cotter pin hole.
★ Tighten nuts equally.
★ Bend cotter pin securely.

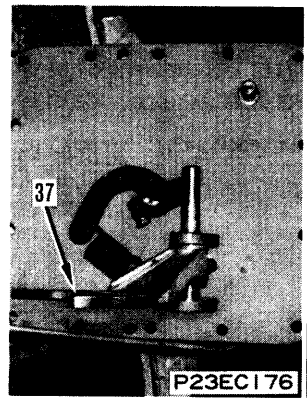


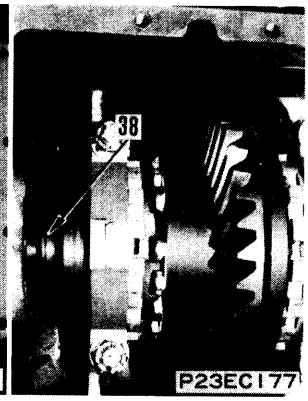
5. Lock
Install lock (29) on L.H. and R.H. adjusting nuts.
★ Bend cotter pin securely.

6. Cover
Attach gasket and install cover (27) together with differential lock chamber (28).
  Cover: Liquid gasket (LG-1)

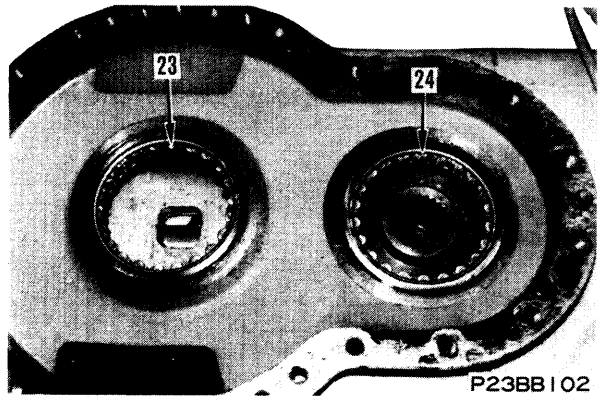


★ Confirm that shifting fork (37) is firmly installed in gear (38).



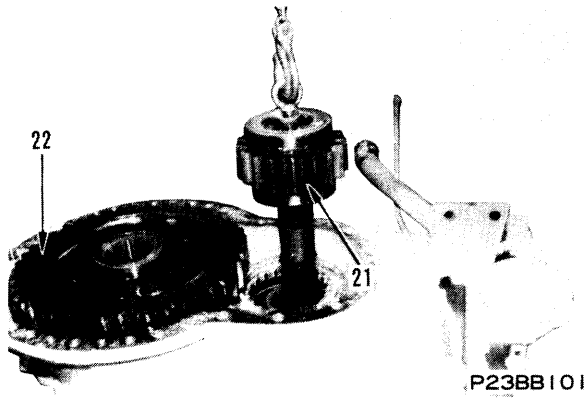


7. **Bearing**
Install bearings (23), (24).

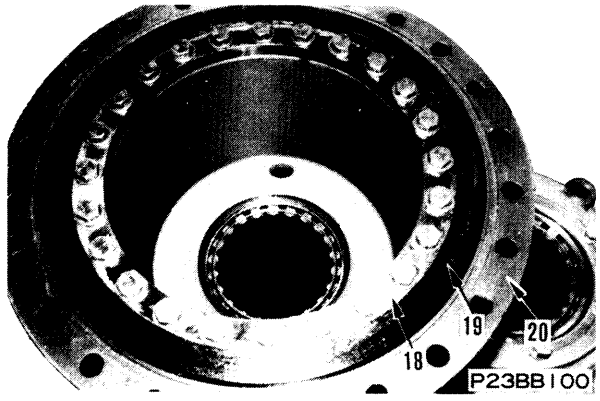


8. **Gear**
Install gear (22).

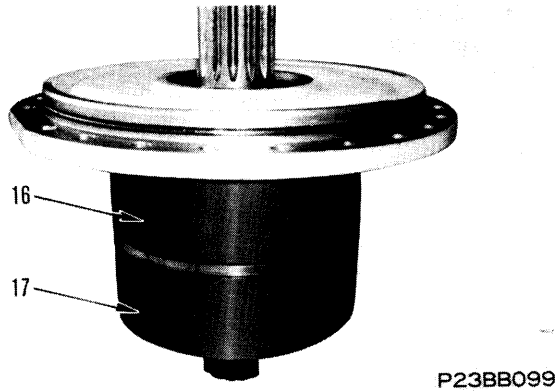
9. **Gear and shaft assembly**
Install gear and shaft assembly (21).



10. **Side case assembly**
1) Install cage (20) on side case.
Install washer (19), plate (18), washer (19) in order and tighten bolt.
Washer (each side): Grease (G2-LI)
kgm Mounitng bolt: 18 ± 2 kgm

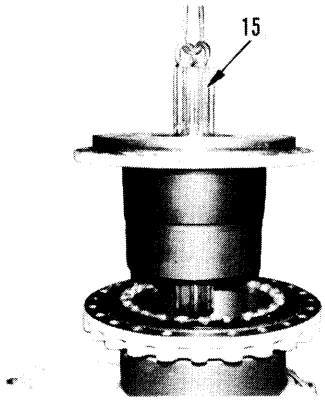


2) Install bushings (16), (17) in joint.
   ★ Slit position of bushing is as follows.
   Slit of bushing (16) faces lower side of chassis.
   Slit of bushing (17) faces upper side of chassis.
   Bushing (each side): Engine oil



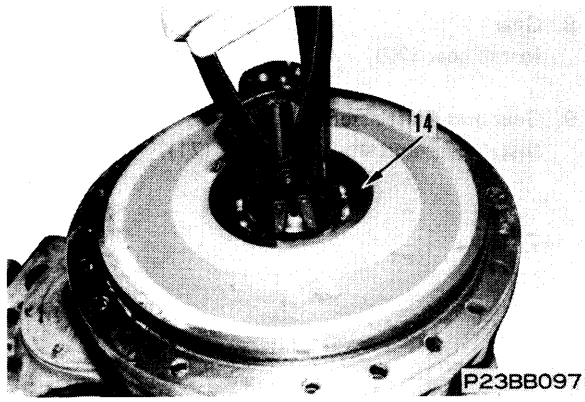
P23BB099

3) Lift shaft and joint assembly (15) and install it to side case.
   kg Shaft and joint assembly: Approx. 150 kg



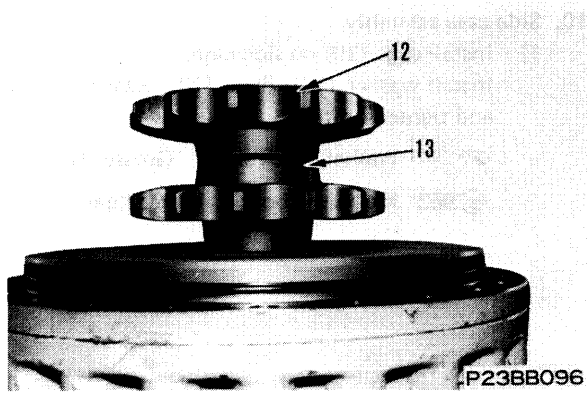
P23BB098

4) Install snap ring (14).



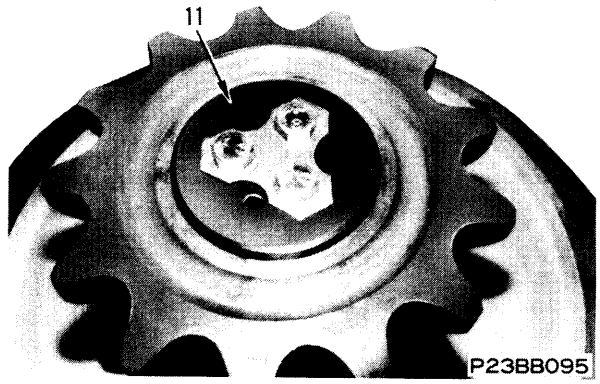
P23BB097

5) Install sprocket (12), collar (13).



P23BB096

6) Install holder (11) of shaft end.
★ Bend lock plate securely.

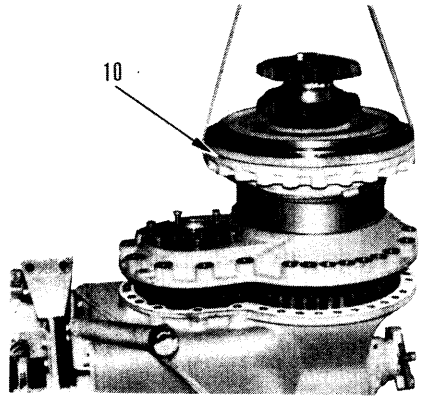


7) Attach gasket to center case and install side case assembly (10).

Center case side: Liquid gasket (LG-1)

kgm Mounting bolt: 28.25 ± 3.25 kgm

kg Side case assembly: Approx. 240 kg



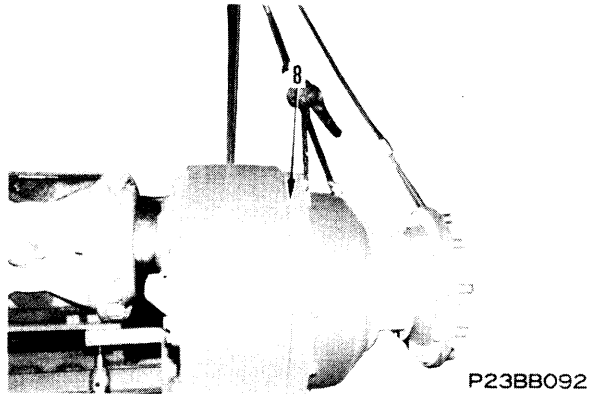
11. Tandem case assembly

Fix O-ring to joint of final drive assembly, lift tandem case assembly (8) and mount it.

Mounting bolt: Liquid gasket (LG-1)

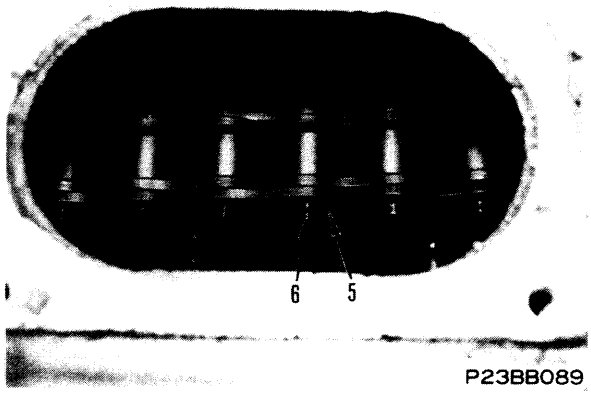
kgm Mounting bolt: 39.25 ± 4.25 kgm

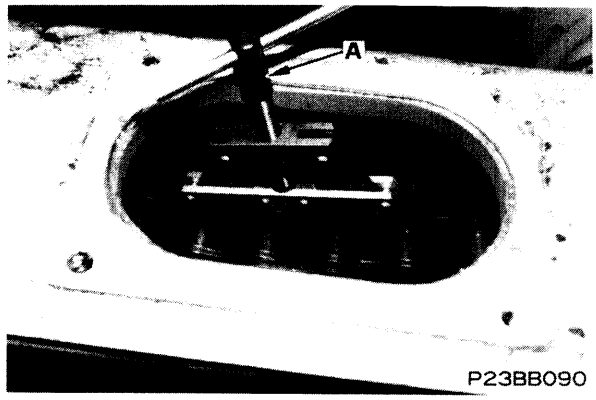
kg Tandem case assembly: Approx. 1030 kg



12. Chain

1) Hang chain on the sprocket. While rotating the hub, install chain.
★ The chain is much easier to connect from the driven side sprocket.
2) Use tool **A**, pull the chain ends, and align pin inserting hole.
3) Insert pin (6) and bend lock pin (5).
★ Bend lock pin securely.

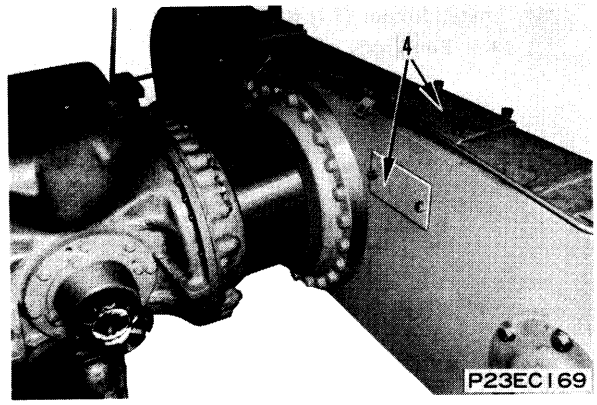




13. Cover

Attach gasket on covers (4) (Front and rear: 6 pcs).

Mounting bolt (tandem case side): Liquid gasket (LG-1)



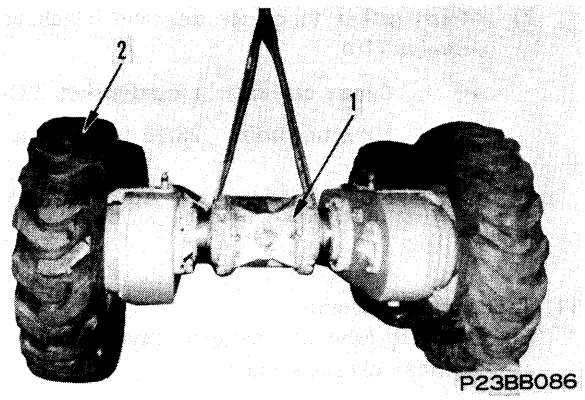
14. Tandem and final drive assembly

1) Lift tandem and final drive assembly (1) and install wheel (2).
2) Tighten tandem case drain plug and refill engine oil through filler port to the specified level.

Tandem case (each): Approx. 105ℓ

3) Tighten final drive case drain plug and refill gear oil through filler port to the specified level.

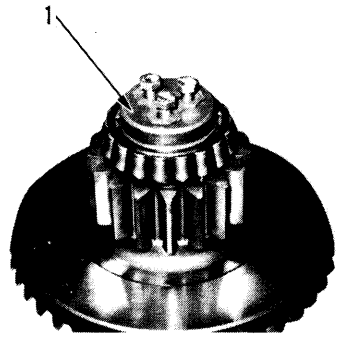
Final drive case: Approx. 40ℓ



DISASSEMBLY OF BEVEL GEAR AND SHAFT ASSEMBLY

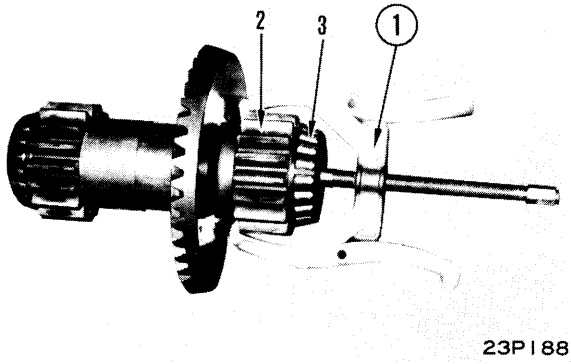
GD705R-4

1. Loosen the bolts and remove holder (1) (both ends).



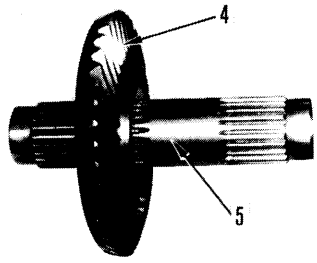
23P187

2. Using gear puller ①, pull out gear (2) and bearing (3) together (both ends).



23P188

3. Pull out bevel gear (4) from shaft (5).

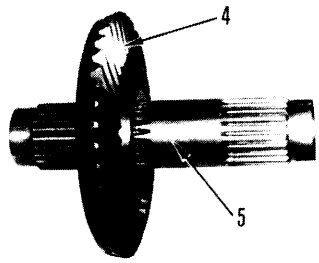


23P189

ASSEMBLY OF BEVEL GEAR AND SHAFT ASSEMBLY

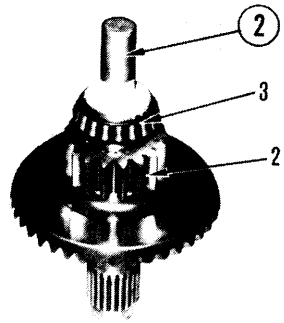
GD705R-4

1. Mount bevel gear (4) on shaft (5).



23P189

2. Mount gear (2), then drive in (press-fit) bearing (3) using press-fit tool ② (both ends).

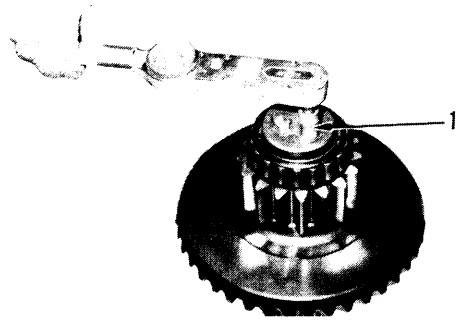


23P190

3. Fit holder (1) and tighten the bolts to the specified torque.

   kgm Tightening torque: 9.0 kgm

   ★ Bend lock plate securely.



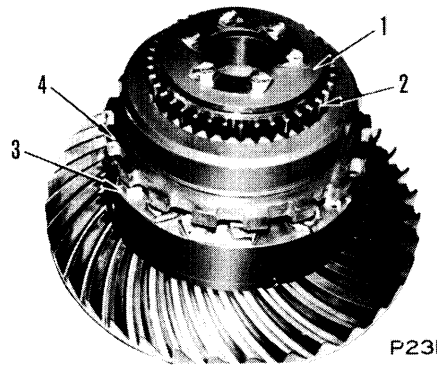
23P191

DISASSEMBLY OF BEVEL GEAR ASSEMBLY

GD705A-4

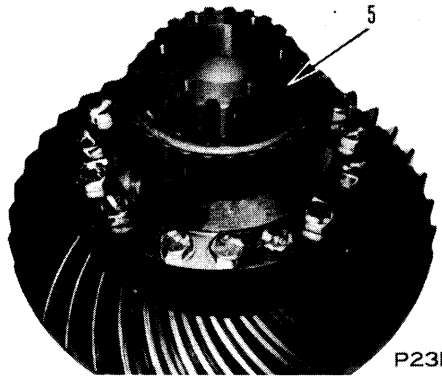
1. **Gear**
   Remove holder (1) and remove gear (2).

2. **Cage**
   Remove cage (3) together with nut (4).



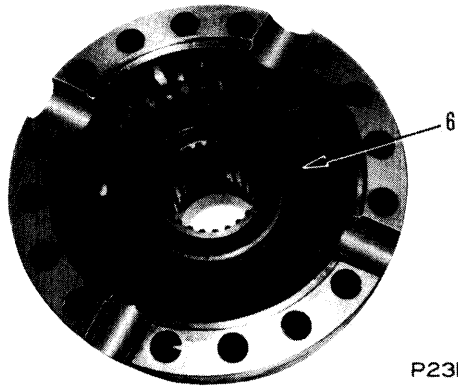
P23EC178

3. **Case and gear assembly**
   1) Remove mounting bolt and remove case and gear assembly (5).



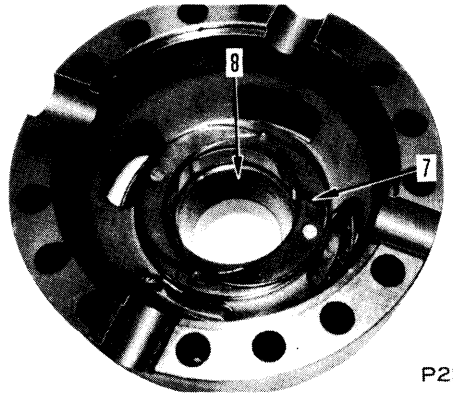
P23EC179

   2) Remove gear (6).



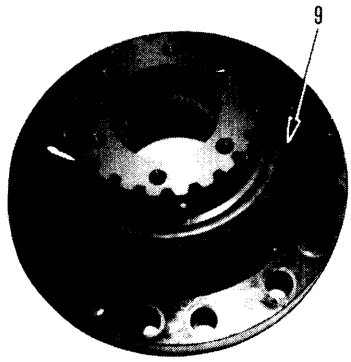
P23BB127

   3) Remove thrust washer (7) and bushing (8).



P23BB128

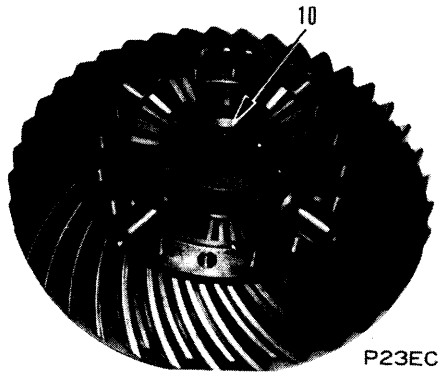
4) Remove bearing (9).



P23BB129

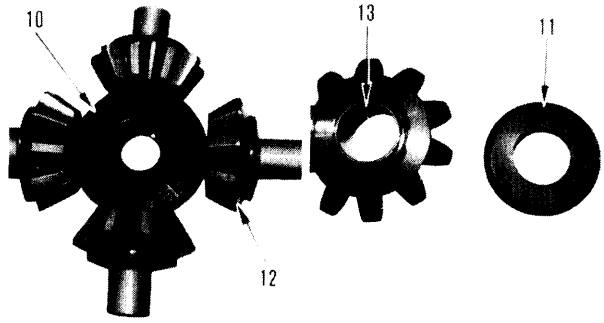
4. Cross joint assembly

1) Remove cross joint assembly (10).



P23EC180

2) Remove washer (11), pinion (12), and bushing (13) from cross joint (10).

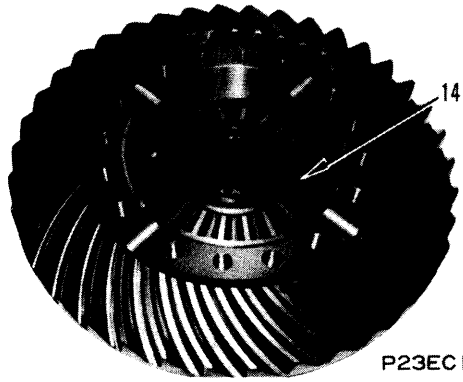


P23BB131

P23BB132

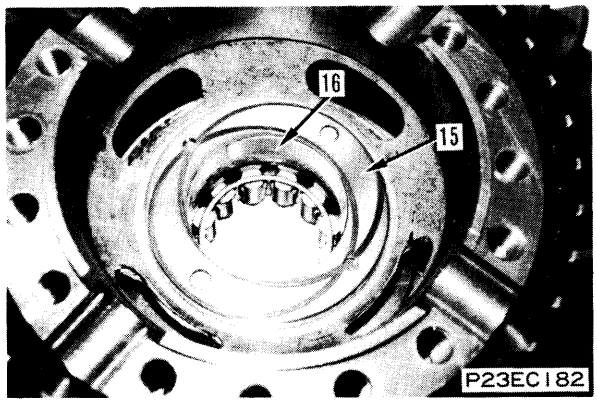
5. Gear

Remove gear (14).



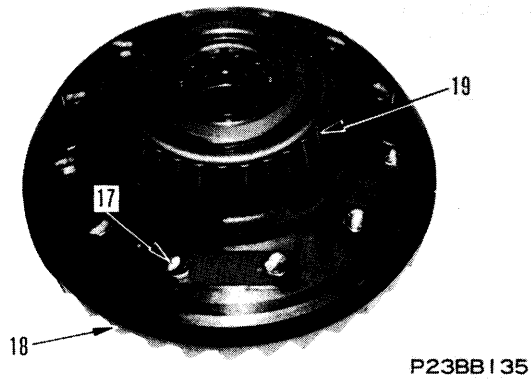
P23EC181

6. **Thrust washer and bushing**
   Remove thrust washer (15) and bushing (16).



7. **Bevel gear**
   Remove mounting bolt (17) and bevel gear (18).

8. **Bearing**
   Remove bearing (19).

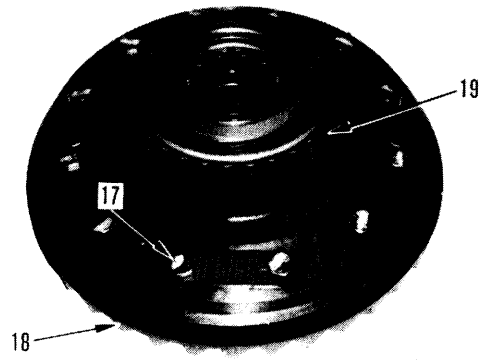


ASSEMBLY OF BEVEL GEAR ASSEMBLY

GD705A-4

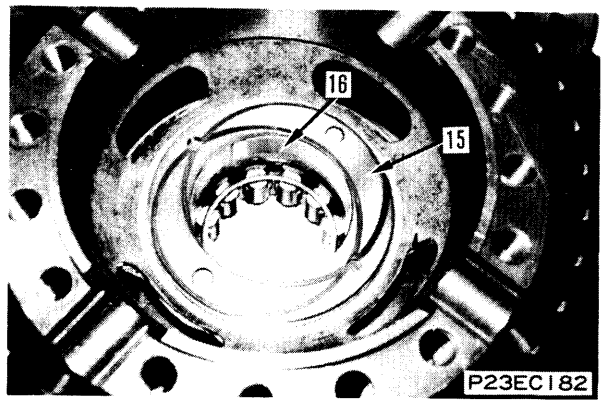
1. **Bearing**
   Install bearing (19).

2. **Bevel gear**
   Install bevel gear (18) and tighten bolt (17).
   ★ Bend lock plate securely.



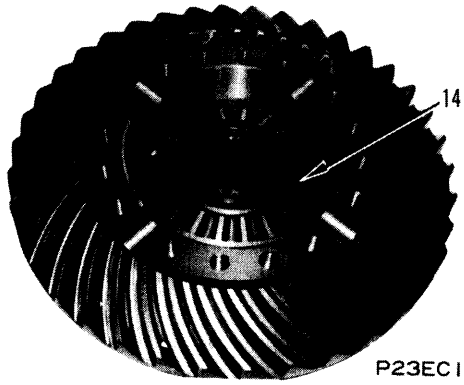
P23BB135

3. **Thrust washer and bushing**
   Install bushing (16) and thrust washer (15).



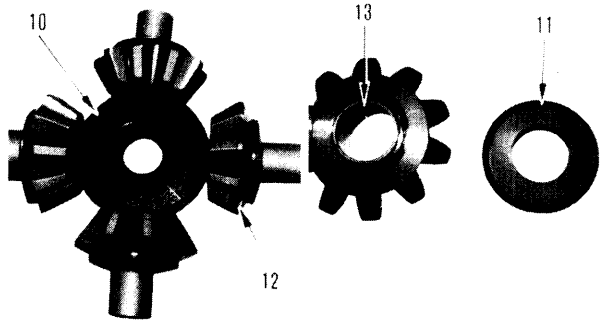
P23EC182

4. **Gear**
   Install gear (14).



P23EC181

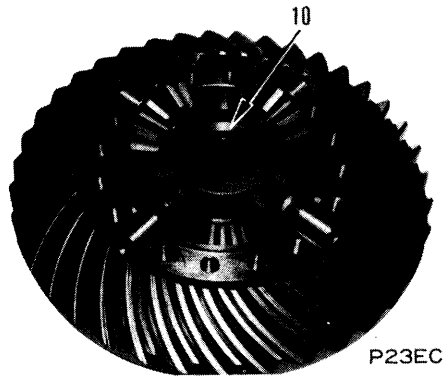
5. **Cross joint assembly**
   1) Install bushing (13) on pinion (12) and install pinion, washer (11) on cross joint (10) in order.



P23BB131

P23BB132

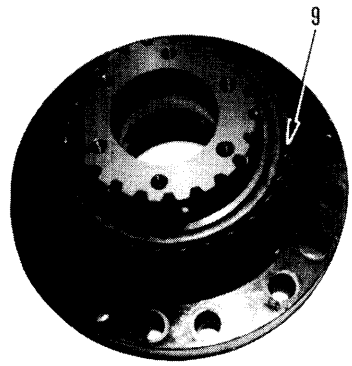
2) Install cross joint assembly (10).



P23EC180

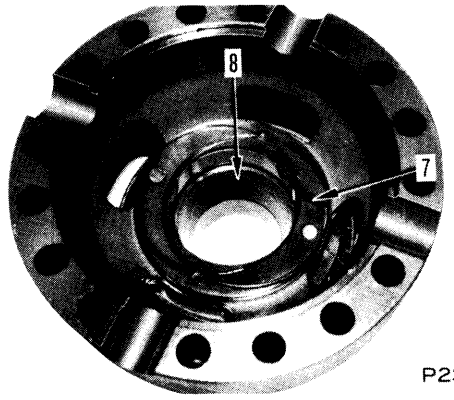
6. Case and gear assembly

1) Install bearing (9).



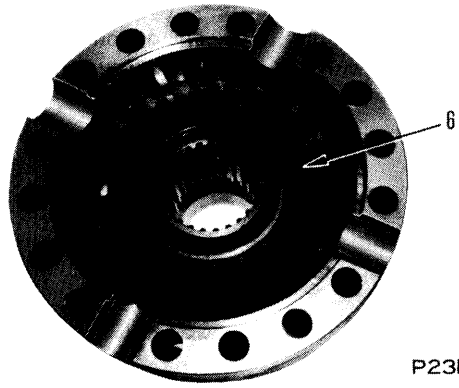
P23BB129

2) Install bushing (8) and thrust washer (7).



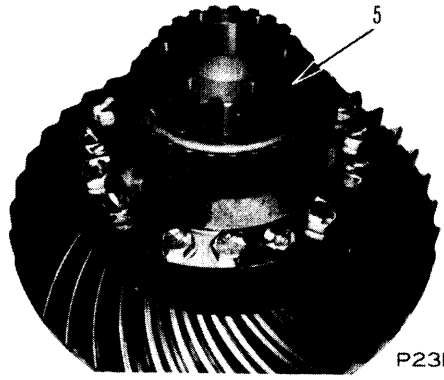
P23BB128

3) Install gear (6).



P23BB127

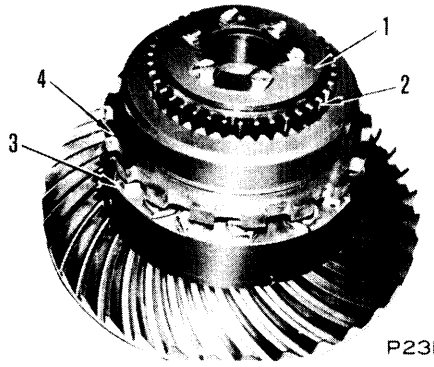
4) Install case and gear assembly (5).
★ Bend lock plate securely.



P23EC179

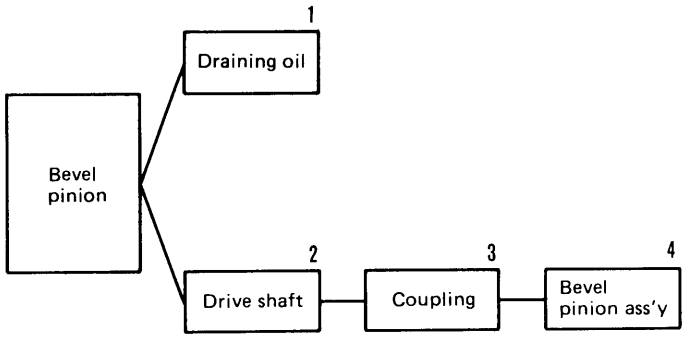
7. **Cage**
Install nut (4) together with cage (3).

8. **Gear**
Install gear (2) and install holder (1).
★ Bend lock plate securely.



P23EC178

REMOVAL OF BEVEL PINION ASSEMBLY

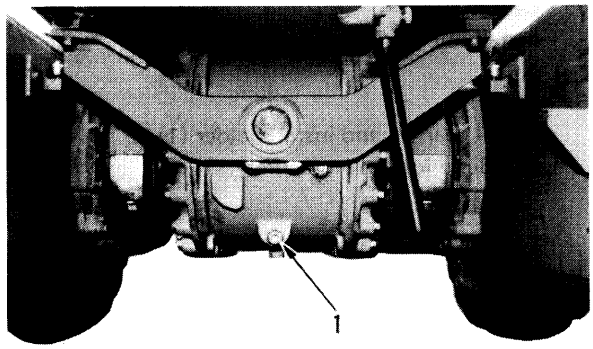


F23B03035

1. **Draining oil**
   Remove drain plug (1) and drain oil from final drive case.

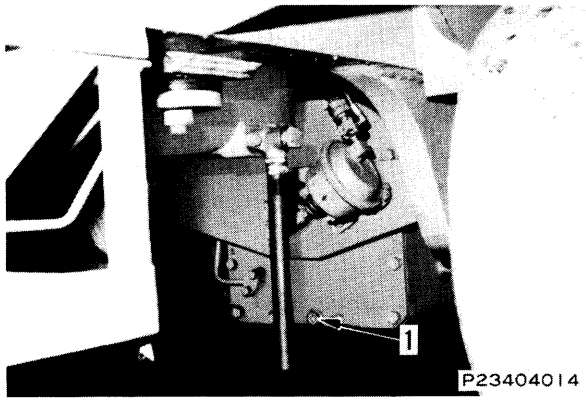
   Final drive case: Approx. 24ℓ GD705R-4
   Approx. 40ℓ GD705A-4

GD705R-4



P23E04058

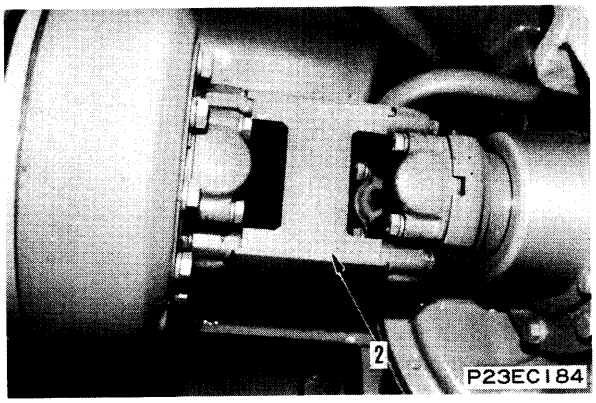
GD705A-4



P23404014

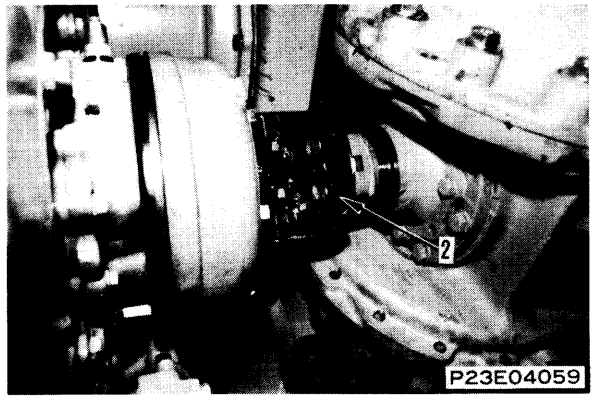
2. **Drive shaft**
   Remove drive shaft (2).

GD705A-4



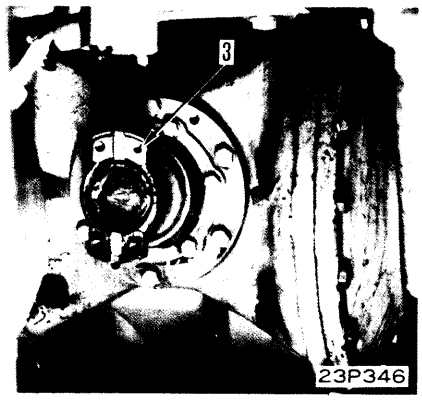
P23EC184

GD705R-4



P23E04059

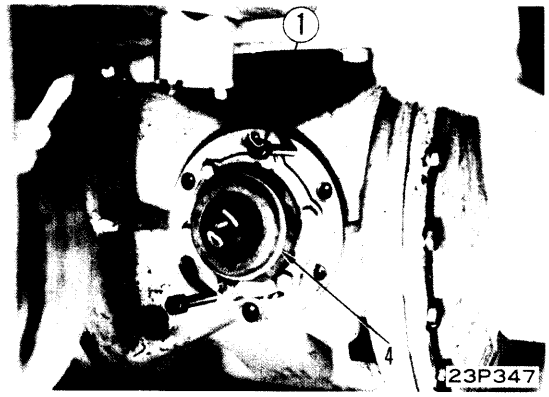
3. **Coupling**
Remove coupling (3).



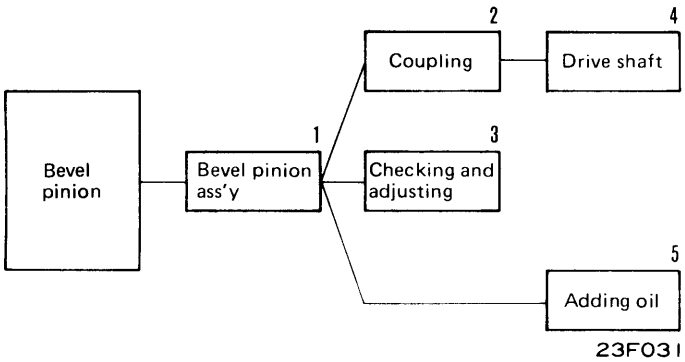
4. **Bevel pinion assembly**
Remove mounting bolt, and using two jack bolts 1 (Thread dia. = 12 mm, Pitch = 1.75 mm, Length = 200 mm) for GD705R-4, (Thread dia. = 14 mm, Pitch = 2.0 mm, Length = 200 mm) for GD705A-4, pull out bevel pinion assembly (4).

kg Bevel pinion assembly: 50 kg (GD705R-4)
60 kg (GD705A-4)

★ Separate the L.H. and R.H. removed shims, and count them for confirmation.



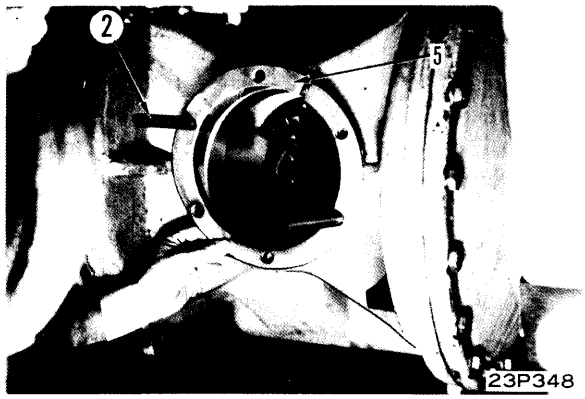
INSTALLATION OF BEVEL PINION ASSEMBLY



23F031

1. Bevel pinion assembly

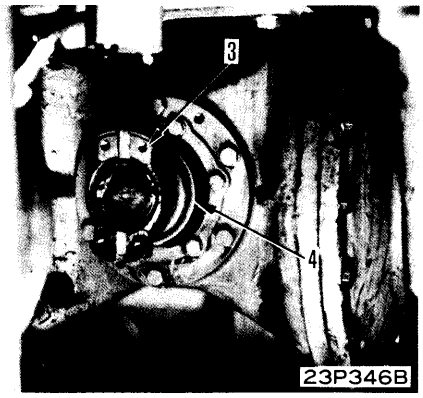
1) Install two guide bolts ② (Thread dia. = 12 mm, Pitch = 1.75 mm, Length = 200 mm) for GD705R-4 (Theread dia. = 14 mm, Pitch = 2.0 mm, Length = 200 mm) for GD705A-4, in bolt holes at final drive side.
2) Install shims (5) for adjusting backlash.
   - ★ Install shims for adjusting of the same thickness as that before removal.
   - ★ Standard shim thickness: 2.0 mm
   - ★ Kinds of shims: t = 1.0 mm, 0.3 mm, 0.1 mm (for GD705R-4)
     t = 0.5 mm, 0.2 mm, 0.1 mm (for GD705A-4)
3) Install bevel pinion assembly (4).



23P348

2. Coupling

Install coupling (3).

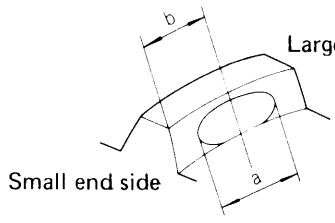


23P346B

3. Checking and adjusting

1) Adjustment of backlash can be accomplished by increasing or decreasing shims (5).
   - ★ Backlash: 0.3 to 0.4 mm
2) Refer to "CHECKING AND ADJUSTING" section in "INSTALLATION OF FINAL DRIVE ASSEMBLY" section for adjusting tooth contact.
   - ★ If adjustment is carried out when bevel pinion is mounted on machine, raise up machine body, place block under case, remove hanger, oil filling port and cover, check and adjust by rotating wheel.

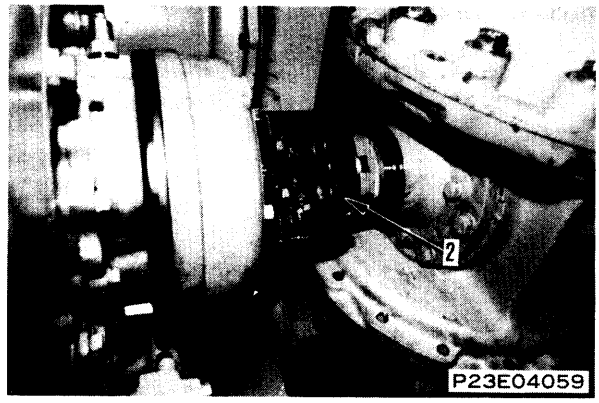
★ Tooth contact a . . . . . Tooth contact width 30 to 50%
b . . . . . Tooth contact center 20 to 40%



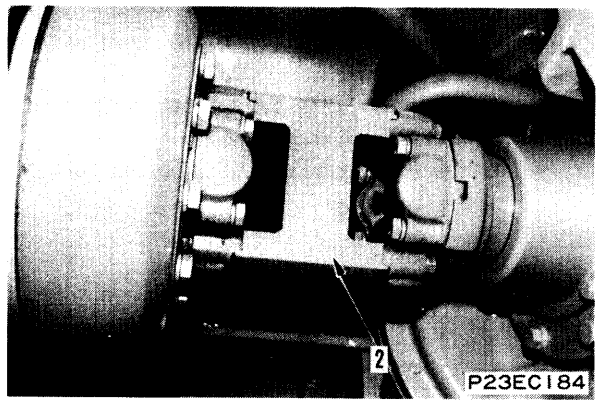
23F032

4. **Drive shaft**
   Install drive shaft (2).

GD705R-4



GD705A-4

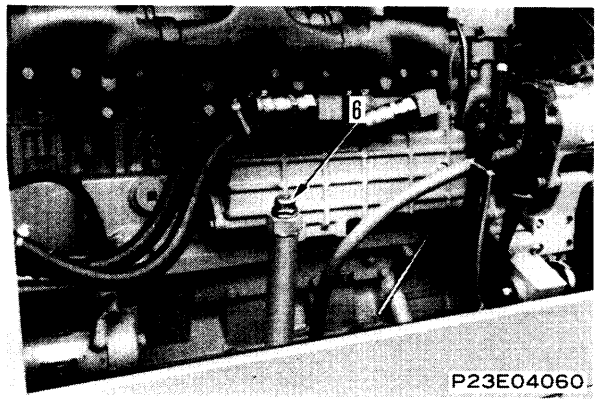


5. **Adding oil**
   Tighten drain plug and add engine oil to specified level through oil filler port (6).

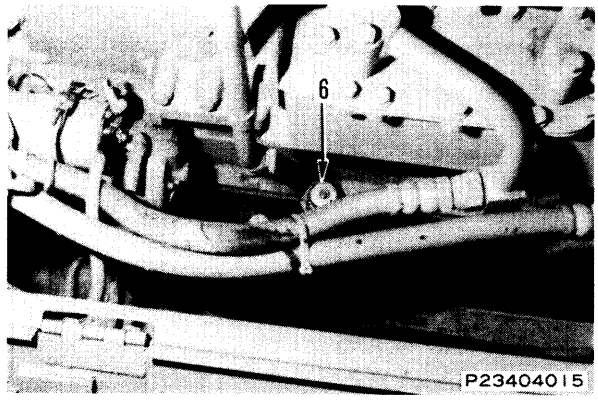
   Final drive case: Approx. 24ℓ (GD705R-4)
   Approx. 40ℓ (GD705A-4)

★ Run the engine to move machine.
Then check the oil level.

GD705R-4

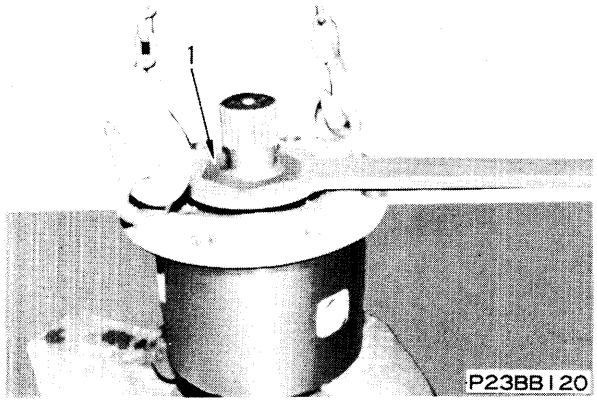


GD705A-4

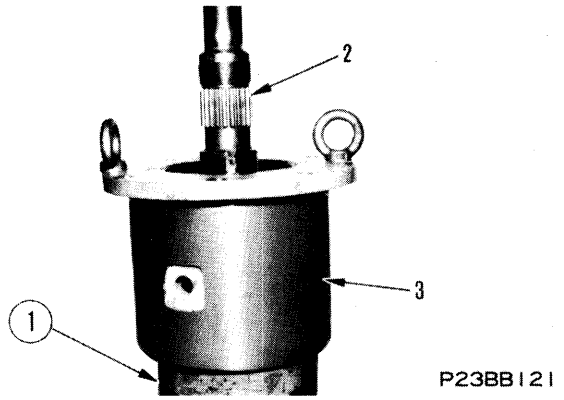


DISASSEMBLY OF BEVEL PINION ASSEMBLY

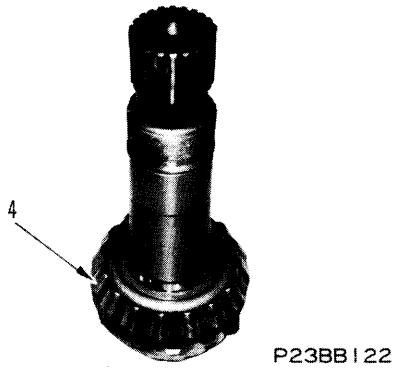
1. **Nut, Lock plate**
   Set bevel pinion assembly in vice and remove nut (1) and lock plate.



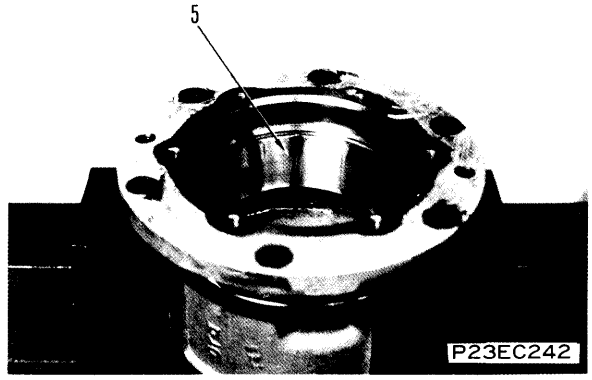
2. **Cage assembly**
   1) Use press-fit tool ① (I.D. ϕ200 mm) and set pinion cage ass'y in press.
   2) Press pinion (2), pull it out from cage (3) to separate pinion and cage.
   ★ It is possible to remove bearing and pull out pinion at the same time.



3. **Pinion side bearing**
   Use a bearing separator, pull out bearing (4).



4. **Bearing outer race**
   Remove outer races (5) (upper and lower: 2 pcs).



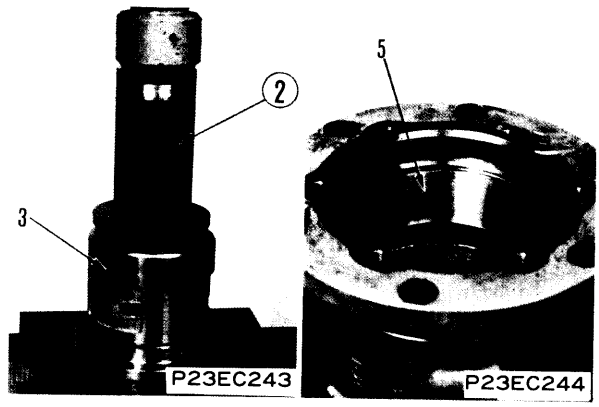
ASSEMBLY OF BEVEL PINION ASSEMBLY

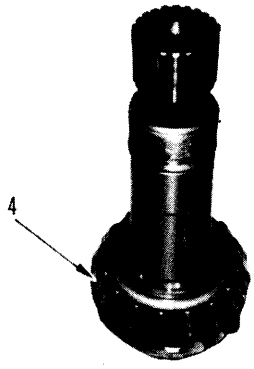
1. **Bearing outer race**
   Using press-fit tool ②, press-fit outer races (5) (Upper and lower: 2 pcs) in cage (3).

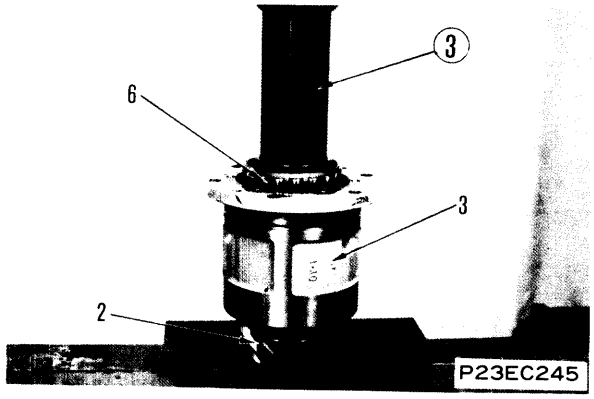
2. **Pinion side bearing**
   Use press-fit tool to press fit bearing (4).

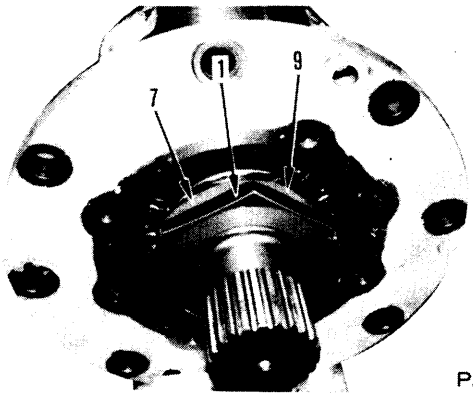
3. **Cage assembly**
   1) Put pinion assembly (2) on the press table and install cage assembly (3).
   2) Use press-fit tool ③ and press-fit bearing (6).
      ★ Press-fit the bearing while rotating the cage. Stop rotating the cage when a little heaviness in felt.

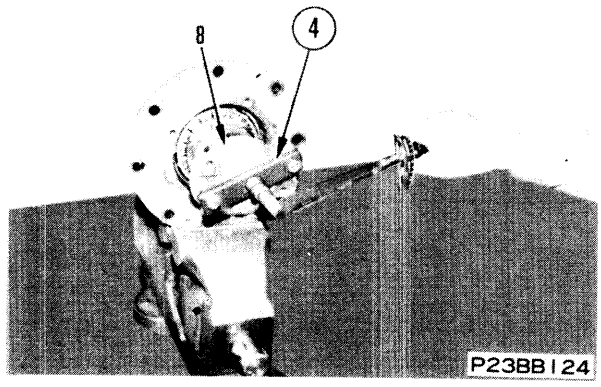
4. **Starting torque adjustment**
   1) Set the pinion cage assembly in a vice and install nut (7).
   2) Tighten nut (7), install tool ④ on coupling (8) and measure starting torque.
      ★ Starting torque: **5.0 to 6.0 kgm**
   3) Loosen nut (7) and set starting torque at 0.5 to 0.8 kgm.
      ★ Nut must not securely be completely loose.
   4) Install lock plate (9), lock nut (1), measurement are shown in item 2 above.
      ★ Tightening torque for lock nut: 40 ± 10 kgm
      ★ Starting torque: 1.2 to 1.6 kgm
   5) Bend lock plate securely.





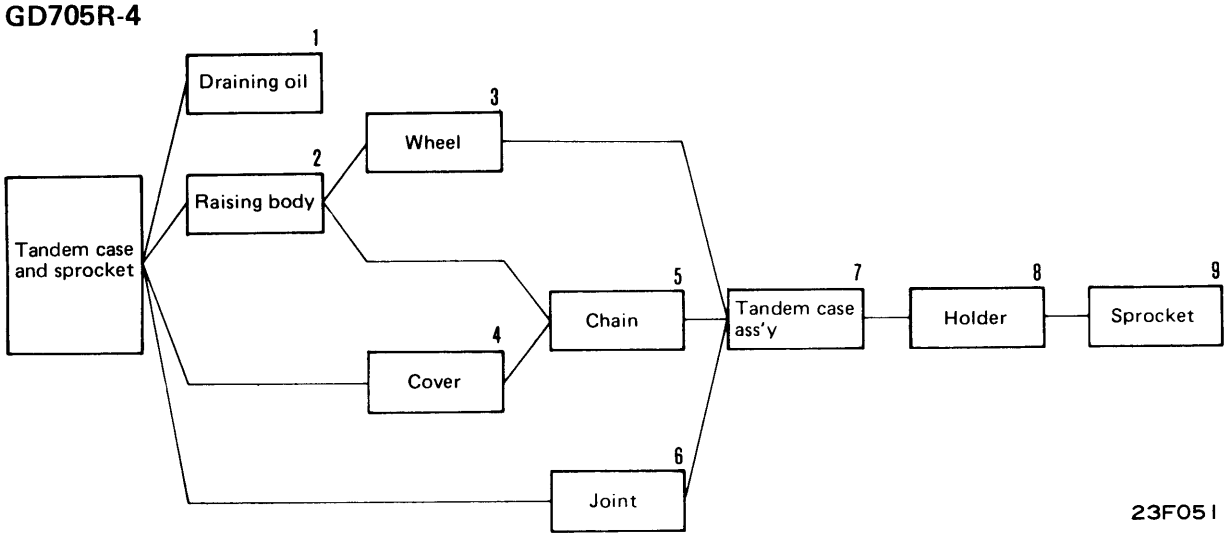






REMOVAL OF TANDEM CASE AND SPROCKET

GD705R-4



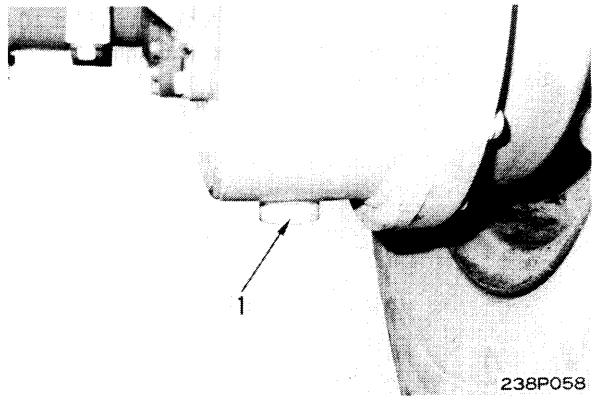
Special tool

	Part number	Part name	Q'ty
A	792-571-1600	Chain puller	1

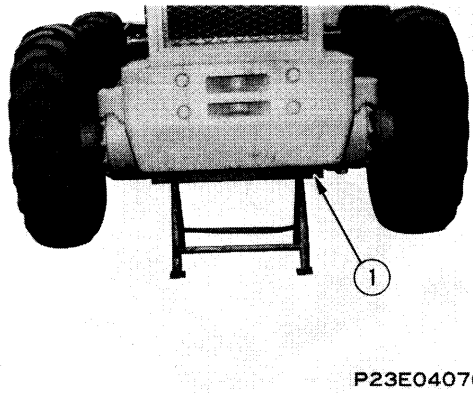
PREPARATORY WORK

- Loosen rear wheel mounting nuts before raising up body.

1. **Draining oil**
   Remove drain plug (1) to drain oil from tandem case.
   Tandem case (one side only): Approx. 36ℓ

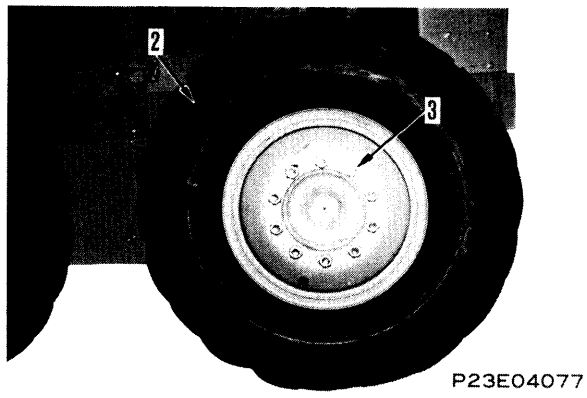


2. **Raising up body**
   Sling body and place block ① under frame to support body.

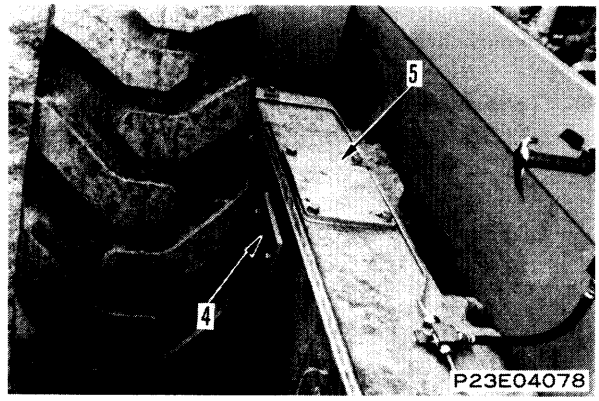


3. **Wheel**
Temporarily sling rear wheels (2), remove nuts (3) and remove front and rear wheels.

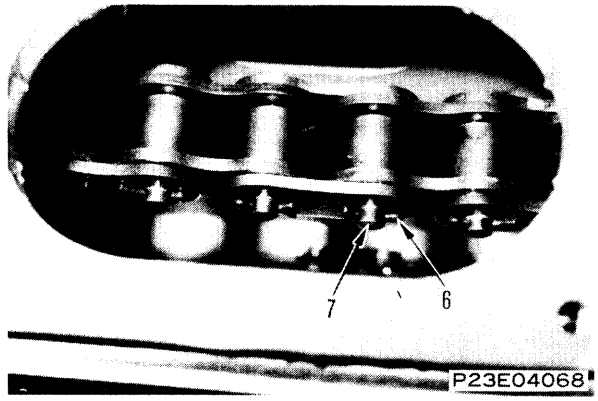
kg Wheel (one): Approx. 160 kg



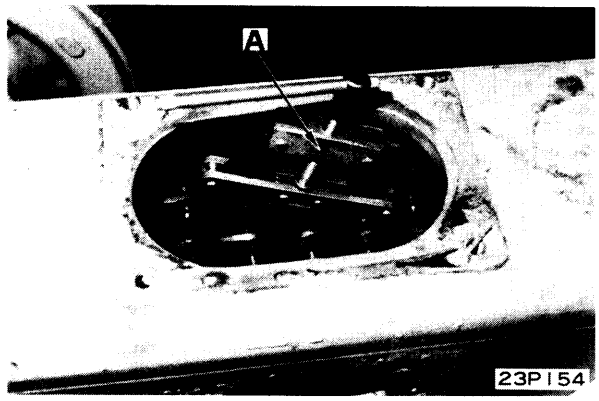
4. **Cover**
Dismount front and rear covers (5) (two covers) and right, front and rear covers (4) (four covers).



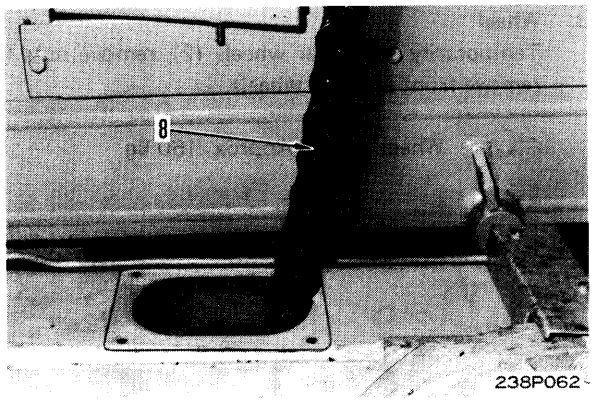
5. **Chain**
1) Rotate the drum to bring the connecting part of the chain into line with the inspection window.



2) Set tool **A** and tighten the chain, then remove lock pin (6) and pin (7).



3) Remove front and rear chains (8).



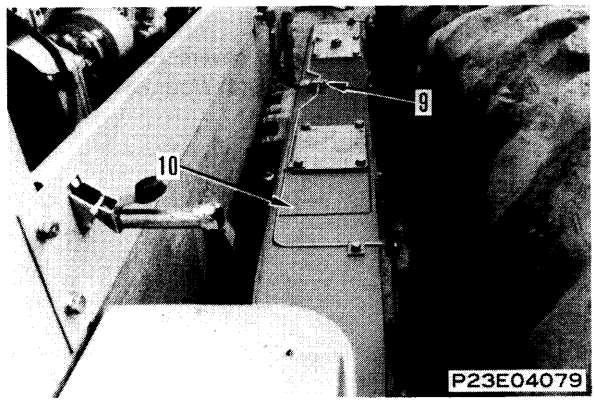
6. Joint
Remove brake piping joint (9).

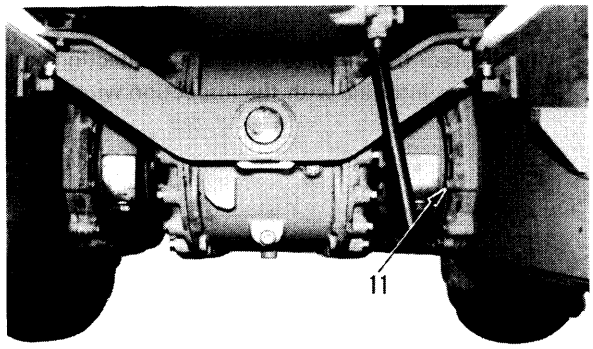
7. Tandem case assembly
1) Temporarily suspend tandem case ass'y (10).

2) Remove mounting bolts (11) and dismount the tandem case ass'y.

kg Tandem case ass'y: Approx. 920 kg

★ When dismounting the tandem case ass'y, be careful to maintain it in a balanced configuration in order to avoid damaging the contact face of the case O-ring.
★ When replacing the sprocket alone, it is possible to do this by dismounting the wheel tandem ass'y without removing the wheel.

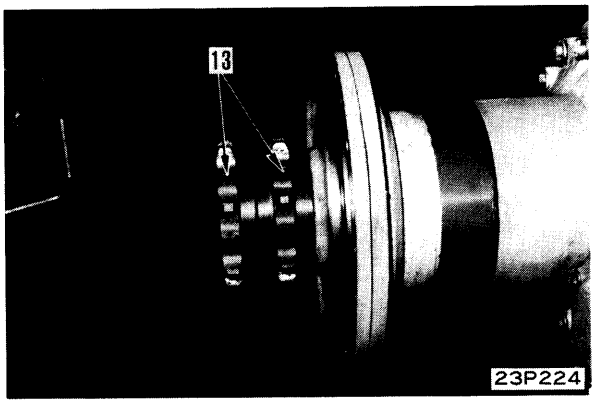


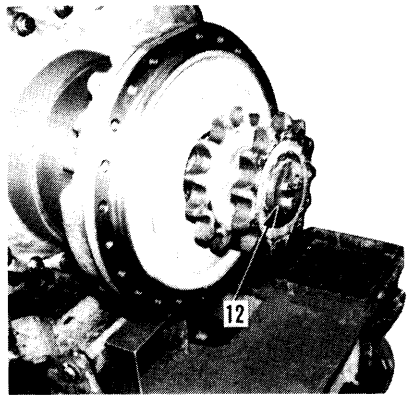


P23E04080

8. Holder
Remove shaft end holder (12).

9. Sprocket
Remove sprocket (13).

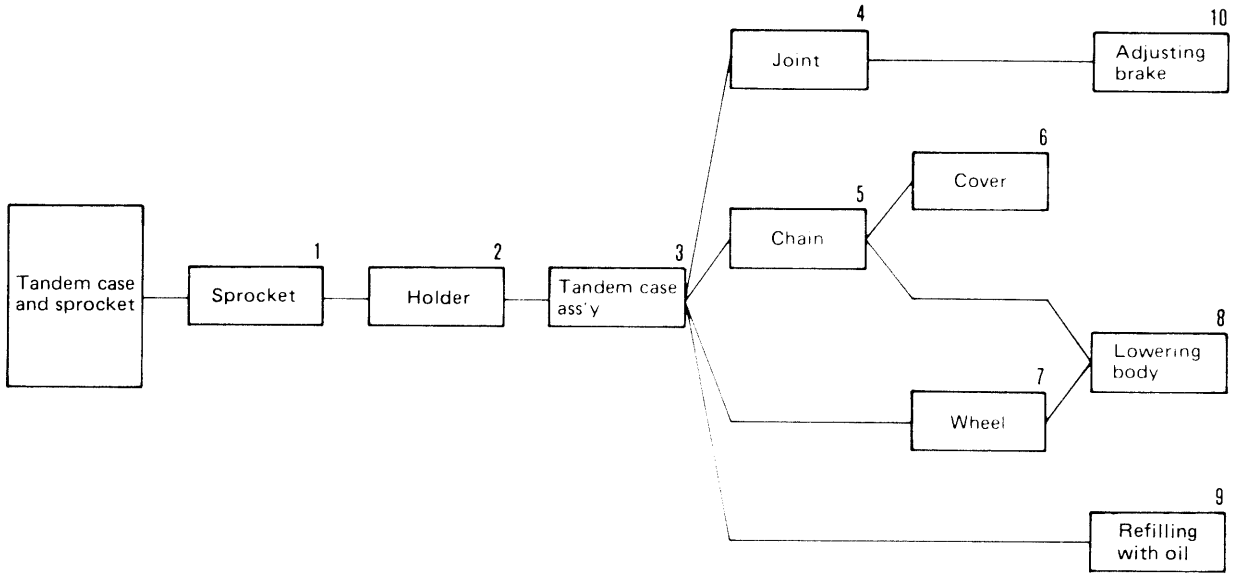




P23BB218

INSTALLATION OF TANDEM CASE AND SPROCKET

GD705R-4

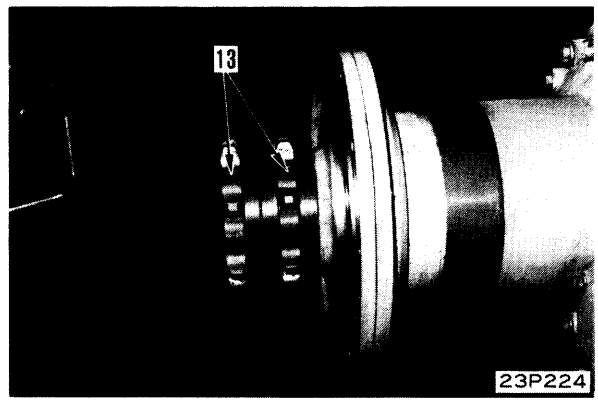


23F052

Special tool

	Part number	Part name	Q'ty
A	792-571-1600	Chain puller	1

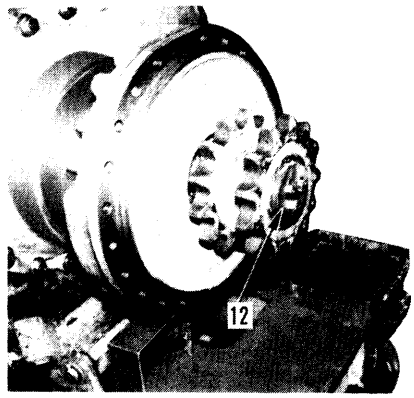
1. **Sprocket**
   Install sprocket (13) on shaft.
   ★ Install sprockets with their boss sides faced inside.



23P224

2. **Holder**
   Install holder (12).
   ★ Bend down lock plate securely.

   kgm Mounting bolt: 9 kgm

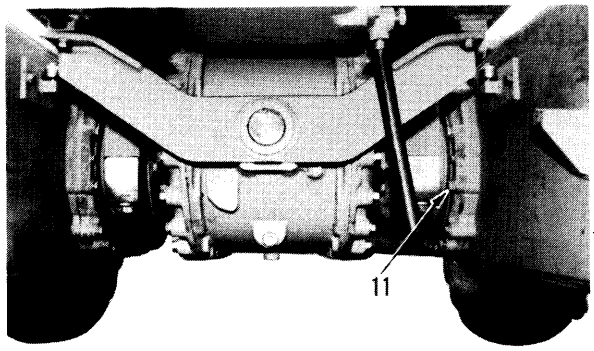


P23BB218

3. **Tandem case ass'y**
   1) Fit O-ring to the joint.
   2) Suspend tandem case ass'y (10) and mount it on the final side joint.
   3) Tighten mounting bolts (11).

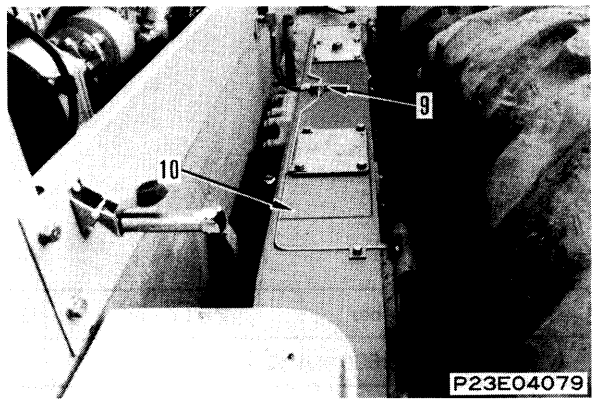
      Bolts: Gasket sealant (LG-1)

      kgm Mounting bolt: 23.5 kgm

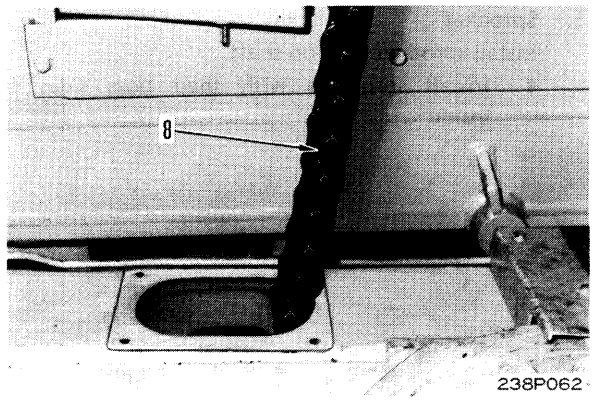


P23E04080

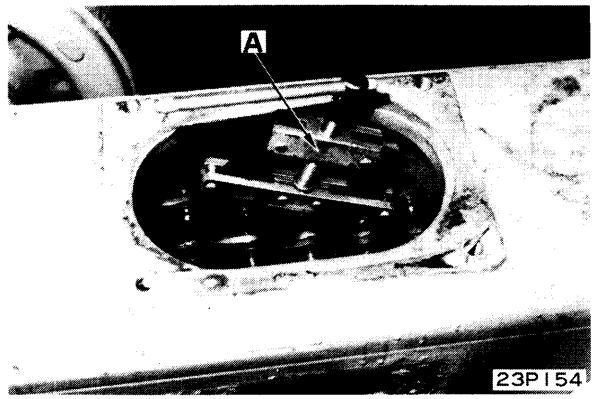
4. **Joint**
   Mount brake piping joint (9).



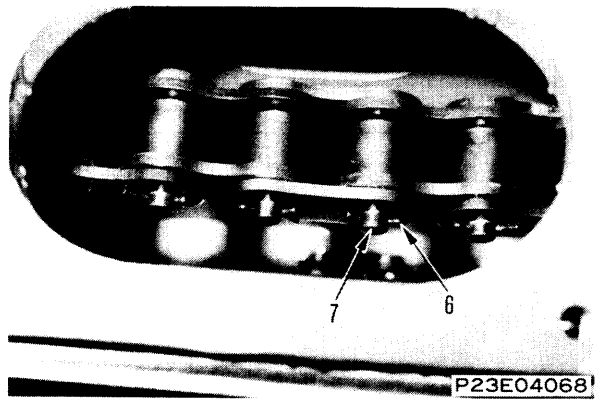
5. **Chain**
   1) Fit chain (8) to the sprocket while rotating the drum.
      ★ It is relatively easy to fit the chain from the driven side sprocket.
      ★ Fit the chain towards the inside at the front of the machine and towards the outside at the rear of the machine.



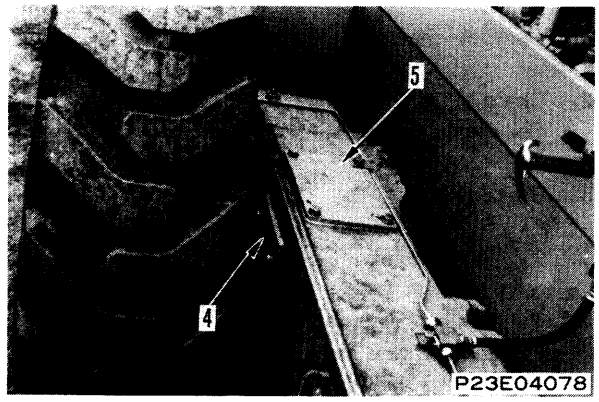
   2) Using tool **A**, connect the chain and align it with the pin.



3) Fit pin (7) and bend lock pin (6).
★ Bend lock pin securely.



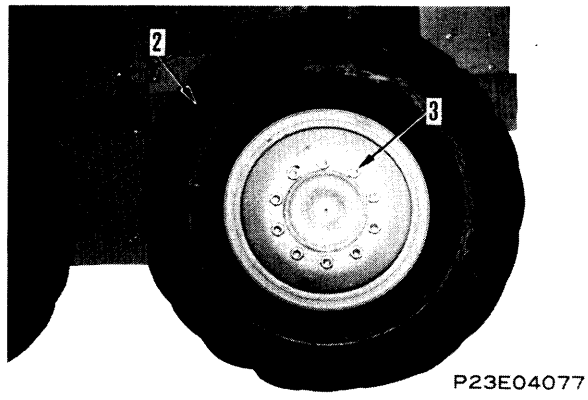
6. Cover
Install covers (5) (two covers) front and rear and covers (4) (four covers) front, rear, left and right.



7. Wheel
Suspend wheel (2), then mount the hub and tighten nuts (3).

kgm Nut: 50 ± 5 kgm

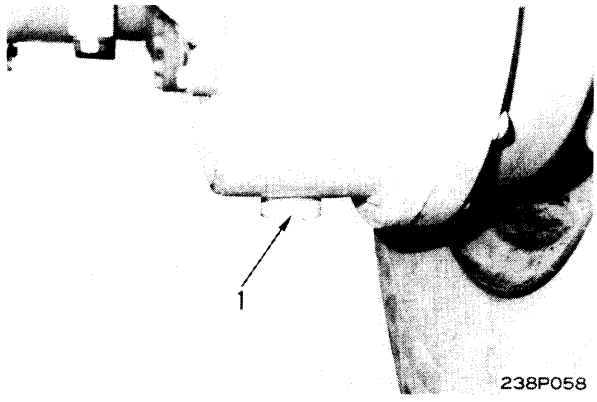
★ It is relatively easy to tighten the nuts after lowering the machine body.



8. Lowering machine body
Lift the machine body and remove support.

9. Refilling with oil
Tighten drain plug (1) and pour in engine oil from the oil filler to the specified level.

Tandem case (one side): 36ℓ



REMOVAL OF SPROCKET ASSEMBLY

GD705A-4

Special tool

	Part number	Part name	Q'ty
A	790-102-1921	Nut wrench kit	1

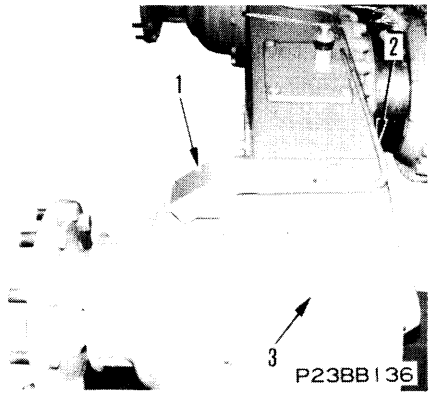
1. **Wheel**
   Remove wheel.

2. **Chain**
   For detail, see 23 REMOVAL OF CHAIN.

3. **Brake tube**
   1) Remove cover (1).
   2) Remove tube (2).

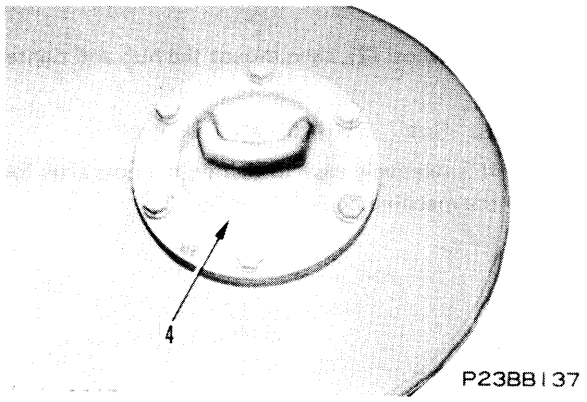
4. **Tandem case assembly**
   Lift tandem case assembly (3) and remove it.

   kg Tandem case assembly: Approx. 1030 kg



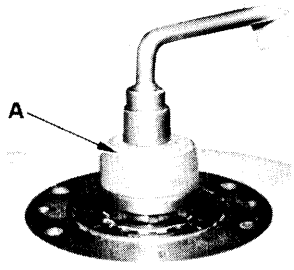
P23BB136

5. **Tandem stopper**
   Remove tandem stopper (4).

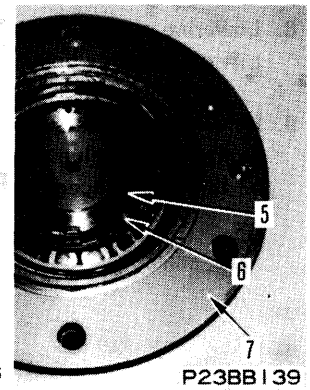


P23BB137

6. **Cage**
   1) Using tool **A**, remove nut (5) and washer (6).
   2) Screw in jack bolt (Thread dia. = 16 mm, Pitch = 2.0 mm) and remove cage (7).



P23BB138

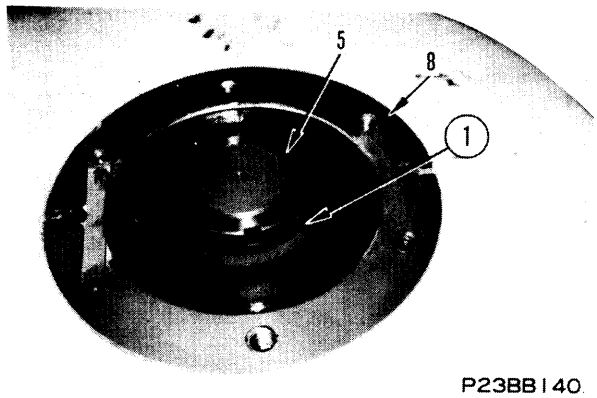


P23BB139

★ Insert collar ① (ϕ95) and temporarily tighten nut (5) so that the sprocket does not slip out.

7. Shim

Remove shim assembly (8).

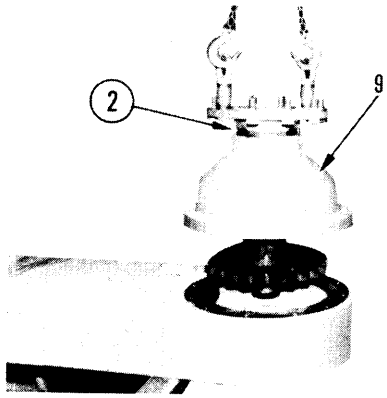


P23BB140

8. Wheel brake and sprocket assembly

1) Fix cage and shaft with guide bolt ② (Thread dia. = 10 mm, Pitch = 1.5 mm, Length = 5 mm).
2) Lift wheel brake and sprocket assembly (9) and remove it.

kg Wheel brake and sprocket assembly: Approx. 300 kg



P23BB141

INSTALLATION OF SPROCKET ASSEMBLY

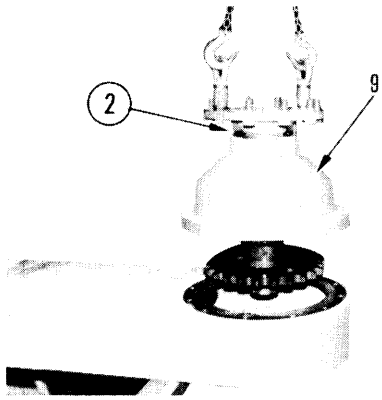
GD705A-4

Special tool

	Part number	Part name	Q'ty
A	790-102-1921	Nut wrench kit	1

1. Wheel brake and sprocket assembly

1) Fix O-ring to support of wheel brake assembly.
   - O-ring: Grease (G2-LI)
2) Lift wheel brake and sprocket assembly (9) and install it on tandem case.
   - Mounting bolt: Liquid gasket (LG-1)
   - kgm Mounting bolt: 23.5 ± 8 kgm
3) Remove guide bolt ②.



P23BB141

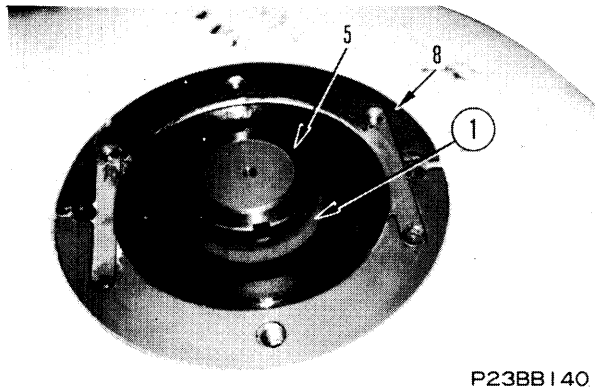
2. Shim

Install shim assembly (8).

3. Cage

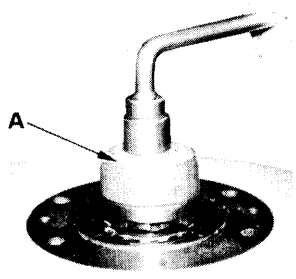
★ Remove nut (5) and remove collar ①.

1) Press-fit bearing in cage (7).

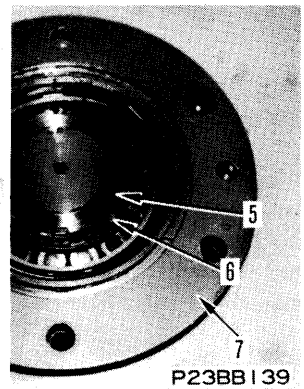


P23BB140

2) Fix O-ring (2 points) and install cage assembly (7).
   - O-ring: Grease (G2-LI)
3) Using tool **A**, install washer (6) and tighten nut (5).
   - kgm Nut: 30 ± 3 kgm

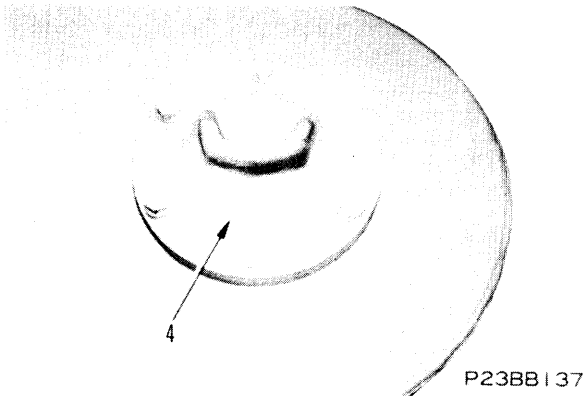


P23BB138



P23BB139

4. **Tandem stopper**
   Install tandem stopper (4).



5. **Tandem case assembly**
   Fix O-ring to final drive case side, lift tandem case assembly (3), and install it.

6. **Brake tube**
   1) Install tube (2).
   2) Install cover (1).

7. **Chain**
   For detail, see 23 INSTALLATION OF CHAIN.

8. **Wheel**
   Install wheel.

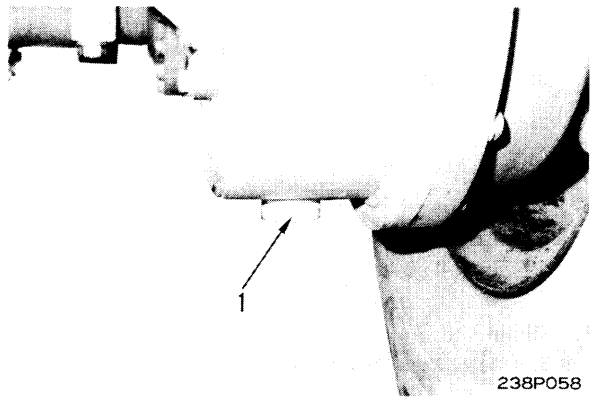
REMOVAL OF CHAIN

Special tool

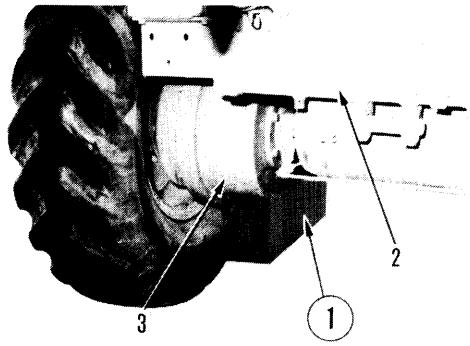
	Part number	Part name	Q'ty
A	792-571-1600	Chain puller	1

1. Remove drain plug (1) and drain tandem case oil.

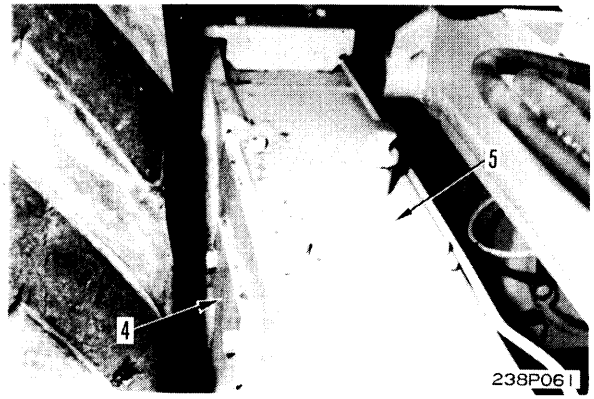
   Tandem case (each): Approx. 36ℓ GD705R-4
   Approx. 105ℓ GD705A-4



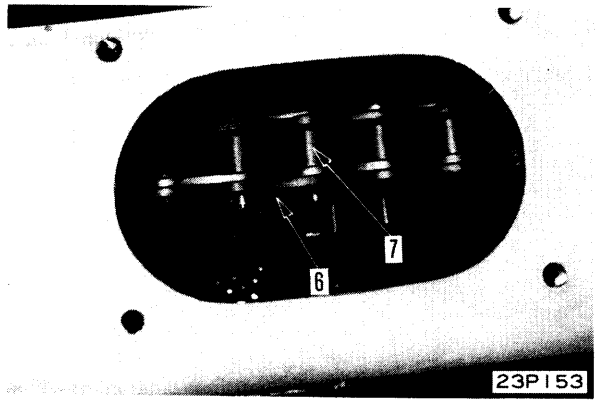
2. Lift chassis (2) and place it on block ① (Height: approx. 400 mm) under tandem case (3).



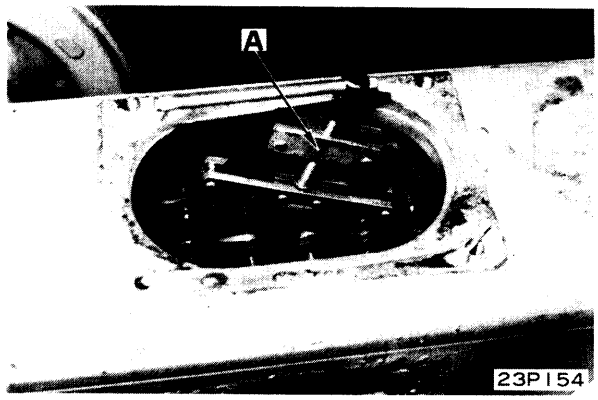
3. Remove covers (5) (Front and Rear: 2 pcs) and covers (4) (L.H., R.H., Front, Rear = 4pcs).



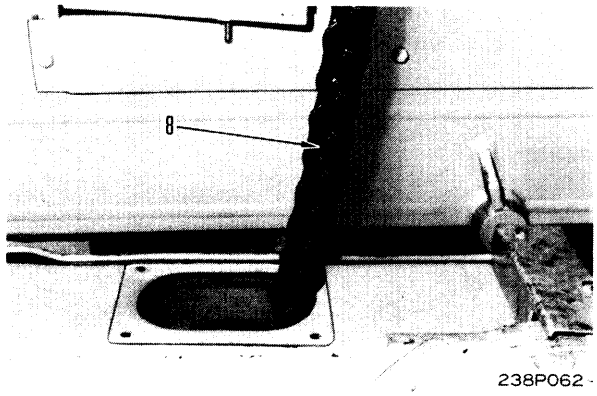
4. **Chain**
   1) Rotating wheel, align the chain connection part and check hole.



   2) Using tool **A**, pull the chain end, remove lock pin (6), and pull out pin (7).



   3) Remove front and rear chains (8).

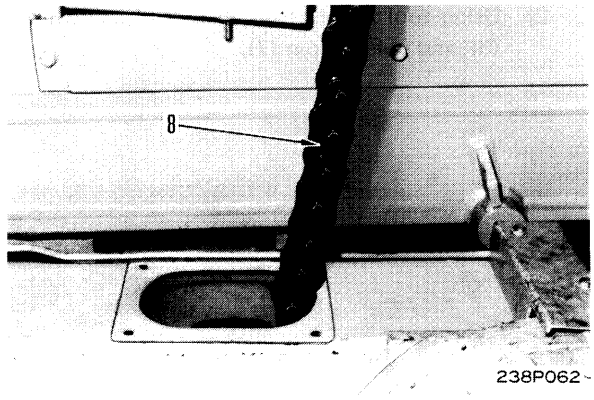


INSTALLATION OF CHAIN

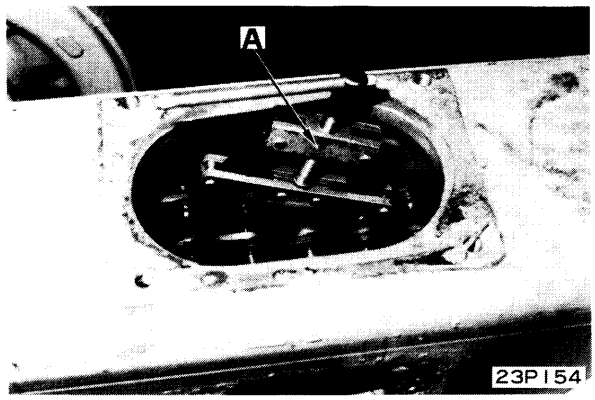
Special tool

	Part number	Part name	Q'ty
A	792-571-1600	Chain puller	1

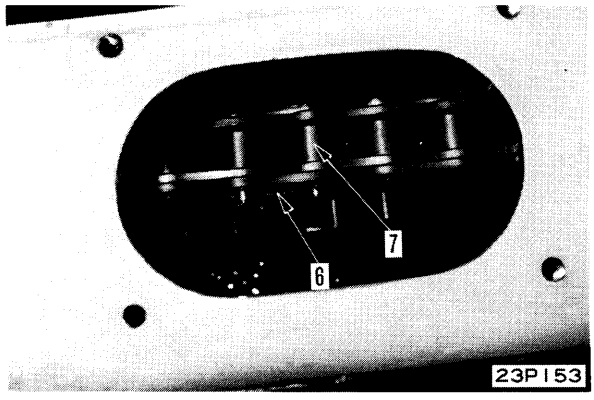
1. **Chain**
   1) Hang chain (8) on sprocket, and install it while rotating the wheel.
      ★ The chain is much easier to connect from the driven sprocket side.
      ★ Install the chain to the inside of the machine at the front and to the outside of the machine at the rear.



   2) Using tool **A**, connect the ends of the chain and align with pin hole.

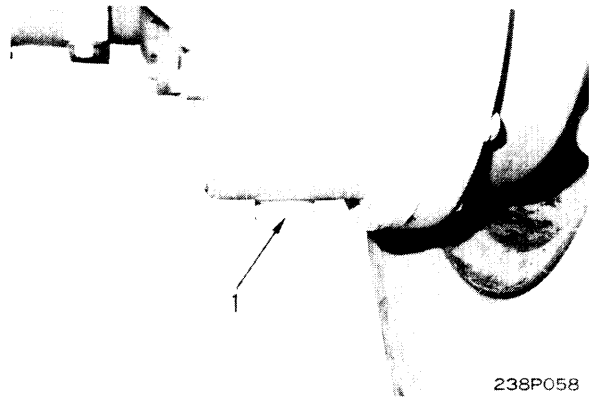


   3) Insert connection pin (7) and install lock pin (6).



2. Tighten drain plug (1). Add engine oil through cover mounting hole.

   Tandem case (each): Approx. 36ℓ GD705R-4
   Approx. 105ℓ GD705A-4

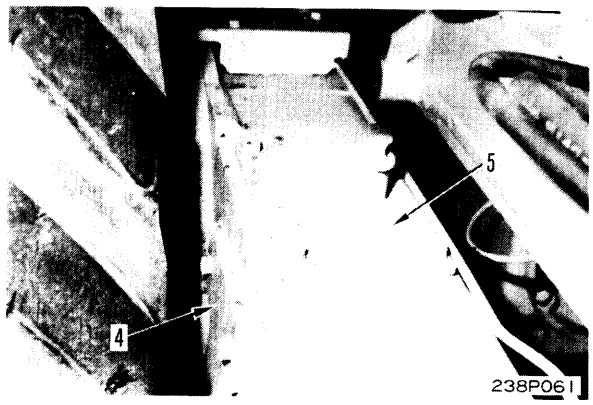


238P058

3. **Cover**
   Attatch gasket and install covers (4), (5).

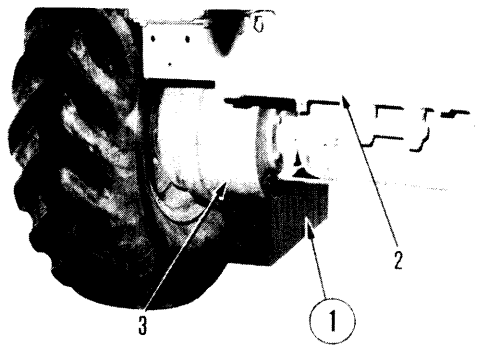
   Bolt and case: Liquid gasket (LG-1)

   ★ Apply liquid gasket to the case side.



238P061

4. Lift the chassis (2) and pull out block ① from tandem case (3).



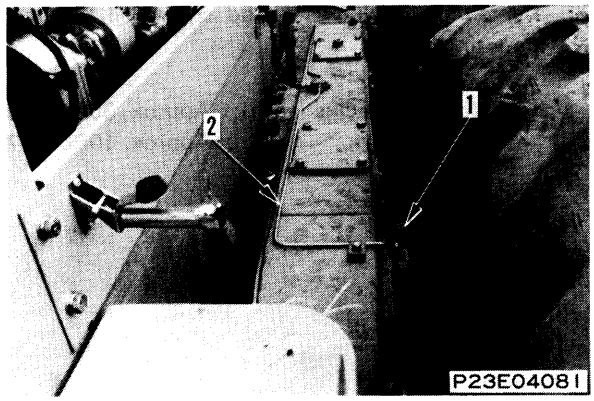
238P065

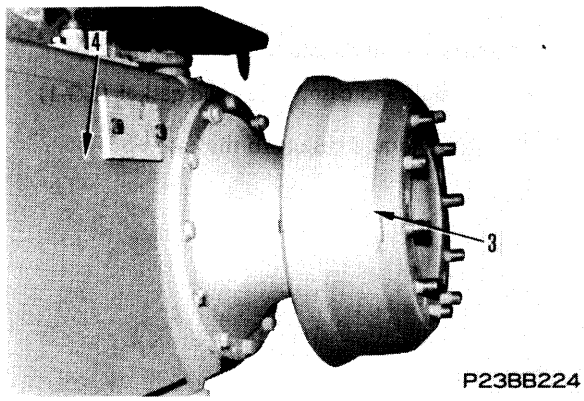
REMOVAL OF WHEEL BRAKE AND SPROCKET ASSEMBLY

GD705R-4

1. Remove wheel. For details, see "REMOVAL OF TANDEM AND FINAL DRIVE".
2. Remove chain. For details, see "REMOVAL OF CHAIN".
3. Remove cover (1) and disconnect brake tube (2).
4. Raise wheel brake (3) and sprocket assembly with crane and remove bolt.
5. Screw in jack bolt and dismount wheel brake and sprocket assembly.

   kg Wheel brake and sprocket assembly: 220 kg





INSTALLATION OF WHEEL BRAKE AND SPROCKET ASSEMBLY

GD705R-4

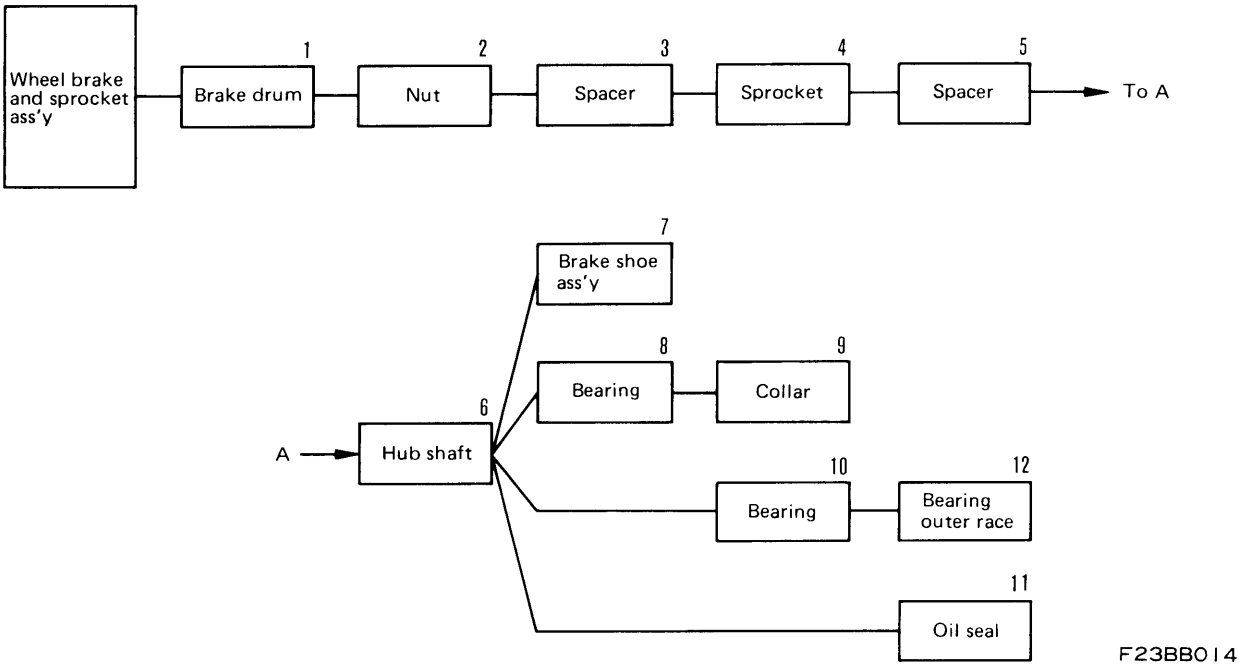
1. Fit O-ring, raise wheel brake and sprocket assembly (3) with a crane and mount the assembly on tandem case (4).

   Mounting bolt: Liquid gasket (LG-1)

   kgm Mounting bolt: 23.5 ± 7.5 kgm
2. Connect brake tube (2) and install cover (1).
3. Install chain. For details, see "INSTALLATION OF CHAIN".
4. Install wheel. For details, see "INSTALLATION OF TANDEM CASE ASSEMBLY AND SPROCKET".
5. Adjust wheel brake. For details, see "TESTING AND ADJUSTING OF BRAKE".

DISASSEMBLY OF WHEEL BRAKE AND SPROCKET ASSEMBLY

GD705R-4



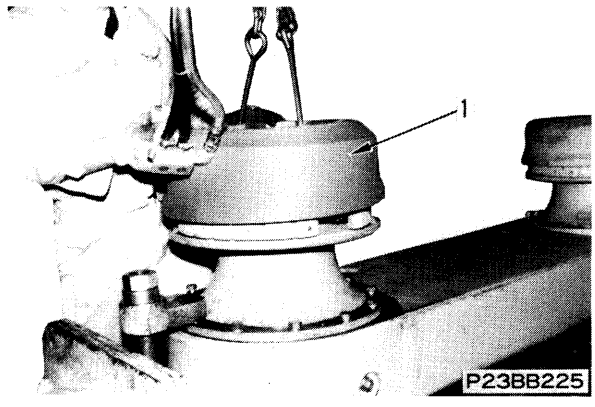
Special tool

	Part number	Part name	Q'ty
A	790-102-1921	Nut wrench	1

1. Brake drum

Raise brake drum (1) with a crane and remove it.

kg Brake drum: Approx. 42 kg



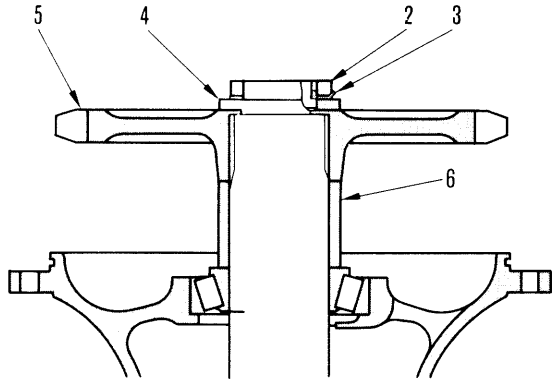
2. **Nut**
   1) Using tool **A**, remove nut (2).
   2) Remove washer (3).

3. **Spacer**
   Remove spacers (4).

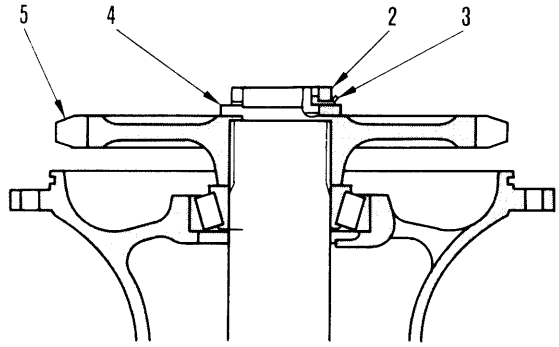
4. **Sprocket**
   Remove sprocket (5).

5. **Spacer**
   Remove spacer (6).

Front side assembly

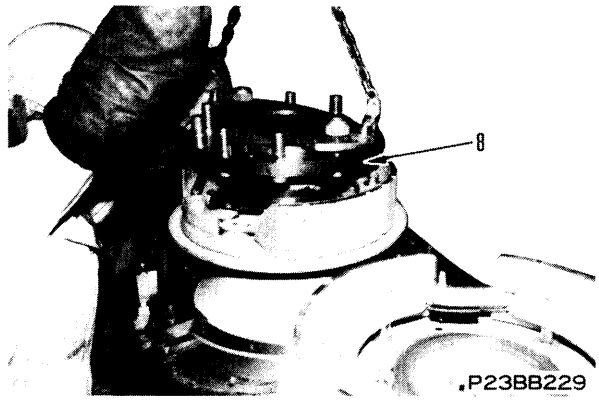


Rear side assembly



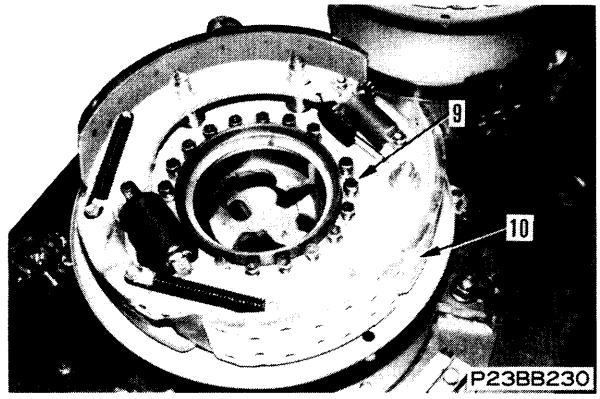
6. **Hub shaft**
   Raise hub shaft (8) with a crane and remove it.

   kg Hub shaft assembly: 65 kg



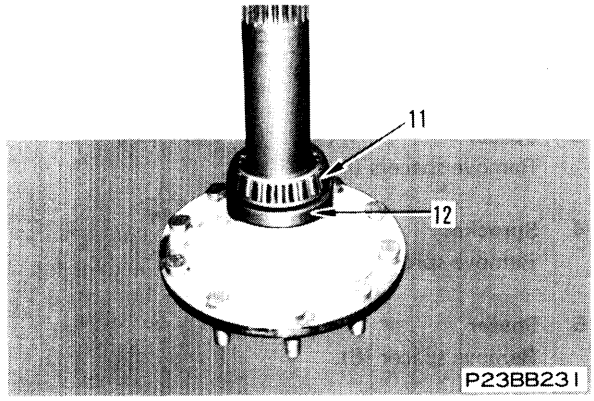
7. **Brake shoe assembly**
   Remove mounting bolt (9) and remove brake shoe assembly (10).

   kg Brake shoe assembly: 27 kg



8. Bearing
Pull out bearing (11).

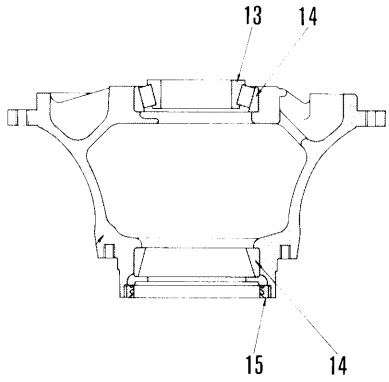
9. Collar
Remove collar (12).



10. Bearing
Remove bearing (13).

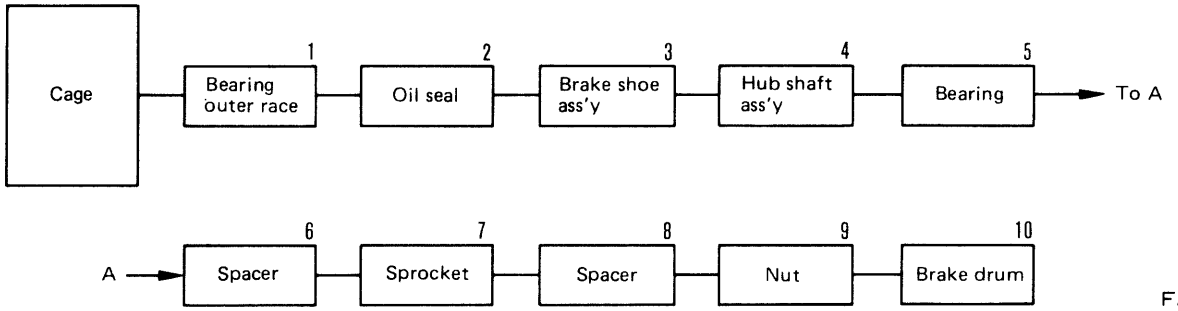
11. Oil seal
Remove oil seal (15).

12. Bearing outer race
Remove bearing outer race (14).



ASSEMBLY OF WHEEL BRAKE AND SPROCKET ASSEMBLY

GD705R-4



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Special tool

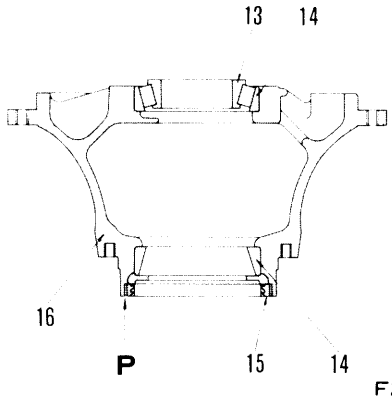
	Part number	Part name	Q'ty
A	790-102-1921	Nut wrench	1

1. Bearing outer race

Press-fit outer race (14).

2. Oil seal

1) Add grease (G2-LI) to **P** of cage.
2) Using a push tool (dia. 180 mm), press-fit oil seal (15).



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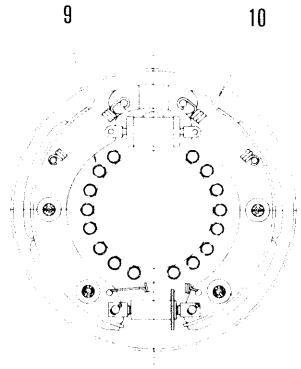
3. Brake shoe assembly

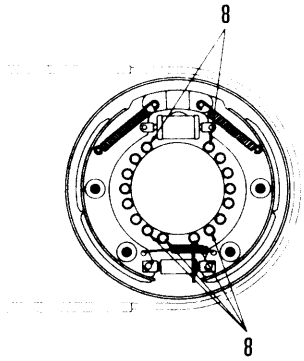
Mount brake shoe assembly (10), install mounting bolt (9).

kgm Mounting bolt (8): 11.25 ± 1.25 kgm

kgm Mounting bolt (9): 6.75 ± 0.75 kgm



F23BB016



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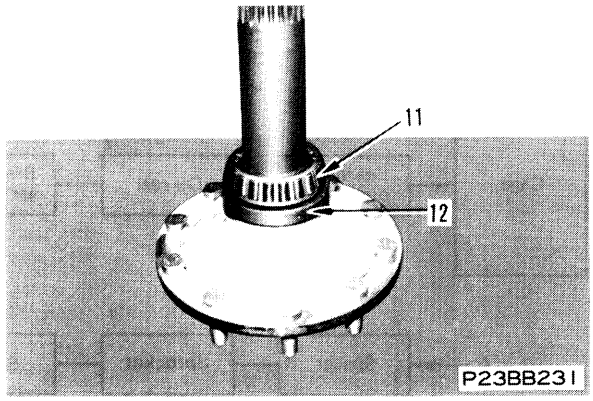
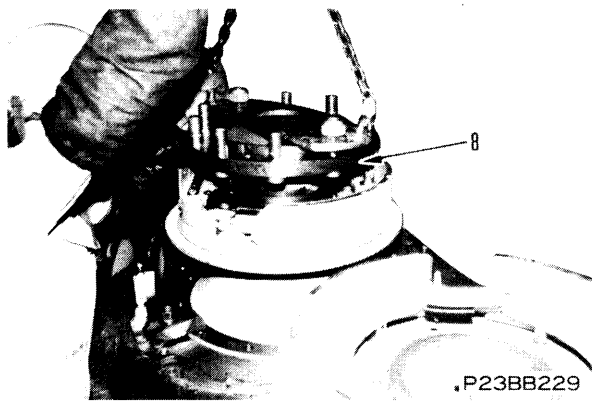
4. Hub shaft assembly

1) Install collar (12).

2) Press-fit bearing (11).

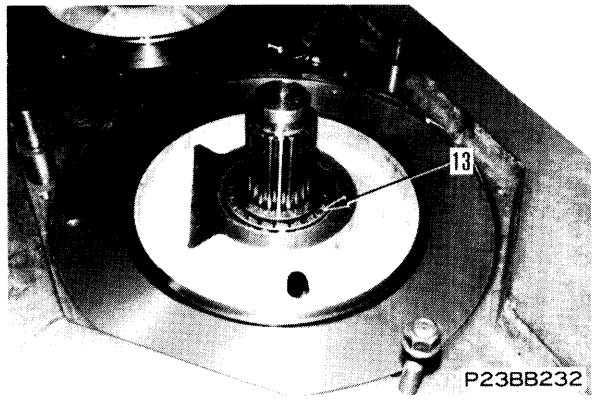


3) Raise hub shaft assembly (8) with a crane and install it.



5. Bearing

Press-fit bearing (13).



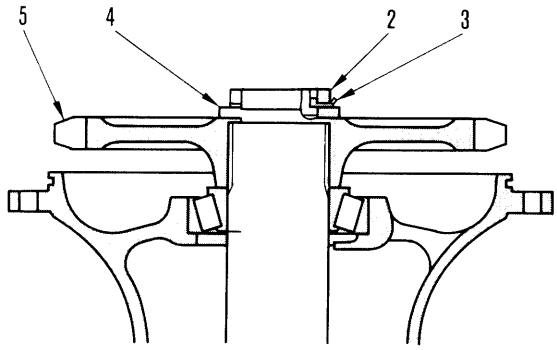
6. Spacer
Install spacer (6).

7. Sprocket
Install sprocket (5).

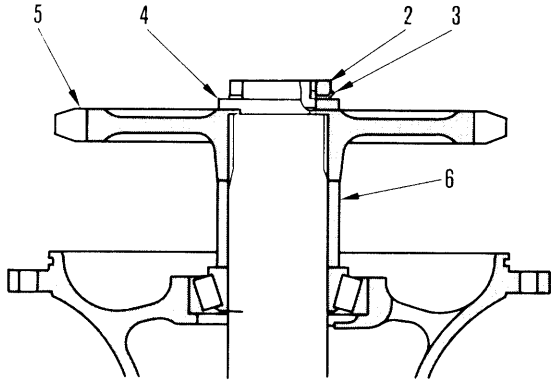
8. Spacer
Install spacers (4).

9. Nut
1) Install lock washer (3).
2) Tighten nut (2), using push-pull scale, measure starting torque.
   ★ Starting torque: 2.25 ± 0.25 kgm
   ★ Bend cotter pin securely.

Front side assembly



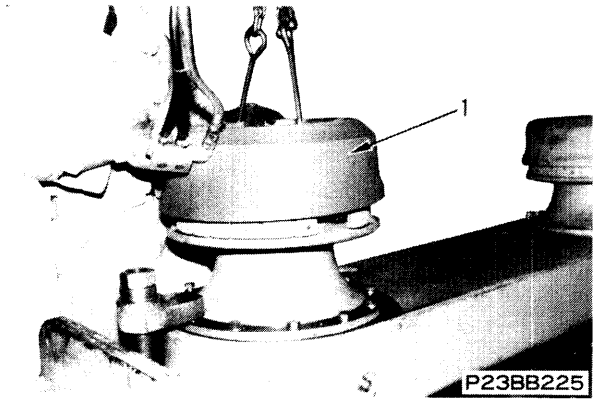
Rear side assembly



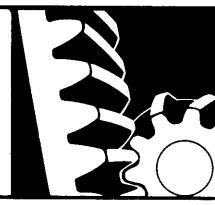
10. Brake drum
Raise brake drum (1) with a crane and install it.

Mounting bolt: Thread tightener (LT-2)

kgm Mounting bolt: 0.01 – 0.5 kgm

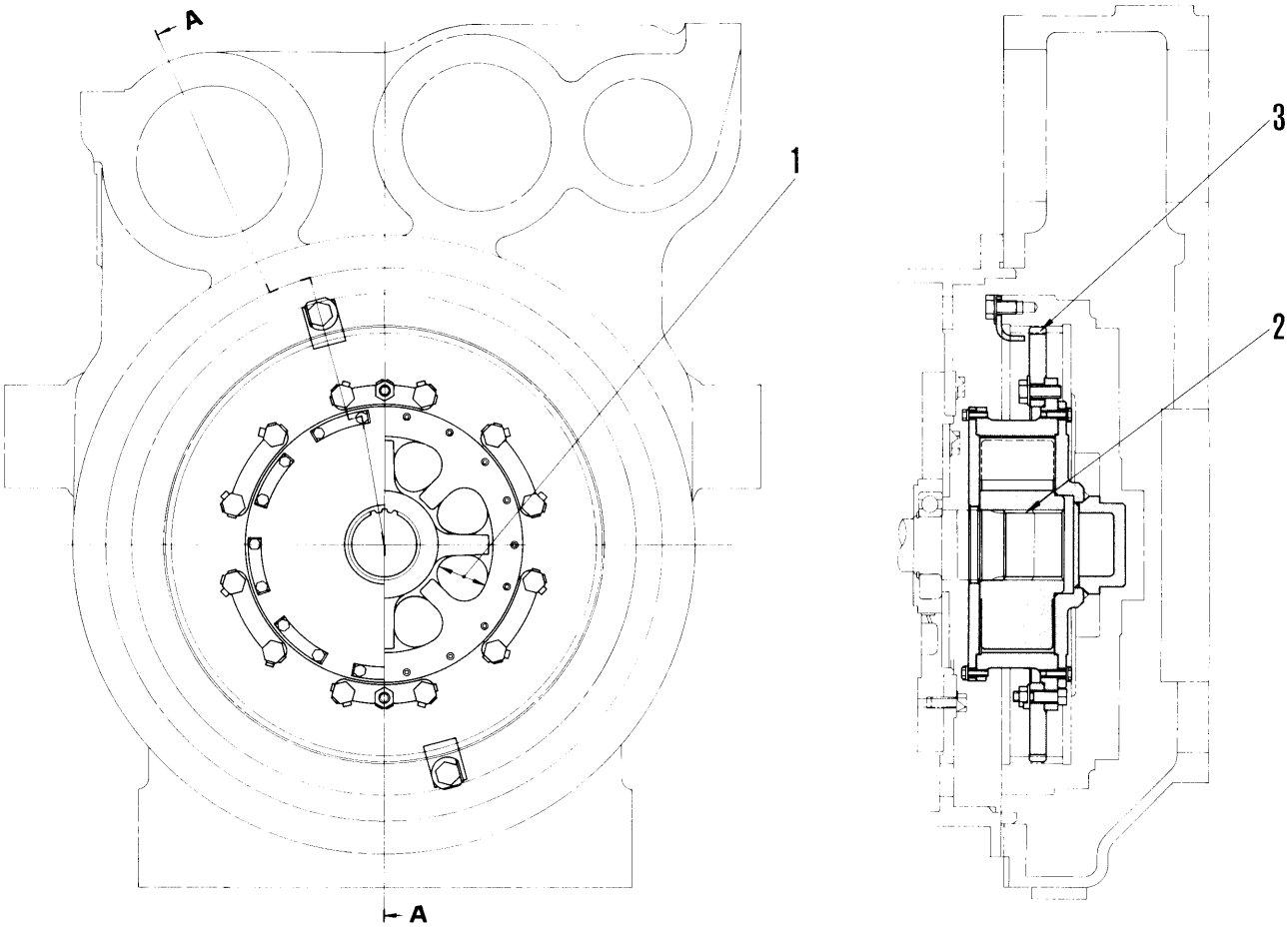


POWER TRAIN
24 MAINTENANCE STANDARD



DAMPER

GD705R-4



Section A–A

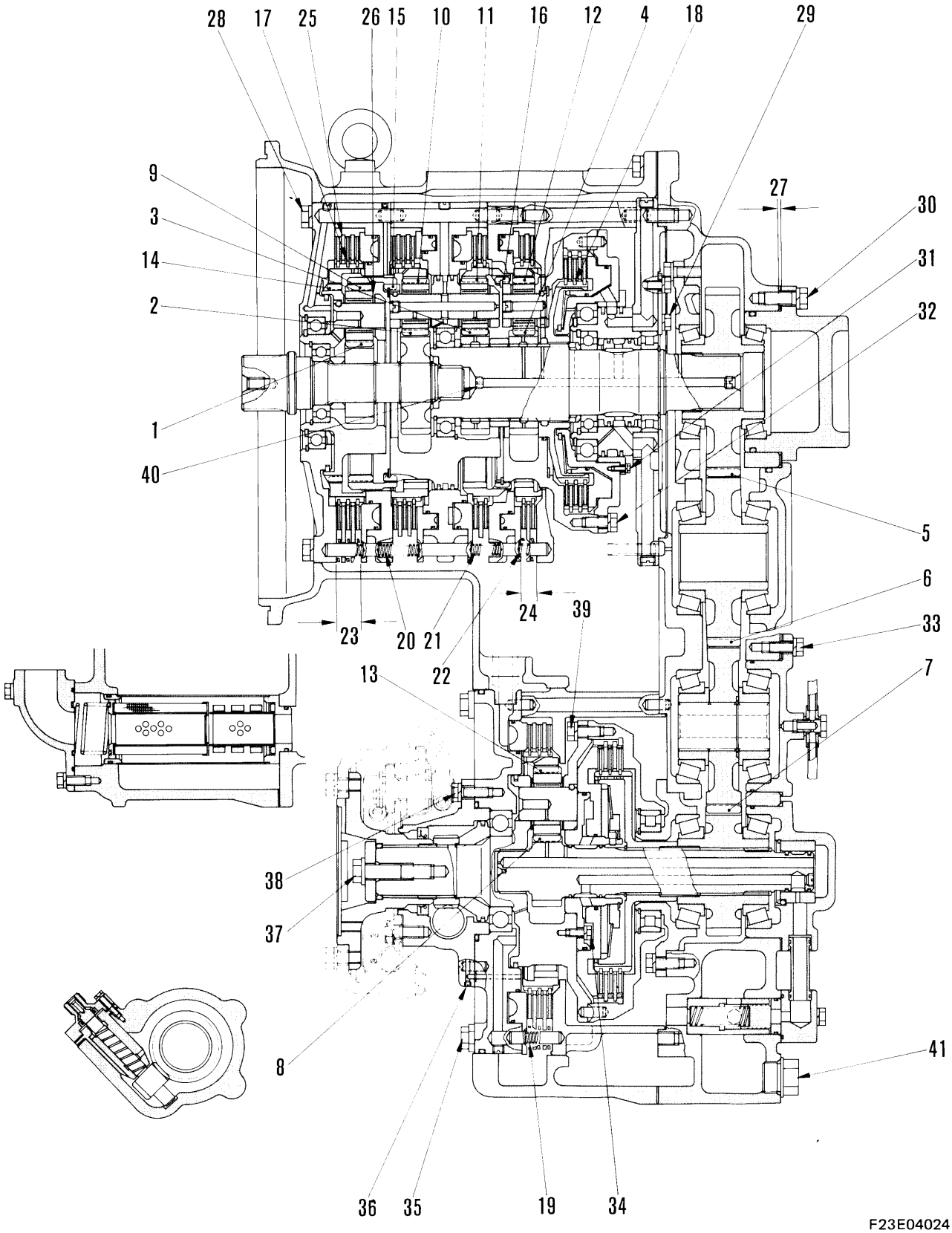
24F012

Unit: mm

No.	Check Item	Criteria		Remedy
1	Wear of damage of rubber	Standard size	Repair limit	Replace rubber
		44	40.5	
2	Backlash between input shaft and inner body	Standard clearance	Clearance limit	Replace
		0.071 – 0.177	0.5	
3	Backlash between flywheel inner teeth and plate	0.4 – 0.55	1.0	

HYDROSHIFT TRANSMISSION

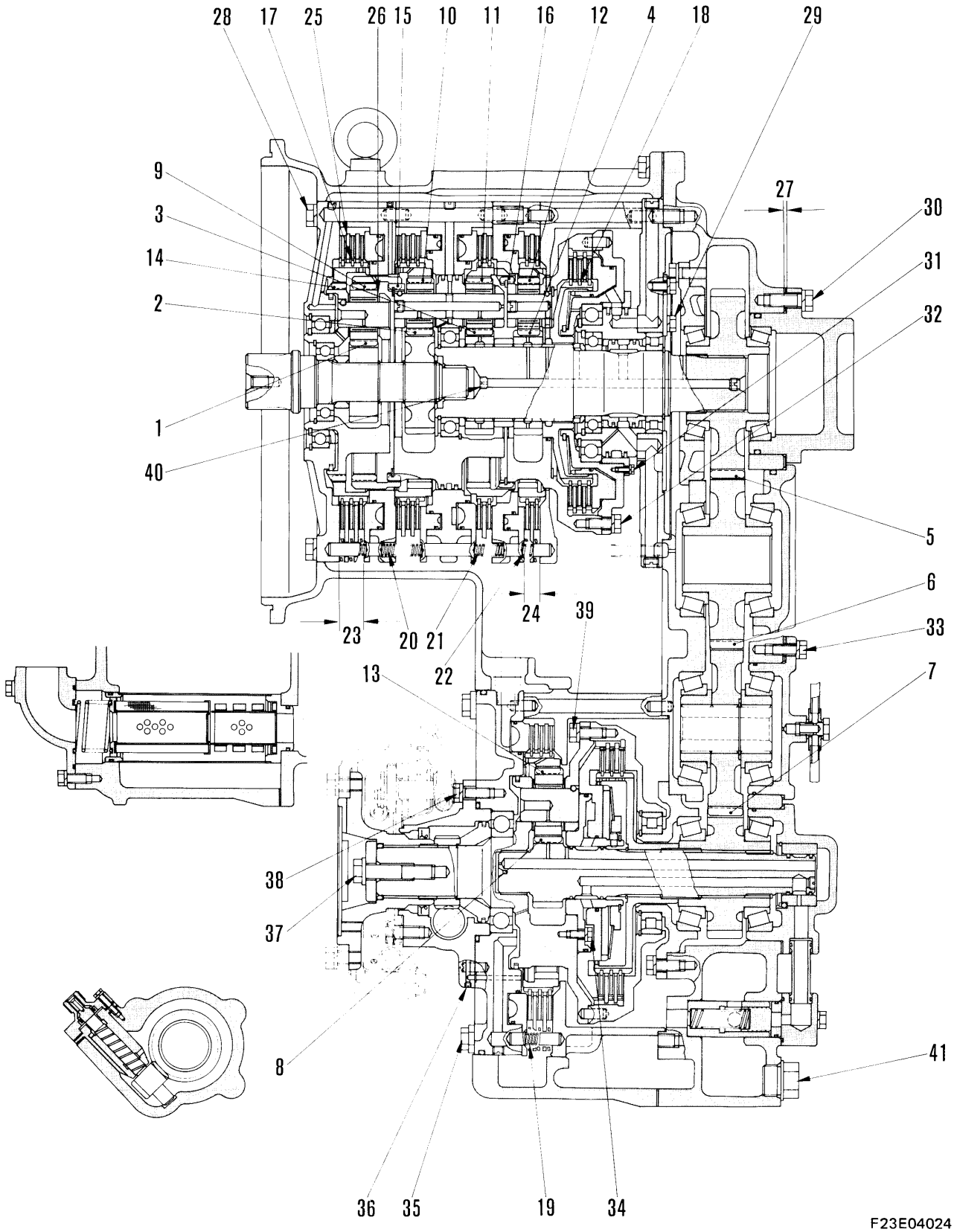
GD705R-4



F23E04024

Unit: mm

No.	Check Item	Criteria					Remedy
1	R Sun gear-to-R Planetary gear backlash	Standard clearance			Clearance limit		
		0.11 – 0.29					
2	F Sun gear-to-F Planetary gear backlash	0.12 – 0.33			–		
3	3rd Sun gear-to-3rd Planetary gear backlash	0.12 – 0.33			–		
4	2nd Sun gear-to-2nd Planetary gear backlash	0.12 – 0.33			–		
5	Transfer input shaft gear-to-Transfer input side idler gear backlash	0.19 – 0.45			–		
6	Transfer input side idler gear-to-Transfer output side idler gear backlash	0.19 – 0.44			–		
7	Transfer output side idler gear-to-Transfer output shaft gear backlash	0.19 – 0.44			–		
8	L Sun gear-to-L Planetary gear backlash	0.11 – 0.29			–		
9	R Planetary gear-to-R Ring gear backlash	0.13 – 0.42			–		
10	F Planetary gear-to-F Ring gear backlash	0.13 – 0.42			–		
11	3rd Planetary gear-to-3rd Ring gear backlash	0.13 – 0.42			–		
12	2nd Planetary gear-to-2nd Ring gear backlash	0.13 – 0.42			–		
13	L Planetary gear-to-L Ring gear backlash	0.13 – 0.42			–		
14	R Ring gear-to-R Carrier backlash	0.18 – 0.54			–		
15	R Ring gear-to-F Carrier backlash	0.18 – 0.54			–		
16	3rd Ring gear-to-3rd Carrier backlash	0.18 – 0.54			–		
17	R, F, 3rd, 2nd, L Ring gears-to-Clutch disc backlash	0.34 – 0.84			–		
18	Clutch disc-to-1st, H Hub backlash	0.19 – 0.55			–		
19	R, L Clutch springs	Standard size			Repair limit		Replace
		Free length x O.D.	Installed length	Installed load	Free length	Load	
		53 x 15.3	44	8.2 kg	51.7	7.0 kg	
20	F Clutch spring	53 x 15.3	47	8.2 kg	51.7	7.0 kg	
21	3rd Clutch spring	39.6 x 15.3	33	8.4 kg	38.6	7.1 kg	
22	2nd Clutch spring	39.6 x 15.3	35	5.9 kg	38.9	5.0 kg	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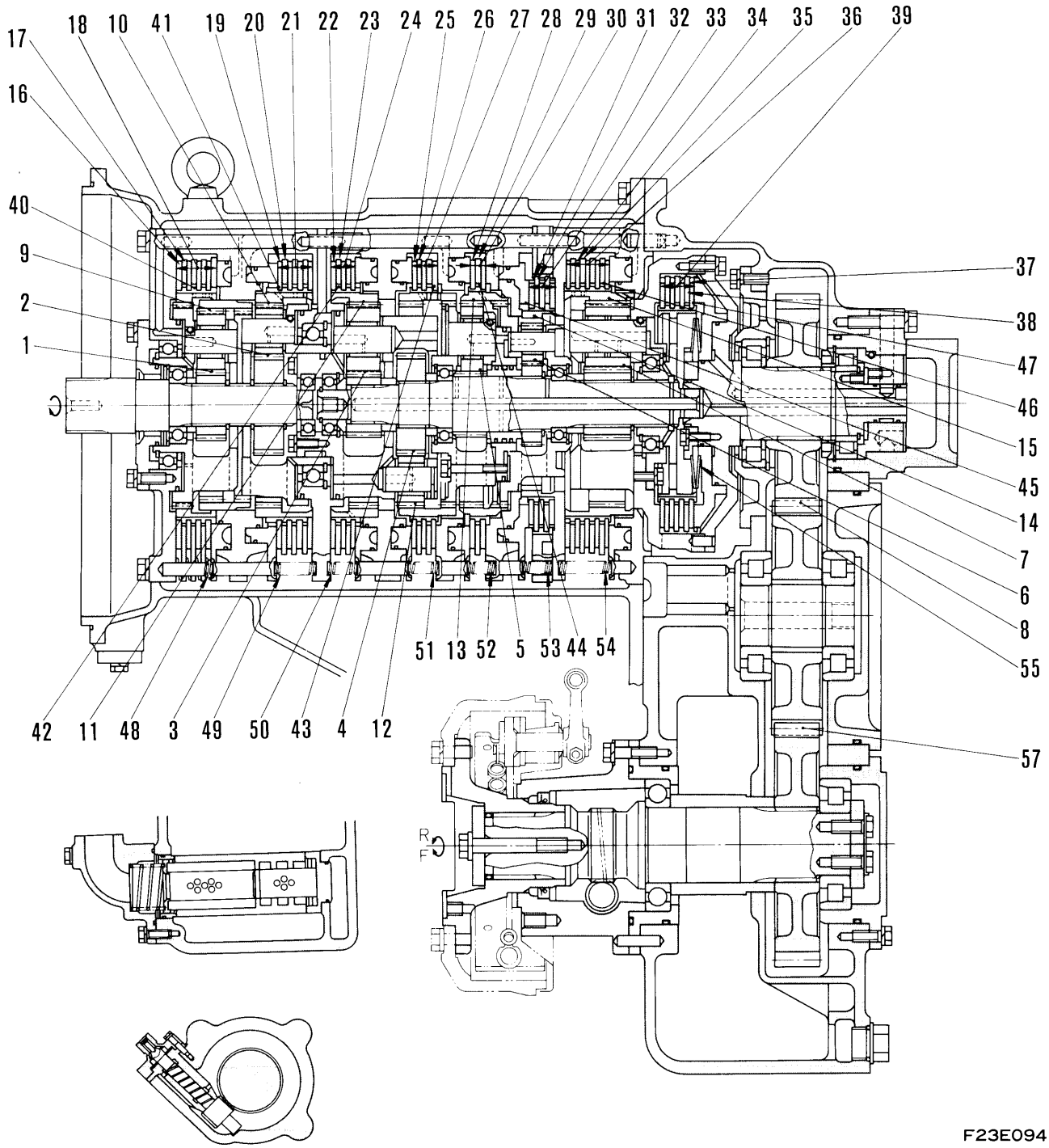
F23E04024

Unit: mm

No.	Check Item	Criteria		Remedy
23	Assembled thickness of disc and plate for R, F, 1st, L.H.	Standard size	Repair limit	
		25	23.5	
24	Assembled thickness of disc and plate for 3rd, 2nd clutch	15	14.1	
25	Thickness of one plate	5	4.7	
26	Side clearance of planetary gear	Standard clearance	Clearance limit	
		0.35 – 0.80	1.5	
27	Thickness of shim	Standard thickness	Repair limit	
		2.0	–	
28	Bolt tightening torque	17 ± 1.0 kgm		
29	Bolt tightening torque	6.5 ± 1.0 kgm		
30	Cage mounting bolt tightening torque	17 ± 1.0 kgm		
31	Bolt tightening torque	1.35 ± 0.15 kgm		
32	Bolt tightening torque	11.0 ± 1.5 kgm		
33	Cover mounting bolt tightening torque	11.0 ± 1.5 kgm		
34	Bolt tightening torque	3.0 ± 0.5 kgm		
35	Housing mounting bolt tightening torque	17 ± 1.0 kgm		
36	Plug tightening torque	0.8 kgm		
37	Holder fixing bolt tightening torque	23.5 ± 2.5 kgm		
38	Cage mounting bolt tightening torque	10.75 ± 1.75 kgm		
39	Bolt tightening torque	11.0 ± 1.5 kgm		
40	Plug tightening torque	0.8 kgm		
41	Drain plug tightening torque	15.5 ± 2.5 kgm		

HYDROSHIFT TRANSMISSION

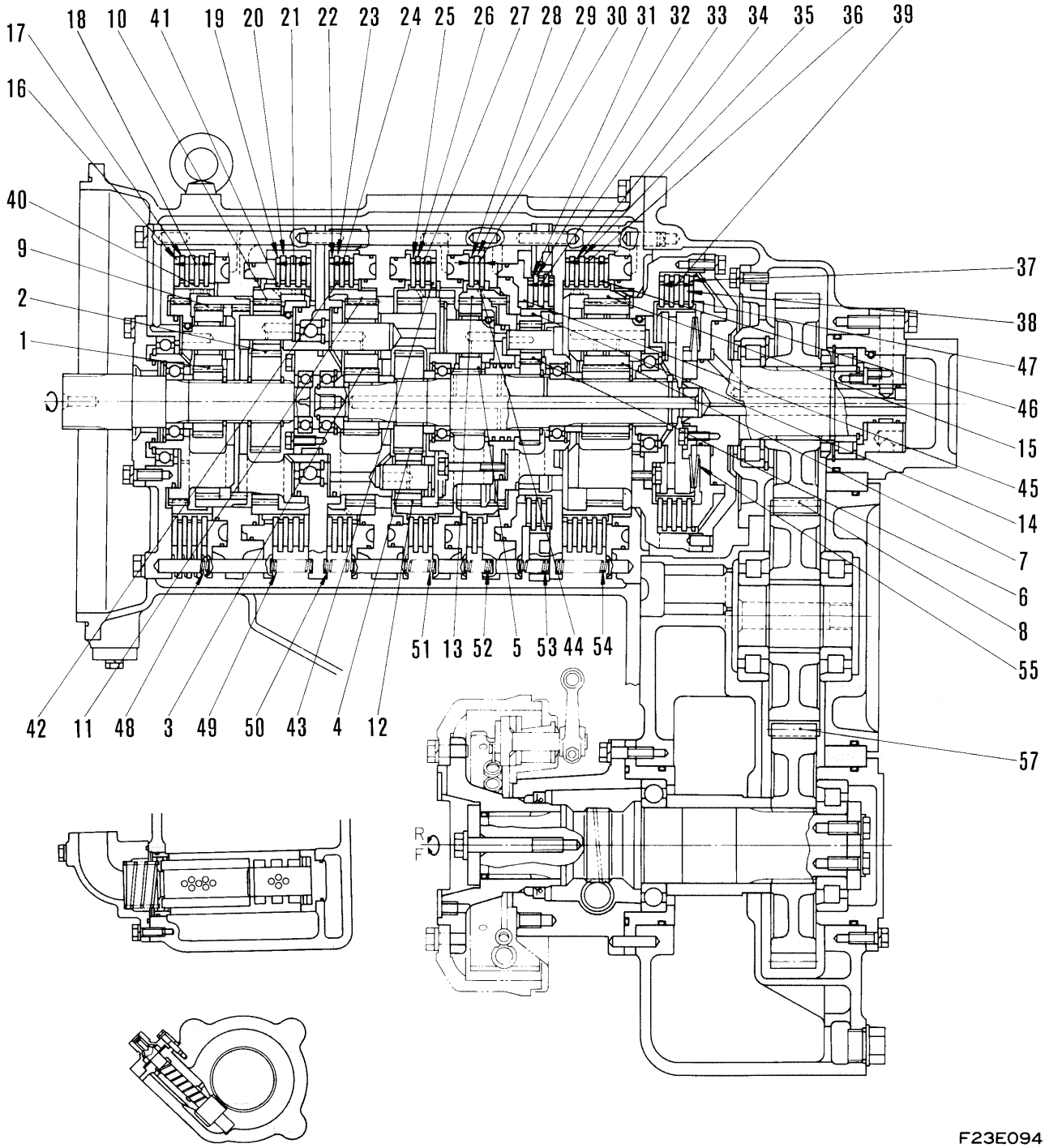
GD705A-4



F23E094

Unit: mm

No.	Check Item	Criteria		Remedy
1	No. 1 sun gear-to-No. 1 planetary gear backlash	Standard clearance	Clearance limit	Replace
		0.13 – 0.32	–	
2	No.2 sun gear-to-No. 2 planetary gear backlash	0.13 – 0.34	–	
3	No. 3 sun gear-to-No. 3 planetary gear backlash	0.13 – 0.32	–	
4	No. 4 sun gear-to-No. 4 planetary gear backlash	0.13 – 0.32	–	
5	No. 5 sun gear-to-No. 5 planetary gear backlash	0.13 – 0.32	–	
6	No. 6 sun gear-to-No. 6 planetary gear backlash	0.11 – 0.28	–	
7	No. 7 sun gear-to-No. 7 planetary gear backlash	0.13 – 0.32	–	
8	Drive gear-to-idle gear backlash	0.26 – 0.61	–	
9	No. 1 planetary gear-to-No. 1 ring gear backlash	0.14 – 0.43	–	
10	No. 2 planetary gear-to-No. 2 ring gear backlash	0.14 – 0.37	–	
11	No. 3 planetary gear-to-No. 3 ring gear backlash	0.14 – 0.43	–	
12	No. 4 planetary gear-to-No. 4 ring gear backlash	0.13 – 0.42	–	
13	No. 5 planetary gear-to-No. 5 ring gear backlash	0.14 – 0.43	–	
14	No. 6 planetary gear-to-No. 6 ring gear backlash	0.12 – 0.22	–	
15	No. 7 planetary gear-to-No. 7 ring gear backlash	0.14 – 0.43	–	
16	Thickness of No. 1 clutch disc	5	4.7	
17	Thickness of No. 1 clutch plate	5	4.7	
18	Thickness of No. 1 clutch	35	32.9	
19	Thickness of No. 2 clutch disc	5	4.7	
20	Thickness of No. 2 clutch plate	5	4.7	
21	Thickness of No. 2 clutch	35	32.9	
22	Thickness of No. 3 clutch disc	5	4.7	
23	Thickness of No. 3 clutch plate	5	4.7	
24	Thickness of No. 3 clutch	25	23.5	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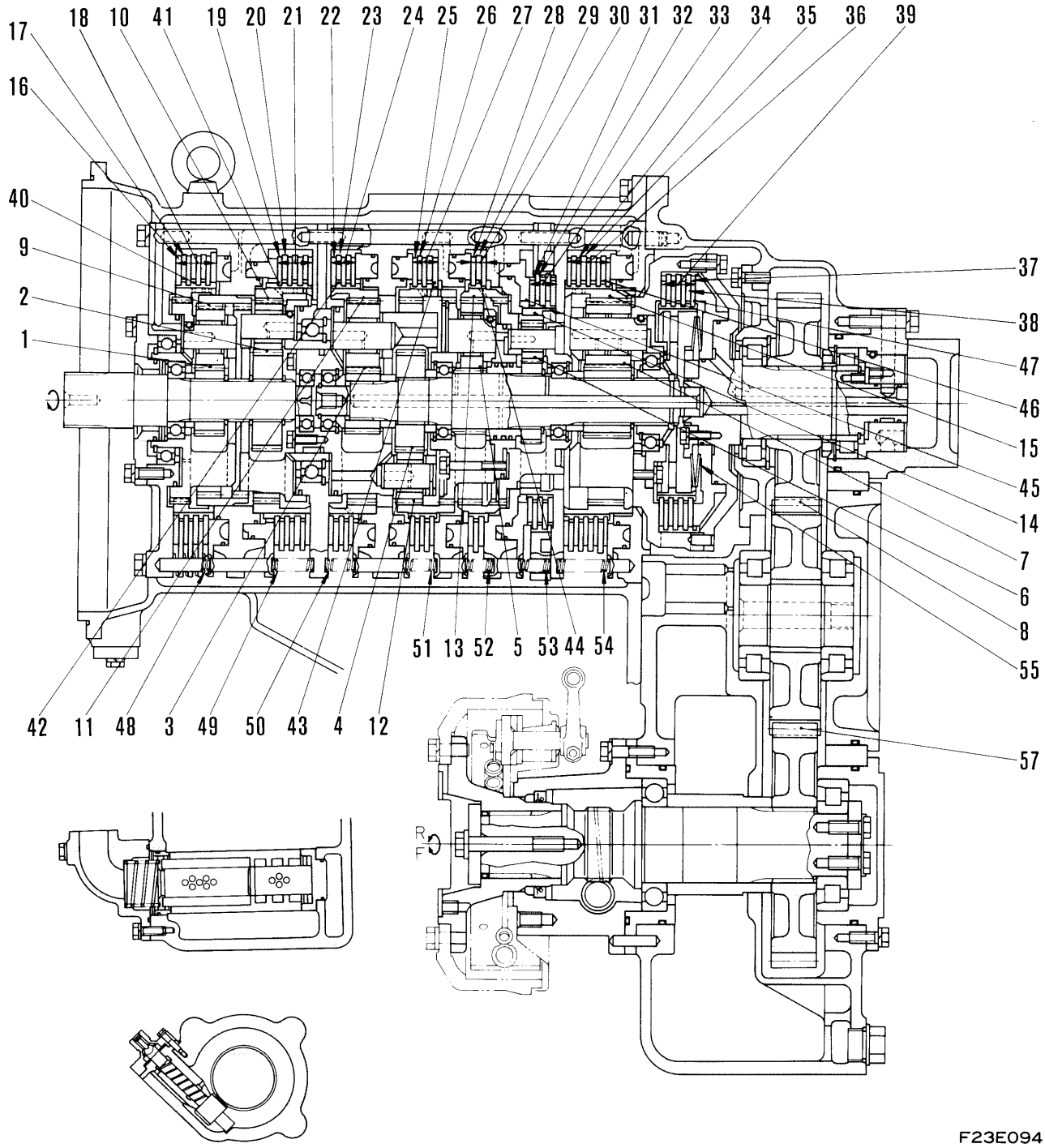
F23E094

Unit: mm

No.	Check Item	Criteria		Remedy
25	Thickness of No. 4 clutch disc	Standard clearance	Clearance limit	Replace
		5	4.7	
26	Thickness of No. 4 clutch plate	5	4.7	
27	Thickness of No.4 clutch	25	23.5	
28	Thickness of No. 5 clutch disc	5	4.7	
29	Thickness of No. 5 clutch plate	5	4.7	
30	Thickness of No. 5 clutch	15	14.1	
31	Thickness of No. 6 clutch disc	5	4.7	
32	Thickness of No. 6 clutch plate	5	4.7	
33	Thickness of No. 6 clutch	25	23.5	
34	Thickness of No. 7 clutch disc	5	4.7	
35	Thickness of No. 7 clutch plate	5	4.7	
36	Thickness of No. 7 clutch	45	42.3	
37	Thickness of No. 8 clutch disc	5	4.7	
38	Thickness of No. 8 clutch plate	5	4.7	
39	Thickness of No. 8 clutch	35	32.9	
40	No. 1 clutch disc-to-No. 1 ring gear backlash	0.29 – 0.67	–	
41	No. 2 clutch disc-to-No. 2 ring gear backlash	0.29 – 0.67	–	
42	No. 3 clutch disc-to-No.3 ring gear backlash	0.29 – 0.67	–	
43	No. 4 clutch disc-to-No. 4 ring gear backlash	0.29 – 0.67	–	
44	No. 5 clutch disc-to-No. 5 ring gear backlash	0.29 – 0.67	–	
45	No. 6 clutch disc-to-No. 6 ring gear backlash	0.19 – 0.54	–	
46	No. 7 clutch disc-to-No. 7 ring gear backlash	0.29 – 0.67	–	
47	No. 8 clutch disc-to-No. 8 ring gear backlash	0.29 – 0.54	–	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F23E094

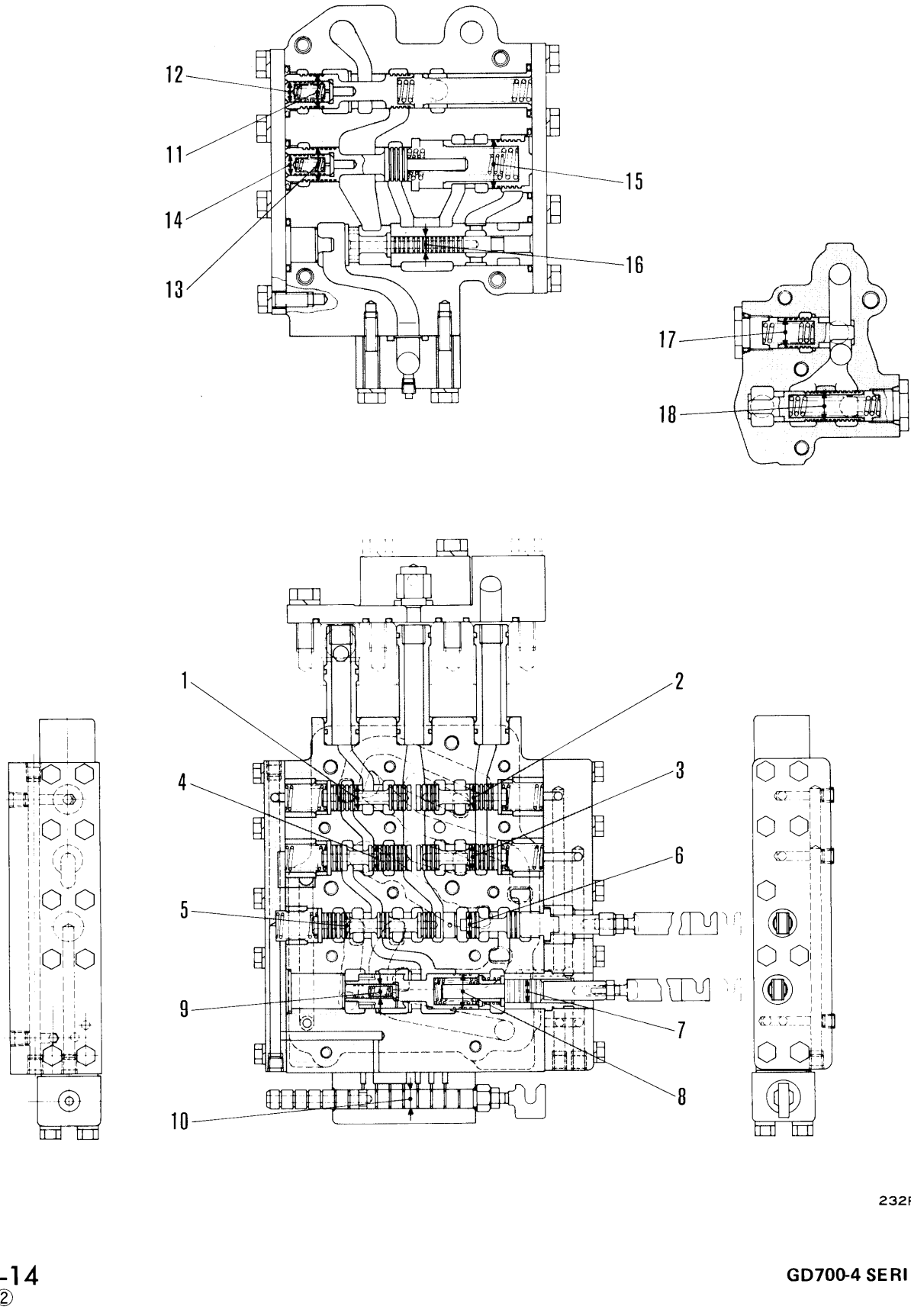
Unit: mm

No.	Check Item	Criteria					Remedy
		Standard size			Repair limit		
48	No. 1 clutch spring	Free length x O.D	Installed length	Installed load	Free length	Installed load	
		53 x	44	8.2 kg	51.7	7.0 kg	
49	No. 2 clutch spring	53 x	47	5.5 kg	51.9	4.5 kg	
50	No. 3 clutch spring	39.6 x	33	8.4 kg	38.6	7.1 kg	
51	No. 4 clutch spring	39.6 x	33.5	7.8 kg	38.6	6.5 kg	
52	No. 5 clutch spring	39.6 x	33	8.4 kg	38.6	7.1 kg	Replace
53	No. 6 clutch spring	39.6 x	34.5	6.5 kg	38.6	5.2 kg	
54	No. 7 clutch spring	66 x	60	8.5 kg	64.9	7.9 kg	
55	No. 8 clutch spring	6.5 x	5.5	143 kg	6.2	100 kg	
56	Side clearance of planetary gear	Standard clearance			Clearance limit		
		0.35 – 0.80			1.5		
57	Idler gear-to-driven gear backlash	0.25 – 0.60			–		

HYDROSHIFT TRANSMISSION CONTROL VALVE

GD705R-4

1. HYDROSHIFT transmission control valve

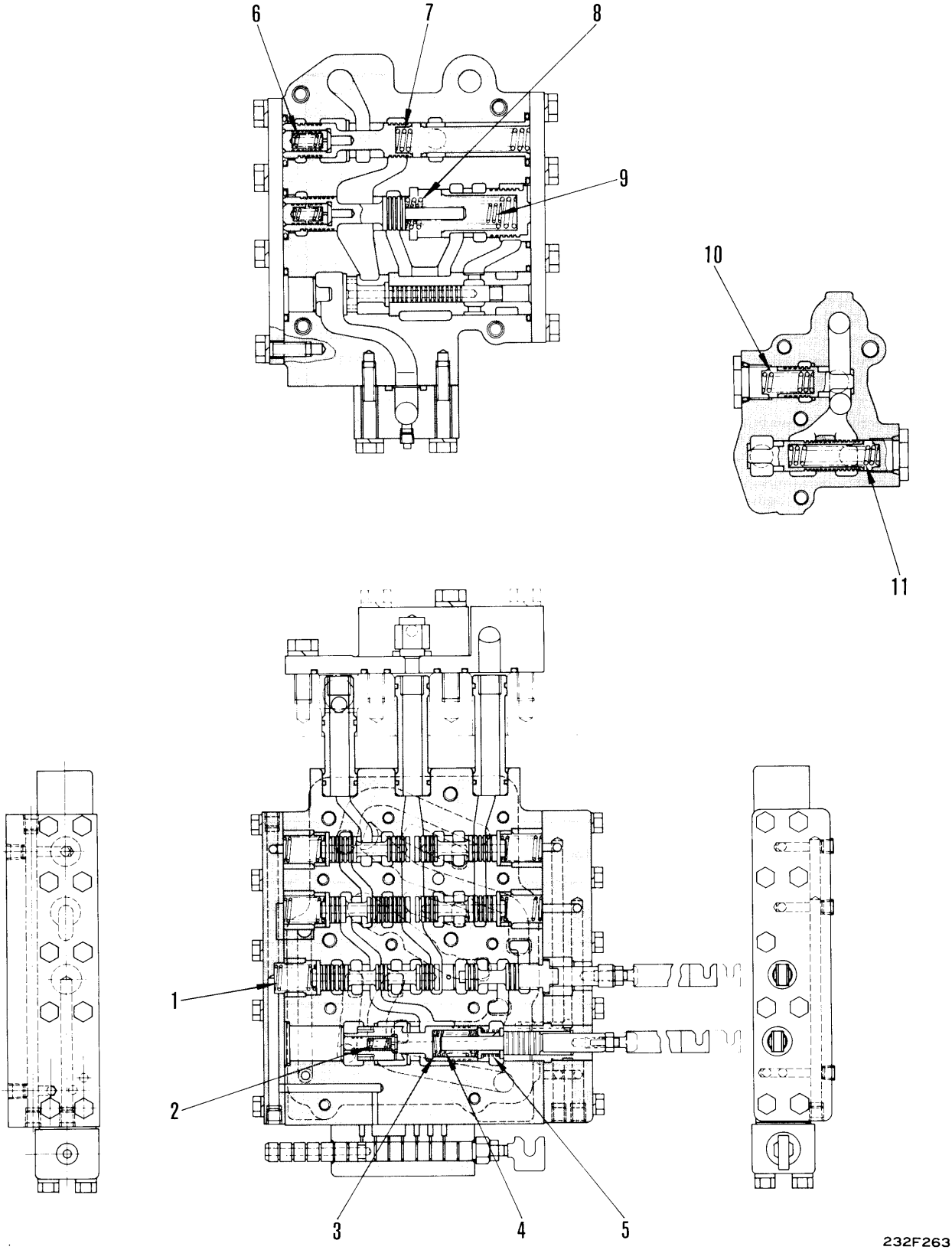


232F262

Unit: mm

No.	Check Item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between shift valve spool (1st) and valve body	19	−0.035 −0.045	+0.013 0	0.035 – 0.058	0.08	
2	Clearance between shift valve spool (3rd) and valve body	19	−0.035 −0.045	+0.013 0	0.035 – 0.058	0.08	
3	Clearance between shift valve spool (2nd) and valve body	19	−0.035 −0.045	+0.013 0	0.035 – 0.058	0.08	
4	Clearance between cut off valve spool and valve body	19	−0.035 −0.045	+0.013 0	0.035 – 0.058	0.08	
5	Clearance between shift valve spool (H.L.) and valve body	19	−0.035 −0.045	+0.013 0	0.035 – 0.058	0.08	
6	Clearance between valve spool (F.R.) and valve body	19	−0.035 −0.045	+0.013 0	0.035 – 0.058	0.08	
7	Clearance between inching valve spool and sleeve	17.2	−0.035 −0.045	+0.018 0	0.035 – 0.063	0.08	
8	Clearance between inching valve and valve body	25	−0.035 −0.045	+0.013 0	0.035 – 0.058	0.08	
9	Clearance between inching valve and valve	10	−0.020 −0.030	+0.015 0	0.020 – 0.045	0.08	Replace
10	Clearance between speed selector spool and valve body	14	−0.035 −0.045	+0.011 0	0.035 – 0.056	0.08	
11	Clearance between priority valve and valve body	25	−0.035 −0.045	+0.013 0	0.035 – 0.058	0.08	
12	Clearance between priority valve and valve spool	15	−0.02 −0.03	+0.018 0	0.029 – 0.048	0.08	
13	Clearance between modulating valve and valve body	25	−0.035 −0.045	+0.013 0	0.035 – 0.058	0.08	
14	Clearance between modulating valve and valve spool	15	−0.02 −0.03	+0.018 0	0.020 – 0.048	0.08	
15	Clearance between modulating valve and valve body	35	−0.035 −0.045	+0.016 0	0.035 – 0.061	0.08	
16	Clearance between quick return valve and sleeve	12	−0.035 −0.045	+0.011 0	0.035 – 0.056	0.08	
17	Clearance between lubrication valve and valve body	22	−0.035 −0.045	+0.013 0	0.035 – 0.058	0.10	
18	Clearance between cooler by-pass valve and valve body	22	−0.035 −0.045	+0.013 0	0.035 – 0.058	0.10	

2. HYDROSHIFT transmission control valve spring



232F263

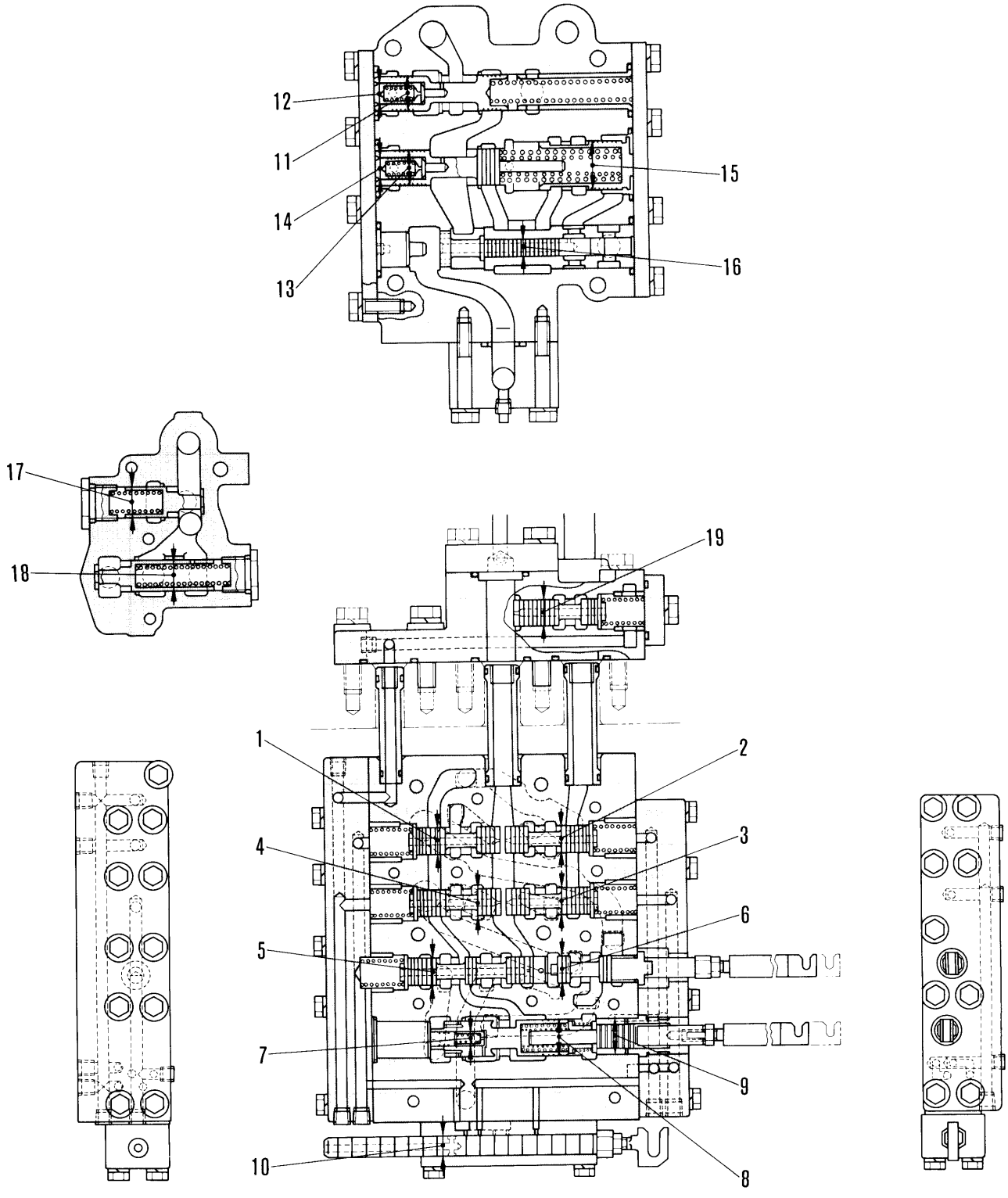
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Spool return spring	Free length x O.D.	Installed length	Installed load	Free length	Load	
		36.75 x	30	6.41 kg		6.09 kg	
2	Inching valve spring	26 x	18	0.66 kg			
3	Inching valve spring (Large)	50.2 x	33	4.02 kg			
4	Inching valve spring (Small)	39 x	33	0.81 kg			
5	Inching valve spring	16.1 x	12.5	1.12 kg			Replace
6	Priority valve spring	35 x 9.5	21	1.33 kg		1.26 kg	
7	Priority valve spring	115.5 x 16.9	100	23.5 kg		22.3 kg	
8	Modulating valve spring (Large)	86.7 x 23.2	65	27.1 kg			
9	Modulating valve spring (Small)	71.2 x 14.3	65	13.4 kg			
10	Lubrication valve spring	39.4 x 15.6	37	6.20 kg		5.9 kg	
11	Cooler by-pass valve spring	71.4 x 14.9	66	13.88 kg		13.2 kg	

HYDROSHIFT TRANSMISSION CONTROL VALVE

GD705A-4

1. HYDROSHIFT transmission control valve

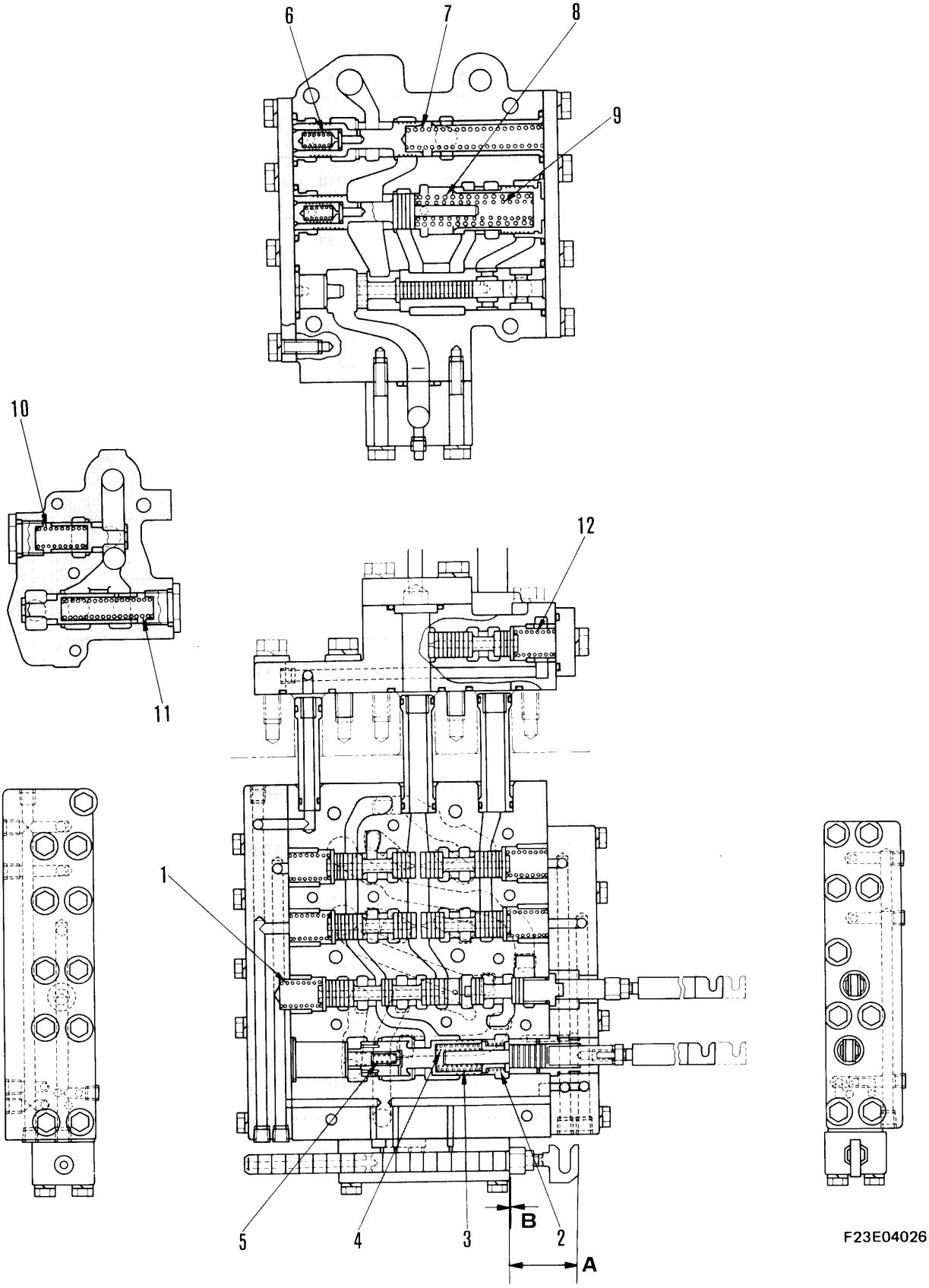


F23E04025

Unit: mm

No.	Check Item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between shift valve spool (3rd) and valve body	19	−0.035 −0.045	+0.013 0	0.035–0.058	0.08	Replace
2	Clearance between shift valve spool (1st) and valve body	19	−0.035 −0.045	+0.013 0	0.035–0.058	0.08	
3	Clearance between shift valve spool (2nd) and valve body	19	−0.035 −0.045	+0.013 0	0.035–0.058	0.08	
4	Clearance between shift valve spool (4th) and valve body	19	−0.035 −0.045	+0.013 0	0.035–0.058	0.08	
5	Clearance between shift valve spool (H.L.) and valve body	19	−0.035 −0.045	+0.013 0	0.035–0.058	0.08	
6	Clearance between valve spool (F.R.) and valve body	19	−0.035 −0.045	+0.013 0	0.035–0.058	0.08	
7	Clearance between inching valve spool and valve body	10	−0.020 −0.030	+0.015 0	0.020–0.045		
8	Clearance between inching valve and valve body	25	−0.035 −0.045	+0.013 0	0.035–0.058		
9	Clearance between inching sleeve and inching valve spool	17.2	−0.035 −0.045	+0.018 0	0.035–0.063		
10	Clearance between speed selector spool and valve body	14	−0.035 −0.045	+0.011 0	0.035–0.056	0.08	
11	Clearance between priority valve and valve body	25	−0.035 −0.045	+0.013 0	0.035–0.058	0.08	
12	Clearance between priority valve and valve spool	15	−0.02 −0.03	+0.018 0	0.020–0.048	0.08	
13	Clearance between modulating valve and valve body	25	−0.035 −0.045	+0.013 0	0.035–0.058	0.08	
14	Clearance between modulating valve and valve spool	15	−0.02 −0.03	+0.018 0	0.020–0.048	0.08	
15	Clearance between valve and valve body	35	−0.035 −0.045	+0.016 0	0.035–0.061	0.08	
16	Clearance between quick return valve and sleeve	12	−0.035 −0.045	+0.011 0	0.035–0.056	0.08	
17	Clearance between lubrication valve and valve body	22	−0.035 −0.045	+0.013 0	0.035–0.058	0.10	
18	Clearance between cooler by-pass valve and valve body	22	−0.035 −0.045	+0.013 0	0.035–0.058	0.10	
19	Clearance between cut off valve and valve body	19	−0.035 −0.045	+0.013 0	0.035–0.058	0.08	

2. HYDROSHIFT transmission control valve spring



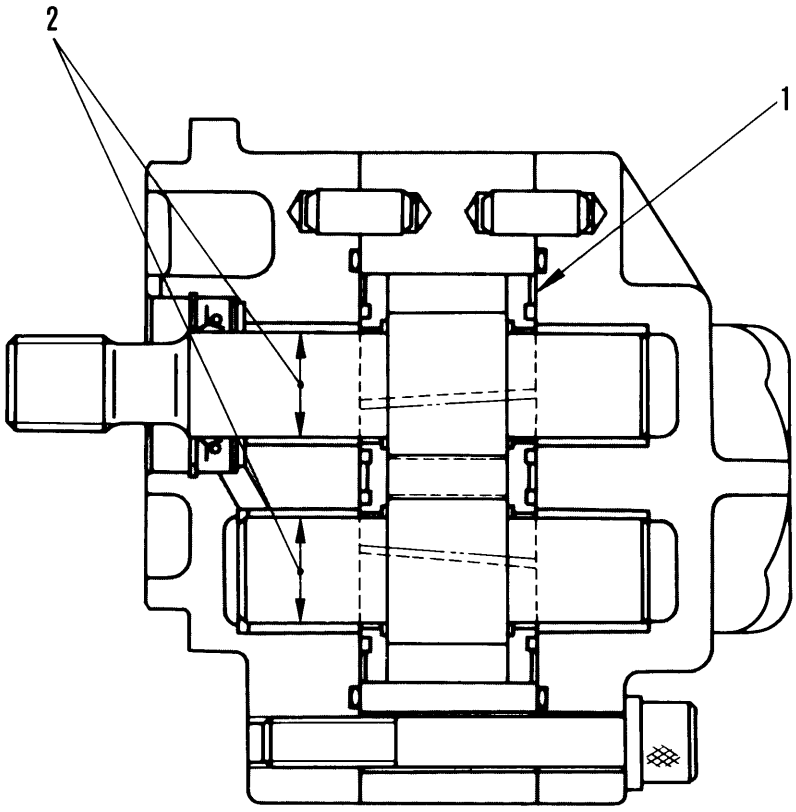
F23E04026

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Spool return spring	Free length x O.D.	Installed length	Installed load	Free length	Load	
		36.75 x 19.3	30.3	6.12 kg	36.1	5.51 kg	
2	Inching valve spring	16.1 x	12.5	1.12 kg			
3	Inching valve spring (Large)	50.2 x	33	4.02 kg			
4	Inching valve spring (Small)	39 x	33	0.81 kg			
5	Inching valve spring	26 x	18	0.66 kg			
6	Priority valve spring	35 x 9.5	21	1.33 kg	34.3	1.26 kg	
7	Priority valve spring	115.5 x 16.9	100	23.50 kg	114.7	22.3 kg	
8	Modulating valve spring (Large)	86.7 x 23.2	65	27.03 kg	85.6	25.7 kg	
9	Modulating valve spring (Small)	71.2 x 14.3	65	13.39 kg	70.9	12.7 kg	
10	Lubrication valve spring	39.4 x 15.6	37	6.20 kg	39.0	5.27 kg	
11	Cooler by-pass valve spring	71.4 x 14.9	66	13.88 kg	70.6	11.8 kg	
12	Cut off valve spring	36.75 x	30	6.41 kg	36.1	5.79 kg	
A	Length between selector valve and yoke	51.4 (for reference)					
B	Clearance between nut and selector valve body	0.1 – 0.3					

HYDROSHIFT TRANSMISSION PUMP SAL045

GD705R-4



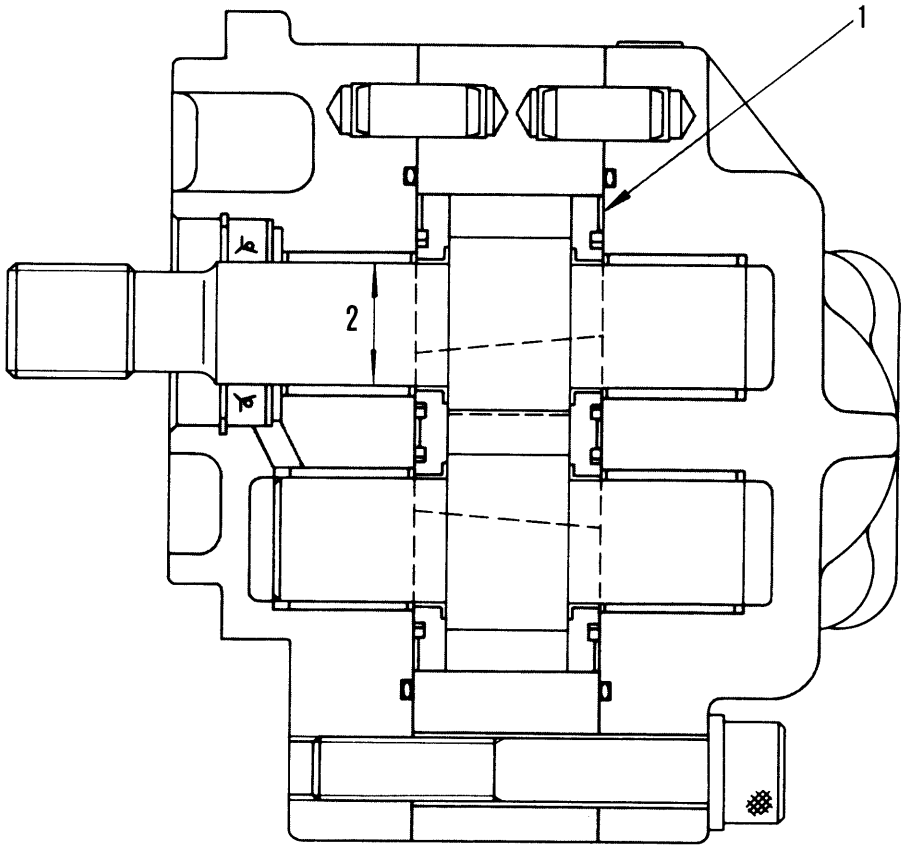
F23B061A

Unit: mm

No.	Check Item	Criteria				Remedy
1	Side clearance between gear case and side plate	Standard clearance		Clearance limit		
		0.10 – 0.15		0.19		
2	Bearing I.D. to gear shaft clearance	0.060 – 0.125		0.20		
3	SAL045 (EO10-CD 50 ± 5°C 210 kg/cm²)	Standard value		Repair limit		
		Pump speed (rpm)	Delivery (ℓ/min.)	Pump speed (rpm)	Delivery (ℓ/min.)	
		3000	121	3000	111	

SAL050

GD705A-4



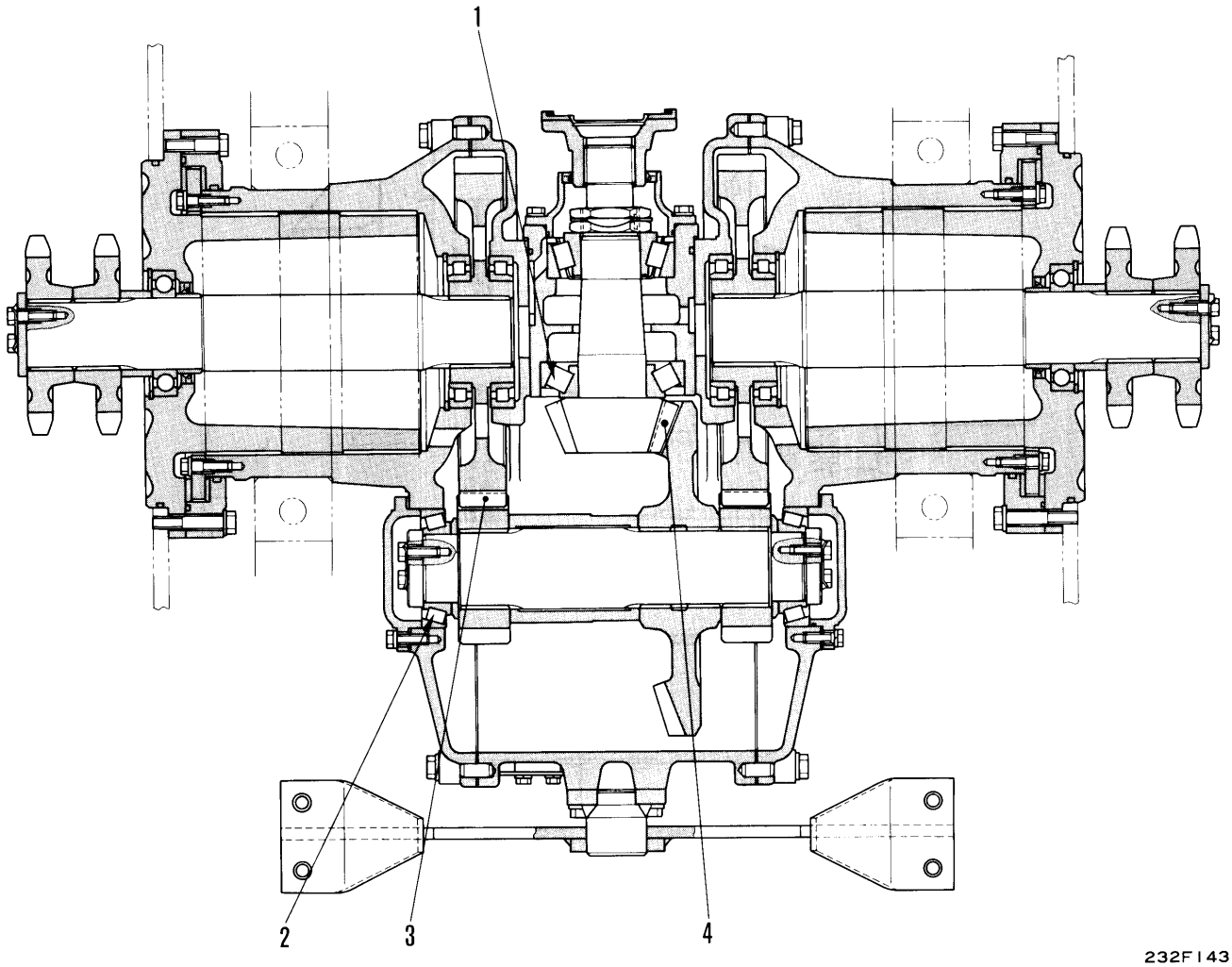
24F004A

Unit: mm

No.	Check Item	Criteria				Remedy
1	Side clearance between gear case and side plate	Standard clearance		Clearance limit		
		0.10 ~ 0.15		0.19		
2	Clearance between bearing I.D. and gear shaft O.D.	0.06 ~ 0.166		0.20		
3	SAL050 SAE10W, Class CD at 50°C 210 kg/cm²	Standard value		Repair limit		
		Pump speed (rpm)	Delivery (ℓ/min.)	Pump speed (rpm)	Delivery (ℓ/min.)	
		3000	138	3000	128	

FINAL DRIVE

GD705R-4

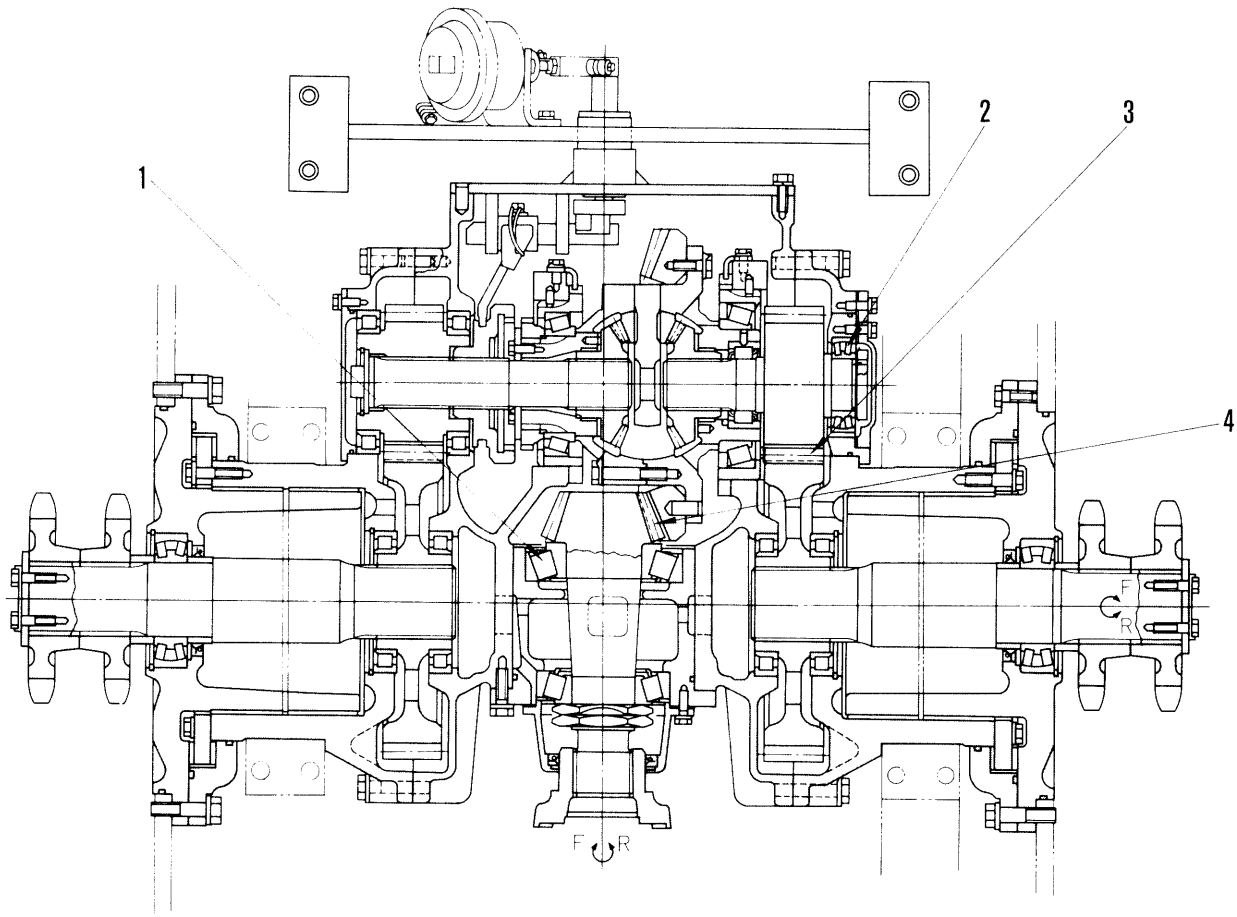


232F143

Unit: mm

No.	Check Item	Criteria		Remedy
1	Preload of bevel pinion bearing	Starting torque: 1.2 – 1.6 kgm		Adjust
2	Preload of side bearing	Starting torque: (Starting torque of bevel pinion bearing) + (0.3 – 0.4) kgm (Measured on pinion shaft)		
3	Backlash between 2nd pinion and 2nd pinion	Tolerance	Repair limit	
		0.24 – 0.60	1.6	
4	Backlash between bevel gear and bevel pinion	0.3 – 0.4	1.4	

GD705A-4



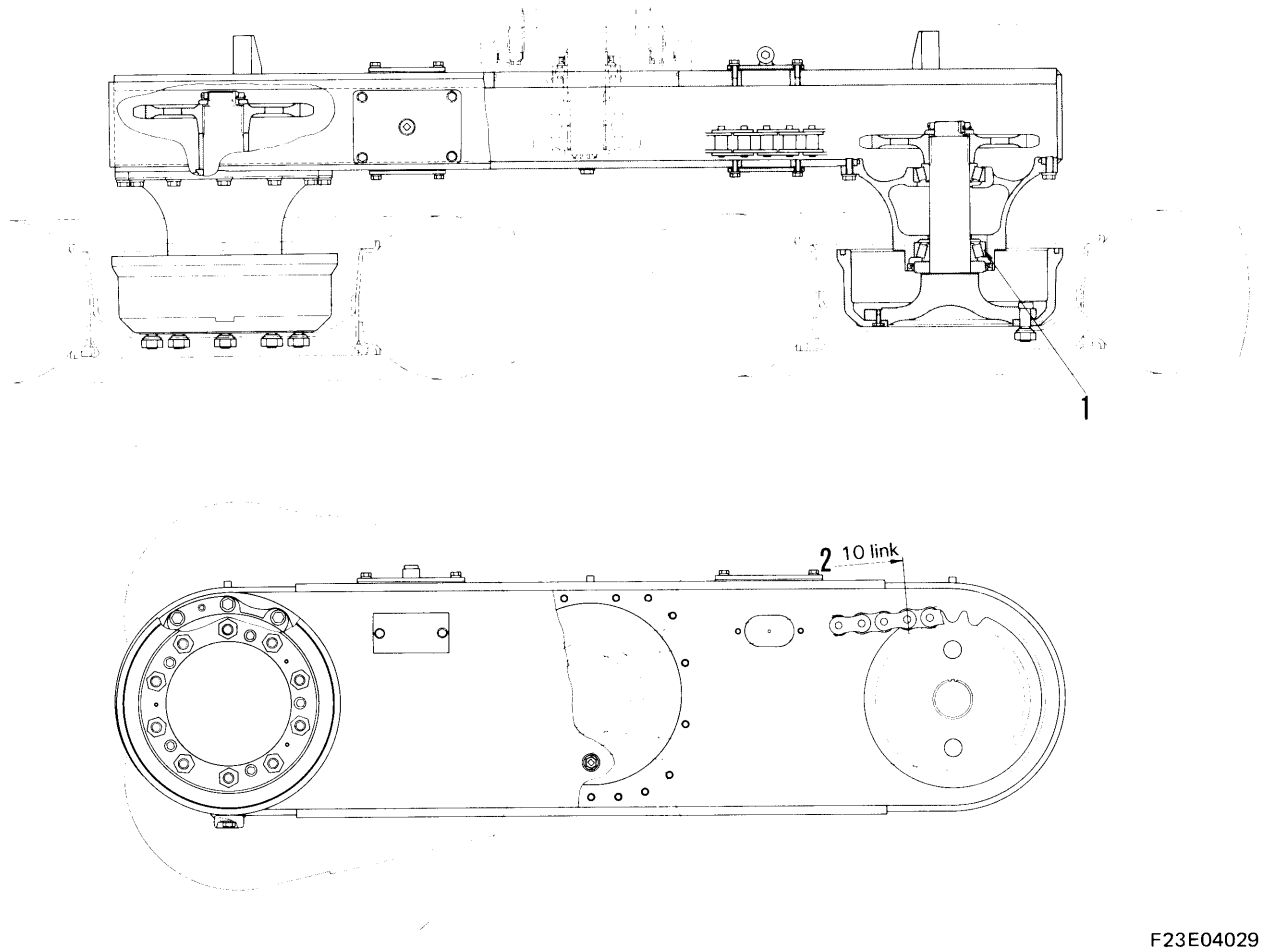
234F107-1

Unit: mm

No.	Check Item	Criteria		Remedy
1	Preload of bevel pinion bearing	Starting torque: 1.2 – 1.6 kgm		Adjust
2	Preload of side bearing	Starting torque: (Starting torque of bevel pinion bearing) + 0.3 – 0.4 kgm		
3	Backlash between 2nd pinion and 2nd gear	Tolerance	Repair limit	
		0.24 – 0.60	1.6	
3	Backlash between bevel pinion and bevel gear	0.3 – 0.4	1.4	

TANDEM DRIVE

GD705R-4

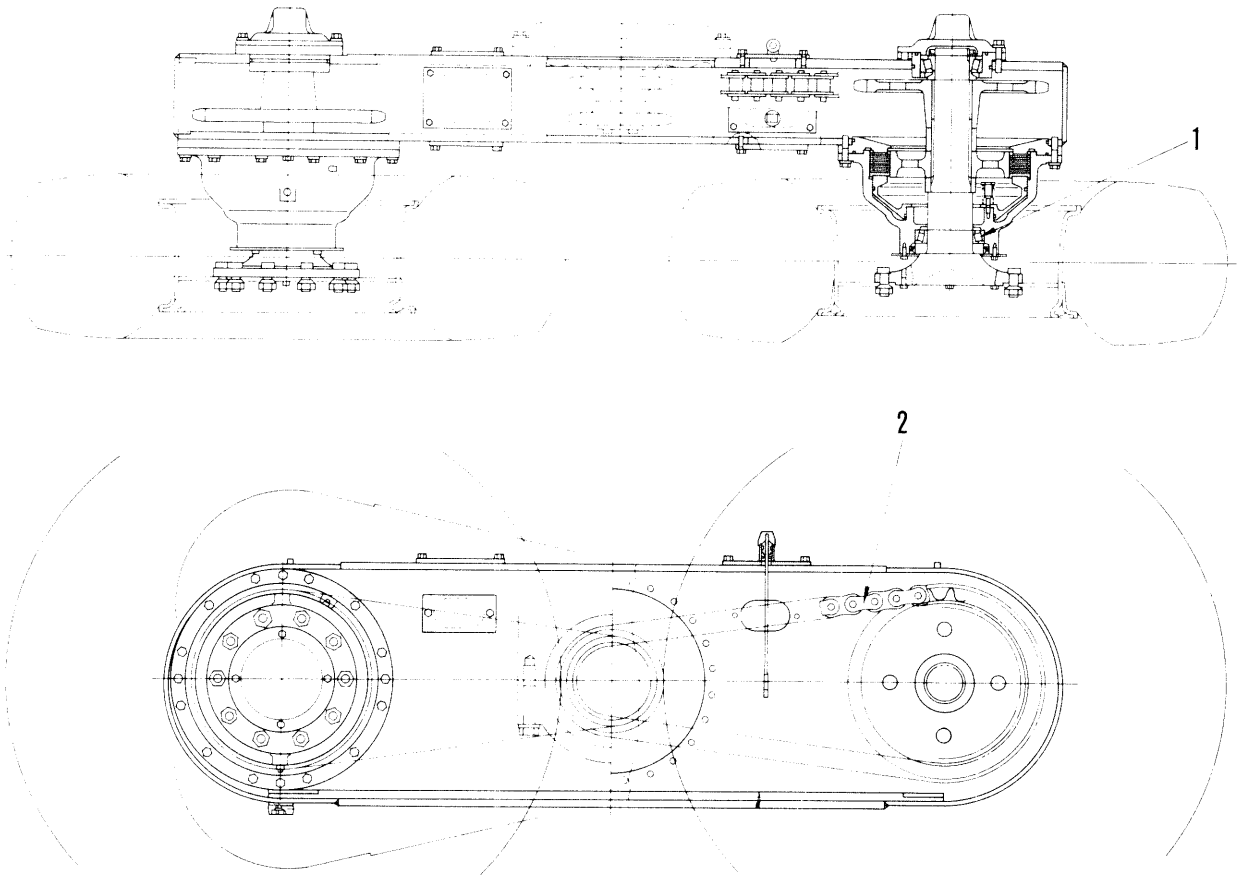


F23E04029

Unit: mm

No.	Check Item	Criteria		Remedy
1	Hub bearing preload	Turning torque: 2.0 – 2.5 kgm		Adjust
2	Extension of chain (10 links)	Standard size	Repair limit	Replace
		508.0	515.62	

GD705A-4



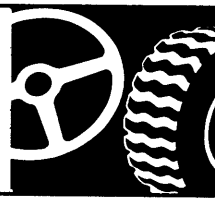
234F108-1

Unit: mm

No.	Check Item	Criteria		Remedy
1	Preload of hub bearing	Starting torque: 2.0 – 2.5 kgm		Adjust
2	Extension of chain (10 links)	Standard size	Repair limit	Replace
		571.5	580	

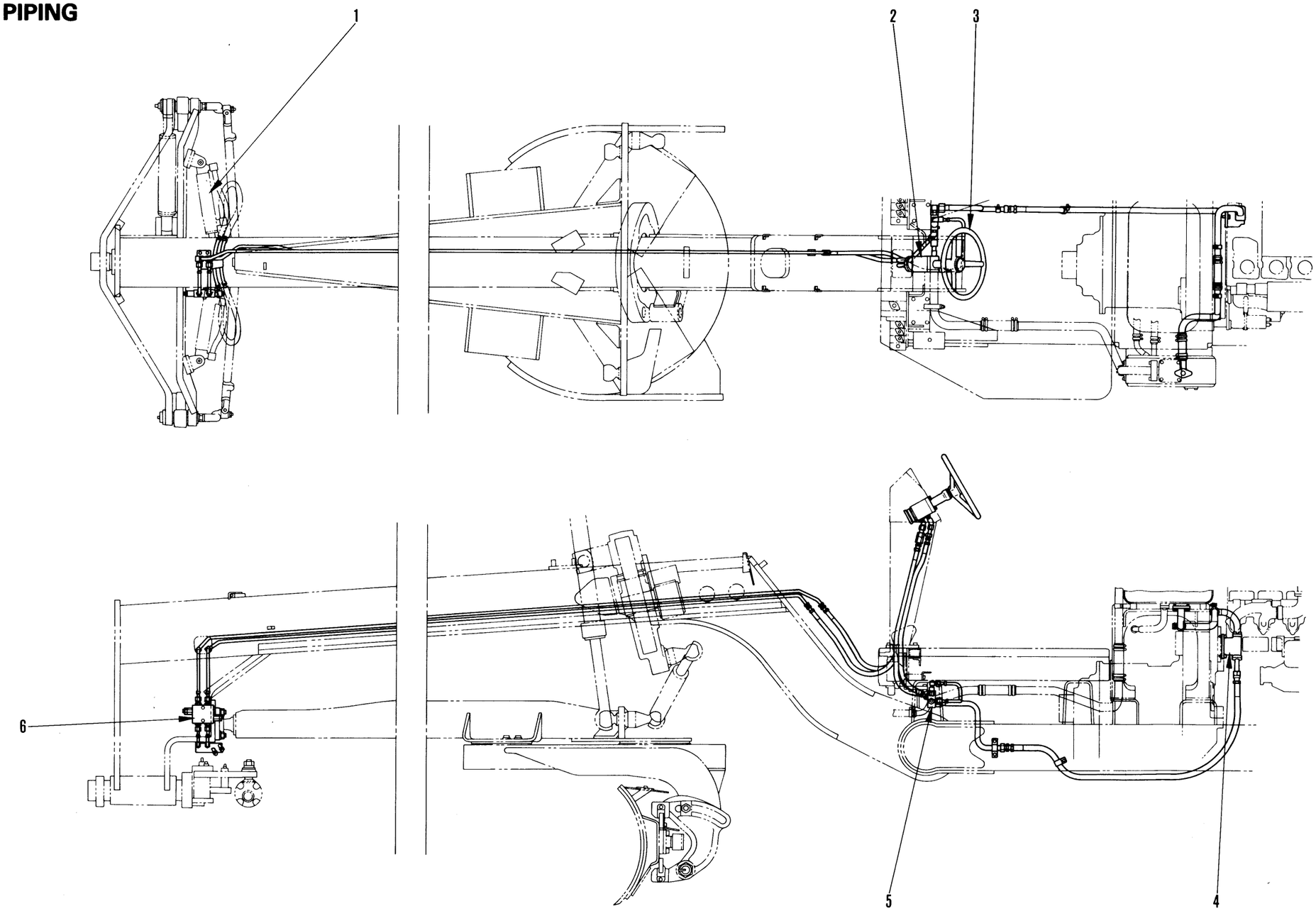
STEERING SYSTEM

41 STRUCTURE AND FUNCTION



STEERING PIPING

GD705R-4



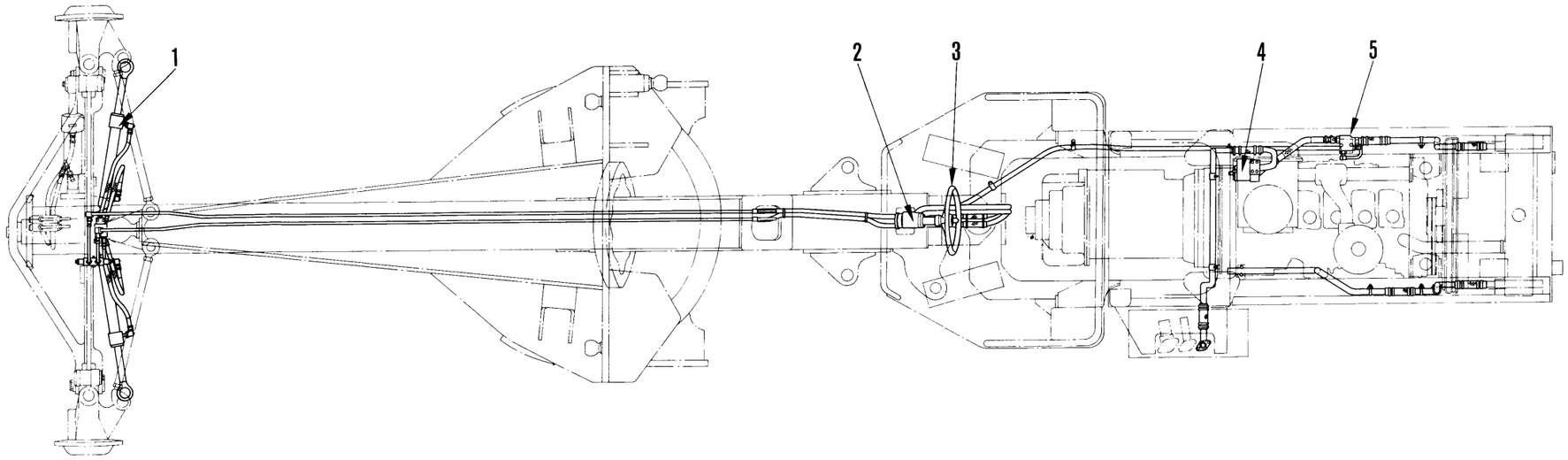
F23E04030

The steering system on the GD705R is fully hydraulic. When steering wheel (3) is turned, an amount of oil in proportion to the angle of turning is sent from steering valve (2) (orbit roll type) to steering cylinder (1). This operates the steering.

1. Steering cylinder
2. Steering valve
3. Steering wheel
4. Steering pump (LAR016)
5. Flow control valve
6. Double relief valve

STEERING PIPING

GD705A-4

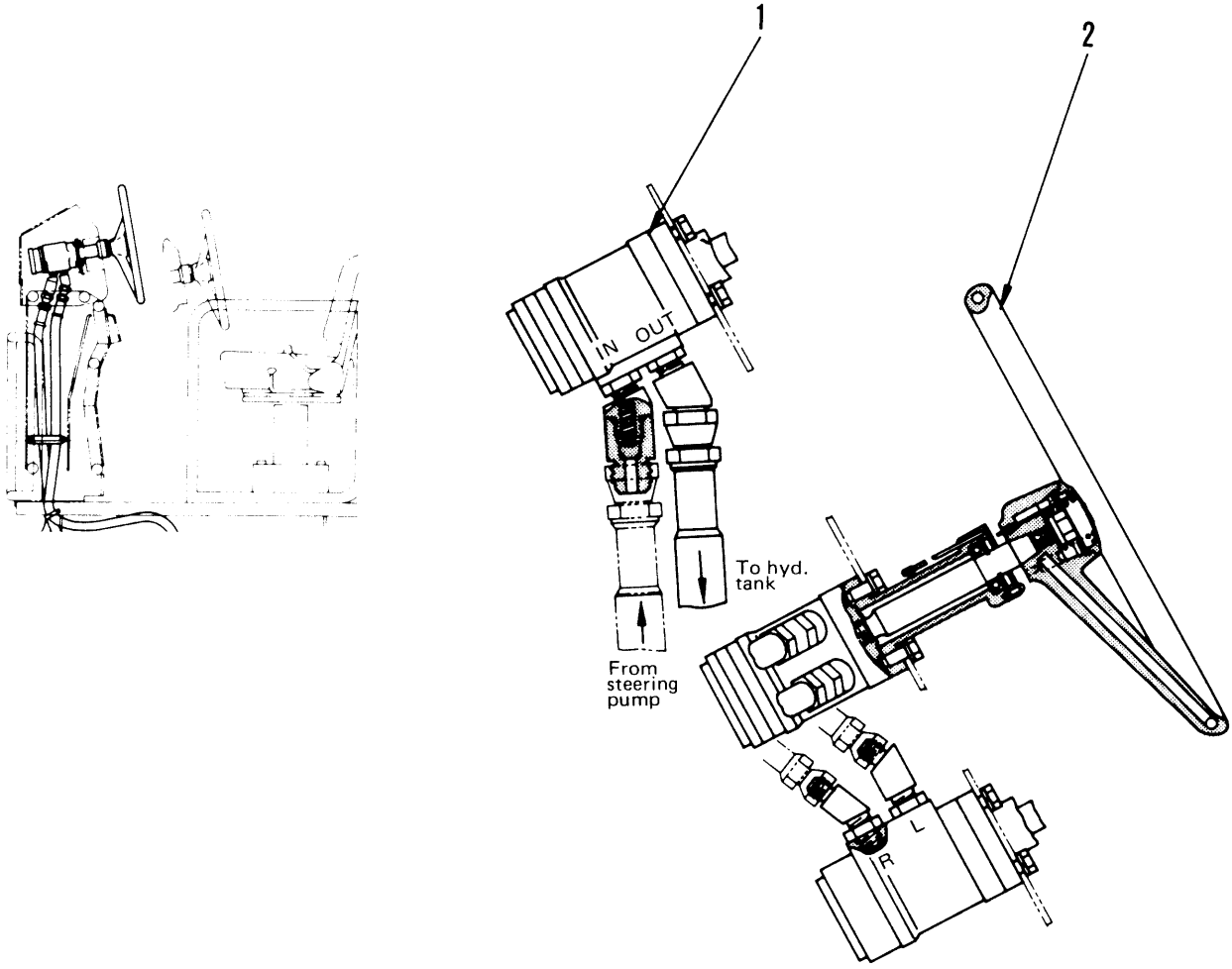


F23404015

The steering system on the GD705A is fully hydraulic. When steering wheel (3) is turned, an amount of oil in proportion to the angle of turning is sent from steering valve (2) (orbit roll type) to steering cylinder (1). This operates the steering.

1. Steering cylinder
2. Steering valve
3. Steering wheel
4. Steering pump (SAR032)
5. Flow control valve
6. Oil cooler
7. Double relief valve

STEERING WHEEL

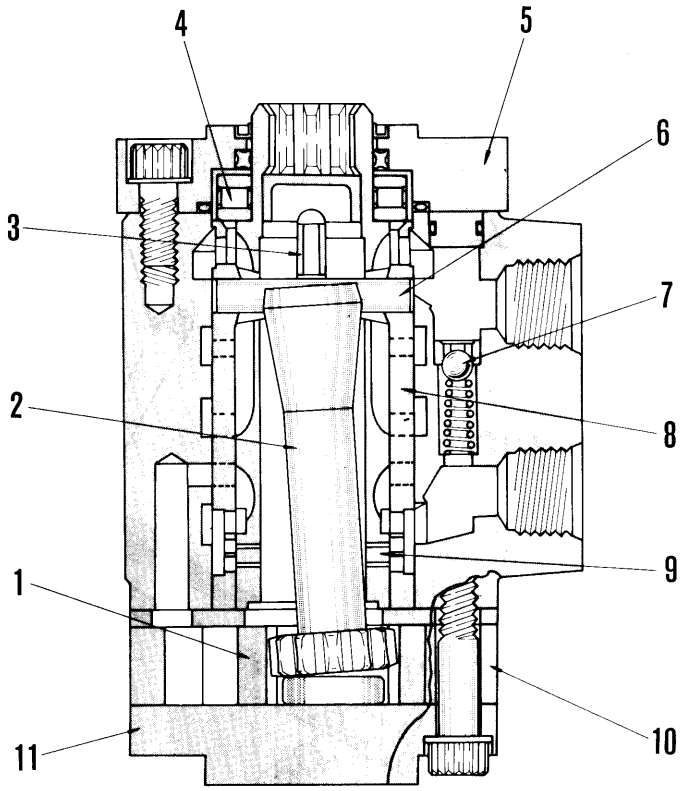


F23AB043

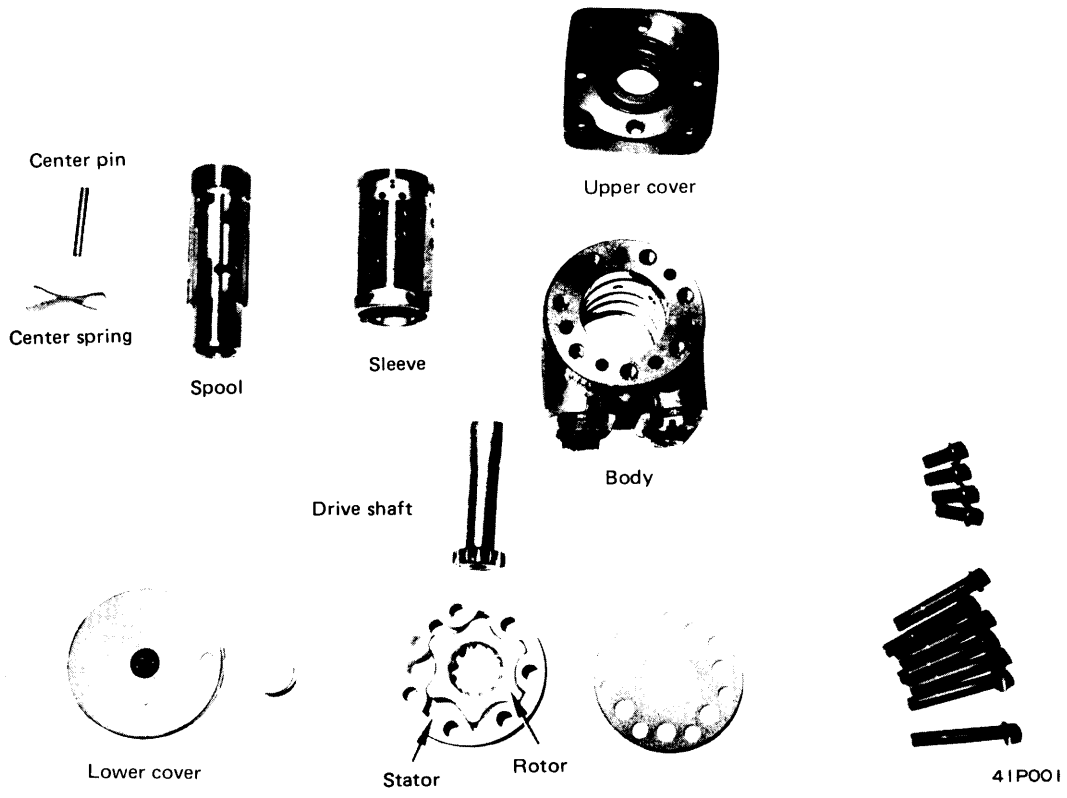
The GD705-4 steering system features hydraulic control. A quantity of oil corresponding to the turn of the steering wheel (2) passes to the steering cylinder via a steering valve (Orbit roll type). The hydraulic oil is also used in the steering system.

1. Steering valve
2. Steering wheel

STEERING VALVE (Orbit roll type)



1. Rotor
2. Drive shaft
3. Center spring
4. Needle bearing
5. Upper cover
6. Center pin
7. Check valve ball
8. Sleeve
9. Spool
10. Stator
11. Lower cover

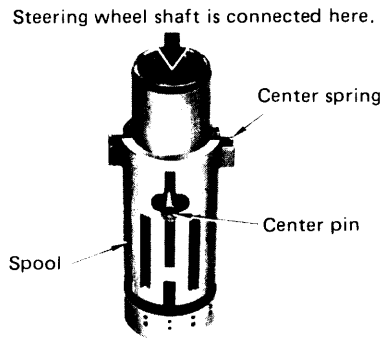


STEERING SYSTEM

STRUCTURE

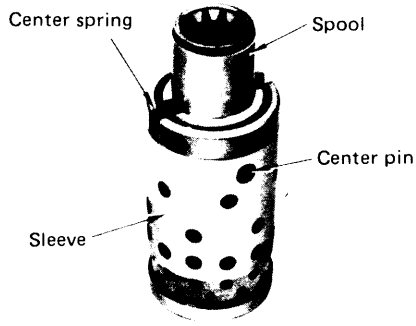
The steering system is of the fully hydraulic type and hydraulic oil is sent to the steering cylinder by this steering valve, oil flow being varied with turning angle of the steering wheel. The valve has a builtin hand pump, which makes it possible to suck up oil directly from the tank so that necessary steering operation can be maintained in case of trouble of the oil pump or the engine. This valve is of the orbit roll type.

- The lower end of the steering wheel shaft is spline-fitted to the top of the spool, which is inserted in the sleeve. The spool and the sleeve are joined to each other with the center pin (which does not contact to the spool when the steering wheel is at neutral position) and the center spring.



41P002

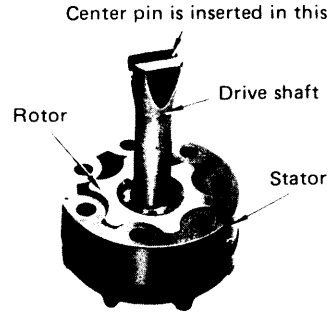
- There is the drive shaft inside the spool. The upper end of the shaft is joined to the center pin and the lower end of it is spline-fitted to the hand pump rotor. The hand pump adjusts oil flow to the cylinder, depending on steering angle of the steering wheel, and also acts to supply oil to the cylinder in case of oil pump or engine trouble by utilizing turning force of the steering wheel to suck up oil directly from the tank.



41P003

- The valve body has four ports which connect to the oil pump, tank, steering cylinder head and steering cylinder bottom, respectively. The pump side port and the tank side port are connected to each other through the check valve, which permits the steering valve to suck up oil directly from the tank in case of oil pump or engine trouble.

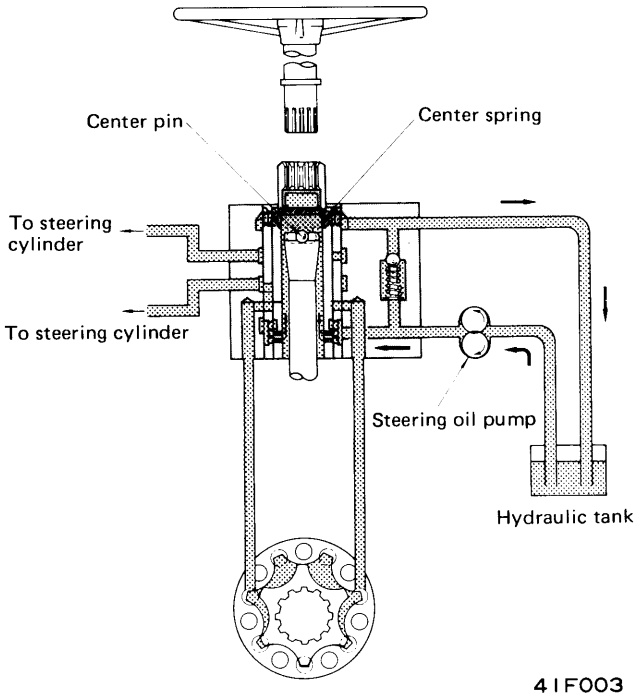
★ For the function of center spring, refer to page 41-12.



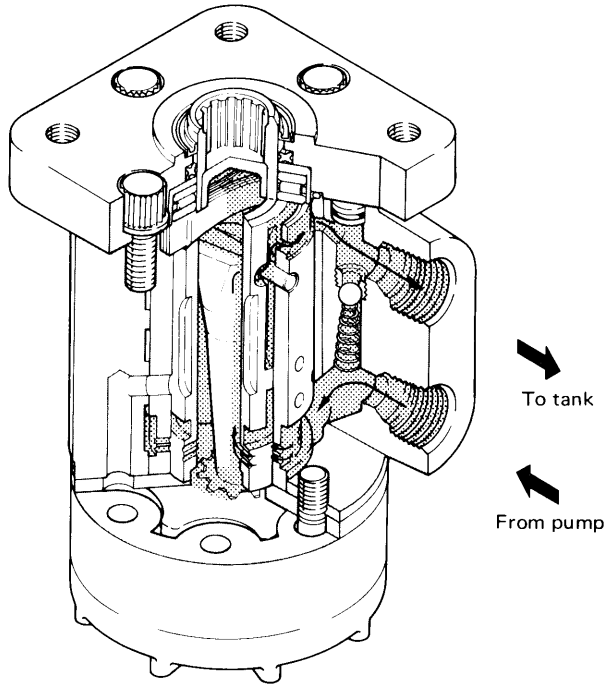
41P004

OPERATION

When steering wheel is not manipulated



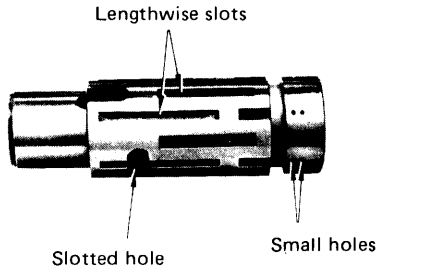
41F003



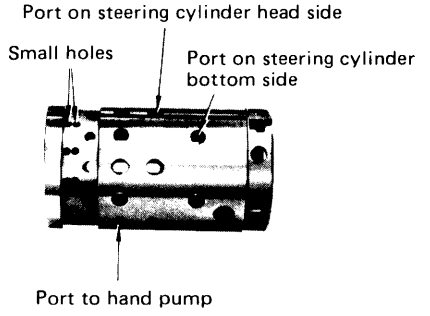
41F004

When the steering wheel is not manipulated, the center spring keeps the spool and the sleeve are stopped in the position at which the center pin is located to the center of the slotted hole in the spool. Under this condition, the ports that connect the sleeve to the steering cylinder and the hand pump are insulated from the lengthwise slots in the spool. While, the small holes in the spool bottom are aligned with those in the sleeve bottom. (Total 24 holes are provided by arranging twin holes at 12 places equally spaced around the circumference of spool or sleeve.)

Oil from the pump enters the valve inlet port and flows through the small holes in the sleeve and spool to the inside of the spool. The oil, in turn, flows through the slotted hole in the spool and the spring mounting portion to the valve outlet port, and is returned to the tank.

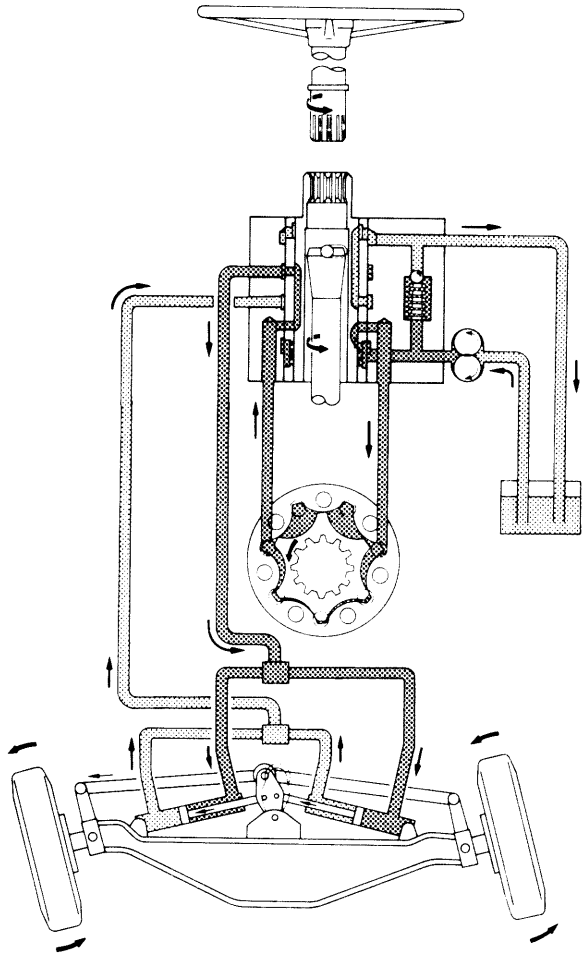


41P005

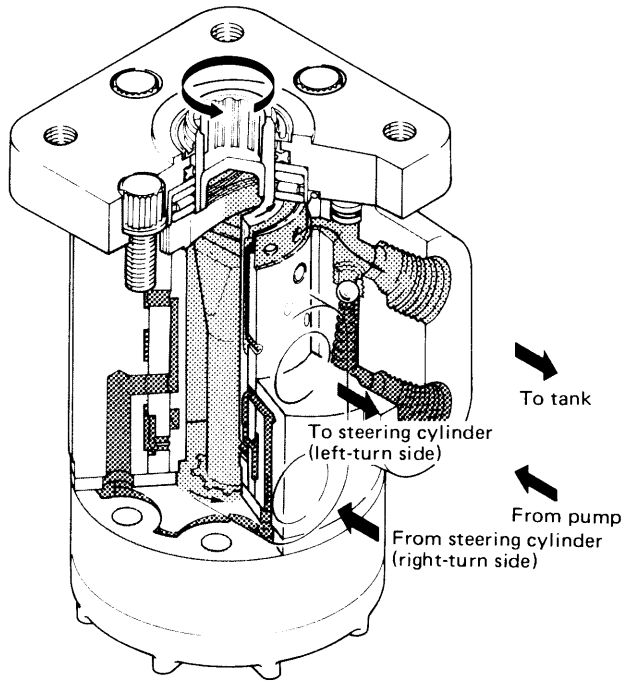


41P006

When steering wheel is manipulated (Turning to the left)



41F005



41F006

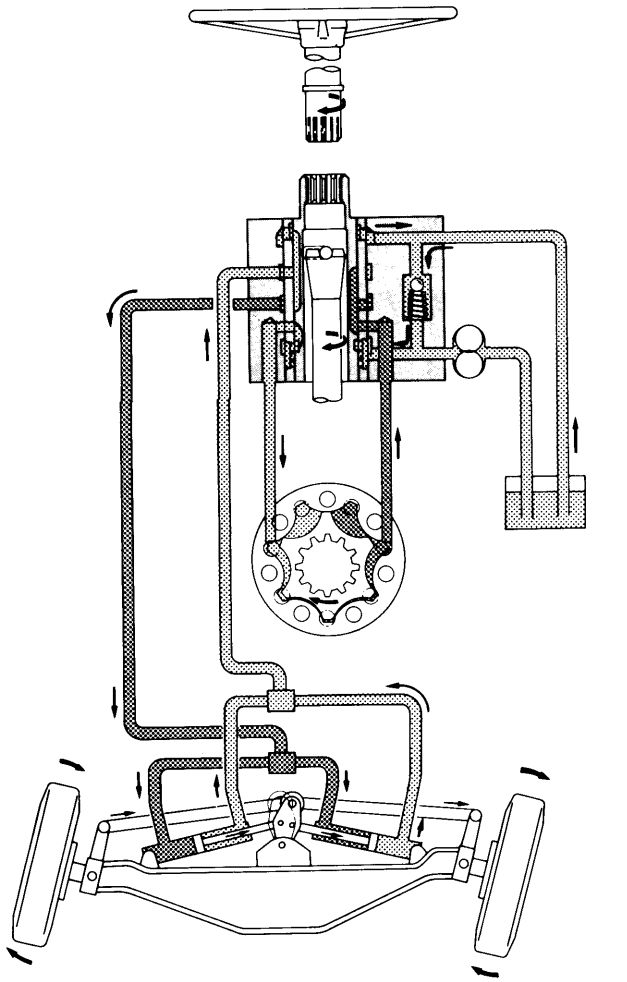
- When the steering wheel is turned to the left, the rotation causes the spool spline-fitted to the steering wheel shaft to turn to the left. As the sleeve is joined to the spool with the center spring, the spring contracted by the spool causes a difference in turning angle between the spool and the sleeve depending on contraction of the spring. As the result, each port in the sleeve is connected to a lengthwise slit in the spool.

- Under this condition, the hand pump port in the sleeve and the steering cylinder port (on the left-steering side) in the sleeve are connected to each other through the lengthwise slits in the spool. Also, the steering cylinder port (on the right-steering side) in the sleeve is connected to the valve outlet port in the sleeve.

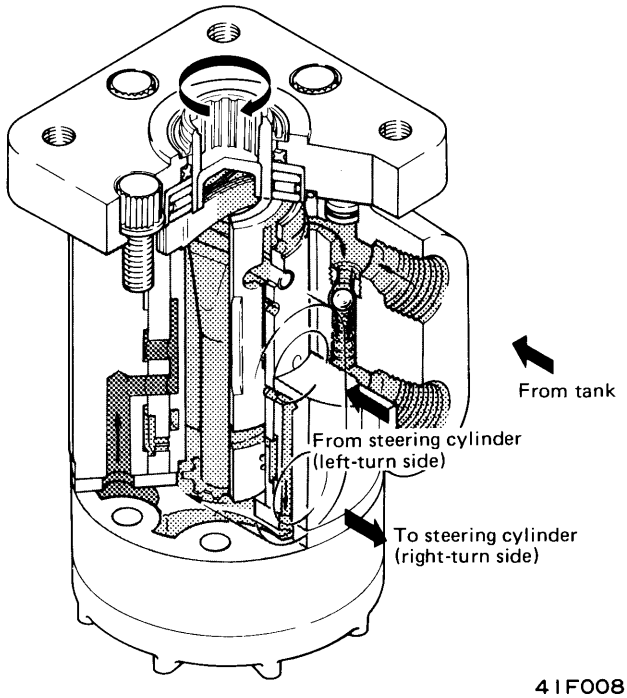
- Oil from the pump enters the hand pump through the valve inlet port and returns to the sleeve. The oil, in turn, flows from a lengthwise slit in the spool, through the steering cylinder port in the sleeve to the steering cylinder. While, oil from the steering cylinder is forced to flow through the port in the sleeve and a lengthwise slit in the spool and returns to the tank.

- Under such a condition as mentioned above, the hand pump is rotated by hydraulic oil from the pump and acts as an oil motor to lighten steering wheel manipulating force. When the steering wheel is stopped turning, difference in turning angle between the sleeve and the spool is removed by return force of the center spring. The same condition as mentioned before under "When steering wheel is not manipulated" is recovered. Refer to page 41-11 for details of mutual relation between the hand pump ports (7 ports) and the sleeve ports (12 ports) which will be connected to each other when the steering wheel is turned to either direction.

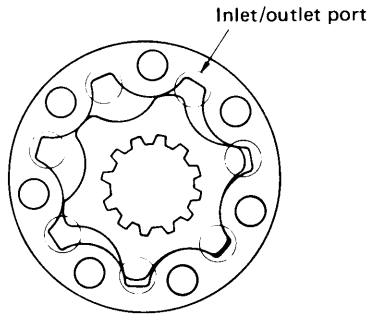
When steering is made with the oil pump mal-functioning (Turning to the right)



41F007



41F008



41F009

- When a motor grader is to be towed by another machine because of some trouble in the oil pump or the engine, keeping normal steering of the grader cannot be neglected to prevent accident. To satisfy this requirement, a built-in hand pump is provided on the bottom of the steering valve. When the steering system is normally supplied hydraulic oil from the pump, the hand pump is only to control flow of oil, its rotation being supported by pressure of oil. When oil from the pump is stopped, the center pin comes into contact with an end of the slitted hole in the spool and, then, turning force of the steering wheel is used for driving the hand pump.

- Like as before-mentioned, a difference occurs in turning angle between the spool and the sleeve and, therefore, each port in the sleeve is connected to a lengthwise slit in the spool. The hand pump is rotated with turning of the steering wheel. The rotation causes the hand pump to suck oil directly from the tank, through the check valve provided between the valve outlet port and the inlet port, and to deliver oil to the steering cylinder.

- The hand pump resemble trochoid pumps, but its ports are arranged on the root of teeth and each port acts as the inlet port and the outlet port alternatively. Oil suction and discharge operation of the hand pump is carried out by the combination of the seven ports in the hand pump and the 12 ports in the sleeve. (see page 41-11)

CONNECTION OF HAND PUMP PORTS TO SLEEVE PORTS

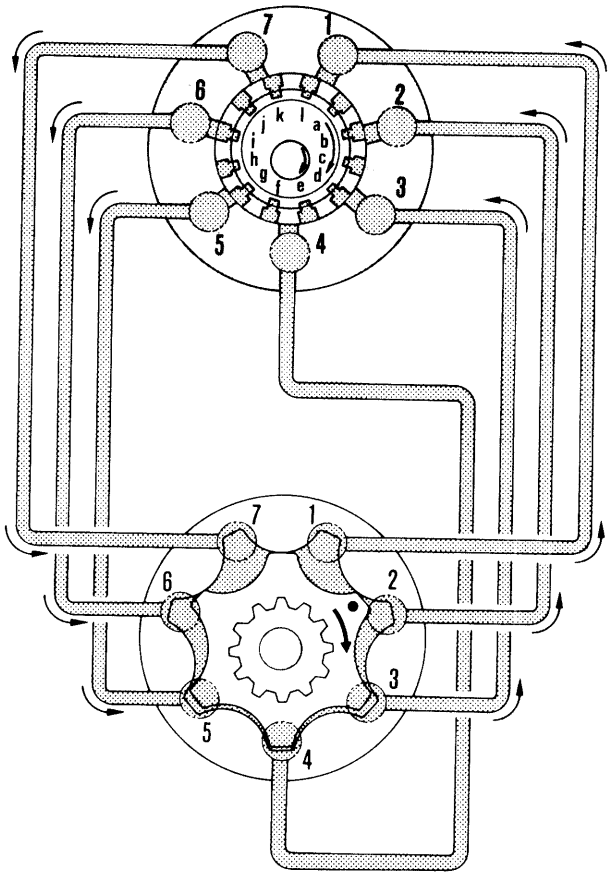


Fig. 1 41F010

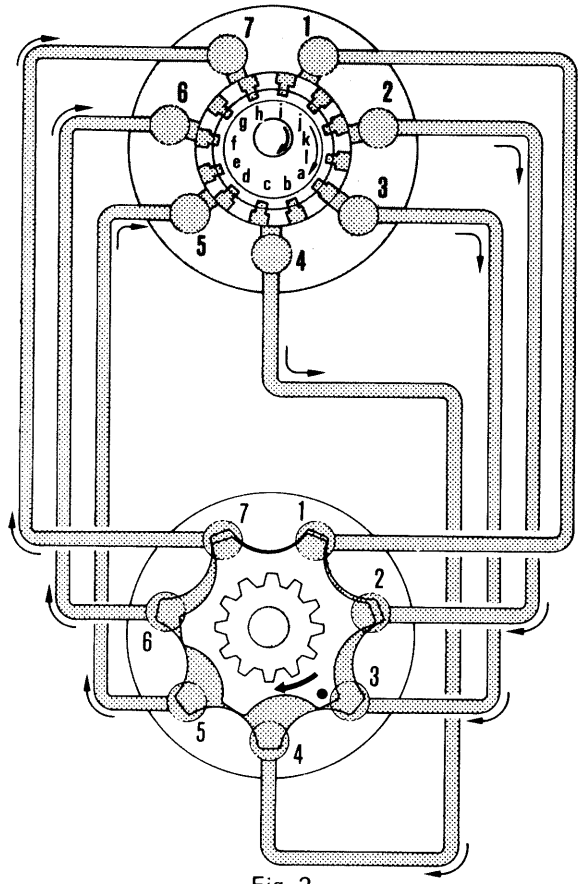
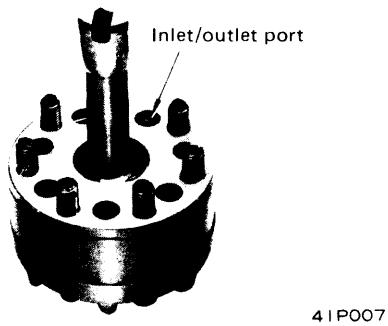


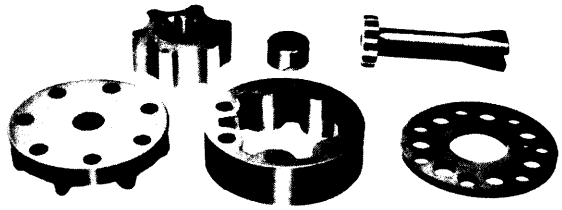
Fig. 2 41F011

- The scheme of connection of hand pump ports (7 ports) to sleeve ports (12 ports) is illustrated above. When the steering wheel is turned to the right, ports 2, c, e, g, i and k are connected through the lengthwise slits in the spool to the pump. Similarly, ports b, d, f, h, j and l are connected to the steering cylinder.

- Under the condition shown in Fig. 1, hand pump ports 1, 2 and 3 are in oil delivery state. At that time, these ports are just connected to sleeve ports 1, b and d, respectively, and oil is sent to the cylinder from these ports. Furthermore, hand pump ports 5, 6 and 7 are in oil suction state and they are just connected to sleeve ports g, i and k ports, respectively. Oil from the steering oil pump is sucked up through these ports. When the steering wheel is turned 90° from the condition shown in Fig. 1, connection of hand pump ports to steering ports shown in Fig. 2 is obtained. Under this condition, hand pump ports 1, 2 and 3 just connected to sleeve ports i, k and a, respectively, are in oil suction state. While, hand pump ports 5, 6 and 7 just connected to sleeve ports d, f and h, respectively, are in oil delivery state.



41P007

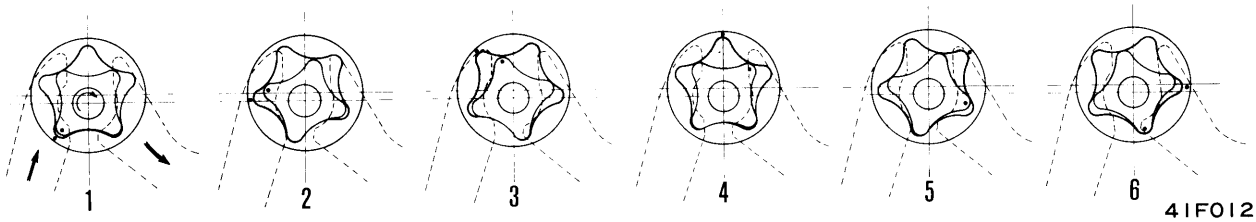


41P008

- As described above, hand pump ports being in oil delivery state are connected to the respective sleeve ports which lead to the steering cylinder. While, hand pump ports being in oil suction state are connected to the respective sleeve ports which lead to the steering oil pump. When supply of oil from the sleering oil pump is stopped because of some trouble in the engine or the pump, the hand pump is forced to suck up oil from the tank and deliver oil to the steering cylinder with manipulation of the steering wheel. Therefore, necessary steering operation can be maintained.
- The other function of the hand pump is to adjust delivery of oil by using the fact that all oil from the steering oil pump must always pass through the hand pump. As the internal gear of the hand pump advances one tooth for each 1/7 turn of the steering wheel, causing delivery of oil corresponding to the advance of the internal gear, quantity of delivery of oil is direct proportion to the steered angle of the steering wheel. This function of the hand pump is not lost even when the engine or steering oil pump is mal-functioning, so that normal oil delivery property can be maintained.

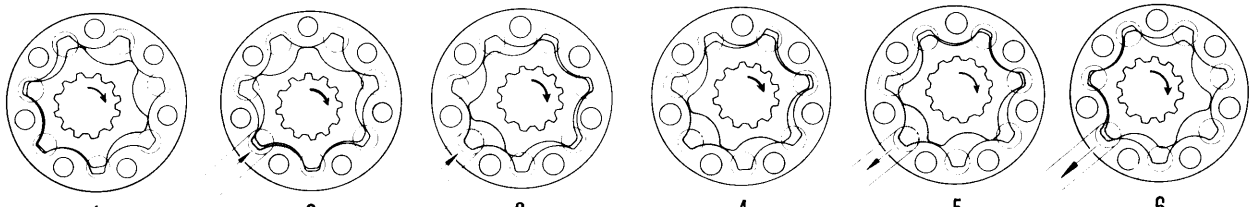
Comparison between trochoid pump and steering valve hand pump

- In the case of the trochoid pump, the inlet port and the outlet port are located separately from each other. When the pump shaft turns as shown in the figure below, the pump sucks oil from the inlet side and delivers it from the outlet side in the sequence of 2 to 6.



41F012

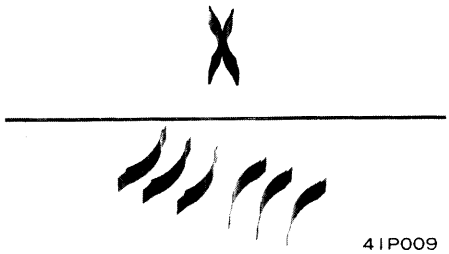
- In the case of the hand pump, the inlet/outlet ports are arranged at the root of teeth of internal gear. When the pump shaft runs, the port shown in the figure is connected to the steering oil pump at the steps 2 and 3 to suck up oil and is connected to the steering cylinder at the steps 5 and 6 to send oil to the cylinder. Each of seven ports performs the same oil suction and delivery operation, independently.

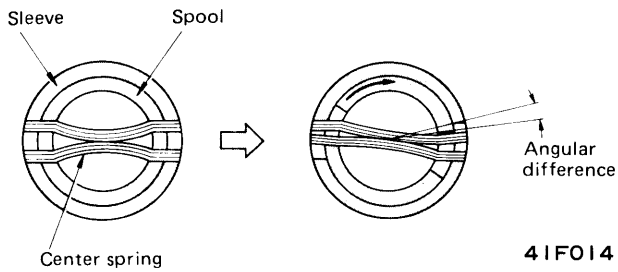


41F013

Function of center spring

- The X-shape center spring, which is formed by two sets of three leaf springs as shown in the photo below, is installed in the sleeve and spool. When the steering wheel is turned in either direction, the spool compresses the center spring. Because of the X-shape spring, some angular difference arises between the sleeve and the spool. This causes the connection of sleeve ports and spool ports to each other so that oil flows through the ports to the steering cylinder. When turning of the steering wheel is stopped, the hand pump stops turning. As oil flow to the cylinder is shut off, oil pressure rises until the main relief valve opens to relieve the oil. To prevent such unnecessary rise of oil pressure, the center spring returns to the original state so that no angular difference between the sleeve and the spool remains. Then, the same condition as mentioned before under "When steering wheel is not manipulated" in page 41-8 is recovered.

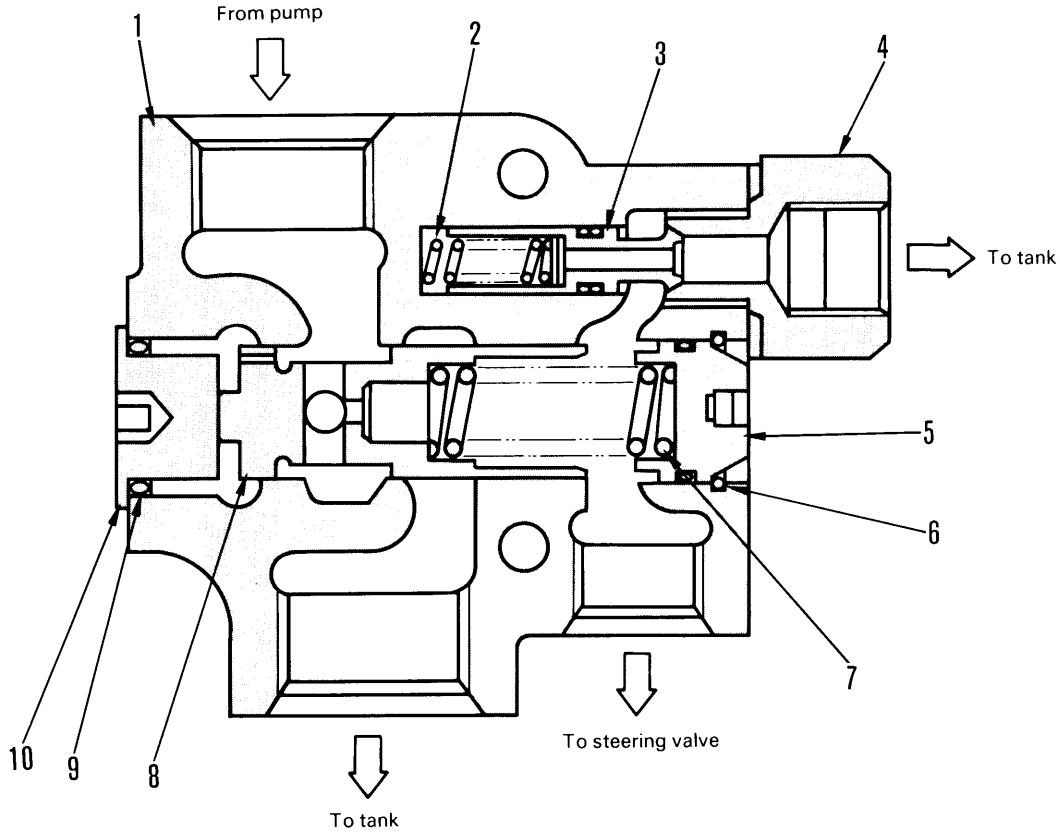

41P009



41F014

FLOW CONTROL VALVE

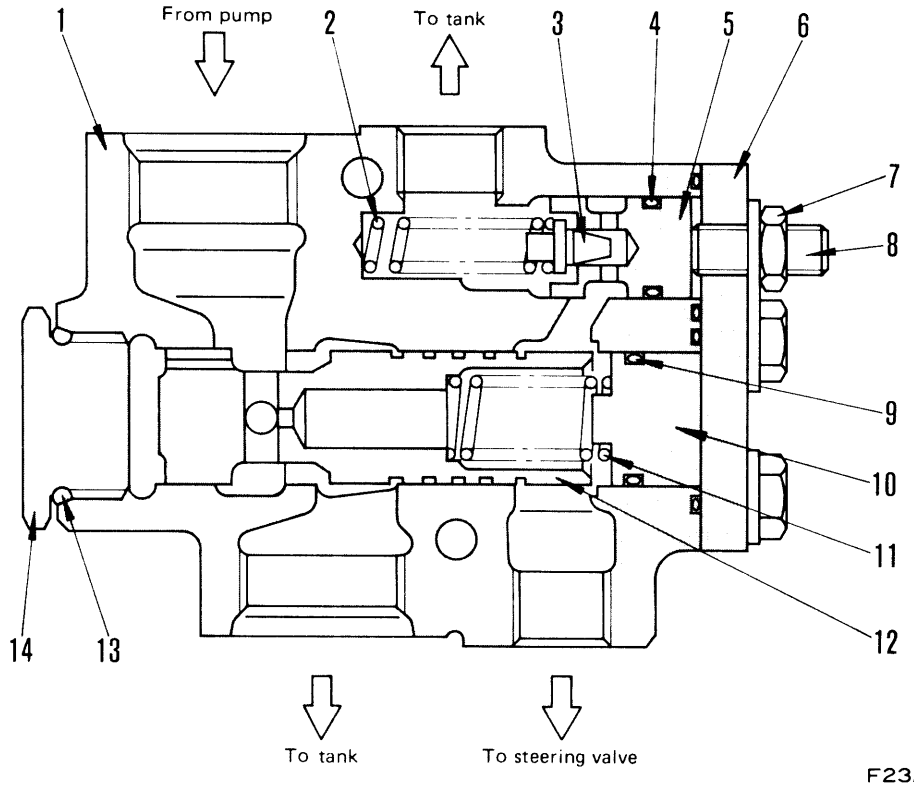
GD705R-4



F23E04031

1. Body
2. Relief spring
3. Relief plunger
4. Connector
5. Spring seat
6. Snap ring
7. Spring
8. Plunger
9. O-ring
10. Plug

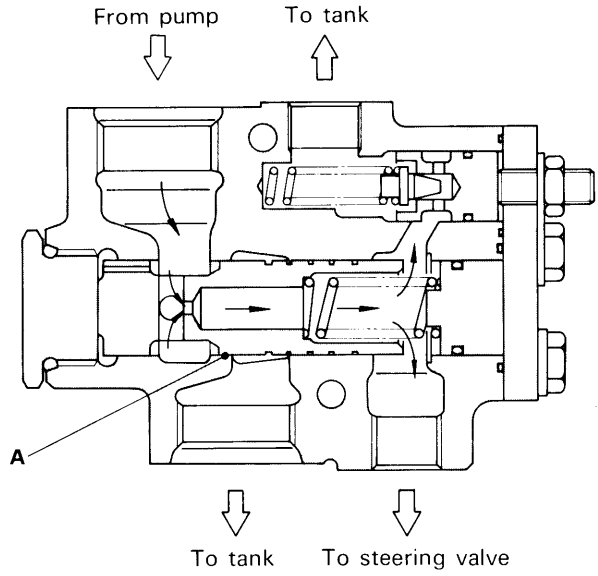
GD705A-4



1. Valve body
2. Relief spring
3. Poppet valve
4. O-ring
5. Housing
6. Plate
7. Nut
8. Adjusting screw
9. O-ring
10. Plug
11. Flow control spring
12. Plunger
13. O-ring
14. Plug

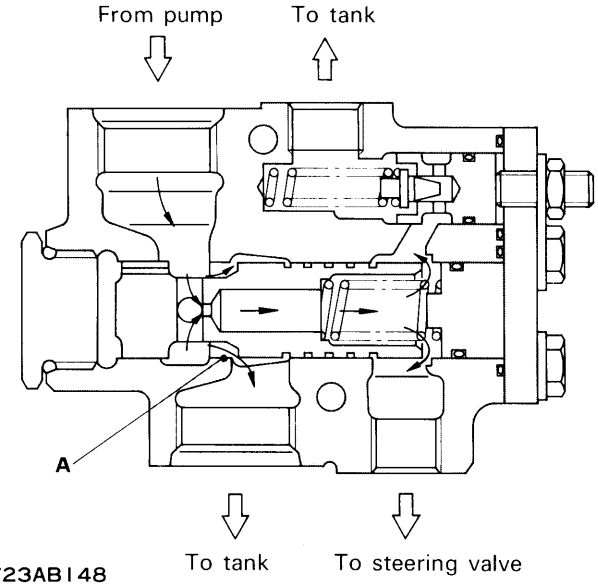
OPERATION (For example GD705A-4)

1. **When pump delivery is lower than regulated flow**
   The flow of oil from the pump (IN side) passes through the orifice and goes to the steering valve (PF side). When this happens, the flow of oil through the orifice causes a difference in pressure on the two sides of the orifice. This difference in pressure acts on the plunger which compresses the spring. Because of the balance with the spring force, portion "A" of the plunger is not connected to the tank (EF side). As a result, all of the oil flows to the steering valve (PF side).



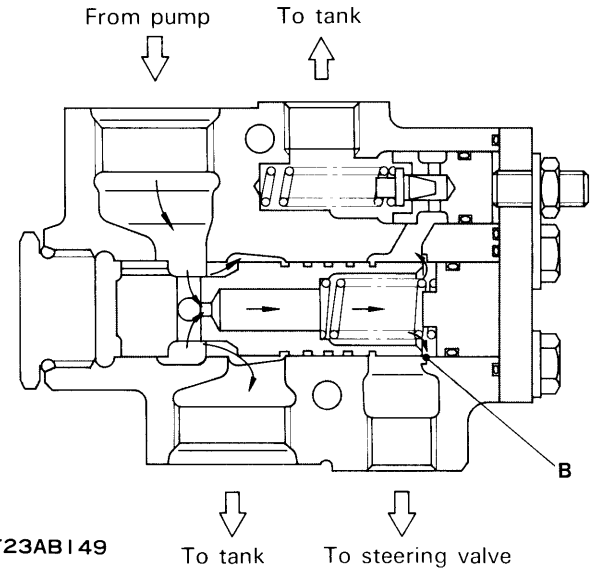
F23AB147

2. **When pump delivery is high than regulated flow**
   When the flow of oil from the pump (IN side) exceeds the set regulated flow, the difference in pressure on the two sides of the orifice becomes larger. The plunger moves, portion "A" opens, and the remaining oil flows to the tank (EF side). In this condition, the steering valve (PF side) circuit functions. If the pressure rises, the plunger moves to make the area of the opening at portion "A" smaller. In this way, the system is kept in balance automatically so that the actuating pressure and set regulated flow can be maintained.



F23AB148

3. **When circuit on tank side (EF side) is actuated**
   If oil flows to the tank (EF side) is actuates the tank circuit (EF side). When the pressure rises, the difference in pressure on the two sides of the orifice causes the plunger to move. This makes the opening at portion "B" smaller, and automatically prevents the excess oil from flowing to the steering valve (PF side).

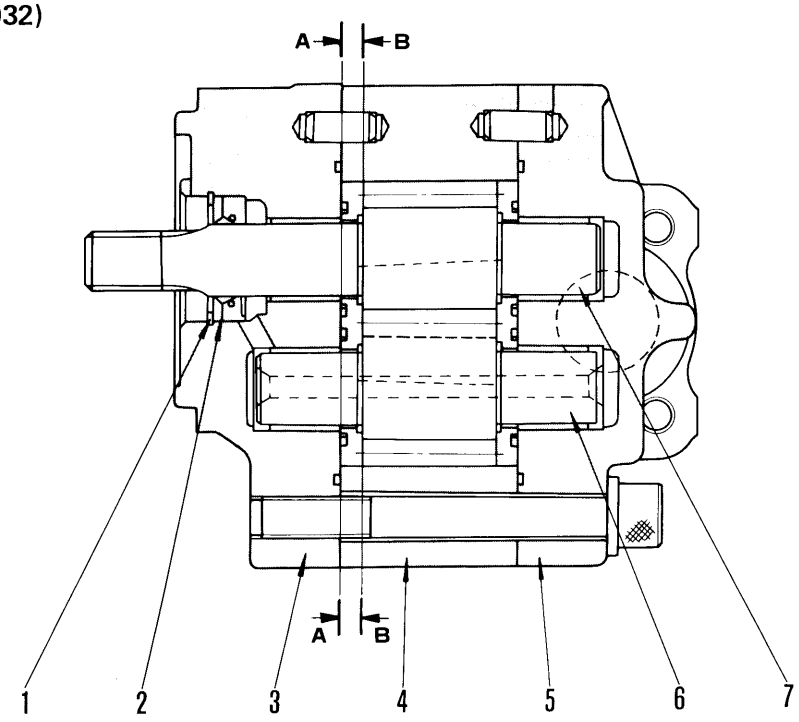


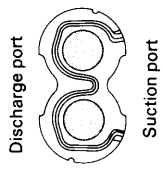
F23AB149

4. **When circuits on steering valve side (PF side) and tank side (EF side) are actuated simultaneously**
   If the actuating pressures of the circuits on both the steering valve side (PF side) and the tank side (EF side) are raised simultaneously, the openings at portions "A" and "B" of the plunger are automatically determined so that a constant regulated flow is maintained.

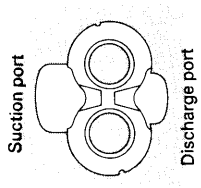
STEERING PUMP

GD705R-4 (LAR016)
GD705A-4 (SAR032)





Section A-A



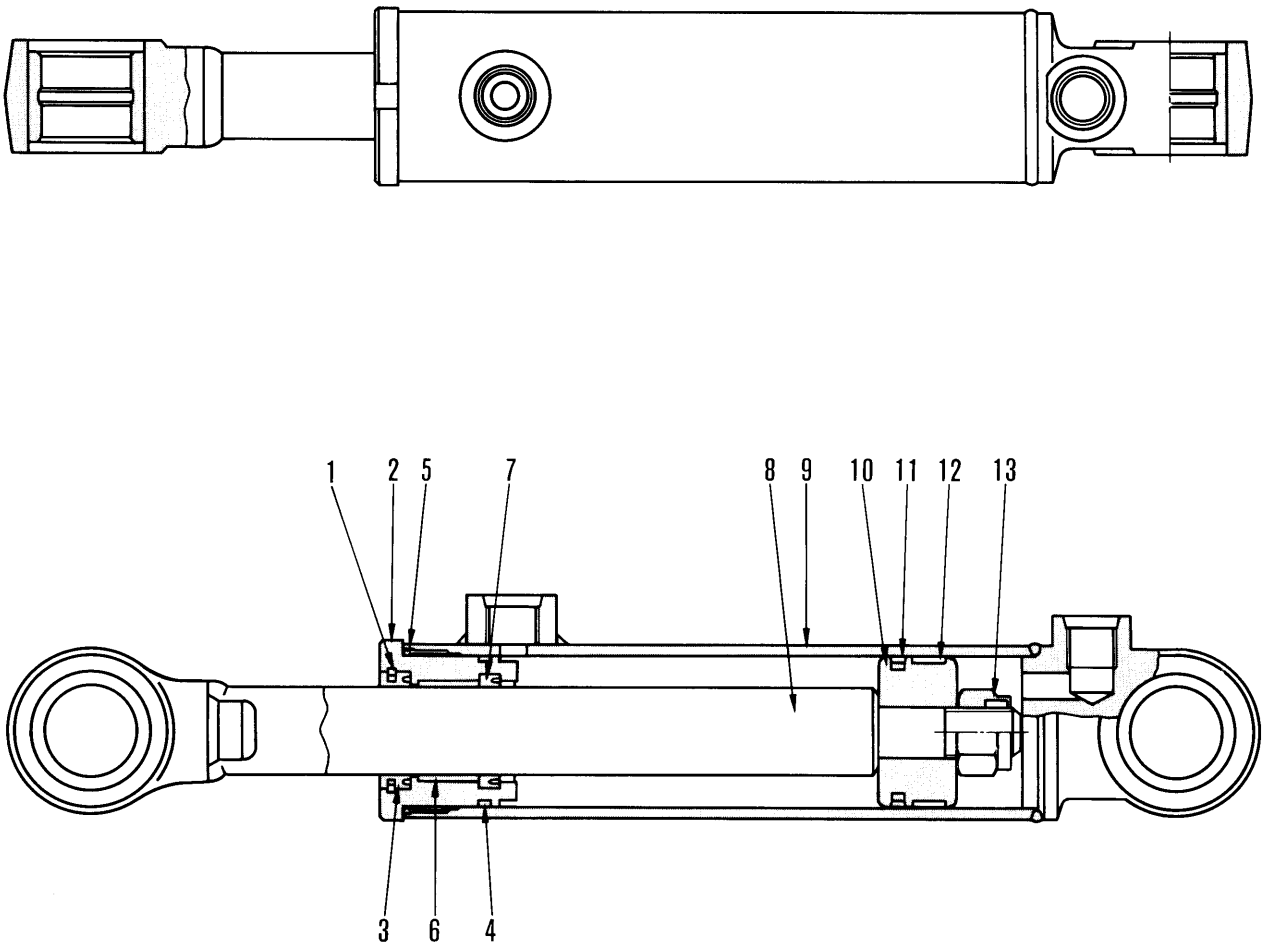
Section B-B

F23E030

1. Snap ring
2. Oil seal
3. Bracket
4. Gear case
5. Carrier
6. Driven gear
7. Drive gear

STEERING CYLINDER

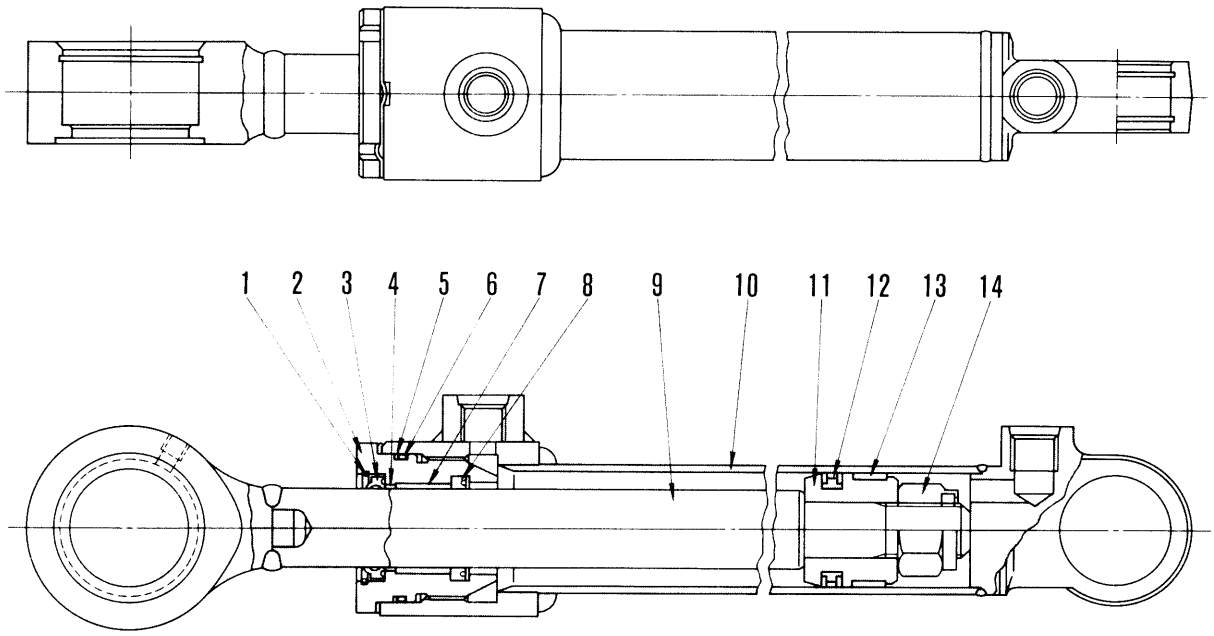
GD705R-4



F23E04032

1. Snap ring
2. Cylinder head
3. Dust seal
4. Back up ring
5. O-ring
6. Bushing
7. Rod packing
8. Piston rod
9. Cylinder
10. Piston
11. Piston ring
12. Wearing
13. Nut

GD705A-4

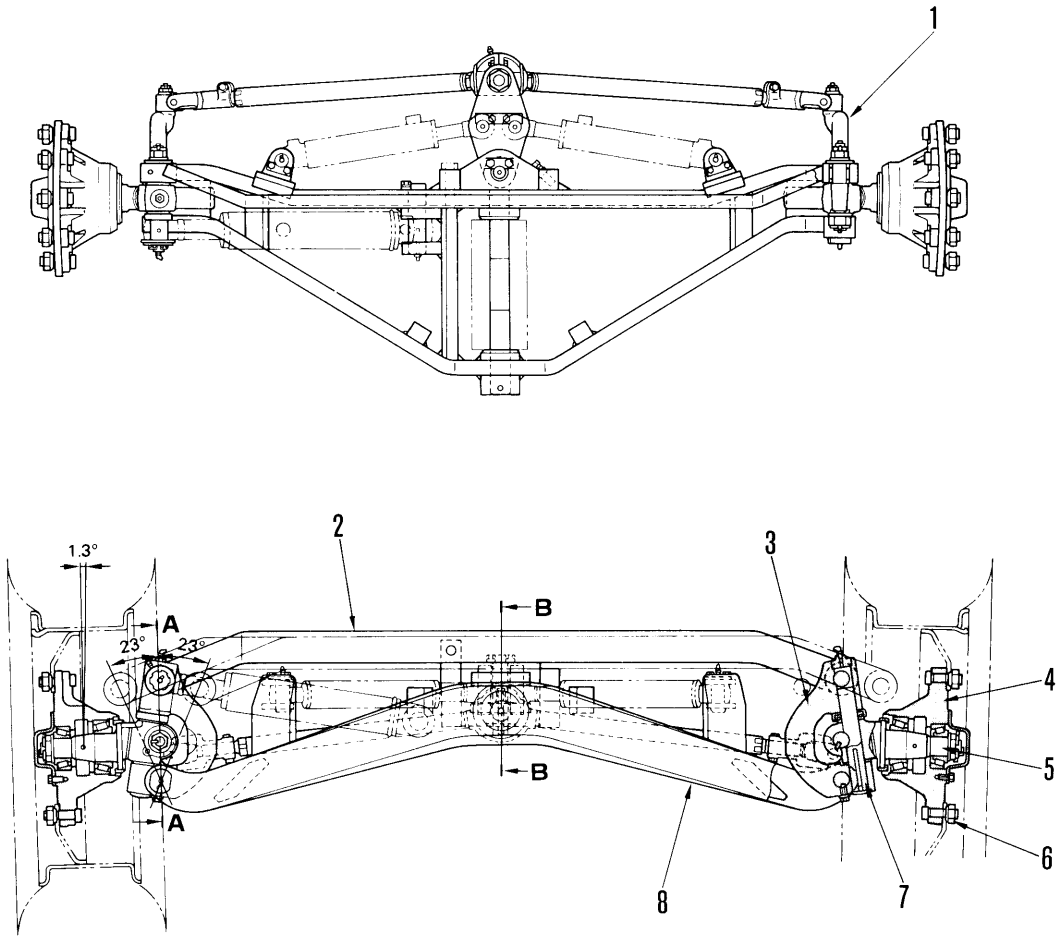


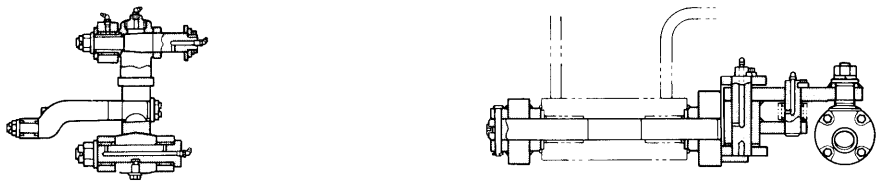
F23E031

1. Snap ring
2. Cylinder head
3. Dust seal
4. Ring
5. Backup ring
6. O-ring
7. Bushing
8. Rod packing
9. Piston rod
10. Cylinder
11. Piston
12. Piston ring
13. Wearing
14. Nut

FRONT AXLE

GD705R-4





Section A – A

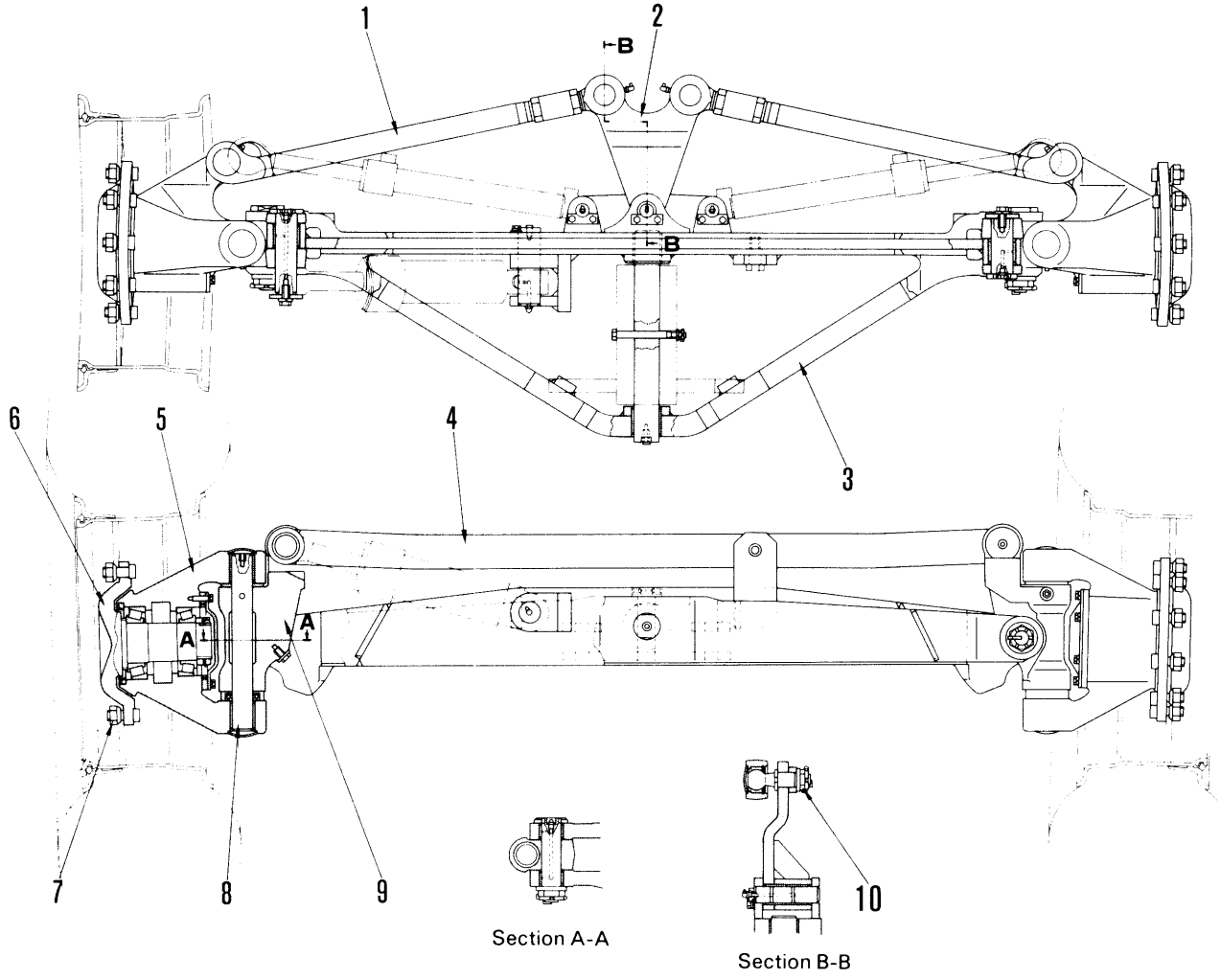
Section B – B

F23E04033

Toe-in 6.5mm
Camber 1.5°
King pin tilting angle 8.5°

1. Knuckle arm
2. Leaning rod
3. Knuckle bracket
4. Hub
5. Knuckle
6. Hub bolt, Nut
7. King pin
8. Front axle

GD705A-4



F23E032

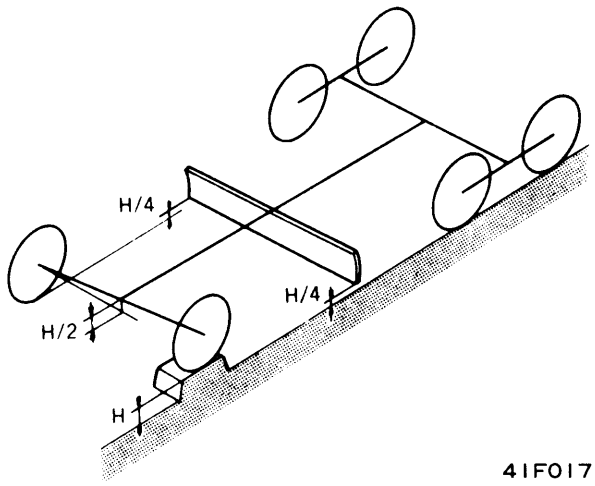
Toe-in 8.2 ± 1.0 mm
Camber 1.5°
King pin tilting angle: 0°

1. Tie rod
2. Pitman arm
3. Front axle
4. Leaning rod
5. Housing
6. Hub shaft
7. Hub nut
8. King pin
9. Bracket
10. Nut

FUNCTION OF FRONT AXLE

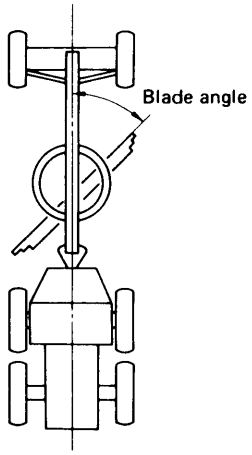
1. **Steering**
   Refer section, "STEERING SYSTEM"

2. **Lessening blade angling and up-and-down movement**
   The axle is fixed in the center with a center pin to the frame so that it can oscillate 13 degrees. This, like the tandem system, restricts the up-and-down movement of the blade to a minimum when one front wheel rides over an object or falls into a hole. When the front wheel rides over an object (height-H), the center point of the front axle rises H/2, as shown in drawing. Because of possible rocking of front axle blade movement rises only H/4 while holding its horizontal posture. Unless the whole oscillating range (left, right 13°) of the front axle is used, the blade moves up-and-down holding its horizontal posture.



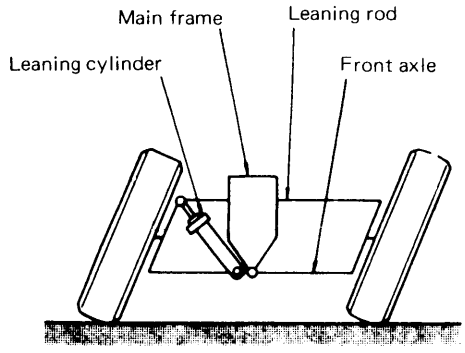
41F017

3. **Prevention of side slipping of front wheels (leaning system)**
   The front wheels can be tilted to left or right. This is called the leaning system, and is to prevent the front wheels from slipping sidewards and to reduce the turning radius.
   Operations with blade at propulsion angle are frequent among grader operations. In proportion to the propulsion angle a side slipping force acts on the blade to cause side slipping.



41F018

Also the distribution of weight on the front and rear wheels is about 3:7, and when the blade cuts into the ground, the load on the front wheels decreases and it is easier for the front wheels to slip sideward.
To counteract this side slipping, the front wheels are leaned to make them more resistant, and this changes the center of the load on the front axle and the center of gravity of the machine and prevents side slipping.

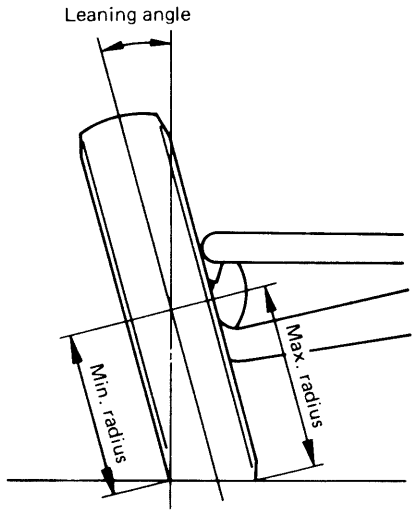


41F019

When the wheel is leaned the angle between the center line of the leaned tire and the perpendicular line is called the "Leaning angle".
Leaning angle is the distance $S = 2 \times \pi \times r$ covered by the tire as it advances, and the side with the greater load radius, in order to advance more than the side with the less load radius, advances in the direction of the leaning. Using this characteristic, the turning radius can be lessened when the leaning operation is carried out.

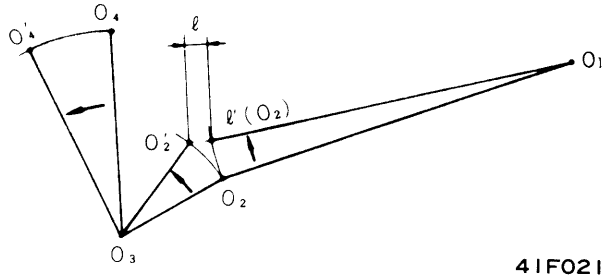
When backing, leaning should be reversed tc the leaning for forward operation by turning a steering wheel in the same direction.

Leaning angle is 16.5°.



41F020

Also, when there is no differential mechanism, even though the front wheels are steered, the rear wheels tend to go straight ahead and this causes the front wheels to slip little by little. Leaning prevents this. Also, the front wheels steering angle is increased by leaning.
Explanation according to the drawing to the right: (In order to keep the explanation simple it will be done without steering.)
When the front wheels are leaned to one side, O_4 revolves 23° around O_3 and comes to O_4, and at the same time O_2 also revolves around O_3 and comes to O_2. The tie-rod revolves around O_1, but since its length is fixed, a clearance "ℓ" is made. However, since O_1, is fixed, the housing is pulled to the "ℓ" and comes to the position "ℓ" (O_2).
Since the front wheels are steered a little in the direction of leaning, the steering angle becomes a little bigger.



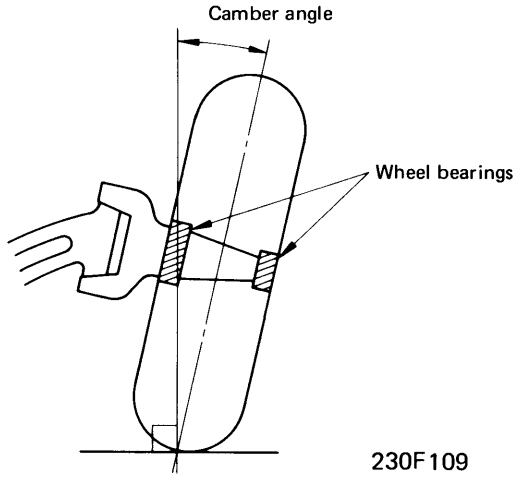
41F021

O_1 : Center of pitman arm ball joint
O_2 : Center of tie-rod end pin
O_3 : Center of mounting pin of housing
O_4 : Center of cylinder rod

FRONT WHEEL ALIGNMENT

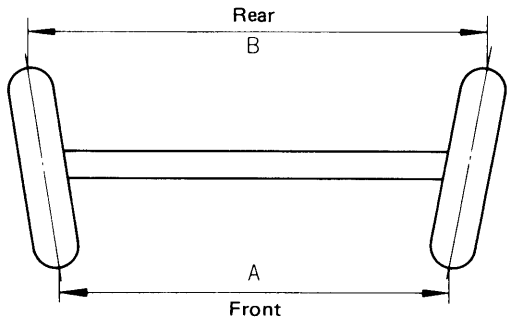
In vehicles steered by the two front wheels, the wheels are fitted by a special method to ensure ease, stability, and accuracy in steering. This special fitting is called alignment, and has a very big influence on operation of the steering wheel.

1. **Camber**
   The front wheels are fitted so that the top of the wheels is further away from the vehicle than the bottom of the wheels in contact with the ground. This slanting is called camber.



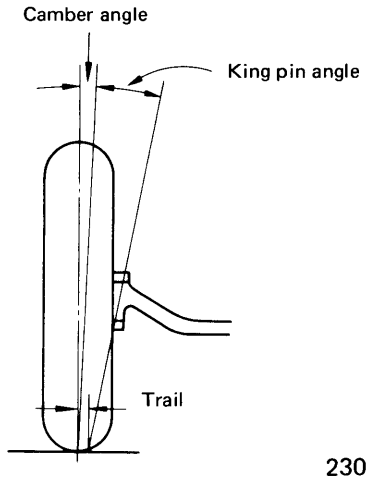
230F109

2. **Toe-in**
   When seen from above, the distance **A** between the front of the front wheels is slightly less than the distance **B** between the rears.
   This is called toe-in.
   When vehicles travel with a camber angle, the force which tends to push the front wheels outwards increases the ground resistance of the wheels, resulting in less stable travel and greater tire wear. By fitting the wheels with a slight inward slant, however, this undesirable tendency can be eliminated. The difference between **A** and **B** of 3 to 7 mm is called the toe-in quantity.



230F110

3. **King pin angle of inclination**
   The king pin is not exactly vertical to the ground but inclines slightly inwards. This angle is called the king pin angle of inclination.
   Together with the camber, this inclination shortens the trail for easier steering wheel operation.
   Since the front wheels turn during operation with the king pin center line as the center axis, the front wheels tend to be lifted up. This action, however, is also accompanied by a reaction which tends to return the wheels to the former position. When the grader turns a little and still is about to proceed straight ahead, releasing the steering wheel will generate the restoring force, and bring the steering wheel back to its former position. This angle is generally about 5° to 8°.



230F111

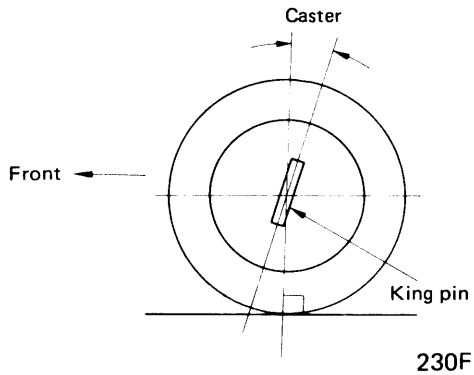
4. Caster (The caster angle in graders is 0°.)

Caster refers to the angle at which the king pin is fitted when the wheel is viewed from the side shown in the accompanying diagram. The angle is called the caster angle.

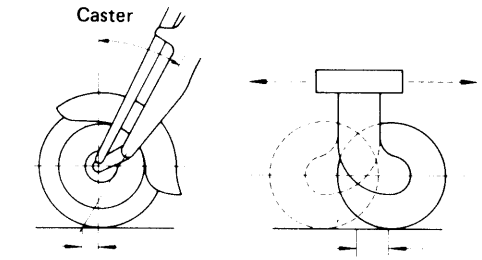
If the king pin is fitted at an angle, the point of contact between the wheel and the ground will be behind the point where the extrapolated king pin center line meets the ground. This means that during travel, there is a force constantly pulling the wheels backward, depending on the ground resistance added to the point where the wheels are in contact with the ground. This backward force tends to keep the wheels directed straight ahead (directional property).

This force also tends to return the steering wheel to the original position when the steering wheel is turned (restoring property).

In automobiles, the caster angle is generally 1° to 3°. In graders, however, the angle is 0°.



230F112

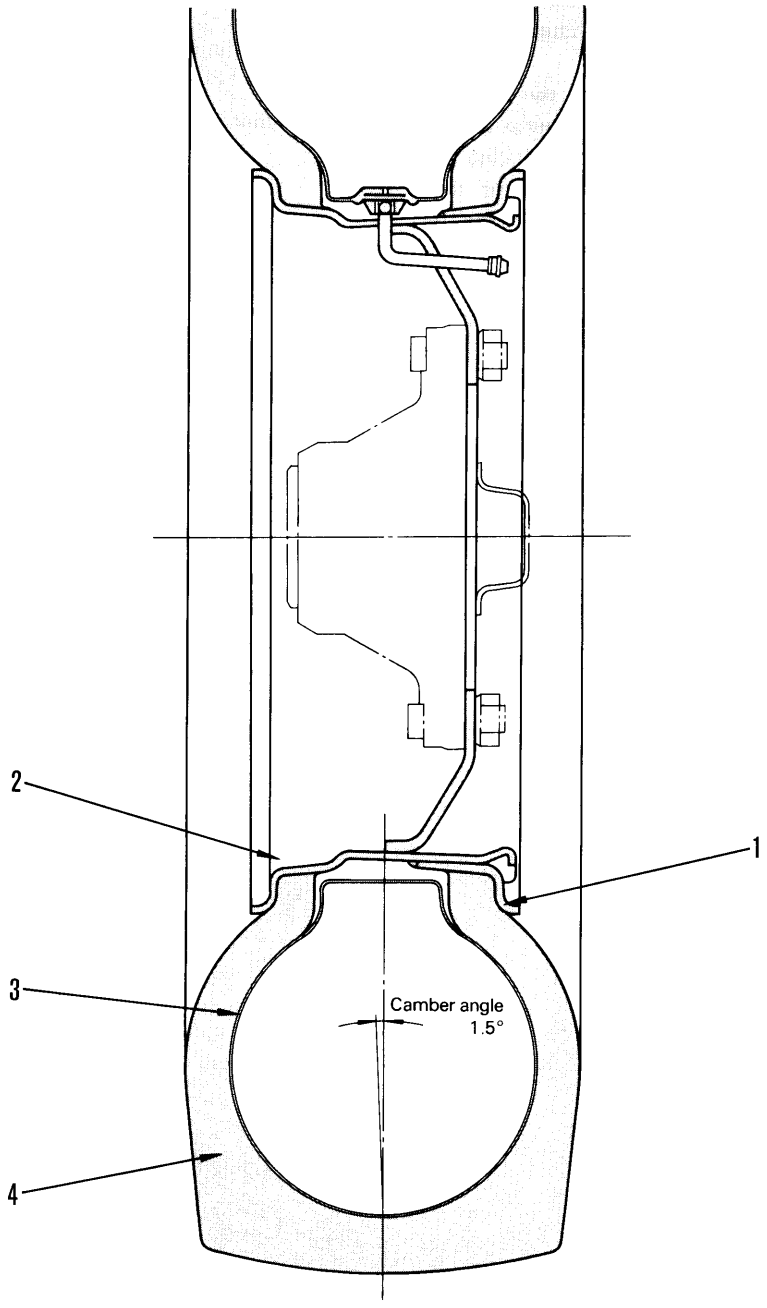


230F113

WHEEL

GD705R-4

FRONT WHEEL

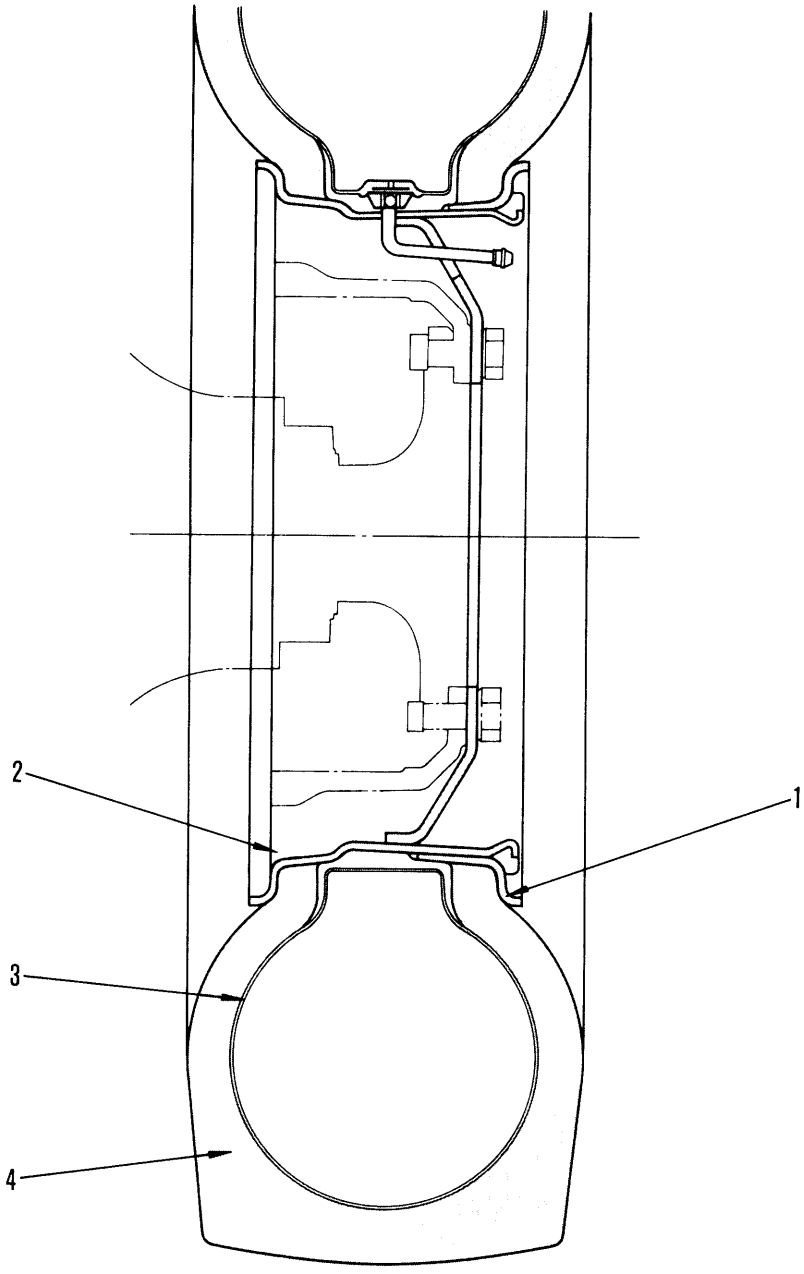


F23E04034

Tire size	14.00 – 24 – 12PR
Tire pattern	Traction
Rim size	8.00TG x 24
Air pressure	3.5 kg/cm^2

1. Side ring
2. Rim
3. Tube
4. Tire

REAR WHEEL



F23E04035

Oscillate angle +13° ∿ −13°

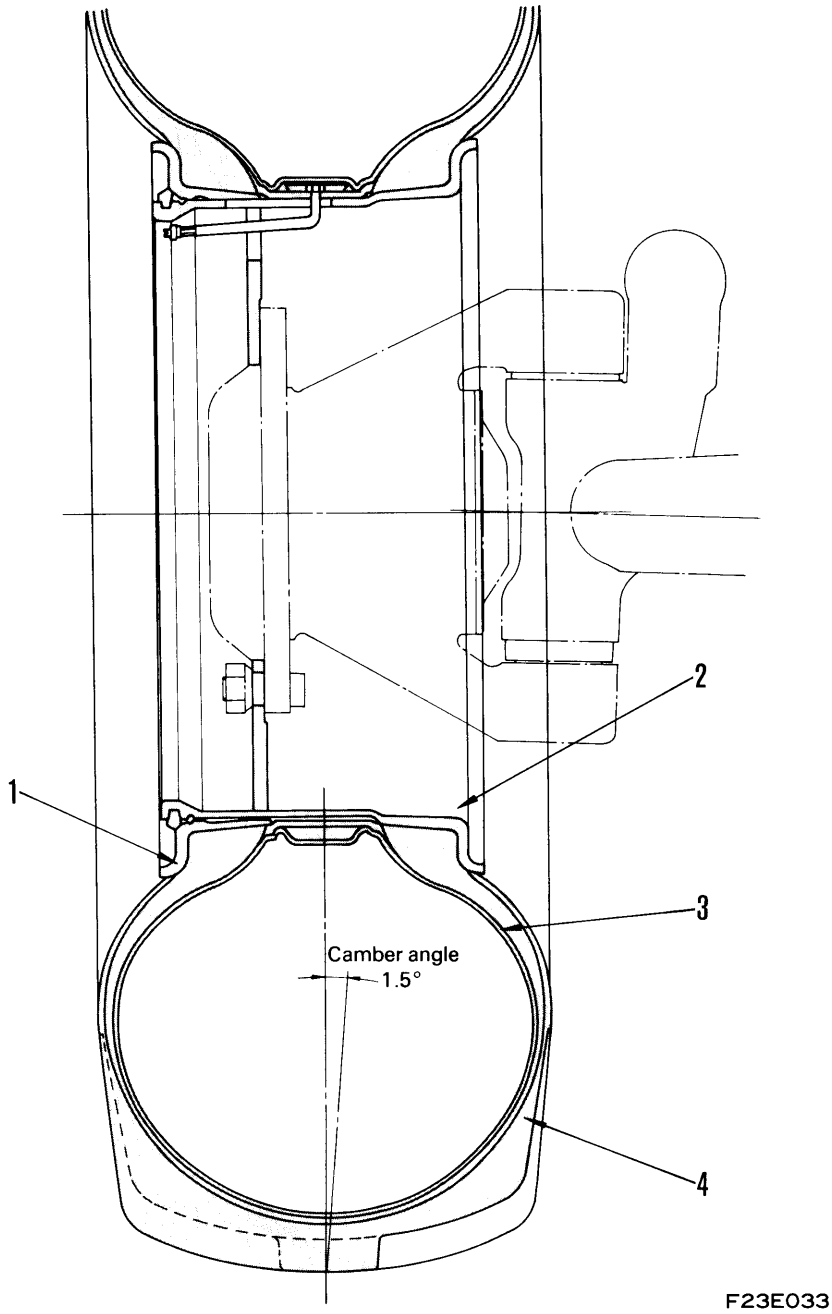
Tire size	14.00 – 24 – 12PR
Tire pattern	Traction
Rim size	8.00TG x 24
Air pressure	3.5 kg/cm^2

1. Side ring
2. Rim
3. Tube
4. Tire

WHEEL

GD705A-4

FRONT WHEEL



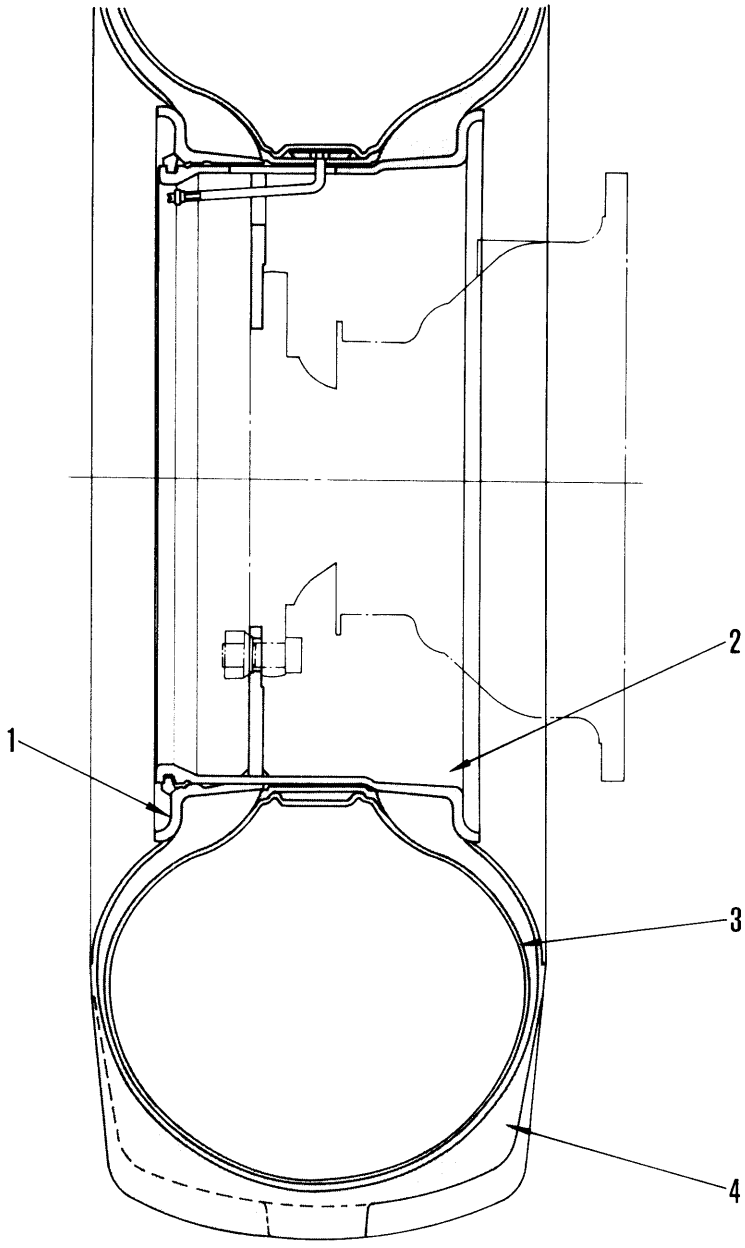
F23E033

Tire size	16.00 – 24 – 12PR
Rim size	10.00VA x 24SDC
Air pressure	2.2 kg/cm^2

1. Side ring
2. Rim
3. Tube
4. Tire

GD705A-4

REAR WHEEL

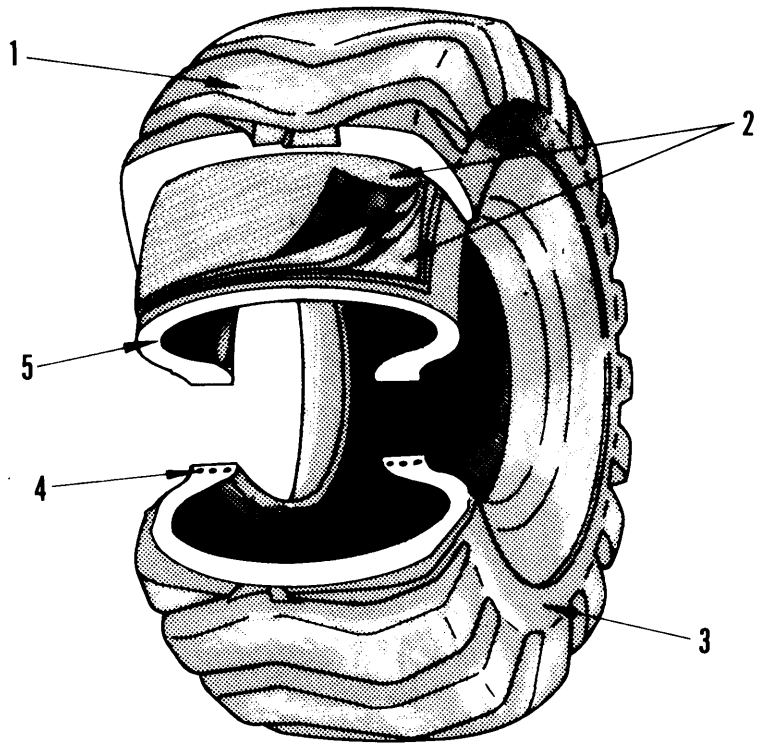


F23E034

Tire size	16.00 – 24 – 12PR
Rim size	10.00VA x 24SDC
Air pressure	2.2 kg/cm^2

1. Side ring
2. Rim
3. Tube
4. Tire

STRUCTURE



230F117

1. Tread
2. Breaker
3. Side wall
4. Bead wire
5. Carcass

There are many different types of tires used in construction machines, and these are used under a wide range of different conditions. Hence, unlike ordinary automobile tires, construction machinery tires vary greatly from type to type.

With the larger scale of construction operations today, the life and cost of the tires of wheeled construction machinery will naturally be related to construction profit factor.

As a result of research into these problems, a tire of large floatation with reduced internal pressure and smaller grounding pressure was developed. This tire is called the "off the road" tire.

The improved performance of construction vehicles also required better performance tires. The "wide base tire" was standardized in 1956.

Most construction vehicles operate in sandy, muddy, o. rocky conditions and cannot, therefore, travel at high speeds. Internal pressure and load are thus determined by speed. On rocky surfaces and also in sandy and muddy conditions, speeds will naturally be slower, and on rocky ground, there is greater likelihood of suffering tire cuts and punctures. In sandy and muddy conditions, tires with reduced internal pressure for greater floatation are used ot prevent the tires from sinking into the sand or mud.

In other words, it is important to select the right type of tire for the right job.

1. **Tread**
   The tread is the outermost layer of a tire, its main purpose being to protect the internal parts of the tire as well as minimizing wear and abrasion. That part of the tread in contact with the ground is called the crown. This is the section which is made with different patterns and groove types to match the conditions where the tire is to be used.

2. **Breaker**
   This section is located between the tread and the carcass. It absorbs shocks applied to the tire and prevents tread damage from penetrating any further.

3. **Sidewall**
   In addition to protecting the carcass, the sidewall swells in and out continuously during travel.

4. **Tire bead**
   Made of copper and steel wires, these beads secure the tire to the rim. The beads in tubeless tires are also very important in maintaining airtight conditions.

5. **Tire body (carcass)**
   The tire body absorbs the load and shocks applied to the tire. It consists of layers of special cord material criss-crossed sufficiently to withstand the internal pressure. In other words, this section forms the tire skeleton.

6. **Ply**
   Located inside the tire body, this section is formed by layers of a powerful nylon cord meterial.

TRACTION AND FLOATATION

Greater floatation is achieved by reducing grounding pressure.

(1) Reduce the air pressure as much as possible.
(2) Use tires which are as wide as possible.
(3) When the load is constant, increase the grouding length and the width of the tire in contact with the ground.
(4) Use wide base tires.
(5) Reduce the machine load.

To increase traction

(1) Increase the machine load.
(2) Use tires with a tread which helps the tire bite into the ground.
(3) Use large diameter tires, and prevent free rotation.
(4) Take the ground conditions into consideration and select the most suitable ground for travel.

Tires for soft ground

(1) Increase the air pressure (to reduce the ground contact area and reduce rotational resistance).
(2) Use tires with a large external diameter (to prevent possible free rotation).
(3) Lighten the load.

TIRE AND RIM NOMINAL DIMENSIONS

Tire Nominal Dimensions

Tire nominal dimensions include tire width in inches, tire inner diameter in inches, and tire strength in ply rating, the three figures being joined by hyphens.

Example

13.00 – 24 – 8PR (Normal tire)
↓ ↓ ↓
Tire width Tire inner diameter Ply rating

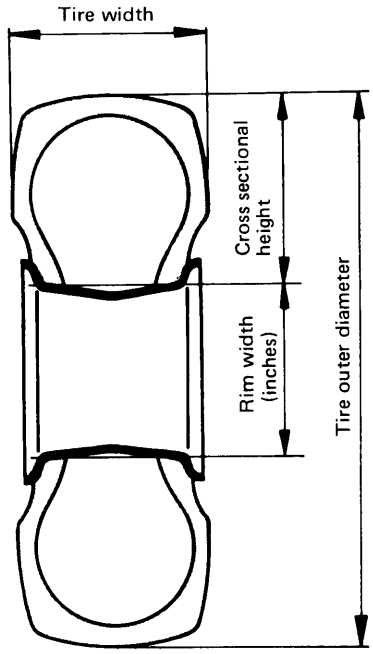
15.5 – 25 – 12PR (Wide base tire)

Rim Nominal Dimensions

Rim nominal dimensions include the width of the tire seat in inches plus a symbol denoting the shape of the edge, and the diameter of the tire seat (tire inner diameter) expressed in inches and joined by an X.

Example

8.50V x 24
- 24 → Rim width (inches)
- V → Symbol indicating shape of edge
- 8.50 → Rim diameter (inches)



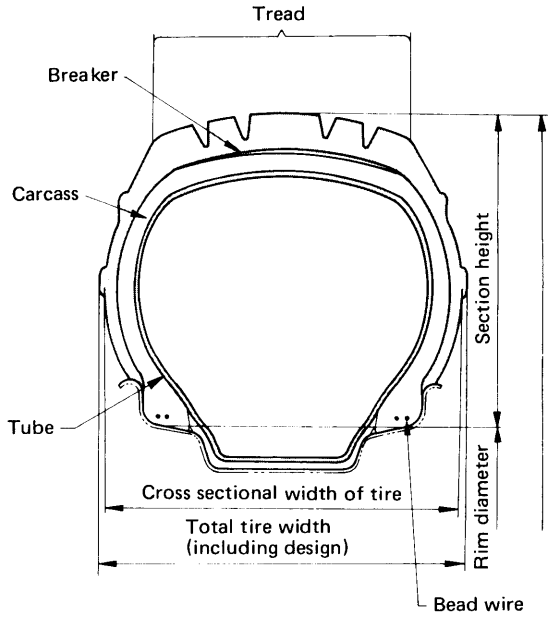
230F118

TUBELESS TIRES

Tubeless tires are commonly used on large dump trucks and large scrapers.

Structurally, tubeless tires include a special layer of rubber on the inside to preserve airtight conditions. The bead section must be very tough, and therefore uses relatively expensive materials. However, due to the difficulty in repairing punctures where the carcass is penetrated, tubeless tires are seldom used on small sized loaders.

With large sized loaders and dump trucks, where the benefits of greater service efficiency have been acknowledged, there is increasing interest in the use of tubeless tires.



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FEATURES

1. No sudden loss of air when the tire is punctured by nails, etc. (Integrated structure with inner liner).
2. Simple rim assembly operation. (No tube or flap).
3. Relatively longer lift due to better thermal radiation during travel.

NORMAL WIDTH TIRES AND WIDE BASE TIRES

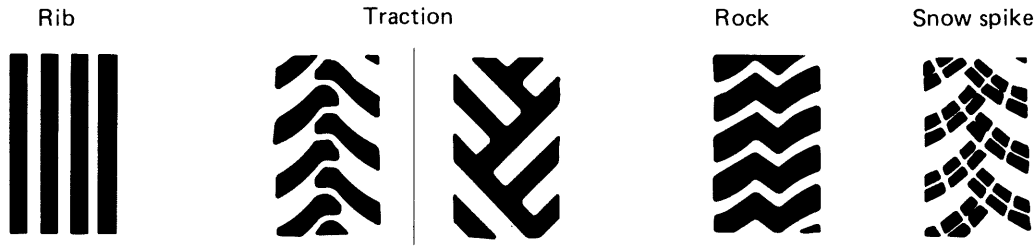
Construction machines use either normal width tires or wide base tires.

OR (OFF THE ROAD) TIRE CLASSIFICATIONS

Service	TRA* classification	Tread	Use
Grader	G-1	Rib	For front wheels of graders.
	G-2	Traction	For rear wheels of graders used where traction is necessary.
	G-3	Rock	For rear wheels of graders used where resistance against external necessary, rather than traction.

*TRA stands for Tire and Rim Association

Tread Patterns



TIRE MOUNTING METHOD

Many graders use traction type tires with a tread pattern designed to prevent slipping and sand clogging.

Rear wheels

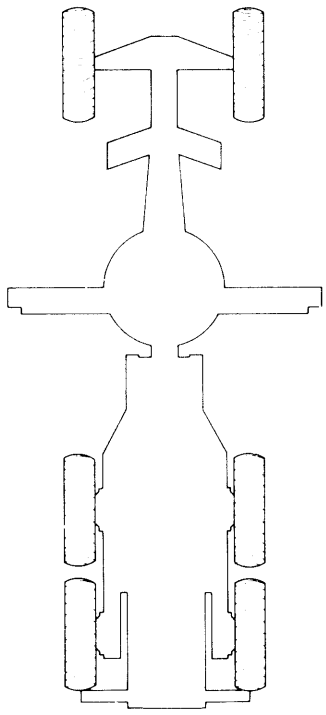
In order to prevent sand clogging in the tread grooves and to protect the tire surface from undue wear during operation, the pattern of the tread on the rear wheels is like a row of inverted V's when seen from behind.

Front wheels

Rib pattern tread is sometimes used on the front wheels in order to prevent lateral sliding during grading operations.

Where traction treads are used, the pattern is in the reverse direction from the rear wheel pattern. That is, the pattern appears like a row of inverted V's when seen from the front.

When the front wheels are pushed forward and roll over, a force is applied just as if the wheels were driven from the direction of the ground. And since this is opposite to the action on the rear wheels, sand clogging and tire wearing is avoided.



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REFERENCE

GENERAL TIRE KNOWLEDGE

Tire punctures

A major disadvantage in rubber tires is the lack of resistance to heat, poor heat conductivity, and relative weakness when wet. A simple experiment where rubber is stabbed with a wet knife and dry knife will illustrate the difference in this respect.

How to prevent punctures

1. Clear the operating area of protrusions and broken rock.
2. Check that the tire air pressure is at the suitable level.
3. Do not travel at high speed during operations. (This applies particularly to large dump trucks and motor scrapers).
4. Use tires with a low ply rating.

Causes of tire wear

1. Poor ground management at work area.
2. Excessive tire slipping.
   - Poor driving skill.
   - Excessive load.
   - Small tire diameter.
3. Unsuitable tire tread selection.

TMPH (Ton-mile per hour)

TMPH is an expression of work performed per hour. Tire TMPH refers to the TMPH of the tire itself, while operating TMPH refers to the TMPH of the operation.

Tire TMPH

Refers to the tire heat generation limit for different sizes, ply ratings and structures.

Operating TMPH

Determined from the following equation based on speed and load.

Operating TMPH calculation

TMPH = (Average tire load) x (Average speed)

Average tire load

= ½ (tire load when vehicle carries empty load + tire load when vehicle is loaded)

Average speed

$$= \frac{\text{round trip distance x number of job cycles per day}}{\text{total hours of operation per day}}$$

Total hours of operation include the recess and dead time.

Note: The unit for round trip distance is miles (1 km = 0.625 mile).

The calculated operating TMPH is calculated and compared with the tire TMPH

1. The operating TMPH should be less than the tire TMPH.
2. If the operating TMPH is greater than the tire TMPH, the problem should be remedied immediately.

Where the operating TMPH is greater than the tire TMPH, there is danger of tire damage due to heat generation. Either change to tires with a higher TMPH, or adjust the operating conditions to reduce the operating TMPH.

TMPH RATING AT AMBIENT TEMPERATURE°C (°F)

Where the ambient temperature in an operating environment is high or where a long haul or high-speed drive is required, the standard tires cannot sometimes be suitable because of its small TMPH.

TMPH should vary depending on the atmospheric temperature. Thus, under the above operating conditions, it is recommended that the optimum tires to determined after obtaining TMPH by applying the previously stated formulas.

NOTES: 1. The TMPH Rating varies depending on the tire manufacturer.
2. The TMPH Rating is based on U.S. ton. (not on metric ton)

OR (OFF THE ROAD) TIRE AIR PRESSURE

- **Tire Air Pressure**

  Tires perform their roles once they have been inflated with air. These roles include support of the vehicle and load, and movement along the ground in response to drive and control forces. Tires also absorb the shock of impact with the ground and are instrumental in changing the direction of the vehicle. To fulfill these roles, tires must be inflated to the proper level.

  Maintaining this proper air pressure is important to protect the tires from damage and ensure longer service life.

  Proper air pressure is determined according to vehicle features, operating conditions, and other conditions. With air pressure at the prescribed level, the standard load specifications should not be exceeded.

- **Importance of Air Pressure**

  When the vehicle is loaded with inflated tires stationary, the tire shape is changed in the vertical direction (vertical flexure) and the horizontal direction (horizontal flexure).

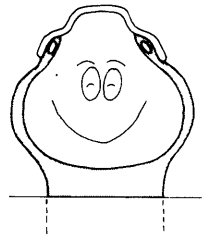
  The relation between vertical flexure and load varies considerably at different air pressures.

  In large dump trucks operating at dam sites, contact between pairs of wheels can sometimes be seen even when the truck does not appear to be overloaded. This would not occur, however, if the tires were at correct air pressure. That is, contact between wheels in this case is more likely to be due to insufficient air pressure than to overloading.

  When the tire is pressed to the ground, the pressure distribution of the section on the ground also changes greatly at different air pressures. The shape of the section on the ground is usually elliptical, and the lower the air pressure (with greater change in tire shape), the longer the length on the ground becomes. That is, a drop in air pressure increases the grounding length and enlarges the movement of the ground surface section. A larger section on the ground leads to accelerated generation of heat and greater tire wear. This subsequently increases the fatigue in the tire carcass and deterioration of the cord material strength.

For these reasons, always check the following points during tire maintenance checks.

a. Check air pressure and refill air at normal temperature (while still cold).
b. Check new tires more frequently.
   New tires tend to expand within a certain fixed period after fitting. The volume capacity also increases, resulting in a corresponding drop in air pressure.
c. Use tire gauges correctly.



Correct air pressure

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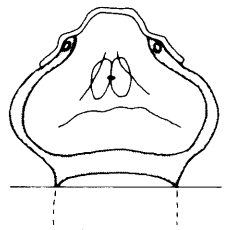

Under inflated

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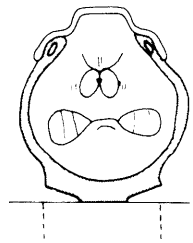

Over inflated

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STEERING SYSTEM
42 TESTING AND ADJUSTING

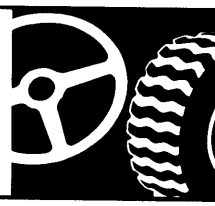


TABLE OF JUDGEMENT STANDARD VALUE

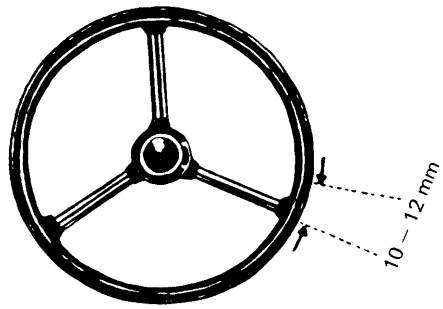
( ): GD705A-4 Serial No. 31001 and up

	Item	Test Condition	Standard	
			GD705R-4	GD705A-4
Stroke	Steering wheel turning angle		5.4 turns ± 50°	5.35 turns ± 50°
	Leaning lever	Travel at the tip of the lever	45 ± 10 mm	45 ± 10 mm (40 ± 10 mm)
	Articulation lever	Travel at the tip of the lever	–	40 ± 10 mm (45 ± 10 mm)
Operating force	Steering wheel (turning direction)	When traveling at engine slow rotation, F-1	Max. 5 kg	Max. 5 kg
	Leaning lever	Maximum value until just before stroke end	Max. 5 kg	Max. 5 kg
	Articulation lever	Maximum value until just before stroke end	Max. 5 kg	Max. 5 kg
Wheels	Tire vibration	Measure tire side surface of both front and rear wheels with dial gauge	Max. 7 mm	Max. 7 mm
	Tire air pressure	Front wheel	3.5 kg/cm²	2.2 ± 0.2 kg/cm²
		Rear wheel	3.5 kg/cm²	2.2 ± 0.2 kg/cm²
	Camber	Level paved surface	1.5° ± 5%	1.5° ± 5%
	Toe in	Level paved surface	6.5 ± 1.5 mm	8.5 ± 1.5 mm
	Leaning angle	Level paved surface	23 ± 2°	23.5 ± 2°
	Wheel bearing band temperature	Measure at surface of wheel cap after traveling 10km	Max. 40°C	Max. 40°C
	Steering wheel play	At engine slow rotation, and with the tires floating measured at the outside circumference of the steering wheel	10 – 12 mm	10 – 12 mm

STEERING WHEEL

CHECKING STEERING WHEEL PLAY

Standard play: 10 to 12 mm
When the play of the steering wheel is outside the standard value or vibrates abnormally or pulls, replace the steering valve assembly.



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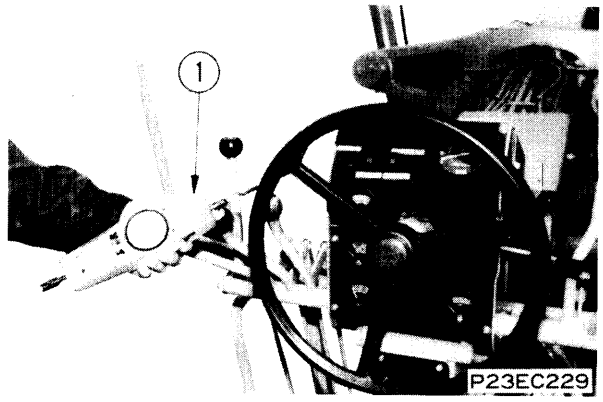
CHECKING STEERING WHEEL OPERATING FORCE

Using push-pull scale ①, measure the operating force of the steering wheel.

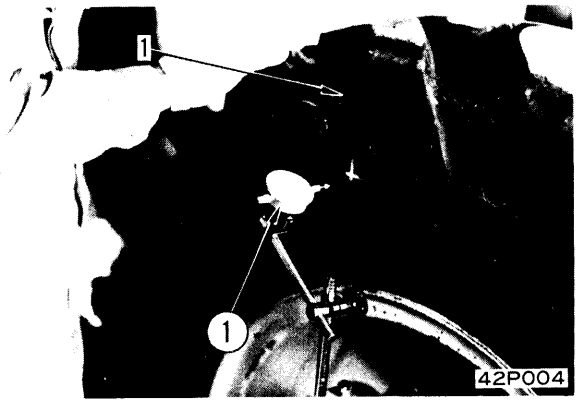
★ Measure operating force of the steering wheel with the engine idling and with the wheels on the ground.



CHECKING TIRE PLAY

FRONT WHEEL CHECK

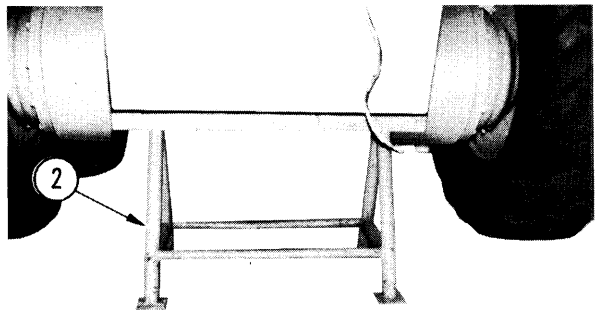
1. Start the engine and raise the front wheels off the ground, using the blade or scarifier as a jack.
2. Use dial gauge ① to measure the tire play while rotating the tire (1) by hand.



REAR WHEEL CHECK

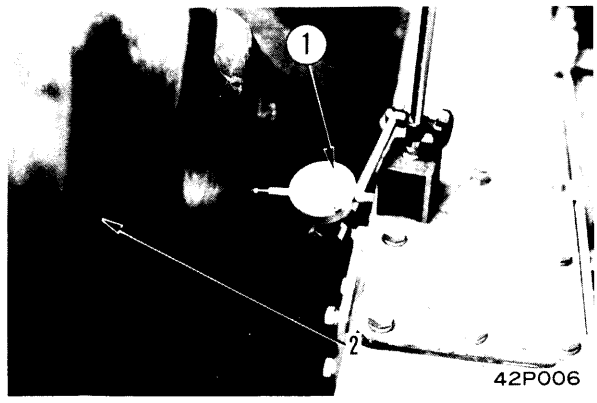
1. Start the engine and raise four rear wheels by operating the blade.
2. Insert block ② in place at rear side of chassis.
3. Use dial gauge ① to measure the tire play while rotating the tire (2) by hand.

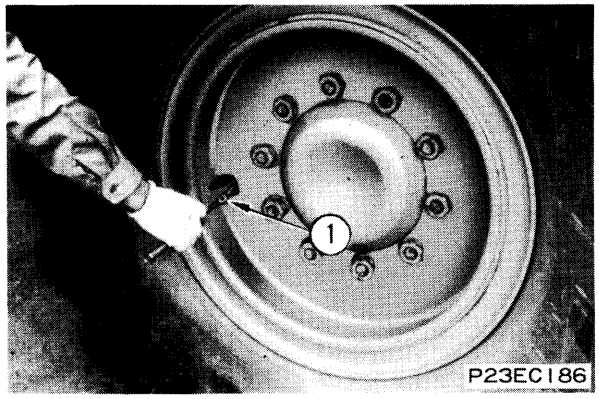
⚠ Measure with engine stopped.



CHECKING AIR PRESSURE OF TIRE

Use tire gauge ① to measure the air pressure of front and rear wheels.





CHECKING TOE-IN

CHECKING TOE-IN

1. Put steering and leaning in central position and park the machine on a level surface.
   ★ Park the machine after it has moved a few meter straight forward.

2. Use convex rule to measure the height from tire tread level to the center of the shaft.

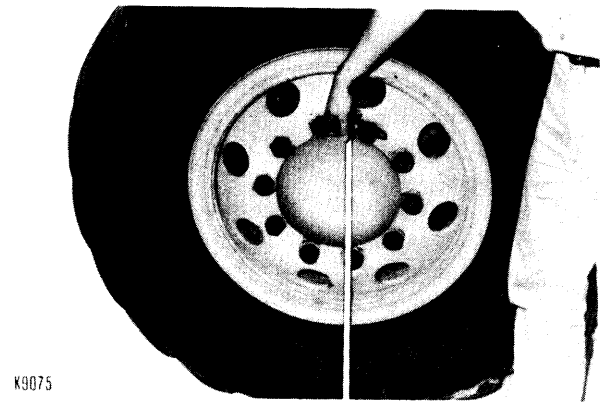
3. Mark the center of the width of both left and right tires at the height attained in item 2.

4. Use convex rule to measure distance **A** between the marks on the left and right tires.

5. Advance the machine slowly and move the marks on the front of the tires to the back. Stop the machine when these marks are the same distance from the tire tread level to the center of the shaft.

6. Use the convex rule to measure distance **B** between the marks on the left and right tires.

7. Standard of toe-in: **B** – **A** = 6.5 ± 1.5 mm (GD705R-4)
   B – **A** = 8.5 ± 1.5 mm (GD705A-4)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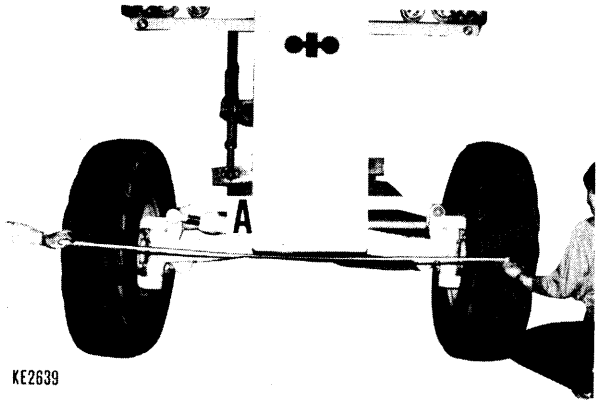

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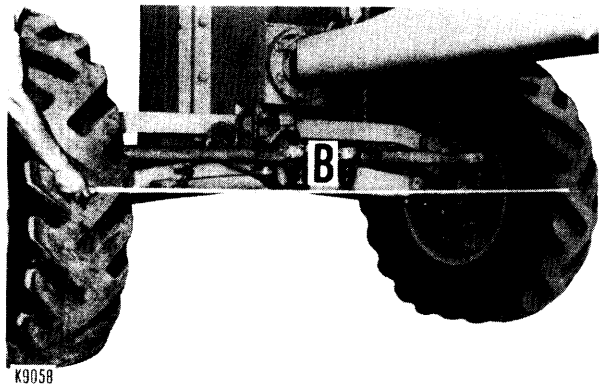

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TOE-IN ADJUSTMENT

★ When toe-in is out-side standard value, adjust it according to following procedure.

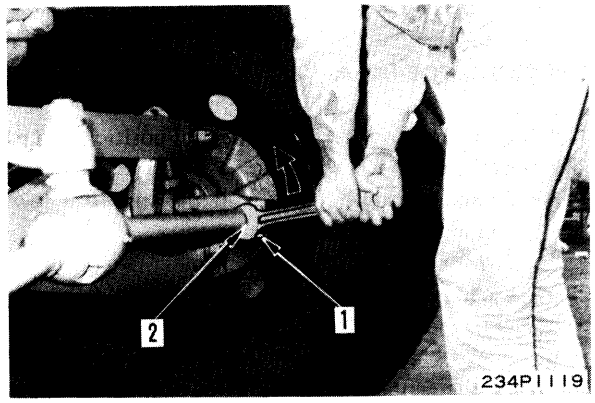
Loosen mounting nuts (1), apply wrench to the notch section (2), turn left and right tie-rods, and adjust to within standard value.

★ Toe-in increases when tie-rod is turned in the direction of the arrow, and decreases when it is turned in the opposite direction.

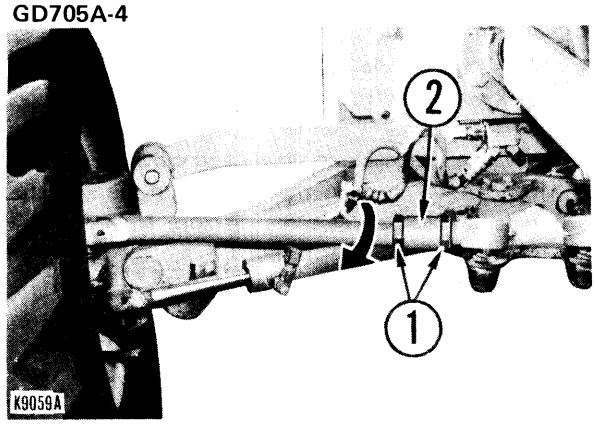
★ Adjust length of left and right (**C** and **D**) tie-rods equally.

★ Adjust with the front axle horizontal without any leaning.

GD705R-4



GD705A-4



GD705R-4

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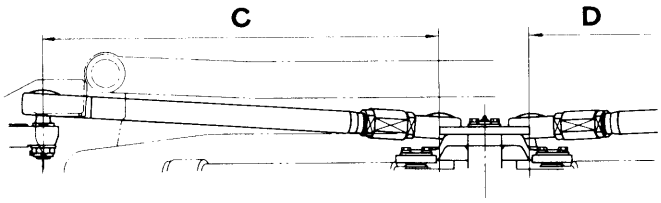
GD705A-4



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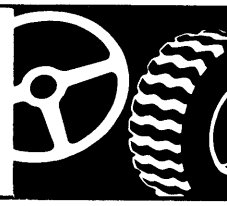
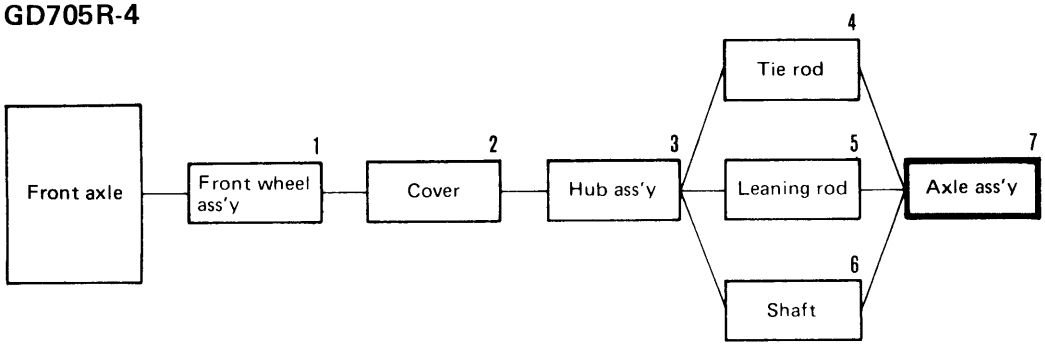
STEERING SYSTEM

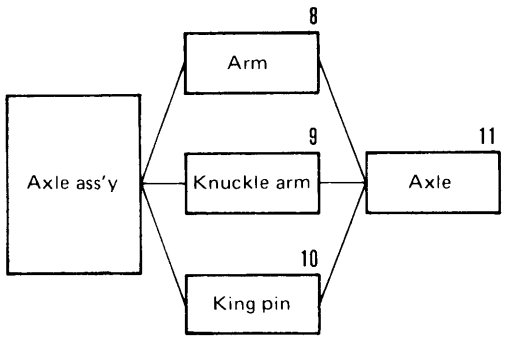
43 DISASSEMBLY AND ASSEMBLY



REMOVAL OF FRONT AXLE ASSEMBLY

GD705R-4

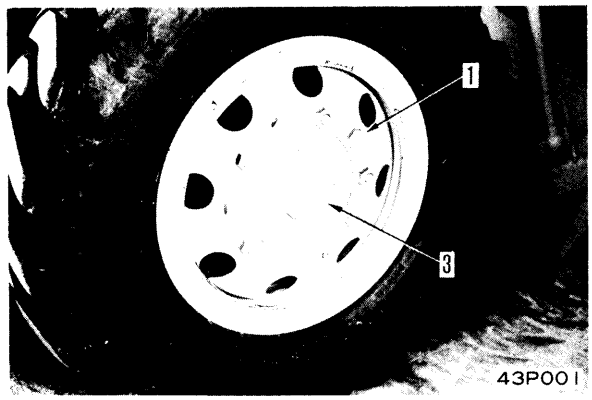




43F001

1. **Front wheel assembly**
   1) Loosen wheel nut (1) a little.
   2) Raise front wheels using the blade as a jack and support the lower part of frame center firmly with a block (700 mm high).
   3) Temporarily sling wheels (2) with nylon sling ①. Remove wheel nuts and remove wheel assembly.

   kg Front wheel assembly: Approx. 160 kg



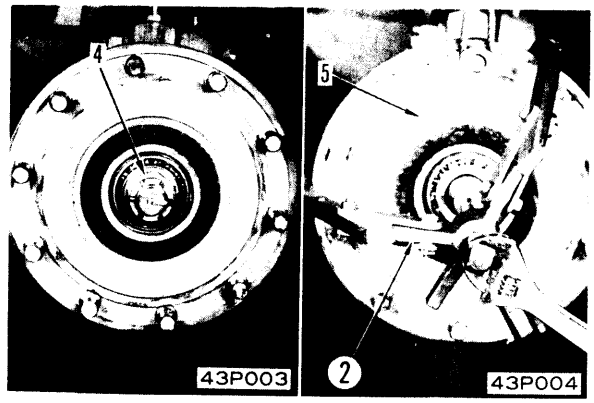
43P001

2. **Cover**
   Remove cover (3).

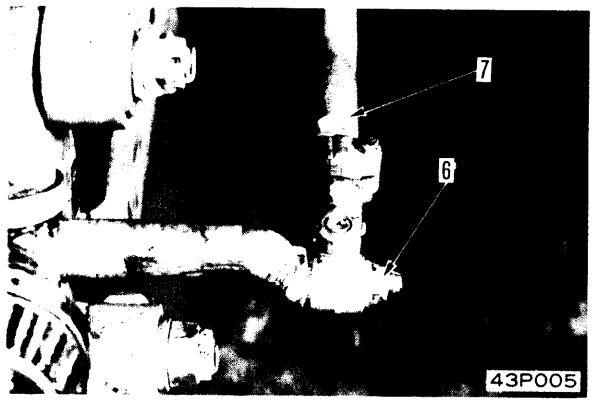
43P002

3. **Hub assembly**
   1) Remove nuts (4).
   2) Temporarily sling hub assembly (5). Using gear puller ②, pull out hub assembly and lift it out.

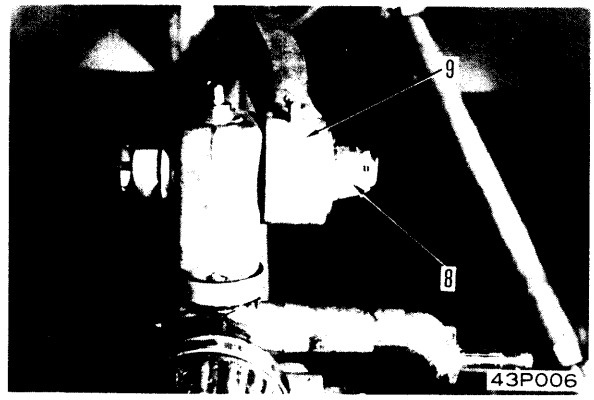
      kg Hub assembly: Approx. 50 kg



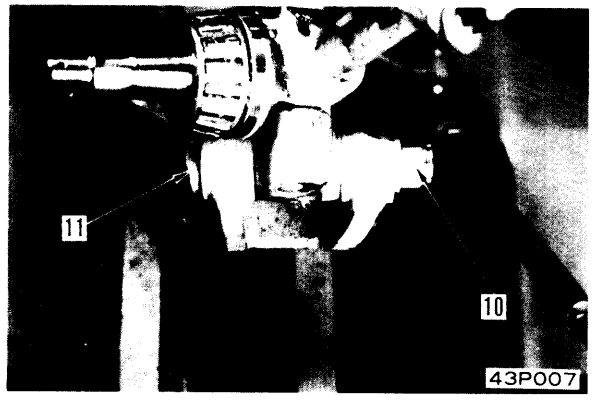
4. **Tie rod**
   Remove nut (6) and disconnect tie rod (7).



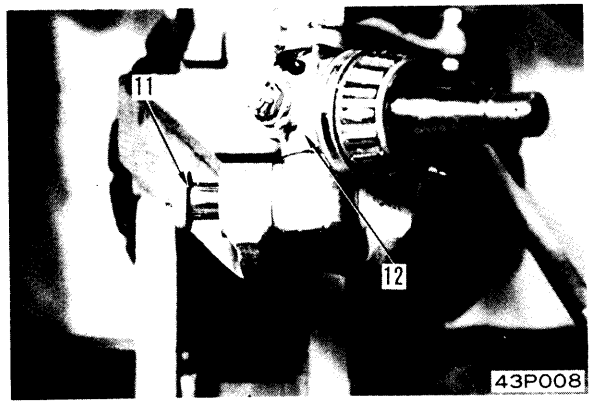
5. **Leaning rod**
   Remove nut (8) and disconnect leaning rod (9).



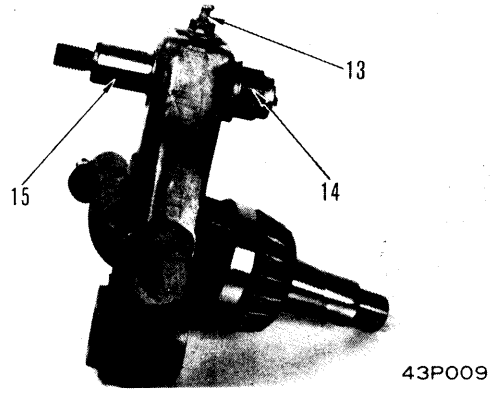
6. **Shaft**
   Temporarily sling bracket and axle. Remove nut (10) and pull out shaft (11).



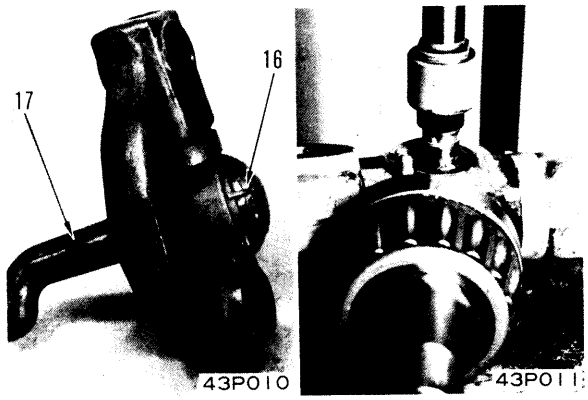
7. **Axle assembly**
Pull out shaft (11) and sling out axle assembly (12).
kg Bracket and axle assembly: Approx. 35 kg



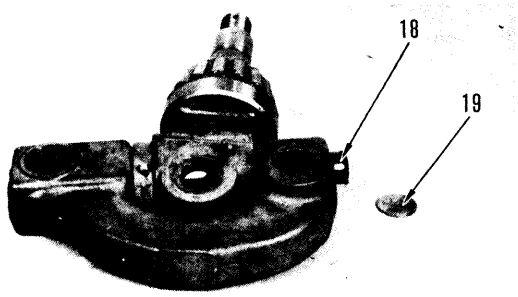
8. **Arm**
1) Remove grease fitting plug (13).
2) Remove nut (14) and pull out arm (15).



9. **Knuckle arm**
Remove nut (16) and pull out knuckle arm (17) using press.

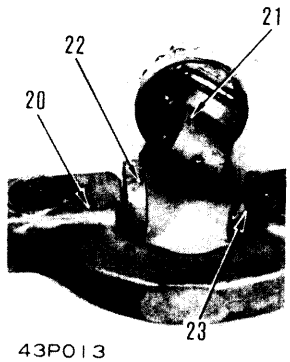


10. **King pin**
Pull out king pin (18).
★ Blind plug (19) can be removed together with king pin.



11. Axle

1) Remove axle (21), bearing (22) and spacer (23) from bracket (20).
2) Remove bearing (24) and spacer (25).



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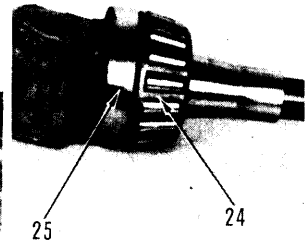

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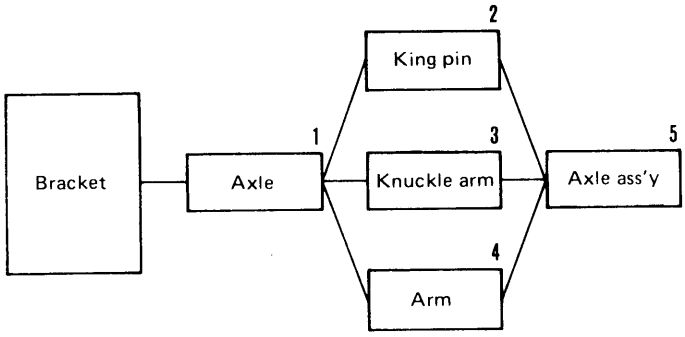
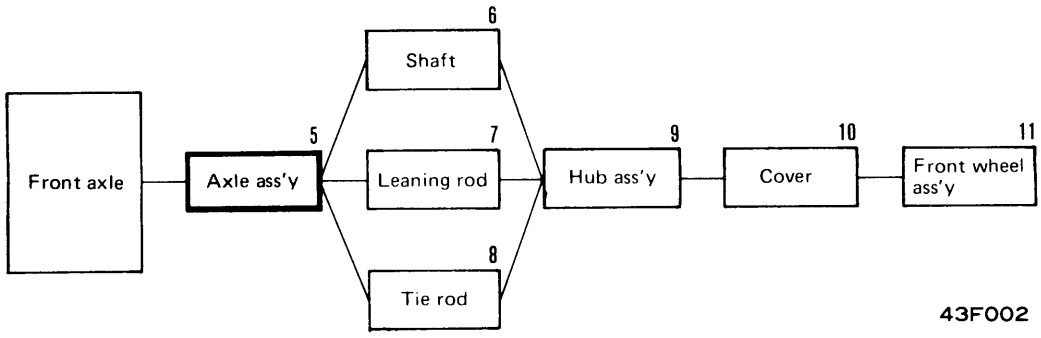
INSTALLATION OF FRONT AXLE ASSEMBLY

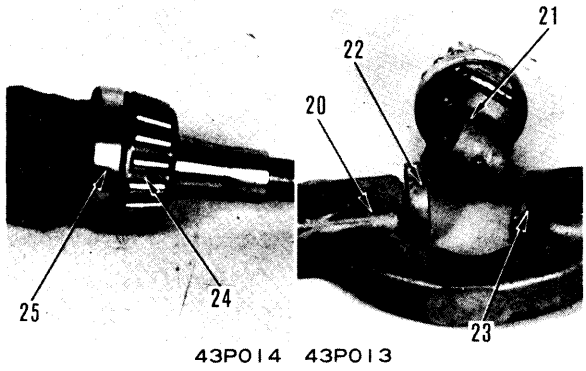
GD705R-4





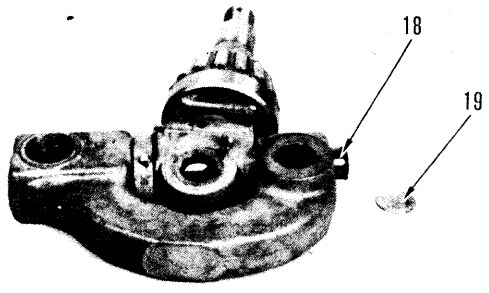
43F002

1. **Axle**
   1) Install spacer (25) and bearing (24).
   2) Install axle (21), bearing (22) and spacer (23) on bracket (20).



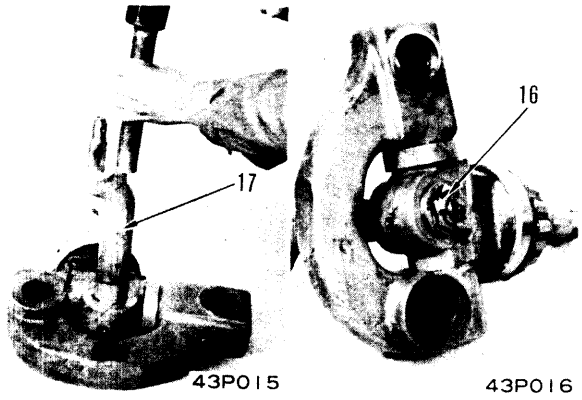
43P014 43P013

2. **King pin**
   Drive king pin (18) and drive blind plug (19).
   ★ Drive king pin with its notch pointed in installation direction of knuckle arm.

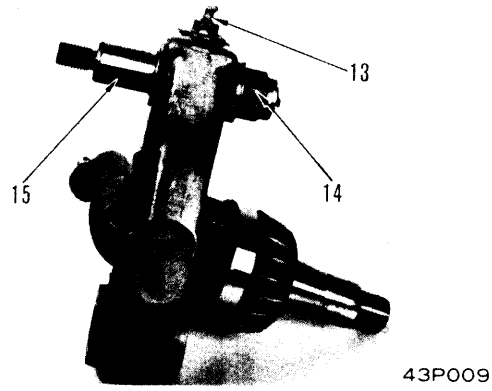


43P012

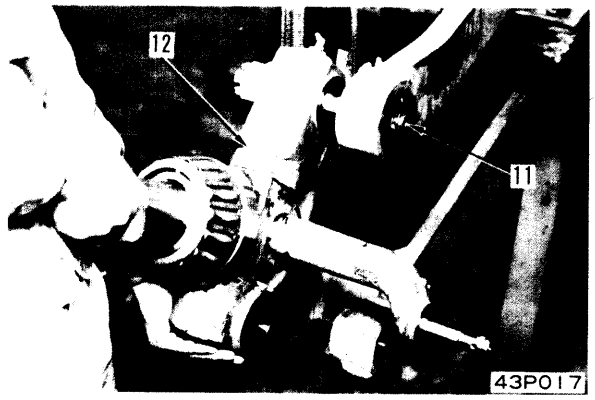
3. **Knuckle arm**
   Drive knuckle arm (17) and loosely install collar and nut (16).
   ★ Fully tighten nut after mounting front axle on machine.
   Knuckle arm: Grease (G2-LI)

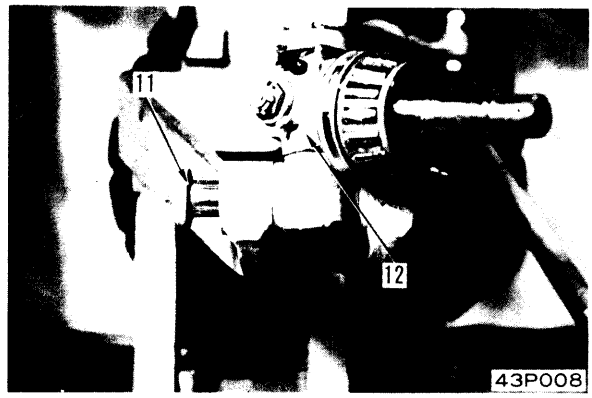


4. **Arm**
   1) Drive arm (15) and loosely install collar and nut (14).
      ★ Fully tighten nut after mounting front axle on machine.
      Fitting plug: Thread tightener (LT-2)
   2) Tighten grease fitting (13).

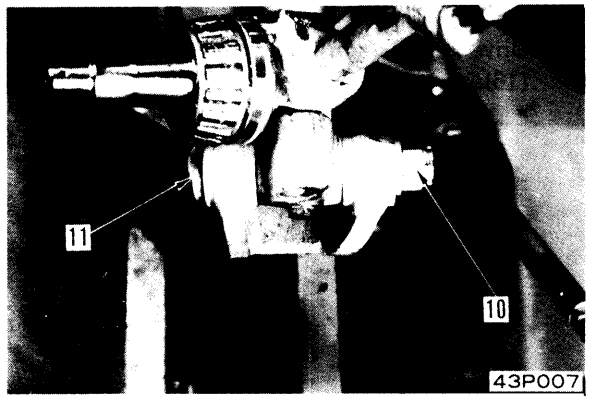


5. **Axle assembly**
   Sling axle assembly (12) in place and insert it with shaft (11).

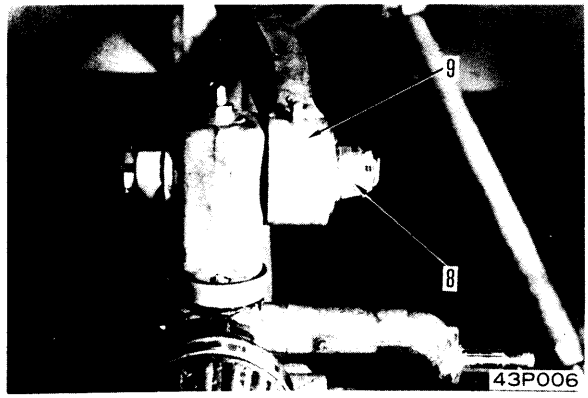




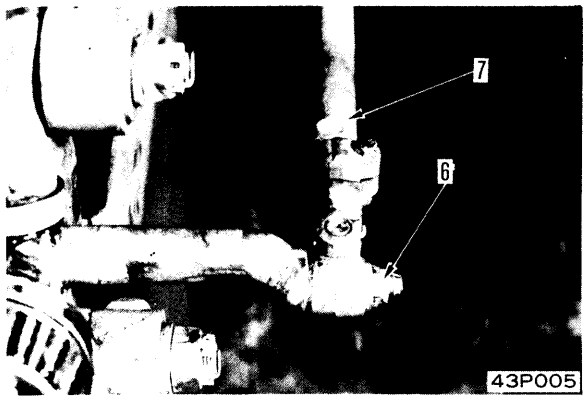
6. **Shaft**
Fasten shaft (11) with nut (10).
kgm Nut: 60 ± 40 kgm
★ Bend down cotter pin firmly.



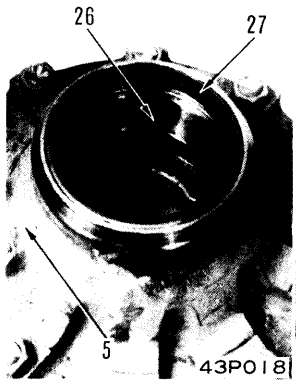
7. **Leaning rod**
Connect leaning rod (9) and tighten nuts (8).
kgm Front nut: 45 ± 25 kgm
kgm Rear nut: 32.5 ± 12.5 kgm
★ Bend down cotter pins firmly.

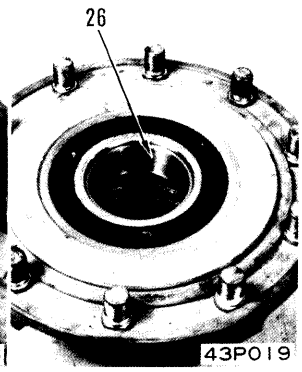


8. **Tie rod**
Connect tie rod (7) and tighten nuts (6).
kgm Front nut: 55 ± 25 kgm
kgm Rear nut: 14 ± 6 kgm
★ Bend down cotter pins firmly.



9. **Hub assembly**
1) Press-fit outer race (26) and oil seal (27) to hub assembly (5).





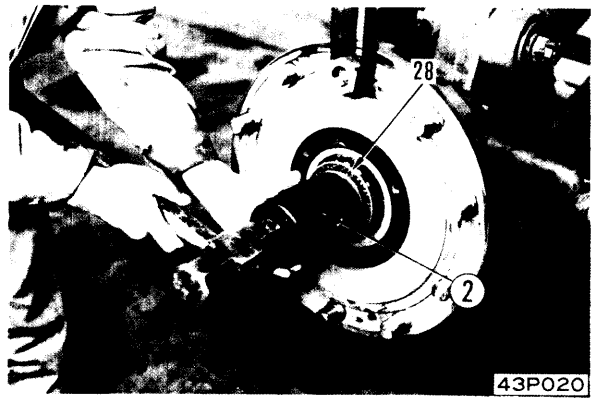
2) Temporarily sling hub assembly. Using press-fitting tool ②, drive in bearing (28).

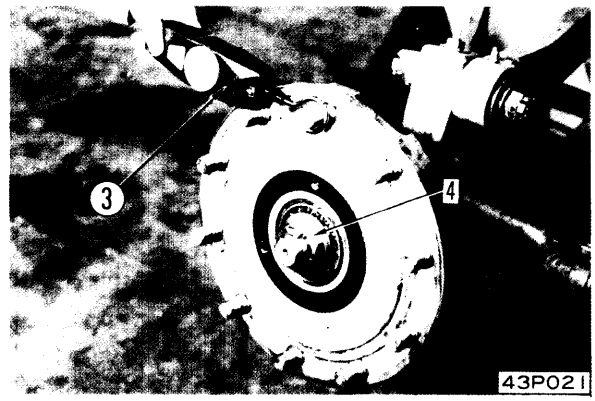
Hub assembly: Grease (G2-LI)

3) Tighten nut (4) and measure torque using push-pull scale ③ .

★ Rotating force: 10 ± 2 kg

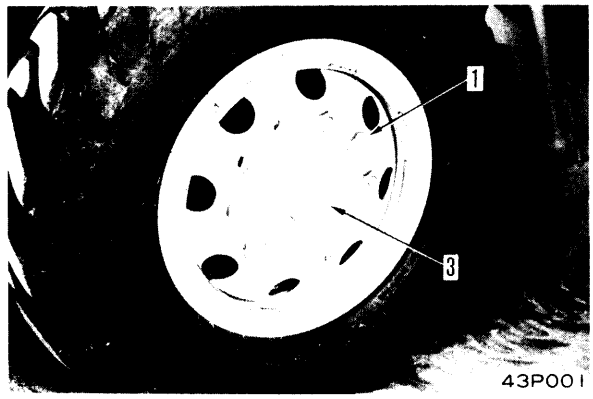
★ Bend down cotter pin firmly.





10. Cover

Attach two gaskets and install cover (3).



11. Front wheel assembly

1) Temporarily sling wheel (2) using a nylon sling ① and loosely tighten wheel nuts.

2) Raise front wheels using the blade as a jack, remove the block, and lower body to the ground.

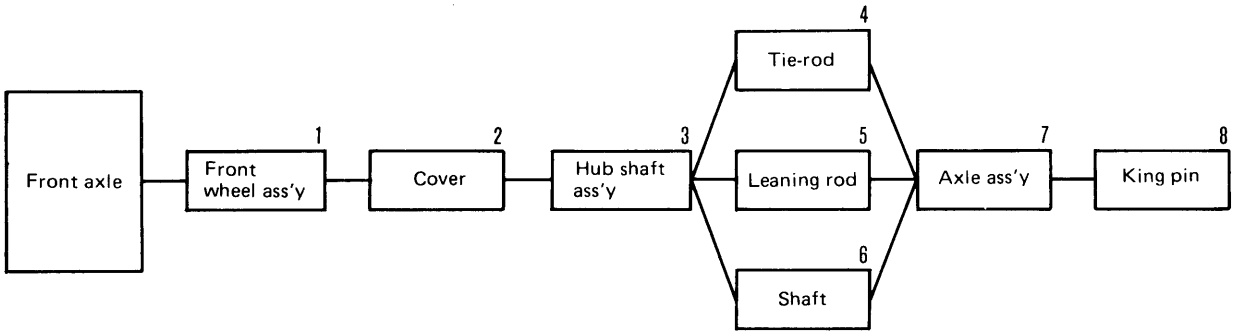
3) Tighten wheel nuts (1).

kgm Wheel nut: 50 ± 5 kgm

Wheel nut: Anti-friction compound (GL-M)

REMOVAL OF FRONT AXLE ASSEMBLY

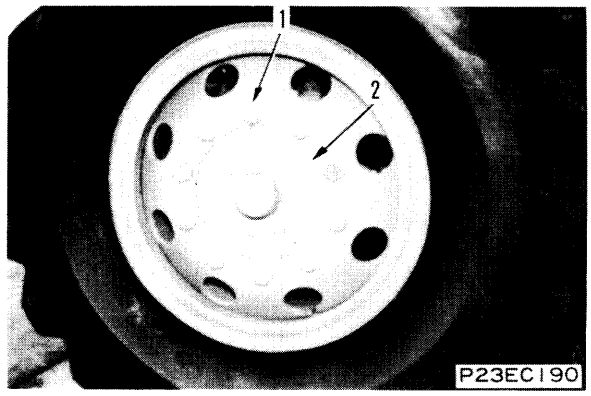
GD705A-4



F23EC022-I

1. **Front wheel assembly**
   1) Loosen wheel nut (1) a little.
   2) Raise front wheels using scarifier or blade as jack. Support the lower part of frame center firmly with a block (Height: 700 mm).
   3) Temporarily lift wheels (2) with a nylon sling, remove wheel nuts (1) and remove wheel assembly.

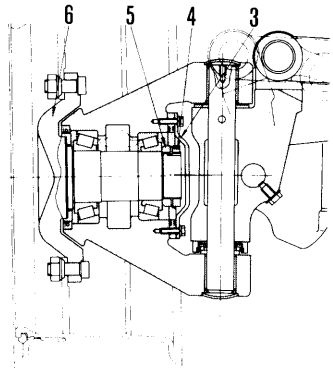
   kg Front wheel assembly: Approx. 235 kg



2. **Cover**
   Remove cover (3).

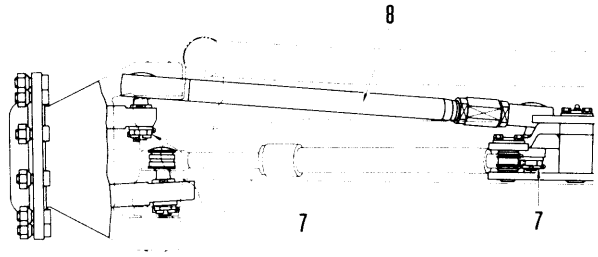
3. **Hub shaft assembly**
   1) Remove nuts (4), (5).
   2) Temporarily lift hub shaft assembly (6), pull out hub shaft assembly, lift it, then remove it.

   kg Hub shaft assembly: Approx. 55 kg



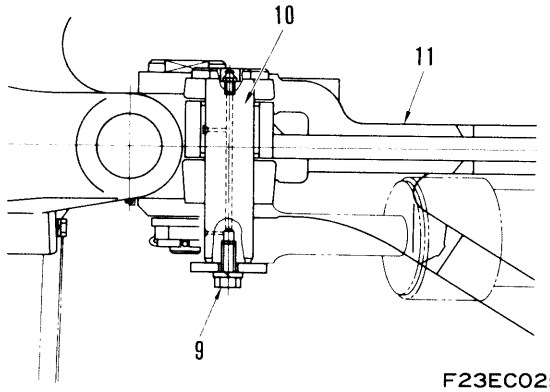
F23EC023

4. **Tie rod**
   Remove nut (7) and disconnect tie rod (8).



F23EC024

5. **Leaning rod**
   Remove bolt (9), pull out pin (10) and disconnect leaning rod (11).

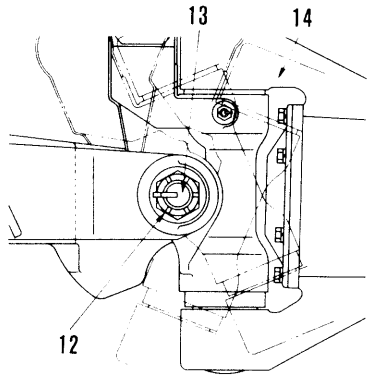


F23EC025

6. **Shaft**
   Temporarily lift axle, remove nut (12) and shaft (13).

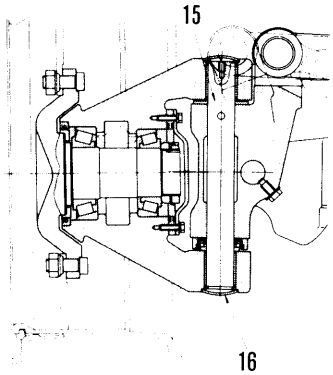
7. **Axle assembly**
   Pull out shaft (13), lift axle assembly (14) and remove it.

   kg Axle assembly: Approx. 375 kg



F23EC026

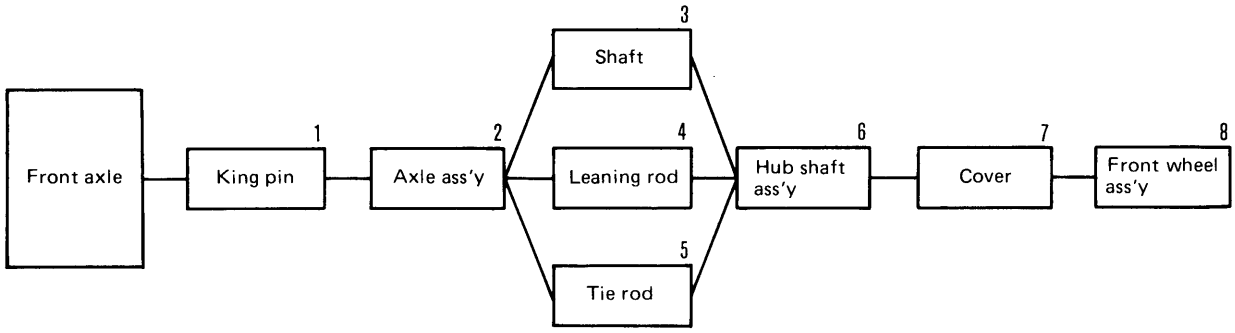
8. **King pin**
   Remove king pin (15).
   ★ Blind plug (16) can be removed together with king pin (15).



F23EC027

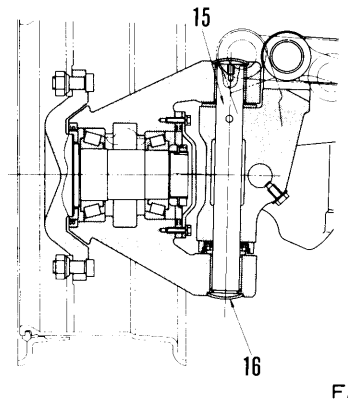
INSTALLATION OF FRONT AXLE ASSEMBLY

GD705A-4



F23EC028-1

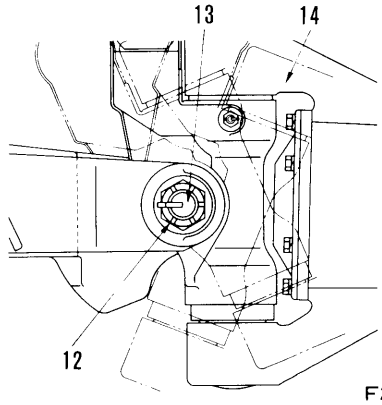
1. **King pin**
   Drive king pin (15) and drive plug (16).
   - Plug: Thread tightener (LT-2)
   - King pin and bushing: Grease (G2-LI)



F23EC027

2. **Axle assembly**
   Lift axle assembly (14) and insert shaft (13).
   - Shaft and bushing: Grease (G2-LI)

3. **Shaft**
   Tighten shaft (13) with nut (12).
   - ★ Bend cotter pin securely.

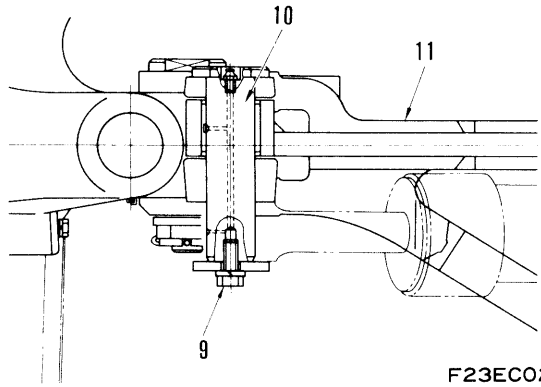


F23EC026

4. Leaning rod

Align the connecting pin hole of leaning rod end (11) and the bracket, and insert connecting pin (10). Then install lock bolt (9).

Bushing: Grease (G2-LI)



F23EC025

5. Tie-rod

Connect tie-rod (8) and tighten nut (7).

Nut: 26.5 ± 4.5 kgm

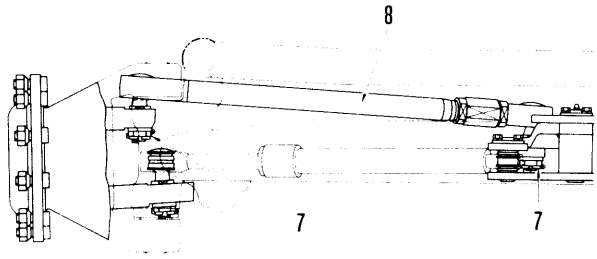
★ Bend cotter pin securely.

6. Hub shaft assembly

1) Temporarily lift hub shaft assembly (6) and install it in housing.

Hub shaft assembly: Grease (G2-LI)

2) Tighten nuts (4), (5).
3) Adjust rotating torque
   - Fasten nut (5) so that it starts to rotate at 30 to 35 kg, as measured by a spring balancer hooked to the hub bolt. Turn the shaft at least 3 times left and right.
   - Loosen nut (5) so that it can start to rotate at 2 to 5 kg. Do not fully loosen the nut.
   - Tighten the lock washer and second nut (4) at 30 to 50 kgm so that the rotating force is 15 to 20 kgm.
   - Measure the rotating force again after rotating hub shaft (6) 3 times and after the bearing roller fits well. Then bend the lock washer.
   - ★ Adjust the preload after the bearing temperature becomes normal.

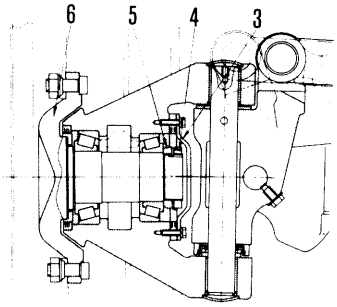


F23EC024

7. Cover

Fix O-ring on plate and install together with cover (3).

O-ring: Grease (G2-LI)

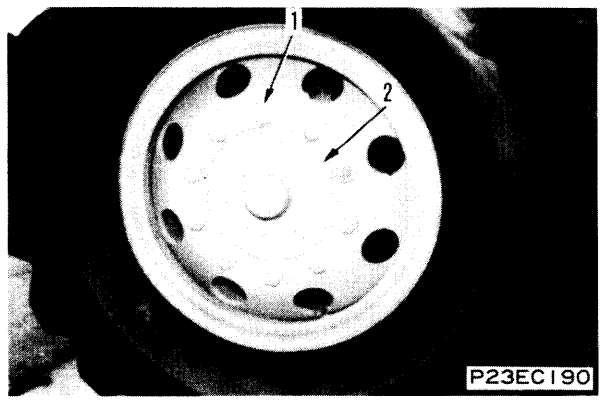


F23EC023

8. Front axle assembly

1) Temporarily lift wheel (2) with a nylon sling and temporarily tighten wheel nut (1).
2) Raise front wheels with scarifier or blade, remove block and lower body to the ground.
3) Tighten wheel nuts (1).

Wheel nut: 50 ± 5 kgm



REMOVAL OF STEERING PUMP ASSEMBLY

Lower the work equipment completely to the ground and stop the engine. Operate the control lever several times to release the remaining hydraulic oil pressure in the hydraulic piping. Then loosen the oil filler cap (1) slowly to release the remaining oil pressure in the hydraulic tank.

1. Remove drain plug (2) and drain oil from hydraulic tank.

   Hydraulic tank: Approx. 70ℓ

2. Remove R.H. side cover.
3. Disconnect steering pump inlet tube (3) and steering pump outlet hose (4) from steering pump.
4. Remove steering pump assembly (5).

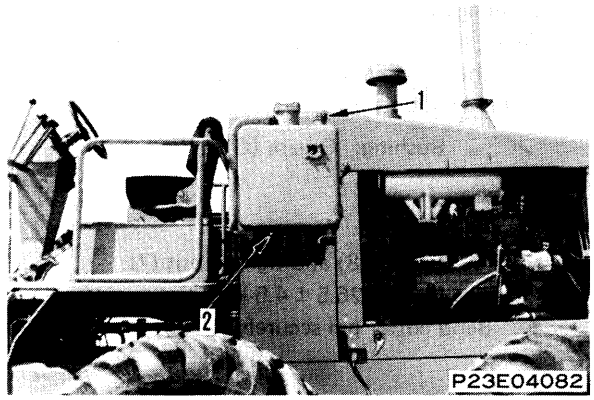
INSTALLATION OF STEERING PUMP ASSEMBLY

1. Fix O-ring and install steering pump assembly (5).
2. Connect steering pump outlet hose (4) to pump.
3. Fix O-ring and install steering pump inlet tube (3) to pump.
4. Install R.H. side cover.
5. Tighten drain plug and refill engine oil through oil filler to specified level.

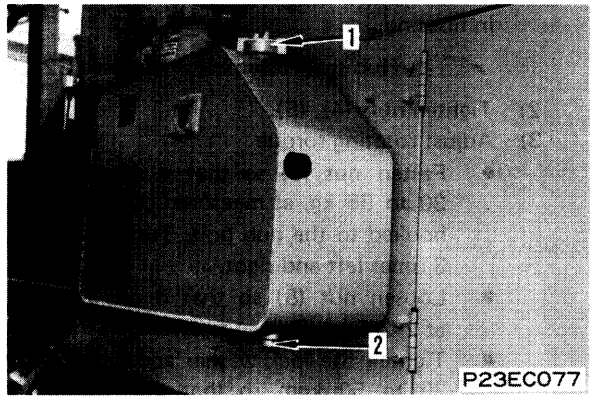
   Hydraulic oil: Approx. 27ℓ (GD705R-4)
   Approx. 70ℓ (GD705A-4)

★ Run the engine to circulate the oil through the system. Then check the oil level again.

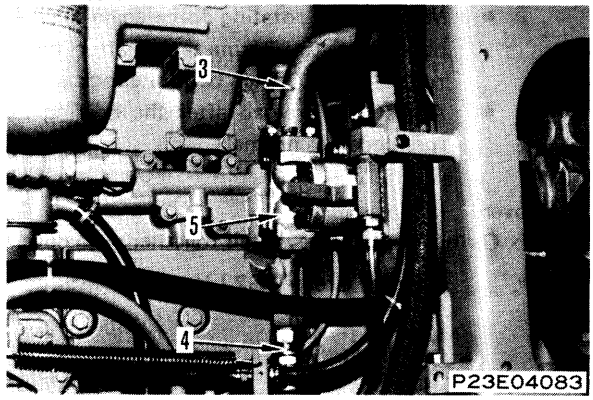
GD705R-4



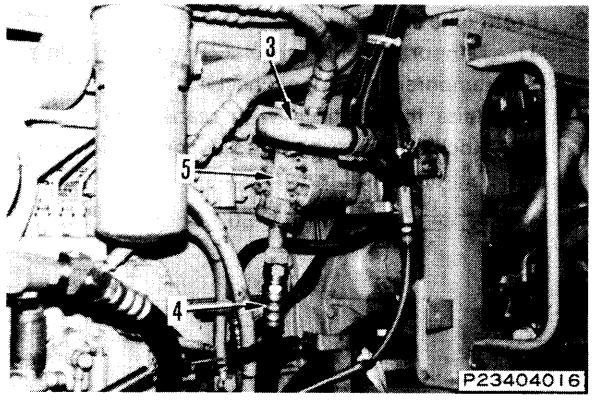
GD705A-4



GD705R-4

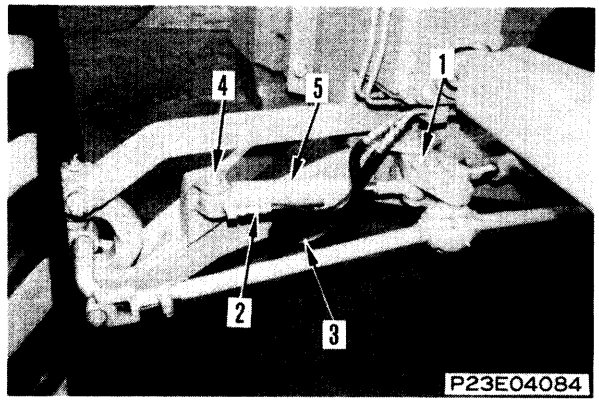


GD705A-4



REMOVAL OF STEERING CYLINDER ASSEMBLY

GD705R-4



1. Remove lock plate and remove pin (1) at head side.
2. Disconnect hoses (2) and (3).
3. Remove lock plate and remove pin (4) at bottom side.
4. Remove steering cylinder assembly (5).

INSTALLATION OF STEERING CYLINDER ASSEMBLY

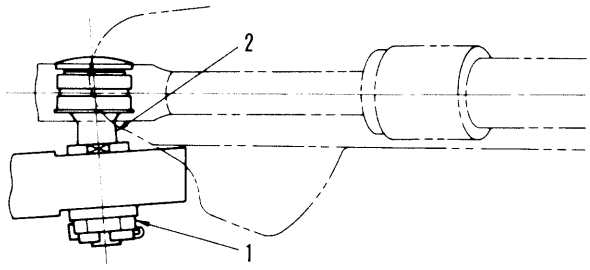
GD705R-4

1. Install steering cylinder assembly (5).
2. Install pin (4) at bottom side and secure it with lock plate.
3. Connect hoses (3) and (2).
   ★ Install hoses, taking care to prevent twisting and interference.
4. Install pin (1) at head side and secure it with lock plate.

REMOVAL OF STEERING CYLINDER ASSEMBLY

GD705A-4

1. Remove nut (1) at head end and remove connecting pin (2).
2. Disconnect hoses (3), (4).
3. Remove lock plate and remove connecting pin (5) at bottom end.
4. Dismount steering cylinder assembly (6).

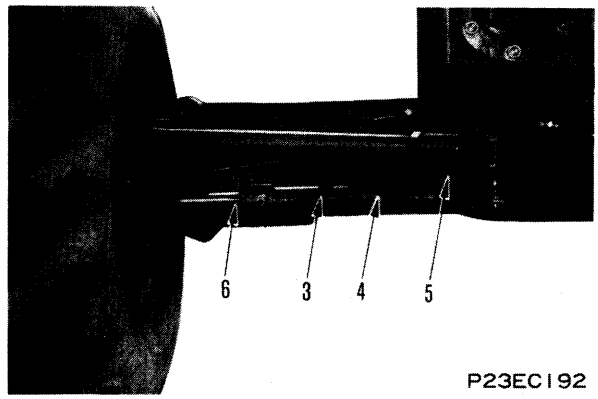


F23EC029

INSTALLATION OF STEERING CYLINDER ASSEMBLY

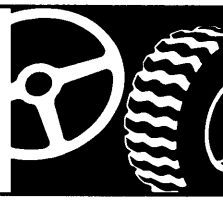
GD705A-4

1. Mount steering cylinder assembly (6).
2. Insert connecting pin (5) at bottom end and fix it with lock plate.
3. Connect hoses (3), (4).
   ★ Install hose without twisting and interference.
4. Insert pin (2) at head side and fix it with nut (1).



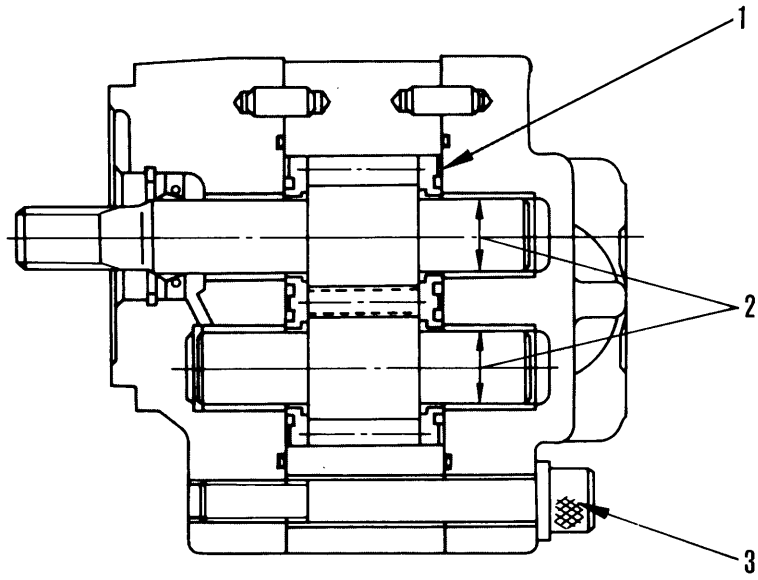
P23EC192

STEERING SYSTEM
44 MAINTENANCE STANDARD



STEERING PUMP

GD705R-4 (LAL016)

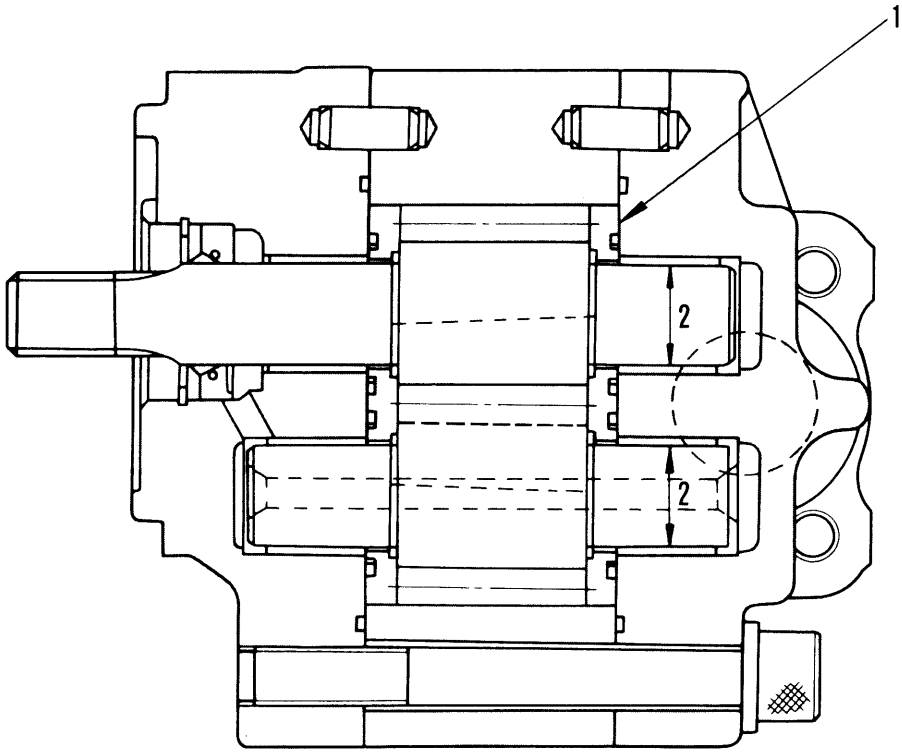


F23B066A

Unit: mm

No.	Check Item	Criteria				Remedy
1	Side clearance between gear case and side plate	Standard clearance		Tolerance		
		0.05 – 0.1		0.15		
2	Clearance between bearing I.D. and gear shaft	0.06 – 0.119		0.20		
3	Case installed tightening torque	6.6 ± 0.6 kgm				
4	LAL016 (EO10-CD, 50 ± 5°C, 175 kg/cm²)	Standard value		Repair limit		
		Pump speed (rpm)	Delivery (ℓ/min)	Pump speed (rpm)	Delivery (ℓ/min)	
		3500	53.0	3500	48.0	

GD705A-4 (SAR032)



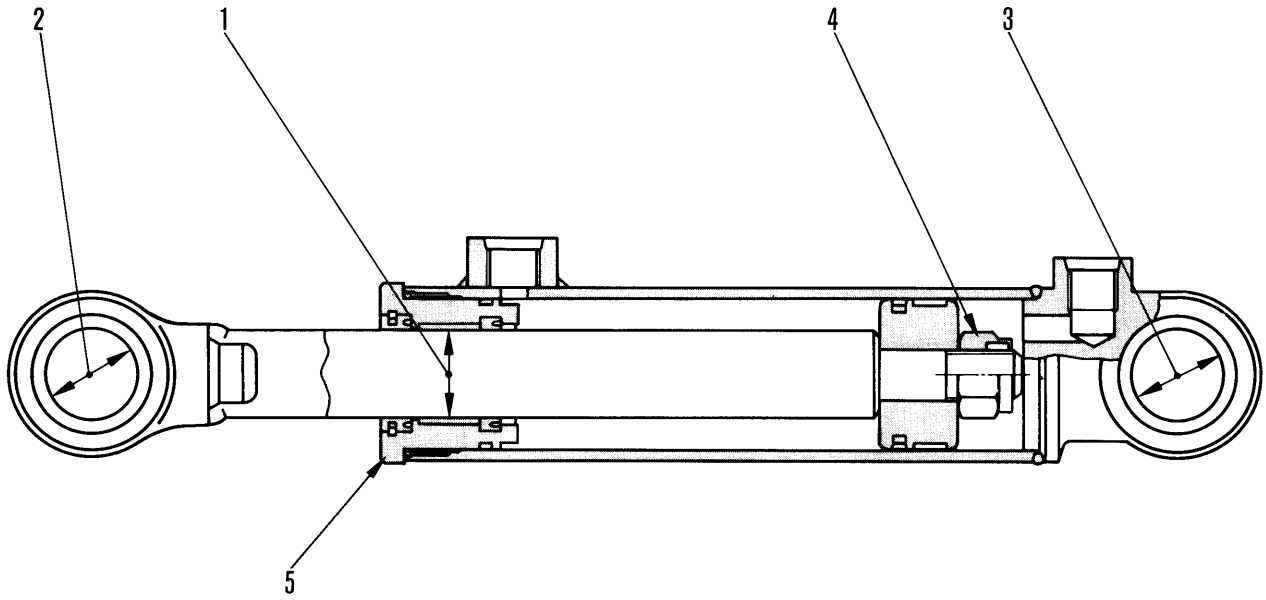
F23E095A

Unit: mm

No.	Check Item	Criteria				Remedy
1	Side clearance between gear case and side plate	Standard clearance		Clearance limit		
		0.10 – 0.15		0.19		
2	Clearance between bearing I.D. and gear shaft diameter	0.06 – 0.166		0.20		
3	SAR032 EO10-CD 50°C 175 kg/cm²	Standard value		Repair limit		
		Pump speed (rpm)	Delivery (ℓ/min.)	Pump speed (rpm)	Delivery (ℓ/min.)	
		3000	72	3000	67	

STEERING CYLINDER

GD705R-4

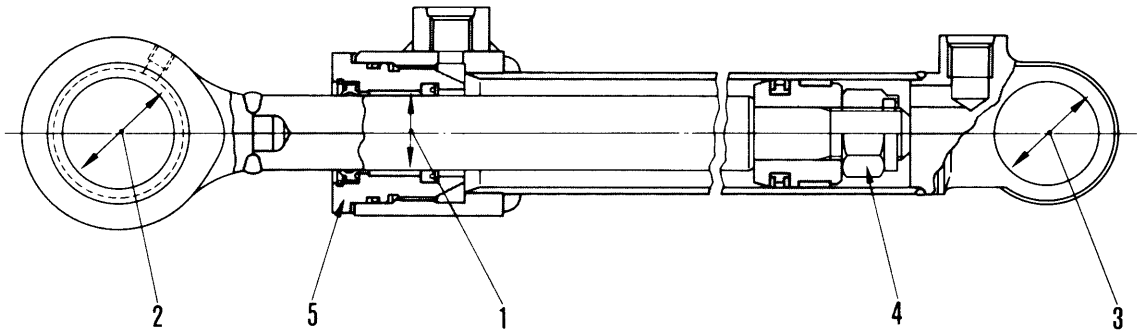


F23E04038

Unit: mm

No.	Check Item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between piston rod and bushing	35	−0.080 −0.142	+0.132 +0.006	0.086 – 0.274	0.6	Replace
2	Clearance between piston rod end and support shaft	35	−0.025 −0.064	+0.142 +0.080	0.105 – 0.206	1	
3	Clearance between cylinder bottom end bushing and support	35	−0.025 −0.064	+0.142 +0.080	0.105 – 0.206	1	
4	Piston nut tightening torque	25 ± 2.5 kgm (Width across flats: 36)					
5	Cylinder head tightening torque	45 ± 4.5 kgm					

GD705A-4



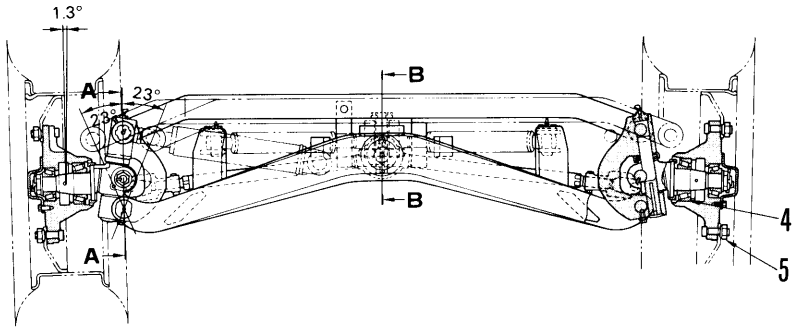
234F119-6A

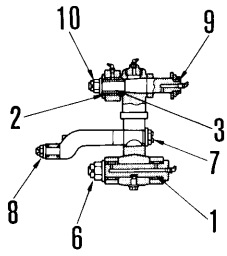
Unit: mm

No.	Check Item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between piston rod and bushing	35	−0.030 −0.142	+0.132 +0.006	0.036 – 0.274	0.6	Replace bushing
2	Clearance between piston rod support shaft and bushing	50	−0.050 −0.075	+0.041 +0.025	0.075 – 0.116	0.6	
3	Clearance between cylinder bottom yoke and bushing	30	+0.009 −0.004	0 −0.010	−0.019 – 0.004	0.6	
4	Piston nut tightening torque	42 ± 4.2 kgm					
5	Cylinder head tightening torque	40 ± 4 kgm					

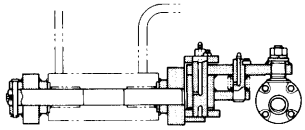
FRONT AXLE

GD705R-4





Section A—A



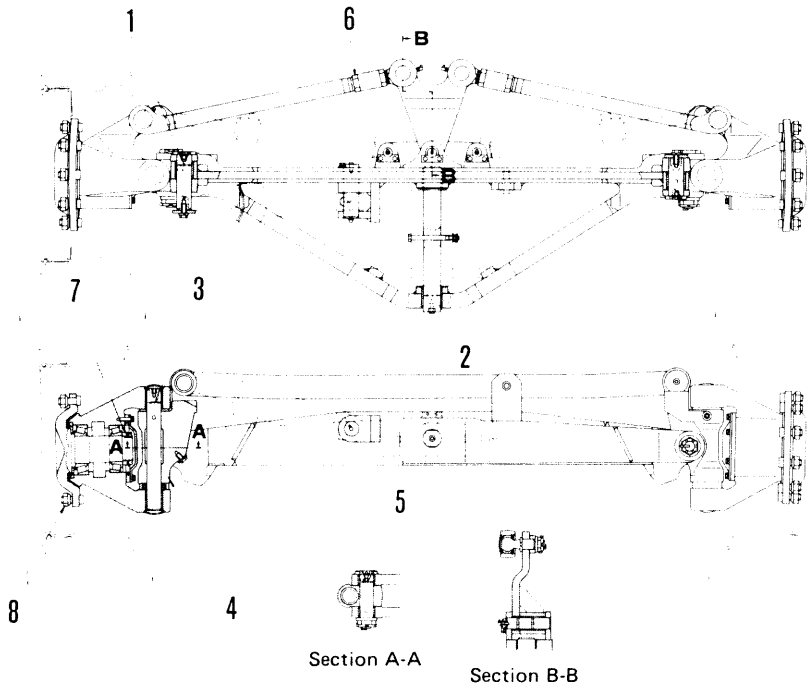
Section B—B

F23E04040

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between knuckle bracket lower shaft and bushing	40	−0.025 −0.064	+0.161 +0.118	0.143 — 0.225	0.5	Replace bushing
2	Clearance between collar (joint arm) and bushing (leaning rod)	40	−0.025 −0.064	+0.161 +0.118	0.143 — 0.225	0.5	
3	Clearance between leaning rod and collar (joint arm)	30	+0.013 −0.008	+0.033 0	0.013 — 0.041	0.1	
4	Hub bearing pre-load	Starting torque: 1.34 — 2.01 kgm					Adjust
5	Wheel nut tightening torque	50 ± 5 kgm					
6	Front axle-to-bracket installed nut tightening torque	60 ± 40 kgm					
7	Knuckle arm stopper nut tightening torque	55 ± 25 kgm					
8	Tie rod joint nut tightening torque	12.5 ± 7.5 kgm					
9	Leaning cylinder installed pin top nut tightening torque	32.5 ± 12.5 kgm					
10	Leaning rod installed pin top nut tightening torque	45 ± 25 kgm					

GD705A-4



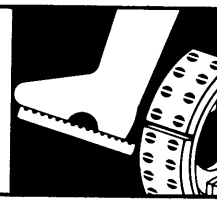
F23E096

Unit: mm

No.	Check Item	Criteria					Remedy
1	Clearance between leaning pin and leaning rod bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole			
		50	−0.025 −0.064	+0.025 +0	0.025 – 0.089	1.0	
2	Clearance between center pin and bushing	60	−0.085 −0.110	−0.025 −0.050	0.035 – 0.085	1.0	
3	Clearance between king pin and bushing	50	−0.025 −0.050	+0.025 +0	0.025 – 0.075	0.4	
4	Axial clearance between knucle and bracket (king pin)	Standard clearance		Interference limit			Replace
		0.143 – 0.331		1.0			
5	Clearance between axle end pin and bushing	Standard size	Tolerance		Standard interference	Interference limit	Replace bushing
			Shaft	Hole			
		45	−0.085 −0.064	−0.025 +0	0.025 – 0.089	0.4	
6	Tie rod joint nut tightening torque	22 – 31 kgm					Adjusting
7	Preload of hub bearing	Starting torque: 2.5 – 3.35 kgm					
8	Hub nut tightening torque	50 ± 5 kgm					

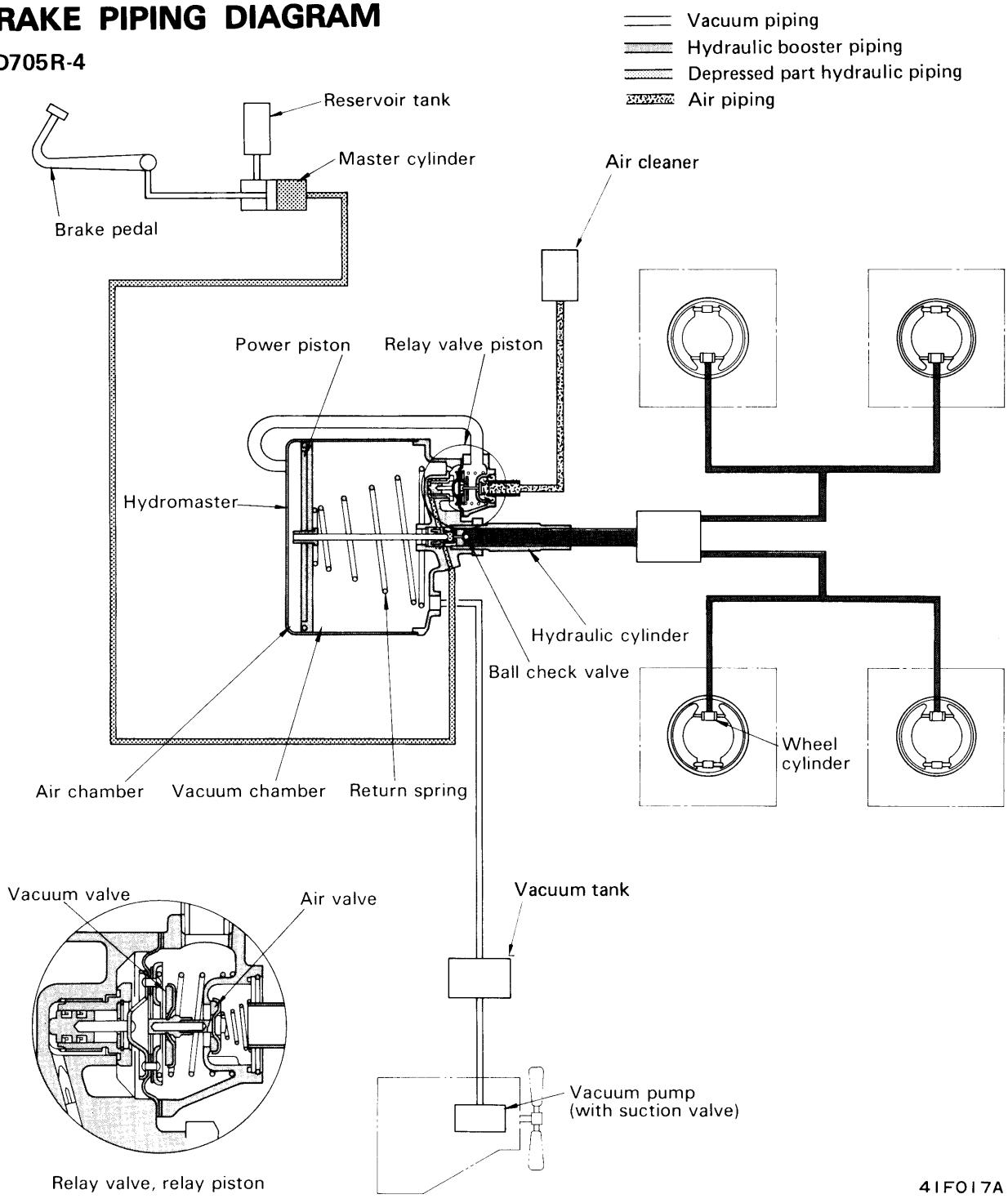
BRAKE SYSTEM

51 STRUCTURE AND FUNCTION



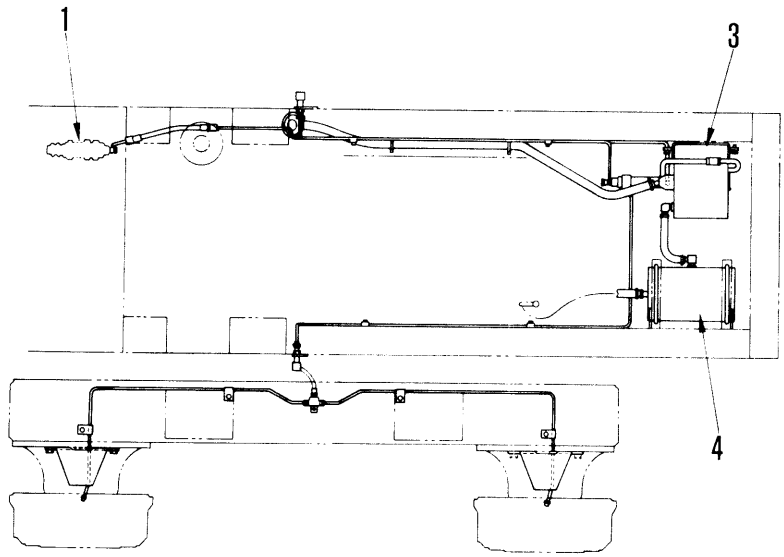
BRAKE PIPING DIAGRAM

GD705R-4

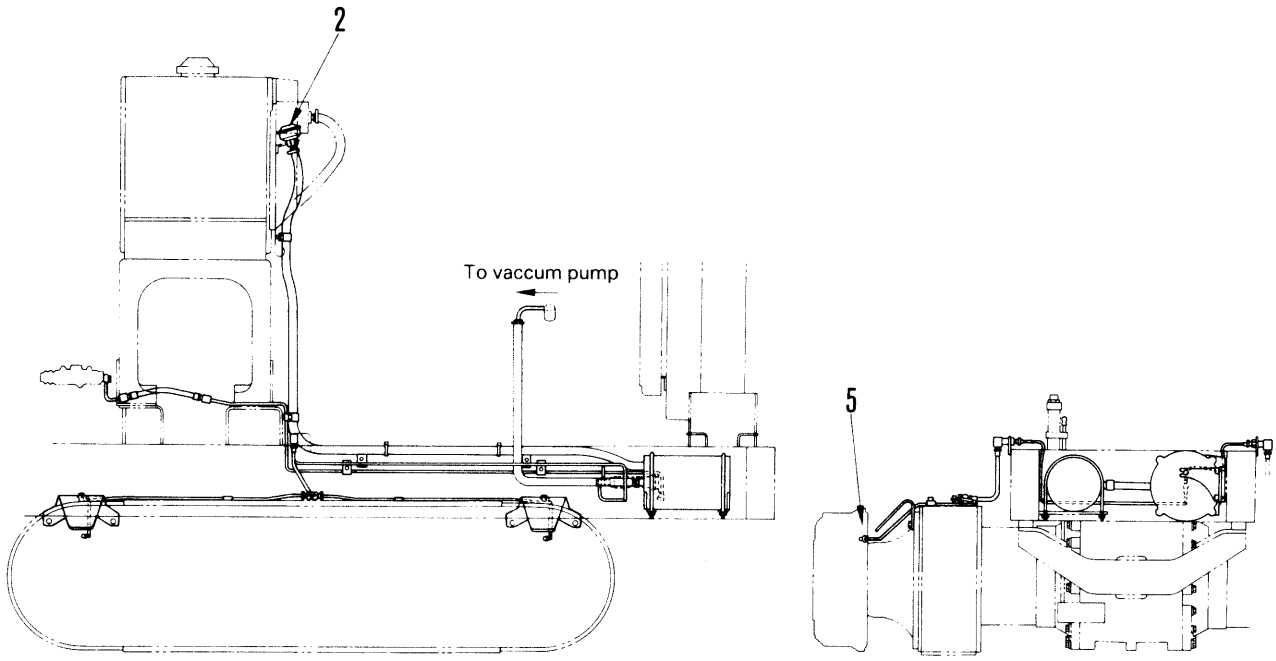


Since there is a hydromaster (vacuum booster device) installed in this braking system, it increases braking efficiency and lessens brake pedal depression force and greatly reduces operator fatigue.
If the hydromaster happens to be failured, it acts as an ordinary hydraulic brake due to an intricate mechanism.

BRAKE PIPING



1. Master cylinder
2. Air cleaner
3. Hydromaster
4. Vacuum tank
5. Wheel Brake



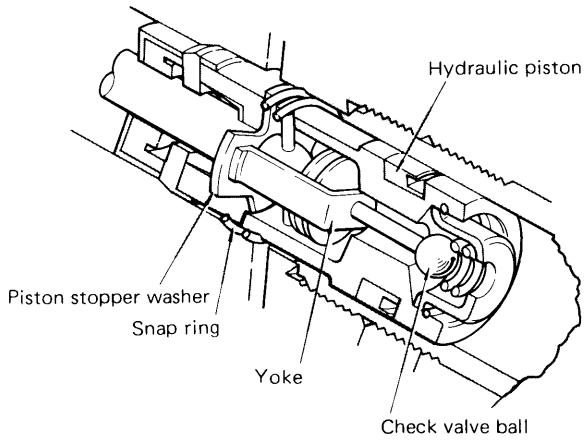
F23E04041

HYDROMASTER

GD705R-4

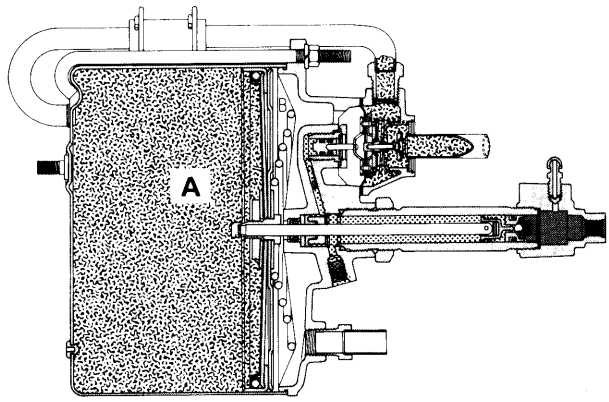
OPERATION OF WHEEL BRAKE

1. **When not being operated**
(when not depressing brake pedal)
When both power piston chambers **A** and **B** are vacuum, and the power piston is pushed to the left side by the return spring, the power cylinder is balanced.
At this time the hydraulic piston hits against the piston stopper washer and pushes the yoke to the right and since the ball check valve is open, brake oil from the master cylinder passes through the hole in the middle of the hydraulic piston to the wheel cylinder. Accordingly, **even though the hydromaster is not operating**, it operates as an ordinary oil brake.



41F018

2. **When being operated** (when depressing brake pedal)
When the brake pedal is depressed, hydraulic pressure is transmitted from the master cylinder to the hydraulic cylinder and the relay valve. Hydraulic pressure acting on the relief valve operates the relief valve piston on the right side and at the same time the diaphragm is pushed to adhere tightly to the vacuum valve. As hydraulic pressure from the master cylinder further increases, the air valve separates from its seat surface and air from the air cleaner flows into the **A** chamber on the power cylinder braking side. (At this time **B** chamber is a vacuum.) This results in a pressure difference between the two sides of the power pistons and it is pushed to the right. This is transmitted directly to the hydraulic piston by the push rod, and the hydraulic piston also operates. When the piston begins to move, the yoke that was in contact with the washer at the top of the piston, separates, and shuts the ball check valve and shuts off brake oil on the master cylinder side and wheel cylinder side, and prevents a back flow of high pressure oil that has arisen on the wheel cylinder side.
This high pressure oil passes through the safety cylinder and acts on the wheel brake cylinder and barkes the machine. Also, because engine rpm are not steady, there are variations in the suction of the vacuum pump, so a vacuum tank has been installed between the hydromaster and the vacuum pump to prevent vacuum pressure from falling.
Even if vacuum pressure falls, it is arranged that a warning buzzer from the vacuum pump sounds in the operator's compartment to warn the operator.



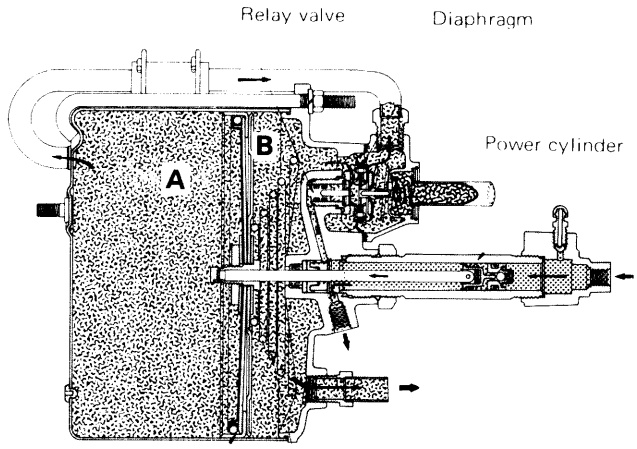
41F019

3. When brake is released.

(When foot is removed from brake pedal and braking stops.)

When the brake pedal is released, hydraulic pressure in the relay piston section drops. Then the air valve adheres tightly to its seat and cuts off air flow from outside. Next, the diaphragm separates from the vacuum chamber and opens the passage of both chambers **A** and **B** in the power cylinder, and air from **A** chamber flows into **B** chamber. Futhermore, because of the suction of the engine vacuum pump inside the hydromaster once again becomes vacuum. The power piston returns, being pushed to the left by a return spring, and at the same time the hydraulic piston also returns to its original position before operation.

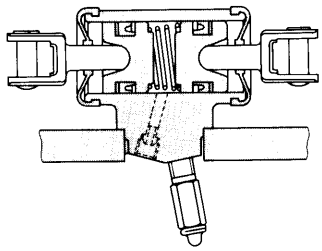
Also, atmospheric pressure, applying on the relay valve (vacuum valve, air valve) and the diaphragm during operation, can be felt normally through the brake pedal as a direct hudraulic pressure reaction. Therefore, the operator, being aware of the degree of brake engagement, can brake freely.



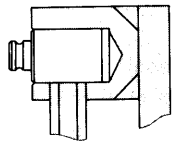
41F020

WHEEL BRAKE

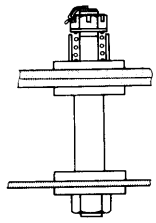
GD705R-4



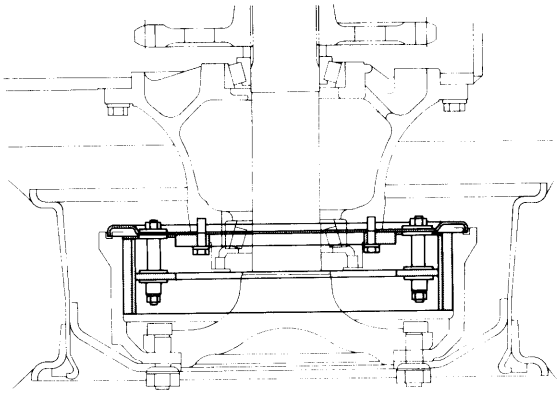
Section A—A

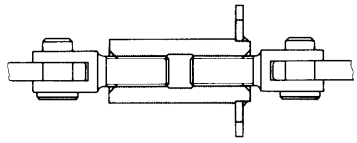


Section B—B



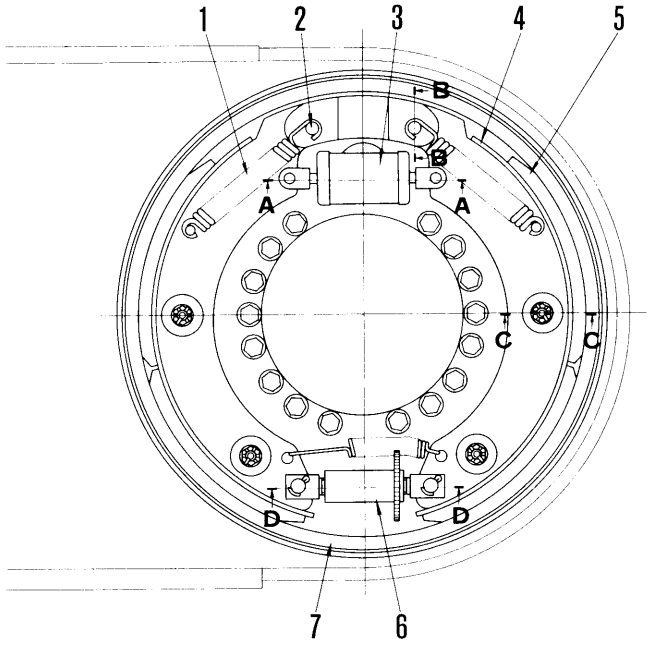
Section C—C





Section D—D

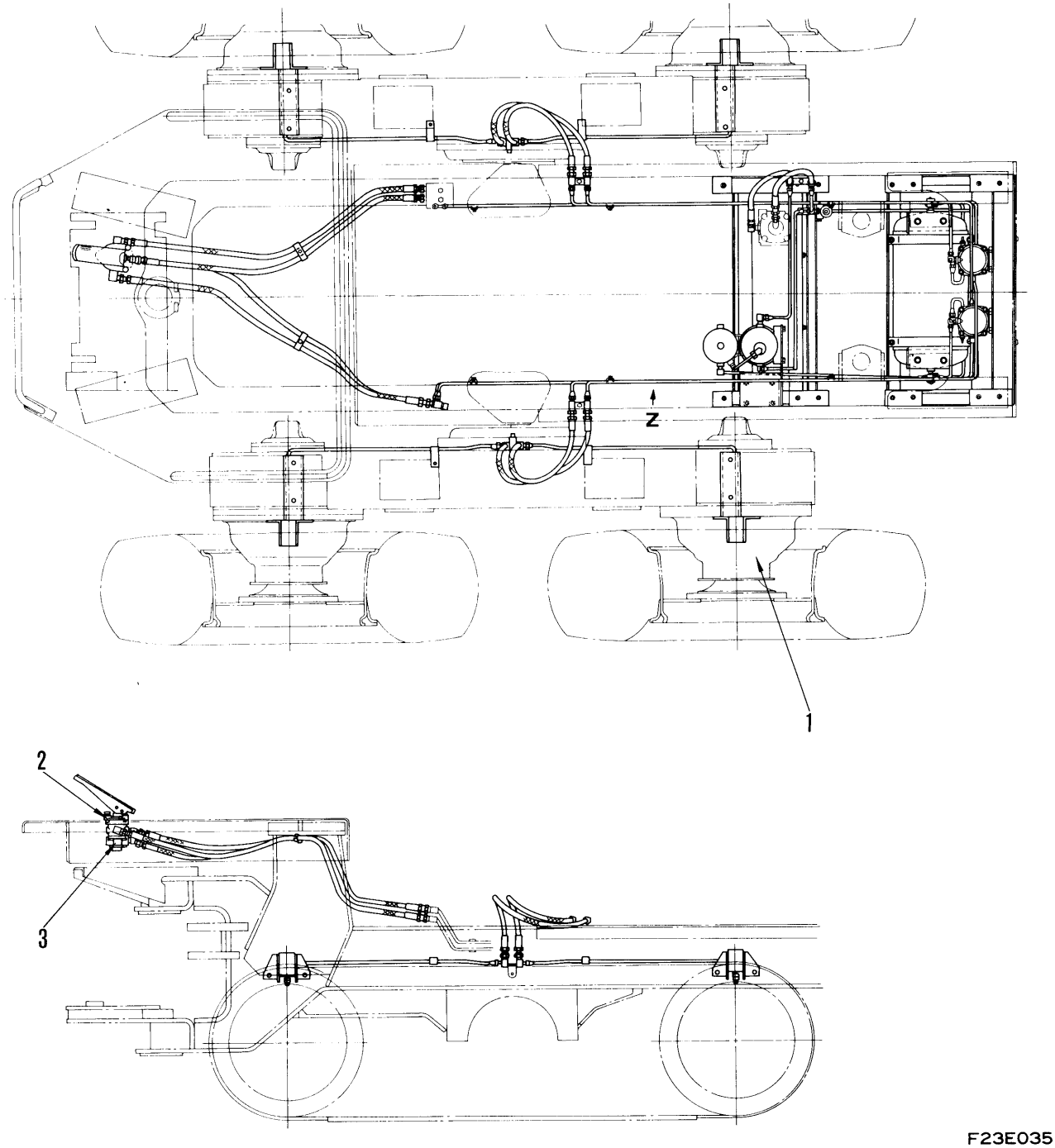
F23B060



1. Return spring
2. Anchor pin
3. Wheel cylinder
4. Shoe
5. Lining
6. Adjuster
7. Brake drum

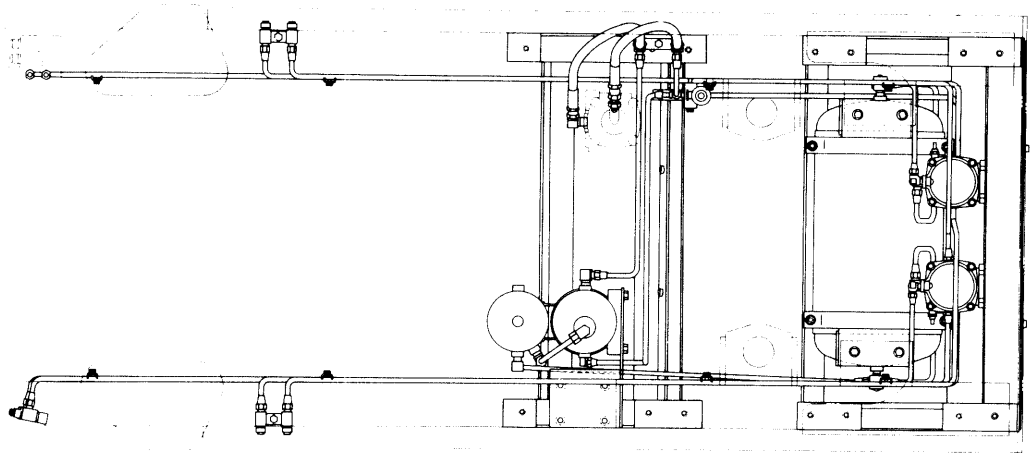
BRAKE AIR PIPING

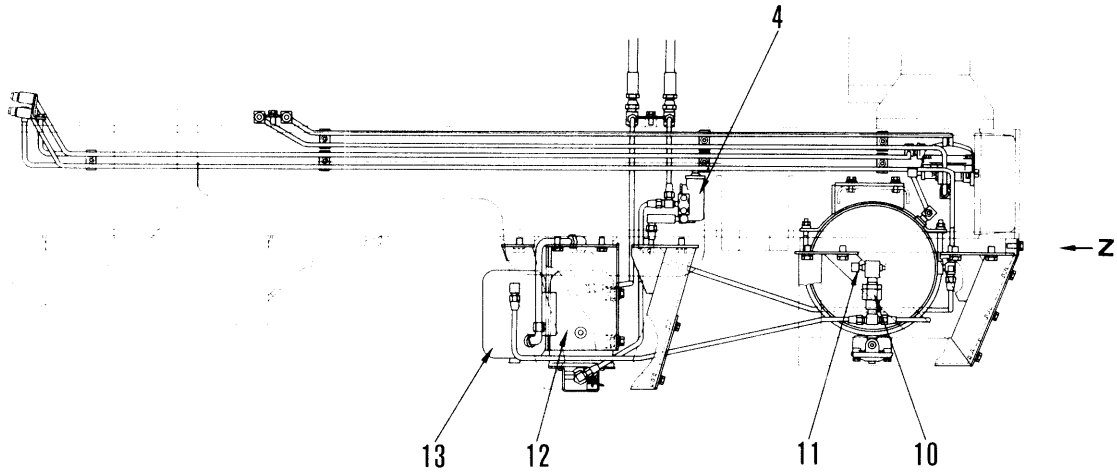
GD705A-4



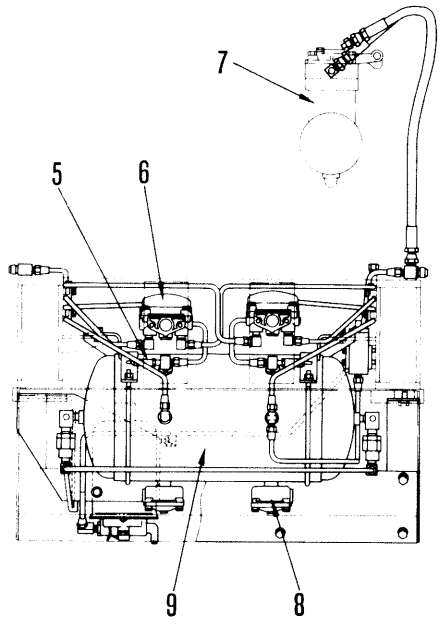
F23E035

1. Disk brake housing
2. Brake valve
3. Stop lamp switch





View Z



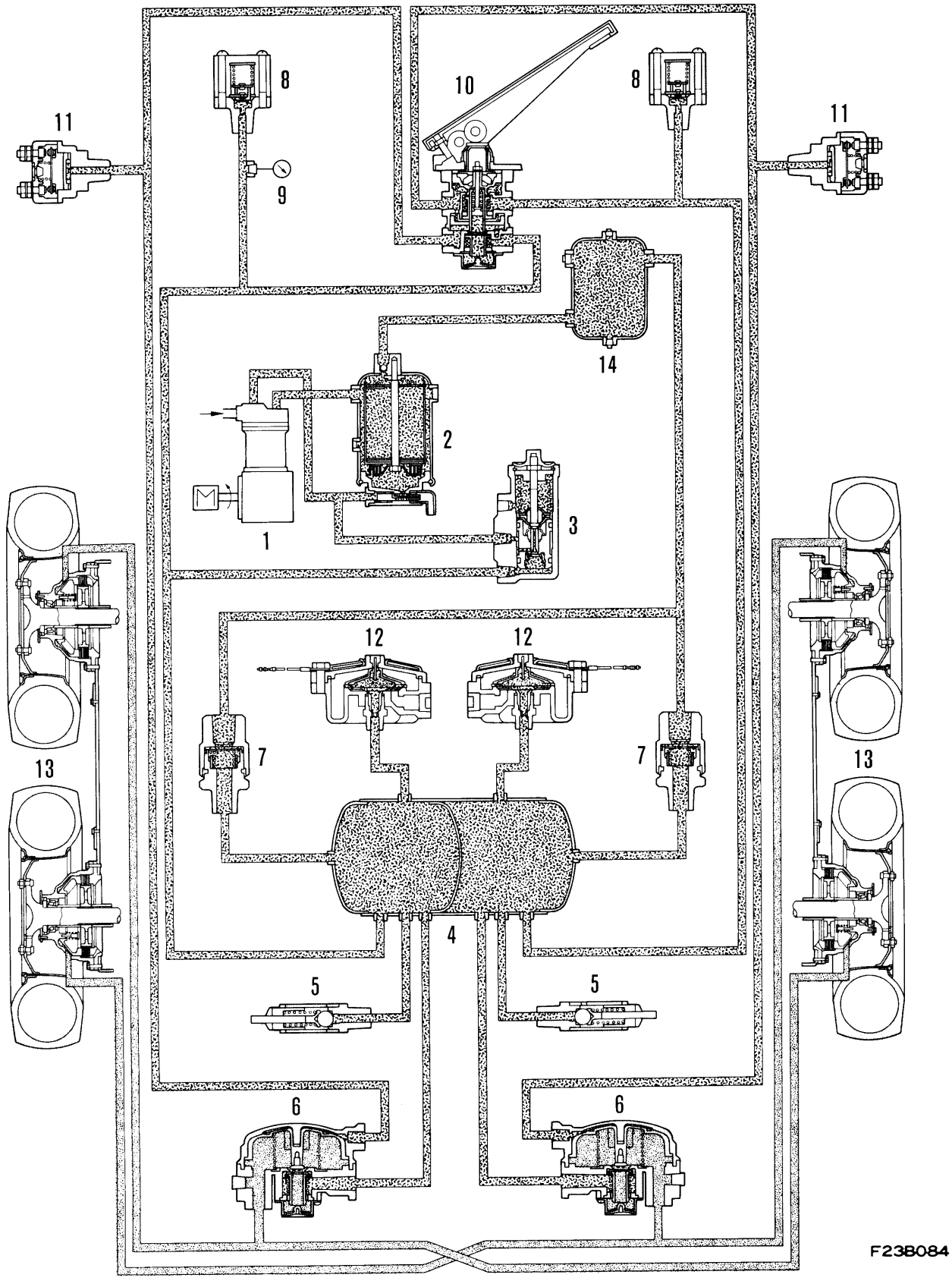
4. Air governor
5. Safety valve
6. Relay valve
7. Air compressor
8. Automatic drain valve (If equipped)
9. Air reservoir
10. Check valve
11. Low pressure switch
12. Air drier (If equipped)
13. Purge tank

F23E036

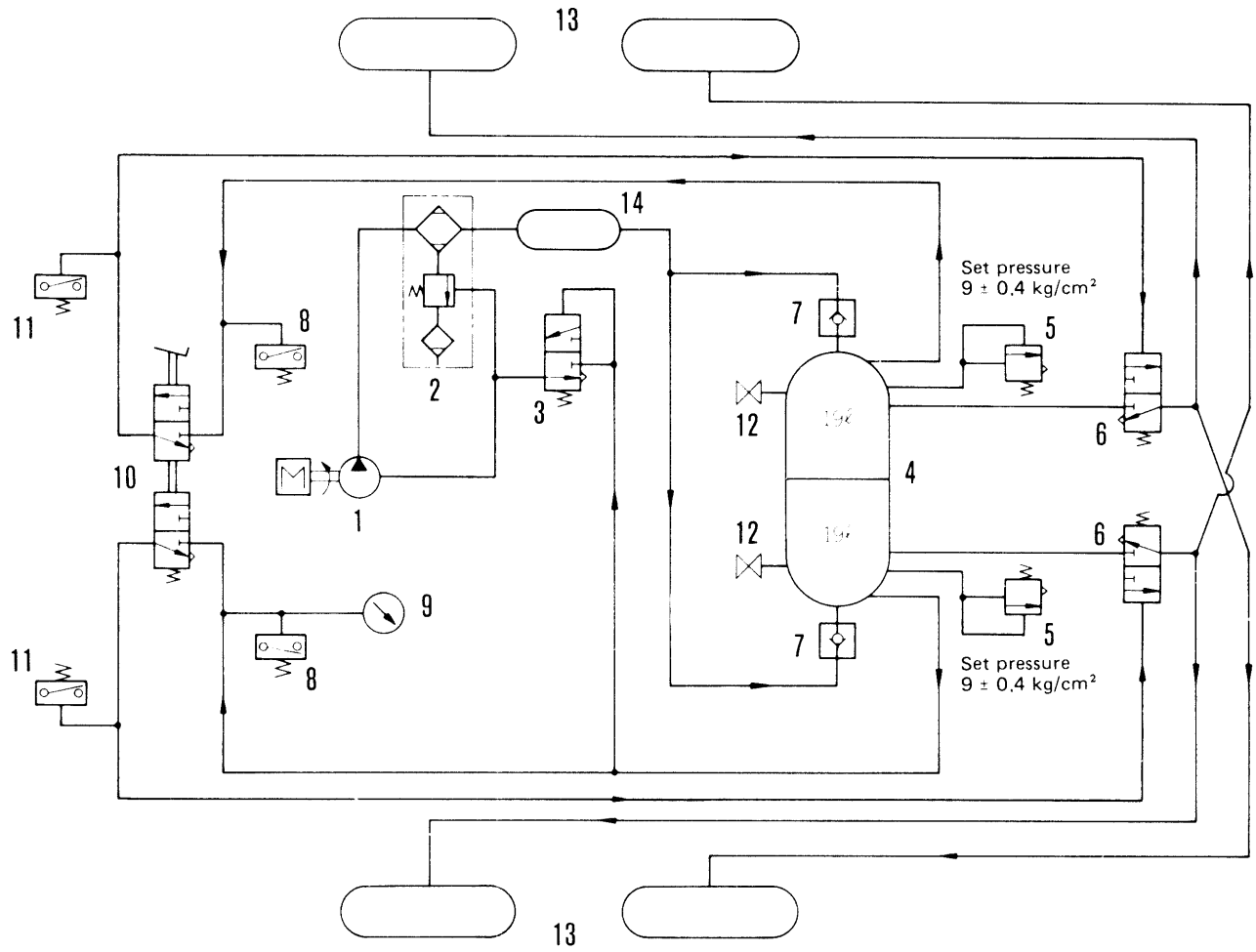
DISC BRAKE SYSTEM

GD705A-4

DISC BRAKE PIPING



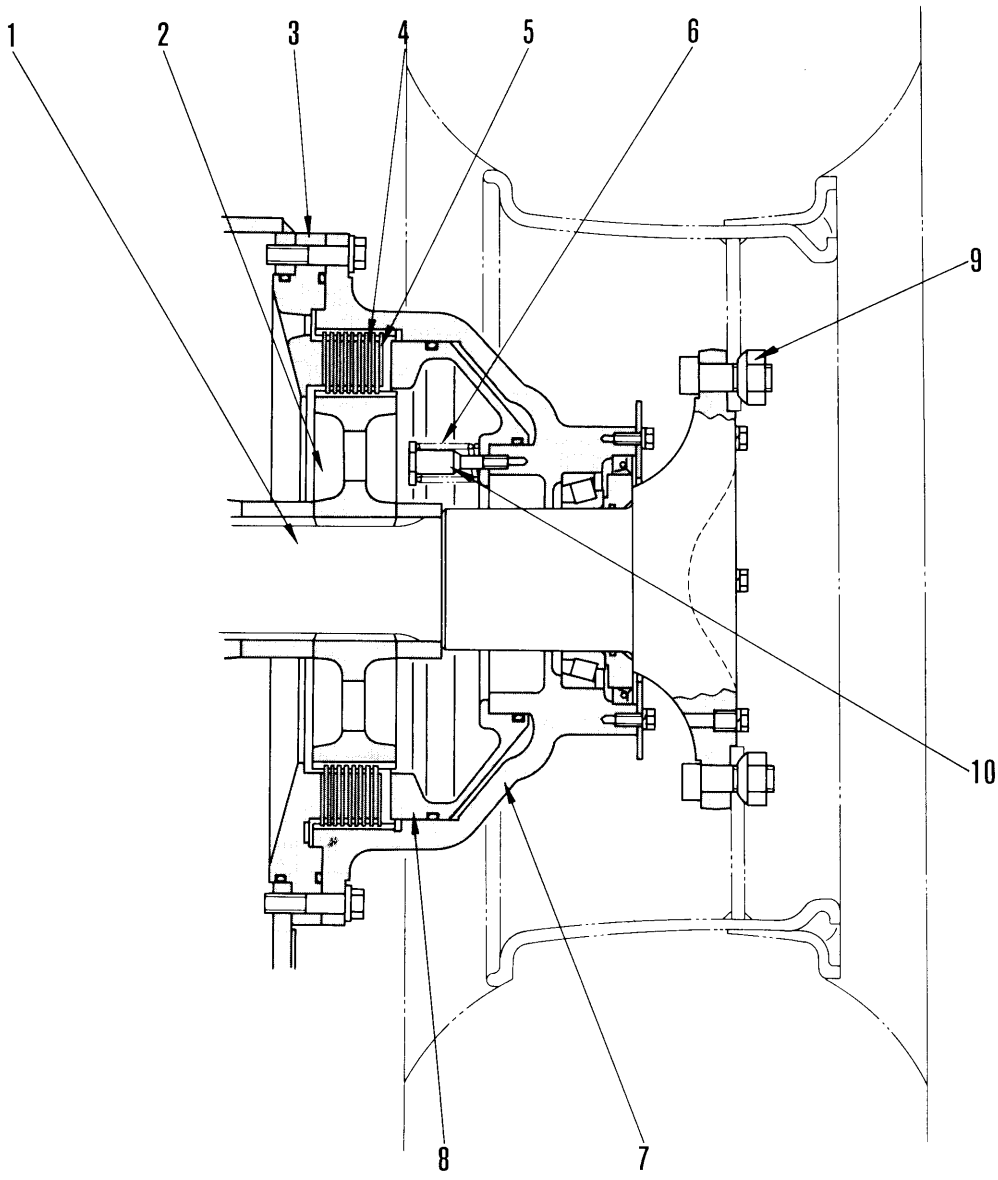
DISC BRAKE PIPING CIRCUIT DIAGRAM



238F046A

1. Air compressor
2. Air drier (If equipped)
3. Air governor
4. Air reservoir
5. Safety valve
6. Relay valve
7. Check valve
8. Low pressure switch
9. Pressure gauge
10. Brake valve
11. Stop lamp switch
12. Automatic drain (If equipped)
13. Disc brake
14. Purge tank

STRUCTURE OF DISC BRAKE



F23E037

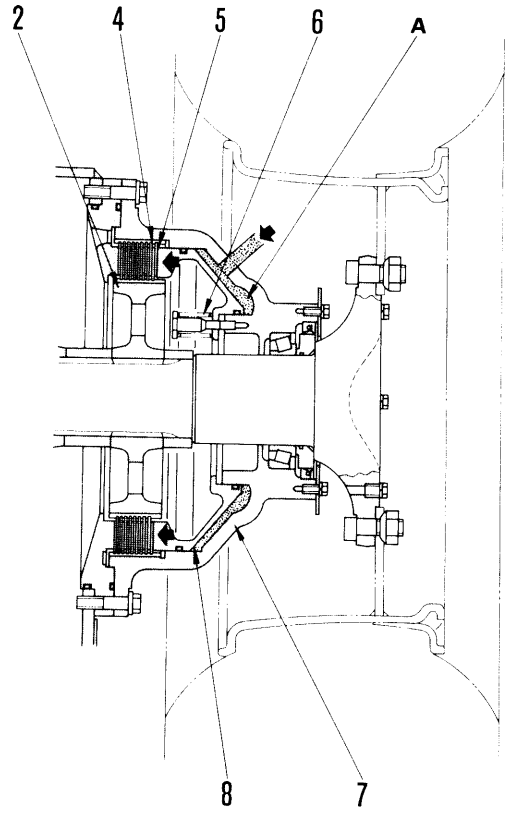
Disc brakes are fitted on the four rear wheels and are actuated by air pressure.
The motive force from the final drive rotates hub shaft (1), gear (2) and disc (4) inside cage (7). This rotation is transmitted to the tires which are fixed to the hub.
Each brake consists of disc (4) which is meshed with plate (5) and gear (2) which are meshed with cage (7).
The discs are cooled by the oil inside the tandem case.

1. Hub shaft
2. Gear
3. Support
4. Disc
5. Plate
6. Spring
7. Cage
8. Piston
9. Nut
10. Bolt

OPERATION

1. **Brake applied**

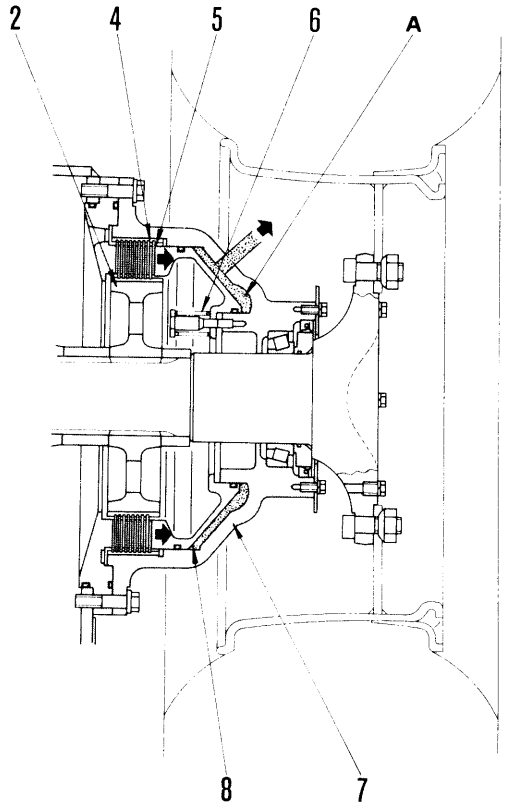
When the brake pedal is depressed, the air circuit is connected to chamber **A** of the disc brake. When the air pressure is greater than the pushing force of spring (6), piston (8) moves to the left, and pushes disc (4) and plate (5). Friction is generated between the disc (meshed with gear (2)) and the plate (meshed with cage (7)). This shows down the rotation of the disc and finally stops it. In other words, the brake is applied.



F23E038

2. **Brake released**

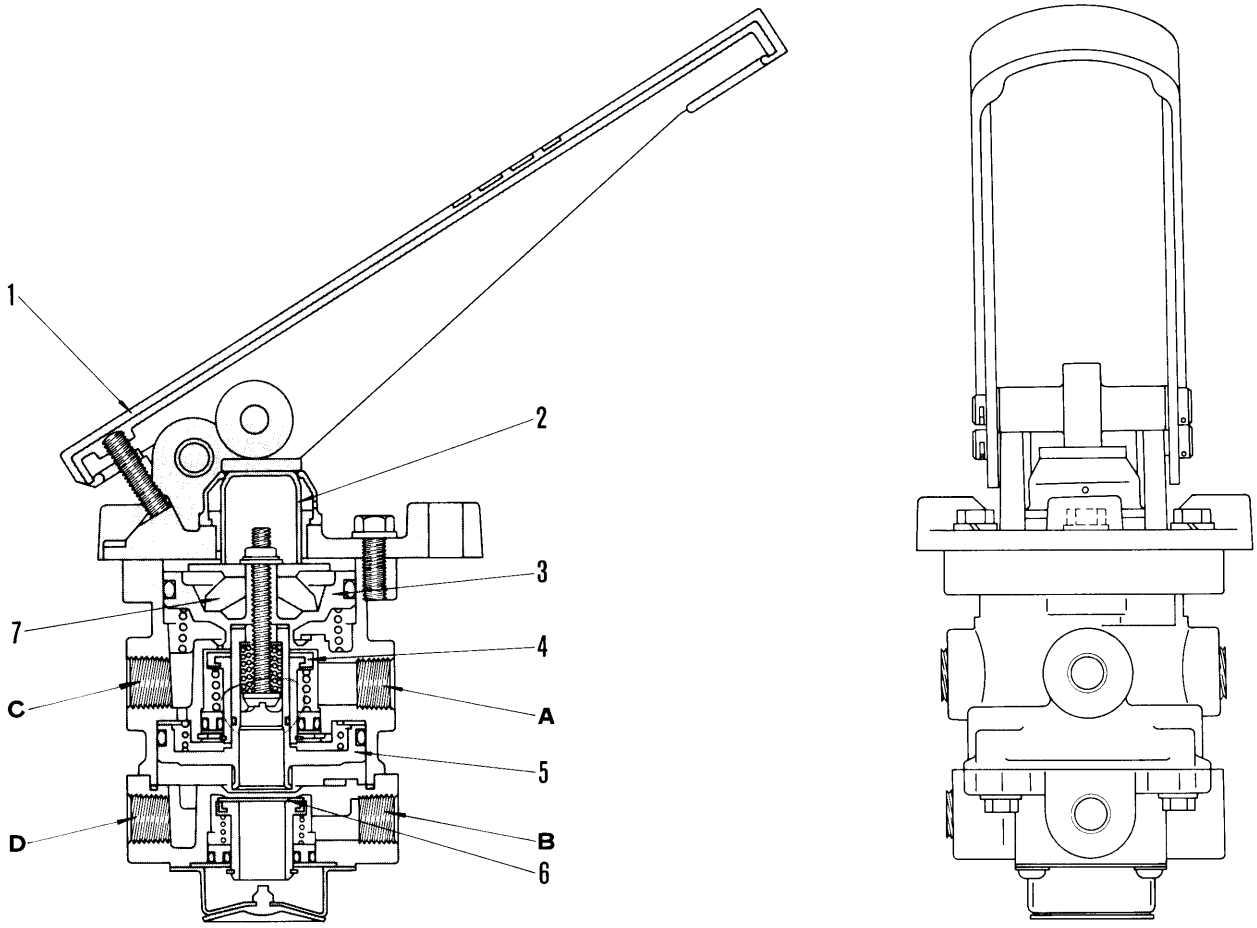
When the brake pedal is released, the air in chamber **A** is released. Spring (6) moves piston (8) back to the right, so the pushing force is reduced. This removes the friction between disc (4) and plate (5), and allows them to rotate freely. In other words, the brake is released.



F23E039

BRAKE VALVE

GD705A-4

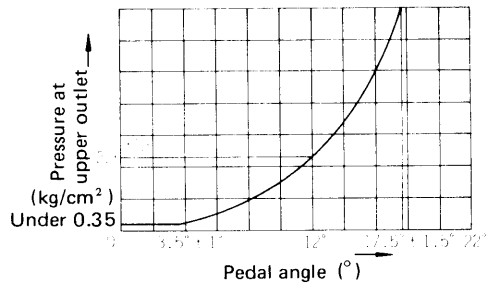


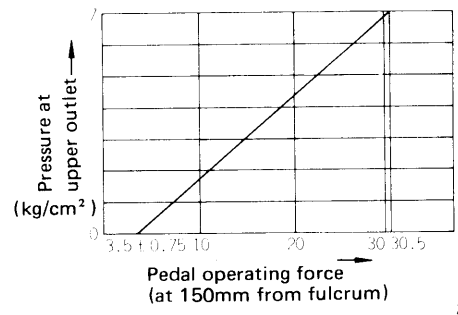
238F051

1. Brake pedal
2. Plunger
3. Piston
4. Inlet valve
5. Piston
6. Inlet valve
7. Rubber spring

A. From air reservoir
B. From air reservoir
C. To R.H. relay valve
D. To L.H. relay valve

Operating capacity curve





238F131

OPERATION

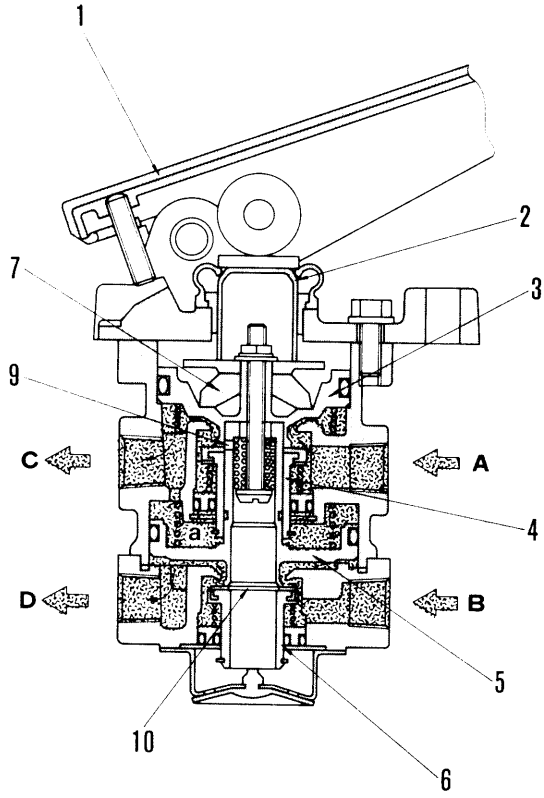
1. **Brake operating**

Upper part

- When brake pedal (1) is depressed, the operating force pushes plunger (2) and rubber spring (7), and these transmit the operating force to piston (3).
- When piston (3) moves down, it closes exhaust outlet (9). At the same time, it pushes down inlet valve (4) and air flows from air reservoir **A** to right relay valve **C**.

Lower part

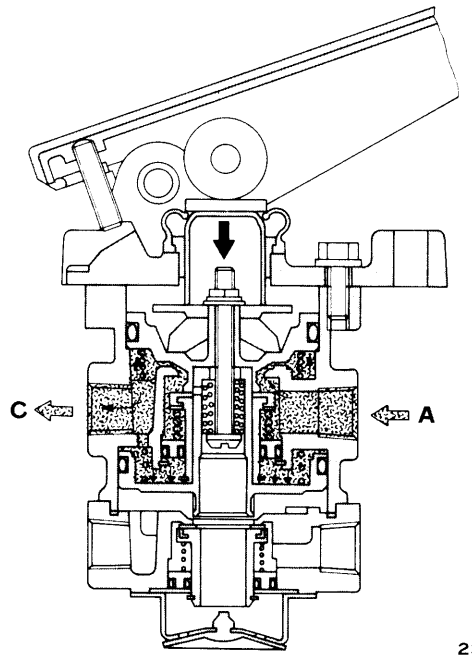
- When inlet valve (4) opens, air flows to chamber 'a' of piston (5).
- The air pressure pushes piston (5) down and this closes exhaust outlet (10). At the same time, it pushes down inlet valve (6) and air flows from air reservoir **B** to left relay valve **D** to actuate the brake.
- Only a small amount of air pressure is needed to move piston (5), so the movement of the lower valve occurs at almost the same time as the movement of the upper valve.



238F052

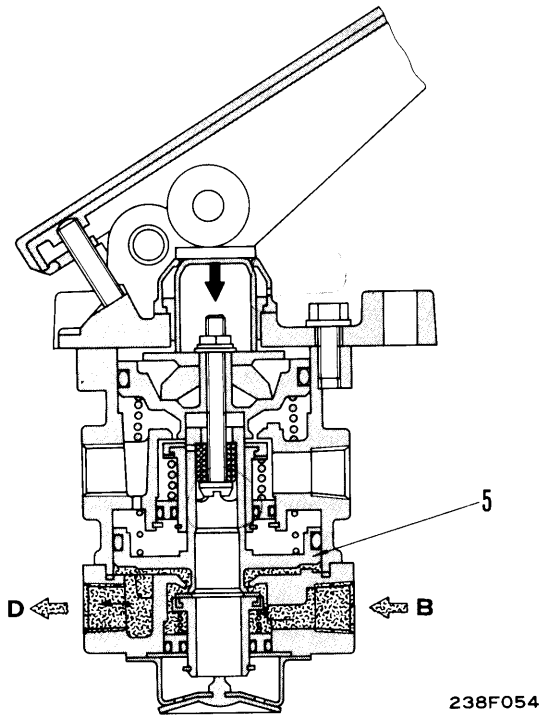
2. **Brake operation when lower side breakes down**

If there is any leakage of air at the lower side, the upper side operates normally but the lower side does not actuate the brake.



238F053

3. **Brake operation when upper side breaks down**
   - If there is any leakage of air at the upper side, piston (5) is pushed down mechanically when the brake pedal is depressed. Because of this, the lower side operates normally but the upper side does not actuate the brake.

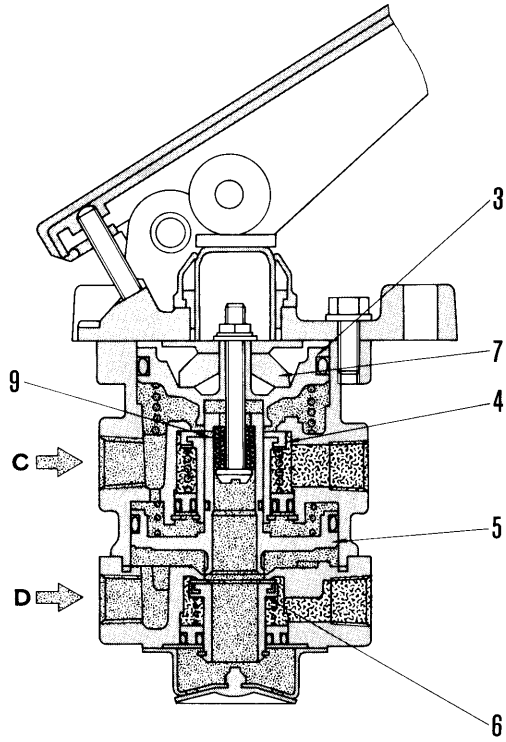


238F054

4. **Balancing operation**

   Upper part
   - If the air pressure in relay valve **C** and the space below piston (3) becomes high, piston (3) will push rubber spring (7) and move up to close inlet valve (4).
   - When this happens, exhaust outlet (9) remains closed, so the air pressure in the relay valve is maintained. As a result, the brake remains applied.

   Lower part
   - When the air pressure at the top and bottom of piston (5) becomes the same, the piston moves down slightly under the force of the spring at the top of the piston and closes inlet valve (6). The exhaust valve is closed so the air pressure is maintained. As a result, the brake remains applied.
   - The pressure in the space in the upper part balances with the operating force of the pedal, and the pressure in the space in the lower part balances with the air pressure in the space in the lower part.



238F055

- When piston (3) and (5) move their whole stroke inlet valves (4) and (6) are completely opened. As a result, the air pressure in the spaces in the upper part and lower part, and in the right and left relay valves is the same as the air pressure in the air reservoir.
- Therefore, until the piston moves its full stroke down, the braking effect is controlled by the amount the brake pedal is depressed.

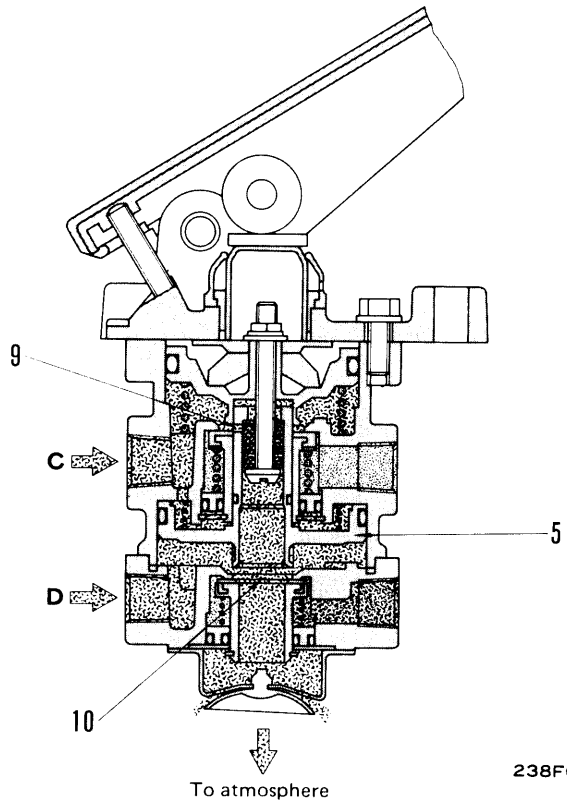
5. **Pedal released**

Upper part

- If the pressure on the pedal is reduced, and the operating pressure is removed from the top of the piston, the piston moves up because of the air pressure at the bottom of the piston and the force of the piston return spring. As a result, the passage to exhaust port (9) is opened and the compressed air in the relay valve is released to the atmosphere.

Lower part

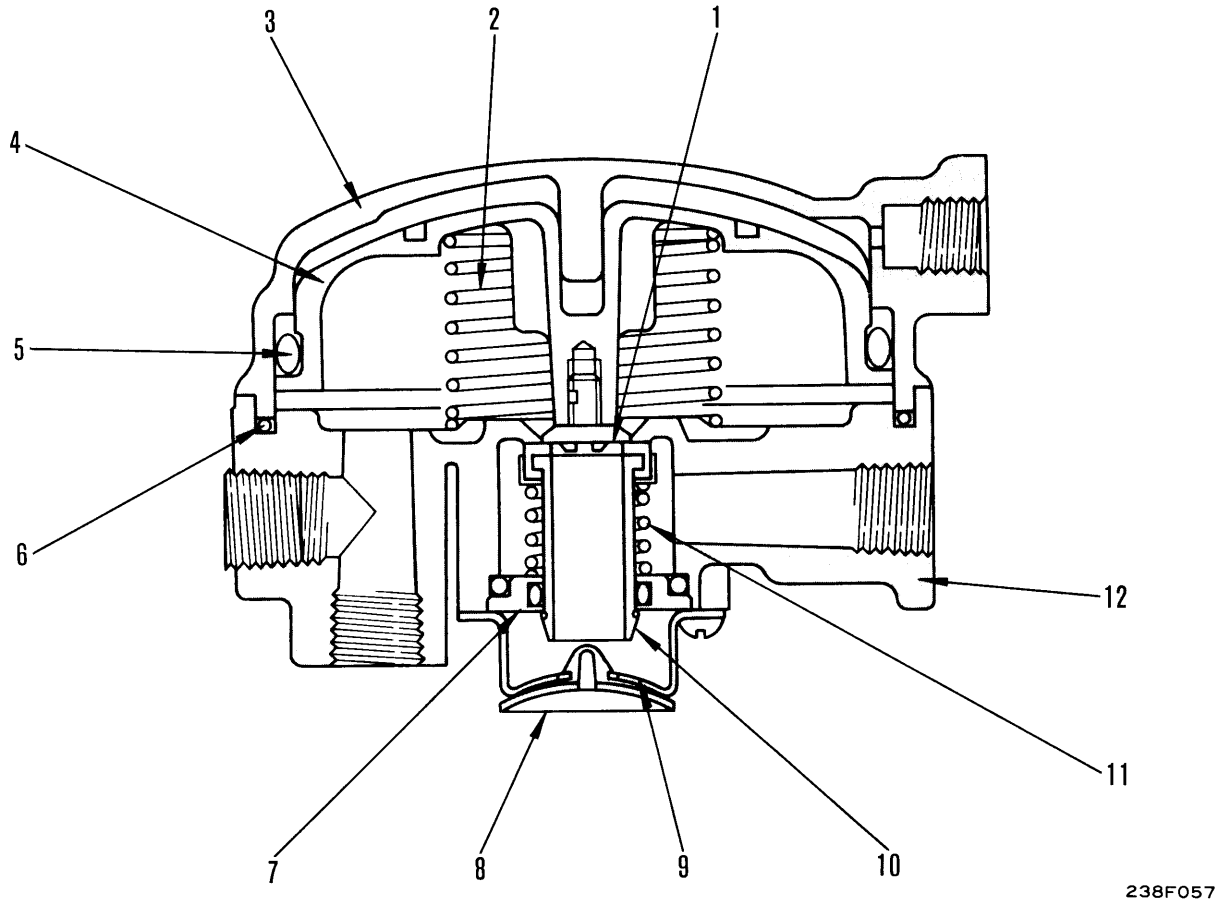
- If the pressure on the pedal is reduced, and the compressed air at the top of piston (5) is released, the air pressure at the bottom of piston (5) pushes piston (5) up. Exhaust port (10) is opened and the compressed air in the relay valve is released to the atmosphere.



238F056

RELAY VALVE

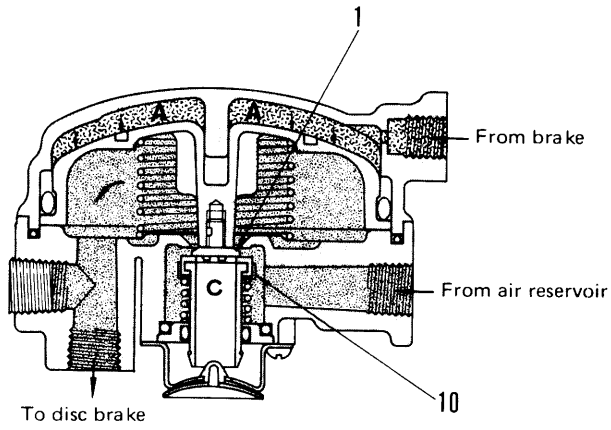
GD705A-4



1. Exhaust valve seat
2. Spring
3. Cover
4. Relay piston
5. O-ring
6. O-ring
7. Valve guide
8. Exhaust check
9. Exhaust cover
10. Inlet exhaust valve
11. Spring
12. Body

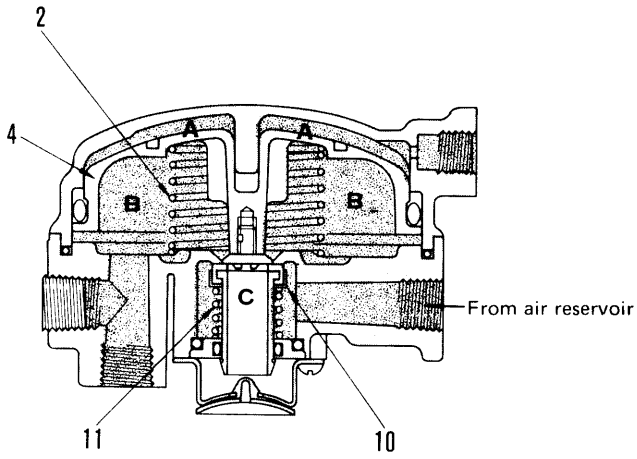
OPERATION

1. **When brake pedal is depressed**
   Compressed air enters chamber **A** at the top of relay piston (4) and pushes the relay piston down. Because of this, exhaust valve seat (1) closes exhaust port **C** and pushes open valve (10).
   When the valve opens, compressed air from the air reservoir passes through the valve and is supplied to the brake chamber.



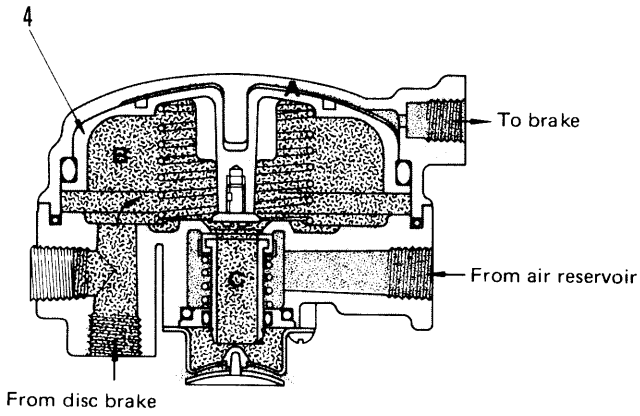
238F058

2. **When brake pedal is held in place**
   The air pressure in chamber **A** at the top of the piston becomes equal to the air pressure in chamber **B** at the bottom of the piston. Spring (2) operates to push up relay piston (4), and spring (11) closes valve (10). In addition, exhaust port **C** stays closed at this position, so the pressure in lower chamber **B** is kept the same. If the pedal is depressed further and the pressure is increased, compressed air will be supplied to the disc brake until the pressure become equal again.



238F059

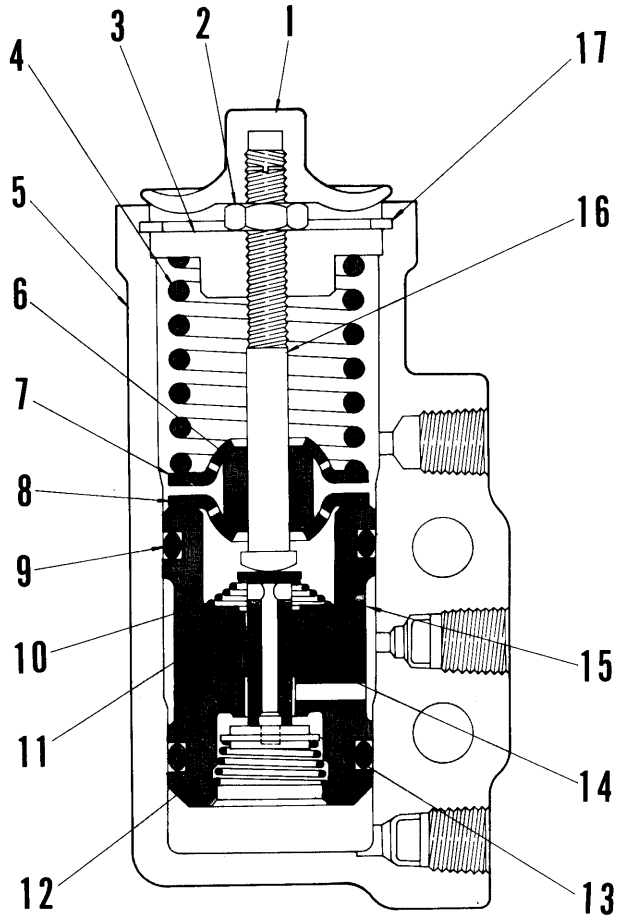
3. **When brake pedal is released**
   The compressed air in chamber **A** at the top of relay piston (4) is released through the brake valve. When the pressure in chamber **A** drops, relay piston (4) is pushed up by the air pressure in chamber **B**. Exhaust port **C** opens, so the air in chamber **B** is released.



238F060

AIR GOVERNOR

GD705A-4



238F061

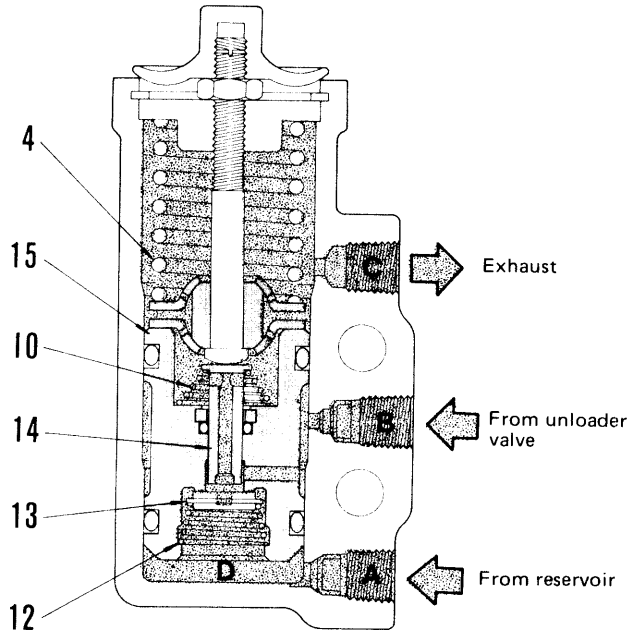
1. Cover
2. Lock nut
3. Spring upper seat
4. Spring
5. Body
6. Spring guide
7. Spring lower seat
8. Spring lower seat
9. O-ring
10. Spring
11. Washer
12. Spring
13. Pressure regulator valve
14. Exhaust stem
15. Piston
16. Adjust screw
17. Snap ring

The air governor is installed to prevent the pressure from rising too high. The reservoir port is connected to the air reservoir; the unloader port is connected to the unloader valve of the air compressor. The governor maintains the pressure inside the air reservoir within the specified range. If the pressure exceeds the specified limit, it stops the air compressor working.

Specified pressure range: 6.9 – 8.8 kg/cm^2

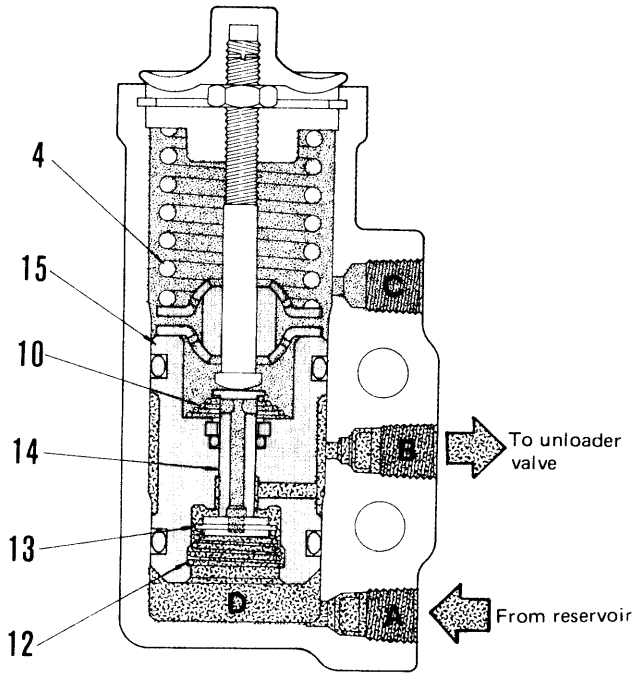
OPERATION

1. **When pressure inside air reservoir is too low**
   - The pressure at reservoir port **A** is too low, so piston (15) is pushed down by spring (4), and unloader port **B** is connected to the exhaust port. There is pressure on the unloader valve, so the compressor is working.



238F062

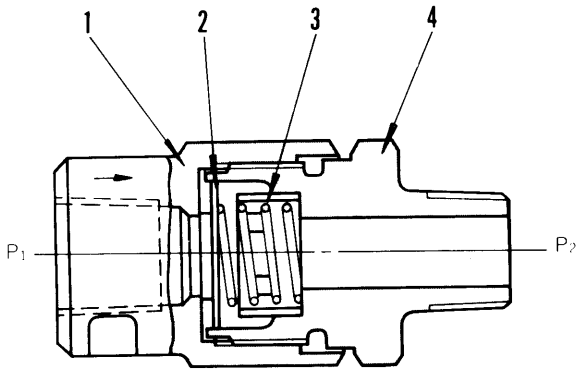
2. **When pressure inside air reservoir is too high**
   - If the pressure at reservoir port **A** is too low, piston (15) is pushed up.
   - When the piston is pushed up, the exhaust port closes and valve (13) opens. Compressed air from reservoir port **A** flows to unloader port **B**. This actuates the unloader valve and makes the compressor run at idling.
   - When the pressure inside the air reservoir drops, the piston is pushed down by spring (4).
   - When the pressure drops below the lower limit, valve (13) closes and exhaust stem (14) opens. Air pressure at the unloader port passes through the exhaust stem and is released to the atmosphere. As a result, the compressor starts working again.



238F063

CHECK VALVE

GD705A-4



238F064

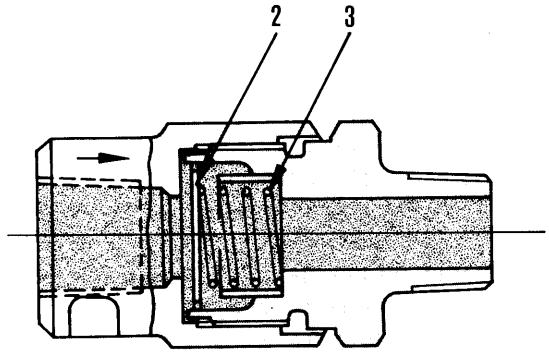
1. Body
2. Disc valve
3. Spring
4. Screw cap

The check valve acts to prevent air in the air reservoir from flowing back to the air compressor when the air compressor is stopped.

OPERATION

When air flows into the check valve from the left, valve (2) leaks its seat and the air flows freely to the various ports.

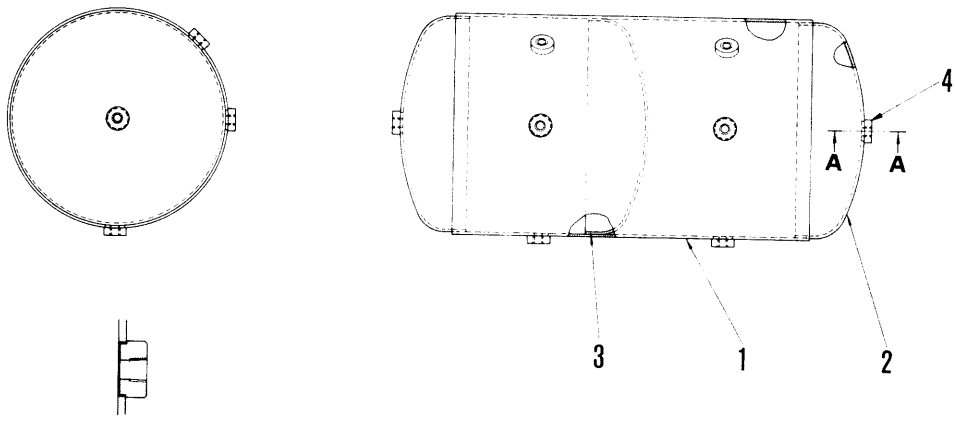
When air flows into the check valve from the right, valve (2) is pushed back into its seat by spring (3) and the air pressure. This shuts off the air flow.



238F065

AIR RESERVOIR

GD705A-4



Section A-A

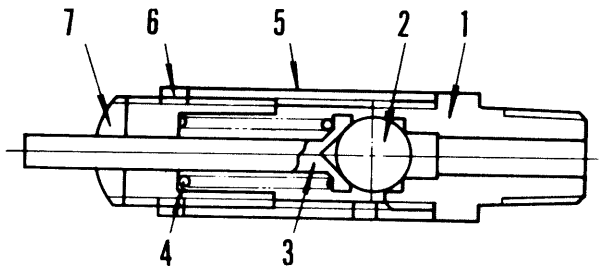
238F066

1. Plate
2. Plate
3. Plate
4. Boss

The air reservoir acts to store the compressed air produced by the air compressor.
Maximum pressure: 9.5 kg/cm^2 (Capacity 19ℓ x 2)

SAFETY VALVE

GD705A-4



238F067

1. Valve seat
2. Ball
3. Release pin
4. Spring
5. Spring cage
6. Lock nut
7. Adjusting screw

The safety valve is installed in the air reservoir and acts to maintain safety in the air circuit. When the pressure inside the air reservoir exceeds 9.5 ± 0.3 kg/cm^2, the safety valve releases compressed air to the atmosphere.

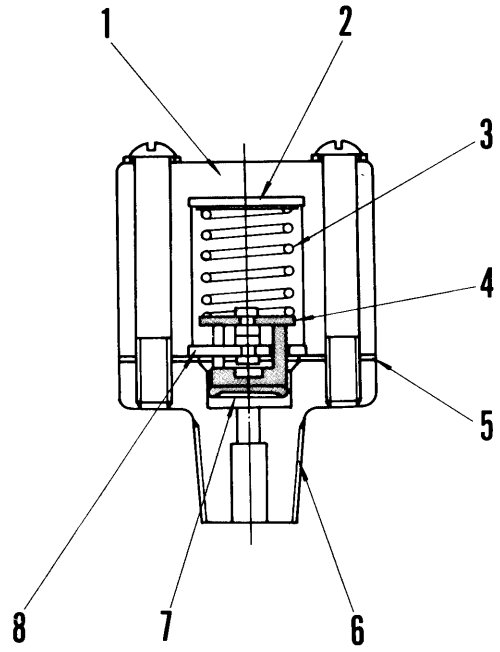
PRESSURE SWITCH

GD705A-4

The pressure switch detects any change in the air pressure. In accordance with these changes, it switches the electric circuit on or off.

PRESSURE SWITCH FOR AIR PRESSURE WARNING (LOW PRESSURE SWITCH)

The contacts of this switch close when the air pressure inside the main tank drops below 4.2 kg/cm^2. A warning buzzer then sounds to warn the operator of loss of braking power.
If the warning buzzer sounds, the operator must stops the machine and wait until the air pressure rises again.

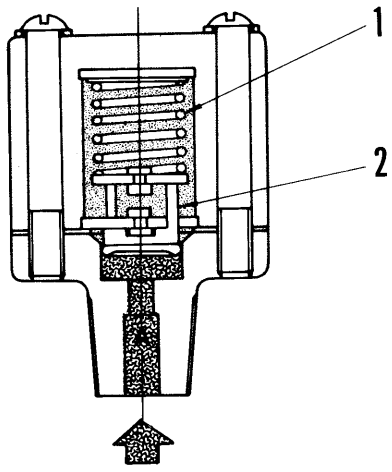


238F068

1. Cover
2. Contact plate
3. Spring
4. Contact disc
5. Gasket
6. Body
7. Piston cup
8. Contact plate

OPERATION

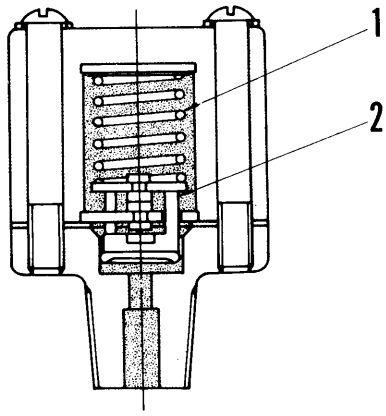
Contacts in OFF position



238F069

1. **When pressure in air ciucuit is above 4.2 kg/cm^2**
   The air pressure acting on piston (2) is higher than the force of the spring, so piston (2) is pushed up. The electrical contacts are open, so no electric current flows in warning buzzer circuit and the buzzer does not sound.

Contacts in ON position



238F070

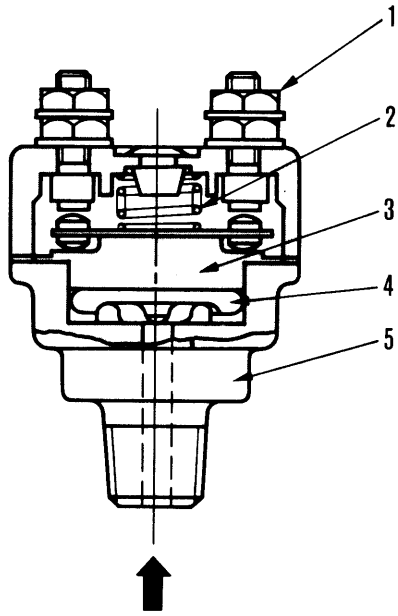
2. **When pressure in air circuit is below 4.2 kg/cm^2**
   The air pressure acting on piston (2) is lower than the force of the spring, so piston (2) is pushed down. The electrical contacts are closed, so electric current flows in warning buzzer circuit and the buzzer sounds.

PRESSURE SWITCH FOR STOP LAMP

This switch acts to light up the stop lamp when the brake pedal is depressed. When the air pressure rises above 0.5 kg/cm^2, the contacts close and the stop lamp lights up.
This switch is at the outlet port of the brake valve. One switch each is installed in both the right and left brake circuits.

OPERATION

When the brake pedal is depressed, air pressure is connected to the lower side of diaphragm (4). When the air pressure rises above 0.5 kg/cm^2, the diaphragm compresses spring (2) and pushes up plunger (3). This brings the points of the plunger and terminal into contact, and the stop lamp lights up.

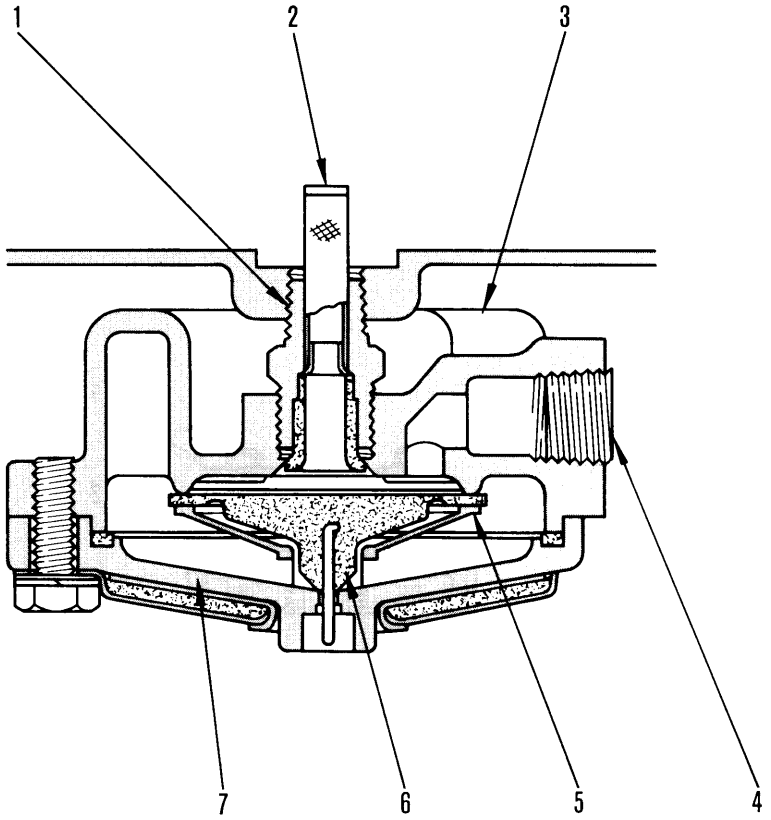


238F071

1. Terminal
2. Spring
3. Plunger
4. Diaphragm
5. Body

AUTOMATIC DRAIN VALVE

GD705A-4 (If equipped)



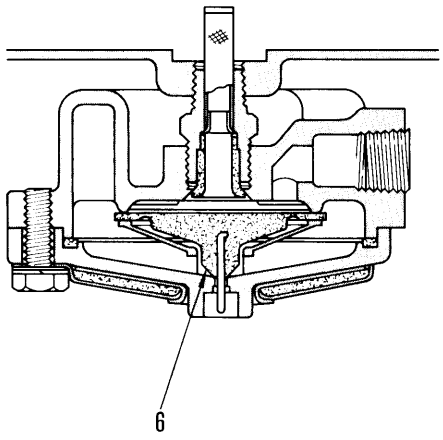
238F072

1. Retainer
2. Filter
3. Body
4. Plug
5. Valve guide
6. Inlet-Exhaust valve
7. Cover

The automatic drain valve is installed at the bottom of the air reservoir. It acts to automatically drain any water which forms when the compressed air is cooled.

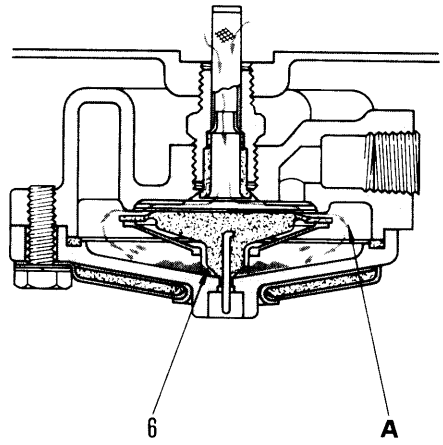
OPERATION

1. When there is no air pressure inside the air reservoir, inlet-exhaust valve (6) is closed.



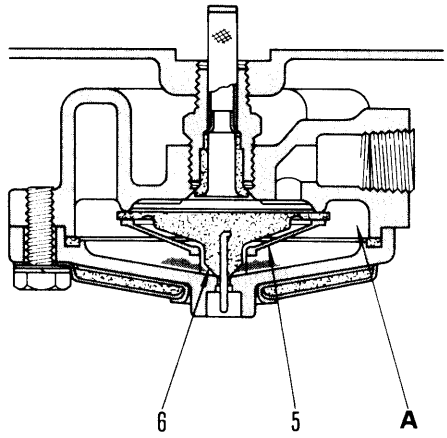
238F073

2. When air pressure enters the air reservoir, inlet-exhaust valve (6) opens even when the pressure is low. Air and water then enter chamber **A**. The inlet-exhaust valve stops open until the pressure inside the air reservoir reaches the maximum pressure (until the governor is cut off).



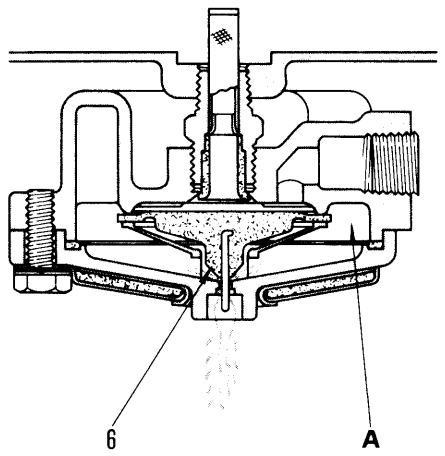
238F074

3. When the pressure in the air reservoir and the pressure in chamber **A** are equal, the spring action of valve guide (5) closes inlet-exhaust valve (6).



238F075

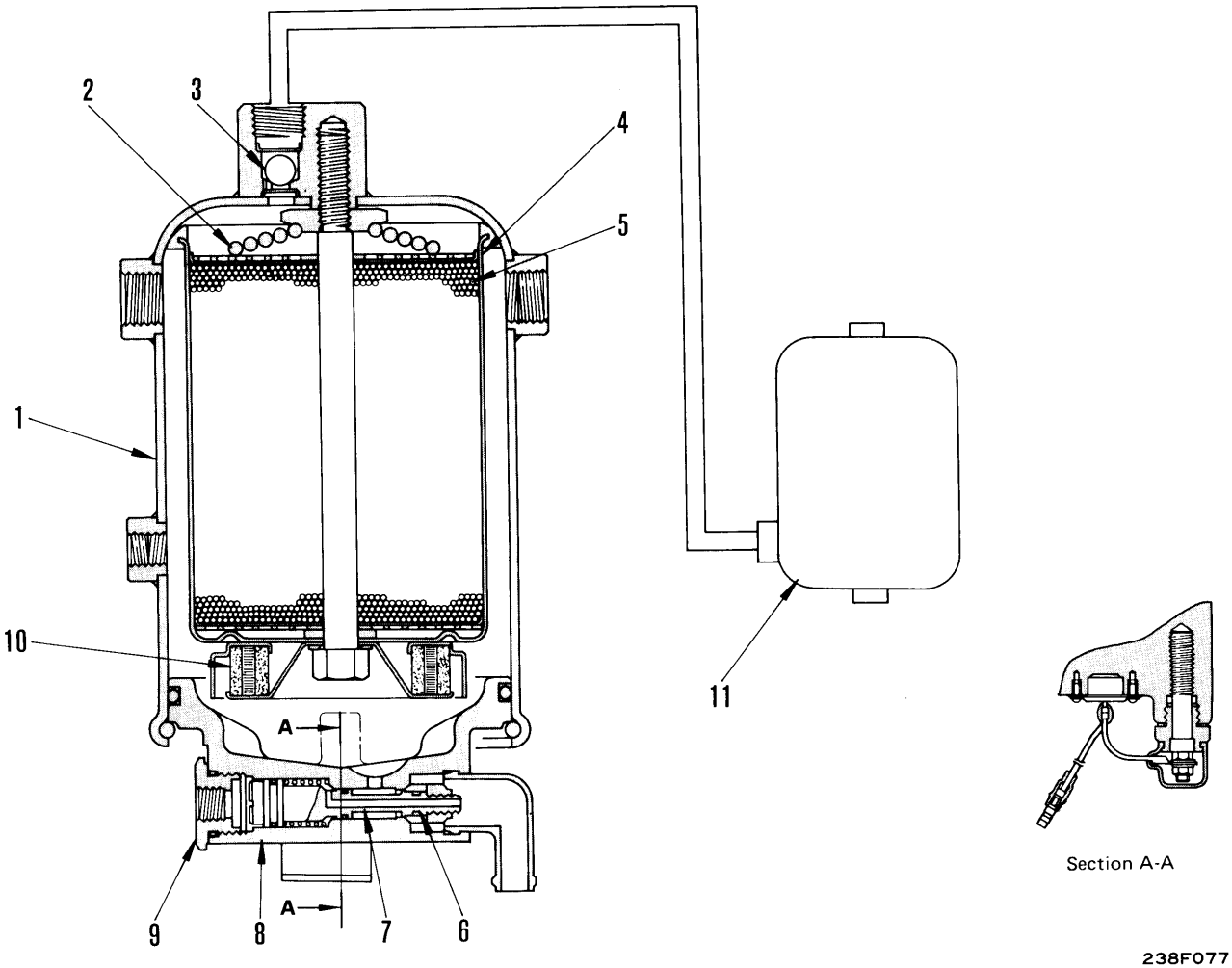
4. When the pressure in the air reservoir drops, and the pressure in chamber **A** is about 0.3 kg/cm^2, inlet-exhaust valve (6) exhausts the air and water.



238F076

AIR DRIER

GD705A-4 (If equipped)



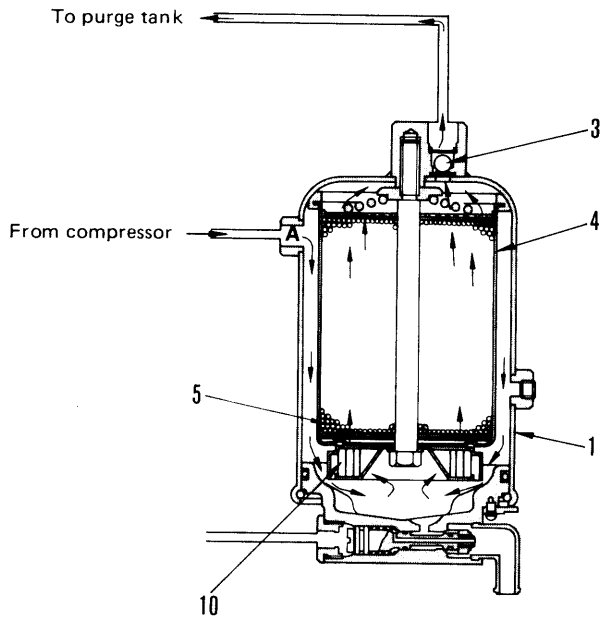
The function of the air drier is to remove the water vapor from the compressed air in the circuit. In this way it protects the components of the equipment and prevents problems with operation in cold areas.

1. Body
2. Spring
3. Check valve
4. Drier cylinder
5. Drying agent
6. Valve
7. Piston
8. Valve body
9. Valve cap
10. Oil filter
11. Purge tank

OPERATION

1. Dehumidifying

When the compressor is working, air from the compressor enters port **A** of the air drier. It is then cooled by the outside of drier cylinder (4), and water and oil collect in the bottom of body (1). The air then passes through oil filter (10) which is fitted with an oil mist separator. Here the fine drops of oil and particles of dust are removed before the air enters the drier cylinder. Any water still included in the air is removed by drying agent (5). When the air reaches the top of the drier cylinder, it is completely dry. This dry air then passes through check valve (3) and the purge tank and is sent to the main tank.

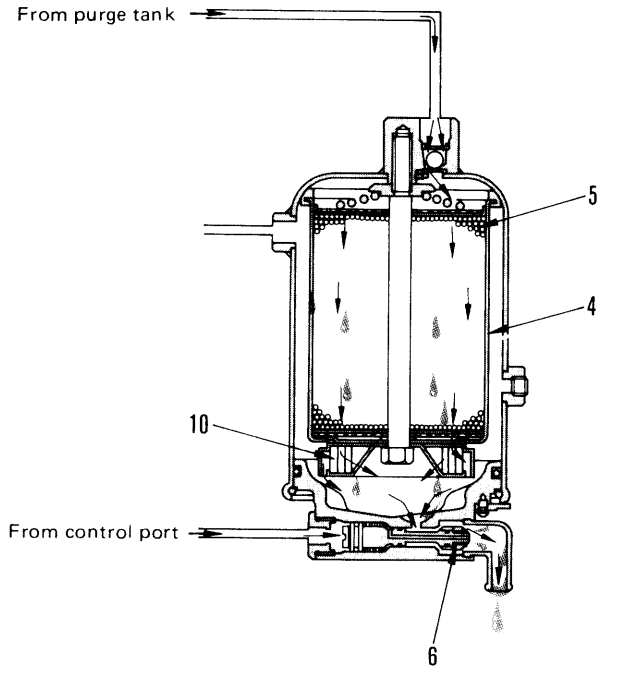


238F078

2. Restoring drying agent

When the air pressure inside the circuit reaches the set pressure, the command from the governor switches the compressor to unloading. The same command is also received by the control ports of the air drier. Valve (6) opens and the air inside drier cylinder (4) is released to the atmosphere. Following this sudden drop in pressure, the dried air in the purge tank passes through orifice 'a'. Because of the drop in pressure, the dry air expands and becomes super-dry air. As it flows back through the drier cylinder, it picks up water from drying agent (5) and carries it out to the atmosphere. This completely dries out the drying agent and prepares it for further use.

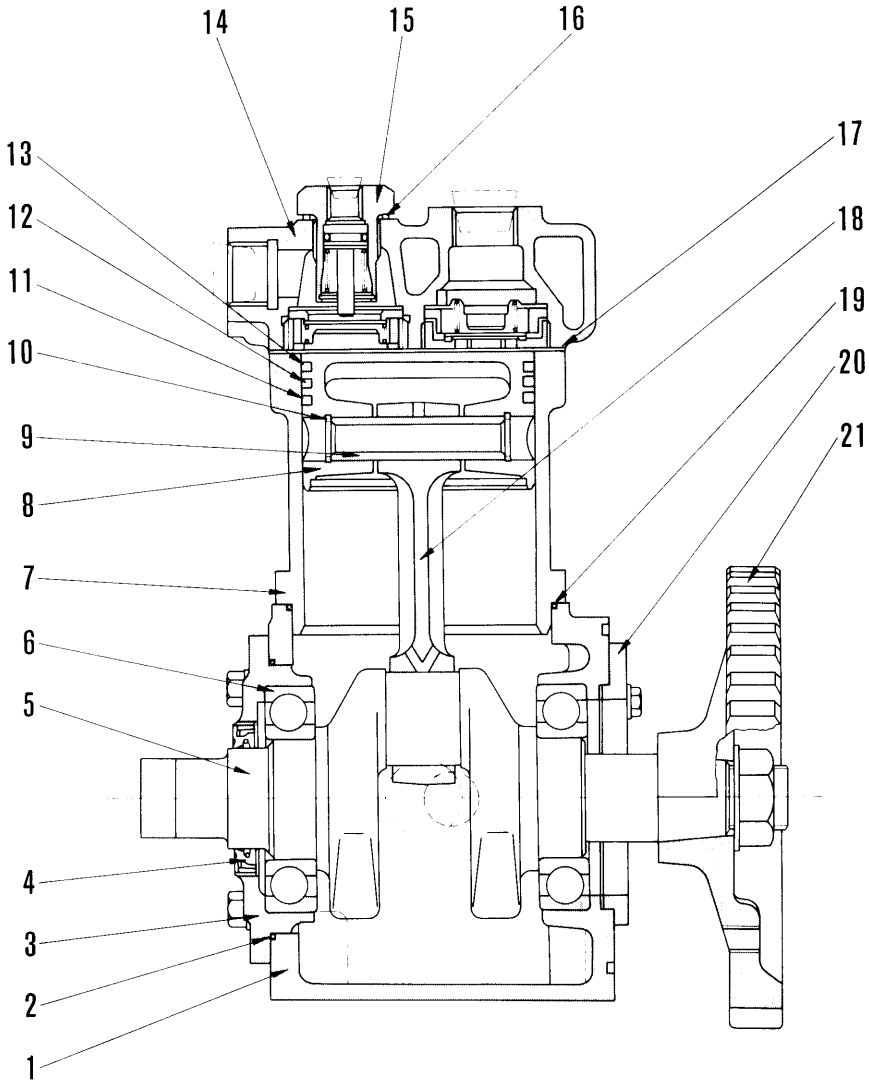
When the loading cycle starts again, the valve closes, and the cylinder returns to dehumidifying action.



238F079

AIR COMPRESSOR

GD705A-4

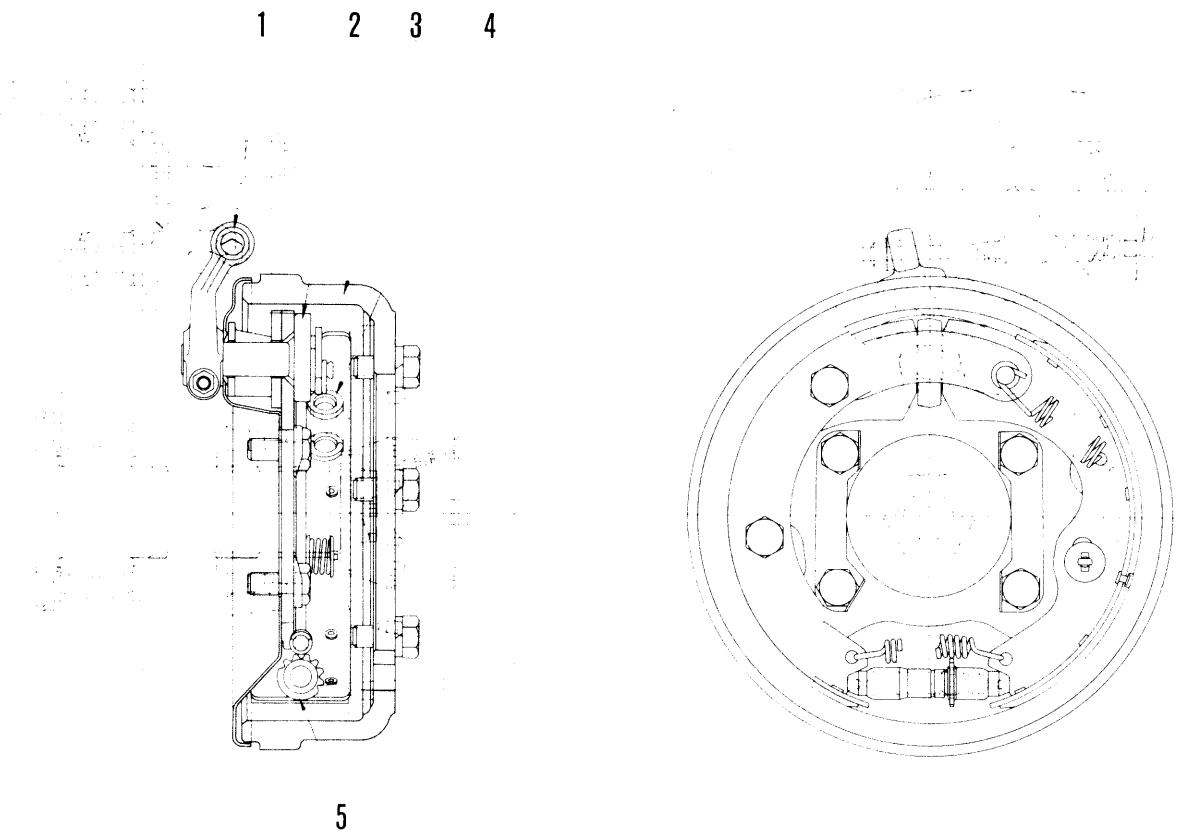


234F1112

Bore x Stroke: 85 x 59.9 mm
Piston displacement: 340 cc

1. Crankcase
2. O-ring
3. Bearing cover
4. Oil seal
5. Crankshaft
6. Bearing
7. Cylinder
8. Piston
9. Piston pin
10. Snap ring
11. Oil ring
12. Second ring
13. Top ring
14. Cylinder head
15. Unloader valve
16. Shim
17. Gasket
18. Connecting rod
19. O-ring
20. Bushing
21. Drive gear

PARKING BRAKE

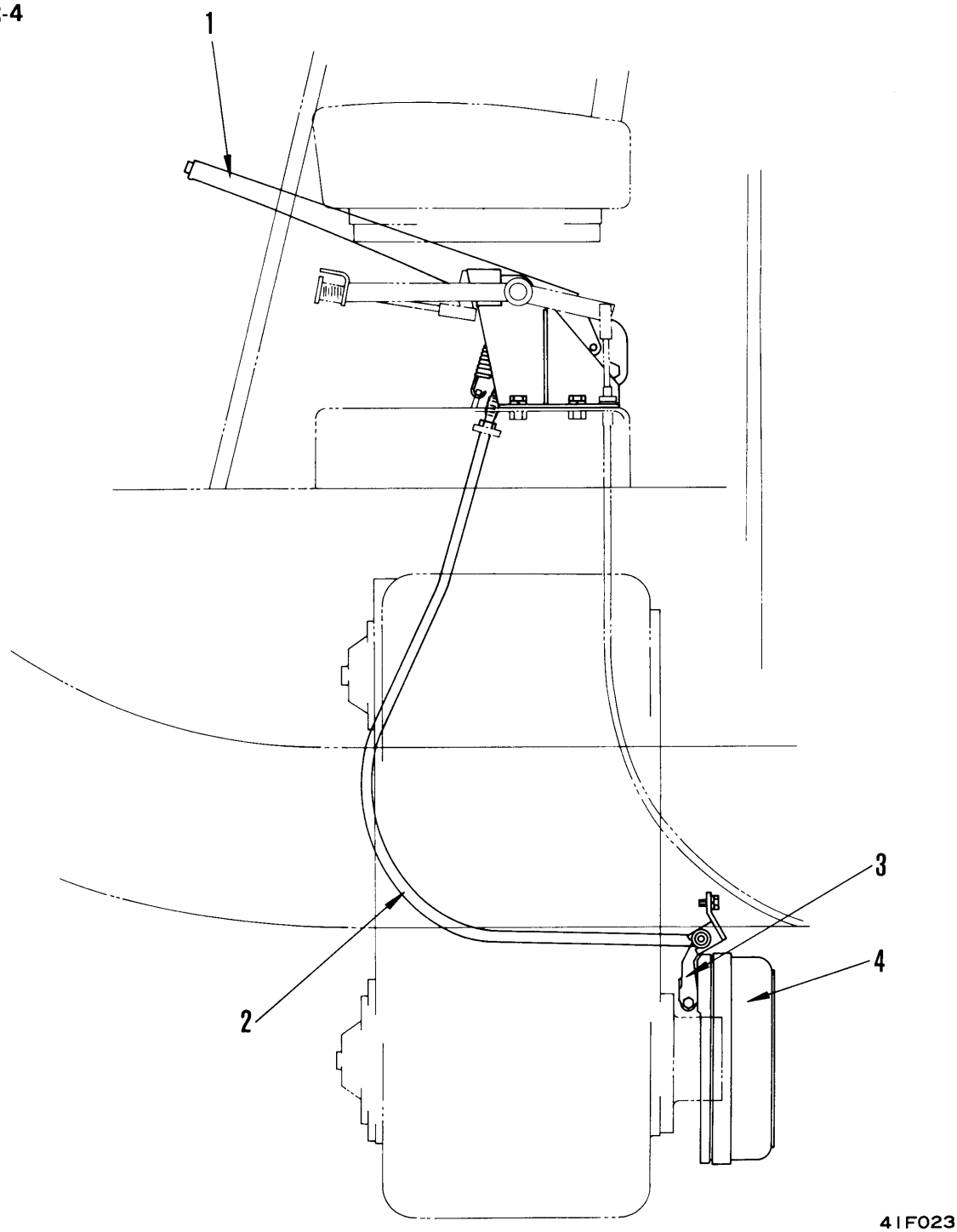


41F022

1. Arm
2. Support plate
3. Drum
4. Return spring
5. Adjuster

PARKING BRAKE CONTROL

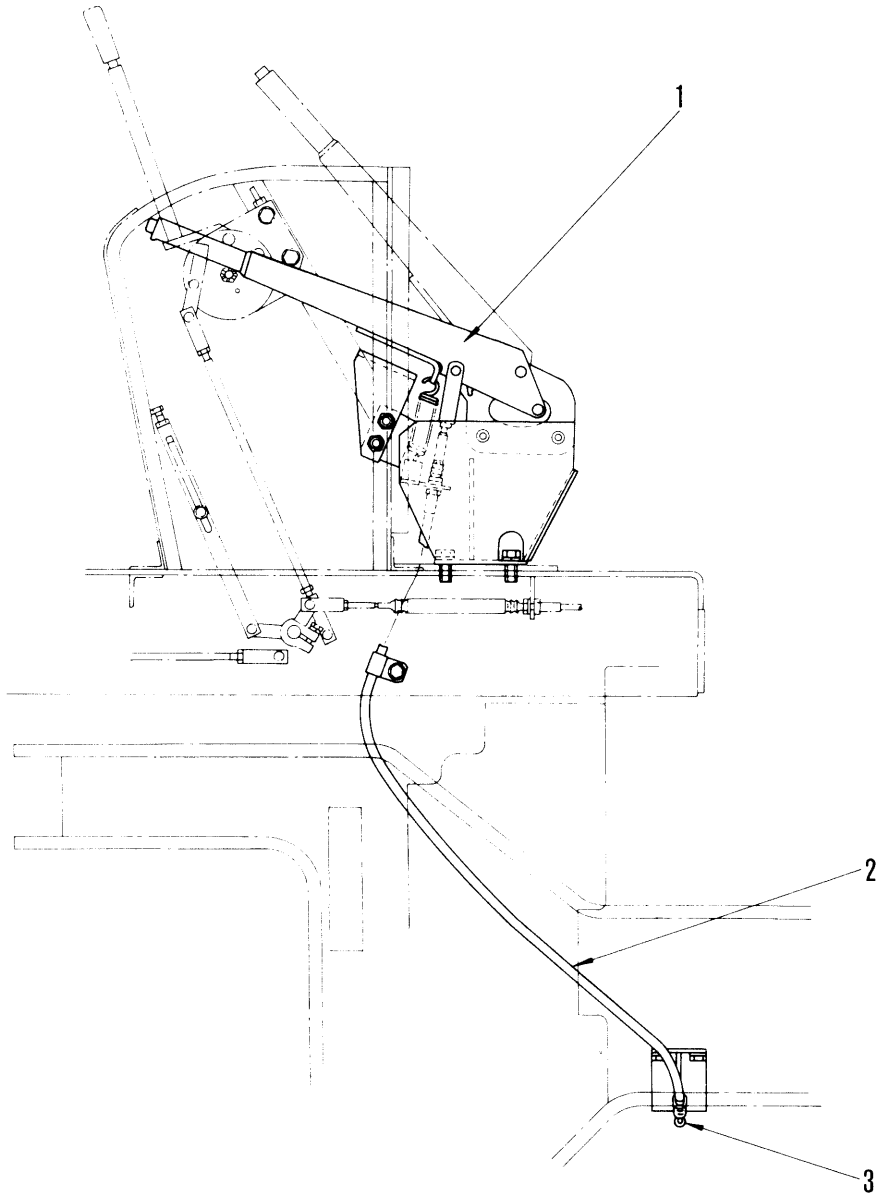
GD705R-4



The parking brake is a mechanical type duo-servo built in expansion type that brakes the transmission output shaft.
When the parking brake lever (1) is pulled, a cam lever (3) is moved by a wire (2) and expands the brake shoe (4) which brakes the output shaft.

1. Parking brake lever
2. Parking brake control wire
3. Lever
4. Brake shoe

GD705A-4

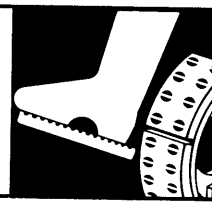


F23E040

1. Parking brake lever
2. Parking brake control wire
3. Lever

BRAKE SYSTEM

52 TESTING AND ADJUSTING



CHECKING BRAKE PEDAL HEIGHT

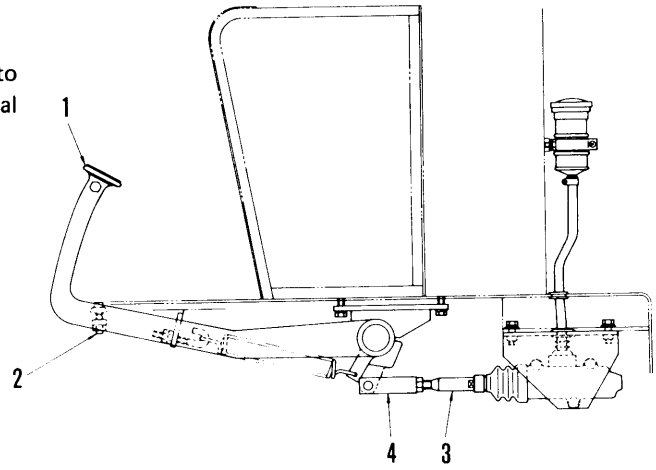
GD705R-4

Use a convex rule to measure the height from the floor to the center of the mounting bolt of the foot rest of the pedal (1).

BRAKE PEDAL HEIGHT ADJUSTMENT

Adjust pedal stopper bolt (2) to fix pedal height.

★ Standard value: 190 ± 5 mm



233F243

CHECKING BRAKE PEDAL PLAY

GD705R-4

Use a convex rule and measure in the direction of pedal operation.

★ Measure with engine stopped.

BRAKE PEDAL PLAY ADJUSTMENT

Adjust the yoke (4) of rod (3) until it is at standard value (10 ± 5 mm).

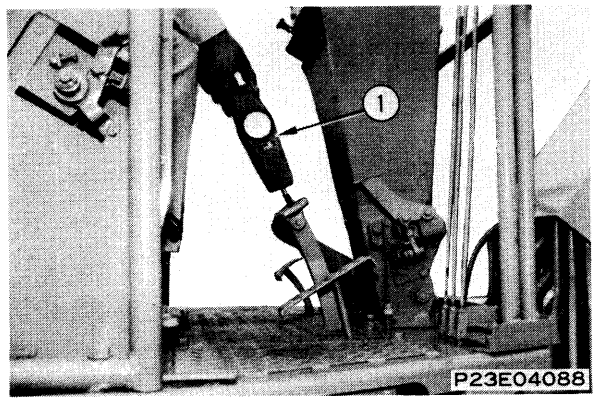
★ Bend the cotter pin securely.

CHECKING BRAKE PEDAL OPERATING FORCE

GD705R-4

Using push-pull scale ①, measure maximum value in the stroke to just before the stroke end of the brake pedal.

★ Measure with engine idling.



CHECKING BRAKE PEDAL DEPRESSION HEIGHT

GD705R-4

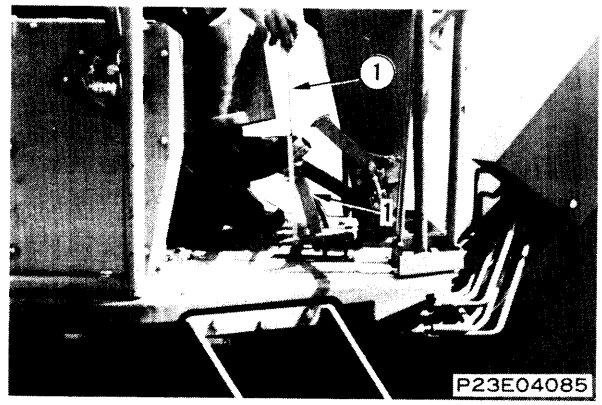
BRAKE PEDAL DEPRESSION HEIGHT CHECK

⚠ Confirm that gear lever is in neutral and that parking brake lever is pulled on.

Start the engine, depress the pedal (1) and use convex rule (1) to measure the stroke from the center of the mounting bolt of the foot rest to floor level.

★ Measure with engine idling.

★ If the stroke is outside standard value when the brake pedal is depressed, or if brake efficiency is low, see section, "WHEEL BRAKE ADJUSTMENT".



WHEEL BRAKE ADJUSTMENT

⚠ Adjust with engine stopped.

1. Insert driver through the adjusting hole in the underside of the back plate and turn adjusting gear until lining and drum contact tightly.

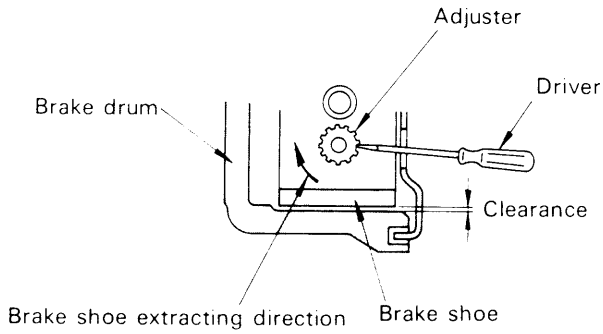
2. Next, return the adjusting gear 4 to 5 ratchets.

3. Remove the rubber blind cap and confirm that clearance is less than 0.4 mm on one side when a 0.6 mm feeler gauge (2) is inserted on the other side of the underside inspection opening.

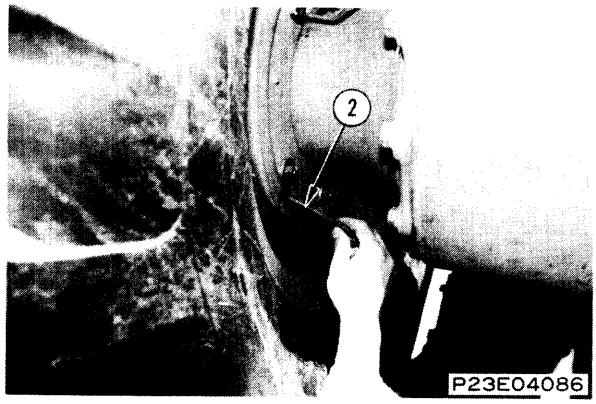
4. After adjusting, depress brake pedal and confirm that pedal depression height is within standard value (96 ± 20 mm).

5. After adjusting, travel for about 500 m, check the temperature of the four brake drums, and confirm there is no dragging.

6. After adjusting, confirm that braking distance at speed of 35 km/h is within the standard value for stopping distance.



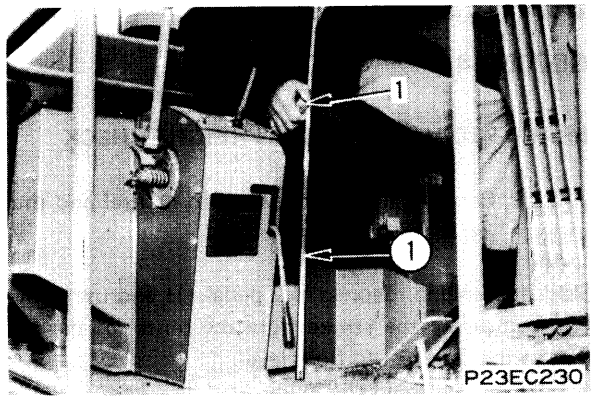
234F040



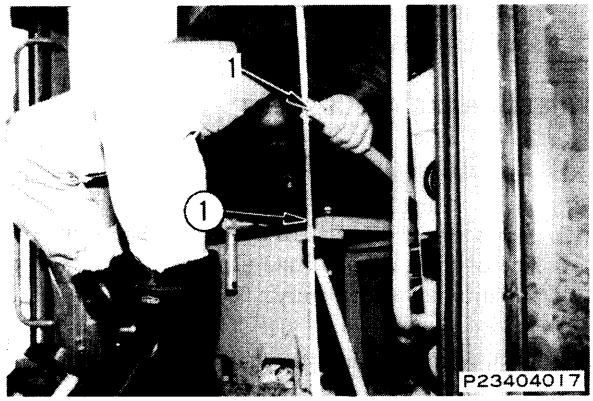
CHECKING PARKING BRAKE LEVER STROKE AND OPERATING FORCE

STROKE CHECK

Use convex rule ① to measure the travel of parking brake lever (1) tip from botton to top.



GD705A-4 Serial No. 31001 and up



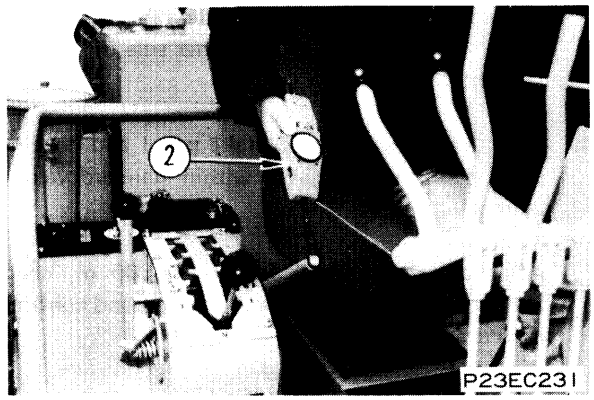
STROKE ADJUSTMENT

⚠ Adjust with engine stopped.

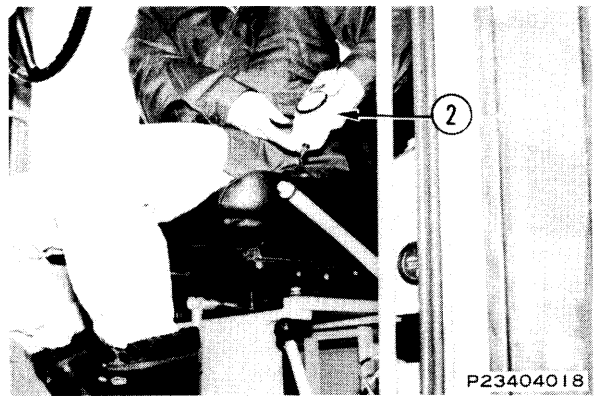
1. Insert driver through adjusting hole of parking brake drum, rotate adjusting gear in the direction of the arrow until lining and drum contact tightly, then return 8 ratchets.
2. After adjusting the lining and drum clearance, pull the parking brake lever and adjust the cable so that the notched section is in the 2 to 3 ratchet range.
3. After adjustment, it is possible to keep the machine stopped on a 1/5 paved gradient by pulling the parking lever.

OPERATING FORCE CHECK

Use push pull scale ② to check the operating force by hanging it on the front end of the parking brake lever and lifting it up.



GD705A-4 Serial No. 31001 and up



BLEEDING AIR INSIDE BRAKE PIPING

GD705R-4

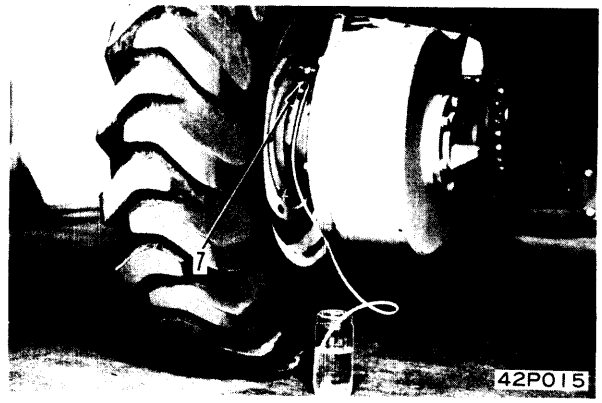
★ Carry out air bleeding in pairs. One worker adds brake fluid to the brake tank by repeatedly depressing the brake pedal. The other bleeds air from the various parts of the brake.
★ Prepare extra brake fluid so that it will not run out during the work.

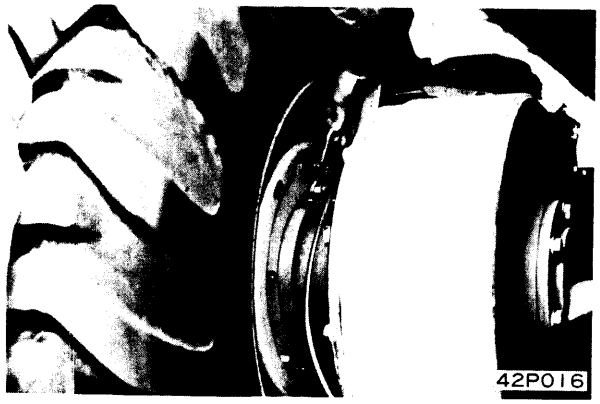
⚠ Bleed air with engine stopped.

1. Install vinyl tube to breather (7) and put the other end in a container half filled with brake fluid.

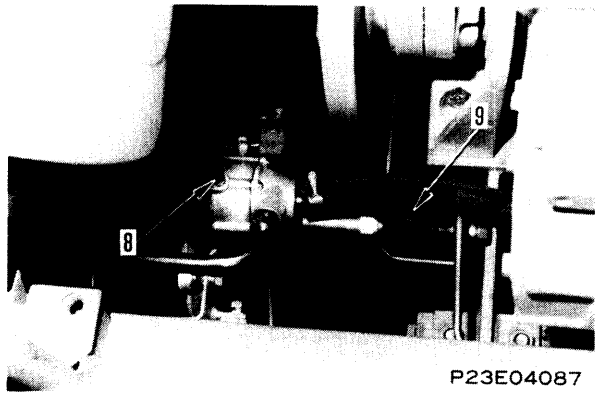
2. Depress the brake pedal a number of times, and loosen the breather plug with the pedal depressed. Tighten it before hydraulic pressure in the cylinder gives out. Repeat this process until air bubbles disappear from the brake fluid.

   ★ Operate the brake pedal about 3 seconds per operation.





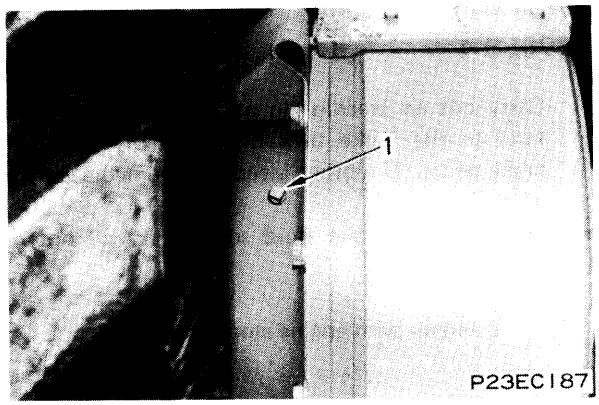
3. Bleed air from hydromaster plugs (8), (9) in that order according to the procedure in item 1 and 2.



CHECKING WEAR OF BRAKE DISC

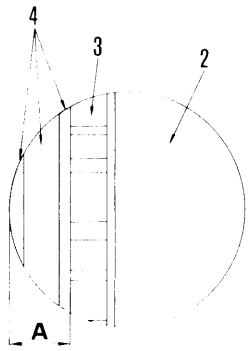
GD705A-4

1. Remove plug (1) of checking hole and peep through from directing above the checking hole.



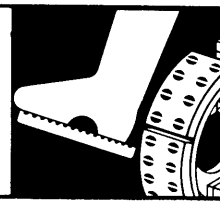
2. Depress brake pedal to push piston (2) against plate (3) and to compress disc (4).

3. Confirm that length **A** in the diagram at right is not **O**. In other words, confirm that a portion of the disc can be seen through the checking hole.



F23EC030

BRAKE SYSTEM
53 DISASSEMBLY AND ASSEMBLY

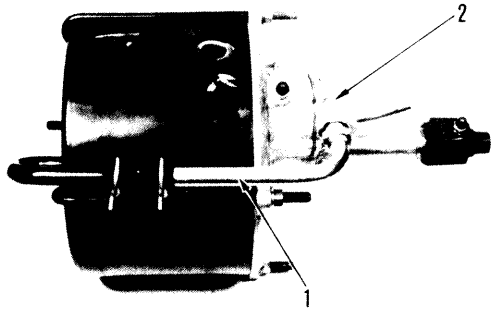


DISASSEMBLY OF HYDROMASTER

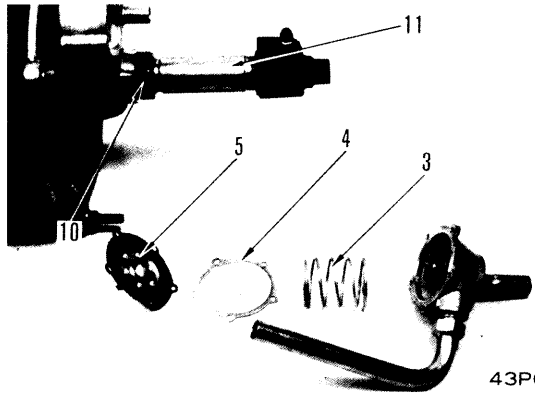
GD705R-4

1. Disconnect tube (1) and valve body (2).
   i) Remove spring (3), gasket (4) and diaphragm (5).
   ii) Remove snap ring (6), pipe (7), spring (8) and O-ring (9).

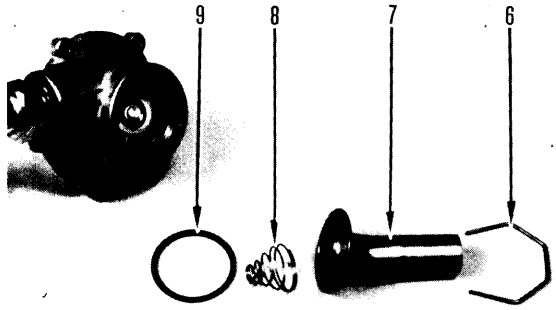
2. Tighten nut (10) and remove cylinder (11).



43P047

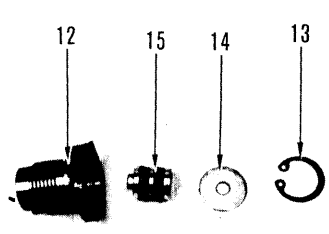


43P048

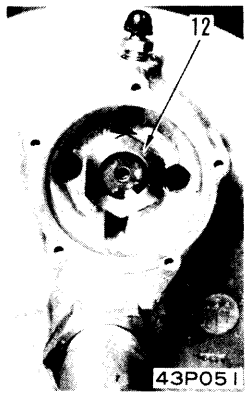


43P049

3. Remove fitting (12), snap ring (13), spacer (14) and piston (15).

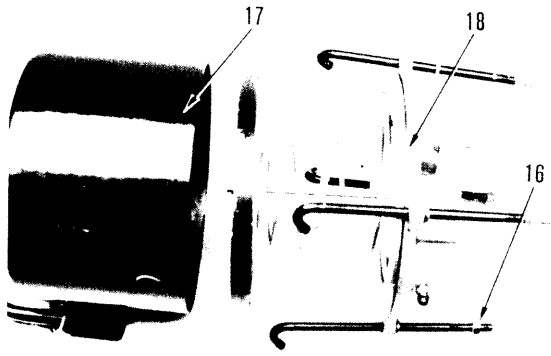


43P050



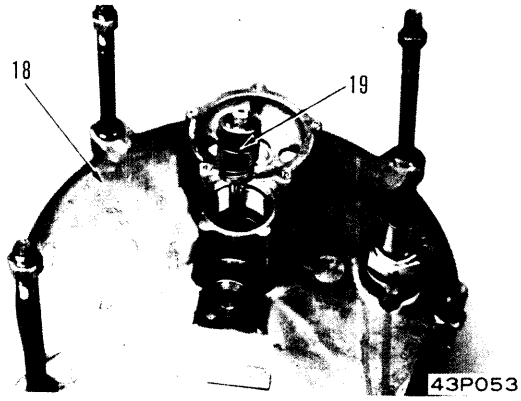
43P051

4. Loosen nut (16) and pull out end plate assembly (18) from cylinder (17).



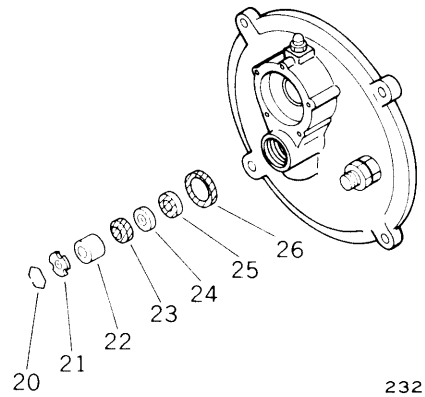
43P052

5. Push in end plate assembly (18), remove pin to remove piston assembly (19), and remove end plate assembly.



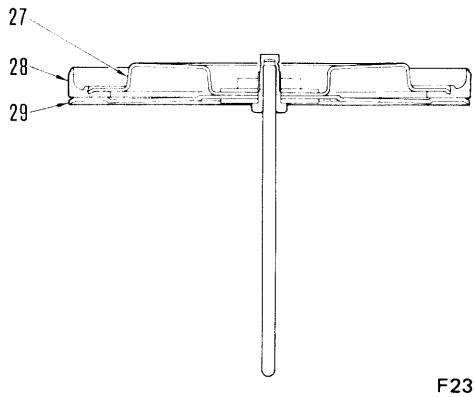
43P053

6. Remove ring (20), washer (21), retainer (22), packing (23), washer (24), oil seal (25) and gasket (26).



232F257

7. Remove plate (27), packing (28) and plate (29).

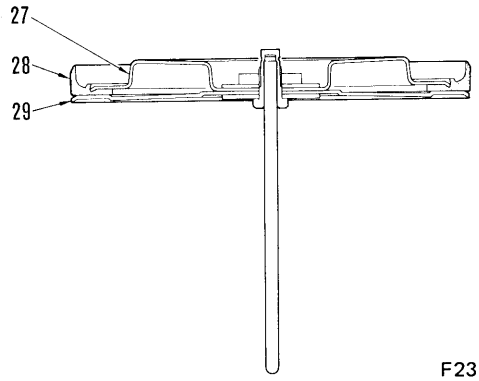


F23E04042

ASSEMBLY OF HYDROMASTER

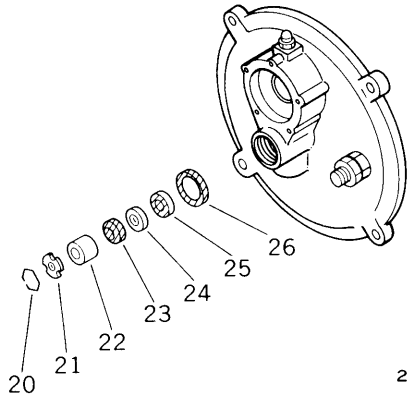
GD705R-4

1. Install plate (29), packing (28) and plate (27).
   Sliding portion of packing: Airmaster paste



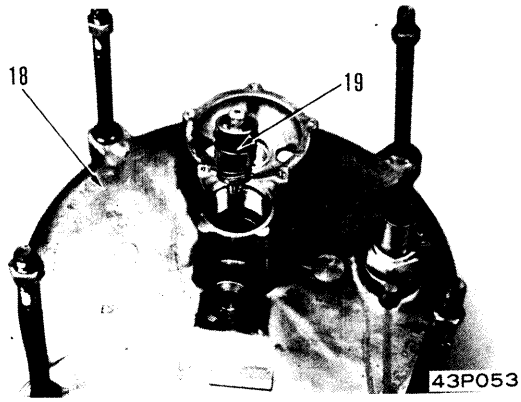
F23E04042

2. Install gasket (26), oil seal (25), washer (24), packing (23), retainer (22) and washer (21), and secure them with ring (20).



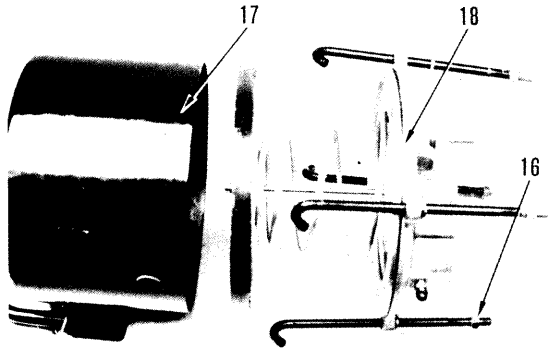
232F257

3. Push in end plate assembly (18) and install piston assembly (19) with pin.



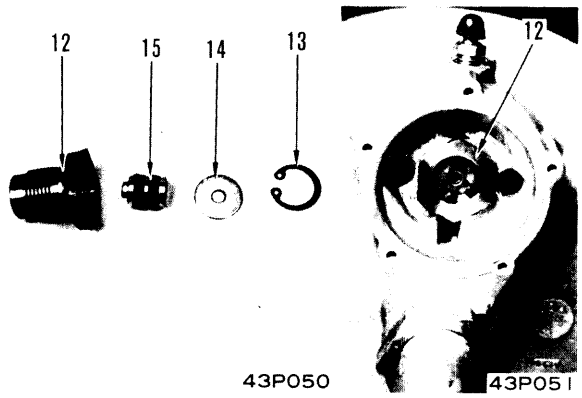
43P053

4. Install end plate assembly on cylinder (17) and secure it with nut (16).
   Inside face of cylinder: Airmaster paste



43P052

5. Secure piston (15) and spacer (14) with snap ring (13) and install fitting (12).

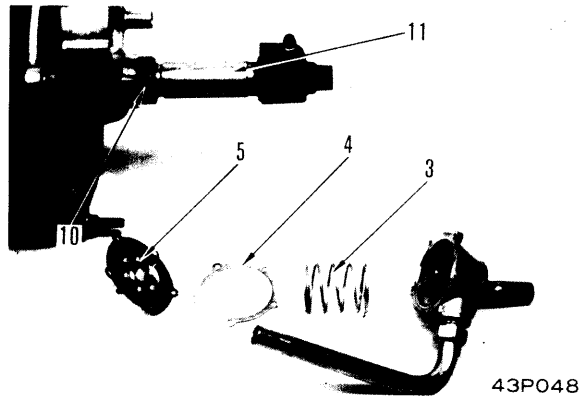


43P050 43P051

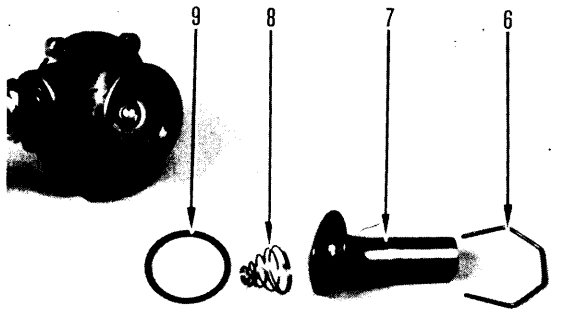
6. Install cylinder (11) and secure it with nut (10).
   ★ Install cylinder with air bleeder plug up.

7. Install O-ring (9), spring (8) and pipe (7) and secure them with snap ring (6).

8. Install diaphragm (5), gasket (4) and spring (3).

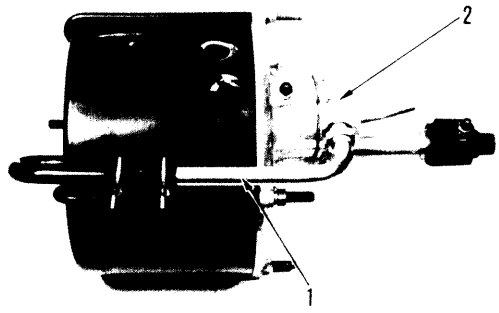


43P048



43P049

9. Install valve body (2) and tube (1) and fasten them with hose clamp.



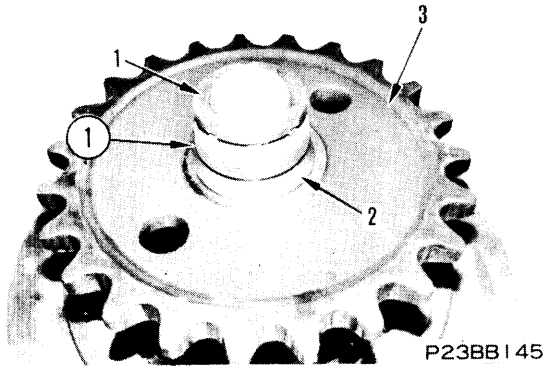
43P047

DISASSEMBLY OF WHEEL BRAKE ASSEMBLY

GD705A-4

1. Sprocket

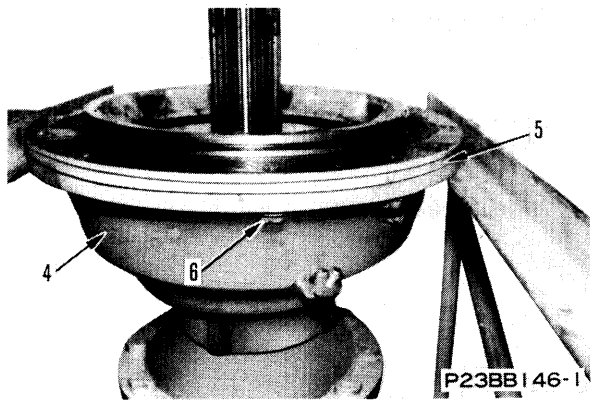
1) Remove bearing nut (1) and remove collar ①.
2) Remove spacer (2) and remove sprocket (3).



2. Support

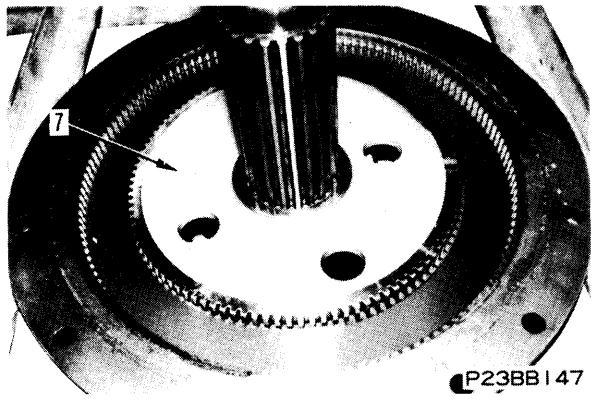
1) Remove four connection bolts (6) between cage (4) and support (5) from behind.
2) Raise support (5) with crane and remove it.

kg Support: Approx. 39 kg



3. Gear

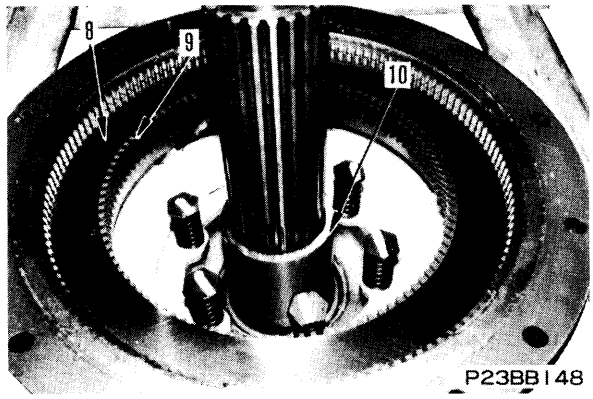
Remove gear (7).



4. Disc, plate

Remove plate (8) and disc (9) in order.

★ Plate: 6 pcs.
Disc: 5 pcs.



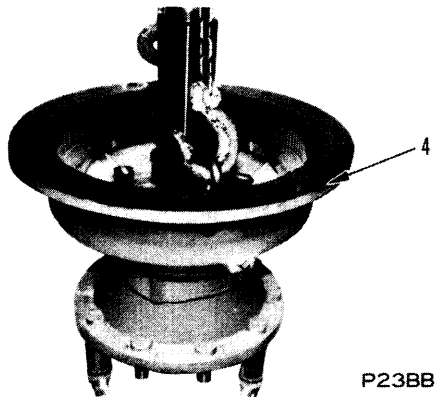
5. Spacer

Remove spacer (10).

6. Cage assembly

Raise cage assembly (4) with a crane and remove it.

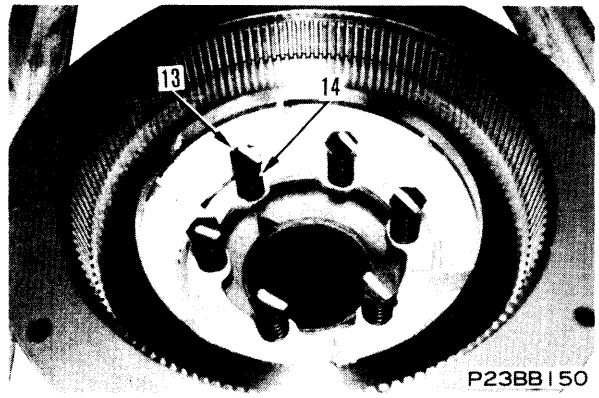
kg Cage assembly: Approx. 79 kg



P23BB149-1

7. Bolt, spring

Remove bolt (13) and spring (14).



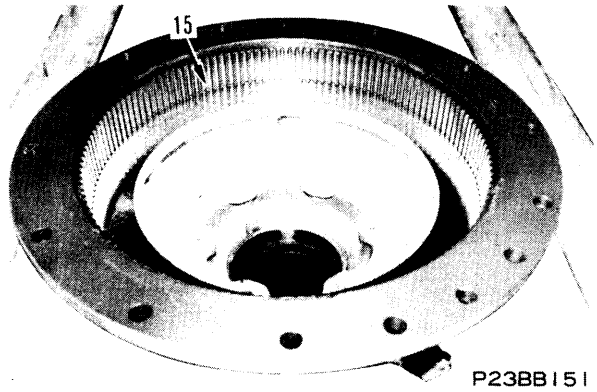
P23BB150

8. Piston

Remove piston (15) from cage.

★ Blowing in air through the air charge port makes it easier to remove the piston.

★ Be careful not to damage piston sliding face and O-ring.

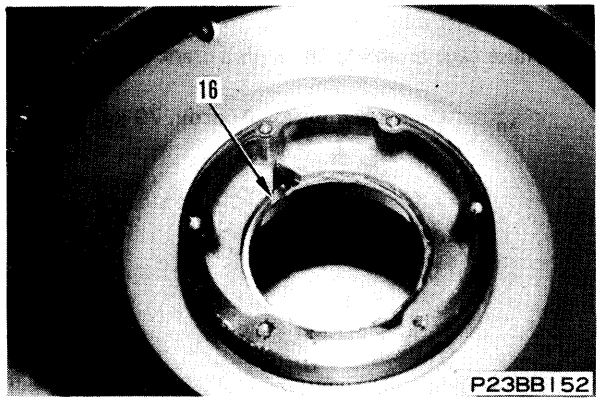


P23BB151

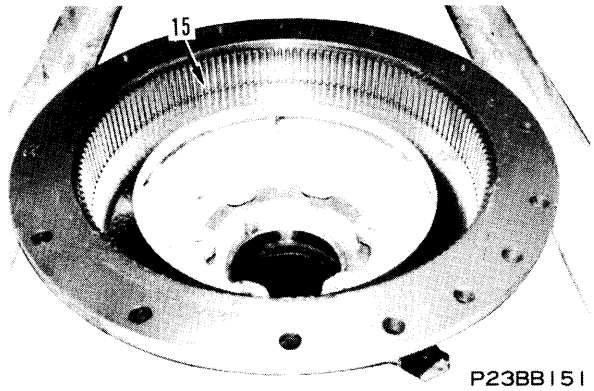
ASSEMBLY OF WHEEL BRAKE ASSEMBLY

GD705A-4

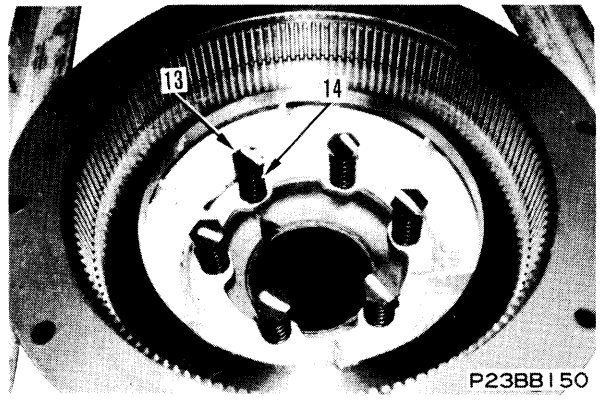
1. **Bearing outer race**
   Press-fit bearing outer race (16) into cage.



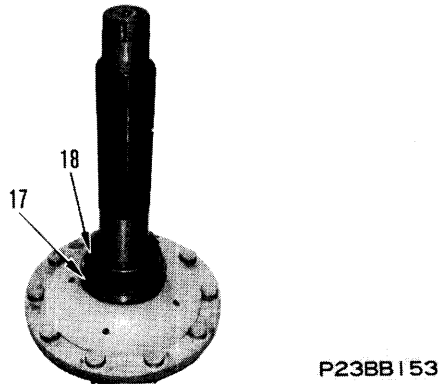
2. **Piston**
   1) Confirm that O-ring sliding faces of cage are not damaged.
      Sliding face: Grease (G2-LI)
   2) Fix O-ring (2 pcs) and force piston (15) in cage.
      ★ Be careful not to damage sliding face and O-ring.
      O-ring groove part: Grease (G2-LI)



3. **Bolt, Spring**
   Install bolt (13), spring (14).
   Mounting bolt: Thread tightener (LT-2)
   Mounting bolt: 7.5 ± 0.5 kgm
   ★ After tightening bolt, blow in air through the air charge port of the brake piping, and move the piston 2-3 cycles.



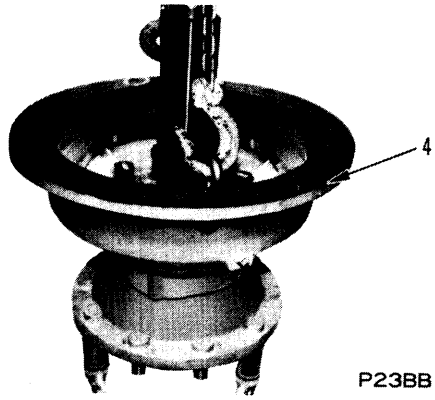
4. **Shaft**
   1) Fix O-ring and install spacer (17).
      O-ring groove part: Grease (G2-LI)
   2) Press-fit bearing (18).



5. Cage assembly

1) Raise cage assembly (4) and install shaft in cage.

kg Cage assembly: Approx. 79 kg



P23BB149-1

6. Spacer

Install specer (10).

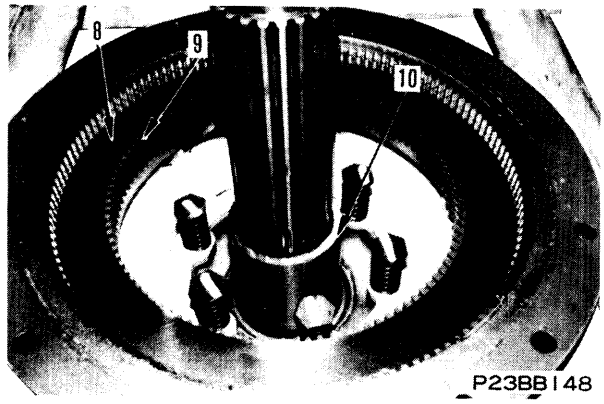
7. Gear

Install gear (7).

8. Disc, Plate

Install plate (8), disc (9) in order.

★ Plate: 6 pcs, Disc: 5 pcs.



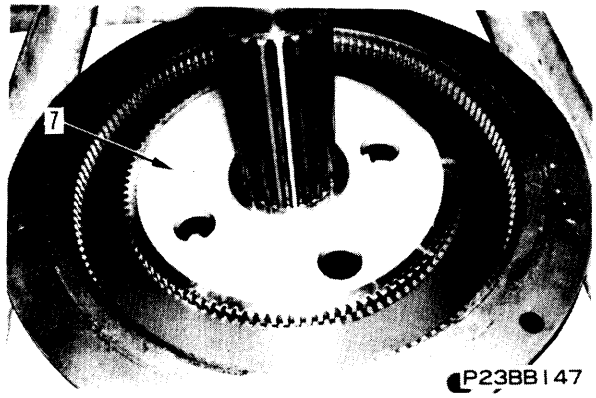
P23BB148

9. Support

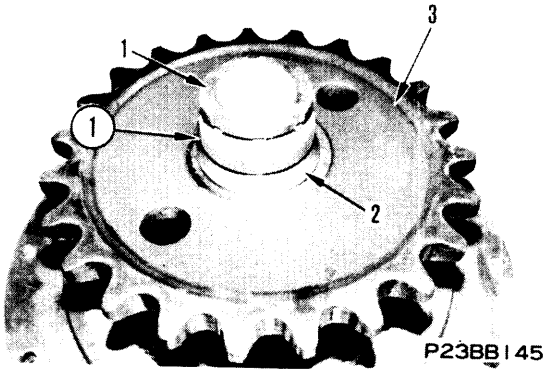
Fix O-ring (2 pcs) in support (5), install it in cage (4) and tighten with four bolts (6).

10. Sprocket

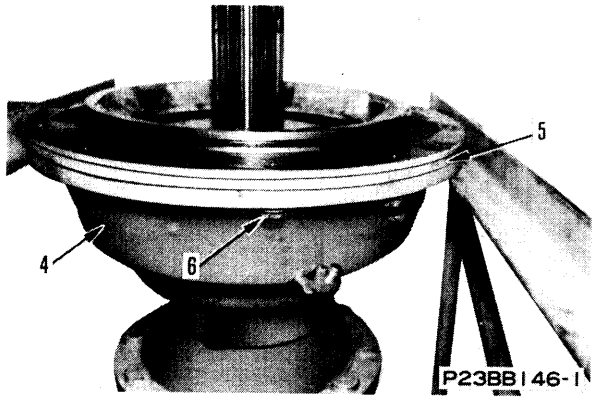
1) Install spacer (2) (above and below sprocket) and sprocket (3).
2) Insert collar ① (ϕ95 mm) and temporarily tighten bearing nut (1).



P23BB147



P23BB145

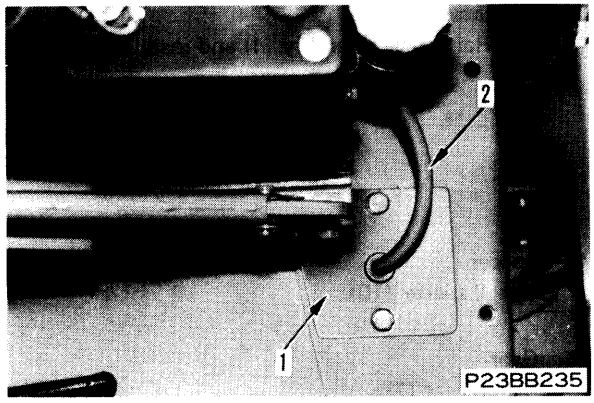


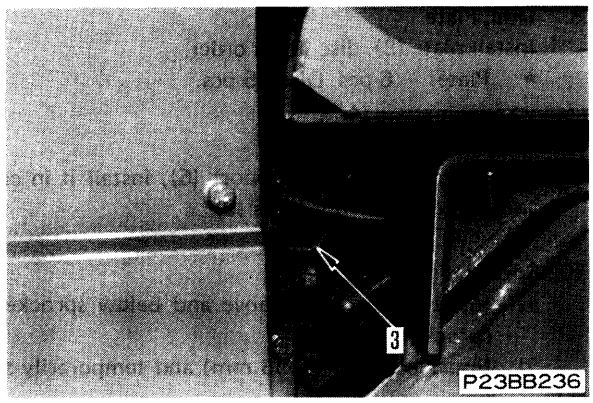
P23BB146-1

REMOVAL OF BRAKE MASTER CYLINDER ASSEMBLY

GD705R-4

1. Remove cover (1).
2. Disconnect hose (2).
3. Disconnect tube (3).
4. Disconnect rod (4).
5. Remove master cylinder assembly (5).

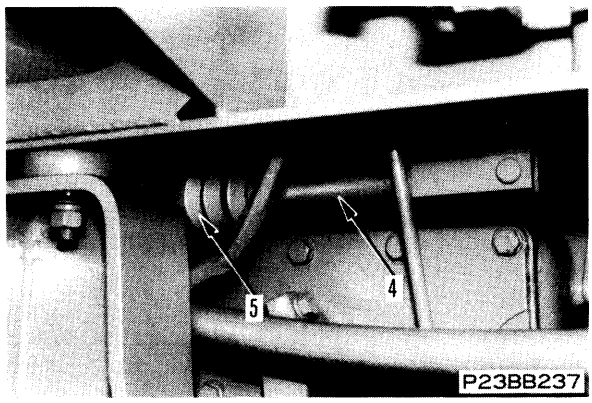




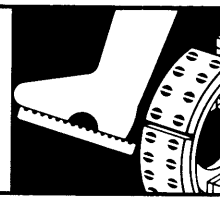
INSTALLATION OF BRAKE MASTER CYLINDER ASSEMBLY

GD705R-4

1. Install master cylinder assembly (5).
   kgm Mounting bolt: 6.75 ± 0.75 kgm
2. Connect rod (4).
3. Fit gasket and connect tube (3).
4. Connect hose (2) and fix it with a clamp.
5. Install cover (1).
6. Add brake fluid up to maximum level.
   ★ After adding brake fluid, bleed the air.
   Depress brake pedal several times to feed the brake fluid, and bleed air from the hydromaster.

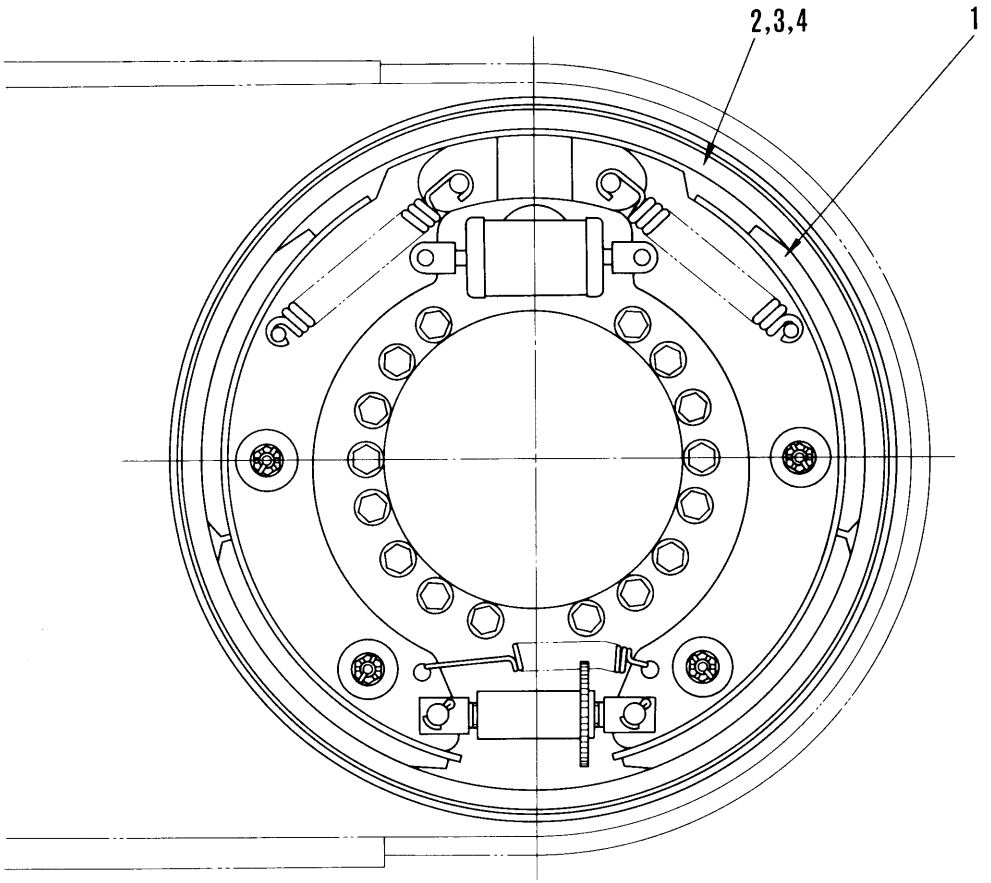


BRAKE SYSTEM
54 MAINTENANCE STANDARD



WHEEL BRAKE

GD705R-4

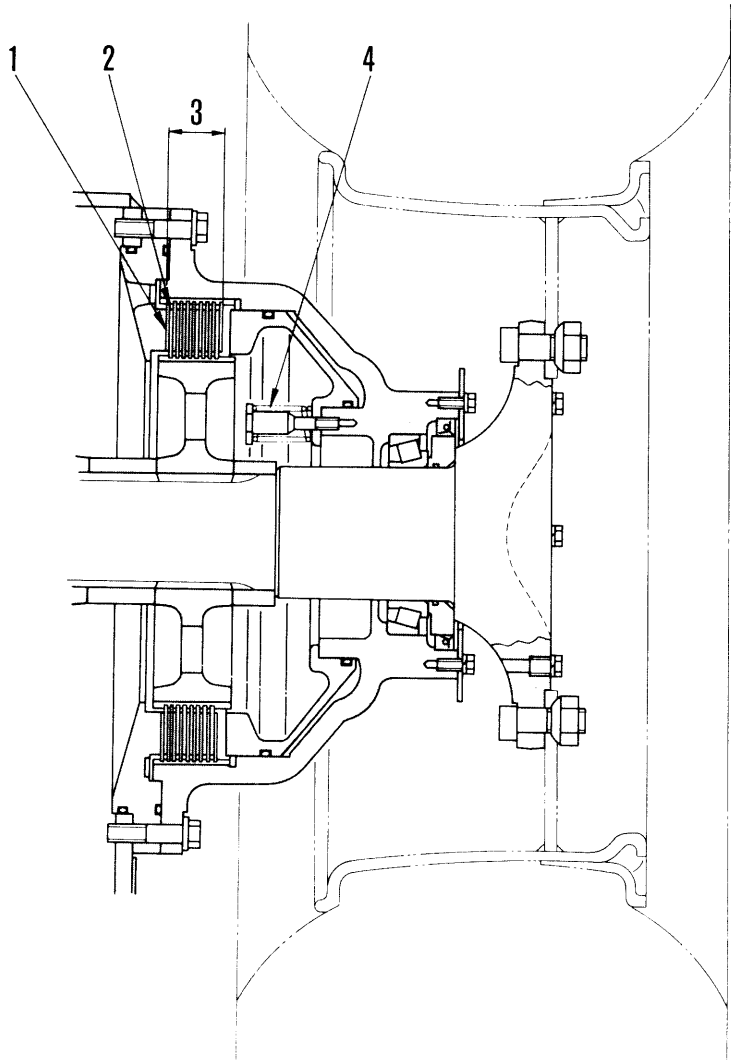


Unit: mm

No.	Check Item	Criteria		Remedy
1	Wear of lining	Standard size	Repair limit	Replace drum
		12	6	
2	Wear of brake drum I.D.	$438.2^{+0.3}_{0}$	442	Replace drum
3	Drum I.D.	Clearance between rivet head and lining surface: max. 0.5		Replace lining
4	Out of roundness of brake drum I.D.	Repair limit: 0.2		Turn or replace

DISC BRAKE

GD705A-4



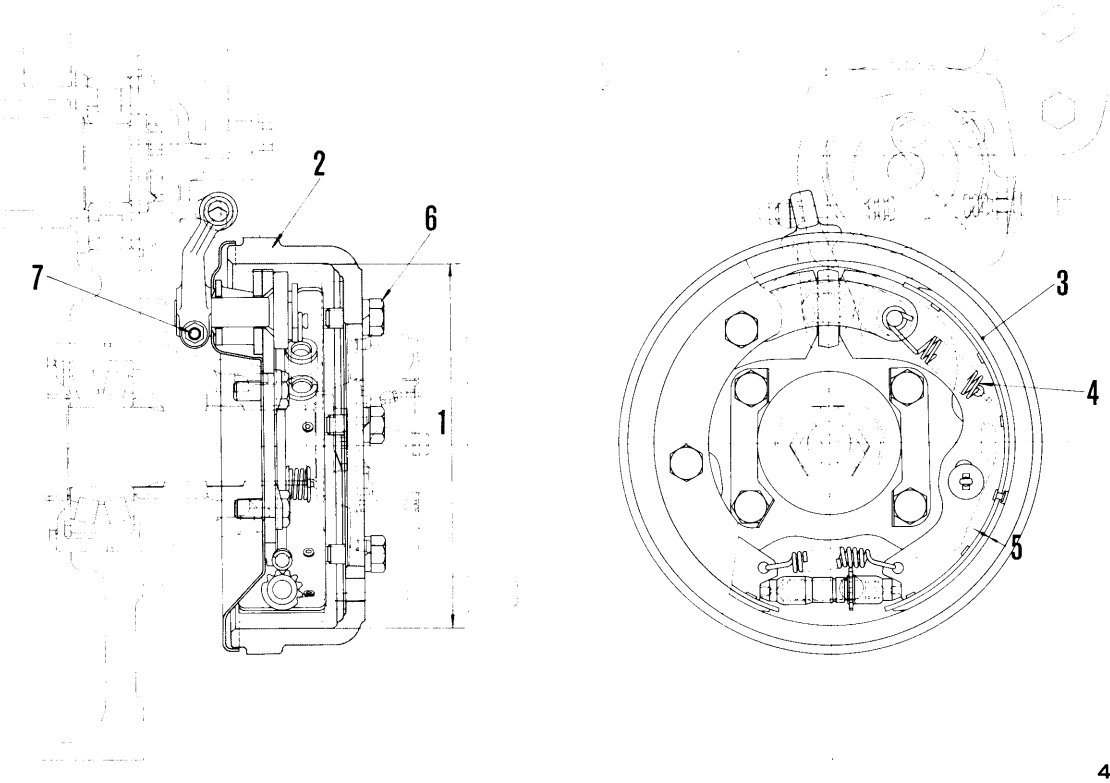
F23E097

Unit: mm

No.	Check Item	Criteria					Remedy
1	Thickness of disc	Standard size			Repair limit		Replace
		3.8 ± 0.1			3.3 ± 0.1		
2	Thickness of plate	2.3 ± 0.1					
3	Total thickness between disc and plate	32.8 ± 1.1			30.3 ± 1.1		
4	Return spring	Standard size			Repair limit		
		Free length x O.D.	Installed length	Installed load	Free length	Installed load	
		71 x	52	16.9			

PARKING BRAKE

GD705R-4

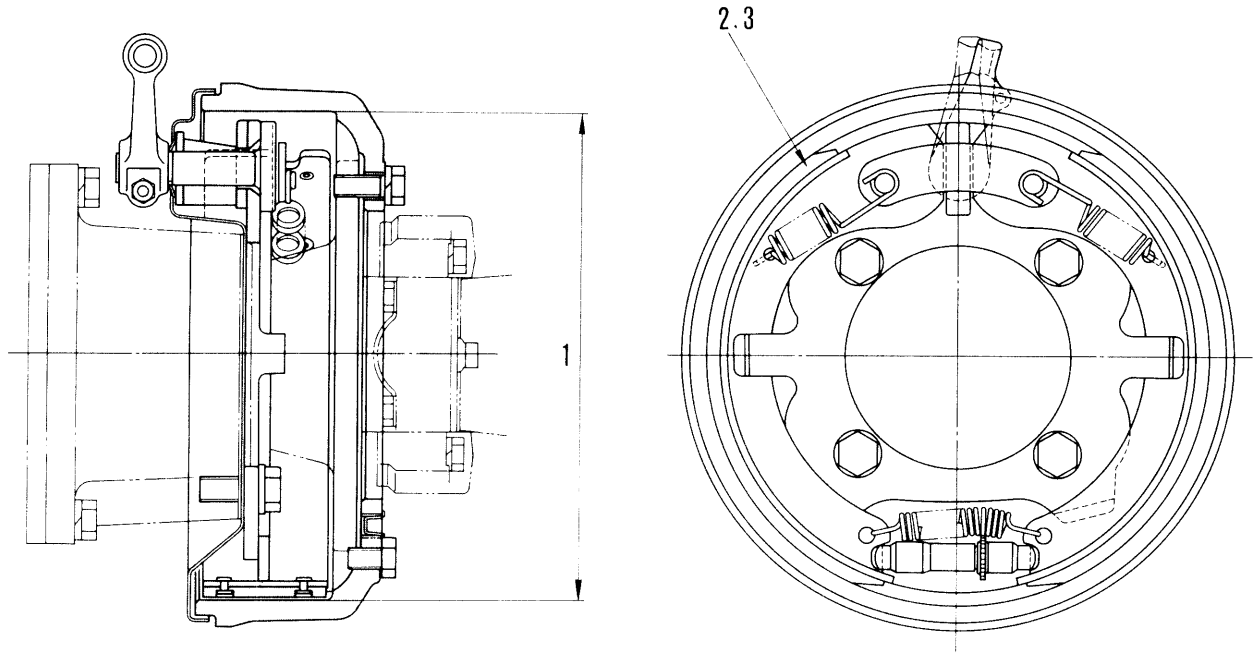


44F003

Unit: mm

No.	Check Item	Criteria					Remedy
1	Wear of brake drum I.D.	Standard size			Repair limit		Replace drum
		254			257		
2	Wear of brake drum						
3	Wear of lining	Clearance between rivet head and lining surface: Max. 0.5					Replace lining
4	Brake shoe return spring	Standard size			Repair limit		Replace spring
		Free length x O.D.	Installed length	Installed load	Free length	Installed load	
		68 x	75	18.5 kg	87	41 kg	
5	Clearance between brake drum and lining	0.23					
6	Brake drum installed bolt tightening torque	18 ± 2 kgm					
7	Arm installed nut tightening torque	1.9 ± 0.4 kgm					

GD705A-4

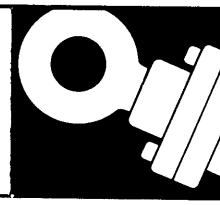


F23E098

Unit: mm

No.	Check Item	Criteria		Remedy
1	Wear of brake drum I.D.	Standard size	Repair limit	Replace drum
		$304.8\ ^{+0.2}_{0}$	308	
2	Wear of lining	Clearance between lining face and rivet head face: Max. 0.5		Replace lining
3	Out of roundness of drum I.D.	Repair limit: 0.2		Turn or replace

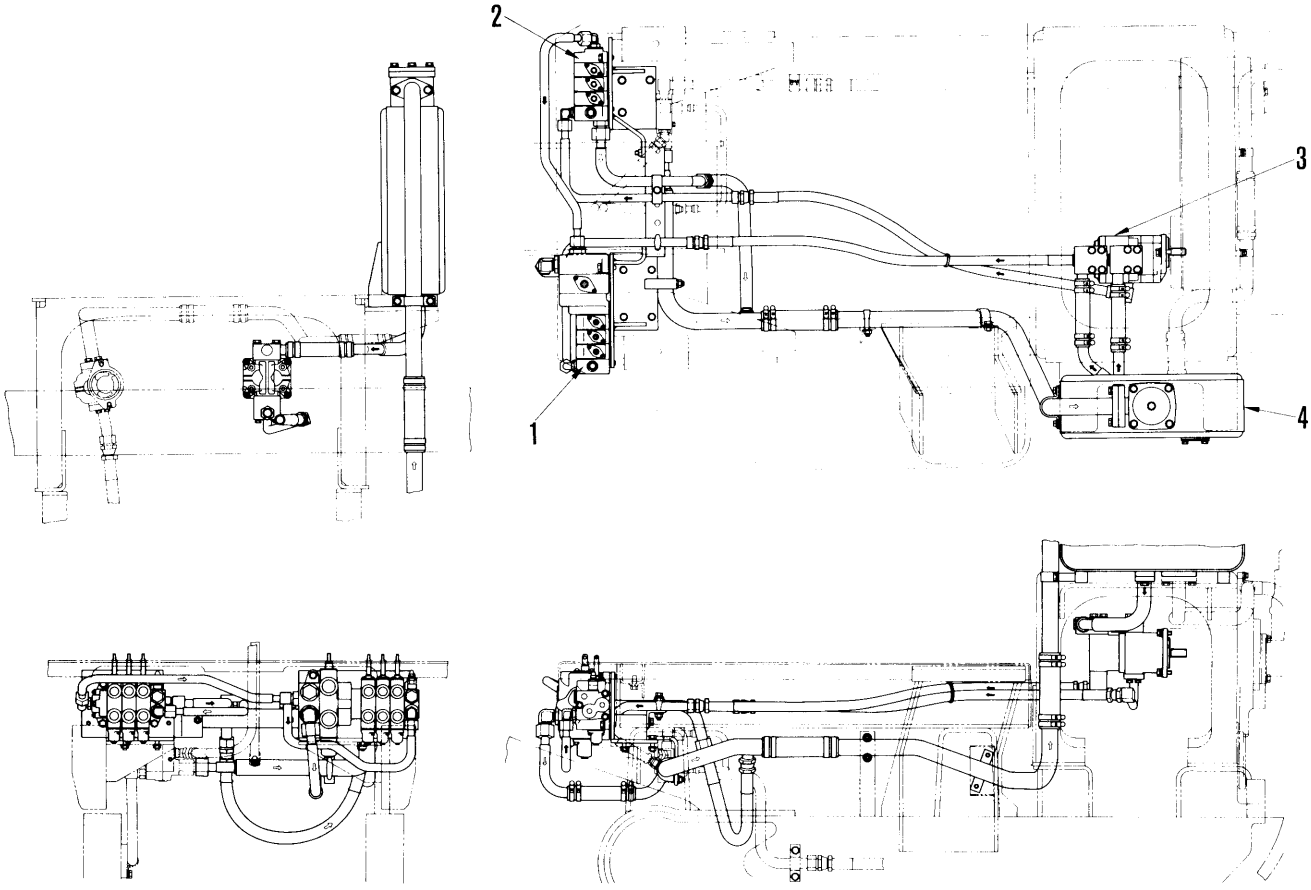
HYDRAULIC SYSTEM
61 STRUCTURE AND FUNCTION



HYDRAULIC CONTROL PIPING

GD705R-4

HYDRAULIC TANK TO CONTROL VALVES



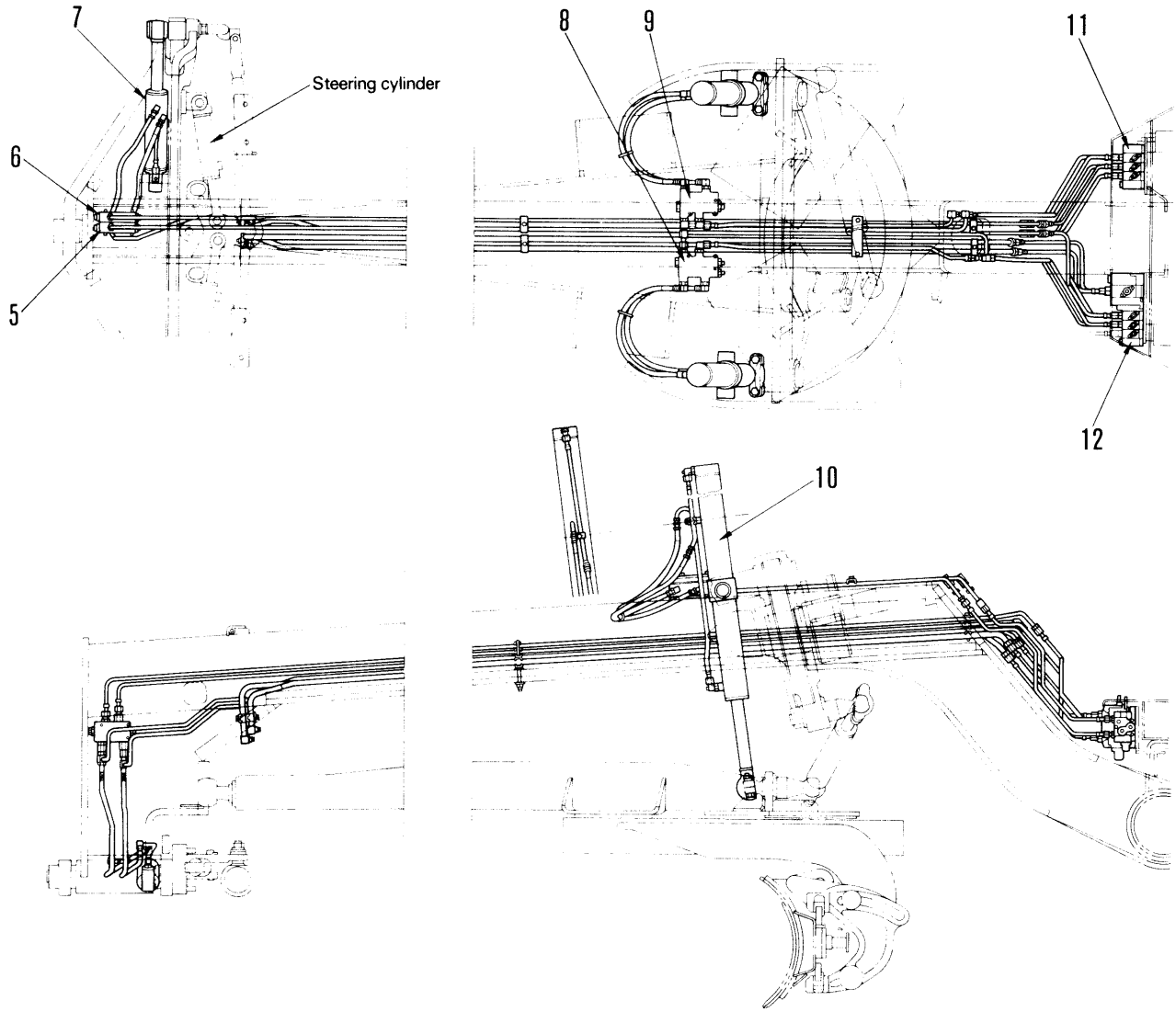
F23E04043

The hydraulic control, which operates the work equipment, consists of hydraulic tank (4), work equipment (3), and high pressure piping which is connected by piping from the control valve to each cylinder and motor.

1. L.H. hydraulic control valve (4-spool)
2. R.H. hydraulic control valve (3-spool)
3. Work equipment pump (LAR020 + 020)
4. Hydraulic tank

GD705R-4

BLADE LIFT AND LEANING

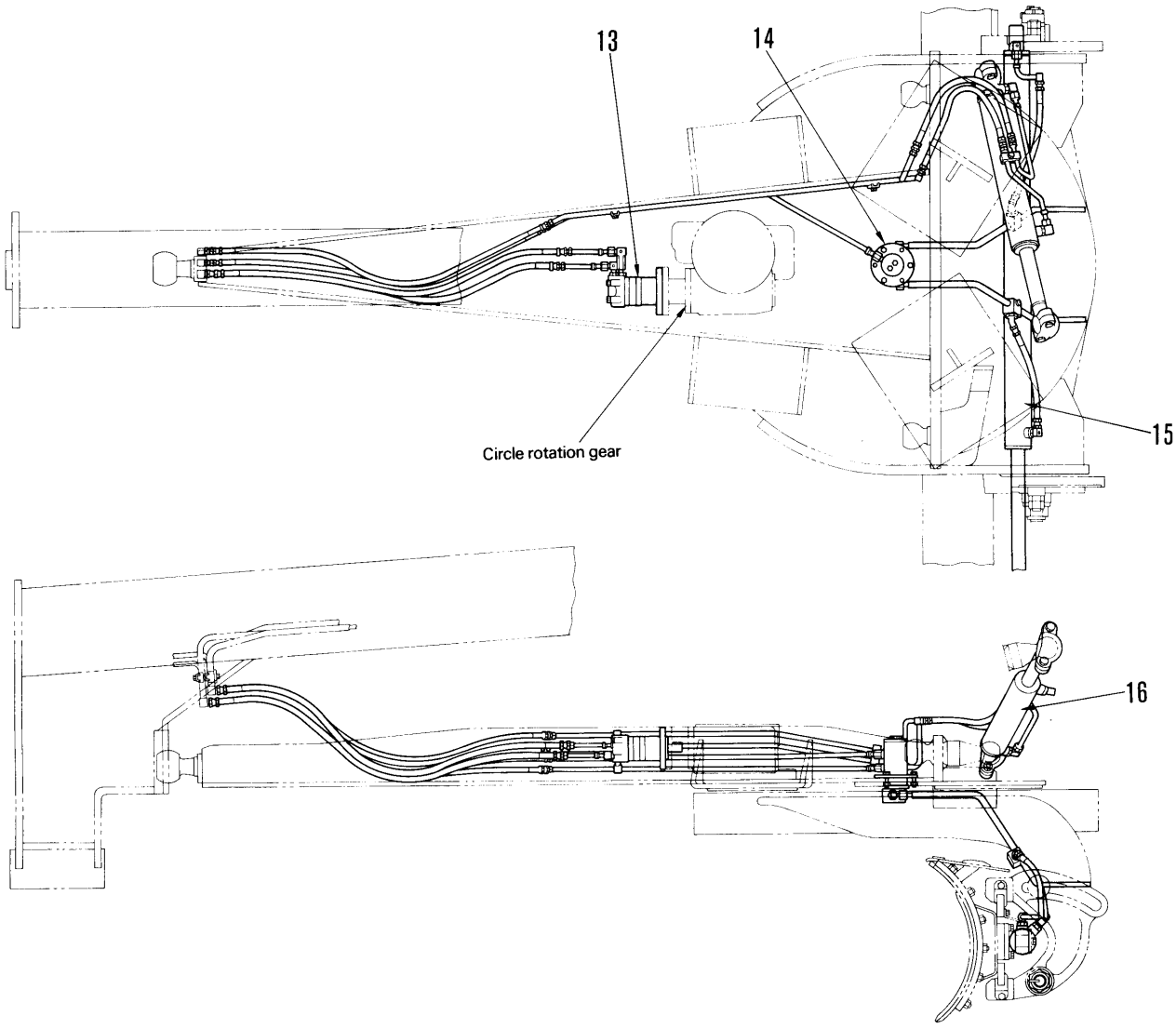


F23E04044

5. Pilot check valve (for drawbar shift)
6. Pilot check valve (for leaning)
7. Leaning cylinder
8. Pilot check valve (for blade lift L.H.)
9. Pilot check valve (for blade lift R.H.)
10. Blade lift cylinder
11. R.H hydraulic control valve (3-spool)
12. L.H. hydraulic control valve (4-spool)

GD705R-4

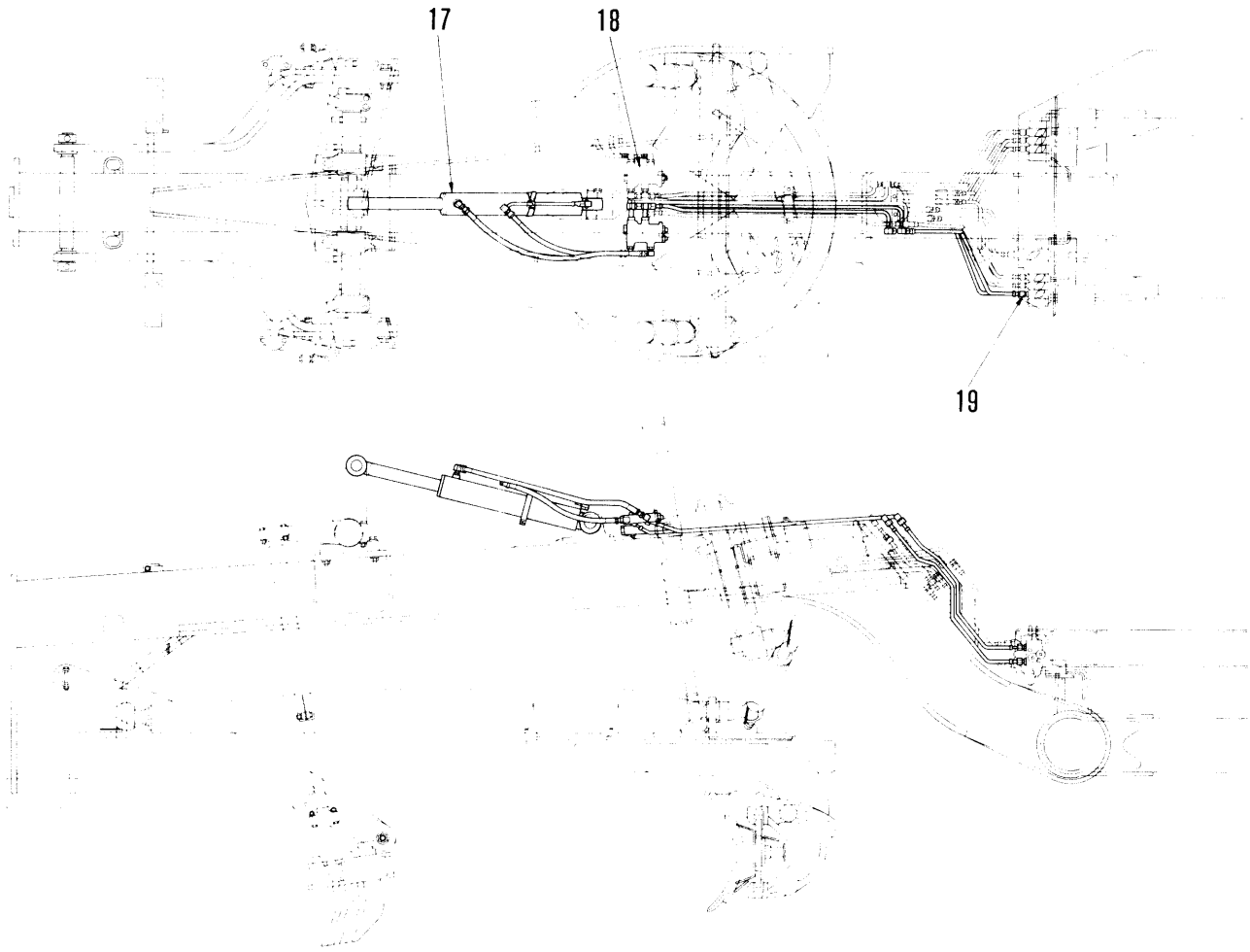
DRAWBAR SHIFT, CIRCLE REVERSE AND BLADE SIDE SHIFT



F23E04045

13. Circle rotation motor (orbit 2-125AD4-E)
14. Rotary joint
15. Blade side shift cylinder
16. Drawbar shift cylinder

SCARIFIER GD705R-4 (If equipped)



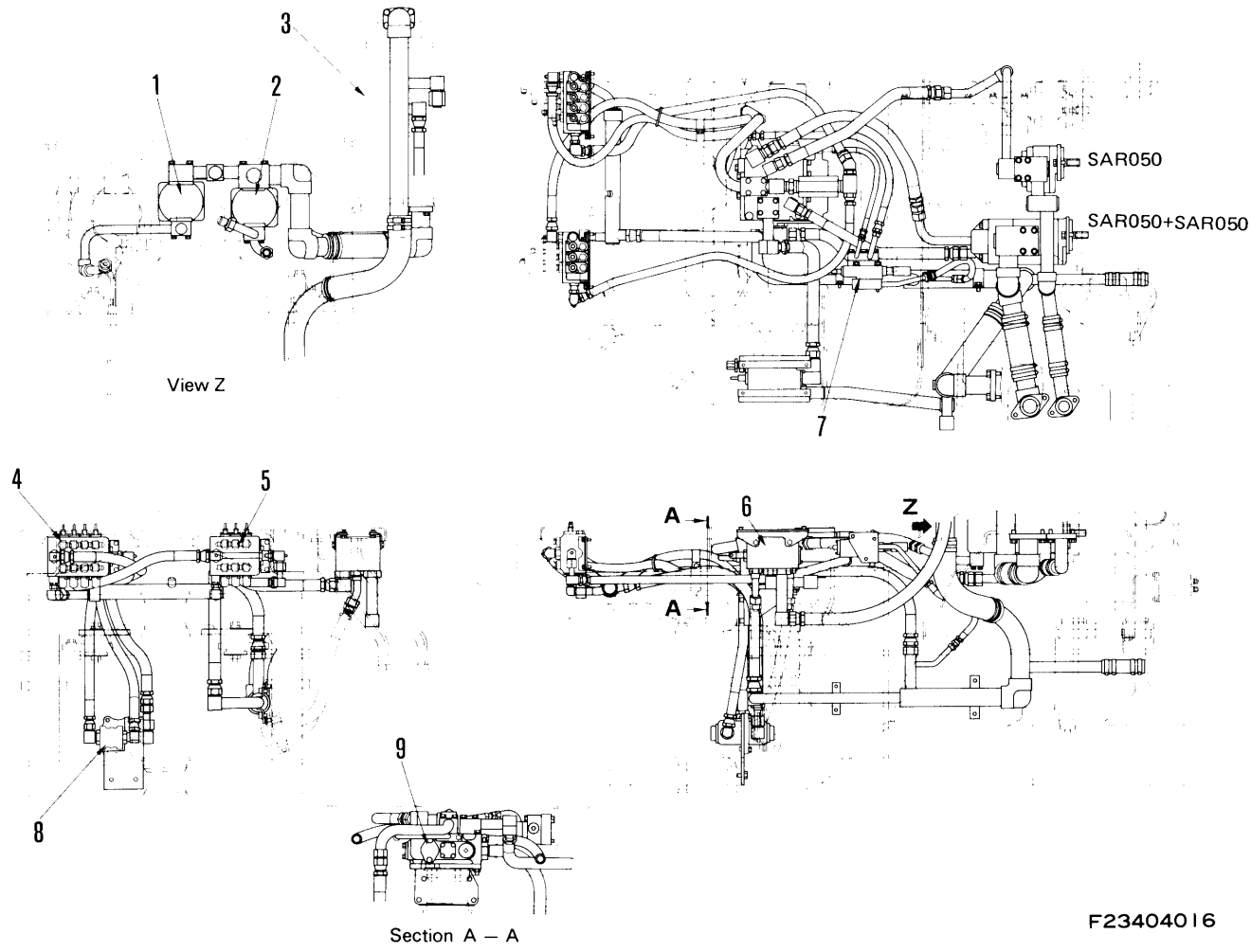
F23E04046

17. Scarifier cylinder
18. Pilot check valve (for scarifier)
19. 4-Spool control valve

HYDRAULIC CONTROL PIPING

GD705A-4

HYDRAULIC TANK TO CONTROL VALVES



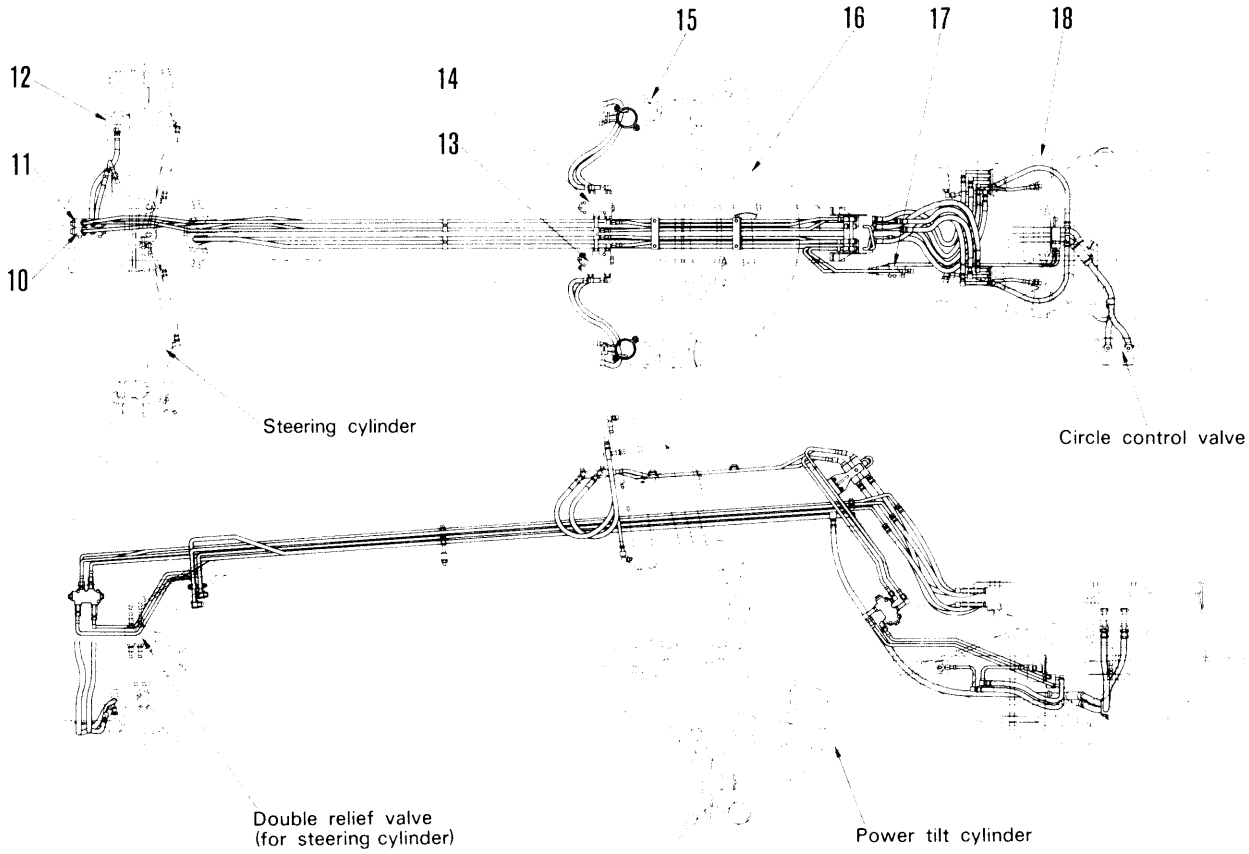
The hydraulic control operating the work equipment consists of the following components: hydraulic tank, gear pump, dual demand valve, flow divider valve and high-pressure piping connecting the hydraulic control valve to the cylinders and motors.

★ Use CLASS-CD SAE10W engine oil for all seasons.

1. Work equipment pump (SAR050)
2. Work equipment pump (SAR050 + SAR050)
3. Hydraulic oil tank
4. Hydraulic control valve (R.H.)
5. Hydraulic control valve (L.H.)
6. Circle control valve
7. Mode control valve
8. Flow divider valve
9. Dual demand valve

GD705A-4

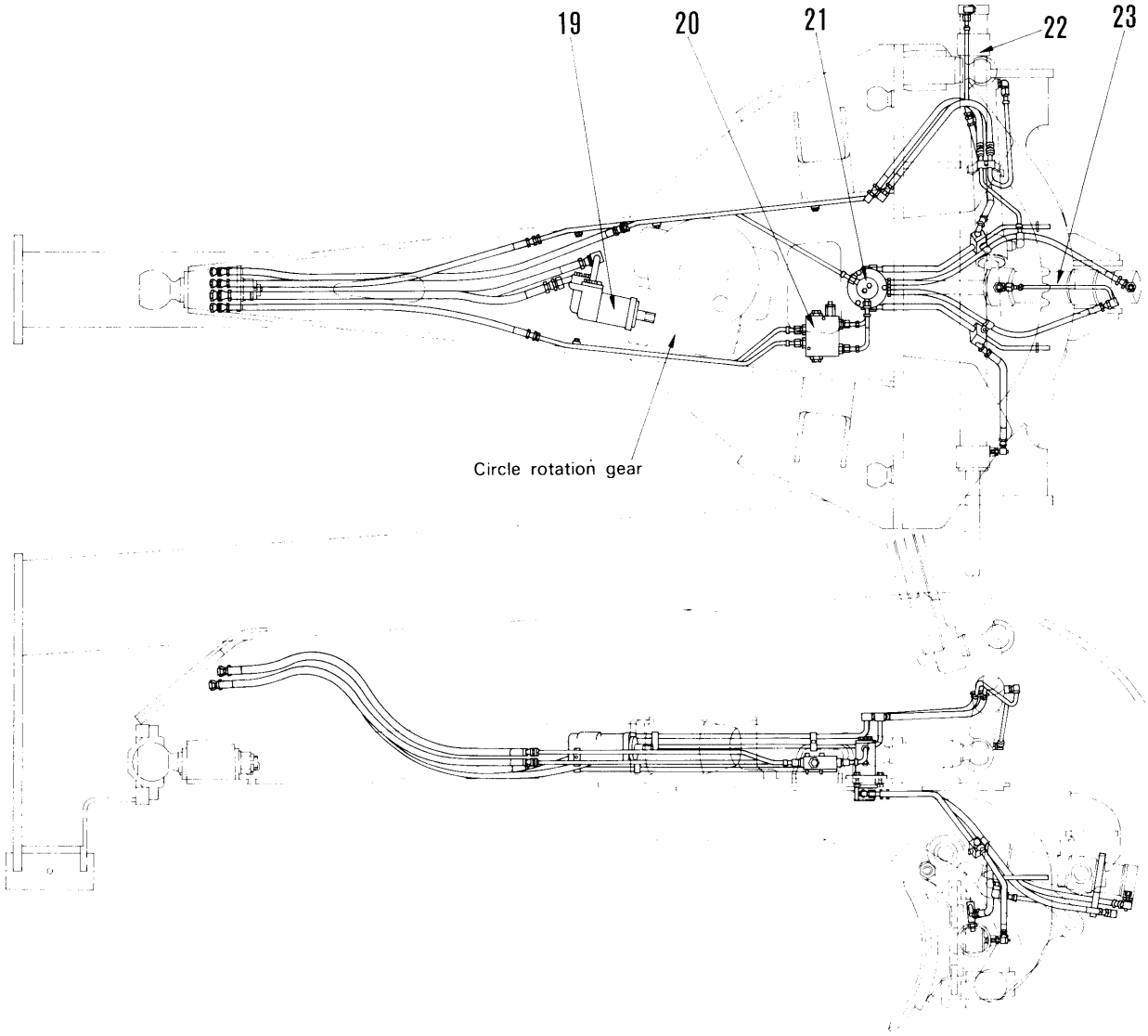
BLADE LIFT AND LEANING



F23404017

10. Pilot check valve (for leaning)
11. Pilot check valve (for drawbar shift)
12. Leaning cylinder
13. Pilot check valve (for blade lift L.H.)
14. Pilot check valve (for blade lift R.H.)
15. Blade lift cylinder
16. Drawbar shift cylinder
17. Pilot check valve (for articulate)
18. Articulate cylinder

GD705A-4
BLADE SIDE SHIFT, CIRCLE ROTATION AND POWER TILT

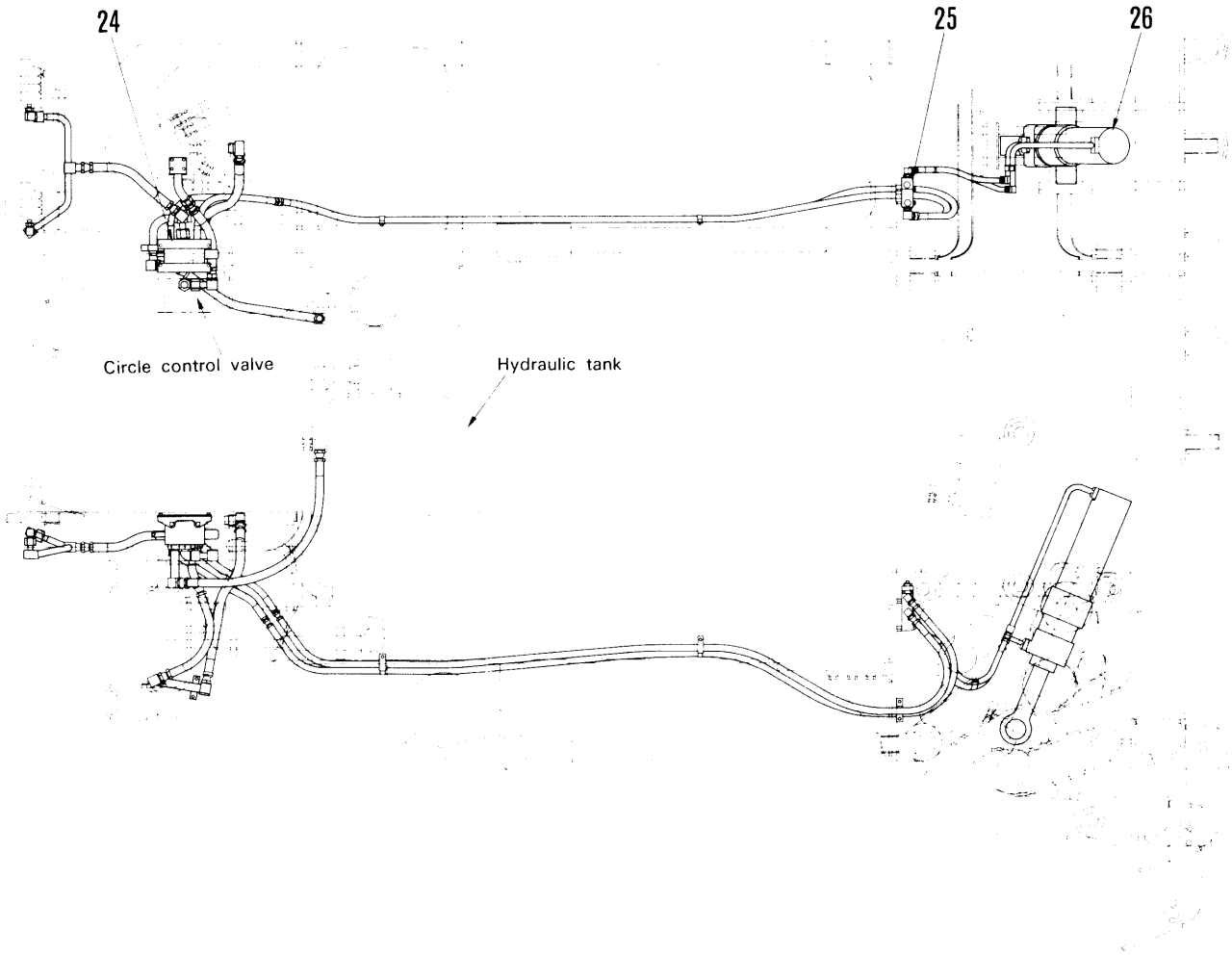


F23404018

19. Circle rotation motor
20. Pilot check valve (for power tilt)
21. Rotary joint
22. Blade side shift cylinder
23. Power tilt cylinder

GD705A-4

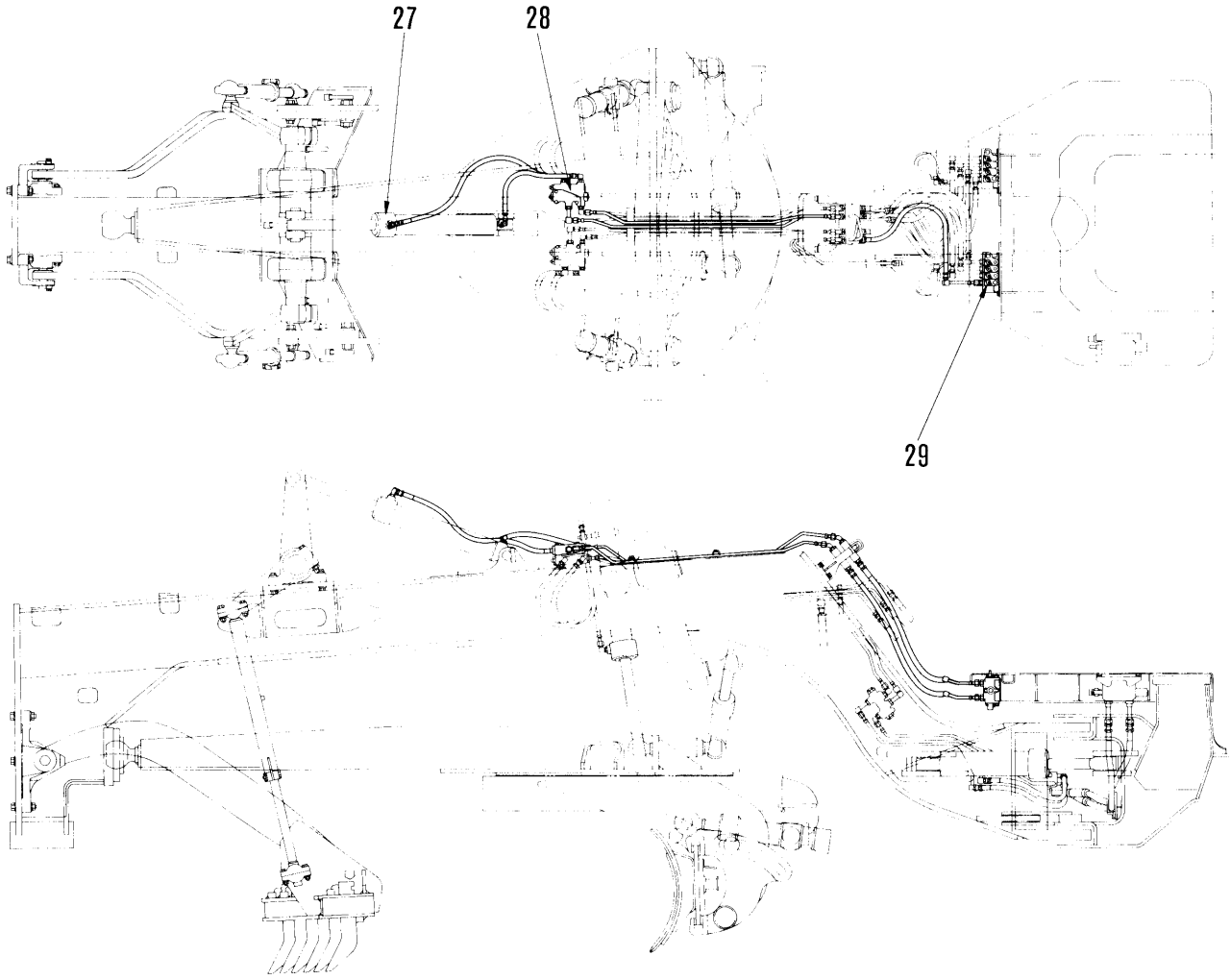
RIPPER (If equipped)



F23404019A

24. Ripper control valve
25. Pilot check valve
26. Ripper cylinder

GD705A-4
SCARIFIER (If equipped)

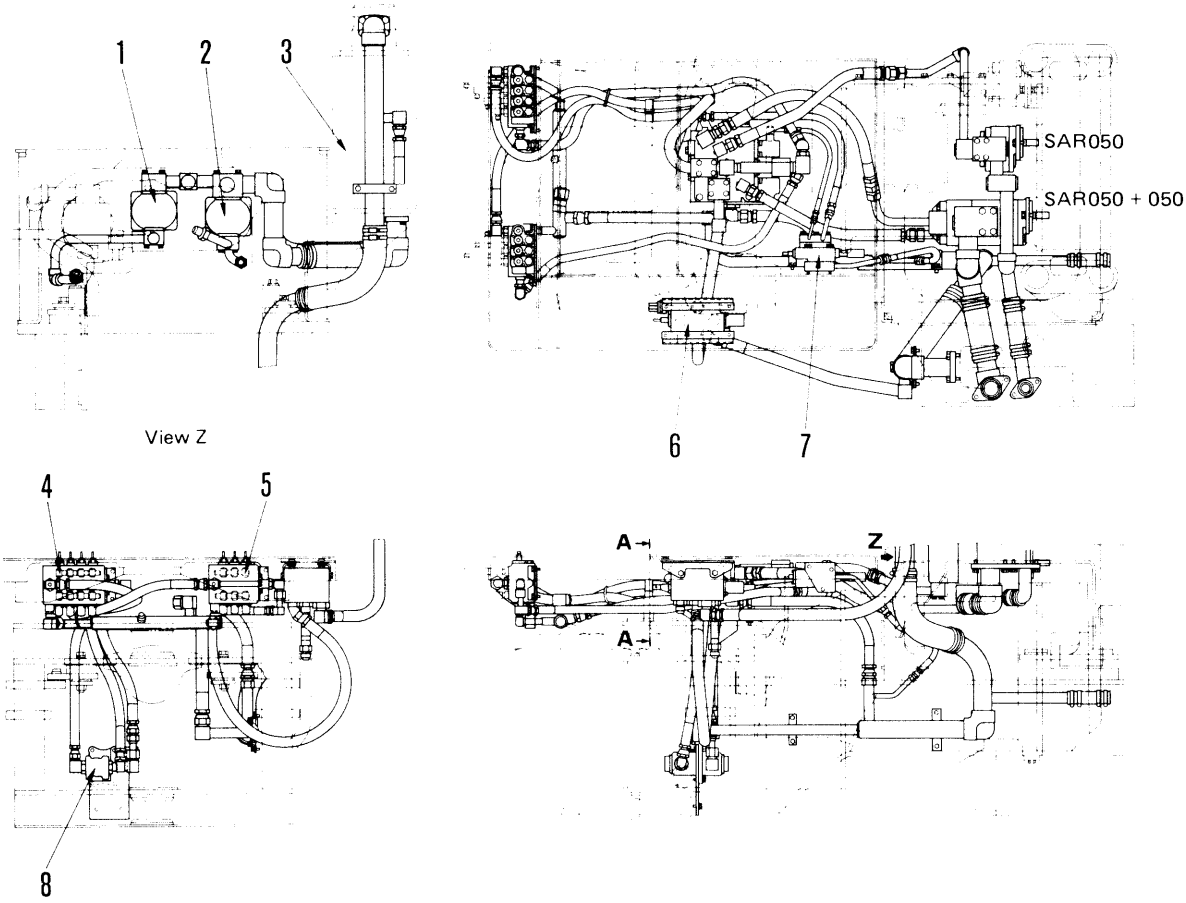


F23404051

27. Scarifier cylinder
28. Pilot check valve (for scarifier)
29. 4-spool control valve

HYDRULIC CONTROL PIPING

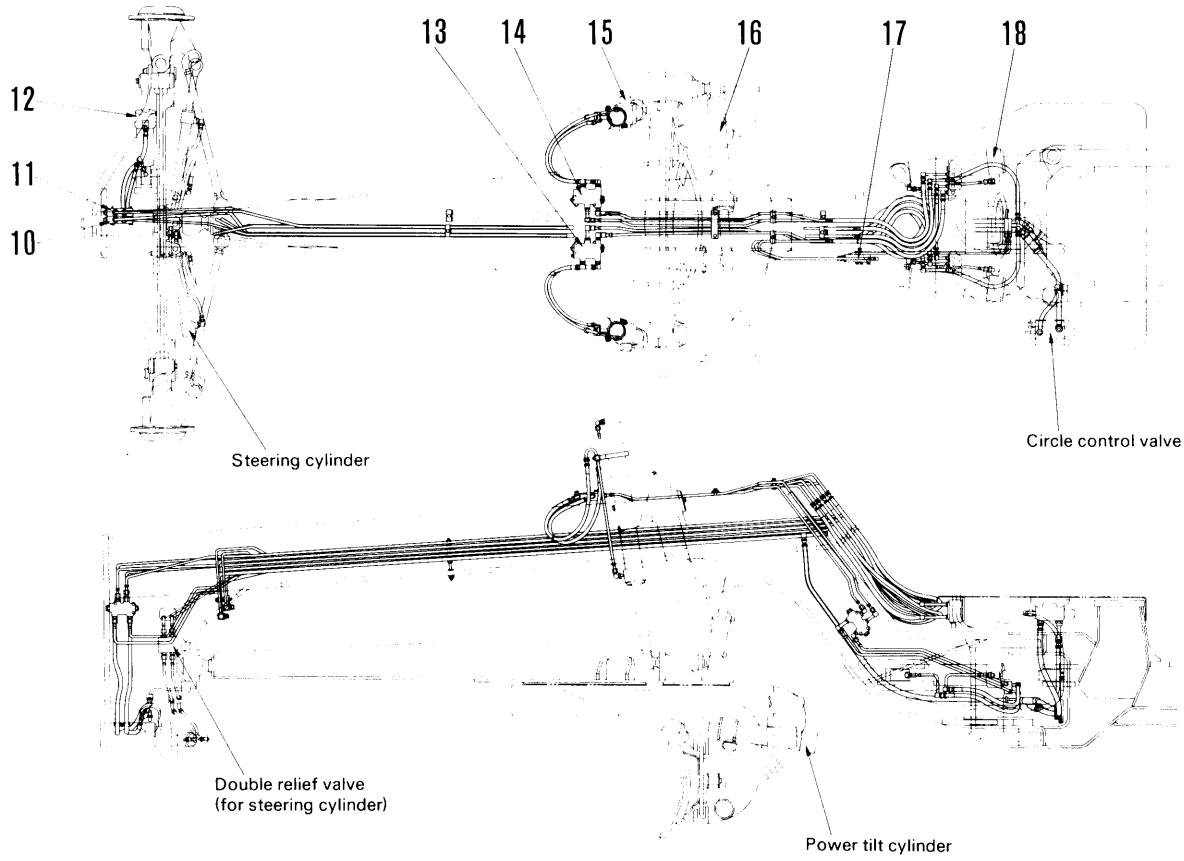
GD705A-4 (Serial No. 31001 and up)
HYDRAULIC TANK TO CONTROL VALVES



F23404052

1. Work equipment pump (SAR050)
2. Work equipment pump (SAR050 + SAR050)
3. Hydraulic oil tank
4. Hydraulic control valve (R.H.)
5. Hydraulic control valve (L.H.)
6. Circle control valve
7. Mode control valve
8. Flow divider valve
9. Dual demand valve

GD705A-4 (Serial No. 31001 and up)
BLADE LIFT AND LEANING

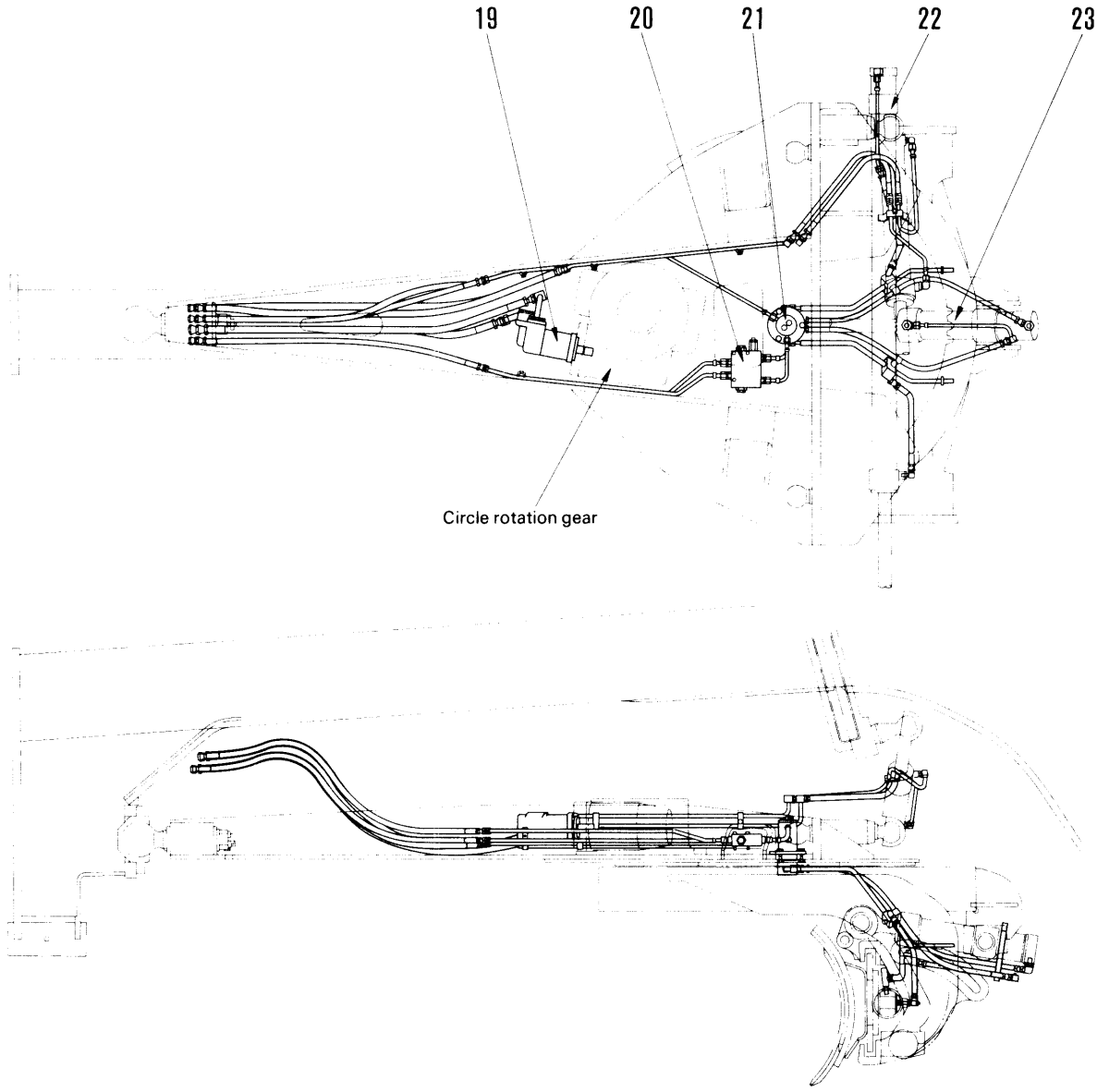


F23404053

10. Pilot check valve (for leaning)
11. Pilot check valve (for drawbar shift)
12. Leaning cylinder
13. Pilot check valve (for blade lift L.H.)
14. Pilot check valve (for blade lift R.H.)
15. Blade lift cylinder
16. Drawbar shift cylinder
17. Pilot check valve (for articulate)
18. Articulate cylinder

GD705A-4 (Serial No. 31001 and up)

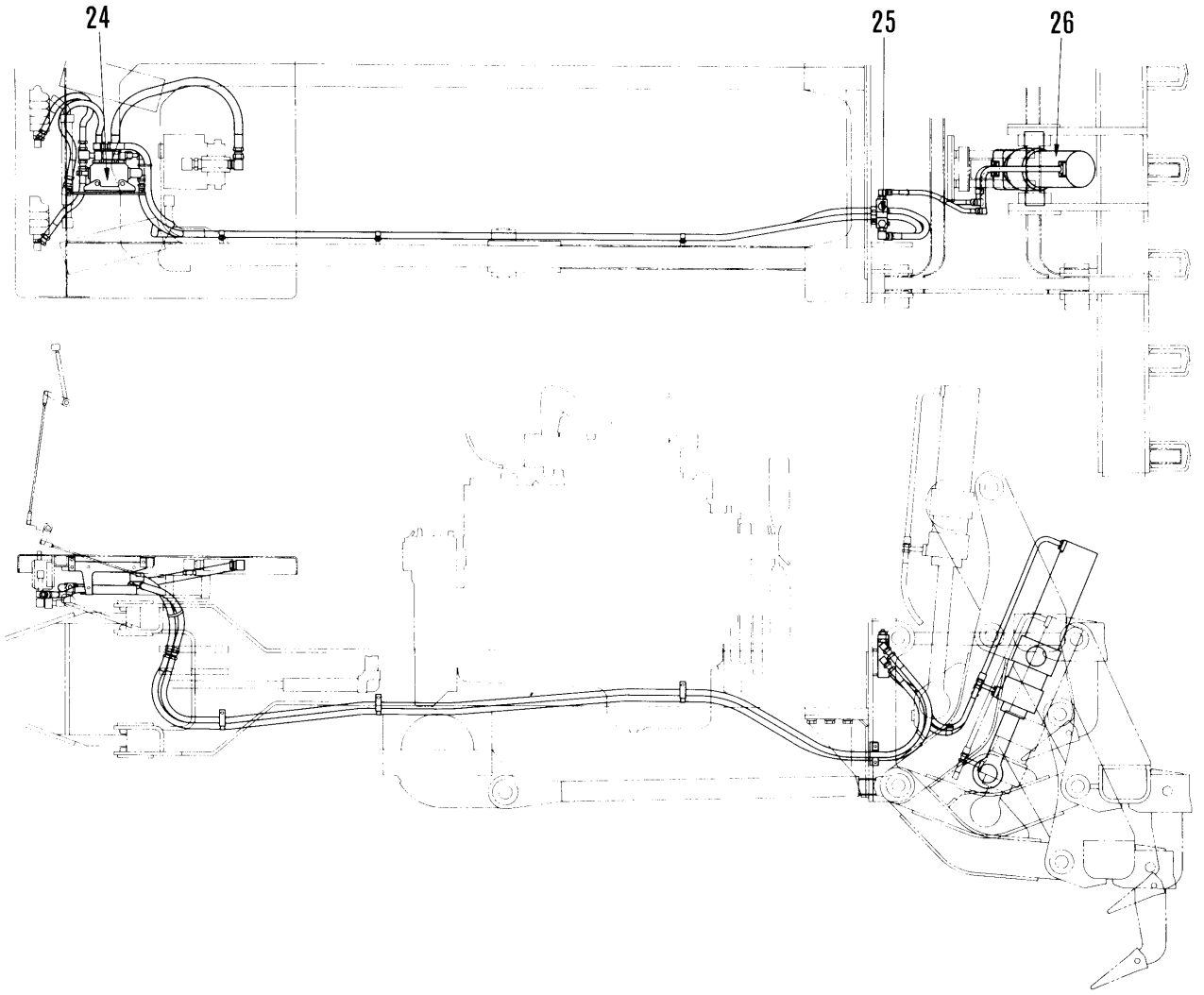
BLADE SIDE SHIFT, CIRCLE ROTATION AND POWER TILT



F23404054

19. Circle rotation motor
20. Pilot check valve (for power tilt)
21. Rotary joint
22. Blade side shift cylinder
23. Power tilt cylinder

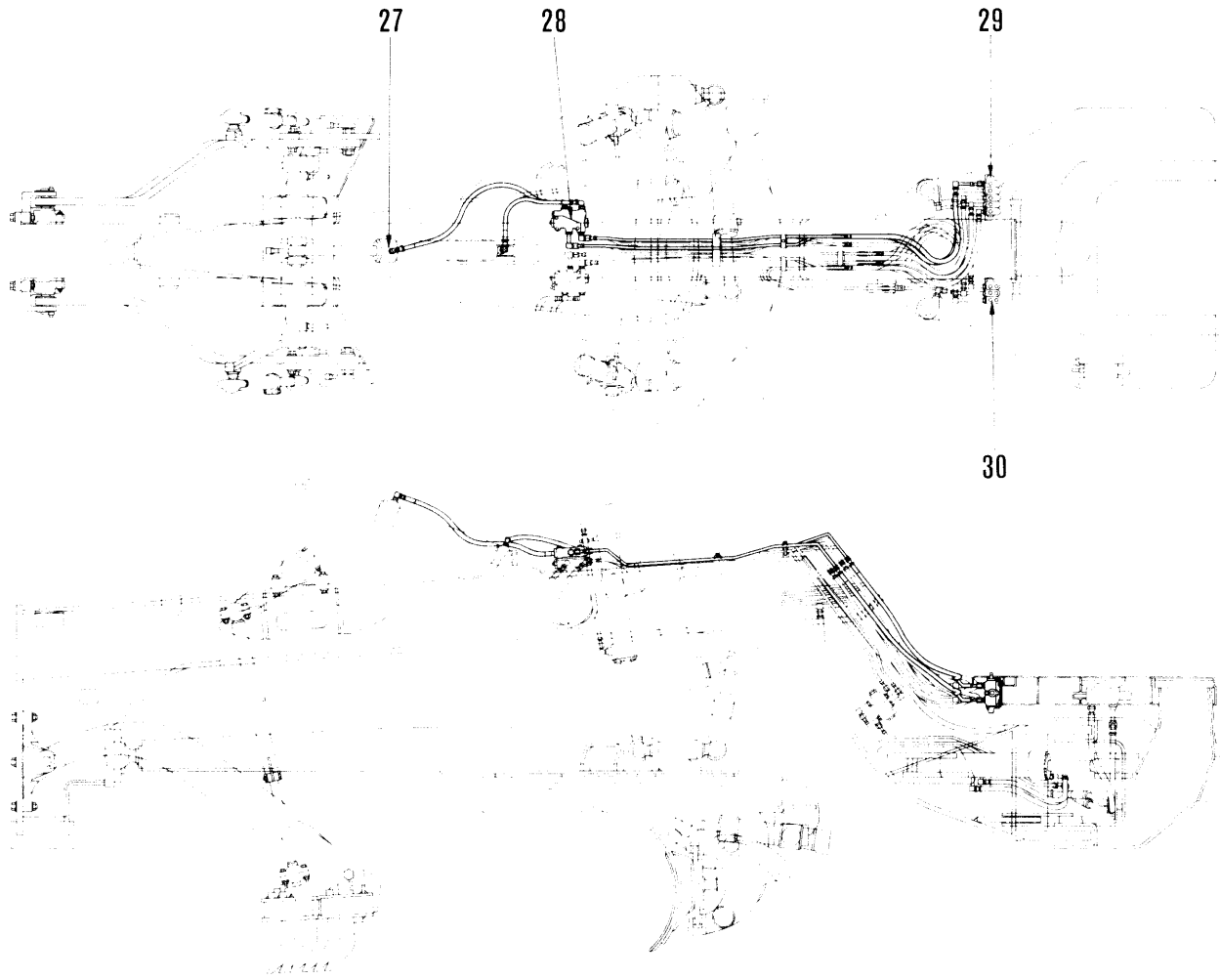
GD705A-4 (Serial No. 31001 and up)
RIPPER (If equipped)



F23404055

24. Ripper control valve
25. Pilot check valve
26. Ripper cylinder

GD705A-4 (Serial No. 31001 and up)
SCARIFIER (If equipped)

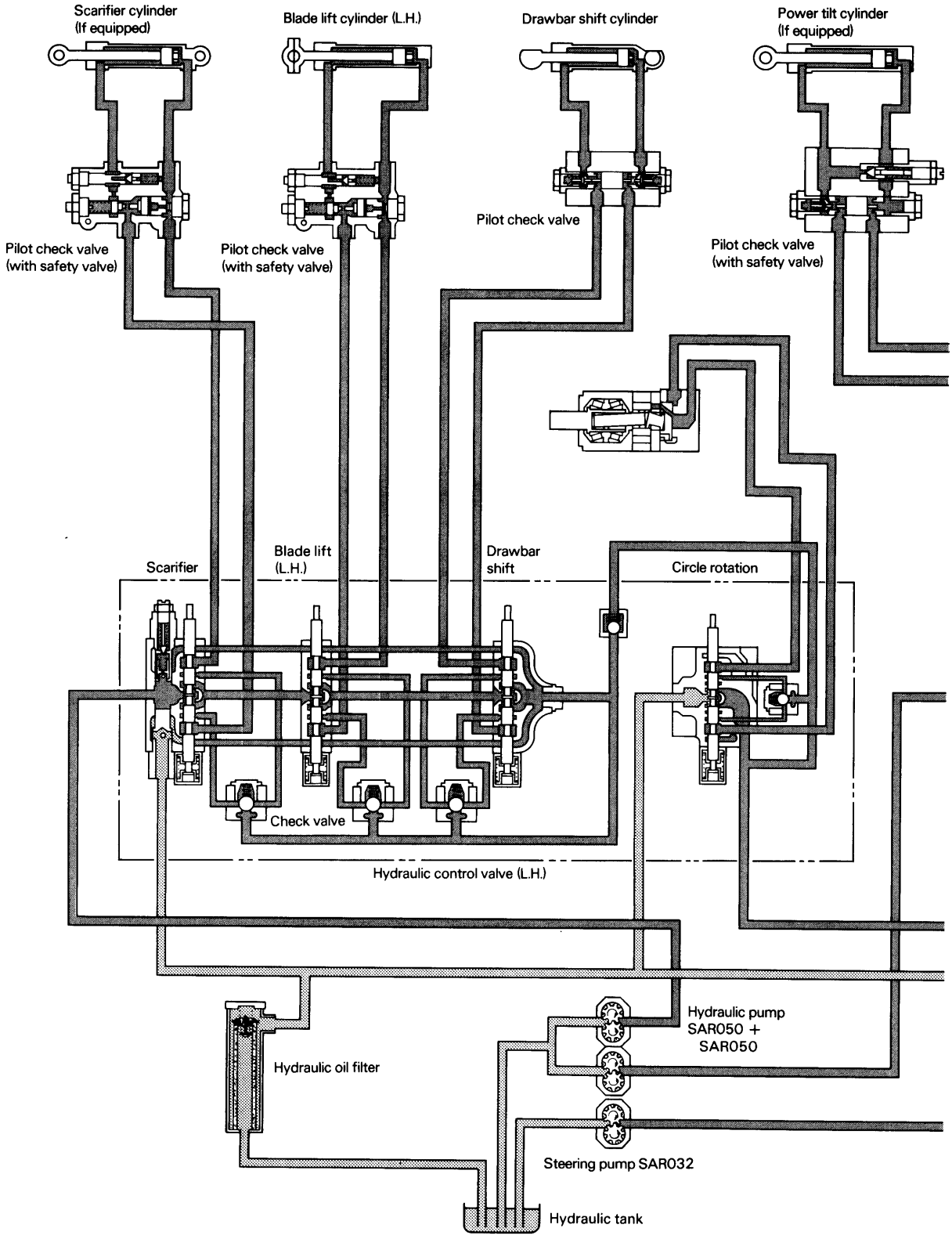


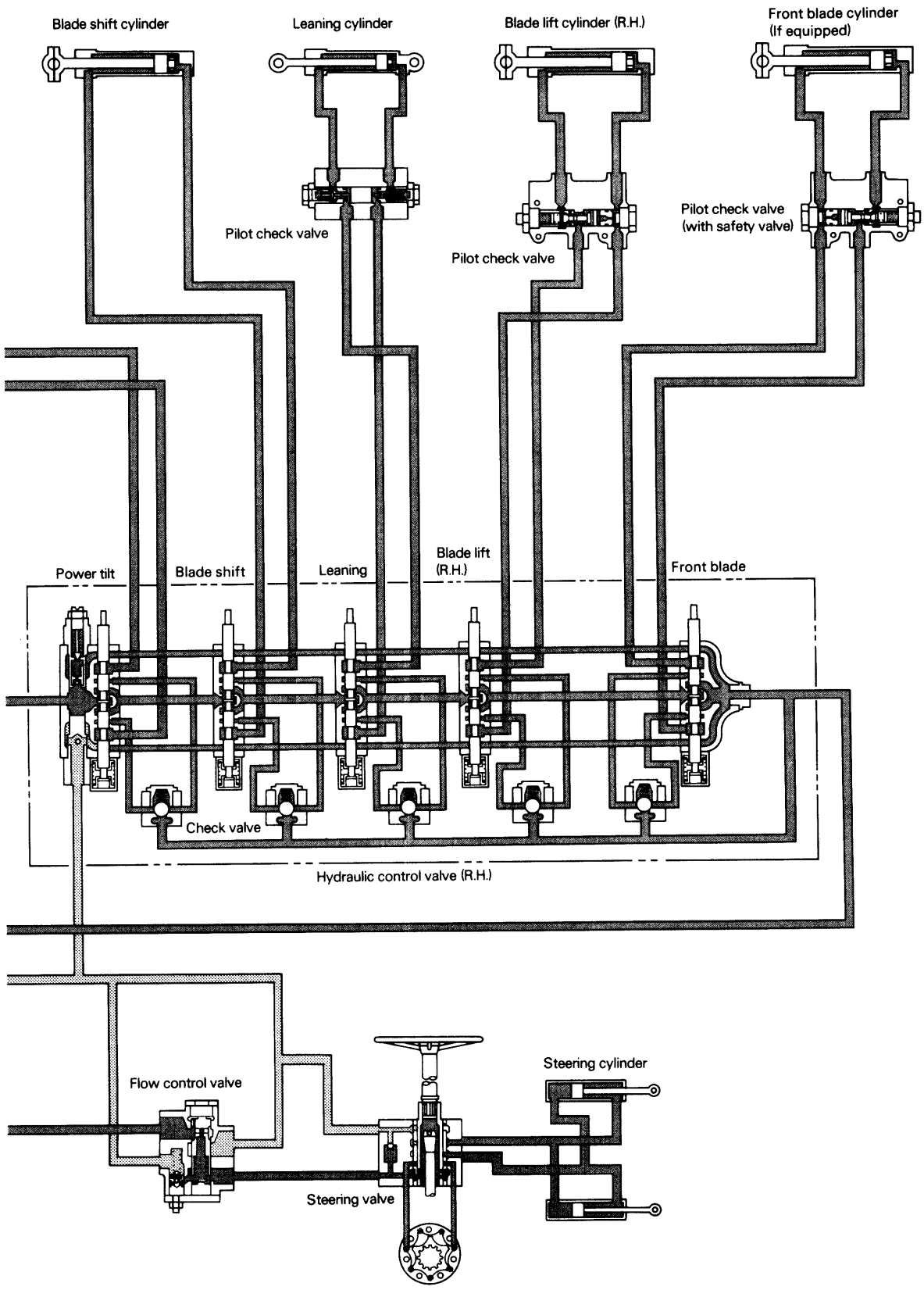
F23404056

27. Scarifier cylinder
28. Pilot check valve (for scarifier)
29. Hydraulic control valve (R.H.)
30. Hydraulic control valve (L.H.)

HYDRAULIC SYSTEM DIAGRAM

GD705R-4

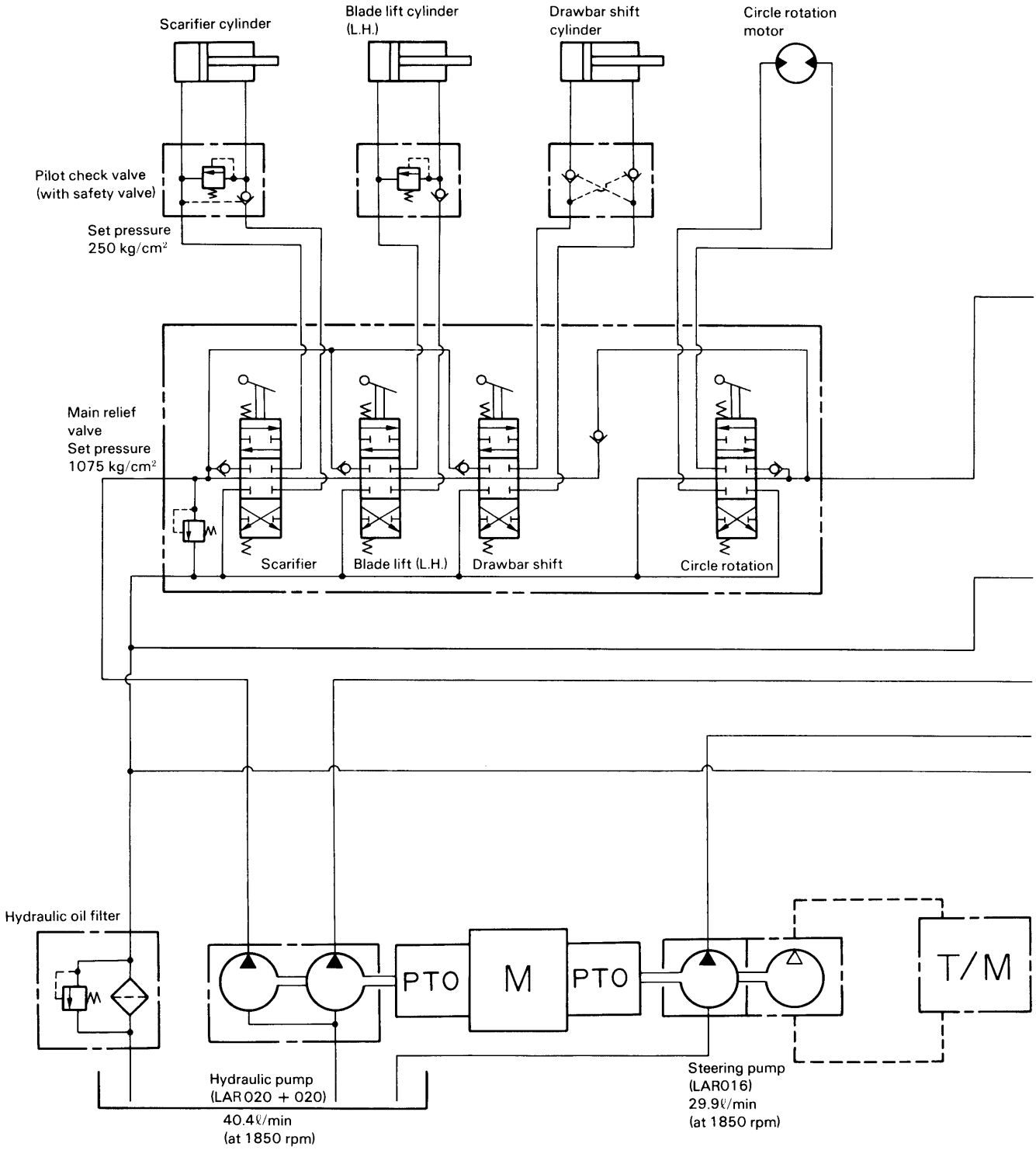


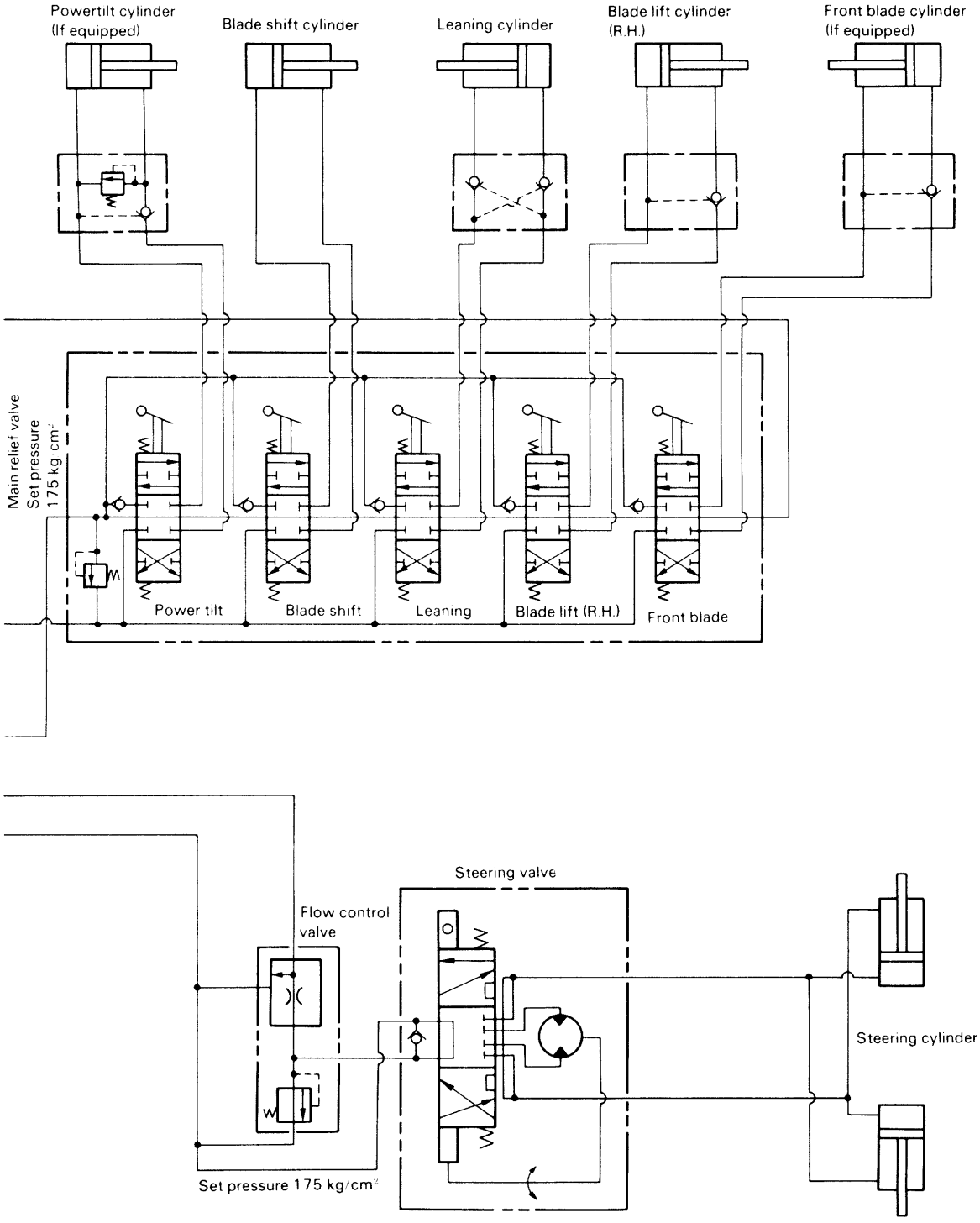

Blade shift cylinder
Leaning cylinder
Blade lift cylinder (R.H.)
Front blade cylinder
(If equipped)
Pilot check valve
Pilot check valve
Pilot check valve
(with safety valve)
Power tilt
Blade shift
Leaning
Blade lift
(R.H.)
Front blade
Check valve
Hydraulic control valve (R.H.)
Flow control valve
Steering cylinder
Steering valve

F23E04047

HYDRAULIC CIRCUIT DIAGRAM

GD705R-4

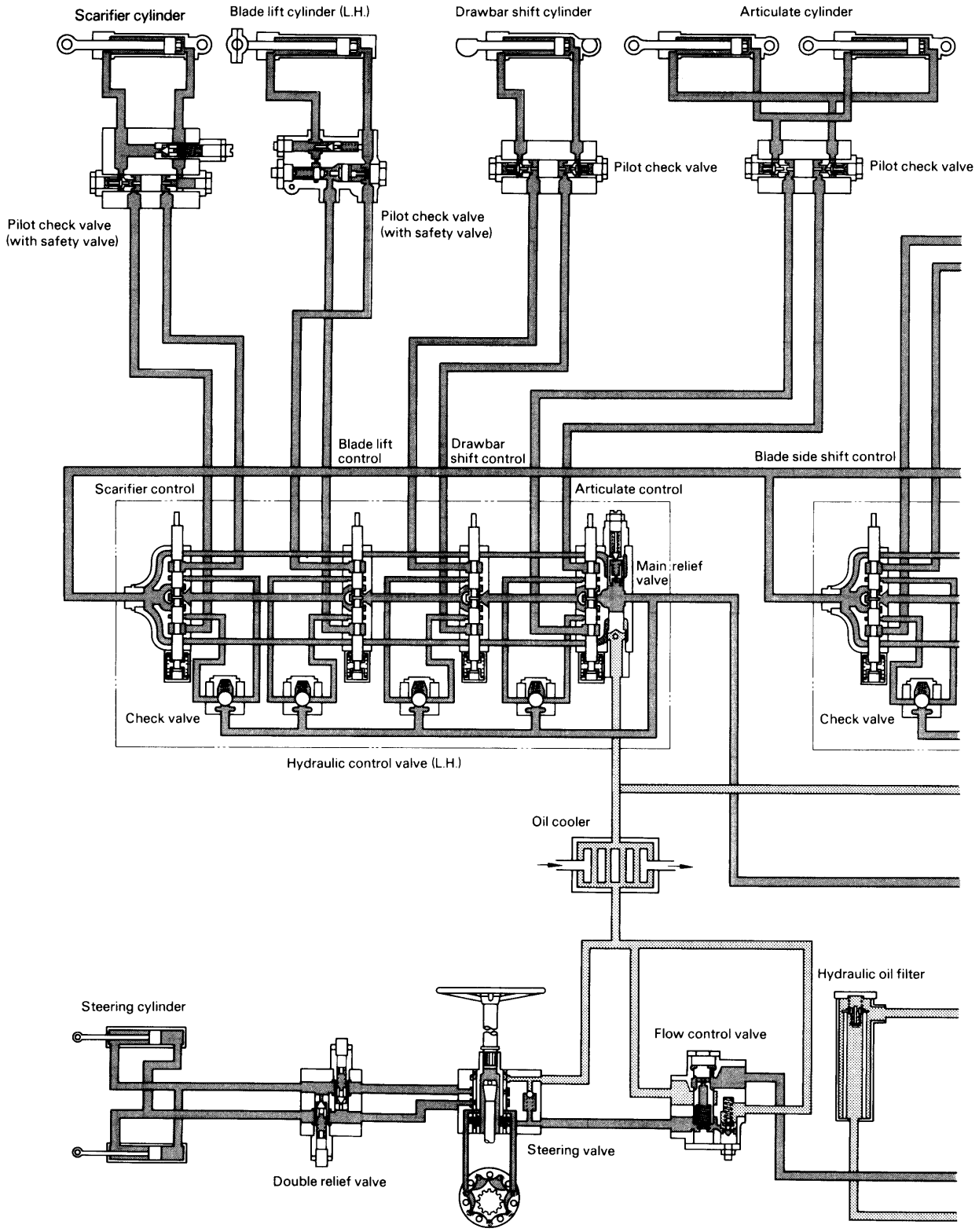


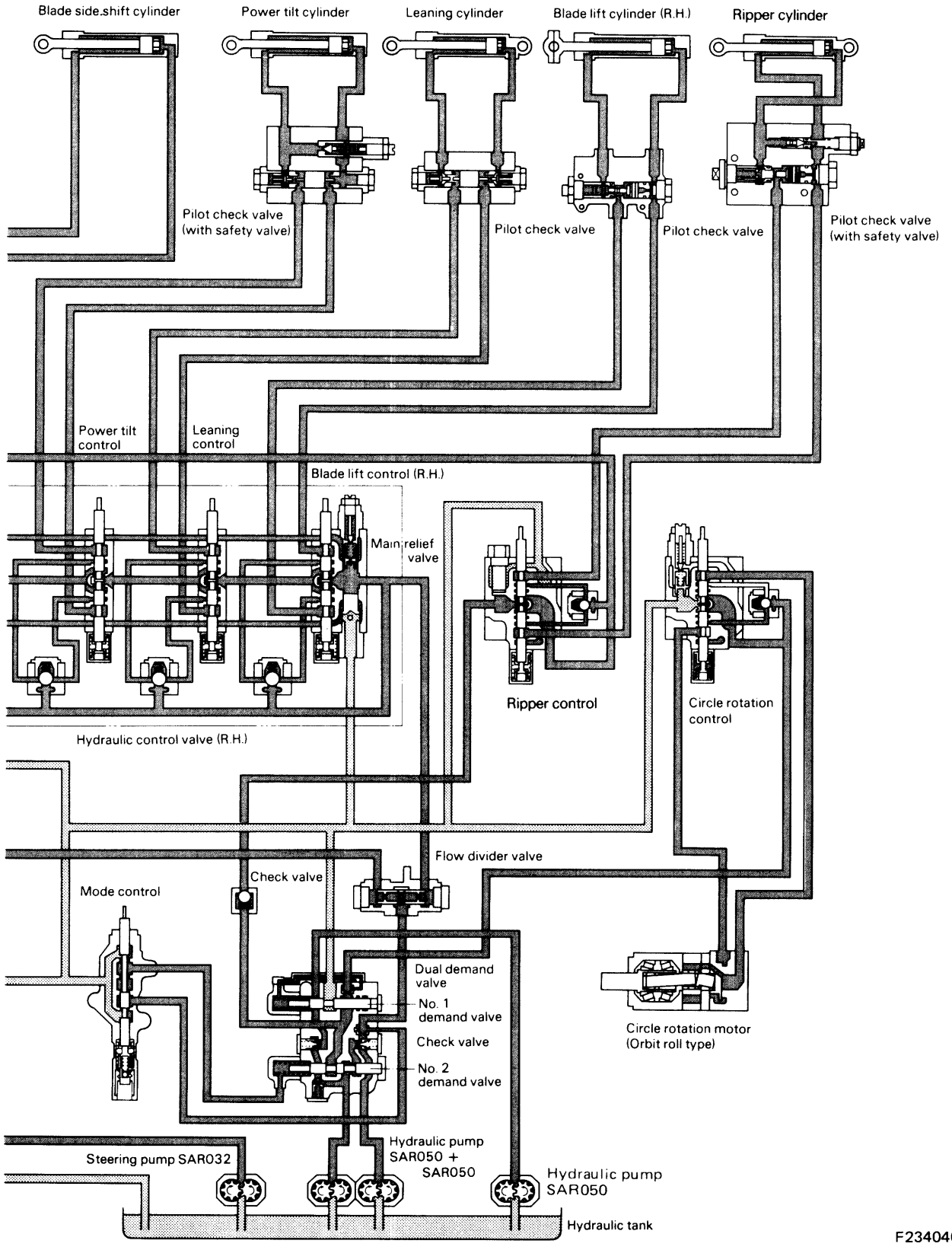

Powertilt cylinder
(If equipped)
Blade shift cylinder
Leaning cylinder
Blade lift cylinder
(R.H.)
Front blade cylinder
(If equipped)
Main relief valve
Set pressure
175 kg/cm²
Power tilt
Blade shift
Leaning
Blade lift (R.H.)
Front blade
Steering valve
Flow control
valve
Steering cylinder
Set pressure 175 kg/cm²

F23E04048

HYDRAULIC SYSTEM DIAGRAM

GD705A-4 (Serial No. 21001 - 31000)

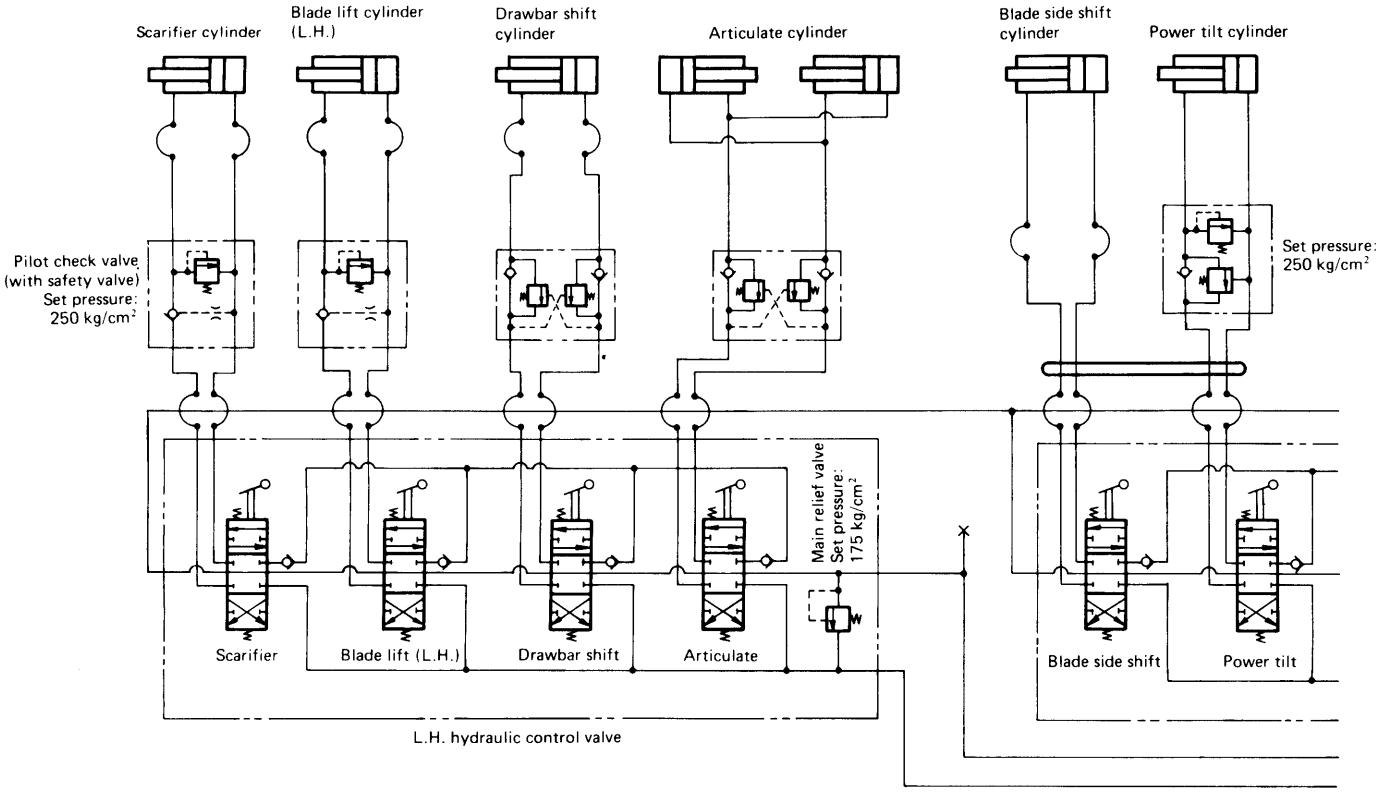


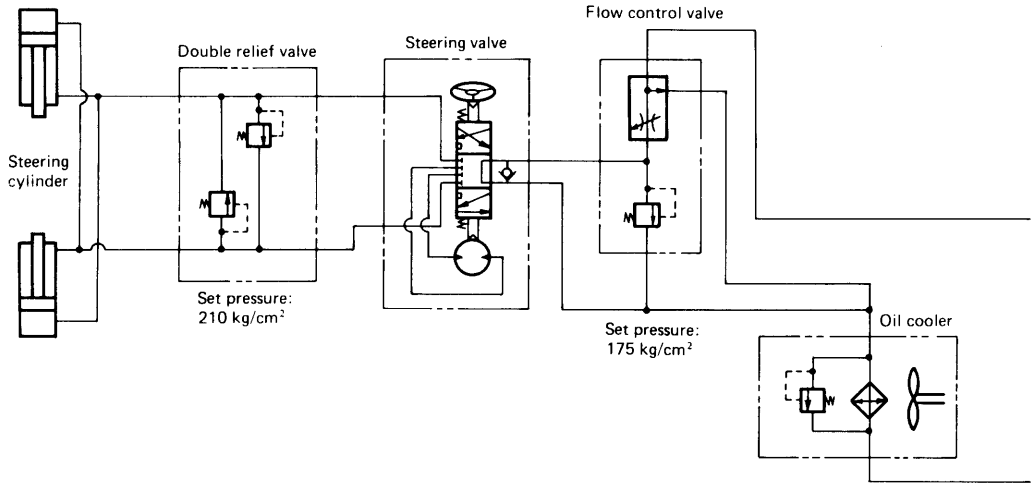

Blade side-shift cylinder
Power tilt cylinder
Leaning cylinder
Blade lift cylinder (R.H.)
Ripper cylinder
Pilot check valve (with safety valve)
Pilot check valve
Pilot check valve
Pilot check valve (with safety valve)
Power tilt control
Leaning control
Blade lift control (R.H.)
Main relief valve
Ripper control
Circle rotation control
Hydraulic control valve (R.H.)
Flow divider valve
Check valve
Mode control
Dual demand valve
No. 1 demand valve
Check valve
No. 2 demand valve
Circle rotation motor (Orbit roll type)
Steering pump SAR032
Hydraulic pump SAR050 + SAR050
Hydraulic pump SAR050
Hydraulic tank

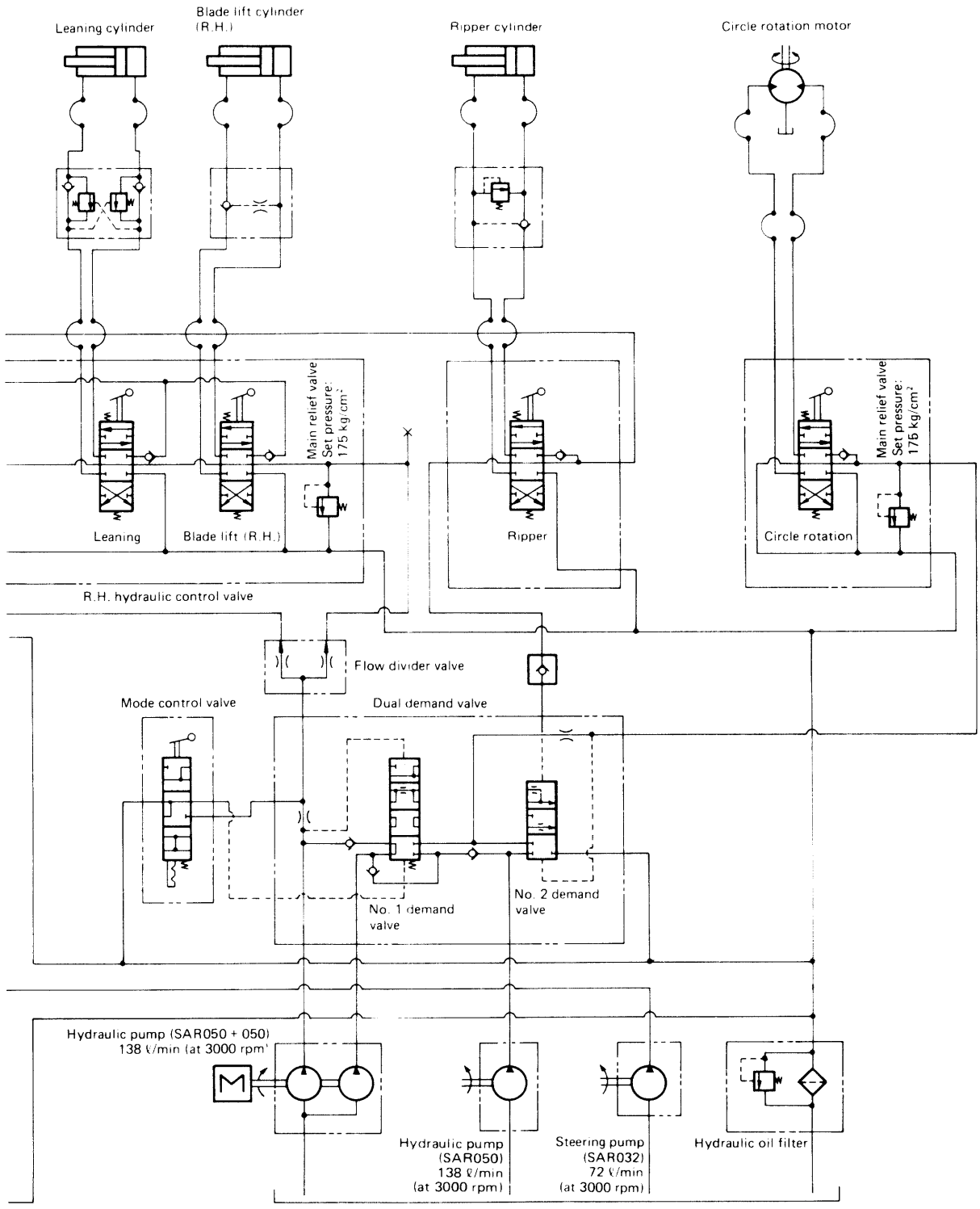
F23404059A

HYDRAULIC CIRCUIT DIAGRAM

GD705A-4 (Serial No. 21001 - 31000)



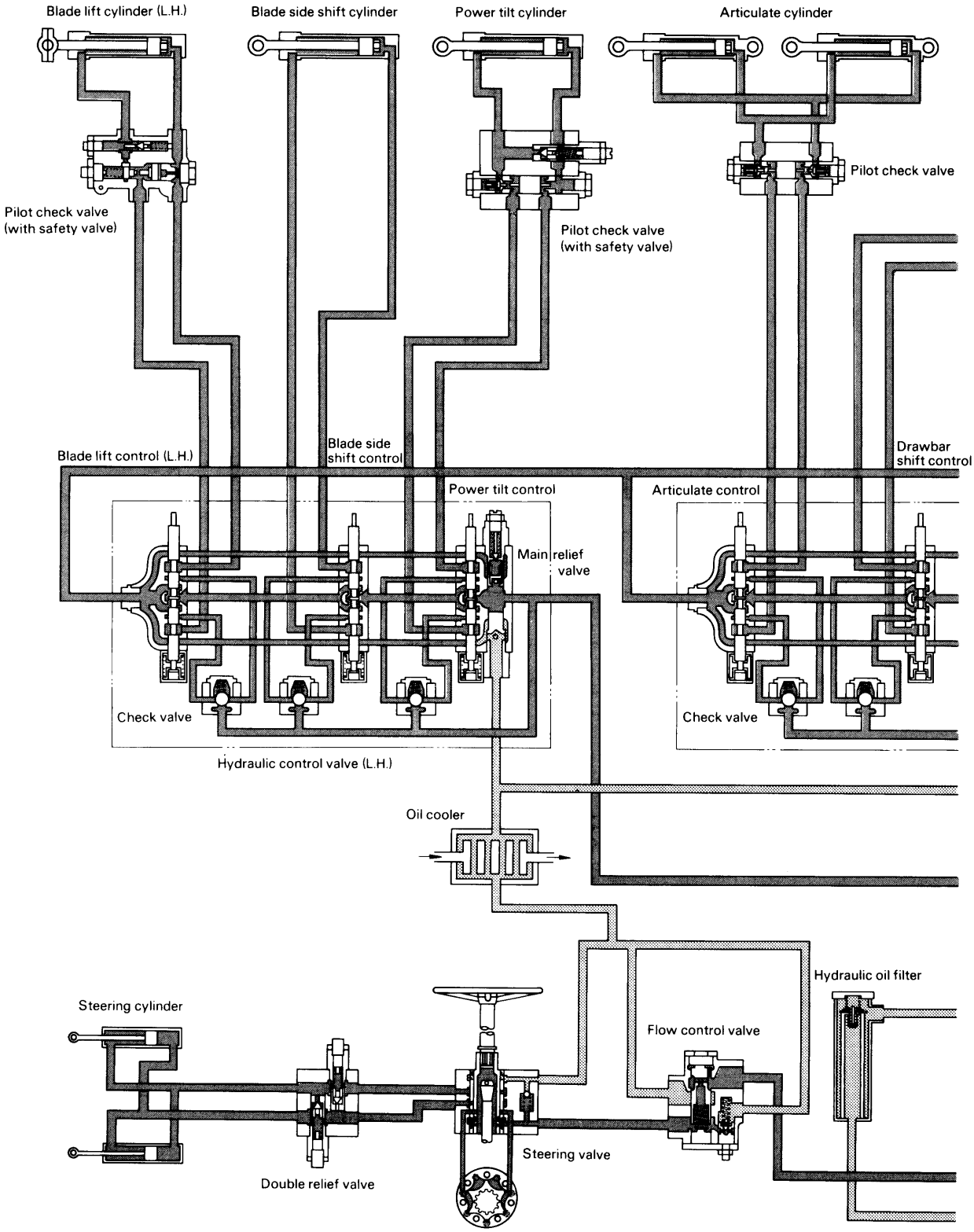


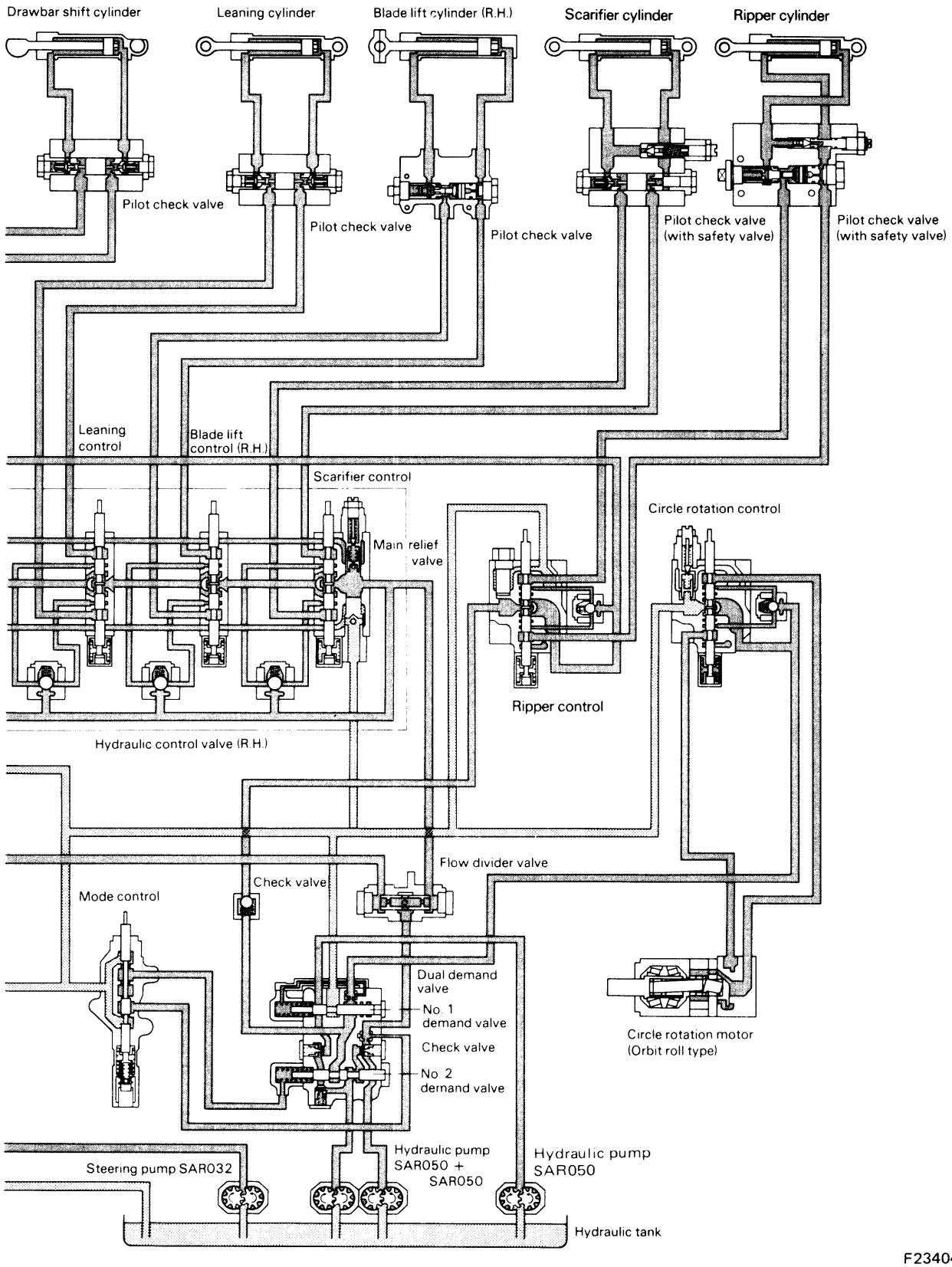

Leaning cylinder
Blade lift cylinder (R.H.)
Ripper cylinder
Circle rotation motor
Main relief valve Set pressure: 175 kg/cm²
Main relief valve Set pressure: 176 kg/cm²
Leaning
Blade lift (R.H.)
Ripper
Circle rotation
R.H. hydraulic control valve
Flow divider valve
Mode control valve
Dual demand valve
No. 1 demand valve
No. 2 demand valve
Hydraulic pump (SAR050 + 050) 138 ℓ/min (at 3000 rpm)
Hydraulic pump (SAR050) 138 ℓ/min (at 3000 rpm)
Steering pump (SAR032) 72 ℓ/min (at 3000 rpm)
Hydraulic oil filter

F23404058

HYDRAULIC SYSTEM DIAGRAM

GD705A-4 (Serial No. 31001 and up)

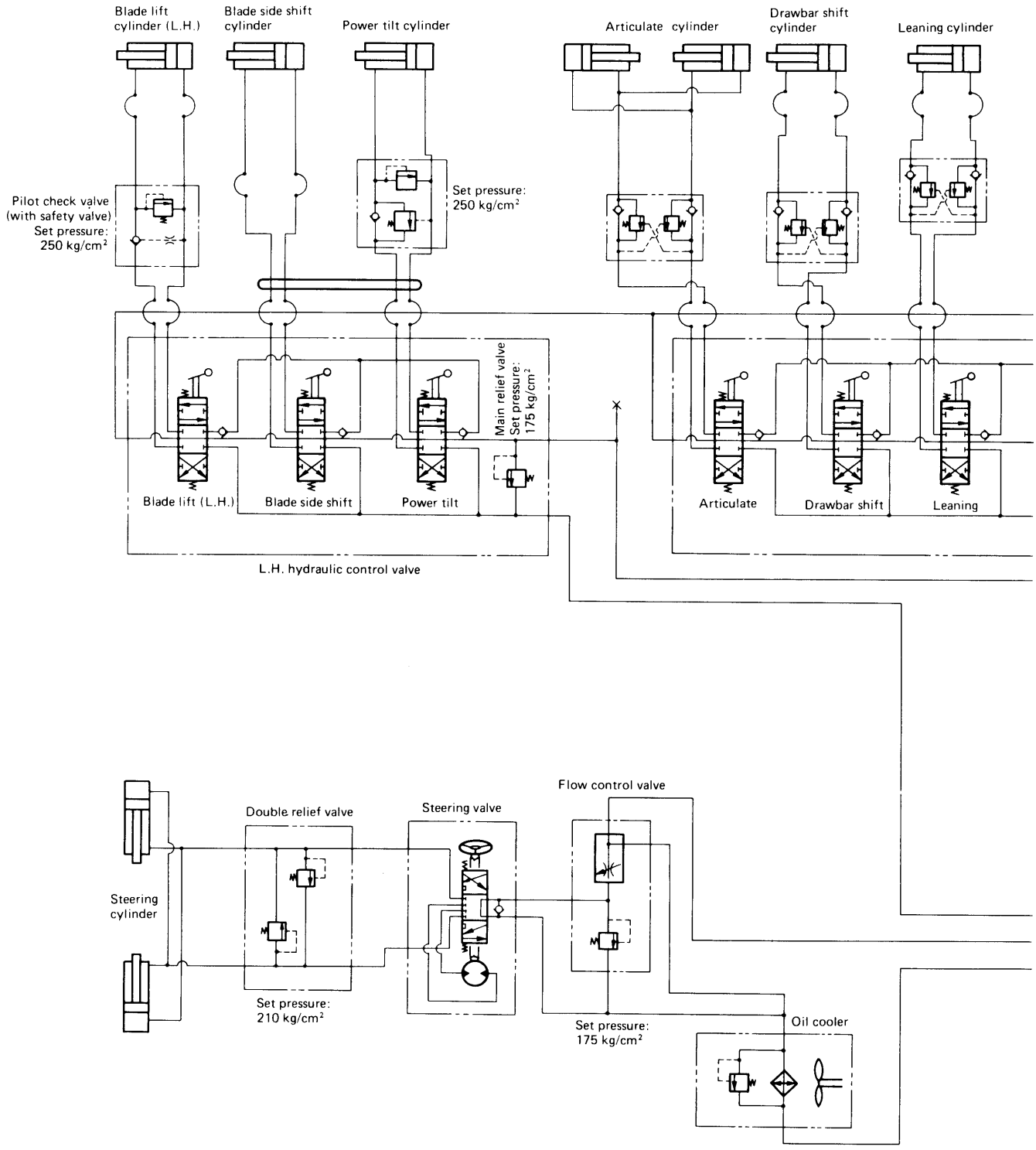


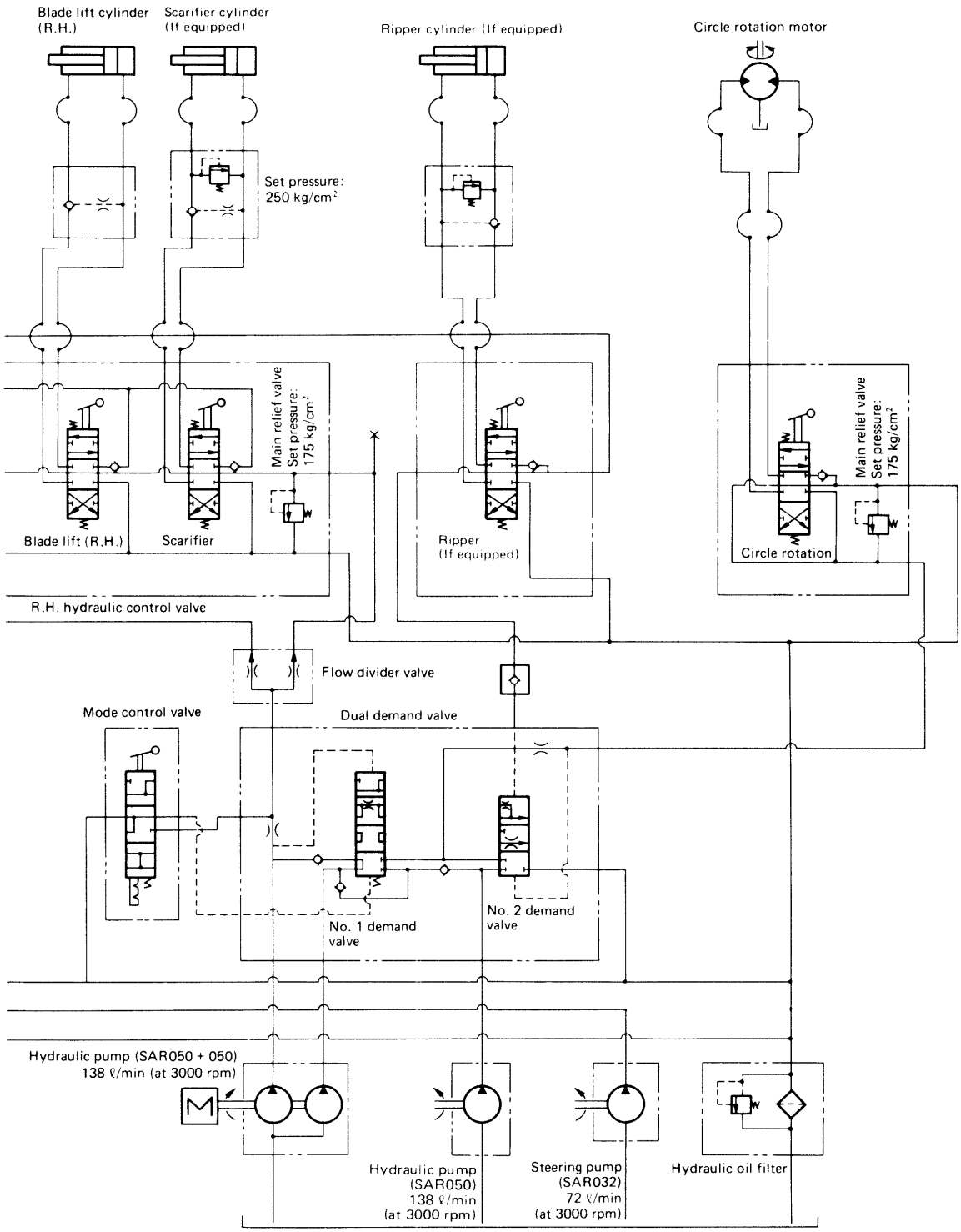

Drawbar shift cylinder
Leaning cylinder
Blade lift cylinder (R.H.)
Scarifier cylinder
Ripper cylinder
Pilot check valve
Pilot check valve
Pilot check valve
Pilot check valve (with safety valve)
Pilot check valve (with safety valve)
Leaning control
Blade lift control (R.H.)
Scarifier control
Main relief valve
Circle rotation control
Ripper control
Hydraulic control valve (R.H.)
Flow divider valve
Check valve
Mode control
Dual demand valve
No. 1 demand valve
Check valve
No. 2 demand valve
Circle rotation motor (Orbit roll type)
Steering pump SAR032
Hydraulic pump SAR050 + SAR050
Hydraulic pump SAR050
Hydraulic tank

F23404057A

HYDRAULIC CIRCUIT DIAGRAM

GD705A-4 (Serial No. 31001 and up)



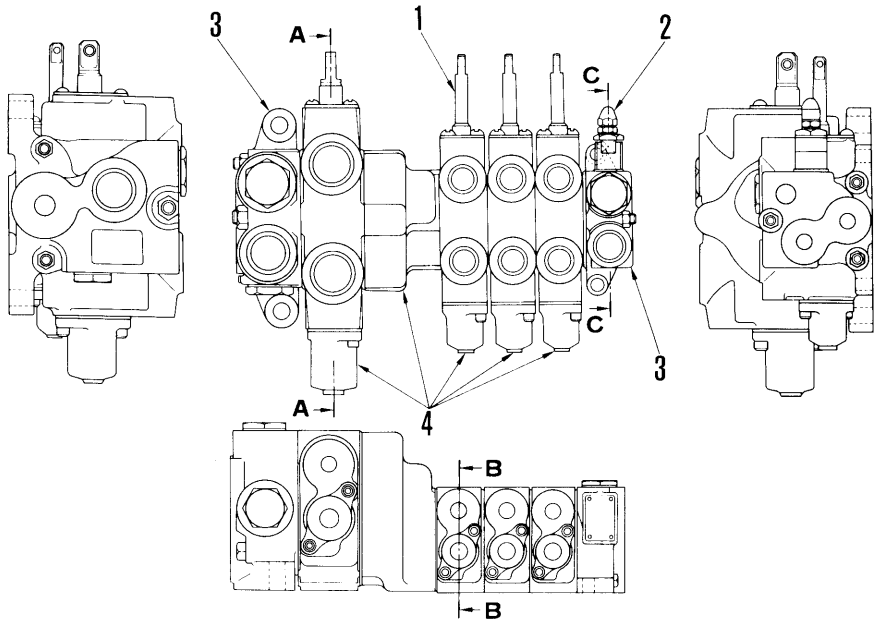

Blade lift cylinder (R.H.)
Scarifier cylinder (If equipped)
Ripper cylinder (If equipped)
Circle rotation motor
Set pressure: 250 kg/cm²
Main relief valve Set pressure: 175 kg/cm²
Blade lift (R.H.)
Scarifier
Ripper (If equipped)
Circle rotation
R.H. hydraulic control valve
Flow divider valve
Mode control valve
Dual demand valve
No. 1 demand valve
No. 2 demand valve
Hydraulic pump (SAR050 + 050) 138 ℓ/min (at 3000 rpm)
Hydraulic pump (SAR050) 138 ℓ/min (at 3000 rpm)
Steering pump (SAR032) 72 ℓ/min (at 3000 rpm)
Hydraulic oil filter

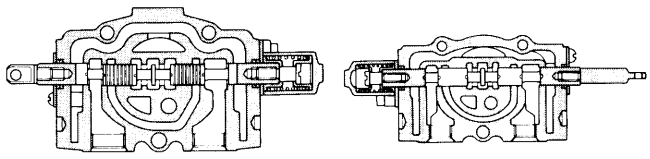
F23404060

HYDRAULIC CONTROL VALVE

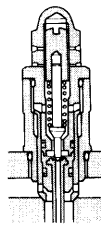
GD705R-4

1. Left hand valve
Drawbar shift, Circle rotation, Scarifier (If equipped), and Blade lift (L.H.)




Section A – A

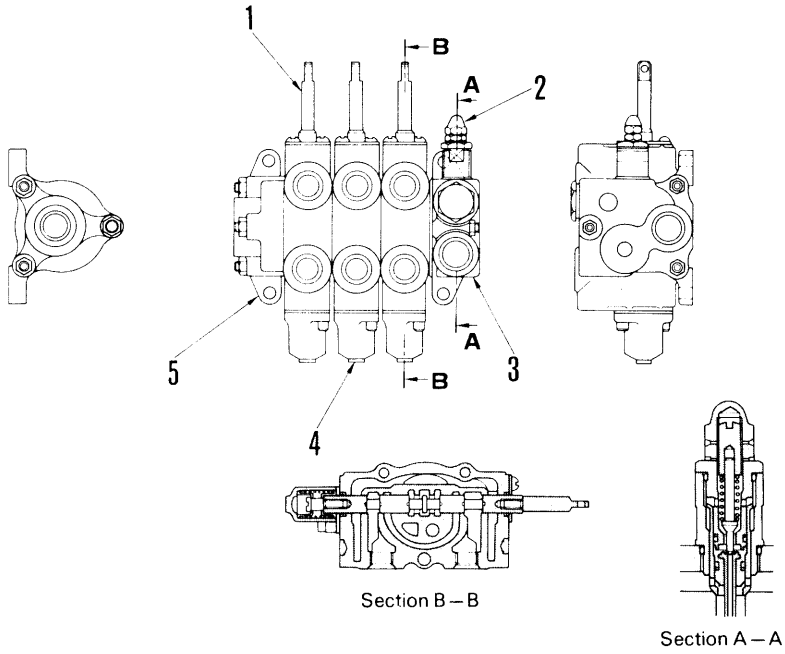
Section B – B


Section C – C

F23E04049

1. Spool
2. Main relief valve
3. Inlet section valve
4. Spool section valve

2. Right hand valve
Blade lift (R.H.) Leaning, and Blade side shift



F23E04050

1. Spool
2. Main relief valve
3. Inlet section valve
4. Spool section valve
5. Outlet section valve

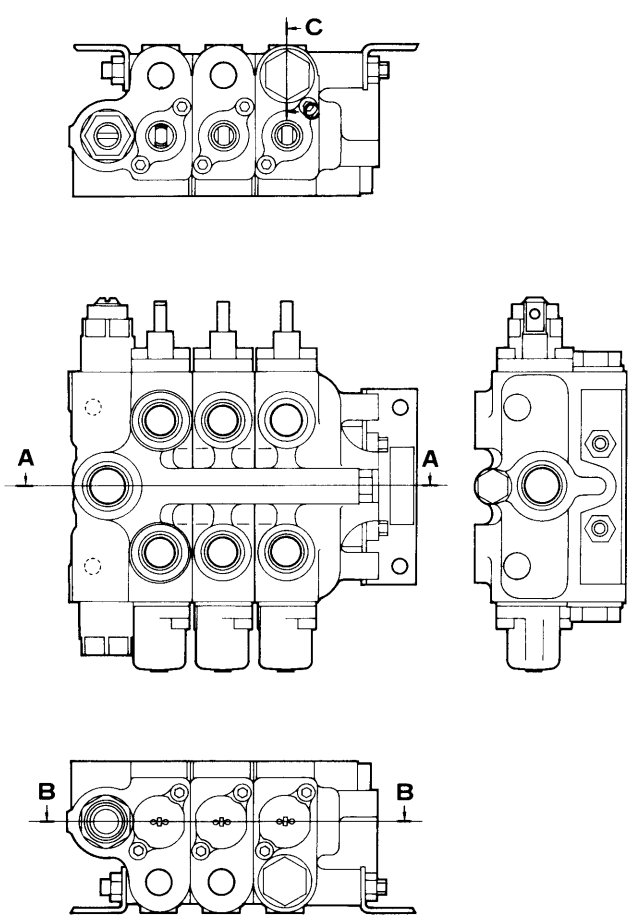
HYDRAULIC CONTROL VALVE

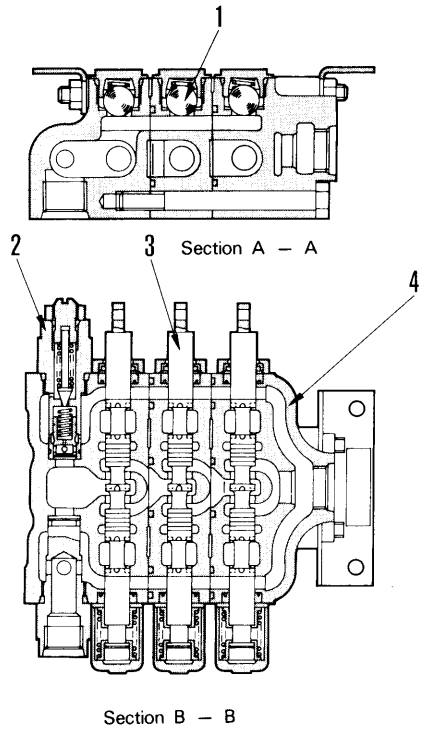
GD705A-4

1. 3-SPOOL VALVE

Left hand valve

- Blade lift (L.H.), Drawbar shift and Articulate (Serial No. 21001 and up)
- Blade lift (L.H.), Blade side shift and Power tilt (Serial No. 31001 and up)





F23AB205

1. Check valve
2. Main relief valve
3. Spool
4. Body

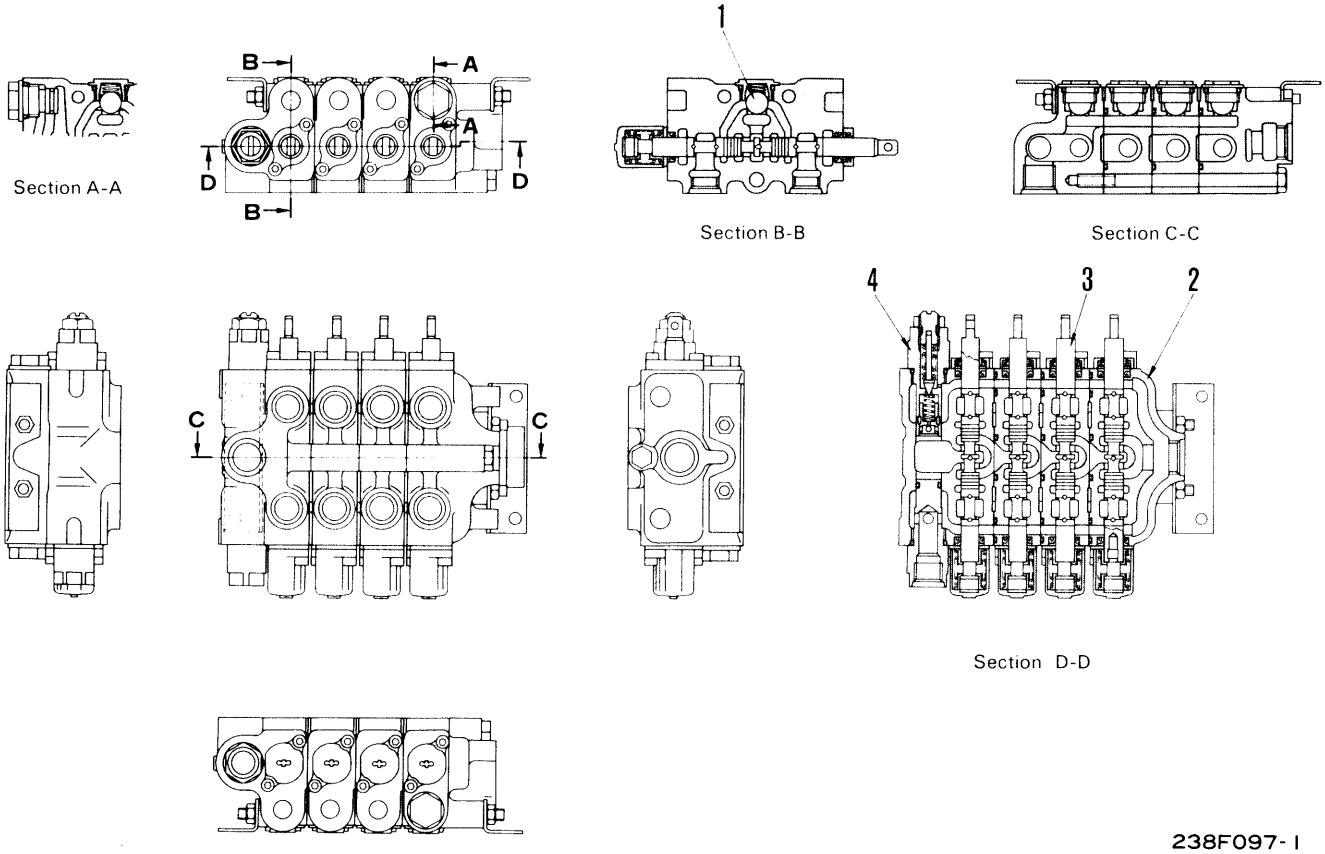
2. 4-SPOOL VALVE

Right hand valve

- Blade lift (R.H.), Leaning, Power tilt and Blade side shift (Serial No. 21001 and up)
- Blade lift (R.H.), Leaning, Drawbar shift and Articulate (Serial No. 31001 and up)

Left hand valve (If equipped)

- Scarifier, Blade lift (L.H.), Drawbar shift and Articulate (Serial No. 21001 and up)



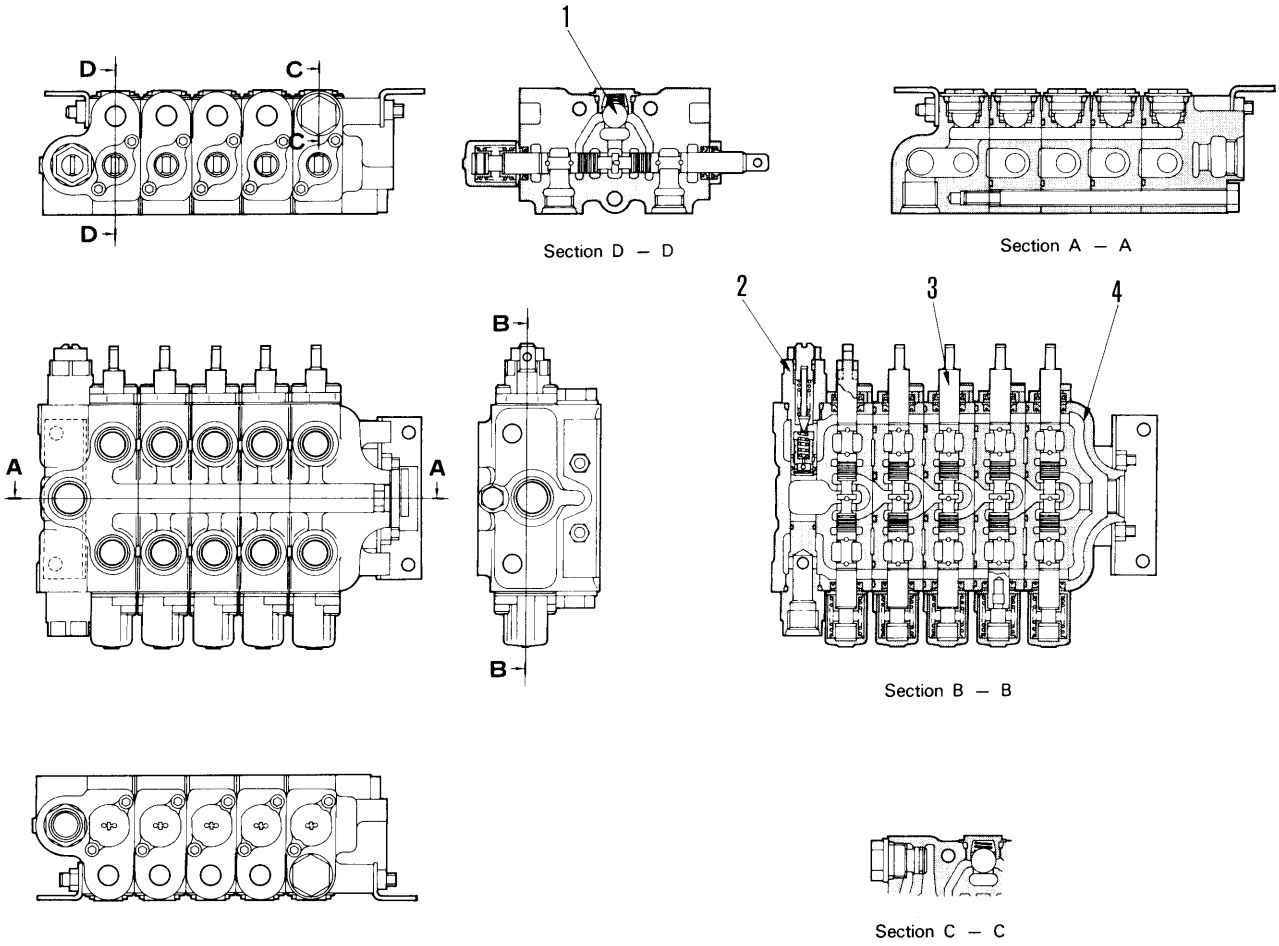
238F097-1

1. Check valve
2. Main relief valve
3. Spool
4. Body

3. 5-SPOOL VALVE

Right hand valve (If equipped)

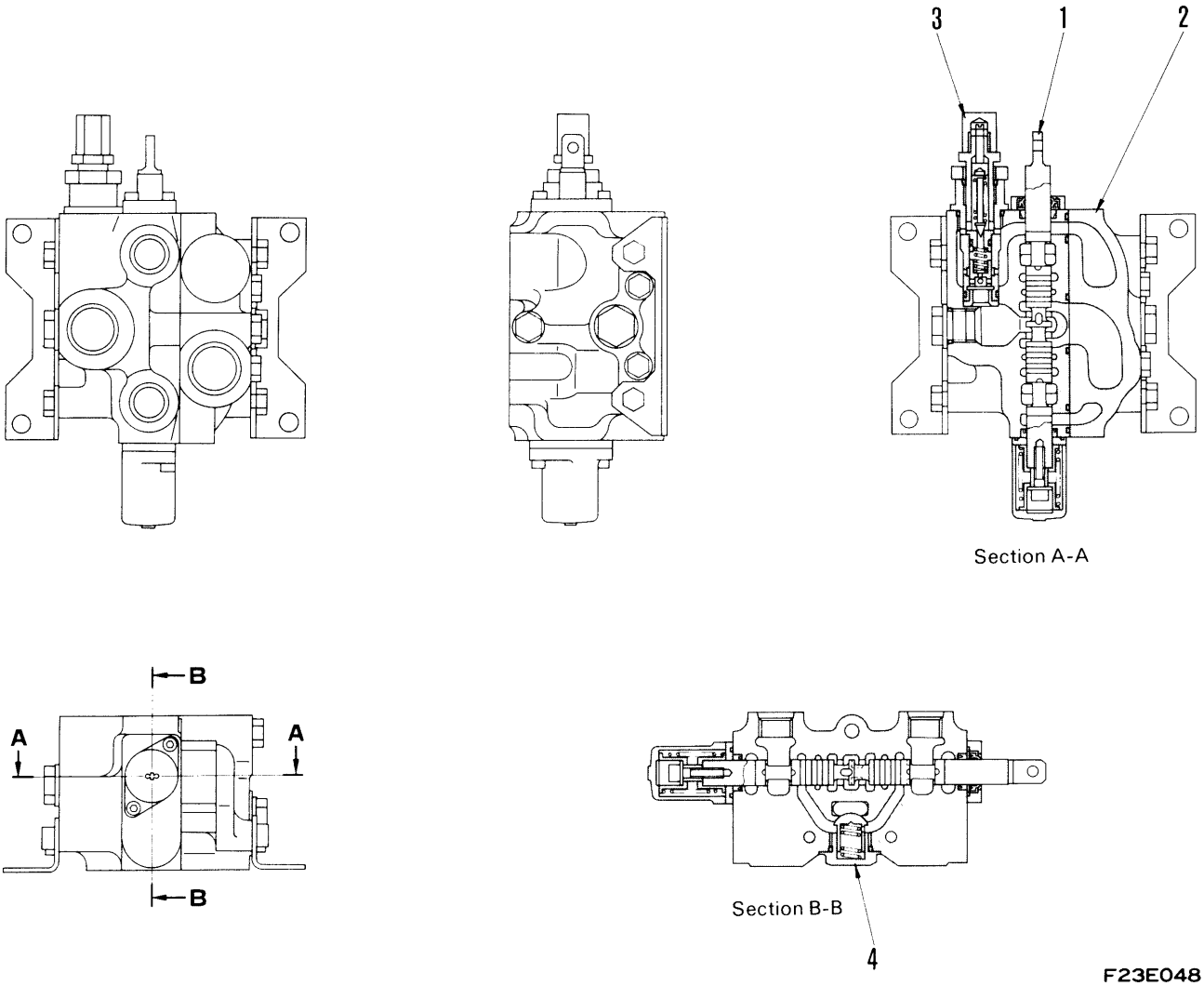
- Blade lift (R.H.), Leaning, Drawbar shift, Articulate and Scarifier (Serial No. 31001 and up)



F23AB206

1. Check valve
2. Main relief valve
3. Spool
4. Body

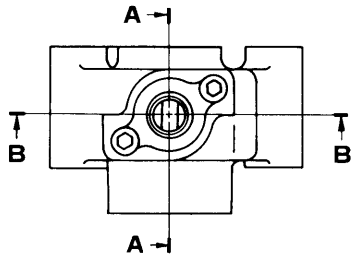
4. CIRCLE ROTATION

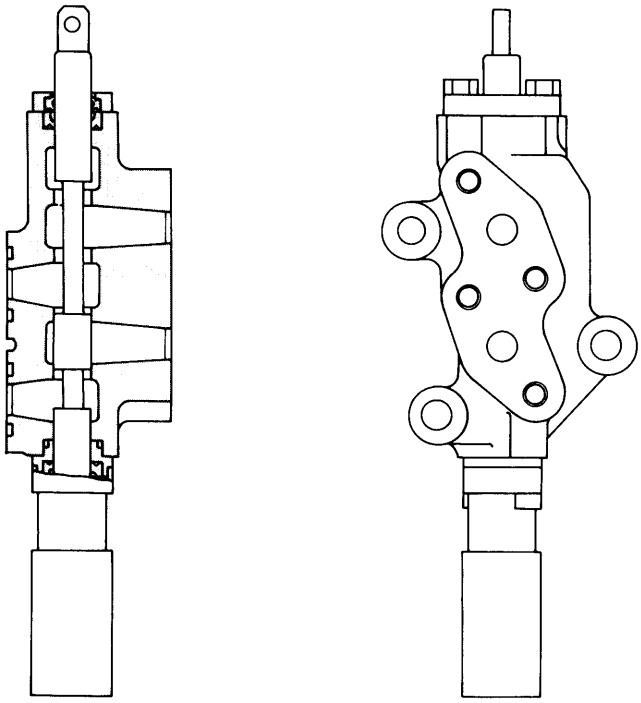


F23E048

1. Spool
2. Body
3. Main relief valve
4. Check valve

5. MODE CONTROL

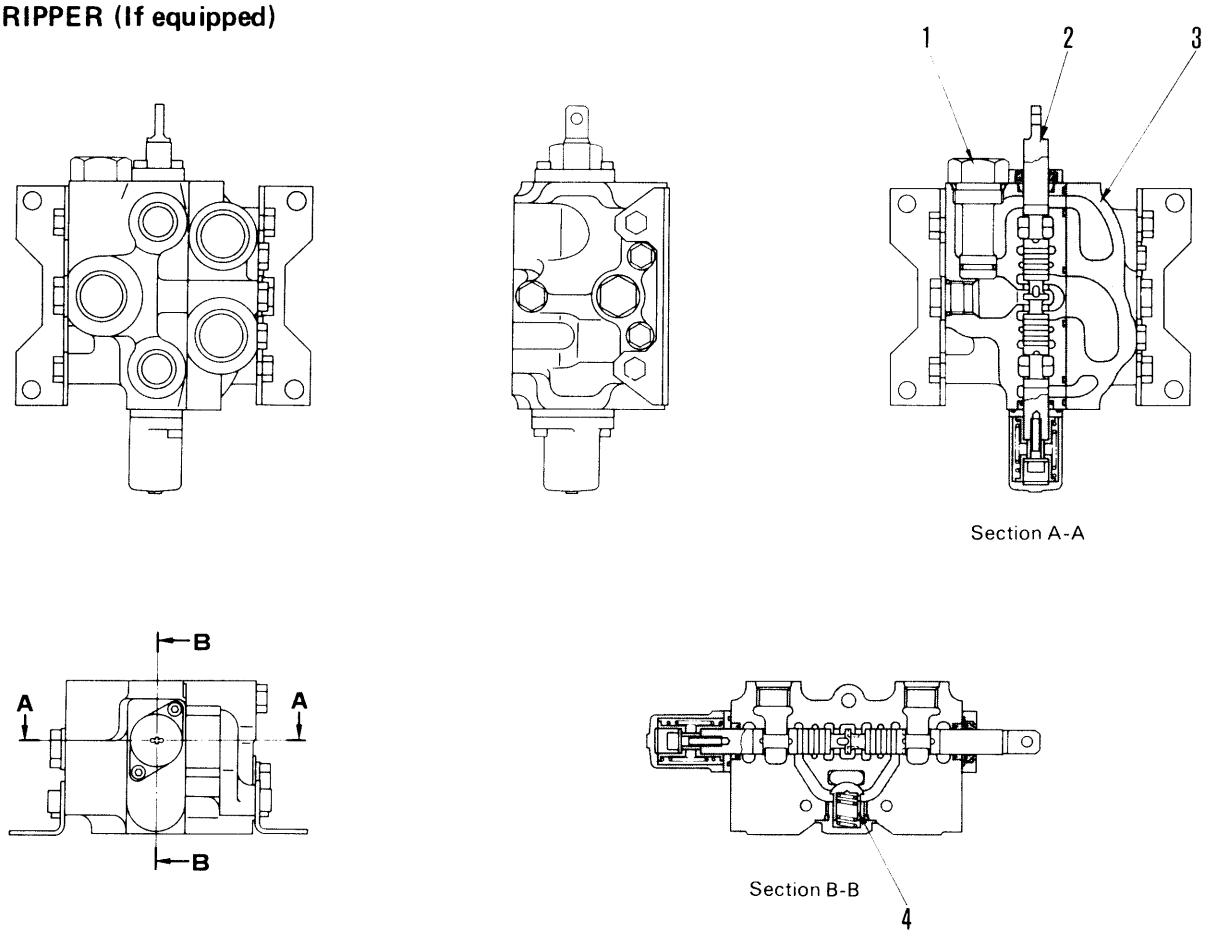




F23E049

1. Cover
2. Valve body
3. Spool
4. Spacer
5. Retainer
6. Spring
7. Plug
8. Retainer
9. Detent ball
10. Plug
11. Plug
12. Detent ball
13. Detent
14. Detent spring
15. Case

6. RIPPER (If equipped)



F23E050

1. Plug
2. Spool
3. Body
4. Check valve

GENERAL

The control valves control the hydraulic cylinders in the hydraulic equipment. In order to control the motion of the hydraulic cylinders, these control valves control the pressure, direction, and flow of the oil fed from the hydraulic pump.

For this purpose, the control valves consist of a main valve (direction changeover valve), a main relief valve, and a check valve, according to their functions.

Main valve (Direction changeover valve)

The main valve selects the oil circuit when a hydraulic cylinder is operated. It consists mainly of the valve body and spool. This valve selects the path of the oil flow by using the reciprocating motion of the spool in the valve body. It also controls the oil flow by gradually opening the spool.

Main relief valve (pressure regulating valve)

The main relief valve is mounted between the hydraulic pump and the main vlave.

When the hydraulic pressure reaches a certain value, the relief valve automatically opens to limit the hydraulic pressure, so that the hydraulic pressure cannot rise further.

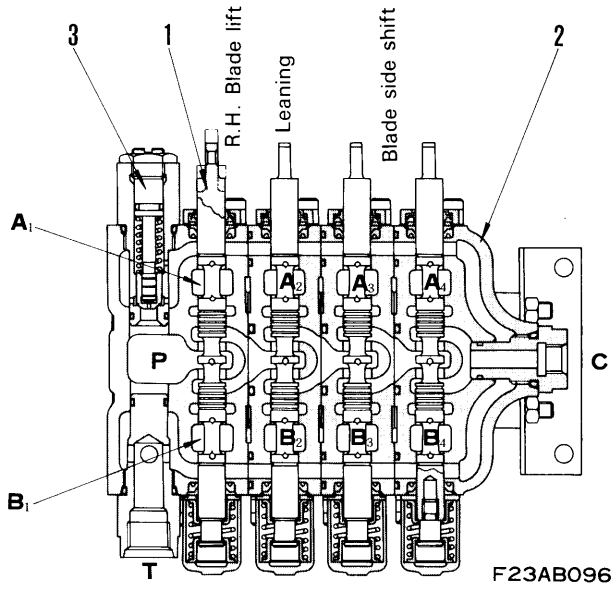
Check valve

The check valve is mounted at the inlet of the main valve. If the cylinder is lifted when the engine is stopped, or if the cylinder is loaded, this valve operates so that oil flows from the pump to the cylinder without allowing it to return from the cylinder to the pump or tank. In other words, oil flows in one direction only.

MAIN VALVE

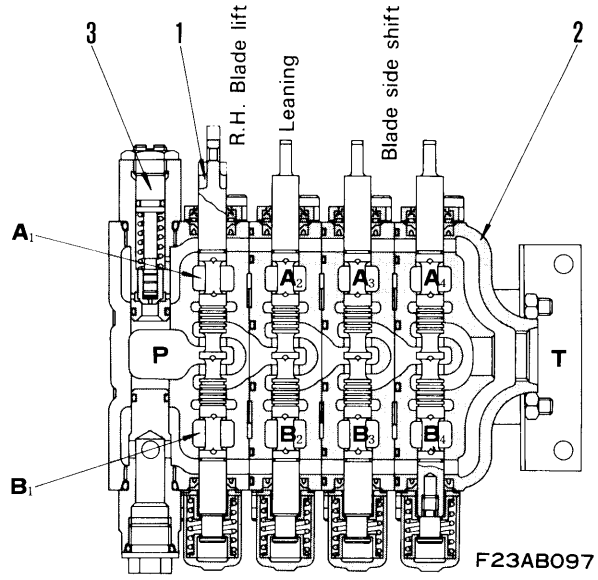
OPERATION

1. **When the spool is set to NEUTRAL**
   The oil from the pump flows into the operation valve from port **P**. Since ports A_1, A_2, A_3, A_4, B_1, B_2, B_3, and B_4 are connected to the actuator and are shut off by the spool, oil fed from port **P** returns to the hydraulic oil tank both from the R.H. valve and the carry-over port **C**, as well as from the L.H. valve and the tank port **T** via the confluent valve.

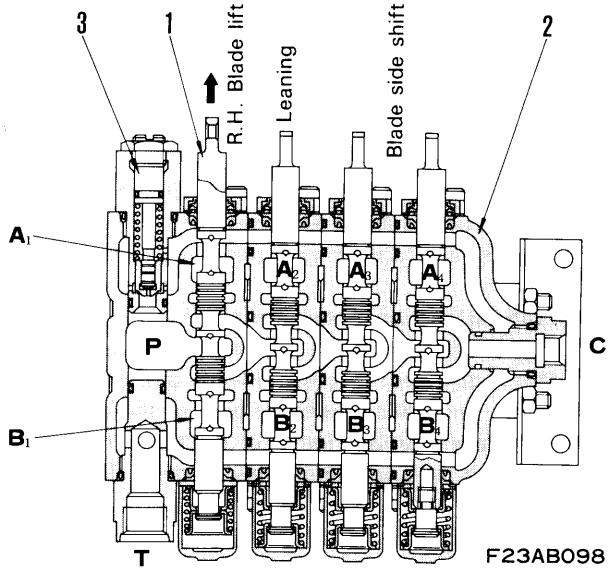


F23AB096

2. **When the spool operates**
   The flow passage connected to the carry-over port **C** (or tank port) is shut off, while port A_1 and B_1 are open.
   The hydraulic oil fed from port **P** opens check valve (4), and flows from port B_1 to the actuator.
   The return oil from the actuator is fed into port A_1, and then it returns to the tank from port **T**.
   In order to ensure fine controllability, ports A_1, **P**, and B_1 are designed to communicate with each other at the start of the spool stroke. If a high retention pressure acts on port A_1 or B_1, the oil at the port reverses and flows into the other port, so that the actuator functions normally only after moving slightly opposite to the intended direction. In order to prevent this phenomenon, a check valve (a) is mounted in each block.



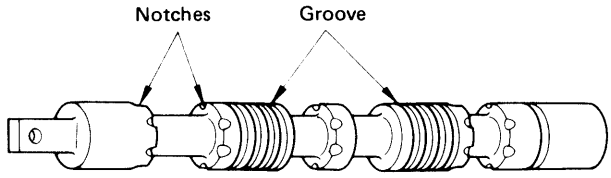
F23AB097



F23AB098

PERFORMANCE

The performance of the operation lever is improved by cutting notches and grooves in the main valve spool.



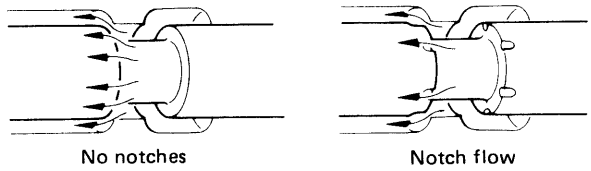
230F152

Fine control

Minor changes in the oil flow rate can be achieved by altering the spool stroke opening surface area during main valve spool operations. This ability to effect minor changes in flow rate is called FINE CONTROL.

If a spool without appropriate notches is operated by fine control, a large quantity of oil will flow when the port is opened, resulting in sudden jerking movement when starting or stopping the work equipment.

With proper notches in the spool, however, the flow rate can be controlled.



230F153

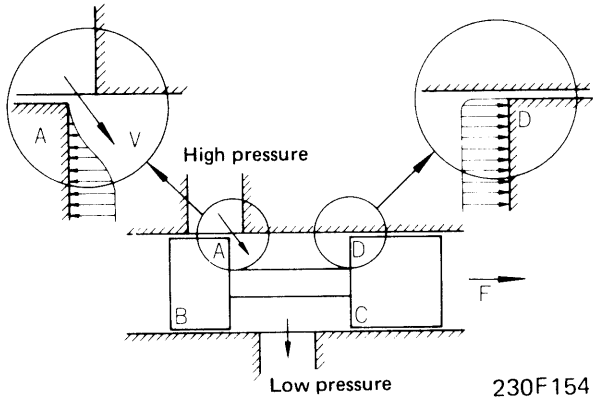
Flow force

When oil flows from the high pressure side to the low pressure side in the spool shown in the diagram at right, the gap betwen the valve body and the spool is restricted, resuling in increased flow at that section.

This increased oil flow rate results in a drop in pressure at that section, which means the pressure at **AB** is lower than at **CD**. This creates force **F** which acts in a direction to close the spool circuit.

This force is called the FLOW FORCE, and the action of this force effects the force required to operate the spool, making smooth operation more difficult, and even impeding automatic spool return after operation.

To minimize the effects of this force, notches are formed as shown in the diagram at right, resulting in the oil flow passing out at a suitable angle.



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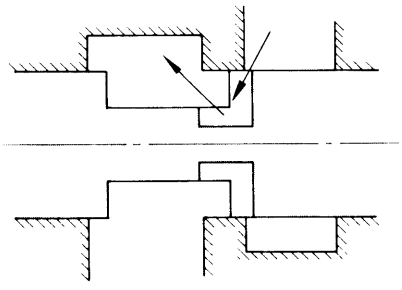


230F155

Hydraulic lock

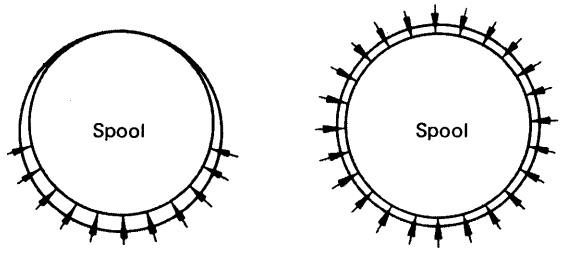
The main valve spool has a tendency to become stuck at higher hydraulic pressures, making it very difficult to operate the spool, or even making manual operation impossible. This is referred to as HYDRAULIC LOCK.

The following factor is considered to be the cause of hydraulic lock.

Although high pressure oil is cut off from other ports by contact between valve body and spool, oil is admitted through a very small gap between contact surfaces. Due to uneveness in the gap, or to the presence of grit, pressure differences are generated around the spool, resulting in the spool being pressed against the low pressure side (see diagram). The spool thus becomes stuck against the valve body.

To prevent hydraulic lock, grooves are cut around the outside of the spool, thereby enabling the oil in the gap between contact surfaces to flow around the spool through the grooves and thereby equalize the pressure on all sides and prevent the spool from sticking.

In addition to hydraulic lock, spool sticking can also be caused by grit biting into the spool (called dirt lock), or distortion in the valve body.

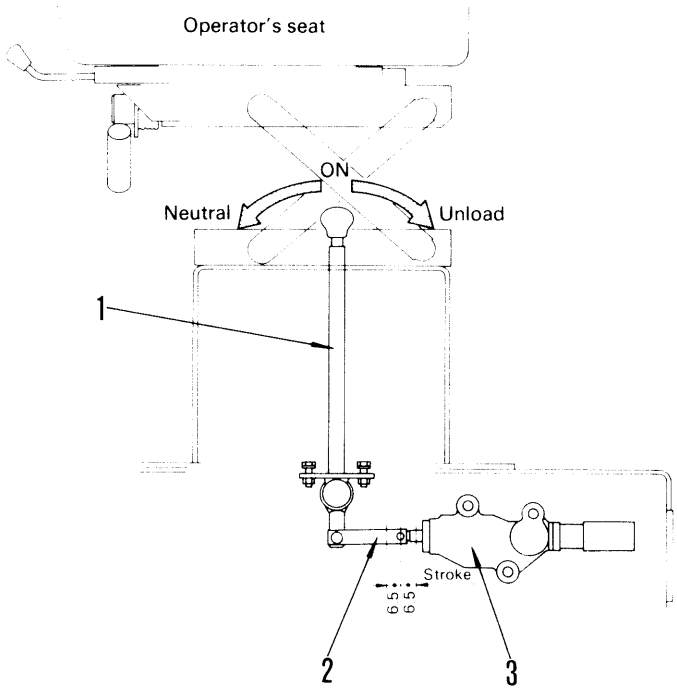


230F156

DDV (Dual Demand Valve)

GD705A-4

CIRCUIT DIAGRAM



F23E052

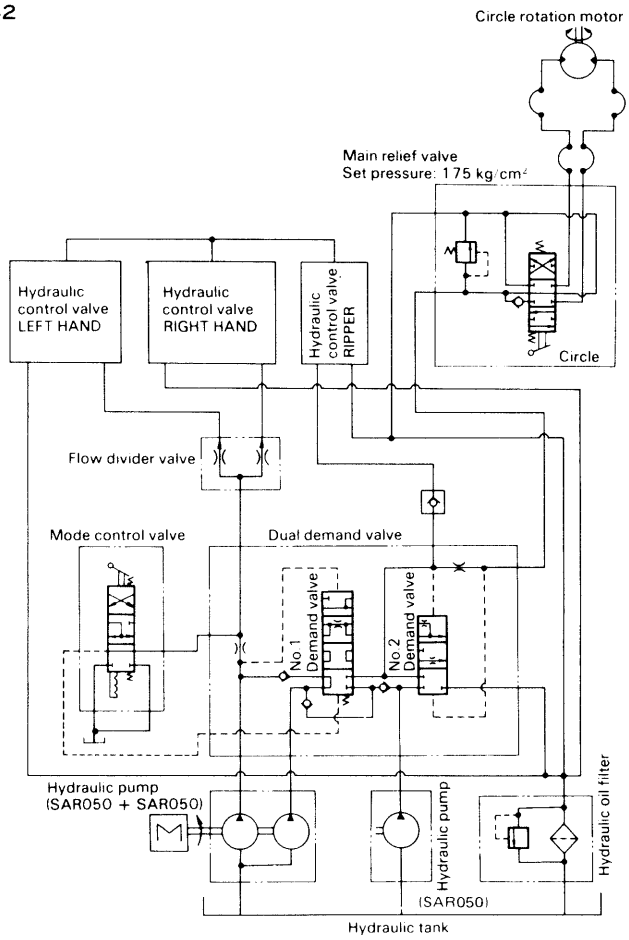
1. Lever
2. Rod
3. Mode control valve

The DDV (dual demand valve) consists of two demands valves.

The No. 1 demand valve, when in neutral, maintains the delivery from each pump at a constant level even if the engine speed is low. Because of this, even if the engine speed drops, the work equipment can be moved at the usual speed. For finishing operations, the selector valve can be set to the ON position to obtain a speed for the work equipment to match the machine speed.

The No. 2 demand valve sends a constant flow of oil to the circle control valve when the engine speed is midrange or above. Any unnecessary oil is unloaded. This prevents any increase in loss of power and in this way improves fuel consumption.

When starting in low temperatures, the selector valve can be set to the UNLOAD position. This improves the ease of starting by unloading the oil delivered by the pump without sending it through the work equipment valve.



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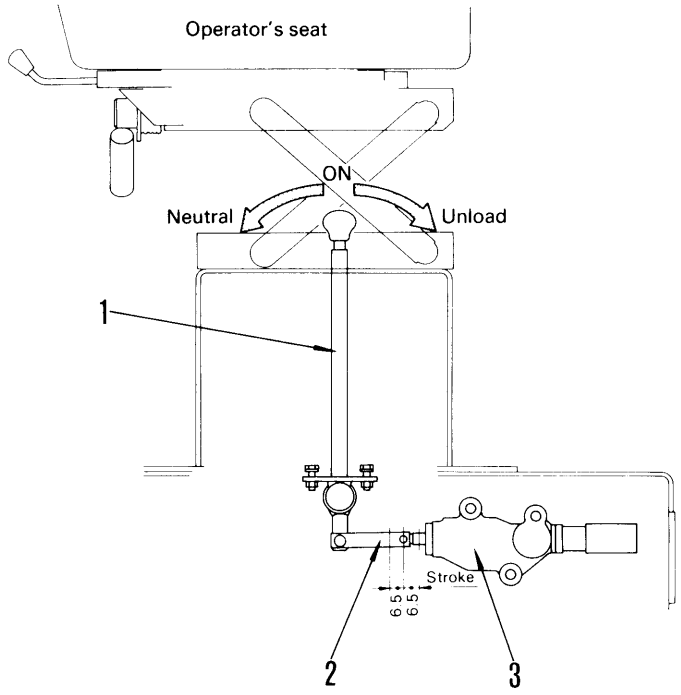
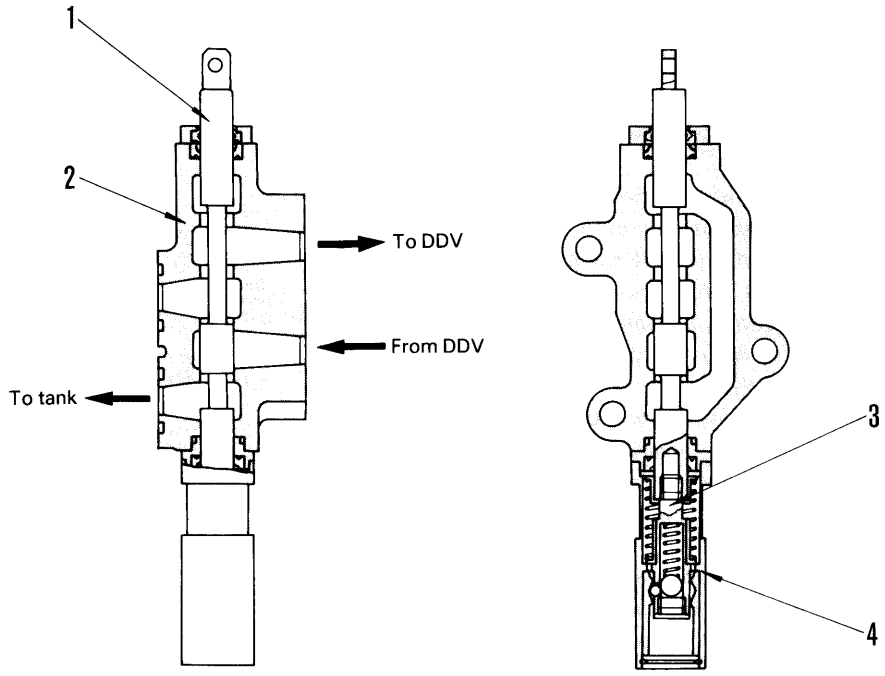
MODE CONTROL VALVE



1. Lever
2. Rod
3. Mode control valve

F23E052



F23E102

This valve acts to switch the DDV to its various positions: NEUTRAL, ON, UNLOAD.

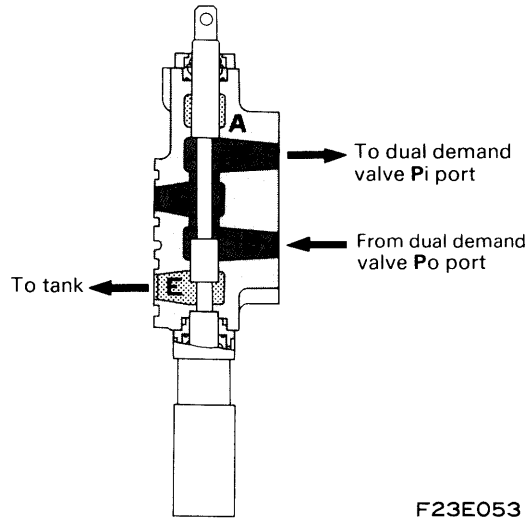
★ For details of the operation of the DDV (dual demand valve), see DDV (DUAL DEMAND VALVE).

1. Spool
2. Body
3. Screw
4. Cover

OPERATION

1. NEUTRAL

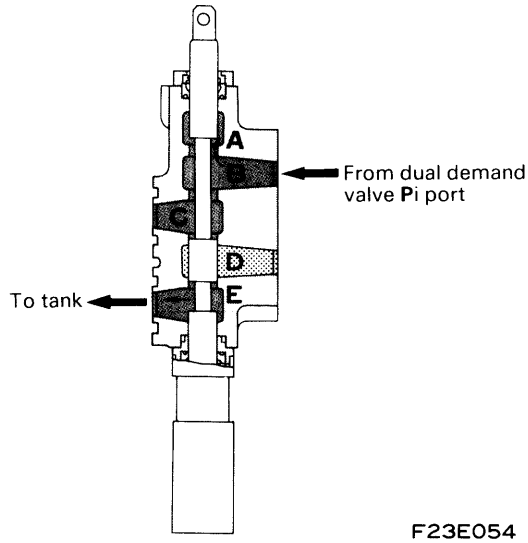
When the DDV lever is placed in the NEUTRAL position, the oil from DDV port Po enters chamber **D**. It then passes through chamber **C** and flows from chamber **B** to DDV port Pi.



F23E053

2. ON

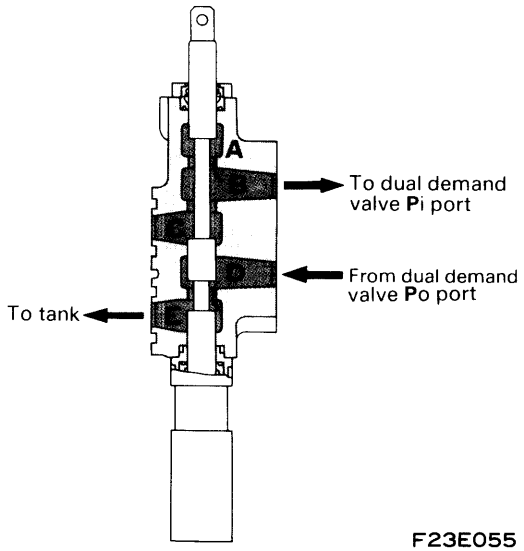
When the DDV lever is placed in the ON position, the oil from DDV port Pi enters chamber **B**. It then flows from chamber **A** through passage **F** to chamber **E** and is drained to the tank.



F23E054

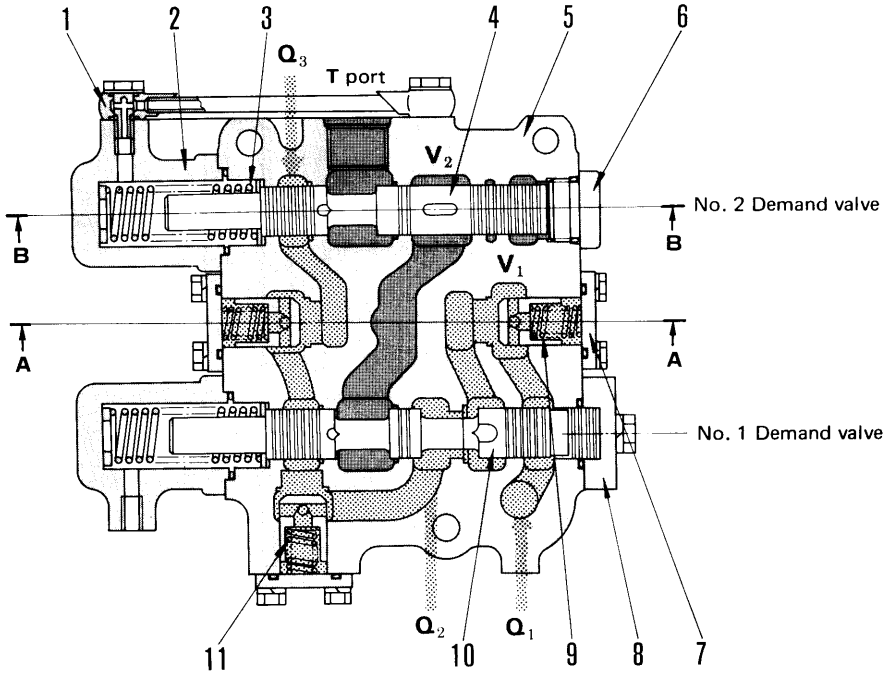
3. UNLOAD

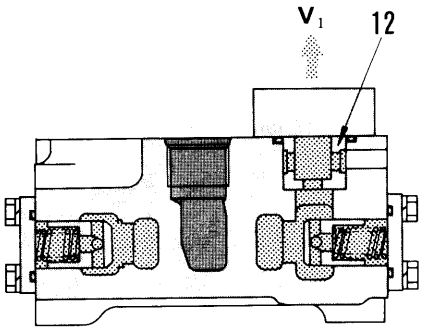
When the DDV lever is placed in the UNLOAD position, the oil from DDV port Po enters chamber **D**. It then divides into two oil flows. One passes through chamber **E**, passage **F**, chamber **A** and chamber **B** and goes to DDV port Pi. The other is drained from chamber **E** to the tank.



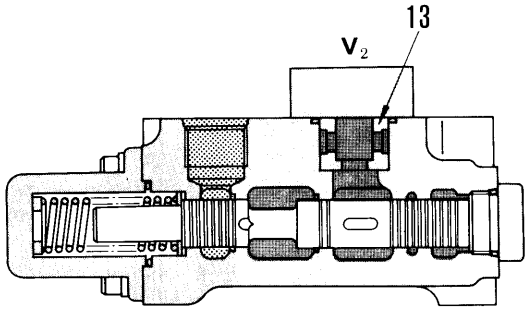
F23E055

DUAL DEMAND VALVE





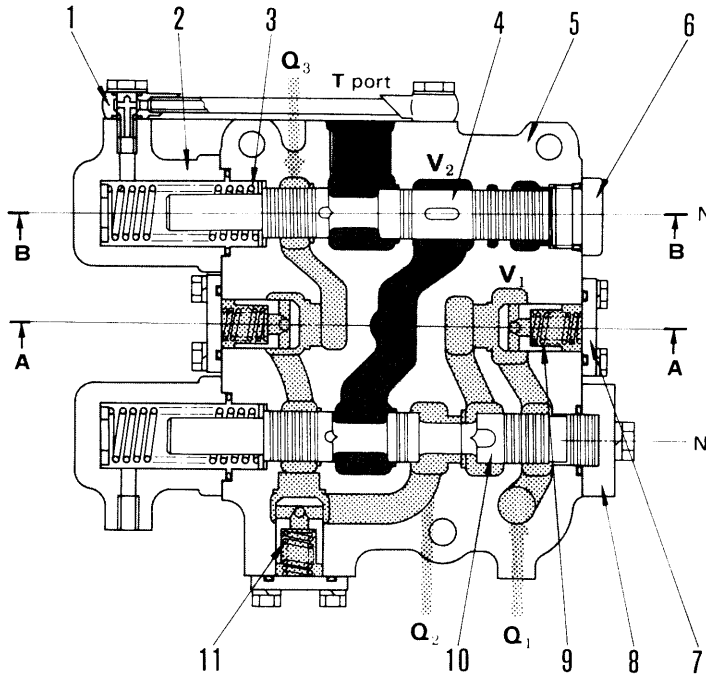
Section A-A



Section B-B

1. Pipe
2. Cover
3. Spring
4. Spool
5. Body
6. Plug
7. Cover
8. Cover
9. Spring
10. Spool
11. Spring
12. Plug (Orifice 1)
13. Plug (Orifice 2)

F23E056



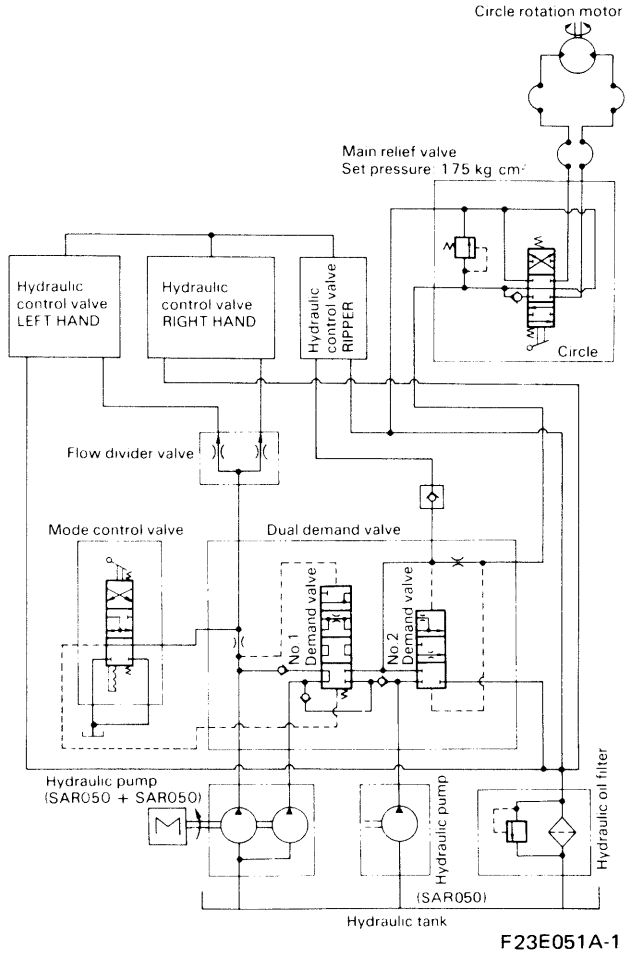
1. Pipe
2. Cover
3. Spring
4. Spool
5. Body
6. Plug
7. Cover
8. Cover
9. Spring
10. Spool
11. Spring

F23E057

OPERATION PRINCIPLES OF DDV26

The oil from the hydraulic tank is delivered to DDV26 from each pump (pumps 1, 2 and 3).

The DDV26 distributes the oil to the V_1 port (to L.H. and R.H. hydraulic control valve), V_2 port (to circle rotation control valve) and **T** port according to the engine speed.



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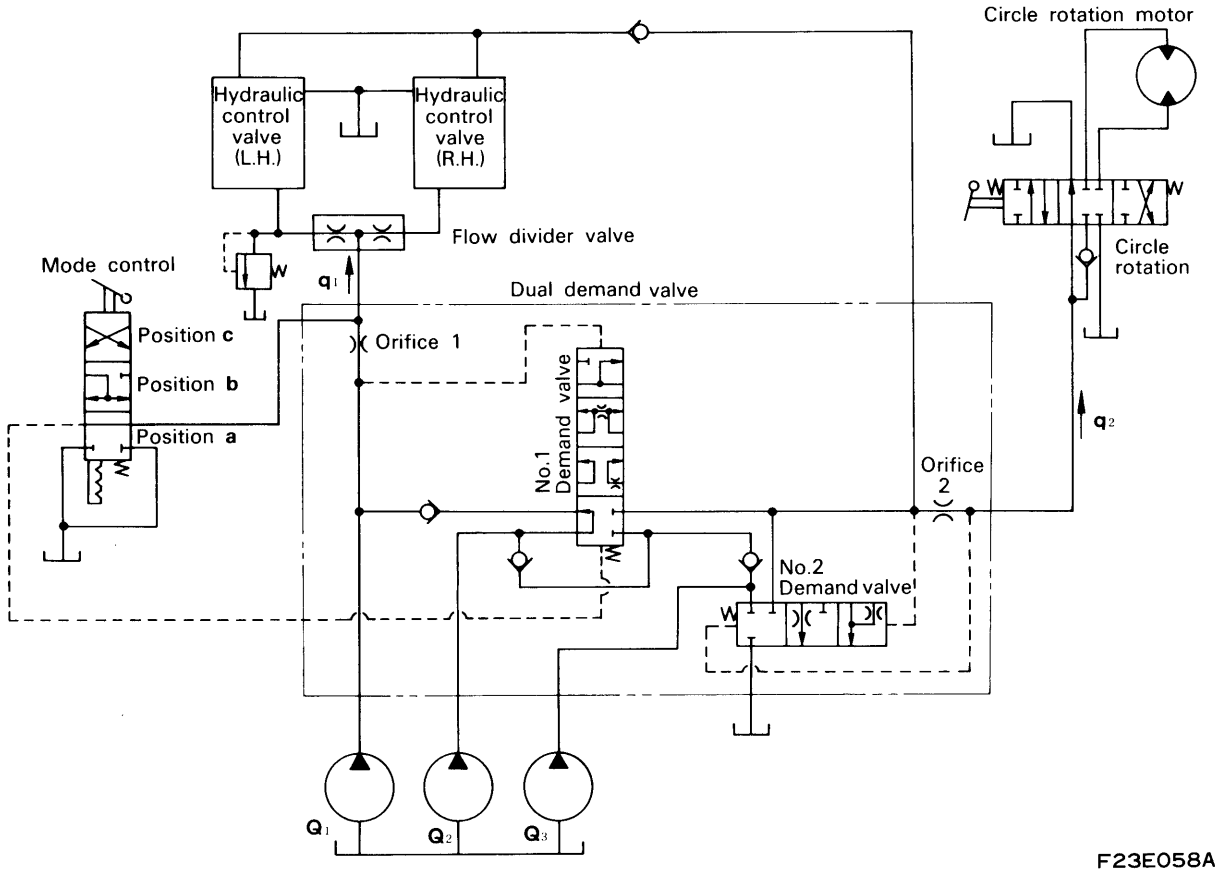


PRECONDITIONS

The explanation given so far assumes the control flow rates of the first and second demand valves to be **QA and QB**, respectively. In actuality, however, speeds N_1 through N_6 vary because of the flow control limits (illustrated) of the first and second demand valves.

PRINCIPLE OF OPERATION WHEN USED WITH MODE SELECTOR VALVE

Position a

See explanation of DDV26 operation principle, items 1 through 10.

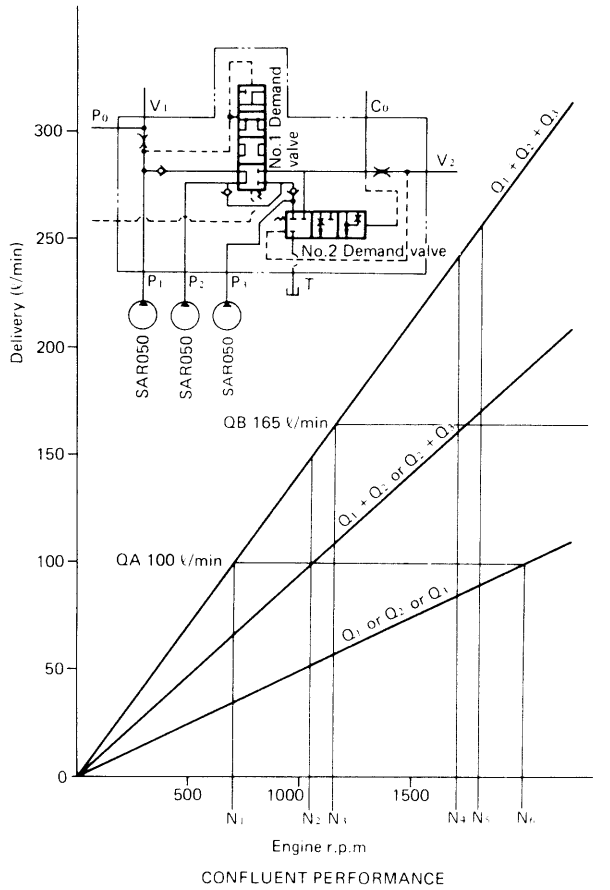
Position b

This position causes pump speed change in proportion to the engine speed.

Since the pump discharge varies in proportion to the travel speed as with the conventional grader, fine control at a low travel speed at the time of road surface finishing operation is possible. This position is advantageous in improving the finishing speed.

Position c

This position causes unloading of pump discharge P_1 through the mode selector valve. Since unloading of the oil from all pumps (P_1, P_2 and P_3) is carried out by-passing operation valves, the load at the time of engine starting is small, resulting in improvement of startability.



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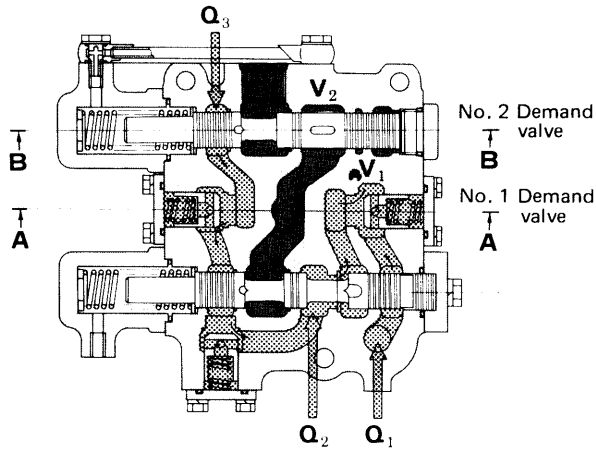
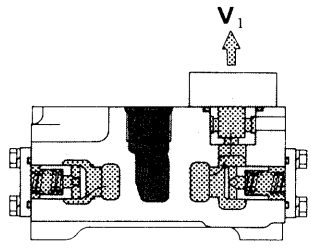
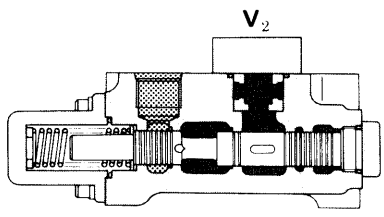




Section A-A

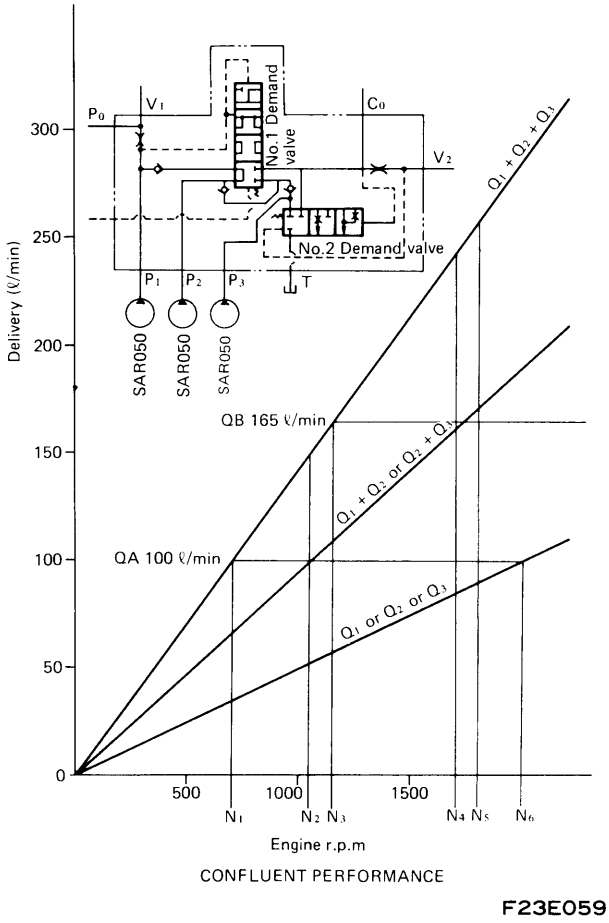


Section B-B

Distribution to each port is as follows:

1. **When the engine speed is N_1 or below: (Fig. 1)**
   The total volume of the oil from pumps 1, 2 and 3 flows to the V_1 port.

Fig. 1 F23E106



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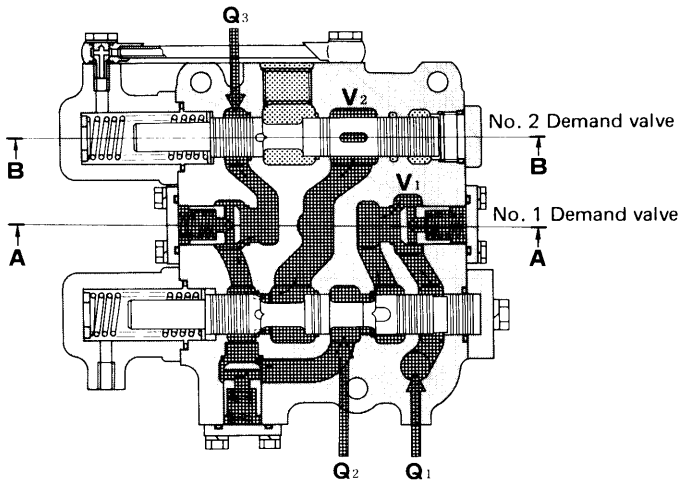
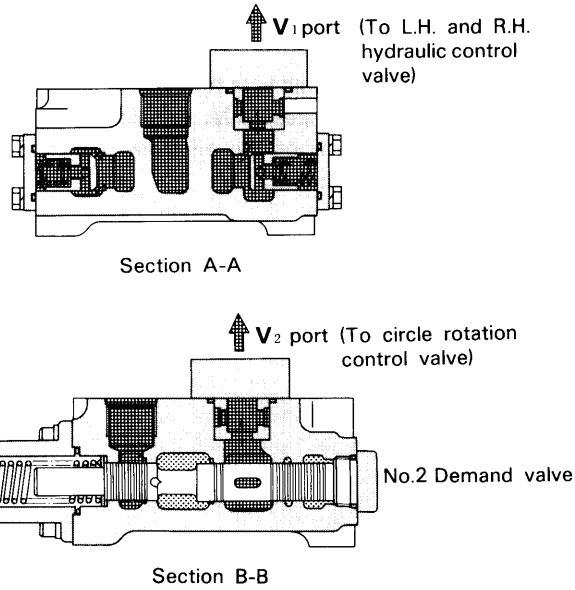
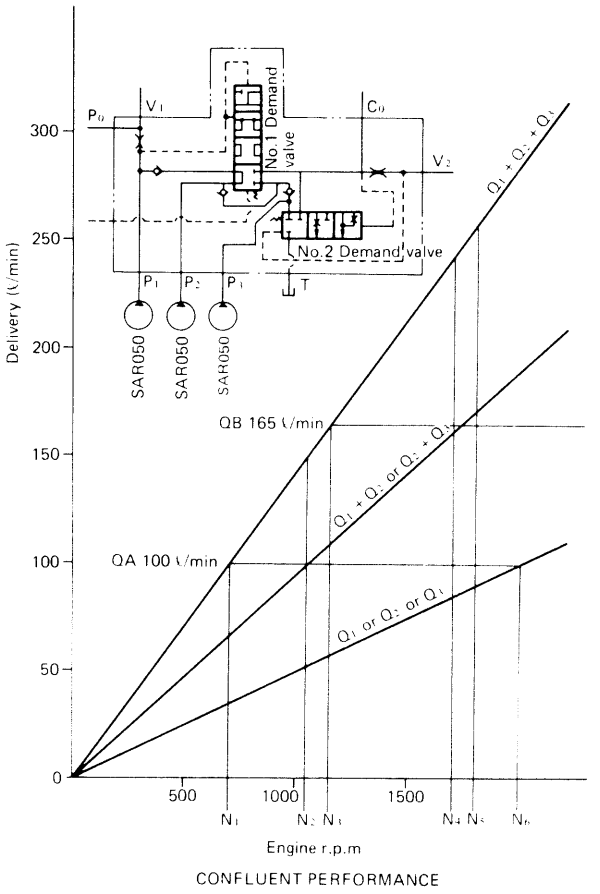


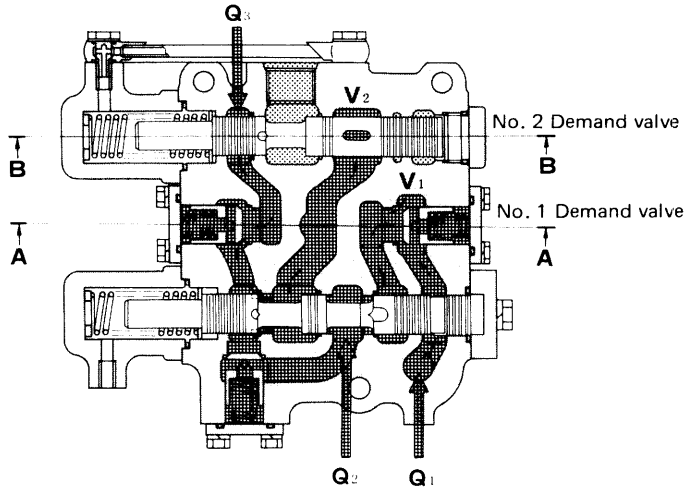


2. When the engine speed is from N_1 up to N_2: (Fig. 2)
The total volume of the oil from pumps 1 and 2 flows to the V_1 port. ΔQ ($Q_1 + Q_2 + Q_3 - QA$) out of the oil from pump 3 flows to the V_2 port.

Fig. 2 F23E060



F23E059



3. When the engine speed is N_2: (Fig. 3)

The toal volume of oil from pumps 1 and 2 flows to the V_1 port, and the total volume of oil discharged from pump 3 flows to the V_2 port.

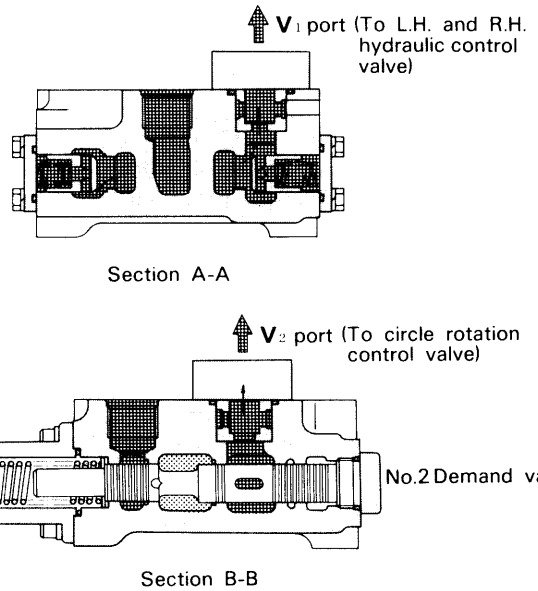
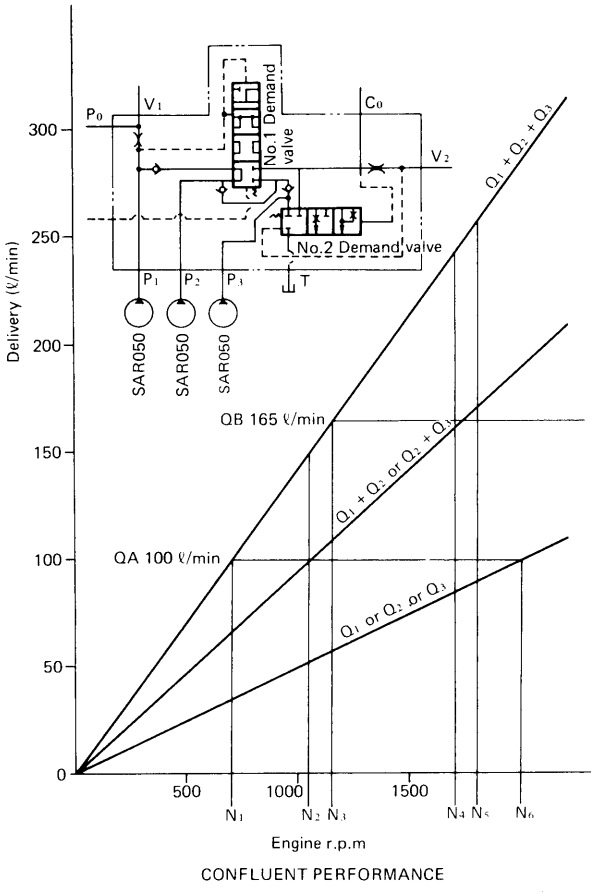


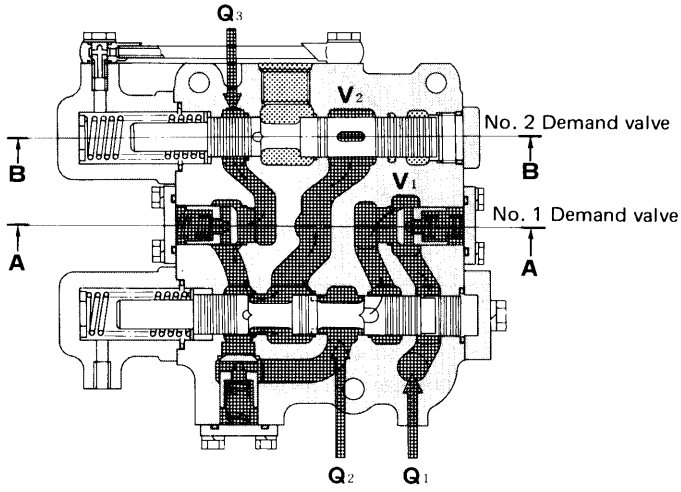
Fig. 3

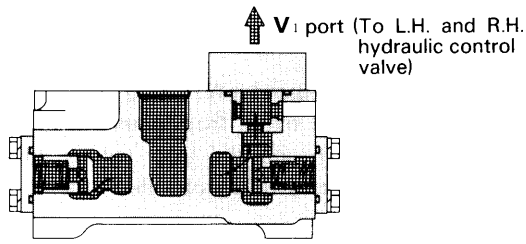
F23E061



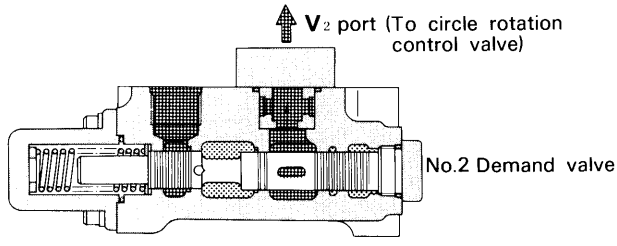
CONFLUENT PERFORMANCE

F23E059





Section A-A

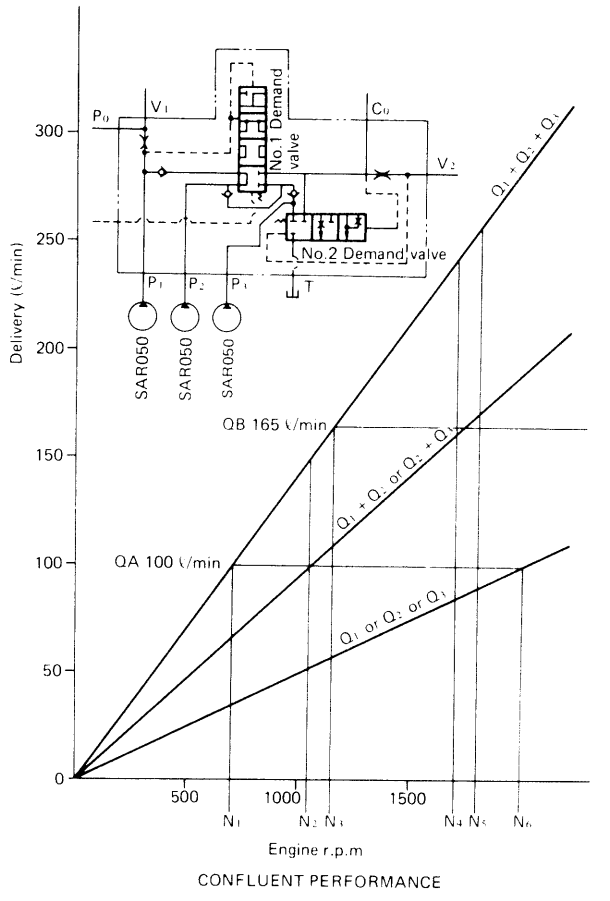


Section B-B

Fig. 4

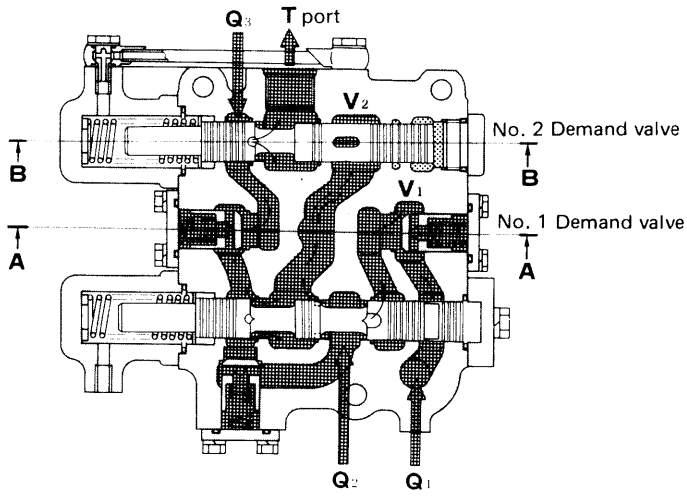
F23E062

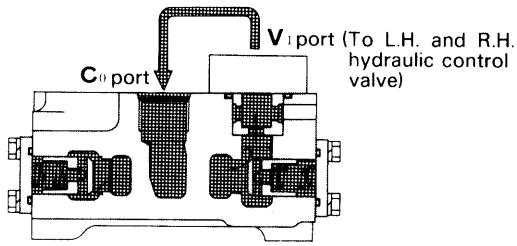
4. **When the engine speed is between N_2 and N_3 (Fig. 4)**
   The total volume of the oil from pump 1 and a part (**QA** − **Q_1**) of the oil from pump 2 flow to the **V_1** port. The total volume of oil from pump 3 and ΔQ (**Q_1** +**Q_2** − **QA**) out of the oil from pump 3 flows to the **V_2** port.



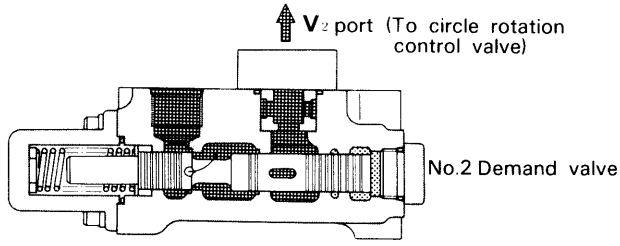
CONFLUENT PERFORMANCE

F23E059





Section A-A



Section B-B

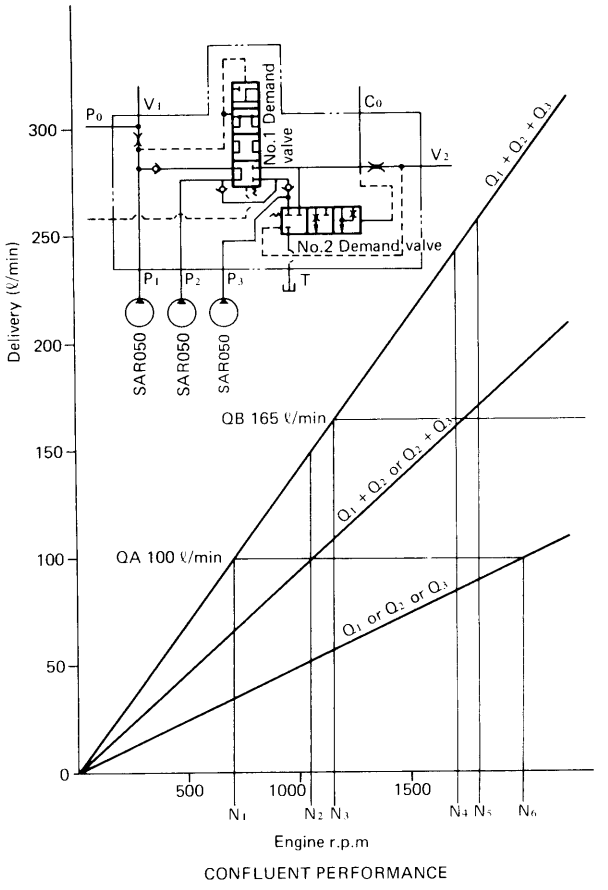
Fig. 5

F23E063

5. When the engine speed is between N_3 and N_4:

a. Same as item 4 when the oil flowing to the V_1 port is used.

b. When the oil flowing to the V_1 port is not used and is led to the **Co** port: (Fig. 5)
The total volume of the oil from pumps 1 and 2 and a part of the oil ($QB - Q_1 - Q_2$) from pump 3 flows to the V_2 port and ΔQ ($Q_1 + Q_2 + Q_3 - QB$) out of the oil from pump 3 flows to the **T** port (for unloading).



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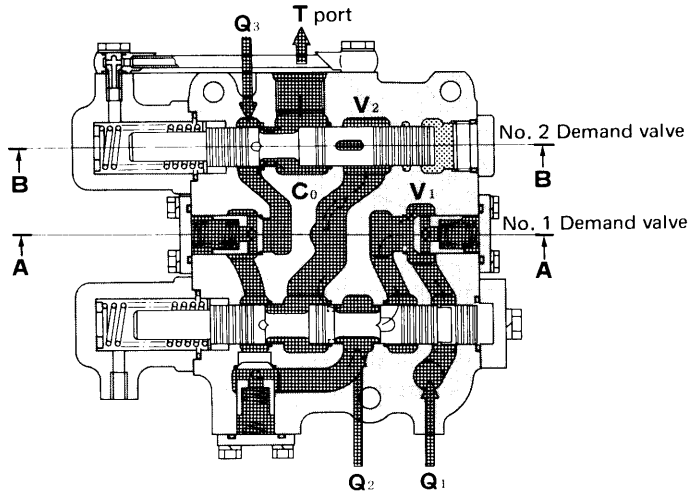
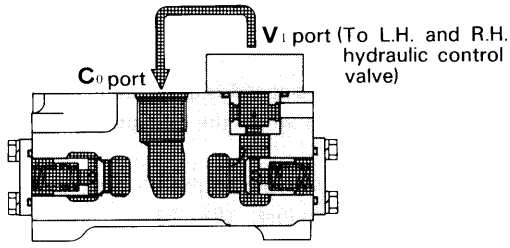
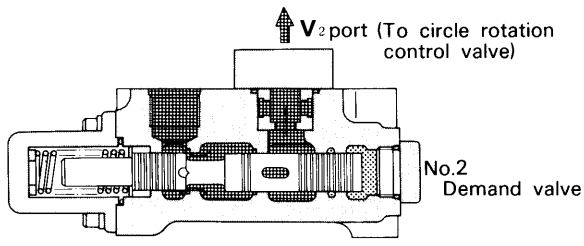




Section A-A



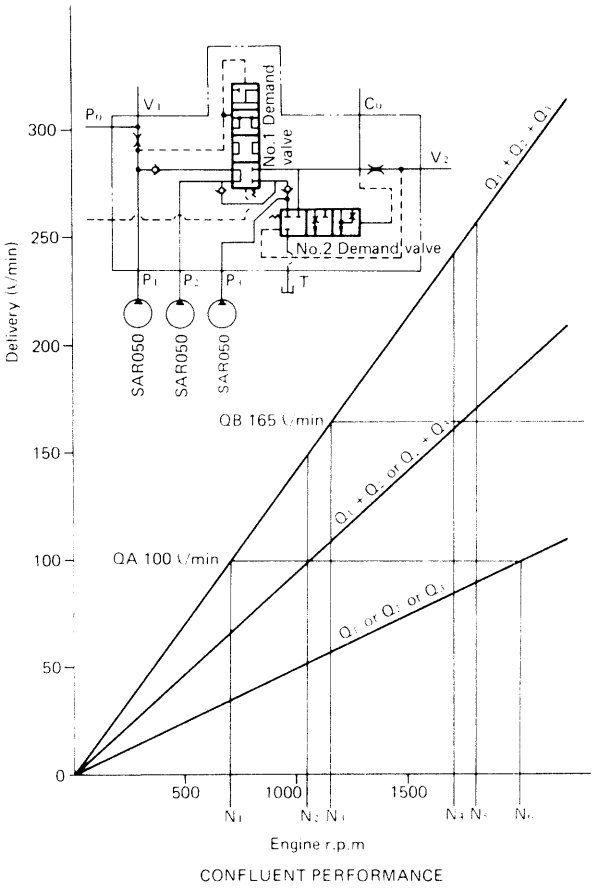
Section B-B

Fig. 6 F23E064

6. When the engine speed is N4:

a. Same as item 4 when the oil flowing to the **V1** port is used.

b. When the oil flowing to the **V1** port is not used and is led to the **Co** port: (Fig. 6)
The total volume of oil from pumps 1 and 2 flows to the **V2** port and the total volume of oil from pump 3 flows to the **T** port.



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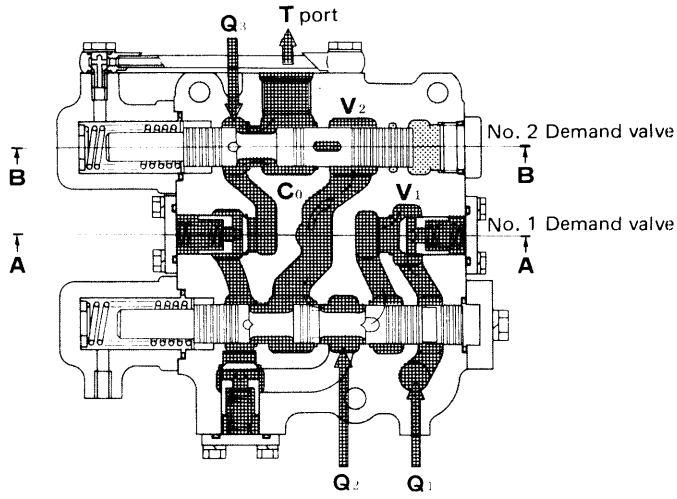


7. When the engine speed is between N_4 and N_5:

a. Same as item 4 when the oil flowing to the V_1 port is used.

b. When the oil flowing of the V_1 port is not used and is led to the **Co** port: (Fig. 7)
The total volume of oil from pump 1 and a part of oil ($Q_B - Q_1$) from pumps 2 flows to the V_2 port.
The total volume of the oil from pump 3 and a part ($\Delta Q = Q_1 + Q_2 - Q_B$) of the oil from pump 2 flows to the **T** port.

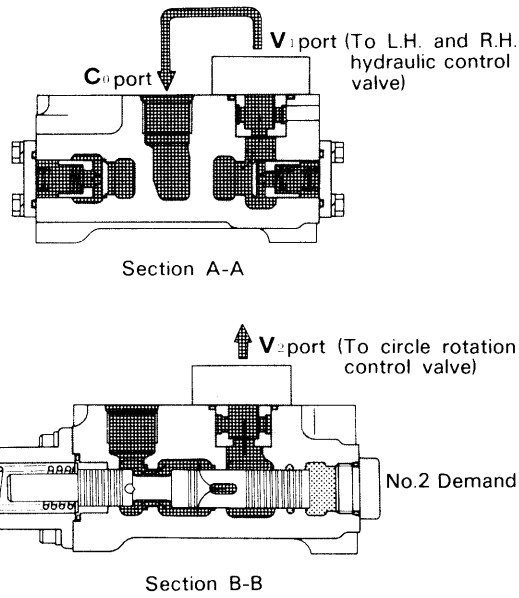
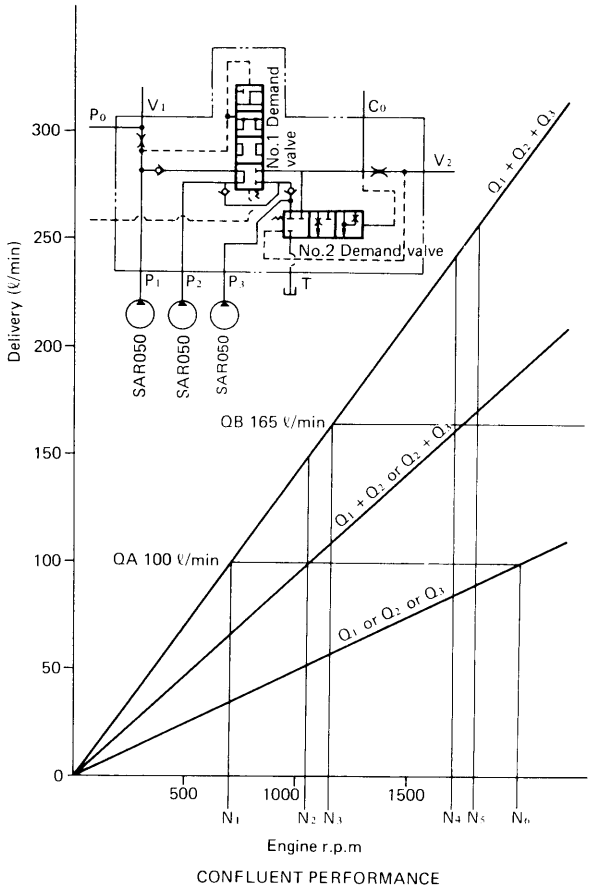


Fig. 7 F23E065



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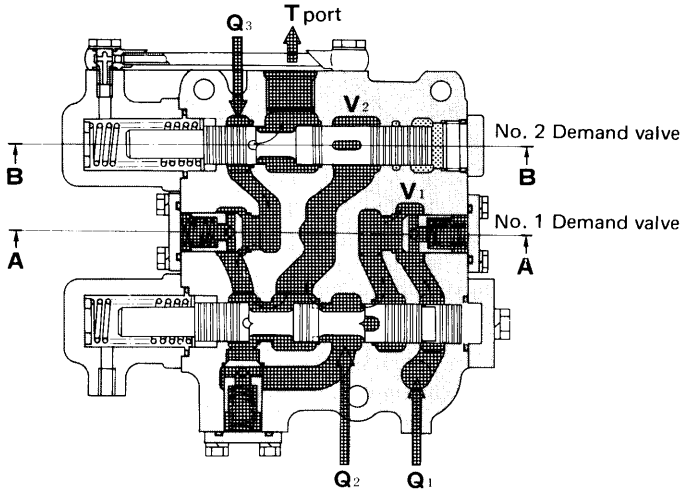
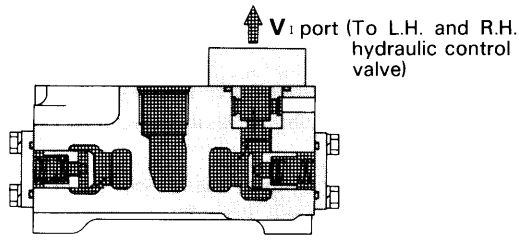
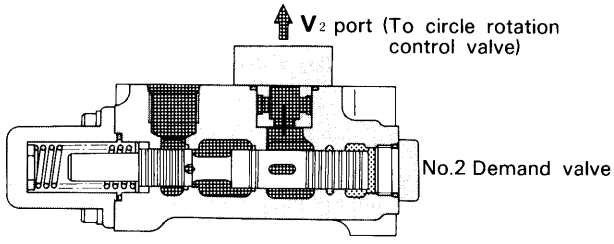




Section A-A



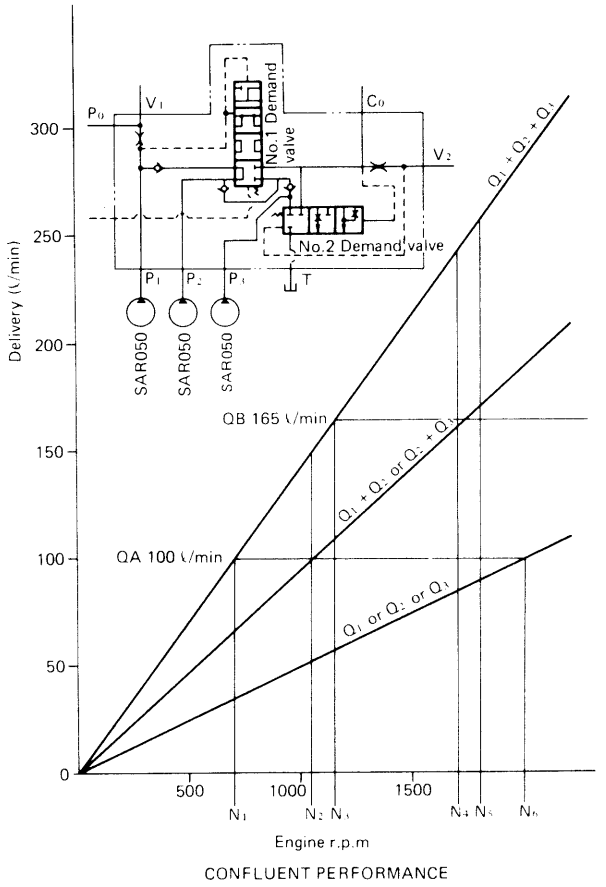
Section B-B

Fig. 8 F23E066

8. When the engine speed is between N_4 and N_5:

a. When the oil flowing to the **V_1** port is used: (Fig. 8)
The total volume of oil from pump 1 and a part (**$Q_A - Q_1$**) of the oil from pump 2 flows to the **V_1** port.
A part (**$\Delta Q = Q_1 + Q_2 - Q_A$**) of the oil from pump 2 and a part (**$Q_A + Q_B - Q_1 - Q_2$**) of the oil from pump 3 flows to the **V_2** port.
A part (**$\Delta Q = Q_1 + Q_2 + Q_3 - Q_A - Q_B$**) of the oil from pump 3 flows to the **T** port.

b. Same as 7 (b) when the oil flowing to the **V_1** port is not used and is led to the **Co** port.



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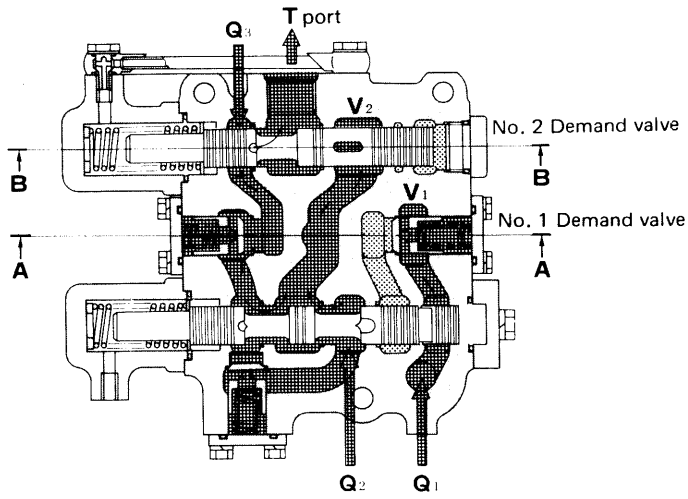
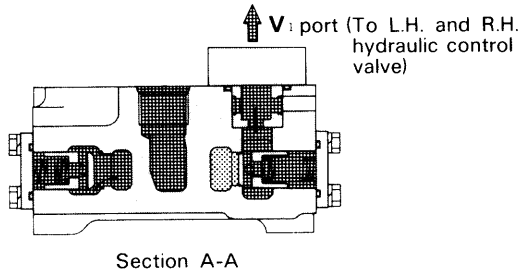


9. When the engine speed is N_6 or above:

a. When the oil flowing to the V_1 port is used: (Fig. 9)
The total volume of the oil from pump 1 flows to the V_1 port. The total volume of the oil from pump 2 and a part ($\Delta Q = Q_2 + Q_3 - QB$) from pump 3 flows to the T port.



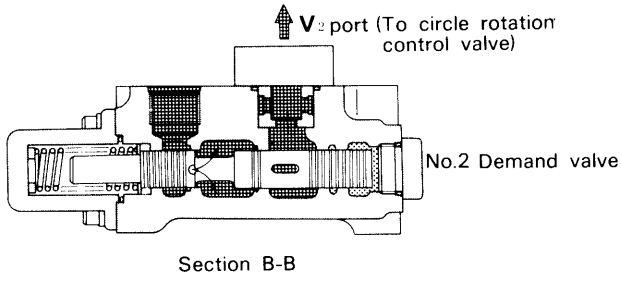
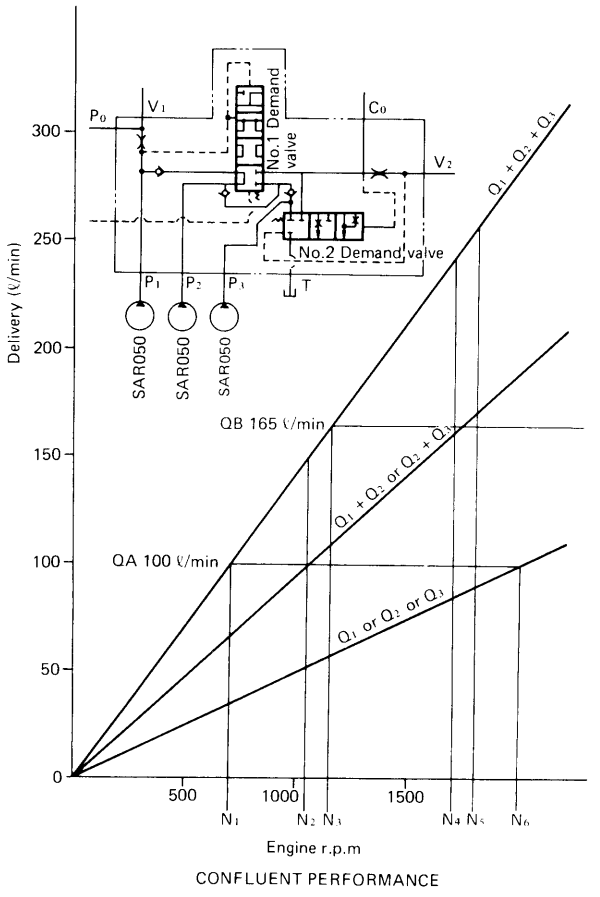
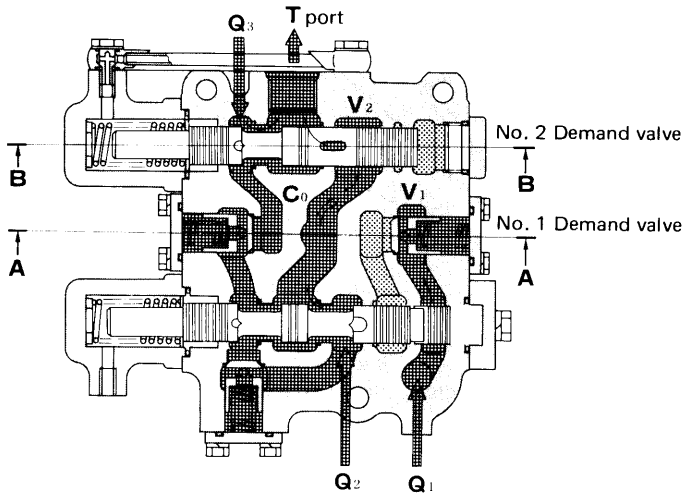
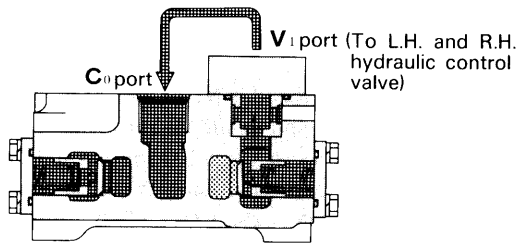


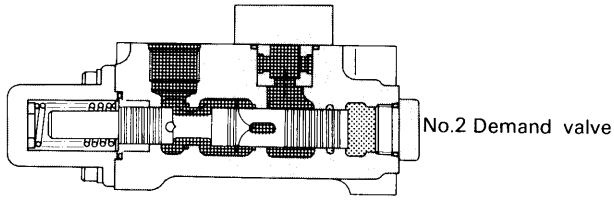
Fig. 9

F23E067







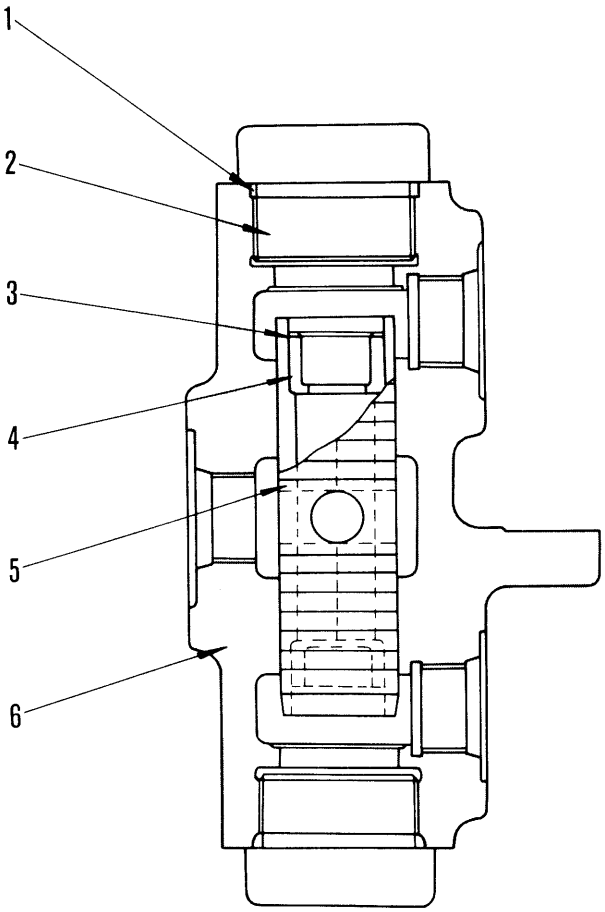


b. When the oil flowing to the **V1** port is not used and is led to the **Co** port: (Fig. 10)
The total volume of the oil from pump 1 flows to the **V1** port → **Co** port. The total volume of the oil from pump 3 and a part (**ΔQ = Q1 + Q2 − QB**) of the oil from pump 2 flows to the **T** port. Therefore, the total volume of oil from pump 1 and a part (**QB − Q1**) of the oil from pump 2 flows to the **V2** port.

Fig. 10 F23E068

FLOW DIVIDER VALVE

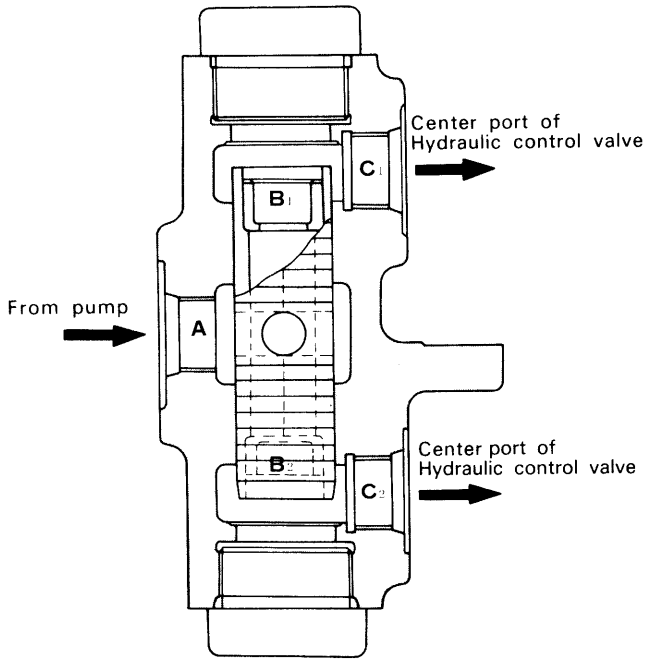
GD705A-4



F23E069

1. O-ring
2. Plug
3. Snap ring
4. Sleeve
5. Piston
6. Housing

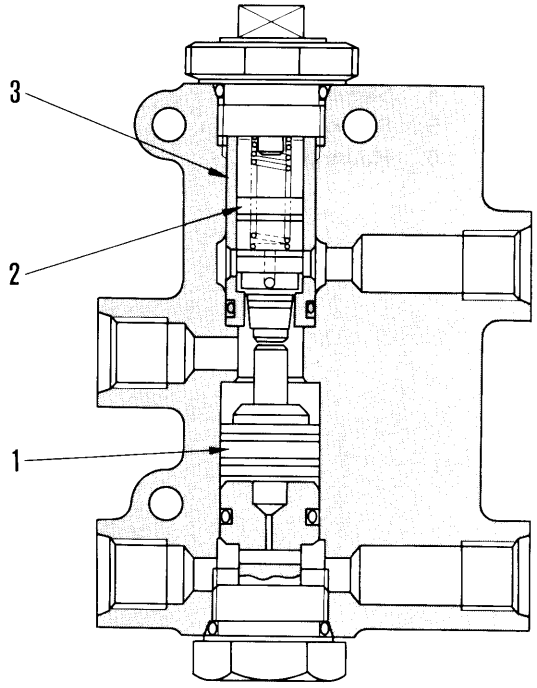
The oil from the DDV enters chamber **A** and is divided according to a constant flow ratio. It then passes through throttles B_1 and B_2, then through chambers C_1 and C_2, and goes to the hydraulic control valve.



F23E107

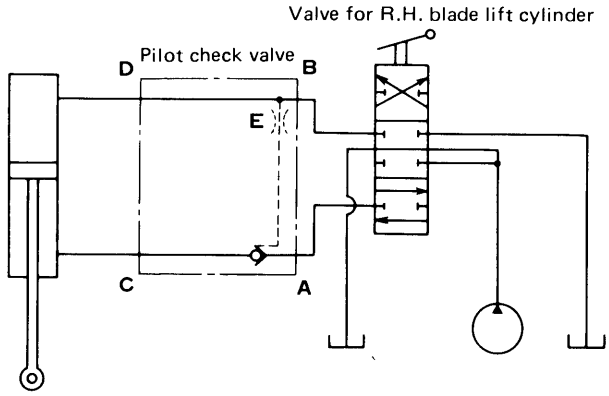
PILOT CHECK VALVE

(For Blade lift R.H.)



234F1119

1. Pilot valve
2. Check valve
3. Sleeve



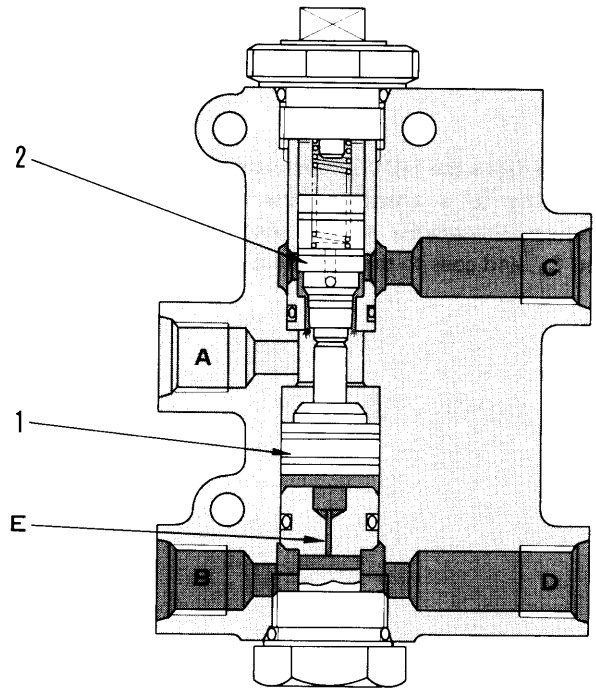
234F1120

OPERATION

Using blade lift cylinder (right) as an example, when trying to lower the blade, when the control valve is operated, pressure develops in the cylinder bottom side of the blade lift cylinder. The pressure passing through the throttle forces the pilot valve (1) downwards and opens the pilot check valve and returns air and oil at the head of the cylinder to the tank. Pressure to hold the blade acts in the blade lift cylinder head side and pushes the check valve (2).

At the instant the check valve opens, oil escapes suddenly from chamber **C** to chamber **A** and pressure at the cylinder bottom side falls.

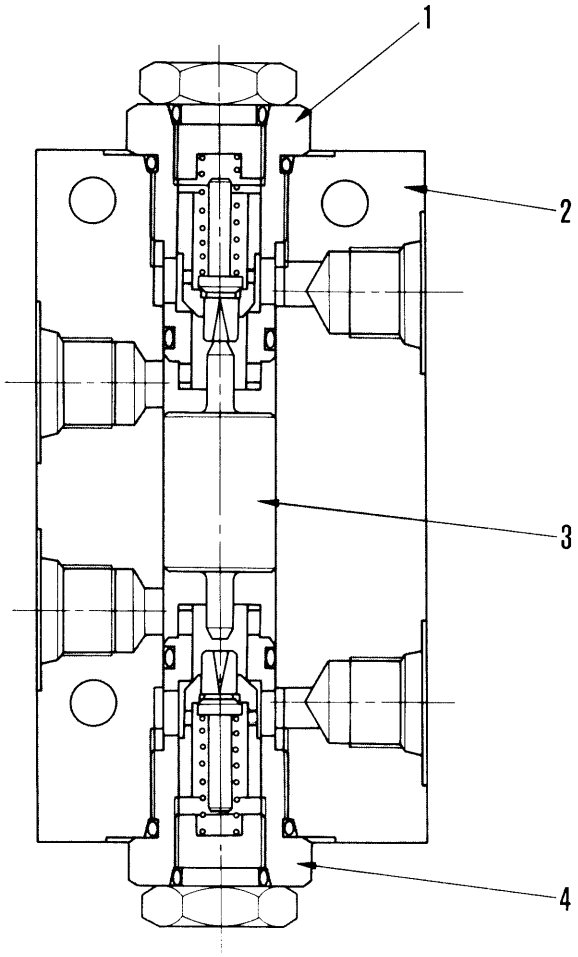
At this time, if there was no throttle in the pilot valve, the pilot valve would be constantly opening and shuttering in response to the changes in pressure at the cylinder bottom side and the head side which would give rise to the phenomena of chattering. For this reason a throttle has been provided at **E** position, so that, even if pressure at the cylinder bottom side fails, it has a damper effect so that the check valve does not close immediately.



234F1121

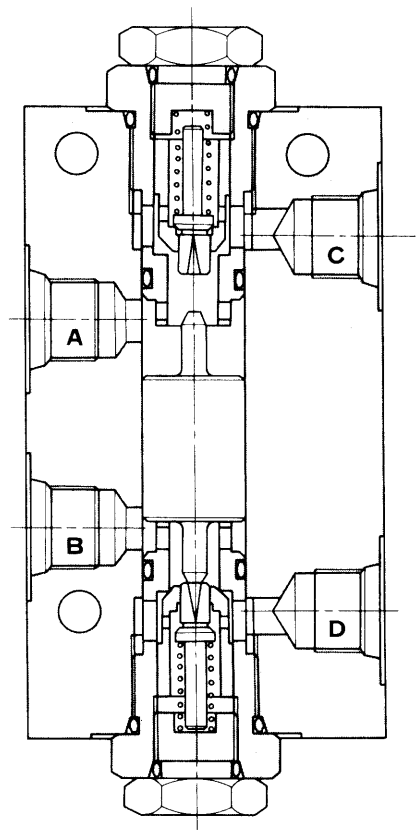
PILOT CHECK VALVE

(For Leaning, Articulate, Drawbar)



F23B092

1. Pilot check valve
2. Body
3. Piston
4. Pilot check valve



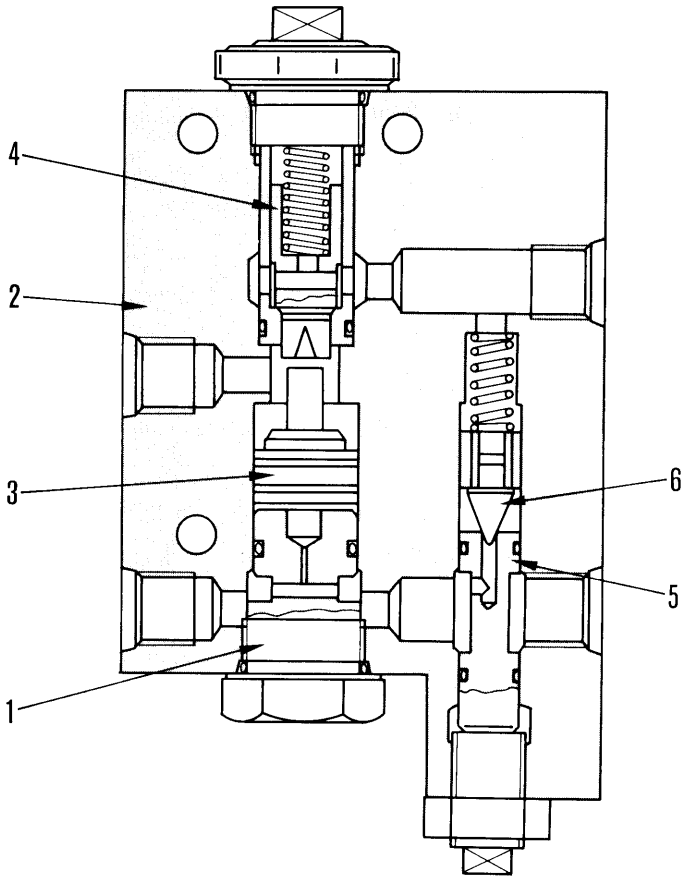
F23B093

OPERATION

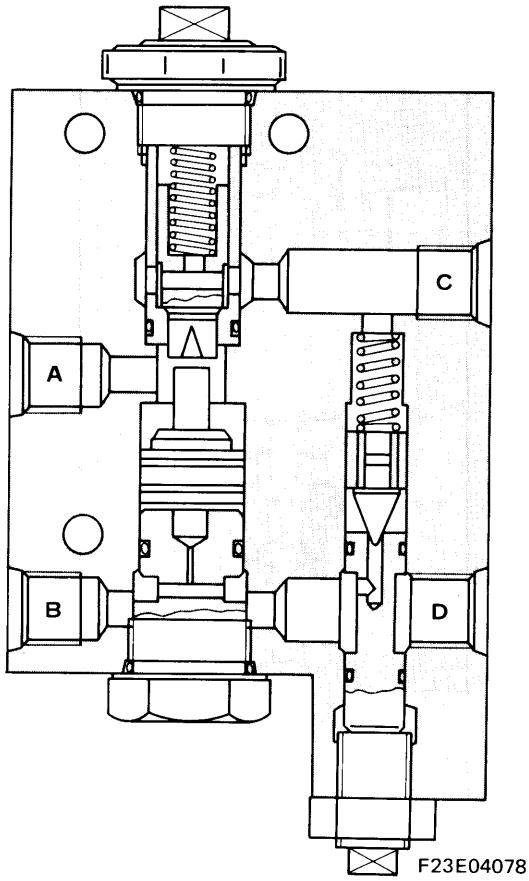
When extending the cylinder, if the control valve is operated, the oil from the pump enters chamber **A**. It pushes the pilot check valve and the piston, and enters chamber **C**. This forms pressure at the bottom end. Because the pressure in chamber **C** rises and pushes the cylinder, the oil in chamber **D** passes through the pilot check valve and flows to chamber **B**. The cylinder then extends.

PILOT CHECK VALVE (With Safety Valve)

(For Power tilt, Ripper (if equipped))



1. Valve
2. Body
3. Piston
4. Pilot check valve
5. Sleeve
6. Poppet



F23E04078

The check valve with safety valve prevents hydraulic drift of the cylinder. At the same time, it protects the cylinder from abnormal pressure inside the cylinder caused by external force.

OPERATION

When extending the blade, the oil from the pump passes through chamber **A** and flows to chamber **C**. The pressure at the bottom rises and pushes the cylinder. When the cylinder is pushed, the oil in chamber B_1 passes through the pilot valve and flows to chamber **B**. When the oil pressure is more than 250 kg/cm^2, the oil from chamber **D** pushes the poppet and flows back to chamber **C**.

When the ripper lever is moved to the LOWER position, the oil from the pump passes through chamber A_2 and pushes pilot check valve (4). It then passes through chamber B_2 and flows to the chamber at the bottom end of the cylinder, and extends the cylinder to lower the ripper. The oil at the head end of the cylinder flows back through chamber A_1 and chamber B_1, and returns to the tank.

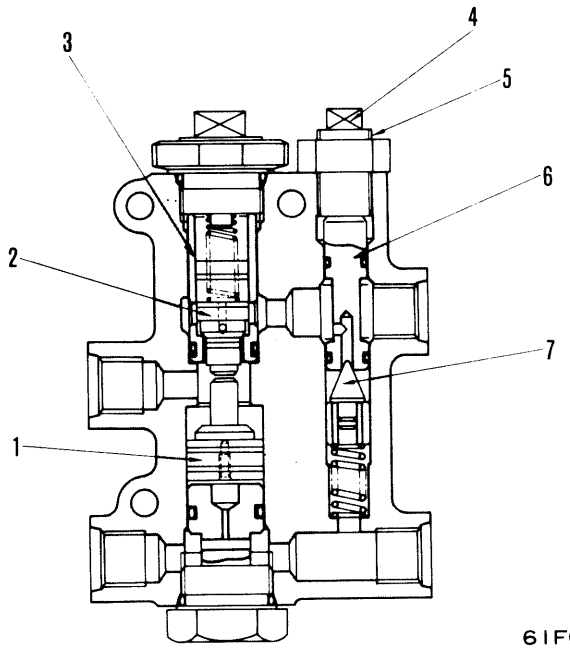
When the ripper lever is moved to the RAISE position, the oil from the pump passes from chamber A_1 through chamber B_1 and flows to the chamber at the head end of the cylinder. When this happens, the pressure in chambers A_1 and B_1 rises. As the pressure rises, piston (3) is pushed, and check valve (4) is pushed open. The oil at the bottom end of the cylinder flows through the restriction in check valve (4) and returns through chamber A_2 to the tank. The cylinder retracts and the ripper rises.

When the ripper is operated, if there is abnormal ripper pressure of over 250 kg/cm^2 generated in chamber B_1, relief valve poppet (6) is pushed open. The oil flows to chamber B_2 and raises the ripper to relieve the shock.

PILOT CHECK VALVE (With Safety Valve)

(For Blade lift L.H., Scarifier (If equipped))

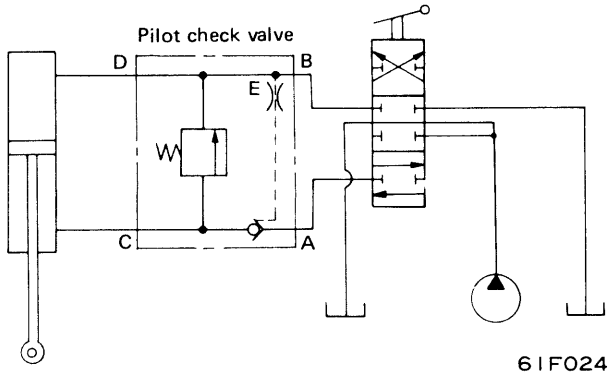
It is installed on the left blade lift and the scarifier cylinders.



61F023

1. Pilot valve
2. Check valve
3. Sleeve
4. Adjusting screw
5. Lock nut
6. Sleeve
7. Poppet

Valve for L.H. blade lift cylinder



61F024

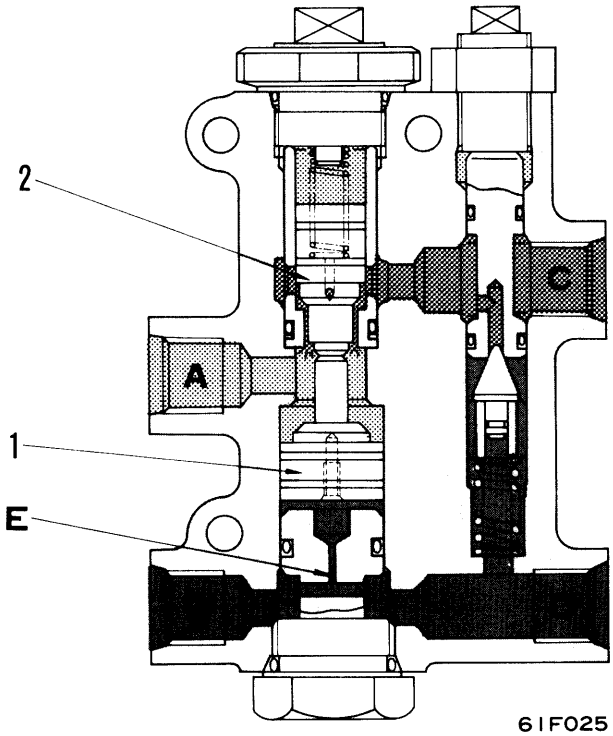
A safety valve is installed on the check valve not only to prevent natural falling of the cylinder and vacuum developping at the cylinder bottom side, but also to preserve the cylinder against abnormal pressure from outside forces.

OPERATION

Using blade lift cylinder (left) as an example,
when trying to lower the blade, when the control valve is operated, pressure develops in the cylinder bottom side of the blade lift cylinder. The pressure passing through the throttle forces the pilot valve (1) downwards and opens the pilot check valve and returns air and oil at the head of the cylinder to the tank. Pressure to hold the blade acts in the blade lift cylinder head side and pushes the check valve (2).

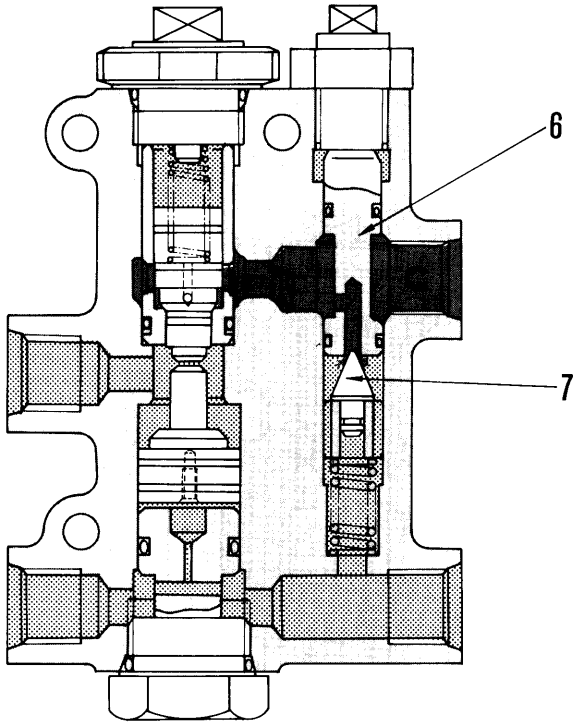
At the instant the check valve opens, oil escapes suddenly from chamber **C** to chamber **A** and pressure at the cylinder bottom side falls.

At this time, if there was no throttle in the pilot valve, the pilot valve would be constantly opening and shuttering in response to the changes in pressure at the cylinder bottom side and the head side which would give rise to the phenomena of chattering. For this reason a throttle has been provided at **E** position, so that, even if pressure at the cylinder bottom side fails, it has a damper effect so that the check valve does not close immediately.



61F025

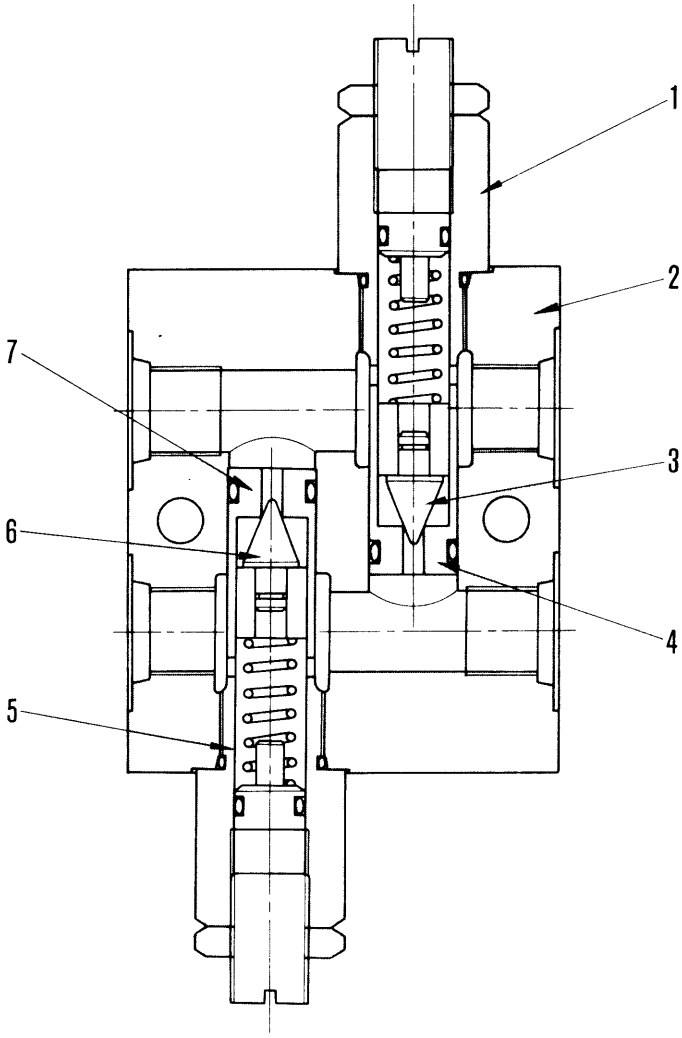
A safety valve poppet (7) has been installed to preserve the cylinder when high hydraulic pressure arises in the cylinder head side of the cylinder because of interference from the work equipment or external force. When high hydraulic pressure (about 250 kg/cm^2) arises to **C**, oil flows through the drill hole in the spool (6) to open the safety valve poppet (7) to flow to the cylinder bottom side of the cylinder.



61F026

DOUBLE RELIEF VALVE

GD705A-4
(For Steering)



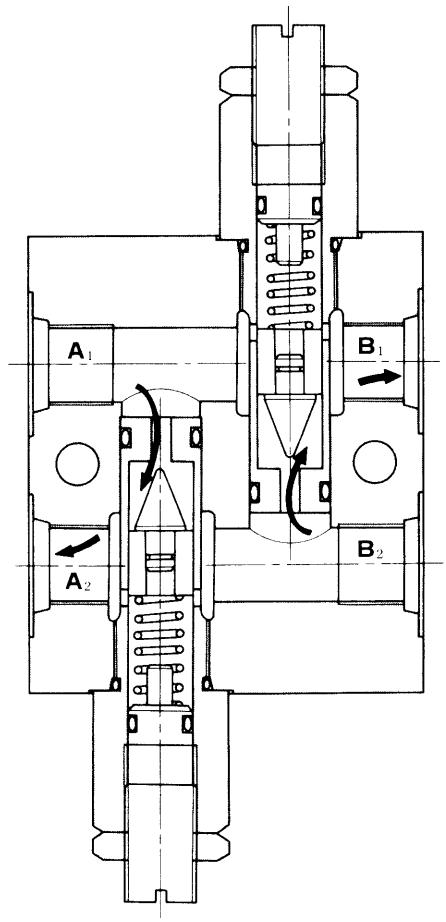
F23B098

1. Relief valve
2. Body
3. Poppet (A)
4. Sleeve
5. Relief valve
6. Poppet (B)
7. Sleeve

The check valve with safety valve protects the cylinder from abnormal pressure inside the cylinder caused by external force.

OPERATION

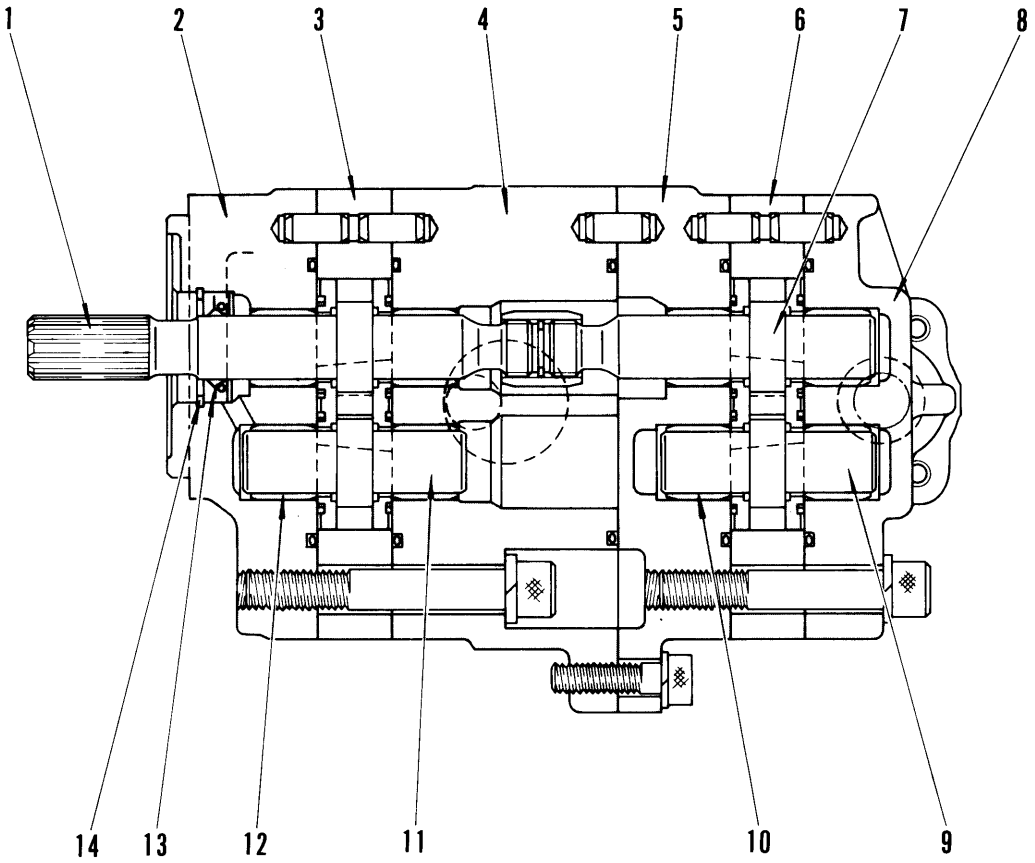
In the hydraulic circuit diagram above, oil from chamber A_1 enters. When there is abnormal pressure of over 210 kg/cm^2, it pushes poppet (B) and flows to chamber A_2. In the same way, when there is abnormal pressure of over 210 kg/cm^2, oil from chamber B_2 pushes poppet (A) and flows to chamber B_1.



F23B099

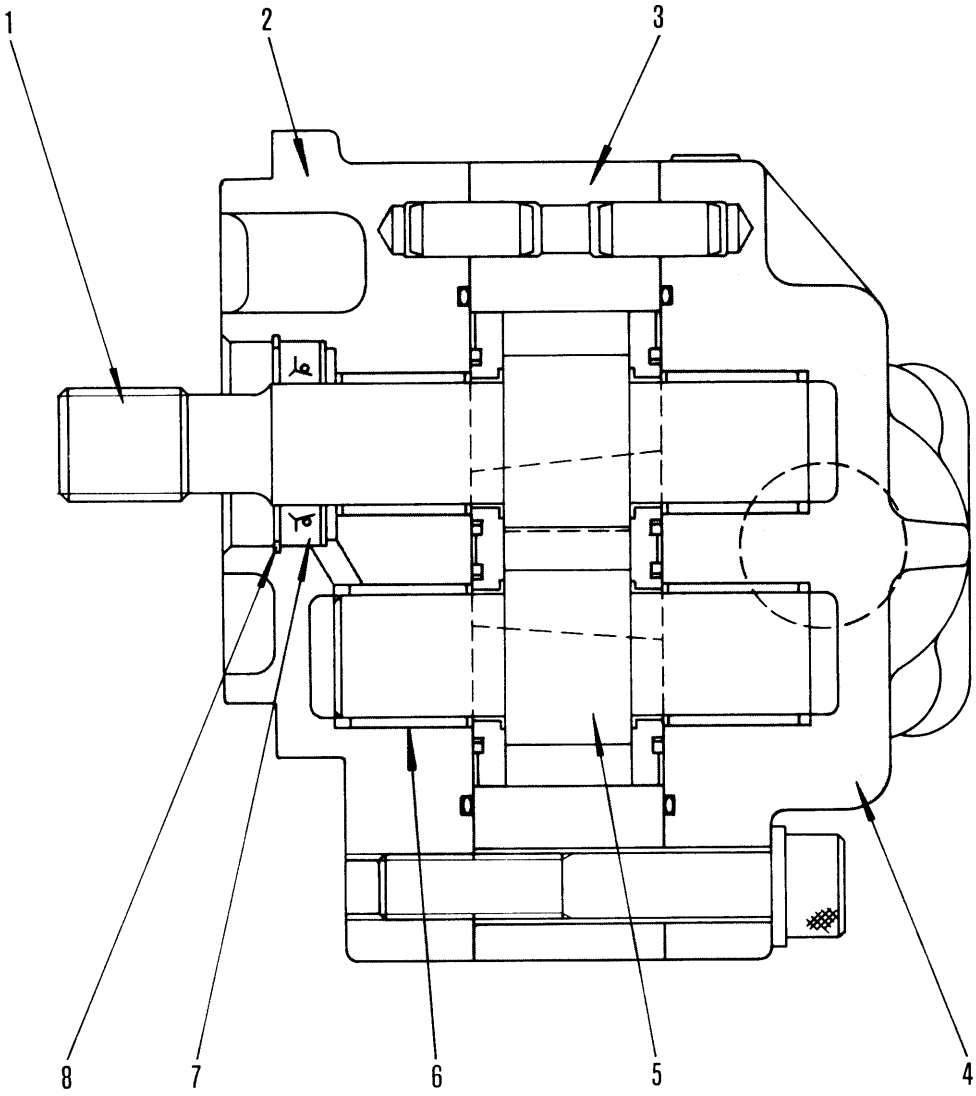
HYDRAULIC PUMP

FOR WORK EQUIPMENT (LAR020 + LAR020) GD705R-4
(SAR050 + SAR050) GD705A-4



1. Drive gear
2. Bracket
3. Gear case
4. Carrier
5. Bracket
6. Gear case
7. Drive gear
8. Cover
9. Driven gear
10. Bushing
11. Driven gear
12. Bushing
13. Oil seal
14. Snap ring

FOR WORK EQUIPMENT (SAR050) GD705A-4



238F039

1. Drive gear
2. Bracket
3. Gear case
4. Cover
5. Driven gear
6. Bushing
7. Oil seal
8. Snap ring

GENERAL

The hydraulic pump receives mechanical energy from the engine and other external devices, and converts it into fluid energy.

It serves as a generating source for the energy needed by the hydraulic devices. The fluid energy is classified as either velocity energy, pressure energy, or positional energy.

The fluid energy utilized for hydraulic pressure is, in most cases, pressure energy.

The hydraulic pump transfers energy by utilizing the static pressure of fluid. The pump displacement is determined by the transfer quantity of oil transferred within its chamber.

The hydraulic pump can easily generate high pressure without any noticeable change of the piston displacement as the load fluctuates. Accordingly, the hydraulic pump is not designed to produce pressure, but instead is designed to provide a constant oil flow. Pump pressure is generated by the resistance (load) which acts to resist the oil flow. As a result, if there is no resistance, no pressure will be produced.

The hydraulic pumps are divided roughly into rotary pumps and reciprocating pumps, according to their structures, and they are further divided into the fixed delivery type and the variable delivery type, depending on their function.

The hydraulic pumps employed on the wheel loader, for example, include the external gear pump and the fixed delivery type vane pump, which belong to the fixed delivery type of rotary pumps.

The external gear pump employs involute spur gears. This category of pump can also be divided into the following types according to their structure.

- Side plate adjusting system

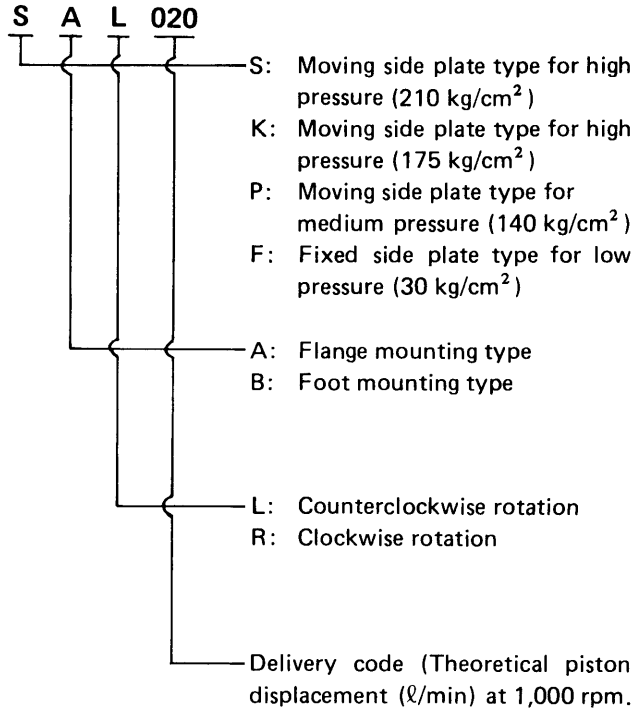
Fixed side plate type (FAL, FAR)
Moving side plate type (PAL, PAR, KAL, KAR, SAL, SAR)
Variable side plate type

- Bearing metal system

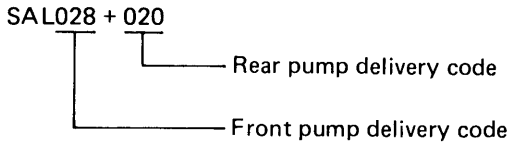
Anti-friction bearing metal type
Plain bearing metal type

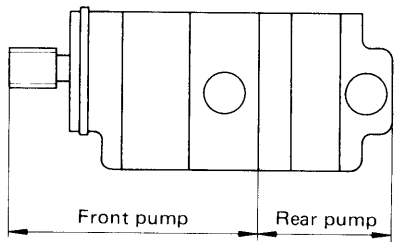
Standard KOMATSU pumps are indicated as follows.

1. Single pump



2. Tandem pump





F23AB133

OPERATING PRINCIPLES

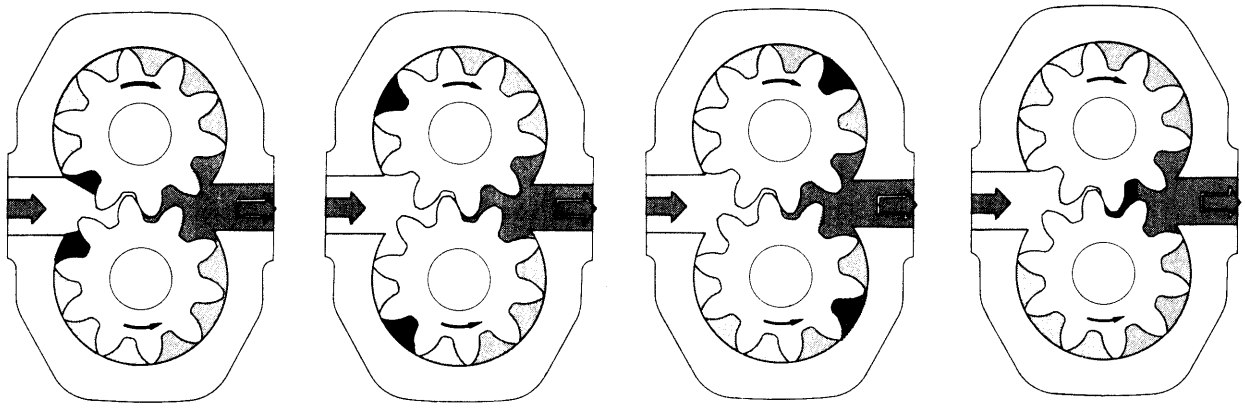
How oil flows

The diagrams at right outline the operating principles of a circumscribed gear pump with two gears intermeshed and rotating within the gear case. Oil entering via the inlet passes between the gear teeth and turns together with the gears, thereby being carried to the outlet. Because of the intermeshing of the gear teeth, only oil at the base of the gear teeth will be carried back to the inlet side.

Since the gears continually carry oil, oil on the discharge side is forced out from the discharge port. The discharge rate increases at faster gear rotational speeds.

If there is no resistance obstructing the flow of oil forced out from the discharge port, there will be no increase in oil pressure as the oil continues to move along the route. If, however, the end of the route is blocked by a hydraulic cylinder and the oil can proceed no further, the oil pressure will increase. If the hydraulic cylinder piston is then pushed out by the increased oil pressure, the pressure will rise no further.

As was described above, the gear pump itself generates the flow of oil, it does not generate pressure. The oil pressure is generated as a result of the load applied, or in other words, oil pressure depends on factors external to the pump.



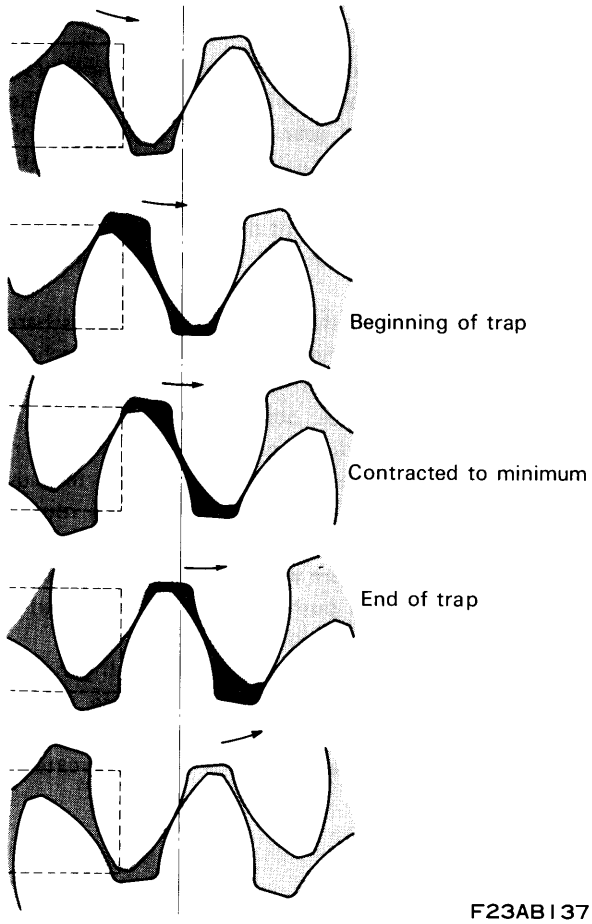
F23AB136

Oil confinement

When the gears of a gear pump mesh and rotate, two pairs of gear teeth will mesh simultaneously at one stage, while only one pair will mesh at another (see accompanying diagrams). When two pairs of teeth mesh simulaneously, the oil in the gap between the meshed teeth is trapped and cut off from both inlet and outlet. This is referred to as "oil confinement".

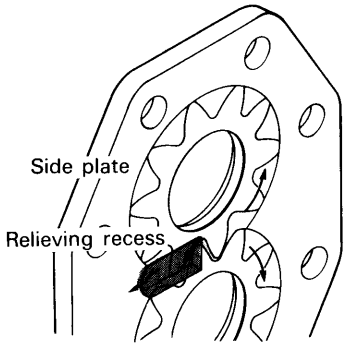
As the gears rotate, the gap trapping the oil moves from the discharge side to the inlet side. During the period when the gap moves from the start of the confinement to the center, the volume of the gap gradually decreases, but while the gap is moving from the center to the end of the confinement, the volume increases again.

Since oil cannot contract, the pressure of the trapped oil increases if there is nowhere for the oil to go when the gap volume decreases. Since this results in the generation of considerable noise and vibration, escape grooves cut in the side plate enable the trapped oil to pass out towards the discharge side. These grooves are cut to connect the gaps with the discharge side when the gap volume is decreasing (see diagram below). In addition, grooves are also cut to connect the inlet side with the gaps when the gap volume is increasing again, thereby replenishing the escaped oil to prevent a vacuum.

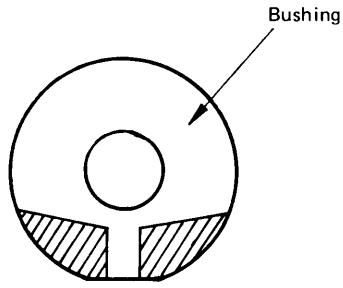


F23AB137

Fixed wall plate type gear pump



Movable side plate type gear pump

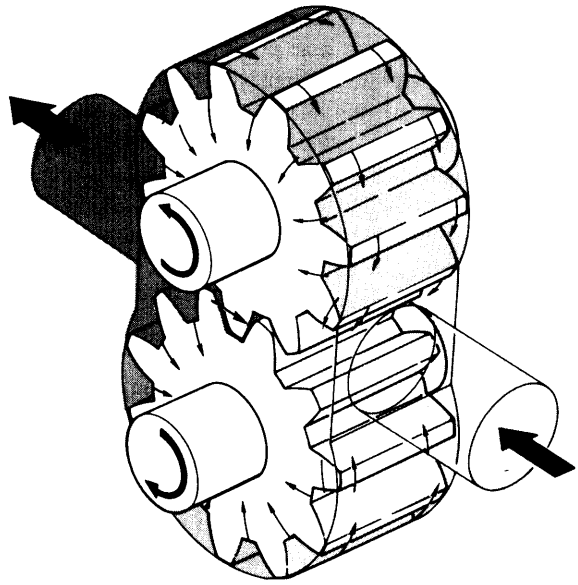


F23AB138

Internal oil leakage

If there are any gaps, oil will leak from positions of higher oil pressure to those of lower oil pressure. In gear pumps, a small gap is left between the gears and the case and side wall to prevent "seizure" and scraping. The oil leaking through this small gap serves to lubricate the pump. This condition is outlined in the diagram at right. Hence, there is a continuous leakage of oil from the high pressure discharge side to the inlet side inside the actual pump, and the discharge rate is reduced by that amount.

If this gap is enlarged by wear and tear, or if the oil viscosity drops due to increased oil temperature during operation, or if a low viscosity oil is used, there will be a subsequent increase in the oil leakage, resulting in a corresponding reduction in the discharge rate.

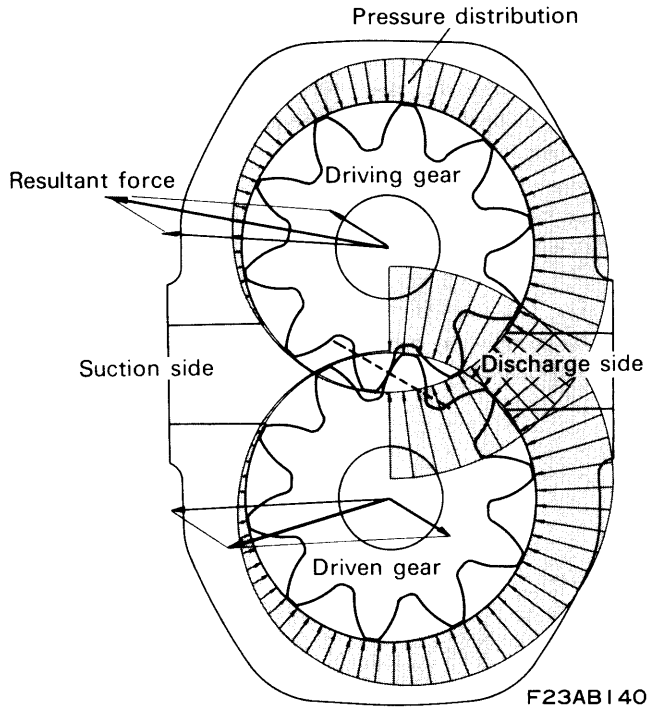


F23AB139

Forces applied to the gear

Due to the oil pressure of the surrounding oil, a force is applied to the center of the gear. This pressure is high on the discharge side due to the discharge pressure, and low on the inlet side due to suction pressure. In the intermediate positions, the pressure gradually falls from the discharge side to the inlet side. This is outlined in the diagram at right. In addition, there are also forces interacting on gear teeth in contact with each other. Due to the forces described above, the gears are pushed over on the inlet side, this thrust being supported by bearings. As a result of this tendency towards the inlet side, the gap between the tips of the gear teeth and the case on the inlet side becomes narrower, and depending on the type of pump (PAL, PAR, KAL, KAR), the gap may sometimes be closed altogether.

Consequently, if the discharge pressure is too high and excessive pressure is applied to the gear, the extra load on the bearings will shorten the bearing life, and the gear teeth will tend to bite into the case. It is therefore essential to avoid increasing the discharge pressure too high.



F23AB140

Movable side plate type gear pump

In movable plate type gear pumps, the bushing which serves as the side plate is fitted into the case and pressed against the side of the gears. This reduces oil leakage from the side of the gears. Since the bushing is pressed constantly against the side of the gears by oil pressure, wearing of the bushing over long periods of time does not increase the size of the gap, thereby keeping oil leakage at a constant level.

Furthermore, the bushing is pushed towards the gears from the cover side by oil pressure, but pushed away from the gears by the pressure of the oil between the gear teeth and of the oil leaking through the gap between bushing and gear.

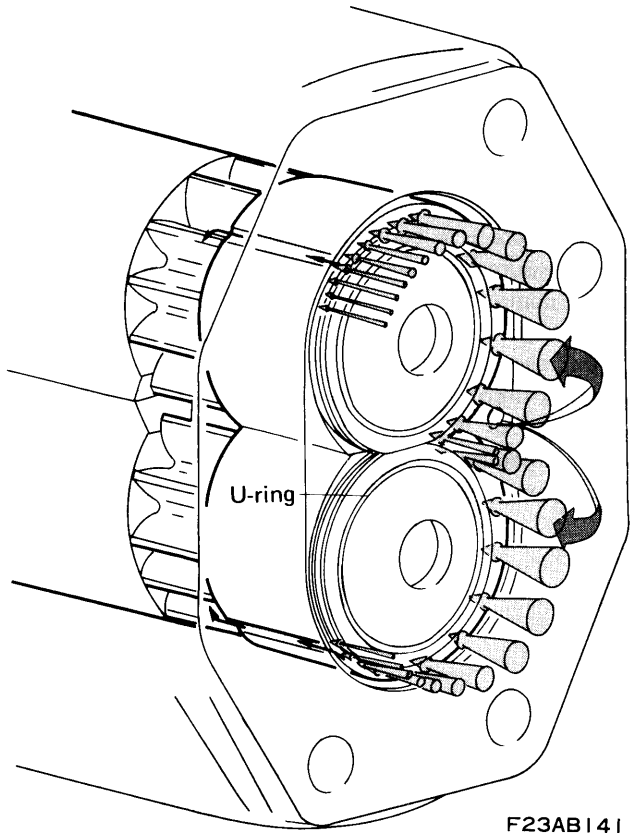
However since the gear oil pressure is high on the discharge side and low on the input side, a force pushing the bushing from the cover side is also added, resulting in a greater push on the discharge side and a smaller push on the inlet side.

By partitioning the surface area of the bushing to which the cover side pressure is applied by means of back up rings fitted on the seal plate as shown in the diagram at right, the surface area on the discharge side will be greater than on the inlet side.

When the pump operates at higher rotational speeds, the pressure on the discharge side decreases, and the distribution of pressure around the gears changes as shown in the diagram.

Consequently, when the rotational speed is changed, the pressure distribution changes, creating a force which pushes against the bushing from the gear side.

Therefore, a pressure balance groove is cut in the bushing. The discharge pressure acts along this groove, thereby stabilizing the pressure distribution whenever the rotational speed is changed.



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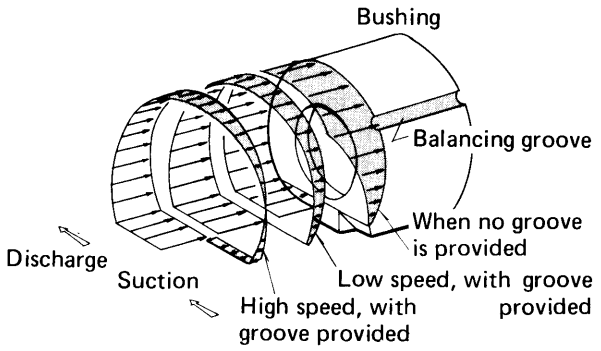
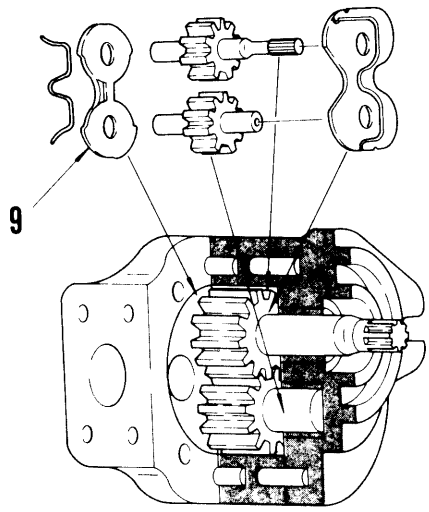


F23AB142

FEATURES

1. Performance and durability
   i) Side plate (9) is made flush with minimal torque loss, and high resistance against wear and tear.
   ii) Stable performance and durability are due to improvements in the hydrobalance mechanism.

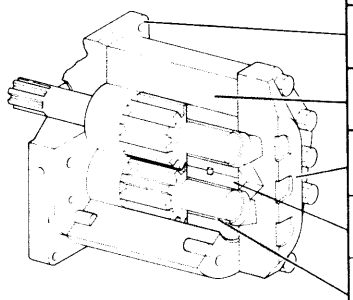


F23AB143

2. Simplification of structure
   - In addition to reduction of mechanically processed parts such as brackets and covers, greater compatibility and standardization of parts has been achieved. The total number of component parts has been reduced.

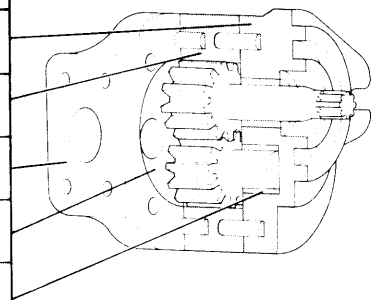
Structural comparison with KA series pumps

KA pump



	KA Series	SA Series
Bracket (mounting flange section)	No standard (exclusive to Komatsu)	SAE standard (international standard)
Gear case	Intake and discharge ports	No ports
Cover	No ports	Intake and discharge ports
Bushing or side plate	Movable bushing	Movable side plate
Plain bearing	Press fit bushing	Press fit to bracket and cover
Number of component parts	60	32
Weight	7.6	6.3

SA pump

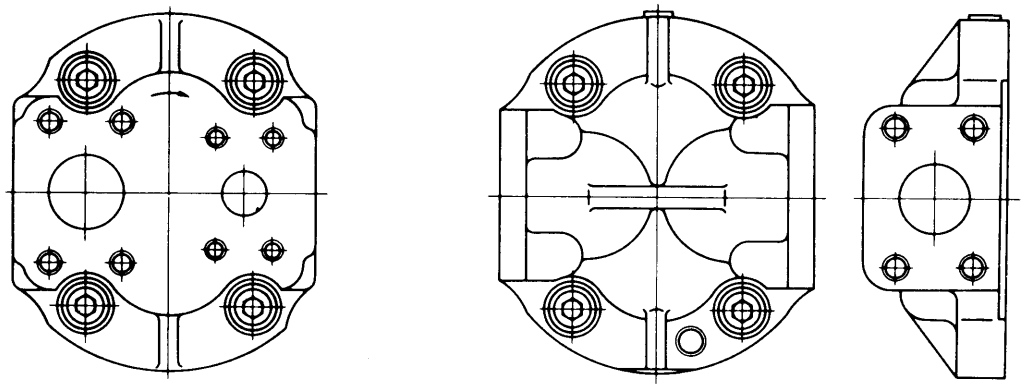


F23AB144

3. Simplification of piping
   - Selection of port shape – side port or rear port.

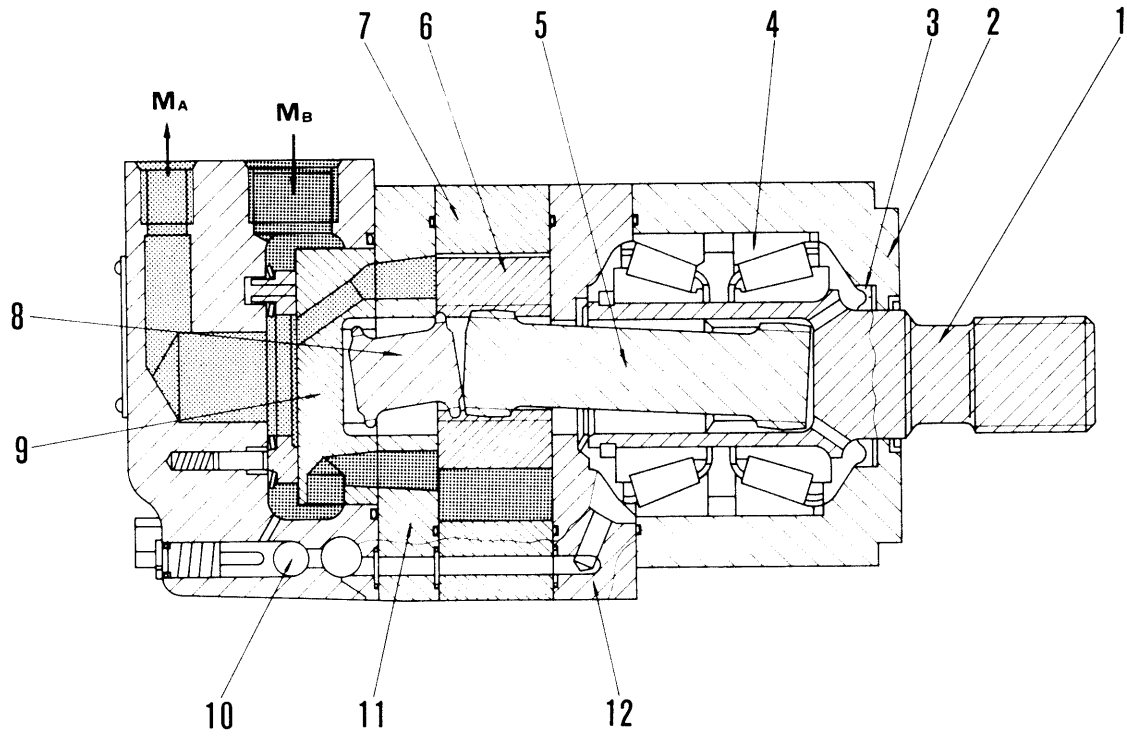
Rear port

Side port



F23AB145

CIRCLE ROTATION MOTOR



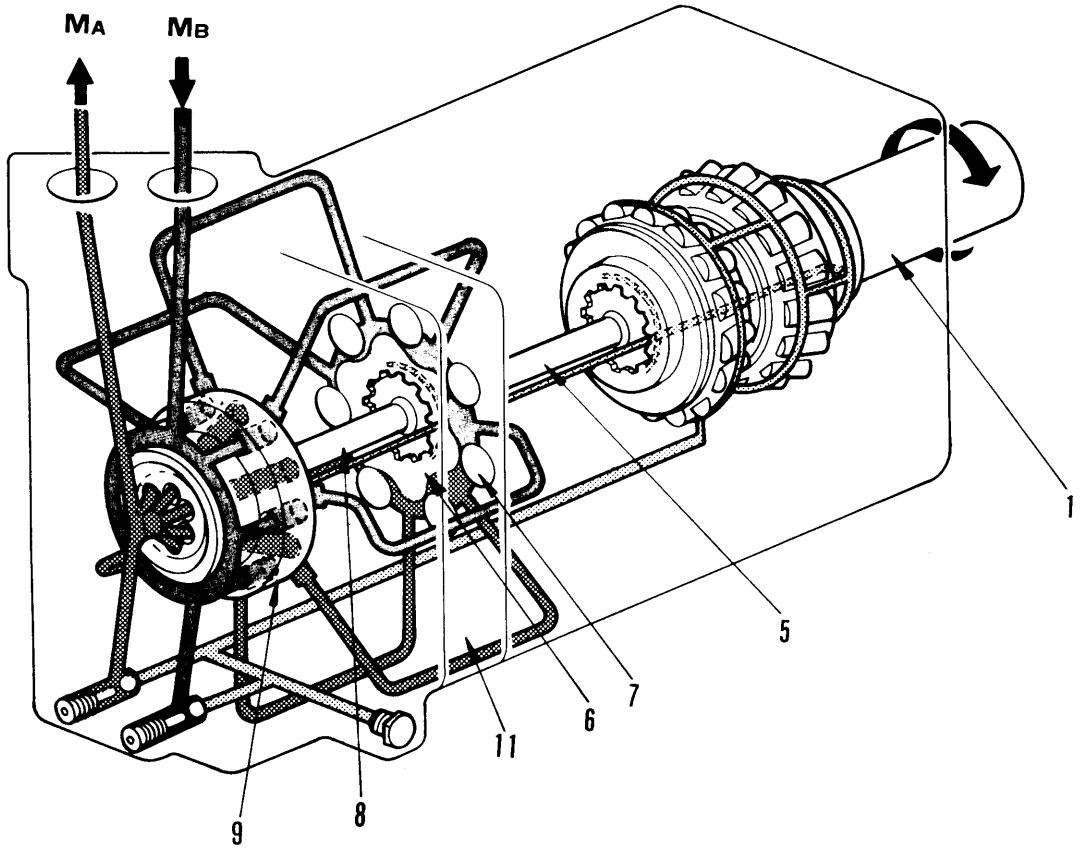
61F007

Orbit motor is used for circle rotation motor; the machine is mounted with this motor on drawbar. Star gear (6) turns with high hydraulic pressure, thereby rotating output shaft (1) which turns together with the star gear (6) and the main drive shaft (5).
This output shaft is connected to circle rotation gear case. Since star gear (6) engages with disc valve drive shaft (8), disc valve (9) also turns, thus changing the position where the hydraulic oil to Geroler (7) enters.

1. Output shaft
2. Flange
3. Oil seal
4. Taper roller bearing
5. Main drive shaft
6. Star gear
7. Geroler housing
8. Disc valve drive shaft
9. Disc valve
10. Check valve
11. Valve plate
12. Pump housing

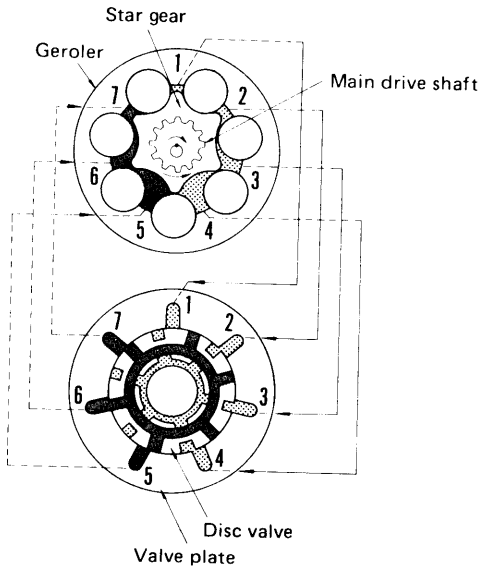
HYDRAULIC PUMP TYPE

	GD705R-4	GD705A-4
Roller	37.5 mm	37.5 mm
Theoretical oil quantity	123 cc/rev.	246 cc/rev.
Rated speed	562 rpm	603 rpm
Instantaneous maximum torque	34.2 kgm	68.5 kgm
Instantaneous maximum pressure	175 kg/cm^2	175 kg/cm^2
Weight	9.8 kg	18.8 kg



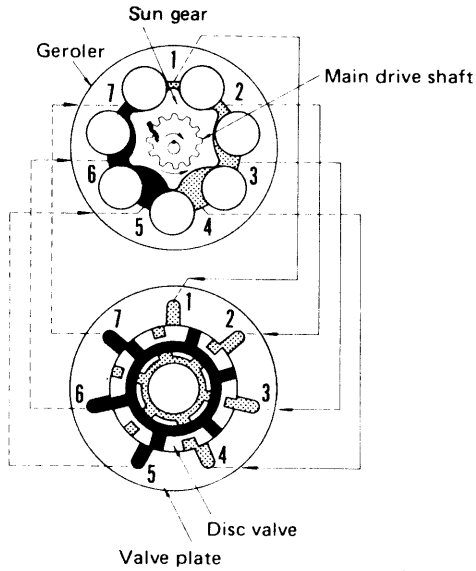
61F008A

Disc valve (9) is furnished with twelve oil holes; the oil of high pressure flows through six oil holes, and the other oil holes serve as a drain port. Disc valve (9) contacts the valve plate (11) with seven oil holes. These oil holes in the valve plate (11) are connected to the chamber made up of star gear (6) and Geroler (7). The oil of high pressure, which has entered to each travelling motor, goes into the chamber via the disc valve (9) and valve plate (11). When the oil of high pressure flows into the chamber, the star gear (6) starts running with the hydraulic pressure. When the star gear (6) rotates, disc valve (9) turns. Thus, the position where the high-pressure oil is delivered to the chamber, is shifted in regular sequence.



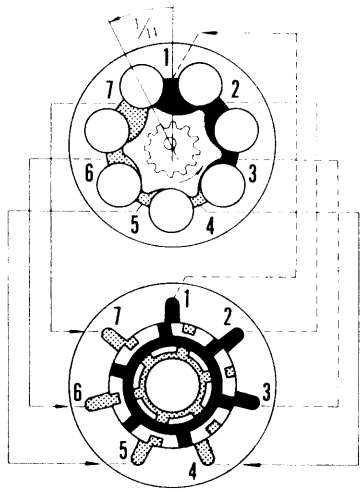
61F009

The star gear (6) rotates on its own axis and it also revolves round the center of Geroler. The rotation of star gear (6) is transmitted to the output shaft via the main drive shaft.

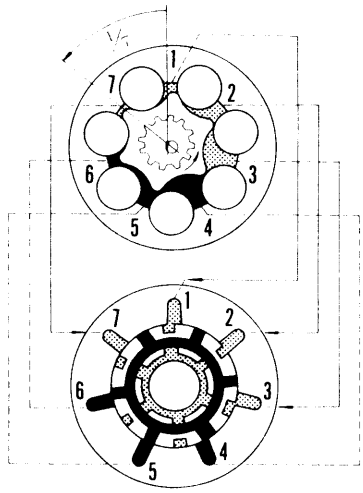


61F010

When star gear (6) makes 1/7 of a rotation left-ward on its own axis, it makes 6/7 of a revolution right-ward. Namely, when the star gear makes one revolution, it rotates 1/6 of a rotation on its own axis. As a result, compared with general hydraulic motors (the difference from the orbit motor can be understood more easily when compared with the trochoid motor), this orbit more makes available a torque 6 times as large as that possible with hydraulic motors. In addition, the rotating speed of the orbit motor can be reduced to as low as 1/6 of the speed of hydraulic motors. Nevertheless, the orbit motor is designed to be of the compact type.



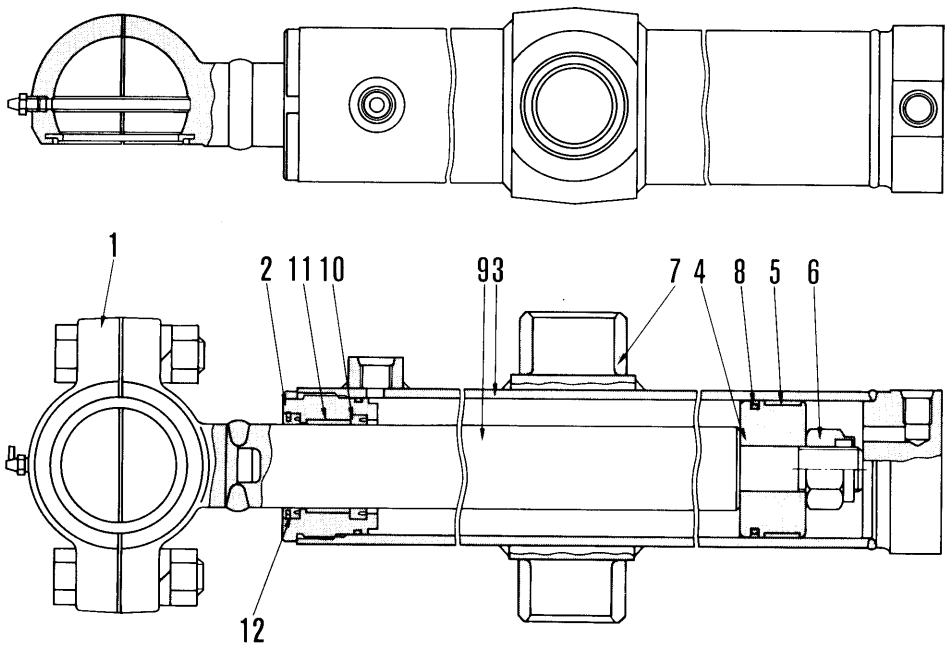
61F011



61F012

HYDRAULIC CYLINDER

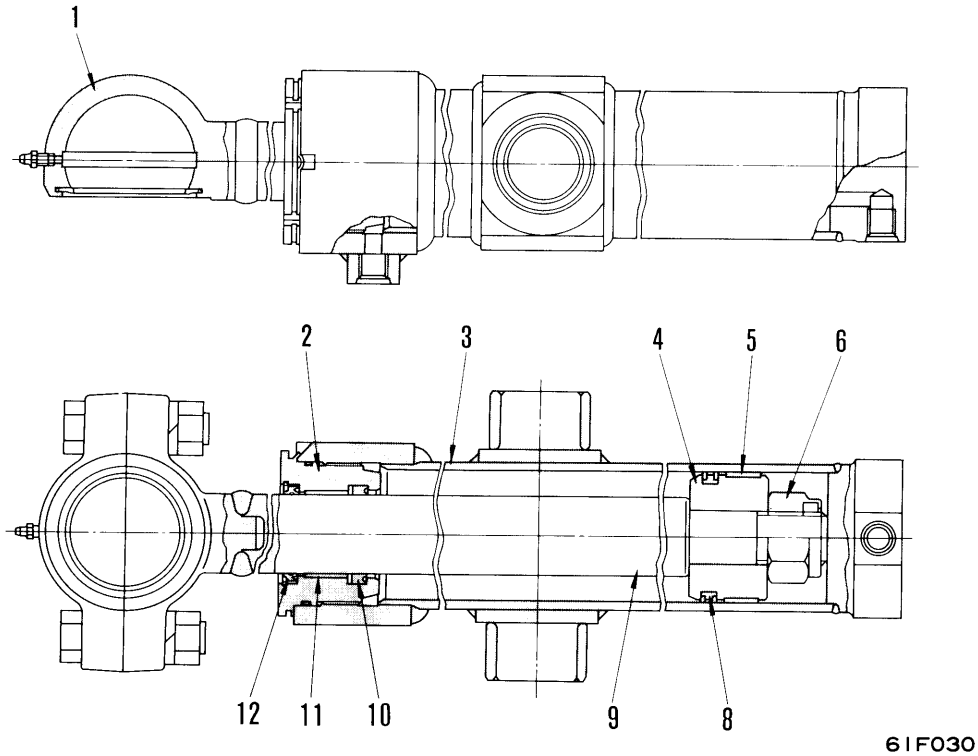
BLADE LIFT CYLINDER
GD705R-4



F23E04051

1. Cap
2. Cylinder head
3. Cylinder
4. Piston
5. Wear ring
6. Piston nut
7. Bushing
8. Piston ring
9. Piston rod
10. Rod packing
11. Bushing
12. Dust seal

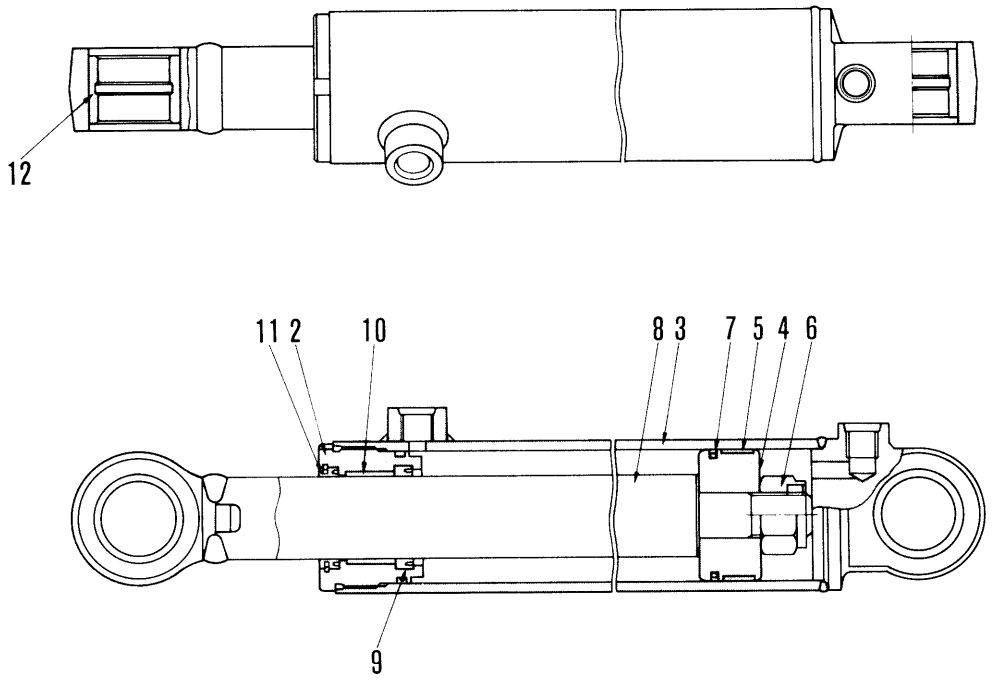
GD705A-4



61F030

BLADE SIDE SHIFT CYLINDER

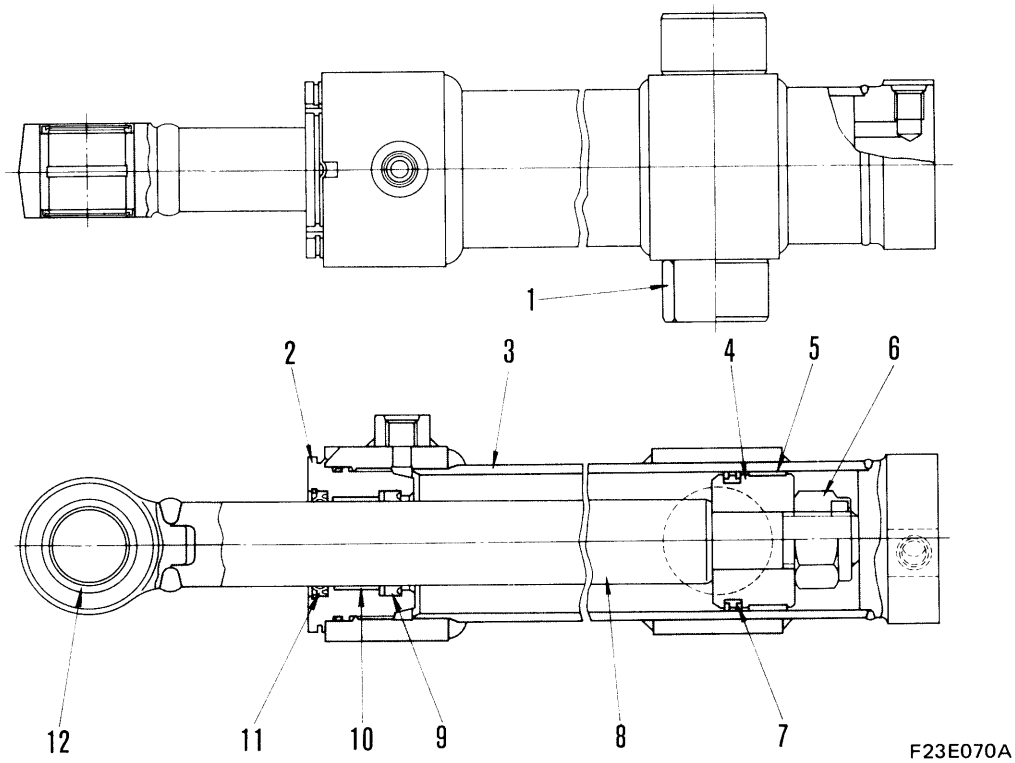
GD705R-4



F23E04052

1. Bushing
2. Cylinder head
3. Cylinder
4. Piston
5. Wear ring
6. Piston nut
7. Piston ring
8. Piston rod
9. Rod packing
10. Bushing
11. Dust seal
12. Bushing

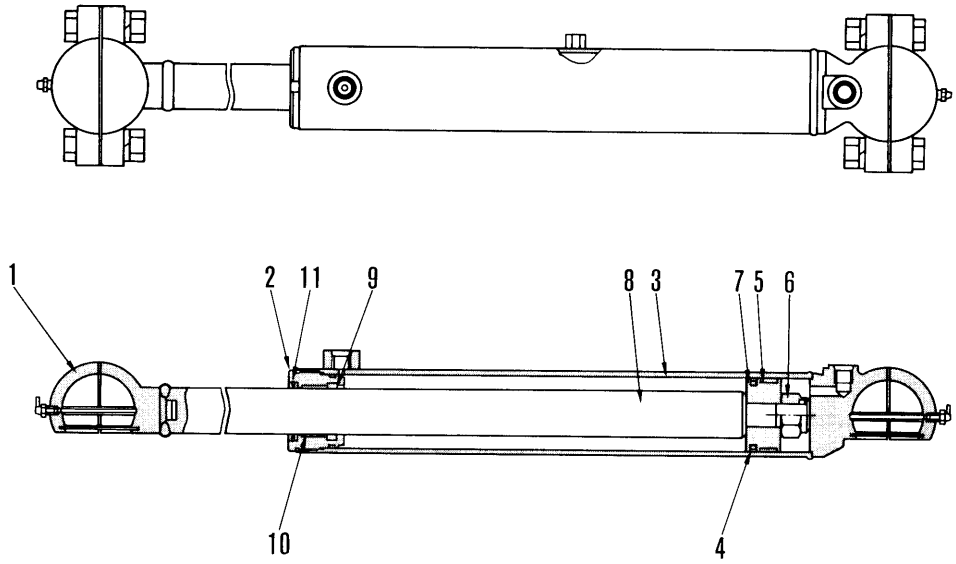
GD705A-4



F23E070A

DRAWBAR SHIFT CYLINDER

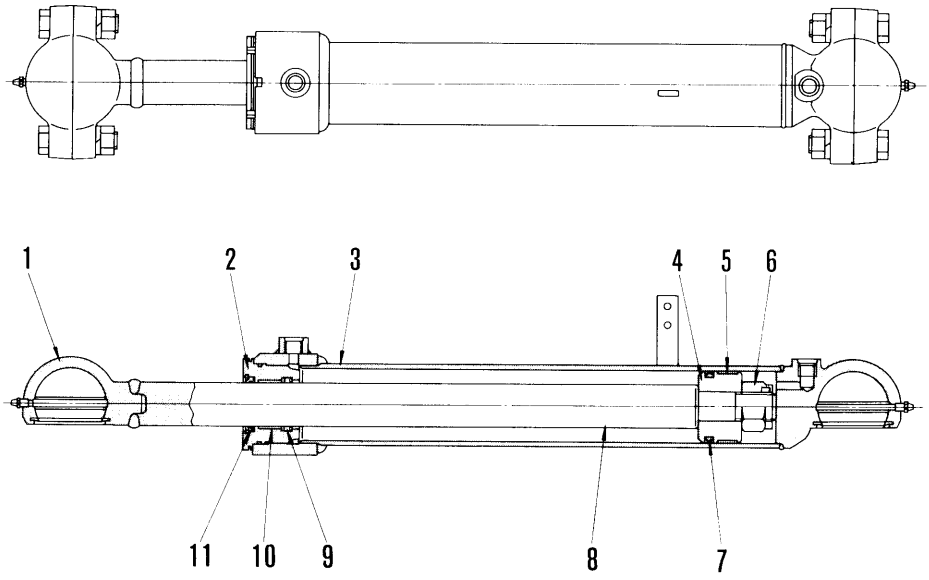
GD705R-4



F23E04053

1. Cap
2. Cylinder head
3. Cylinder
4. Piston
5. Wear ring
6. Piston nut
7. Piston ring
8. Piston rod
9. Rod packing
10. Bushing
11. Dust seal

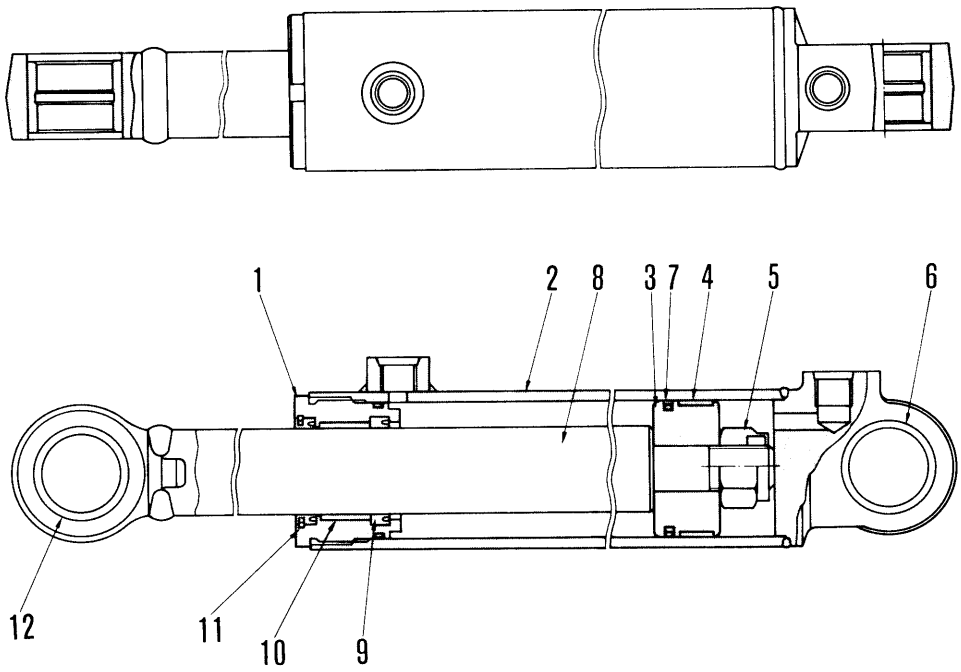
GD705A-4



61F029A

LEANING CYLINDER

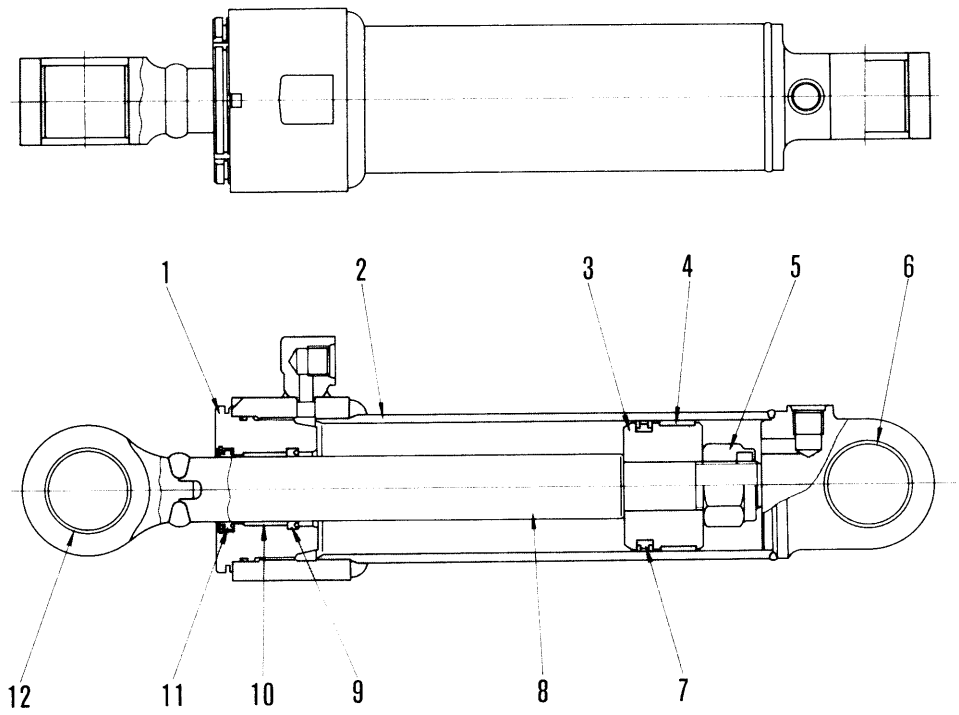
GD705R-4



F23E04054

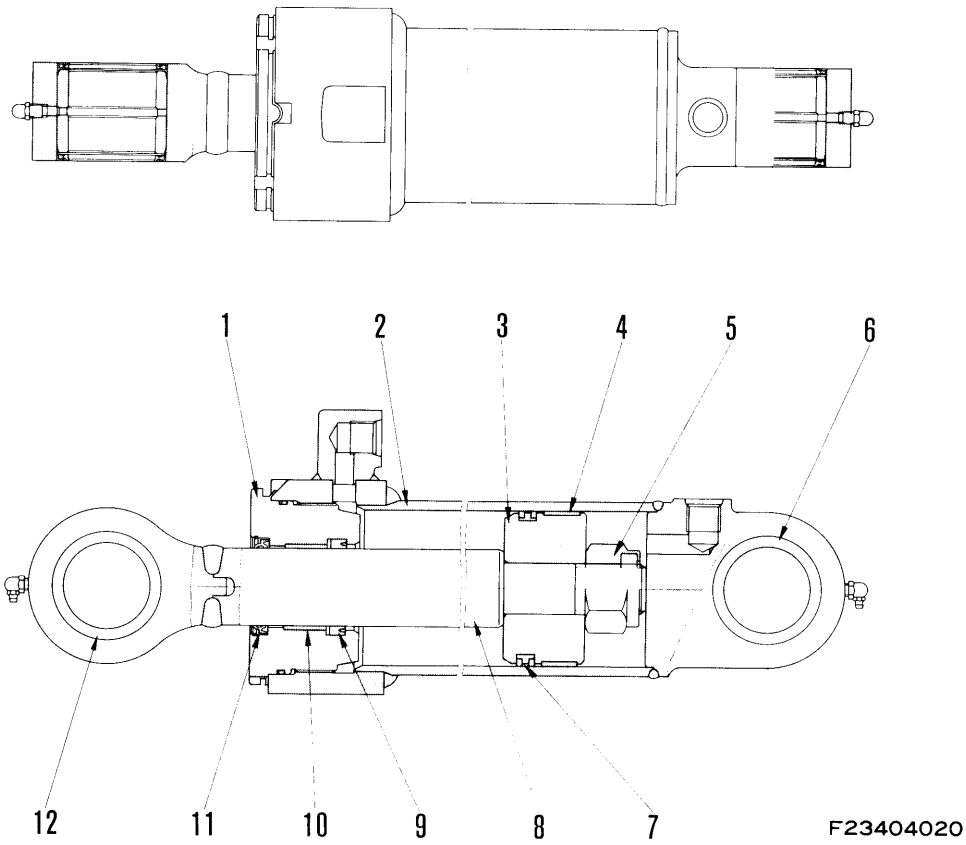
1. Cylinder head
2. Cylinder
3. Piston
4. Wear ring
5. Piston nut
6. Bushing (bottom side)
7. Piston ring
8. Piston rod
9. Rod packing
10. Bushing
11. Dust seal
12. Bushing (head side)

GD705A-4

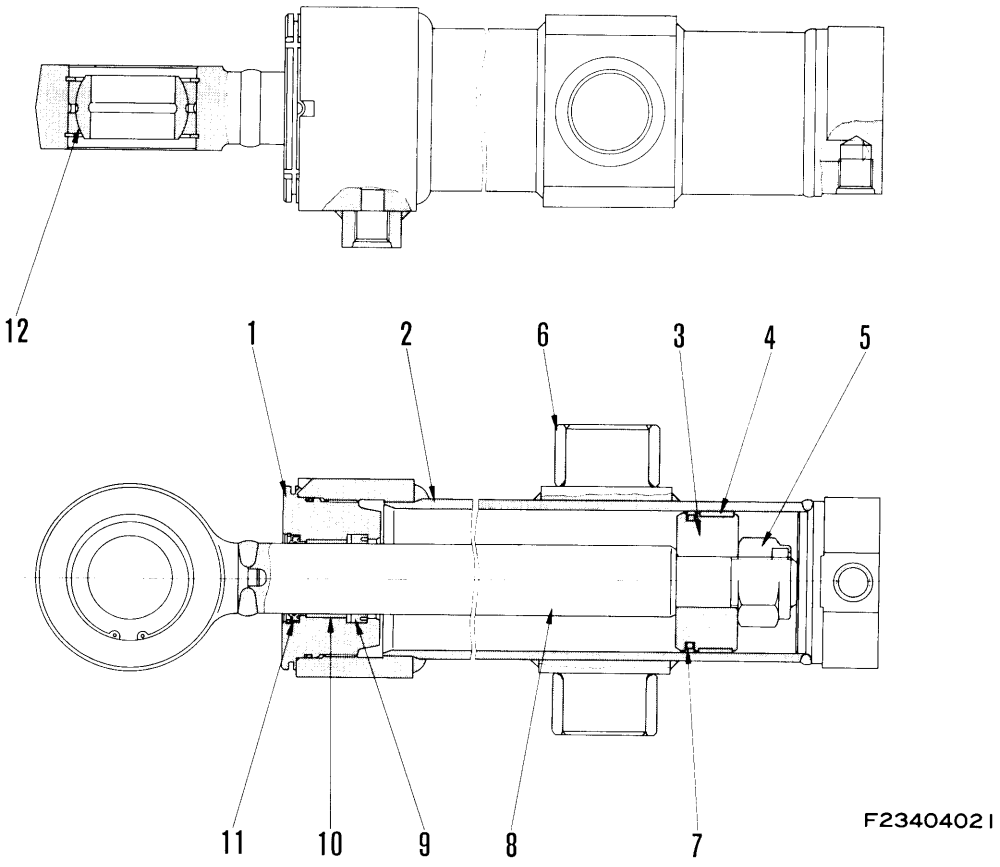


F23E071A

ARTICULATE CYLINDER GD705A-4



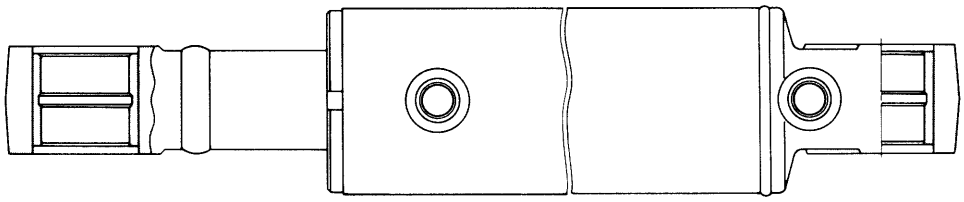
POWER TILT CYLINDER GD705A-4

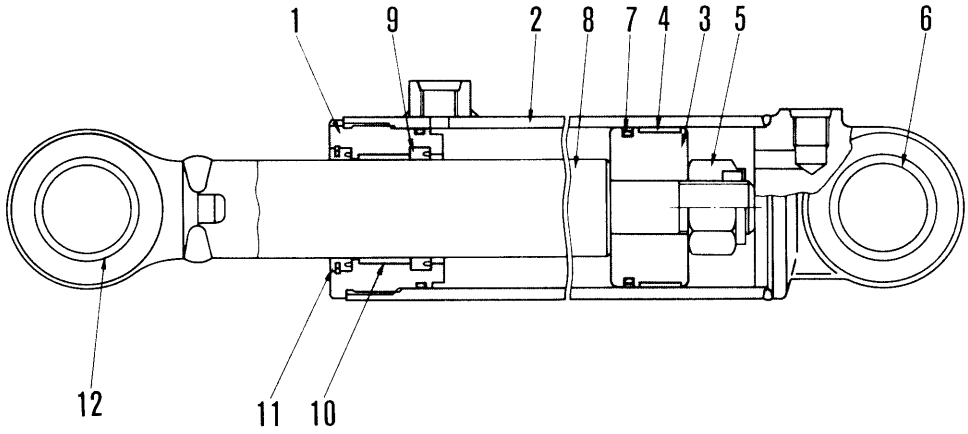


1. Cylinder head
2. Cylinder
3. Piston
4. Wearing
5. Piston nut
6. Bushing (Bottom side)
7. Piston ring
8. Piston rod
9. Rod packing
10. Bushing
11. Dust seal
12. Bushing (head side)

SCARIFIER CYLINDER (If equipped)

GD705R-4

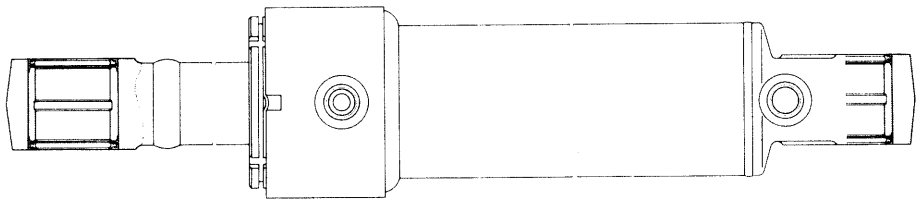


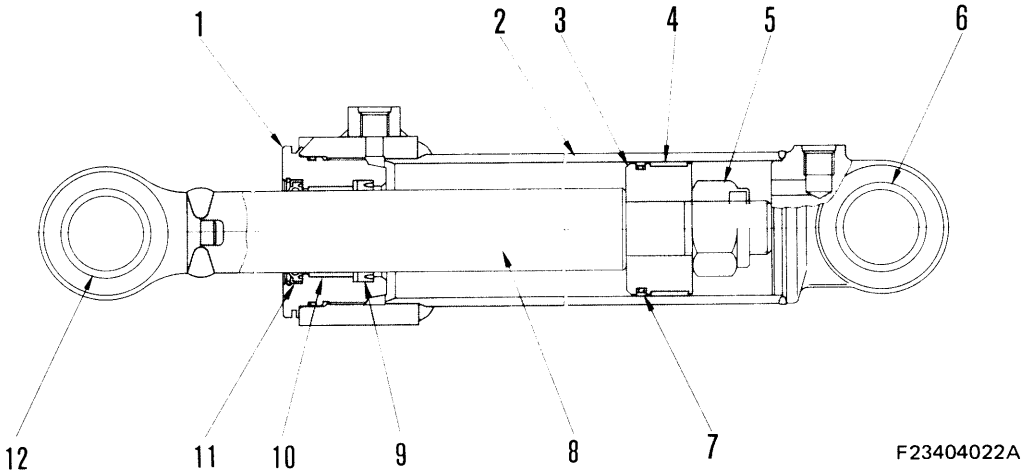


F23E04055

1. Cylinder head
2. Cylinder
3. Piston
4. Wearing
5. Piston nut
6. Bushing (bottom side)
7. Piston ring
8. Piston rod
9. Rod packing
10. Bushing
11. Dust seal
12. Bushing (head side)

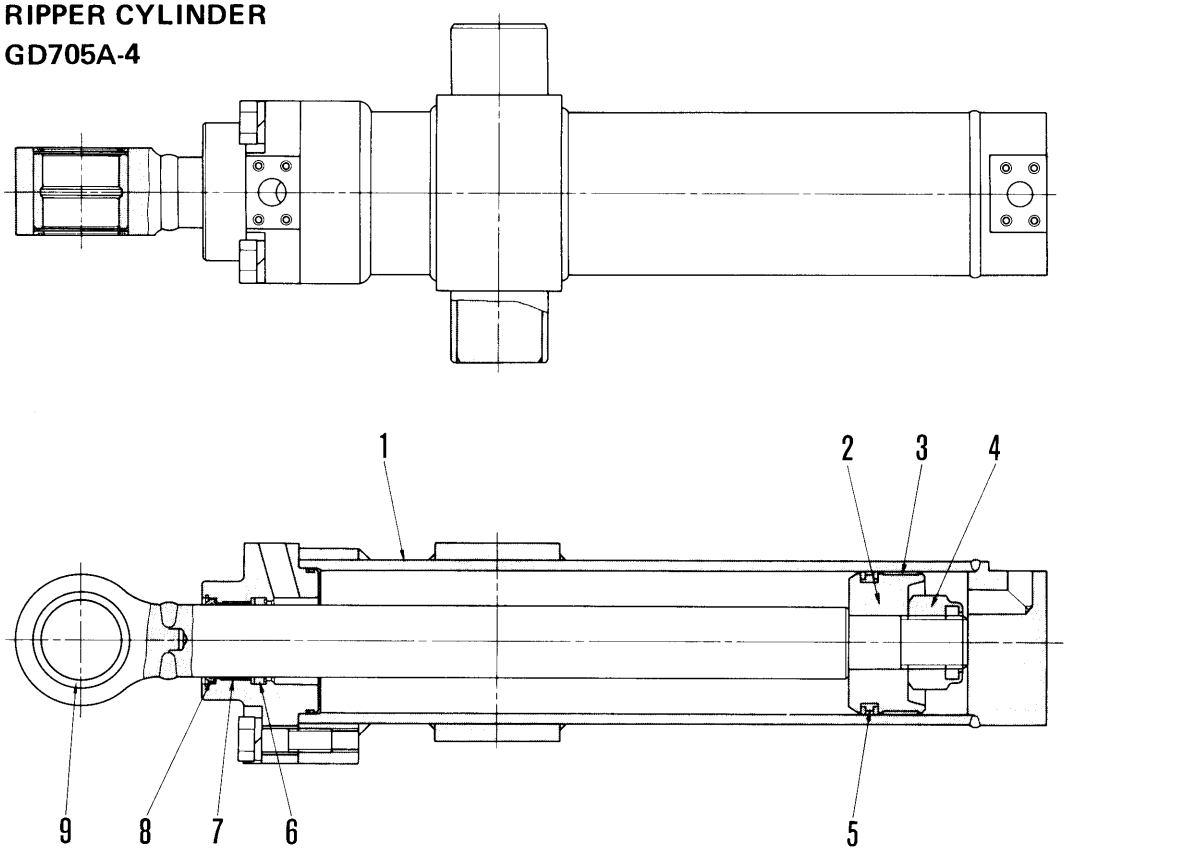
GD705A-4





F23404022A

RIPPER CYLINDER
GD705A-4



F23E075

1. Cylinder
2. Piston
3. Wearing
4. Piston nut
5. Piston ring
6. Rod packing
7. Bushing
8. Dust seal
9. Bushing (Head side)

OUTLINE

The hydraulic cylinder is a mechanism for converting fluid energy into mechanical energy for linear drive purposes. The cylinder has oil inlets and outlets at both the head end (piston rod end) and the bottom end, and by applying oil pressure to both ends, the oil is alternately forced in and out of the cylinder resulting in the piston and piston rod being moved back and forth.
Cylinders with this kind of action are referred to as double-acting cylinders and are used in motor grader.

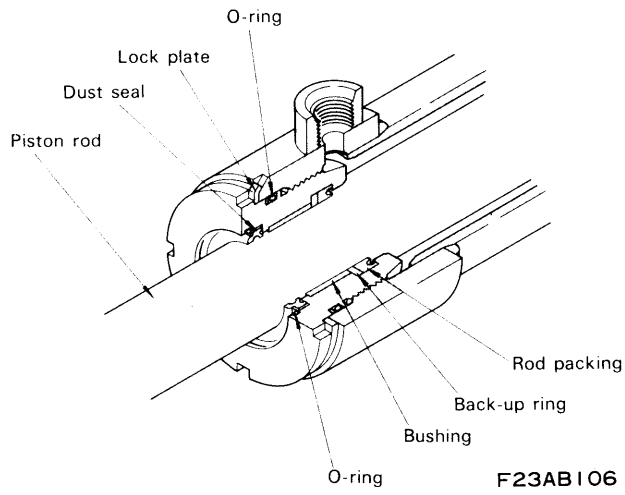
STRUCTURE AND FUNCTION

Cylinder

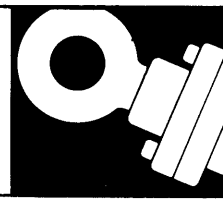
Cylinders are made of steel piping with a base welded to the bottom. The inside of the piping is finished by honing in order to prevent oil leakage and abrasion with the packing.

Cylinder head

The cylinder head of motor grader is secured to the cylinder by cutting a thread into the head and screwing it into the cylinder.
The cylinder head has a center hole through which the piston rod is passed. This hole is fitted with a bronze bushing to prevent the piston rod from rubbing directly against the cylinder head.
This section is also packed to prevent leakage of cylinder oil through the gap between the cylinder head and piston rod. In addition, a dust seal is employed to prevent grit adhering to the piston rod from being carried into the cylinder when the rod is pushed in.



HYDRAULIC SYSTEM
62 TESTING AND ADJUSTING



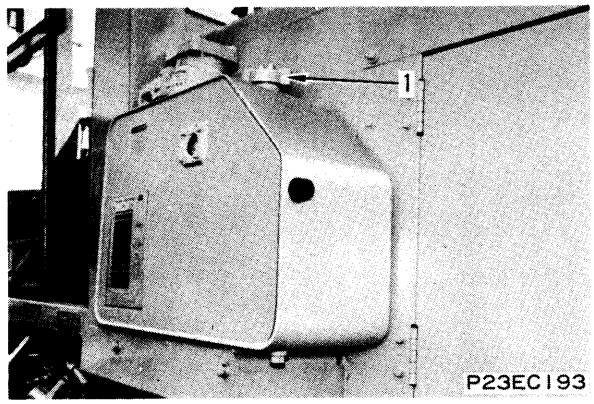
CHECKING HYDRAULIC OIL TEMPERATURE

Special tool

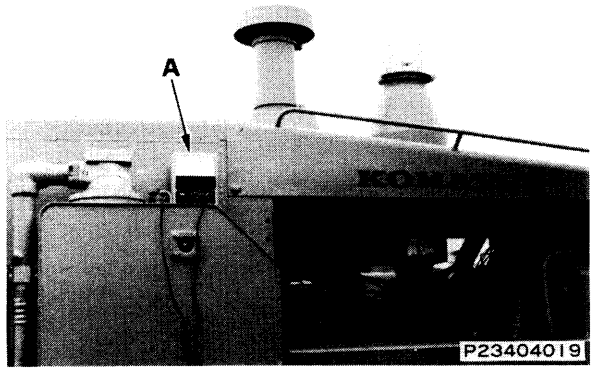
	Part number	Part name	Q'ty
A	795-500-1300	Thermistor	1

1. Remove hydraulic oil tank cap (1) and remove strainer.

When removing cap, loosen the oil filler cap slowly to release the remaining oil pressure in the hydraulic tank.

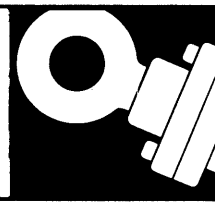


2. Insert sensor into filling port and measure oil temperature with thermistor gauge A.



HYDRAULIC SYSTEM

63 DISASSEMBLY AND ASSEMBLY



REMOVAL OF HYDRAULIC TANK

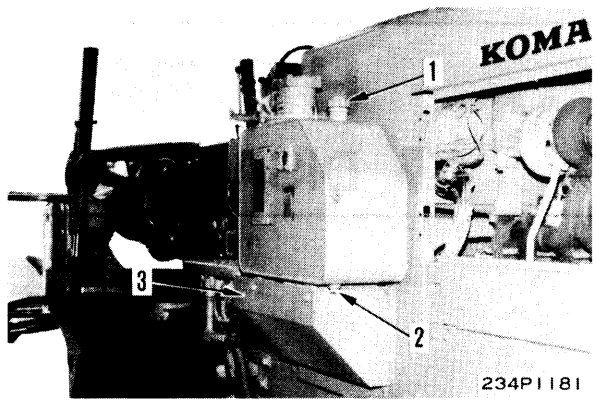
GD705A-4

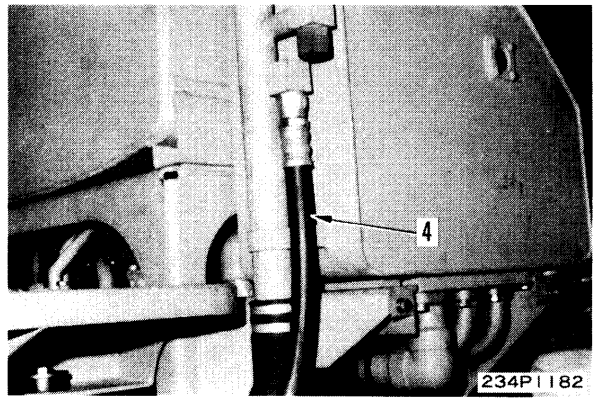
Lower the work equipment completely to the ground and stop the engine. Operate the control lever several times to release the remaining hydraulic pressure in the hydraulic piping. Then loosen the oil filler cap (1) slowly to release the remaining oil pressure in the hydraulic tank.

1. Remove drain plug (2) and drain oil from hydraulic tank.

   Hydraulic tank: 70ℓ

2. Remove cover (3).
3. Disconnect hose (4).
4. Disconnect hoses (5), (6) (7), (8).
5. Lift hydraulic tank and dismount it.





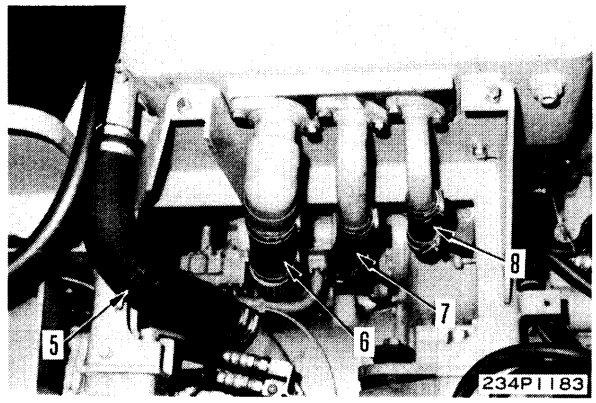
INSTALLATION OF HYDRAULIC TANK

GD705A-4

1. Lift hydraulic tank and mount it.
2. Connect hoses (8), (7), (6), (5).
3. Connect hose (4).
4. Install cover (3).
5. Tighten drain plug (2).
6. Add engine oil through hydraulic oil filler (1) to the specified level.

   Hydraulic oil tank: 70ℓ

★ Run the engine to circulate the oil through the system. Then check the oil level again.



REMOVAL OF HYDRAULIC PUMP ASSEMBLY

GD705R-4

Lower work equipment completely to the ground.

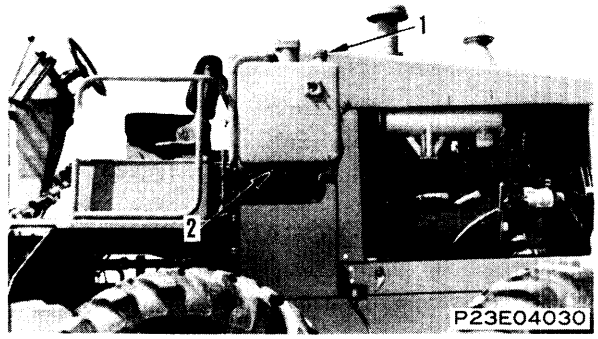
Slowly loosen cap (1) to release the oil pressure from the hydraulic tank.

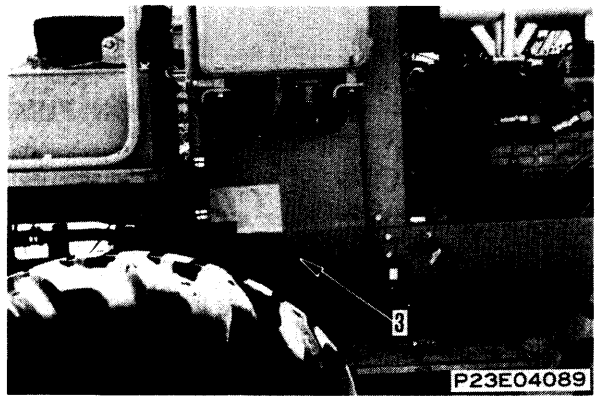
1. Remove drain plug (2) and drain engine oil from the hydraulic tank.

   Hydraulic tank: Approx. 27ℓ

2. Remove cover (3).
3. Disconnect inlet tubes (4), (5).
4. Disconnect outlet hoses (6), (7).
5. Dismount hydraulic pump assembly (8).

   Hydraulic pump assembly: Approx. 11 kg





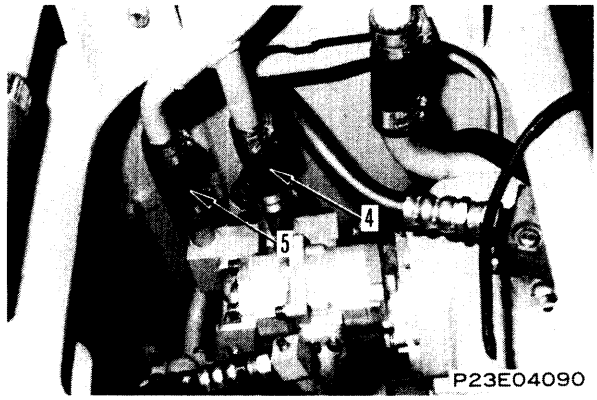
INSTALLATION OF HYDRAULIC PUMP ASSEMBLY

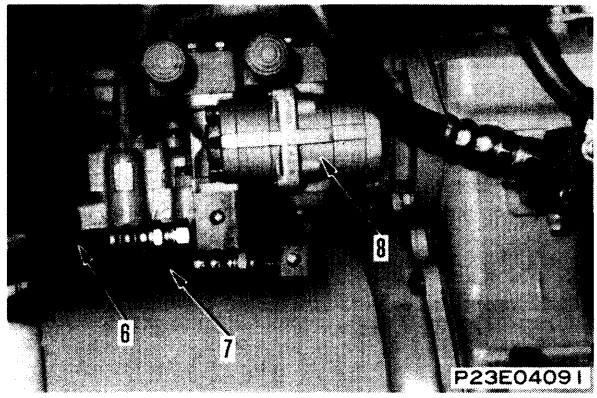
GD705R-4

1. Fit O-ring and mount hydraulic pump (8).
2. Connect outlet hoses (6), (7).
3. Connect inlet tubes (4), (5).
4. Install cover (3).
5. Tighten drain plug (2) and add engine oil through filler port (1) to the specified level.

   Hydraulic tank: Approx. 27ℓ

★ Run the engine to circulate engine oil through the system. Then check oil level again.





REMOVAL OF HYDRAULIC PUMP ASSEMBLY

GD705A-4

⚠ Lower the work equipment completely to the ground and stop the engine.

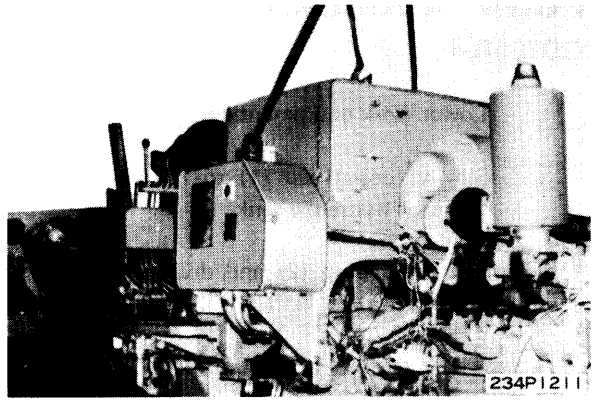
★ Remove fuel tank assembly (incl. hydraulic tank).
For details, see 13 REMOVAL OF HYDRAULIC PUMP ASSEMBLY (incl. HYDRAULIC TANK).

REMOVAL OF HYDRAULIC PUMP ASSEMBLY

1. Disconnect inlet tube (1), outlet tube (2) and outlet hose (3) from hydraulic pump assembly.

2. Remove hydraulic pump assembly (4).

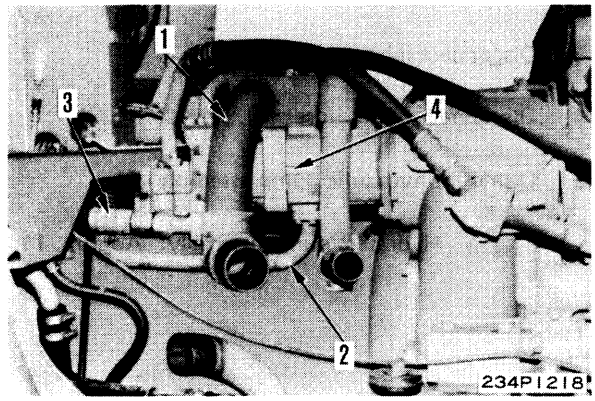
kg Hydraulic pump assembly: Approx. 14 kg



REMOVAL OF CIRCLE ROTATION PUMP ASSEMBLY

1. Remove inlet tube (5) and outlet tube (6) from circle rotation pump.
2. Remove circle rotation pump assembly (7).

kg Rotation pump assembly: Approx. 6 kg



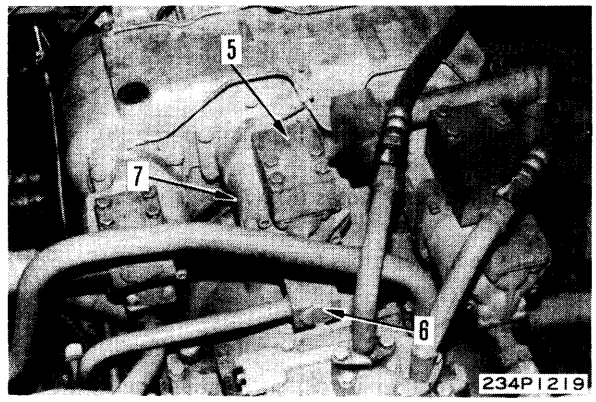
INSTALLATION OF HYDRAULIC PUMP ASSEMBLY

GD705A-4

INSTALLATION OF HYDRAULIC PUMP ASSEMBLY

1. Install hydraulic pump assembly (4).
   ★ Fit O-ring at PTO case end.

2. Connect outlet hose (3), outlet tube (2) and inlet tube (1).



INSTALLATION OF CIRCLE ROTATION PUMP ASSEMBLY

1. Install circle rotation pump assembly (7).
   ★ Fit O-ring at PTO case end.

2. Install outlet tube (6) and inlet tube (5).

★ Install fuel tank assembly (incl. hydraulic tank).
For details, see 13 INSTALLATION OF FUEL TANK ASSEMBLY (incl. HYDRAULIC TANK).

REMOVAL OF HYDRAULIC CONTROL VALVE ASSEMBLY

GD705R-4

⚠ Lower work equipment completely to the ground.

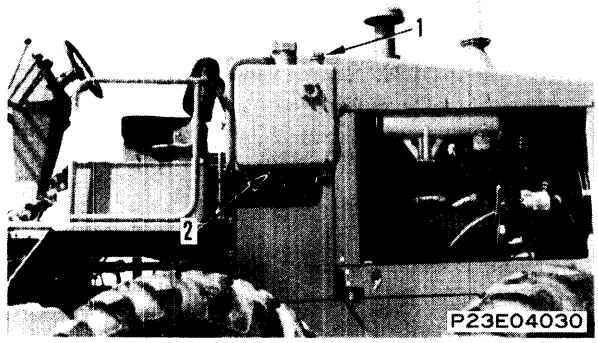
⚠ Operate the control valve several times to release the oil pressure from the piping.
Slowly loosen the filler cap (1) to release the remaining oil pressure from the hydraulic tank.

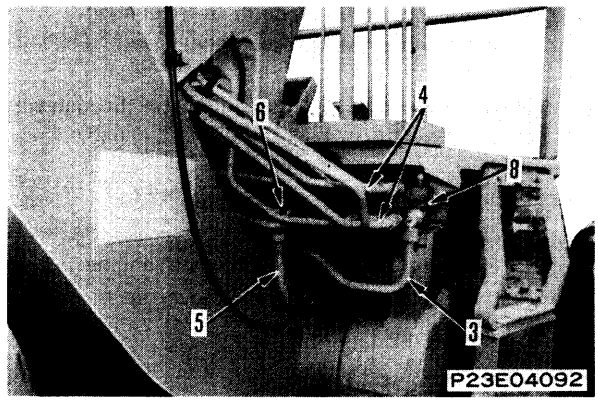
1. Remove drain plug (2) and drain engine oil from the hydraulic tank.

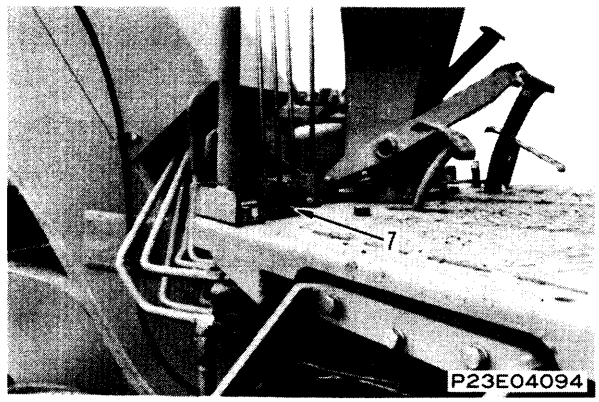
   Hydraulic tank: Approx. 27ℓ

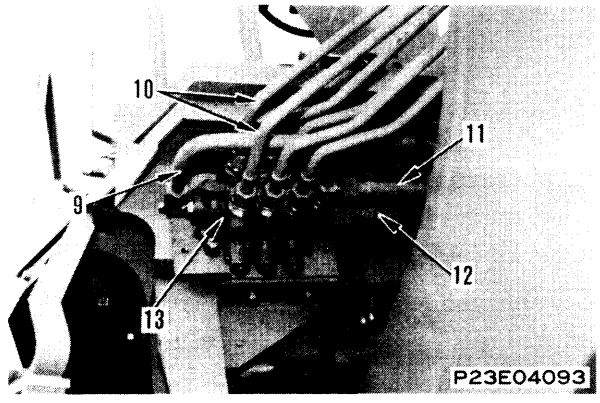
2. Dismount L.H. control valve assembly
   1) Disconnect inlet tube (3), eight cylinder tubes (4), outlet tube (5), carry over tube (6).
   2) Remove joint pins (7) for control lever and dismount L.H. control valve assembly (8).

3. Dismount R.H. control valve assembly
   1) Disconnect carry over tube (9), six cylinder tubes (10), inlet tube (11), outlet tube (12).
   2) Remove joint pins (7) for control lever and dismount R.H. control valve assembly (13).









INSTALLATION OF HYDRAULIC CONTROL VALVE ASSEMBLY

GD705R-4

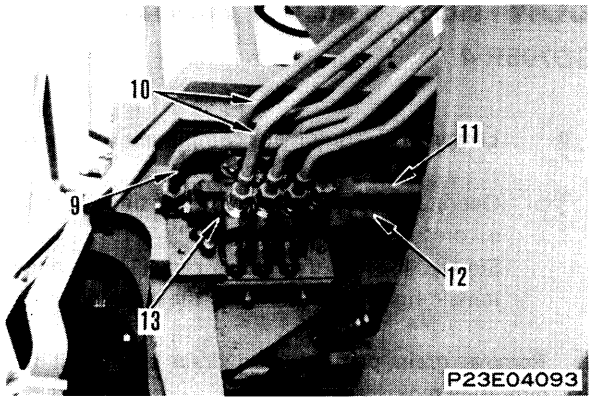
1. Mount L.H. control valve assembly
   1) Mount L.H. control valve assembly (8) and connect control lever with joint pins (7).
   2) Connect carry over tube (6), outlet tube (5), eight cylinder tubes (4), inlet tube (3).
      ★ Bend cotter pin securely.

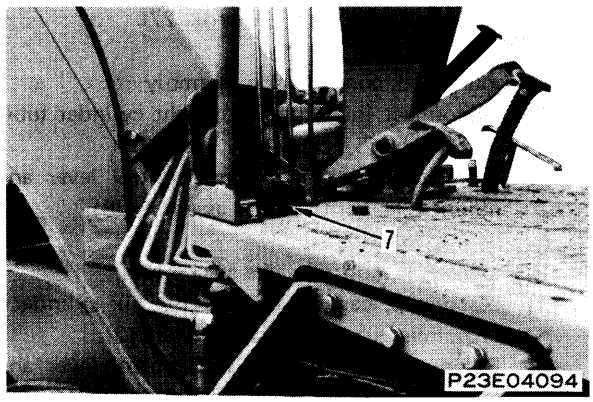
2. Mount R.H. control valve assembly
   1) Mount R.H. control valve assembly (13) and connect control lever with joint pins (7).
   2) Connect outlet tube (12), inlet tube (11), six cylinder tubes (10), carry over tube (9).
      ★ Bend cotter pin securely.

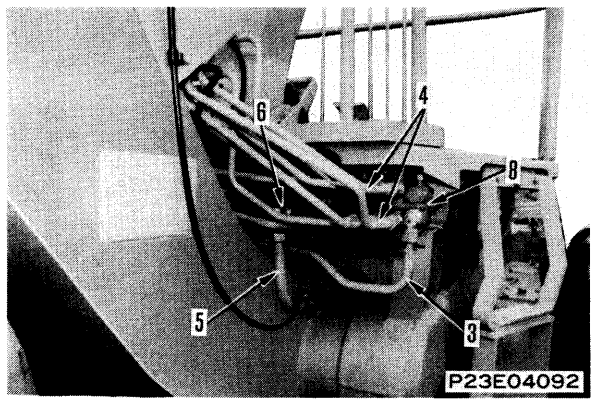
3. Tighten drain plug (2), add engine oil through filler port (1) to the specified level.

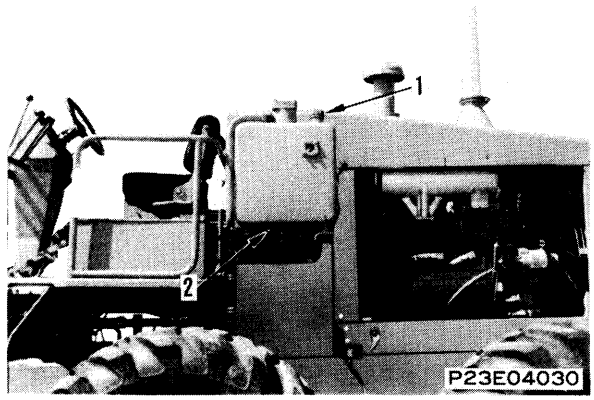
   Hydraulic tank: Approx. 27ℓ

   ★ Run the engine to circulate engine oil through the system. Then check oil level again.









REMOVAL OF HYDRAULIC CONTROL VALVE ASSEMBLY

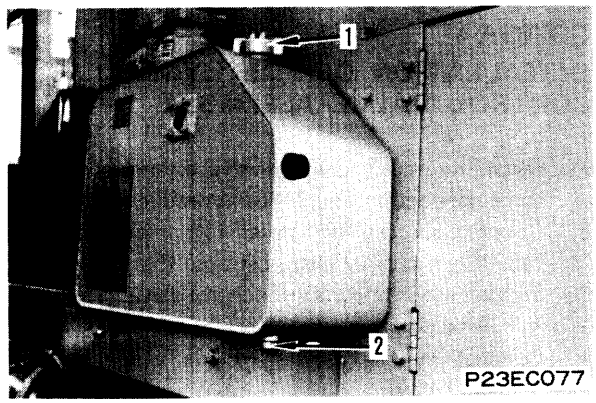
GD705A-4

⚠ Lower work equipment completely to the ground.

⚠ Operate the control lever several times to release the remaining hydraulic oil pressure in system. Then loosen the oil filler cap (1) slowly to release the remaining oil pressure in the hydraulic tank.

1. Remove drain plug (2) and drain oil from hydraulic oil tank.

Hydraulic oil tank: Approx. 70ℓ

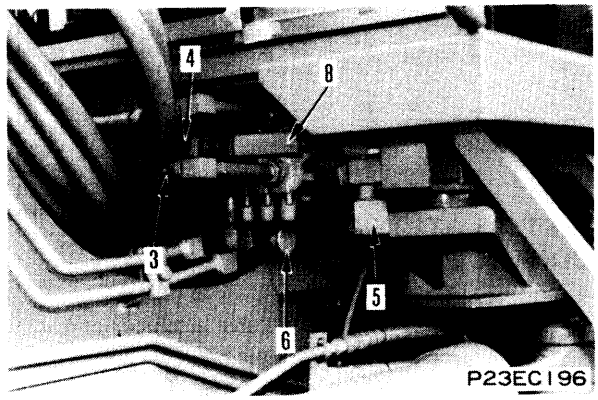


P23EC077

REMOVAL OF L.H. HYDRAULIC CONTROL VALVE

1. Disconnect six cylinder hoses (3), inlet hose (4), outlet tube (6) and carry over port hose (5).
2. Pull out three connecting pins (7) of control lever and dismount L.H. control valve assembly (8).
3. Remove mounting bolt of control valve.

★ Disconnect cylinder hoses in the order shown in the diagram below.

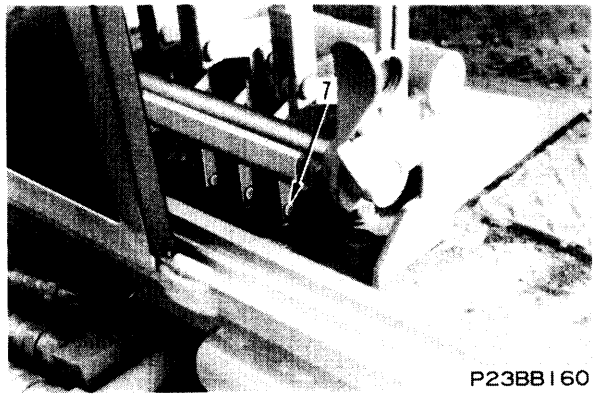


P23EC196

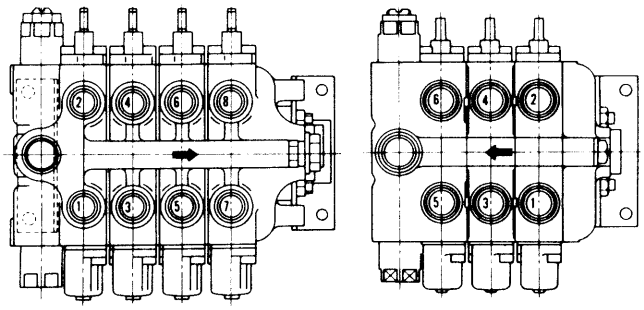
REMOVAL OF R.H. HYDRAULIC CONTROL VALVE

1. Disconnect eight cylinder hoses (9), inlet hose (10), outlet tube (11), and carry over port hose (12).
2. Pull out four connecting pins and dismount R.H. hydraulic control valve assembly (13).
3. Remove mounting bolt of control valve.

★ Disconnect cylinder hoses in the order shown in the diagram below.

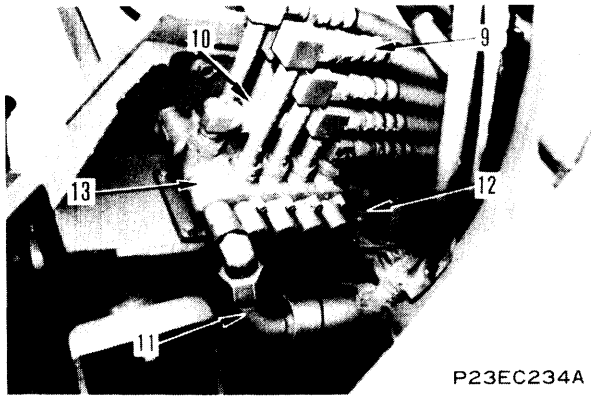


P23BB160



R.H. valve L.H. valve

F23EC032A



P23EC234A

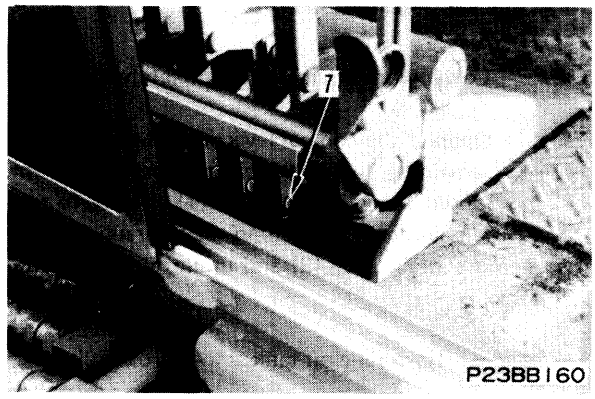
INSTALLATION OF HYDRAULIC CONTROL VALVE ASSEMBLY

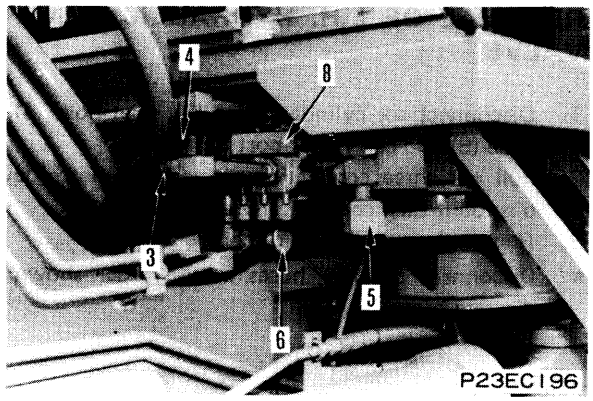
GD705A-4

INSTALLATION OF L.H. HYDRAULIC CONTROL VALVE ASSEMBLY

1. Install hydraulic control valve assembly (8) and insert three connection pins (7) of hydraulic control lever.
2. Connect six cylinder hoses (3), inlet hose (4), outlet tube (6), and carry over port hose (5).
3. Tighten mounting bolt of control valve.
   ★ Bend cotter pin securely.

★ Connect cylinder hoses in the order shown in the diagram below.

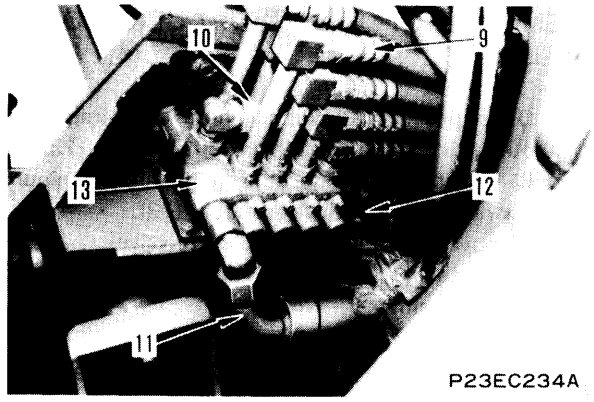


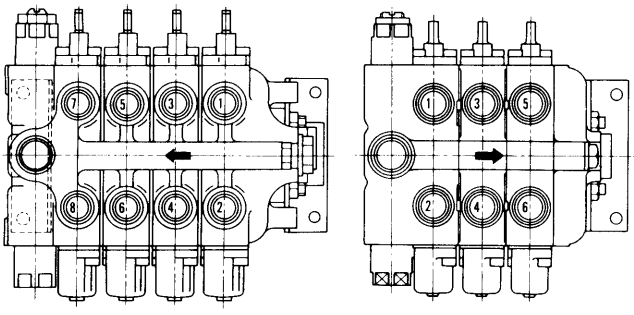


INSTALLATION OF R.H. HYDRAULIC CONTROL VALVE ASSEMBLY

1. Install hydraulic control valve assembly and install four connection pins of hydraulic control lever.
2. Connect eight cylinder hoses (9), inlet hose (10), outlet tube (11), and carry over port hose (12).
3. Tighten mounting bolt of control valve.
   ★ Bend cotter pin securely.

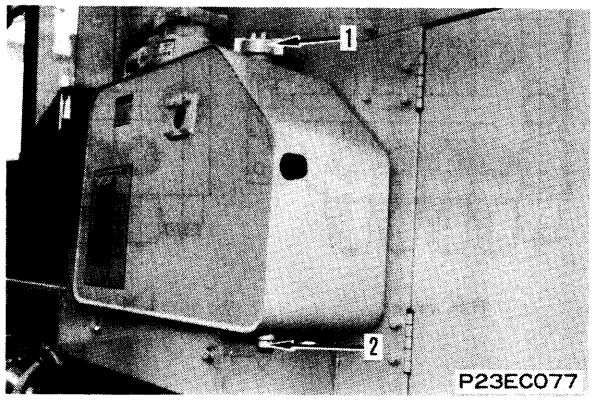
★ Connect cylinder hoses in the order shown in the diagram below.





R.H. valve L.H. valve

F23EC033A



REFILLING WITH OIL

Tighten drain plug (2) and refill engine oil through oil filler port (1) to specified level.

Hydraulic tank: Approx. 70ℓ

★ Run the engine to circulate the oil through the system. Then check the oil level again.

REMOVAL OF BLADE LIFT CYLINDER ASSEMBLY

⚠ Lower work equipment completely to the ground.

1. Raise blade lift cylinder assembly (1) with a crane.
2. Remove cap (2), and disconnect it from drawbar (3).
3. Run the engine, operate control lever and fully retract piston rod.

   ⚠ To prevent piston rod from coming out, fix piston rod with wire.

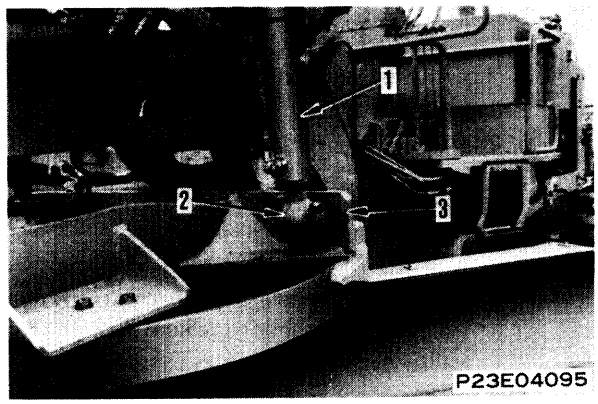
   Stop engine, operate the control lever several times to release the oil pressure from the system.
4. Disconnect hoses (4), (5) from cylinder.
5. Remove cap (6) and dismount blade cylinder assembly (1).

   kg Blade cylinder assembly:
   Approx. 55 kg (GD705R-4)
   Approx. 63 kg (GD705A-4)

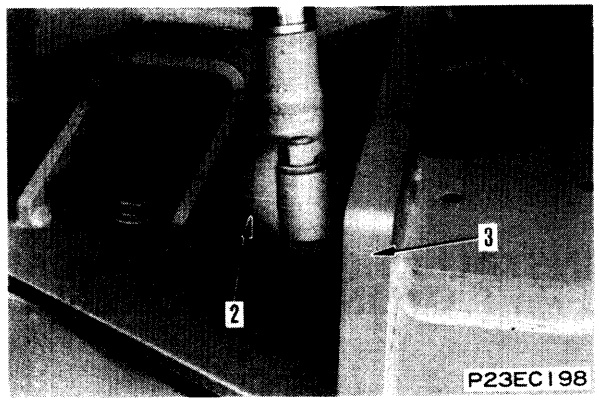
INSTALLATION OF BLADE LIFT CYLINDER ASSEMBLY

1. Raise blade lift cylinder assembly (1) with crane, install seal, and set in position with the yoke. Align dowel pin and install cap (6).
2. Install cap (6) and tighten with bolt.
3. Connect hoses (5), (4) to cylinder.
   - ★ Be sure to connect hoses to the correct end.
   - ★ Install hoses without twisting.
4. Run the engine, extend piston rod, and install dust seal. Then set in position with drawbar (3).
5. Fit shim, install cap (2) and tighten with bolt.
   - ★ Operate the control lever to circulate engine oil through in cylinder. Then add engine oil into hydraulic tank to be specified level.

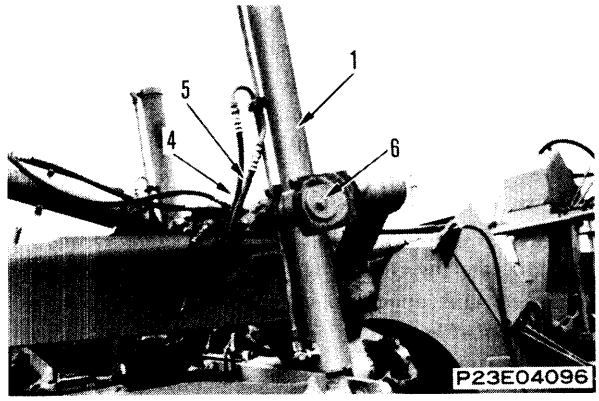
GD705R-4



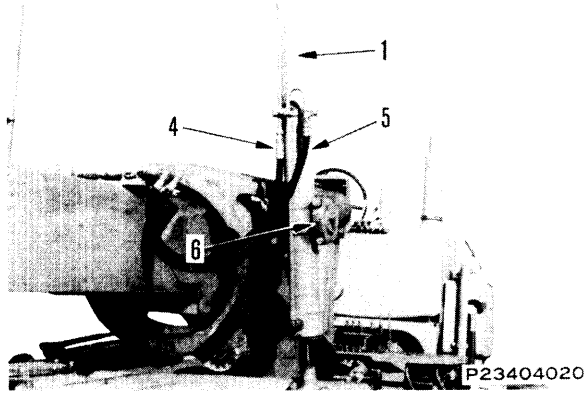
GD705A-4



GD705R-4



GD705A-4



REMOVAL OF DRAWBAR SHIFT CYLINDER ASSEMBLY

⚠ Lower work equipment completely to the ground.

1. Sling center of drawbar shift cylinder assembly (1) and raise it with a crane.
2. Remove cap (2) and disconnect it from bracket.
3. Start engine. Fully retract piston rod.

⚠ Stop the engine. Operate control lever several times the remaining pressure from the hydraulic piping.

4. Disconnect hoses (3), (4) from cylinder.
5. Remove cap (5) and dismount drawbar shift cylinder assembly (1).

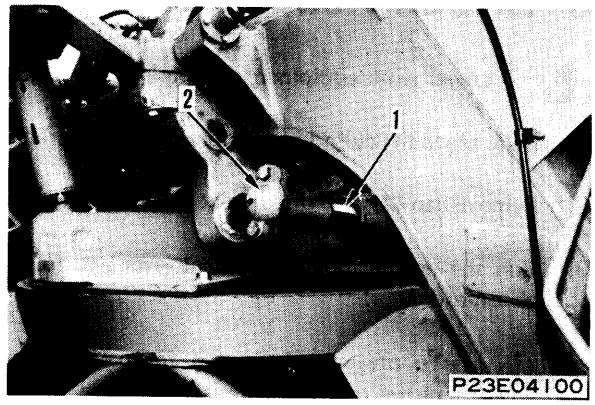
kg Drawbar shift cylinder assembly: Approx. 35 kg
Approx. 30 kg (GD705R-4)
Approx. 35 kg (GD705A-4)

INSTALLATION OF DRAWBAR SHIFT CYLINDER ASSEMBLY

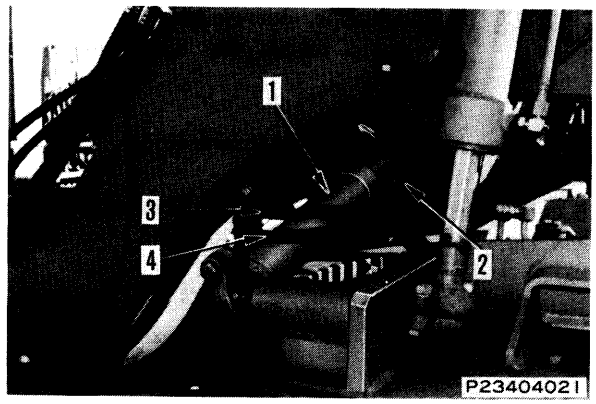
1. Sling center of drawbar shift cylinder assembly (1) and raise it with a crane.
   Install dust seal (6) and align the ass'y with drawbar (7).
2. Install shims (8) and install cap (5).
3. Connect hoses (3), (4) to cylinder.
   ★ Be sure to connect the hoses to the correct end.
   ★ Install hoses without twisting.
4. Start engine, extend piston rod and install dust seal. Align piston rod with the brocket.
5. Install shim and install cap (2).

★ Operate the control lever to circulate oil in the cylinder then add engine oil into the hydraulic tank to the specified level.

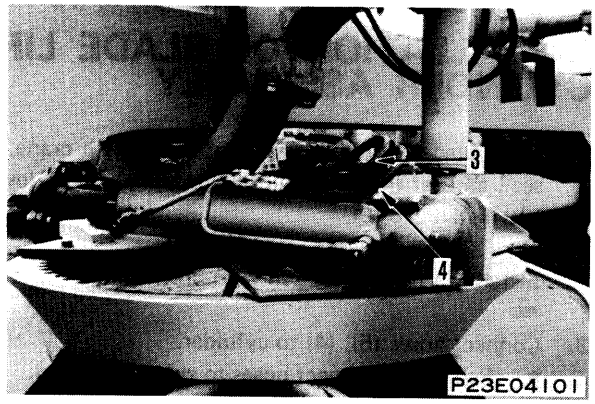
GD705R-4

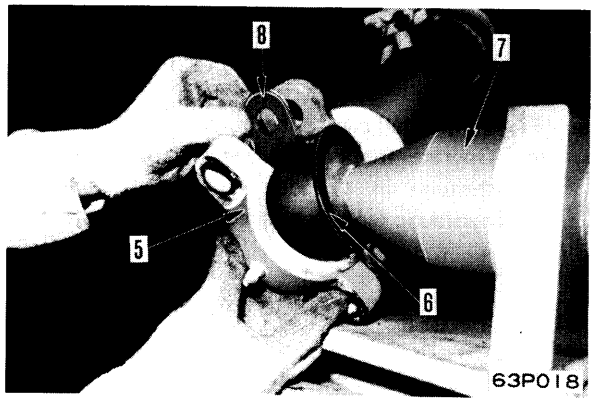


GD705A-4



GD705R-4



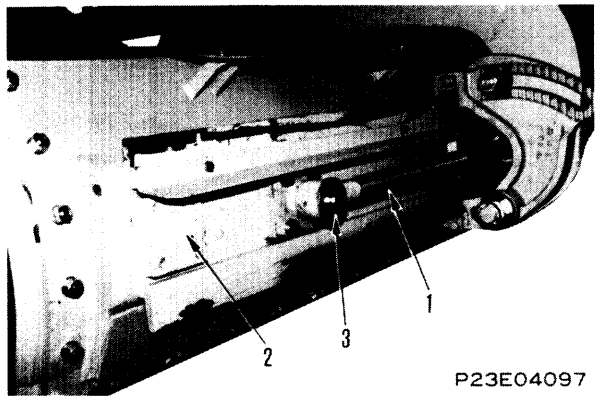


REMOVAL OF BLADE SIDE SHIFT CYLINDER ASSEMBLY

GD705R-4

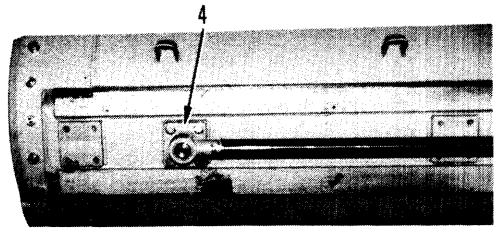
⚠ Start engine and operate lever to raise blade about 200 mm off the ground and support swing circle lower part with block.

1. Operate lever to fully extend piston rod (1) to push blade (2).
2. Remove bolt and remove plate (3).



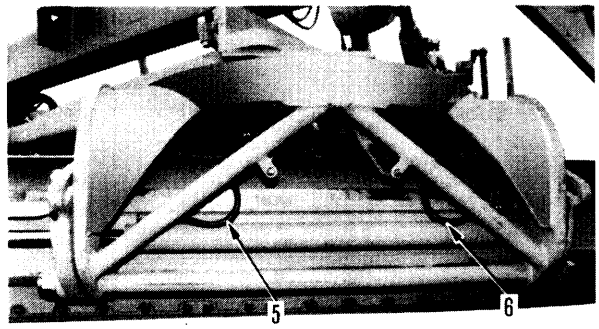
P23E04097

3. Temporarily sling cylinder piston rod and disconnect bracket (4) from blade.
4. Start engine and operate lever to fully retract piston rod.
5. Sling blade (2) and push it out to the piston where cylinder can be removed.



P23E04098

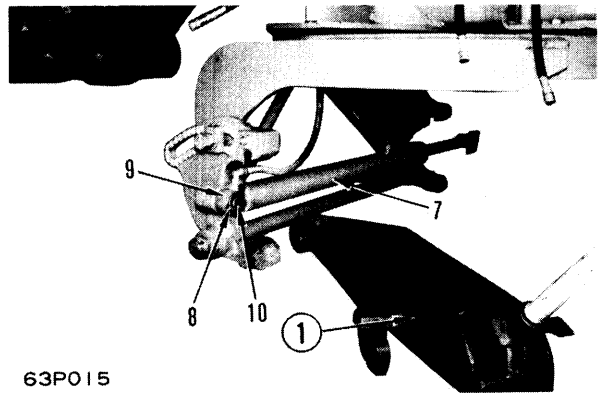
6. Disconnect hoses (5) and (6) from cylinder.



P23E04099

7. Put jack (1) to blade side shift cylinder assembly (7), remove snap ring (8) and pull washer (9) and shaft (10), remove cylinder assembly.

kg Blade side shift cylinder: 45 kg

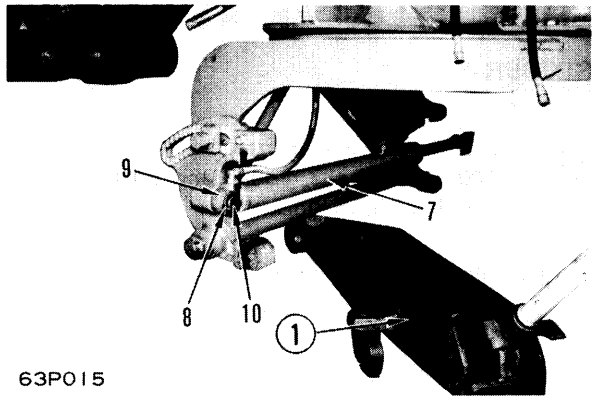


63P015

INSTALLATION OF BLADE SIDE SHIFT CYLINDER ASSEMBLY

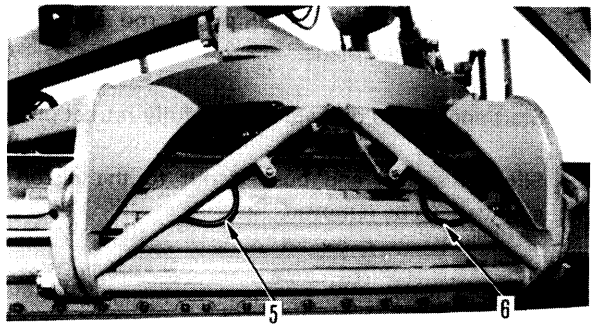
GD705R-4

1. Put blade side shift cylinder assembly (7) on jack ①. Align hole on cylinder with that on adjuster. Drive shaft (10) and install washer (9) and install snap ring (8).



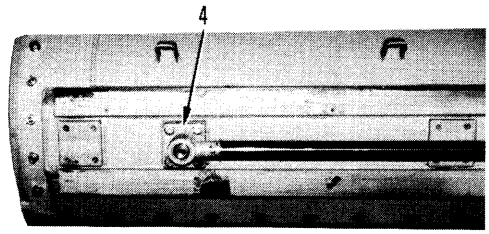
63P015

2. Connect hoses (6) and (5) to cylinder.
   ★ Install hoses using care to avoid twisting.



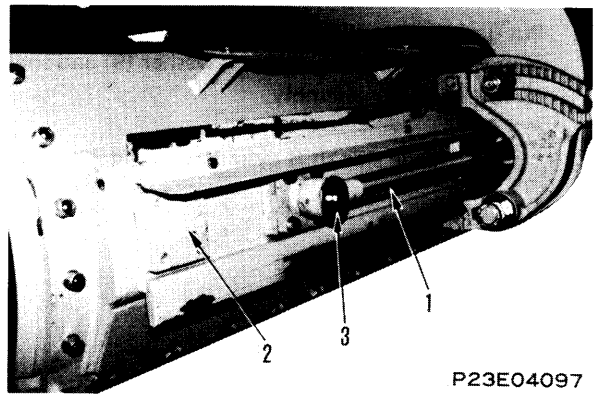
P23E04099

3. Sling blade (2) and fully extend piston rod to the installable position.
4. Sling piston rod (1) and start engine to extend piston rod fully.
5. Install bracket (4) to blade.



P23E04098

6. Install plate (3).
7. Raise blade to remove block.
   ★ Operate control lever to circulate oil through the cylinder and add engine oil to hydraulic tank up to the specified level.

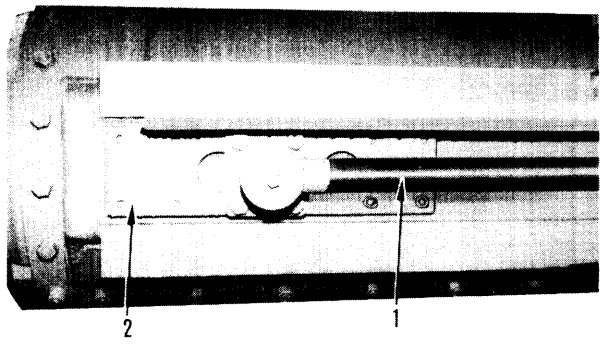


P23E04097

REMOVAL OF BLADE SIDE SHIFT CYLINDER ASSEMBLY

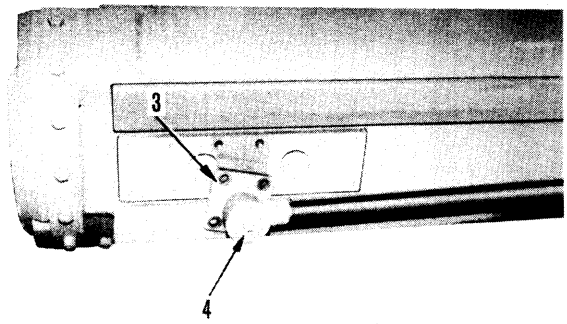
GD705A-4

⚠ Start engine, operate control lever to raise work equipment, (approx. 200 mm) then put blocks under the circle.



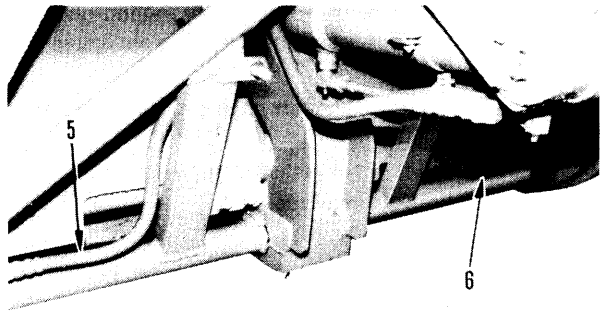
P23BB163

1. Operate control lever to fully extend piston rod (1), then push out blade (2).
2. Temporarily raise piston rod and disconnect bracket (3) from blade.
3. Remove bolt (4) and remove bracket.
4. Start engine. Operate control lever to fully retract piston rod.
5. Sling the center of blade (2) raise it with a crane, remove cylinder and push it out slightly to the side.



P23BB164

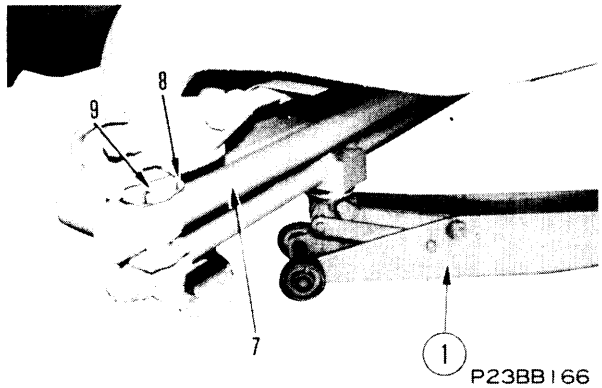
6. Disconnect hoses (5), (6) from cylinder.



P23BB165

7. Put blade side shift cylinder assembly (7) on jack ①, remove bolt (8) and washer (9) and remove cylinder assembly.

kg Blade side shift cylinder assembly: Approx. 72 kg

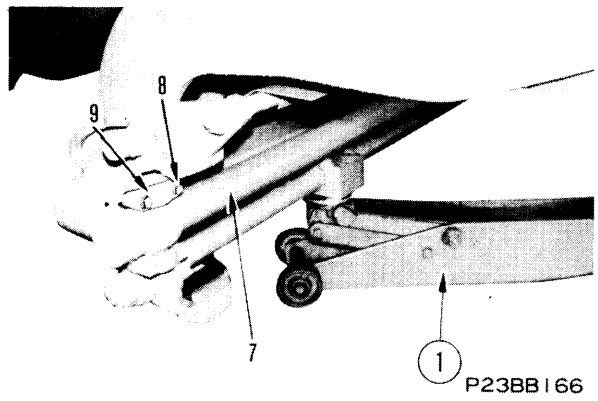


P23BB166

INSTALLATION OF BLADE SIDE SHIFT CYLINDER ASSEMBLY

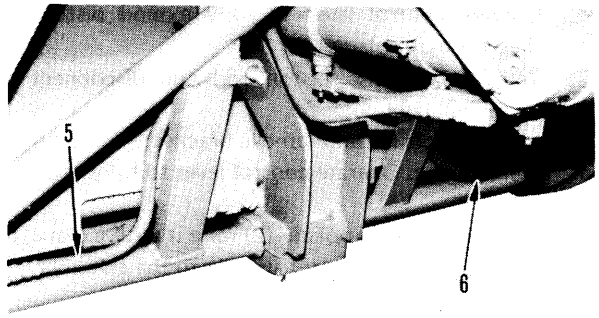
GD705A-4

1. Put blade side shift cylinder assembly (7) on jack ①, align adjuster hole with cylinder.
   Install washer (9) and bolt (8).



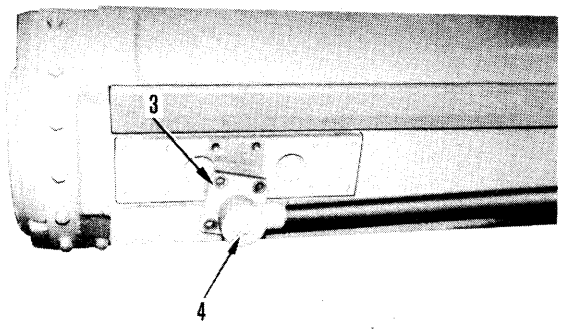
P23BB166

2. Connect hoses (5), (6) to cylinder.
   ★ Install hoses without twisting.



P23BB165

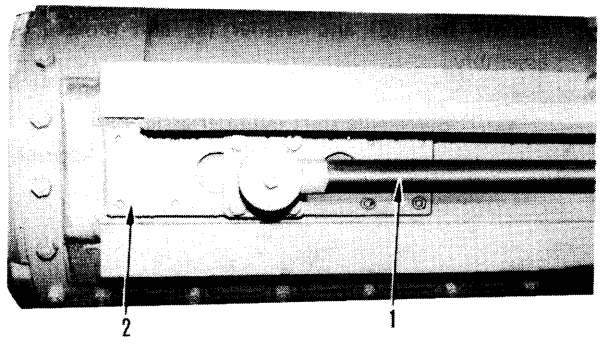
3. Raise blade (2) with a crane, fully extend piston rod and push it in until it reaches a position where it can be connected.
4. Raise piston rod (1), start engine and fully extend piston rod (1).
5. Install bracket (3) in rod end and install bolt (4).
6. Connect bracket on blade.



P23BB164

7. Raise work equipment and pull out block.

★ Operate control lever to circulate the oil in the cylinder, then add engine oil into the hydraulic tank to the specified level.



P23BB163

REMOVAL OF LEANING CYLINDER ASSEMBLY

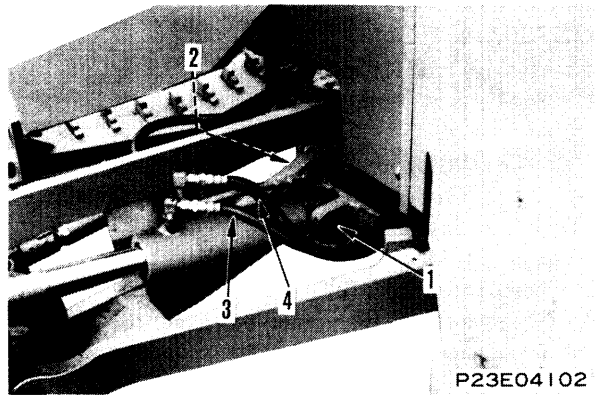
GD705R-4

Special tool

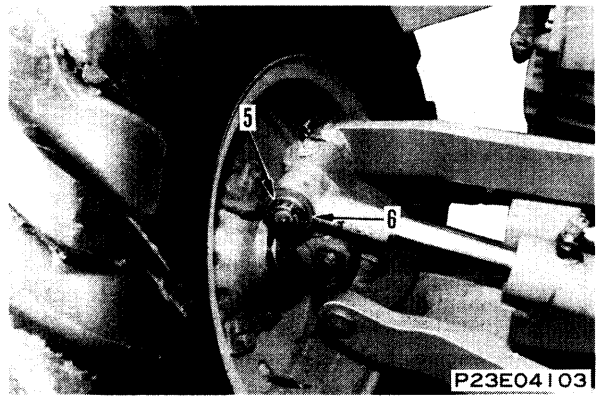
	Part number	Part name	Q'ty
A	790-102-1820	Nut wrench kit	1

1. Remove retaining plate (2) of cylinder bottom end pin (1).
2. Run the engine, fully retract the piston rod.

   Stop engine, operate the control lever to release the oil pressure from the system.
3. Disconnect hoses (3), (4) from cylinder.
4. Using tool **A**, remove nut (5) and washer (6). Then dismount leaning cylinder assembly (7).



P23E04102



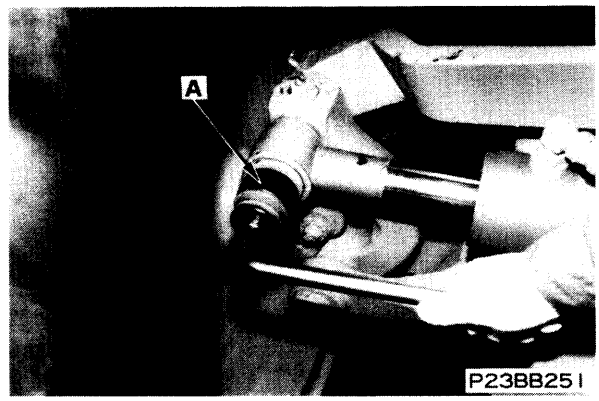
P23E04103

INSTALLATION OF LEANING CYLINDER ASSEMBLY

GD705R-4

1. Connect leaning cylinder assembly (7) to shaft.
2. Fit two washers (6). Use tool **A** to tighten nut (5).
   ★ Bend cotter pin securely.
3. Connect hoses (4), (3) to cylinder.
   ★ Be sure to connect the hoses to the correct end.
   ★ Install hoses without twisting.
4. Run the engine, extend piston rod and align pin holes of cylinder bottom end and axle bracket (8), then install retaining plate (2) of bottom end pin (1).

★ Operate control lever to release the remaining oil pressure through the system. Add engine oil to hydraulic tank to the specified level.



P23BB251

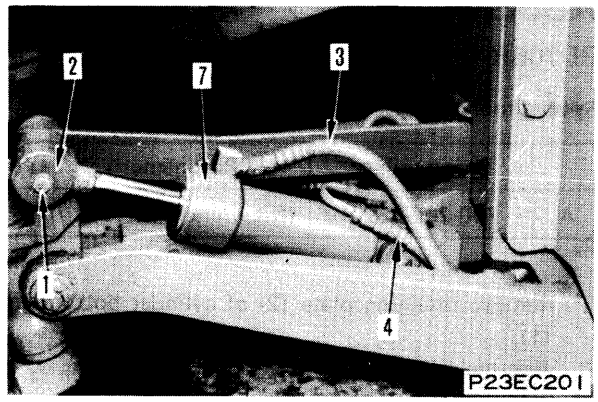
REMOVAL OF LEANING CYLINDER ASSEMBLY

GD705A-4

1. Remove bolt (1) and spacer (2).
2. Start engine. Fully retract piston rod.

> Stop the engine. Operate control lever several times to release the remaining pressure from the hydraulic piping.

3. Disconnect hoses (3), (4) from cylinder.
4. Remove bolt (5), retaining plate (6) and dismount leaning cylinder assembly (7).

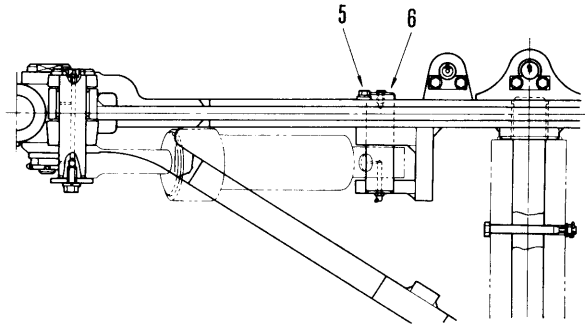


INSTALLATION OF LEANING CYLINDER ASSEMBLY

GD705A-4

1. Connect leaning cylinder assembly (7) to shaft.
2. Install retaining plate (6) and tighten it with bolt (5).
3. Connect hoses (4), (3) on cylinder.
   - ★ Be sure to connect the hoses to the correct end.
   - ★ Install hoses without twisting.
4. Start engine. Extend piston rod and align pin hole of cylinder bottom end and axle end bracket. Then install it with spacer (2) and bolt (1).

★ Operate control lever to circulate oil in the cylinder, then add engine oil into the hydraulic tank to the specified level.



F23EC034

REMOVAL OF ARTICULATE CYLINDER ASSEMBLY

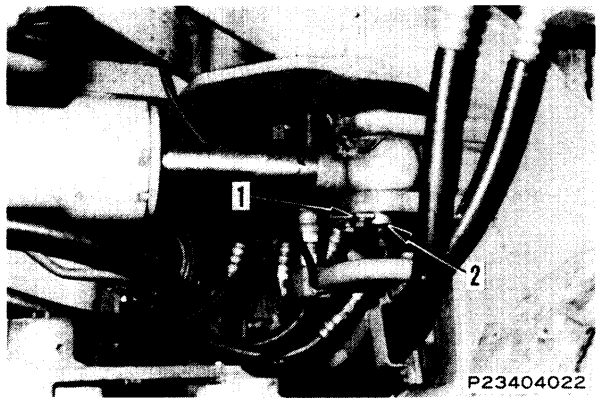
GD705A-4

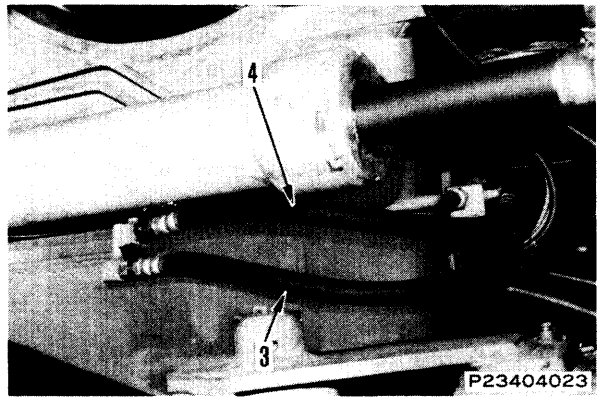
1. Remove retaining plate (1) at head, then remove pin (2).

   If it is difficult to remove the pin because of residual pressure in the cylinder, loosen the sleeve nut of the hose to discharge the residual pressure.

2. Draw the cylinder toward the vehicle body, and disconnect cylinder bottom hose (3) and cylinder head hose (4) from the cylinder.
3. Temporarily hoist cylinder assembly (5).
4. Remove bottom retaining plate (6) and bottom pin (7).
5. Hoist cylinder assembly (5) and remove it.

   kg Articulate cylinder assembly: Approx. 44 kg



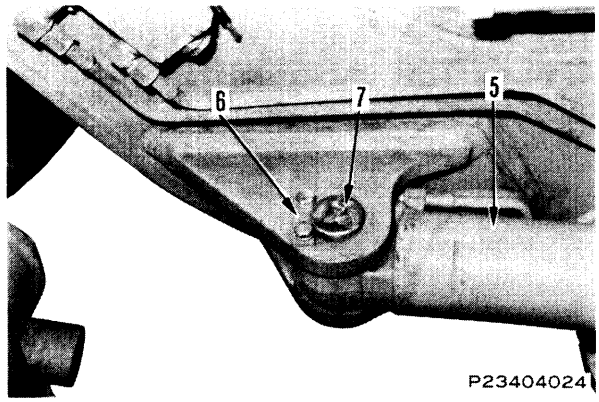


INSTALLATION OF ARTICULATE CYLINDER ASSEMBLY

GD705A-4

1. Sling center of cylinder assembly (5) and raise it with a crane so that the bottom of the cylinder assembly is positioned on the mounting bracket.
2. Insert bottom pin (7), and fix it to retaining plate (6).
3. Connect cylinder head hose (4) and bottom hose (3) to the cylinder.
   ★ Install hoses without twisting and interference.
4. Start the engine, extend the cylinder rod. Align the piston rod connecting pin holes with the holes in the bracket.
5. Insert connecting pin (2) at head end and fix it with retaining plate (1).

★ Operate the control lever to circulate oil in the cylinder then add engine oil into the hydraulic tank to the specified level.



REMOVAL OF POWER TILT CYLINDER ASSEMBLY

GD705A-4

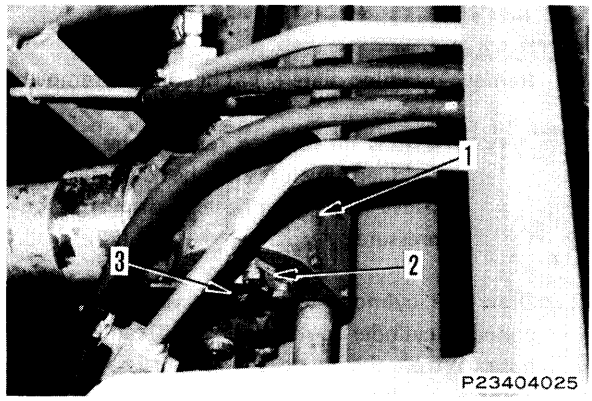
⚠ Lower work equipment completely to the ground.

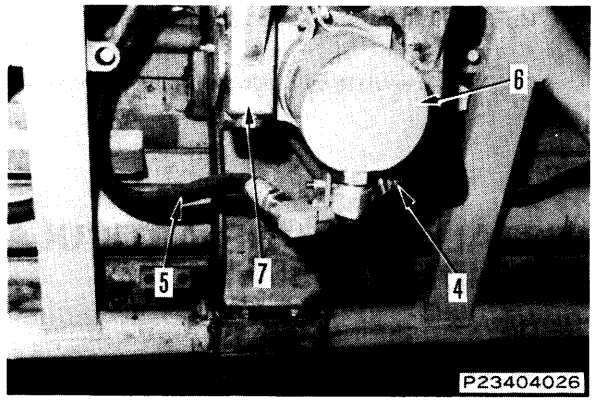
1. Place support under the blade.
2. Remove cover (1).
3. Remove retaining plate (2) at cylinder head end, then remove pin (3).

   ⚠ If it is difficult to remove the pin because of residual pressure in the cylinder, loosen the sleeve nut of the hose to discharge the residual pressure.

4. Disconnect hose at cylinder bottom end (4) and at cylinder head end (5) from cylinder.
5. Fit wire around center of cylinder (6) and raise it.
6. Remove cap (7).
7. Raise cylinder assembly (6) and remove it.

   kg Power tilt cylinder: Approx. 41 kg





INSTALLATION OF POWER TILT CYLINDER ASSEMBLY

GD705A-4

1. Raise cylinder assembly (6) and set bottom in position on mounting bracket.
2. Install cap (7).
3. Connect cylinder hoses on head side (5) and bottom side (4) to the cylinder.
   ★ Install hose without twisting.
4. Start engine. Extend cylinder. Align the piston rod connecting pin holes with the holes in the bracket.
5. Insert pin (3) and fix it with retaining plate (2).
6. Install cover (1).

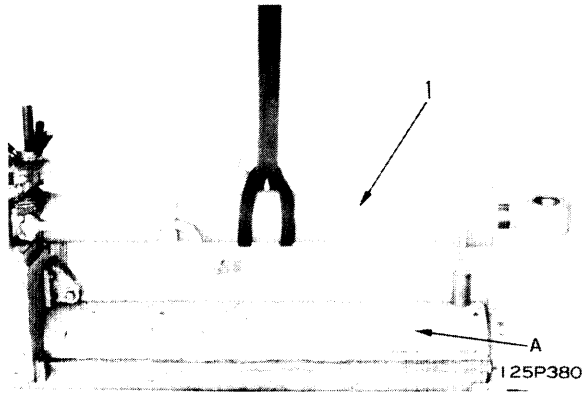
★ Operate the control lever to circulate oil in the cylinder then add engine oil into the hydraulic tank to the specified level.

DISASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY

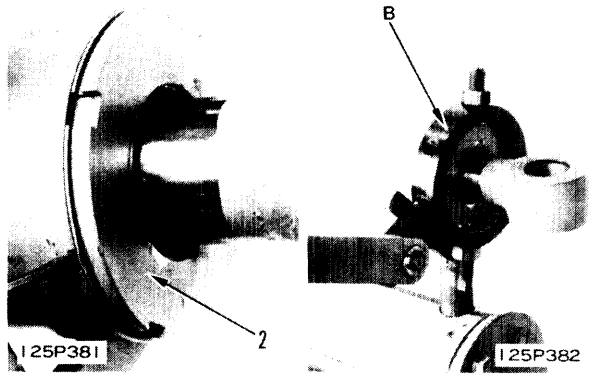
Special tools

	Part number	Part name	Q'ty
A	790-502-1000	Cylinder repair stand	1
B	796-731-1300	Wrench	1

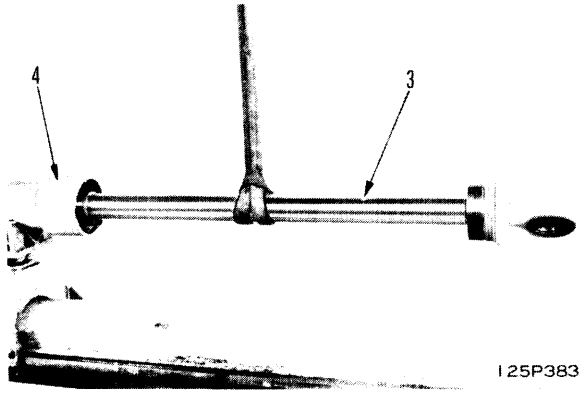
1. Remove the cylinder head and piston rod assembly from the cylinder.
   1) Set cylinder (1) down onto tool A.



   2) Unlock cylinder head (2) and loosen the cylinder head with tool B.
      ★ Since cylinder head (2) is locked at one or two points on the circumference with caulking, it is necessary to use a chisel to unlock it.

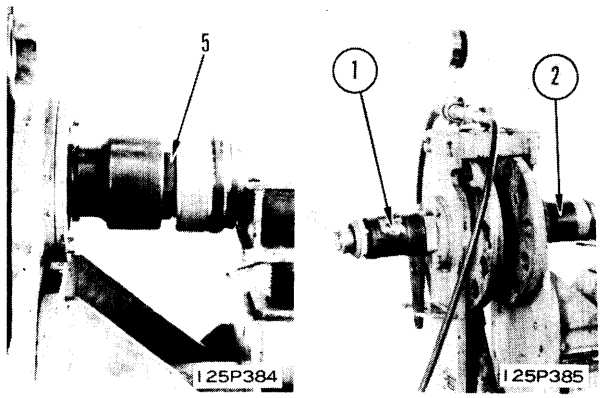


   3) Carefully draw out the cylinder head and piston rod assembly (3) from cylinder (4).
      ★ When hoisting the cylinder head and piston rod assembly with a wire rope, wrap waste rags around it ot avoid damaging the rod.
      ★ Some hydraulic oil may spill out of the cylinder at the lower end. Therefore, place a drain oil pan under the cylinder head.
      ★ If piston rod (3) cannot be drawn out of cylinder (4) smoothly, turn it a little while pulling it.
      ★ Be particularly careful not to damage the piston ring (slipper seal) on the threaded part of the cylinder while removing it.

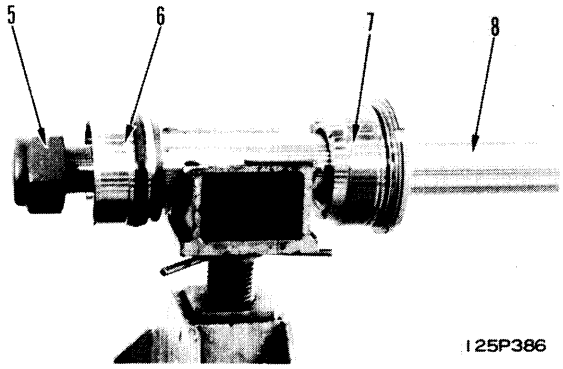


4) Remove the cylinder (4) from tool **A**.

2. Set the cylinder head and piston rod assembly onto tool **A**, and loosen the piston nut by using socket ① and power wrench ② .



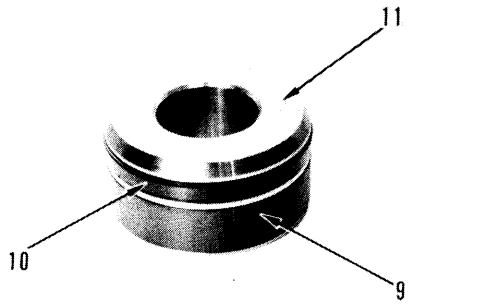
3. Remove piston nut (5). Then remove piston assembly (6) and cylinder head (7) from rod (8).

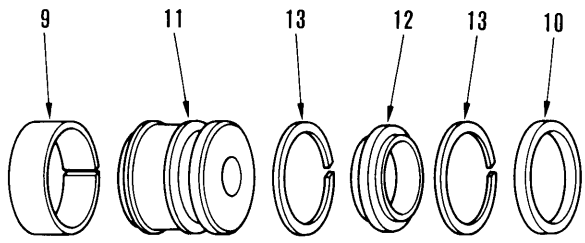


DISASSEMBLY OF PISTON ASSEMBLY

★ If the piston rings (slipper seal (10), backup ring (13) and back ring (12)) are not damaged, do not disassemble them.

1. Remove wear ring (9) from piston (11).
2. Remove backup ring (13), slipper seal (10) and back ring (12), if they show signs of damage.
   ★ Once the backup ring, slipper seal and back ring have been removed, they can no longer be used. Always replace them with new ones.



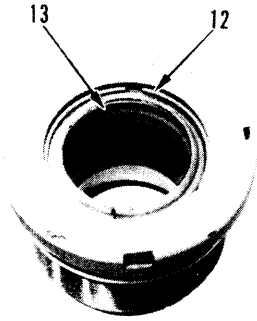


DISASSEMBLY OF CYLINDER HEAD ASSEMBLY

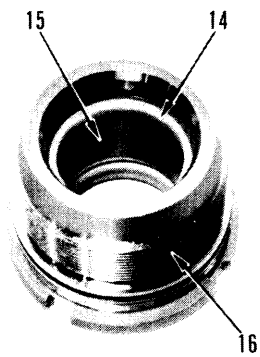
★ Don't disassemble the dust seal and other seals if they are not damaged.
★ Once seals are removed, they cannot be reused. They must always be replaced with new ones.

1. Remove snap ring (12) and detach dust seal (13) from cylinder head (16).
2. Remove rod packing (14) from cylinder head (16) by using a screwdriver.
   ★ Be careful not to damage any other parts while prying out the rod packing.

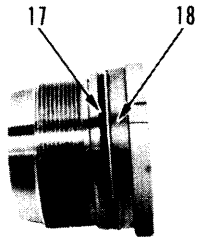
3. Remove bushing (15) from the cylinder head.
4. Remove O-ring (17) and back-up ring (18).



125P388



125P389



125P390

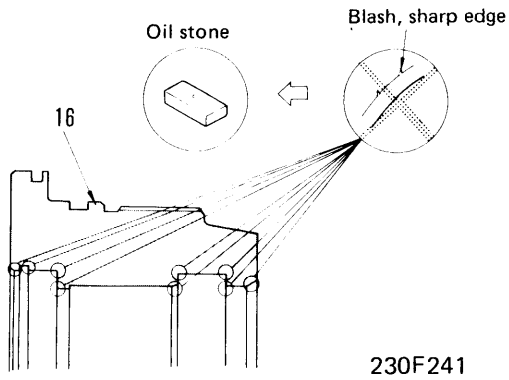
ASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY

Special tools

	Part number	Part name	Q'ty
A	790-502-1000	Cylinder repair stand	1
B	796-731-1300	Wrench	1
C	790-702-1000	Expender	1
D	796-720-1660	Ring	1

ASSEMBLY OF CYLINDER HEAD ASSEMBLY

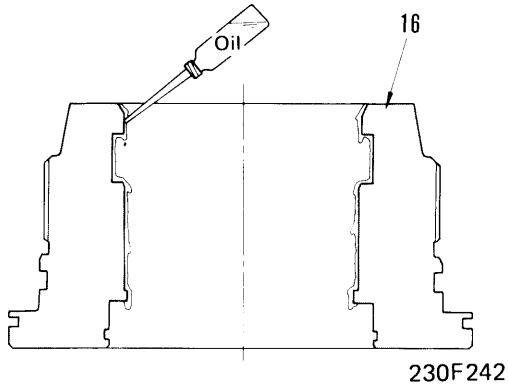
★ Remove any sharp edge, etc., from the fitting grooves of the rod packings and dust seals in cylinder head (16) (parts marked with O in the figure at right) by using an oil stone, so that seals are not damaged when they are being inserted.



230F241

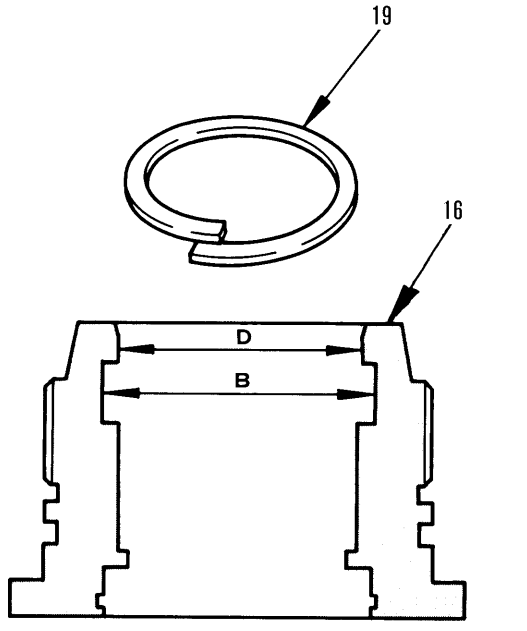
1. Apply a coat of grease (or hydraulic oil) around the inner walls of cylinder head (16) and fitting grooves of the rod packings (shaded section).

★ Observe steps 2 and 3 below if backup ring (19) is attached to the U-packing.



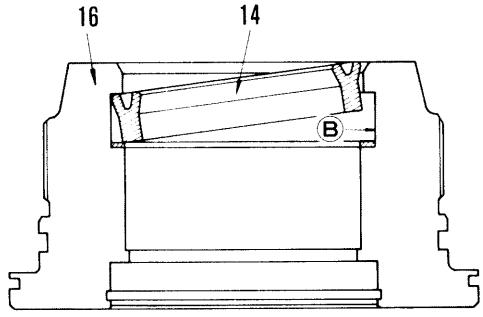
230F242

2. Fit backup ring (19) into groove Ⓑ by pressing it to a smaller size than inner diameter D.



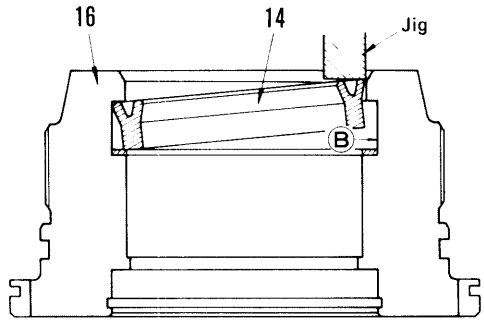
F23AB134

3. Press in rod packing (14) until it fits snugly into groove (B)
   Install the rod packing in the specified direction.
   ★ Be careful to install rod packing facing in the right direction.



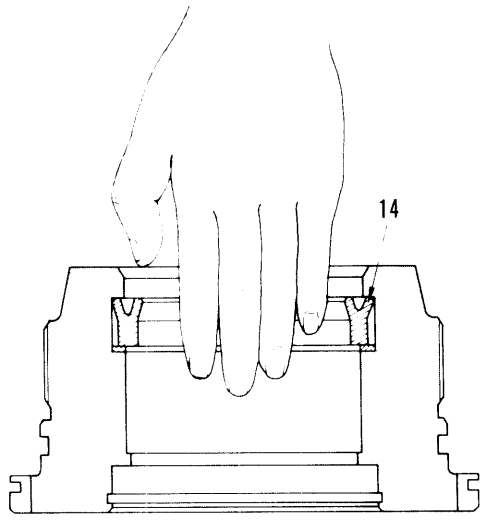
230F246

4. Assemble the rod packing into groove (B) by slightly pressing in its opposite side with a jig, as shown in the illustration.
   ★ Use a copper, aluminum, or plastic jig which is free of any sharp edge, etc, which may contact the rod packing.
   In order to prevent the rod packing from being damaged, we recommend that you assemble the rod packing by hand without using the jig.



230F245

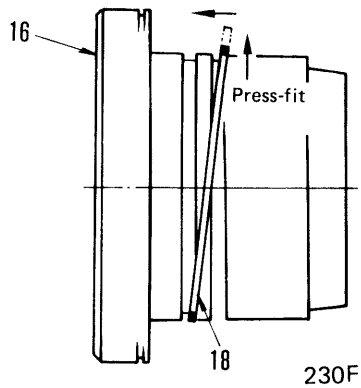
5. Check the internal circumference of the lip for any defects, and for the condition of the fit in the groove, while pressing the internal circumference of rod packing (14) against the external circumference by hand.



230F247

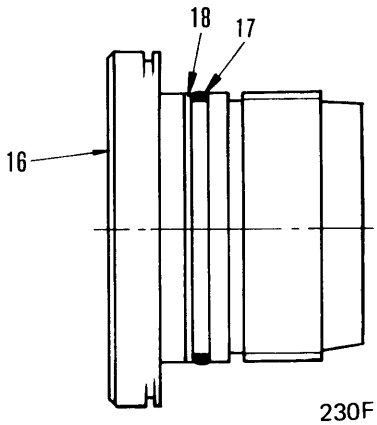
6. Immerse back-up ring (18) in 30° to 50°C hot water for two or three minutes.

7. Take back-up ring (18) out of the hot water and fit it over the cylinder head by stretching it slightly.
   ★ When assembling the cylinder head assembly, make sure that back-up ring (18) has first cooled down and returned to its original size.

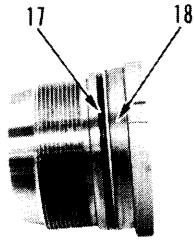


230F249

8. Insert O-ring (17) into cylinder head (16).

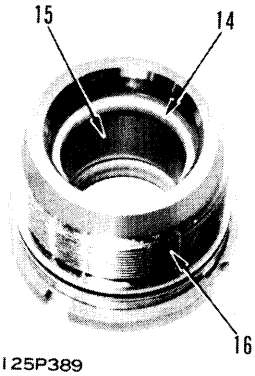


230F250



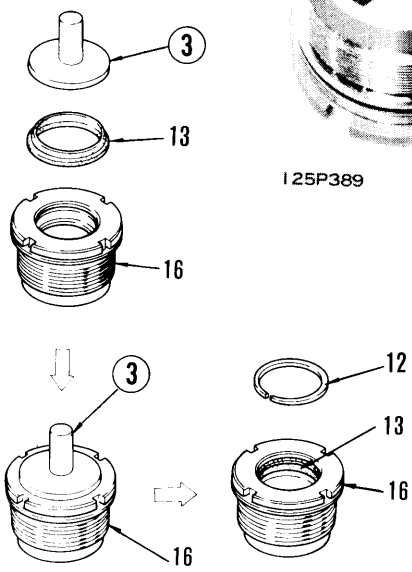
125P390

9. Press bushing (15) into cylinder head (16) by using a Push tool, and then fit snap ring (14).
   ★ Take particular case to deform the bushing when press fitting.



125P389

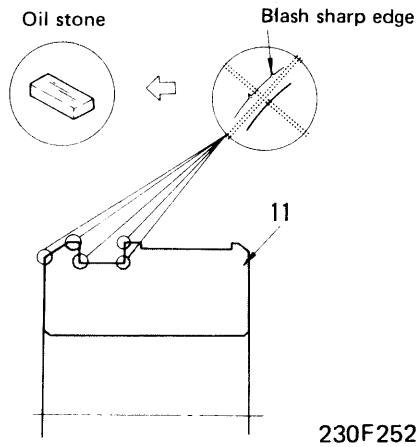
10. Press-fit dust seal (13) into cylinder head (16) by using a push tool ③ , and then fit snap ring (12).



230F251

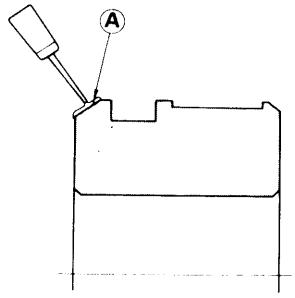
ASSEMBLY OF PISTON ASSEMBLY

★ Remove any sharp edge, etc., from the fitting grooves of the piston ring (parts marked with O in the figure) by using an oil stone so that the piston ring is not damaged as it is being inserted. Make sure that these parts are free of burrs, etc.



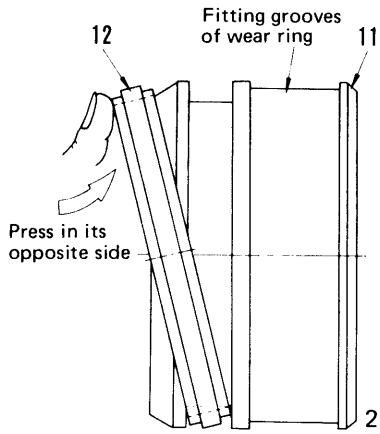
230F252

1. Apply a coat of grease (or hydraulic oil) to the upper Ⓐ face of the taper surface of piston (11).



230F253

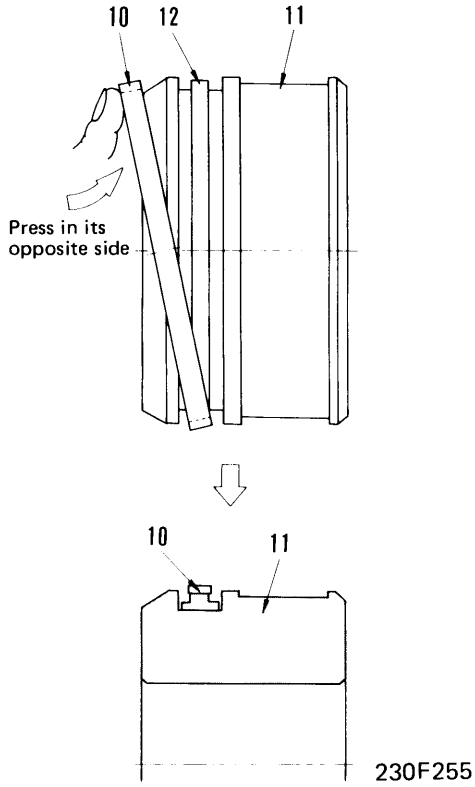
2. First insert the circumferential part of pack ring (12) into the groove, and then assemble it by pressing in its opposite side by hand along the taper surface.



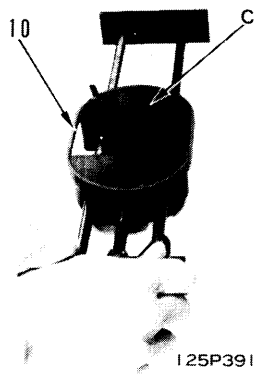
230F254

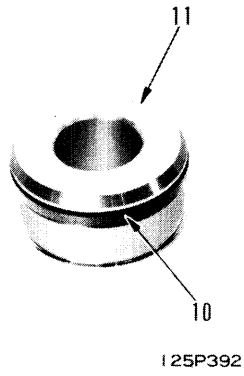
3. Immerse slipper seal (10) into 60° to 100°C hot water for at least 5 minutes so that it can easily be fitted onto piston (11).

4. First insert the circumferential part of slipper seal (10) into the groove, and then assemble the slipper seal into the groove by pressing in its opposite side by hand along the taper surface.



★ The following procedure may be observed in place of steps 3 and 4.
   1) Using tool **C**, expand piston ring (10).
      ★ After setting the piston ring in tool **C**, rotate the handle 8 to 10 times to expand.
   2) Remove piston ring (10) from tool **C** and assemble on piston (11).





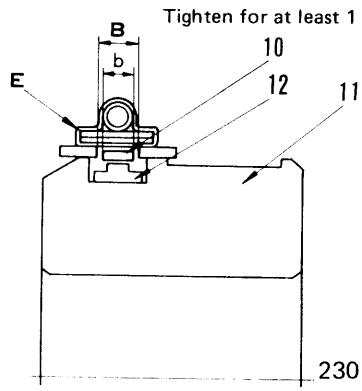
5. After fitting slipper seal (10), tighten the outer circumference of slipper seal (10) to forcedly contract it.
   ★ If slipper seal (10) is inserted into the cylinder tube with its outer diameter stretched, it may be damaged by the threaded part (circular cylinder), or it may be caught between the cylinder tube and the threaded part. For this reason, it is necessary to contract it by force.

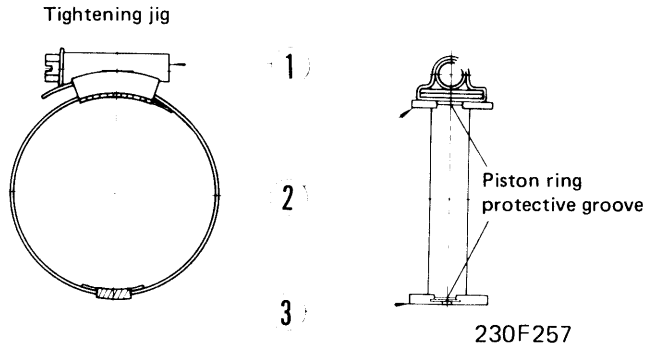
- **Tightening procedure**
  Set slipper seal (10) so that width **b** is set to groove width **B** of the protective cover, by using tightening jig **E**, as shown. Continue tightening it for at least 1 minute.

- **References:**
  For low pressure hoses, the JUBILEE clamp is recommended.
  (See the following table)

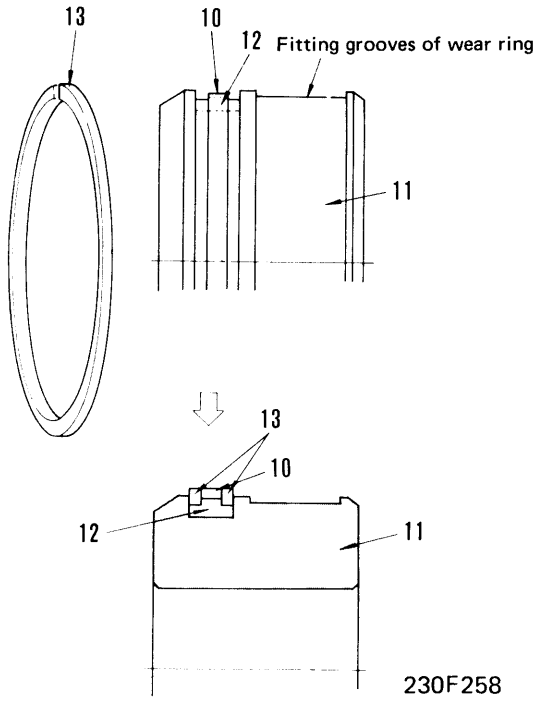
Cylinder diameter	JUBILEE clamp parts No.
ϕ50 – ϕ60	3
ϕ70 – ϕ80	4
ϕ90 – ϕ100	5
ϕ110 – ϕ120	6
ϕ130 – ϕ150	7
ϕ160 – ϕ180	7½
ϕ200 – ϕ225	9½

Parts name	Q'ty per set	Remarks
① Clamp	1	See the above table
② Protective cover	1	For fixed rubber material
③ Protective cover	1	For sliding rubber material

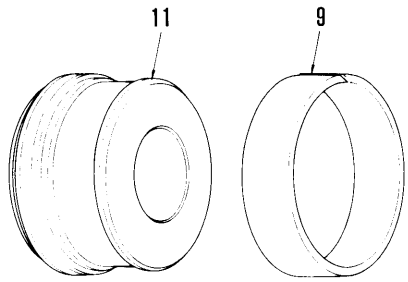


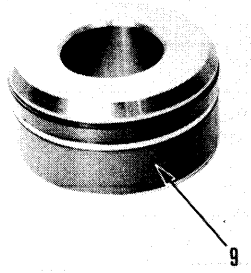


6. Assemble back-up ring (13) onto piston (11).



7. Assemble wear ring (9) onto piston (11).





125P394

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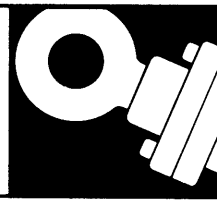
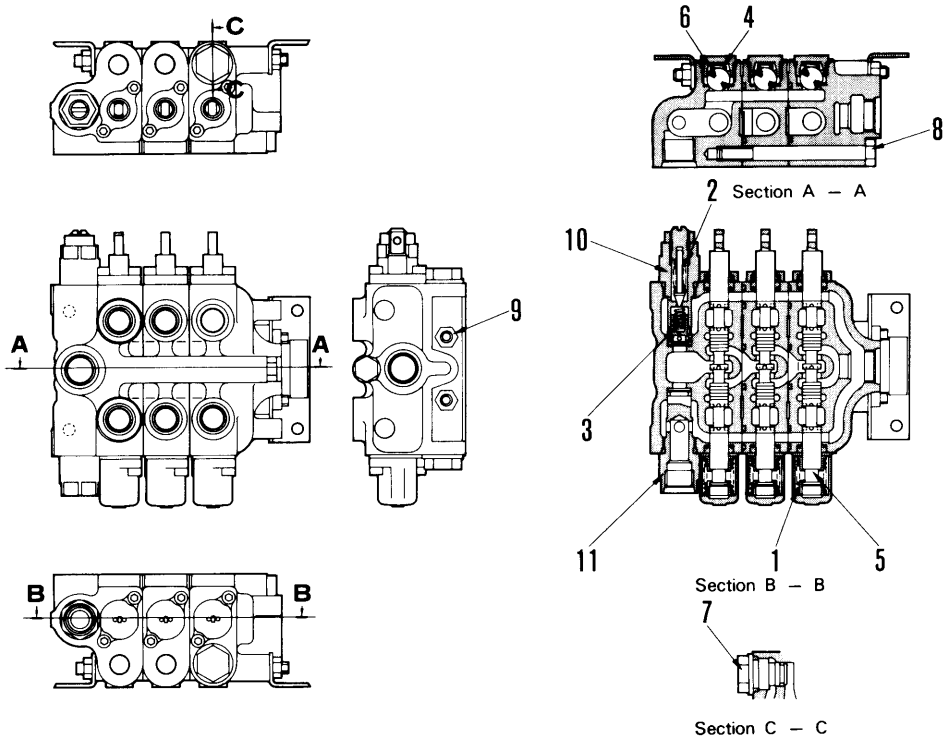
HYDRAULIC SYSTEM
64 MAINTENANCE STANDARD



HYDRAULIC CONTROL VALVE

GD705A-4

3-SPOOL

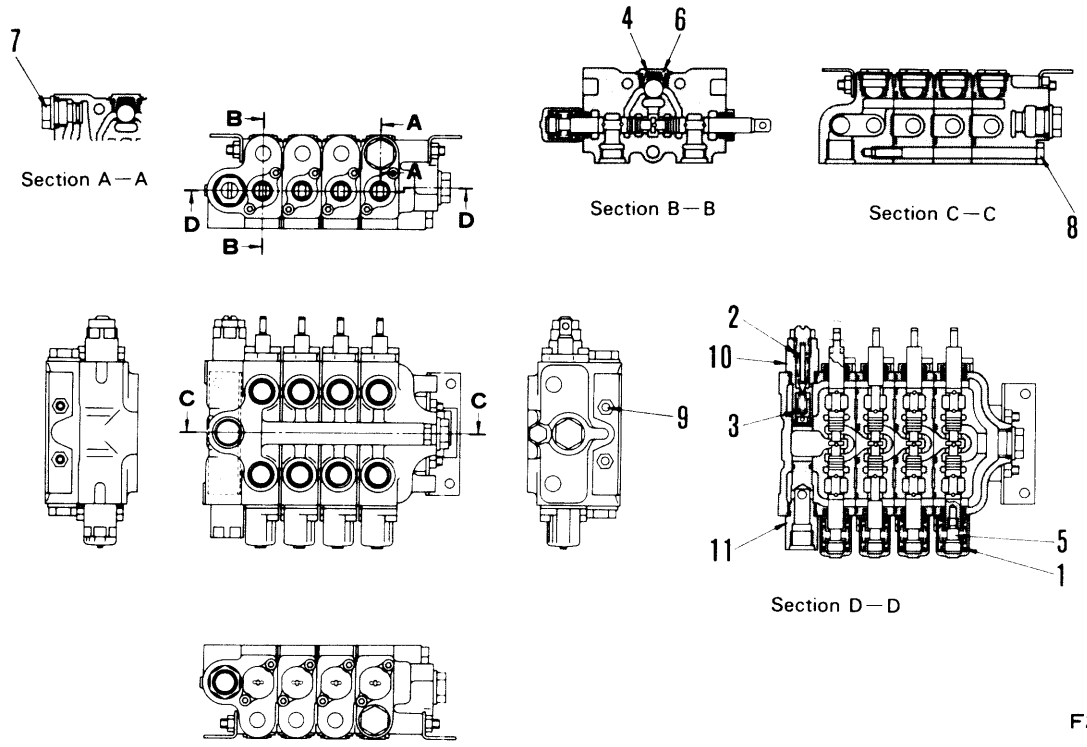


F23AB205-1

Unit: mm

No.	Check Item	Criteria					Remedy
		Standard size			Repair limit		
1	Spool return spring	Free length x O.D.	Installed length	Installed load	Free length	Installed load	Replace spring
		55.7 x 22.3	26.5	10 kg	–	8 kg	
2	Poppet spring	29.6 x 9.5	26.5	12.6 kg	–	10.1 kg	
3	Main valve spring	23.3 x 7.2	19	2 kg	–	1.6 kg	
4	Check valve spring	18.0 x 12.5	7.5	0.2 kg	–	0.16 kg	
5	Plug tightening torque	1.5 ± 0.5 kgm					Adjusting
6	Plug tightening torque	7 ± 1 kgm					
7	Plug tightening torque	7 ± 1 kgm					
8	Body joint bolt tightening torque	5.75 ± 0.75 kgm					
9	Bolt tightening torque	2.75 ± 0.75 kgm					
10	Main relief valve tightening torque	5.5 ± 0.5 kgm					
11	Plug tightening torque	7 ± 1 kgm					

GD705A-4
4-SPOOL

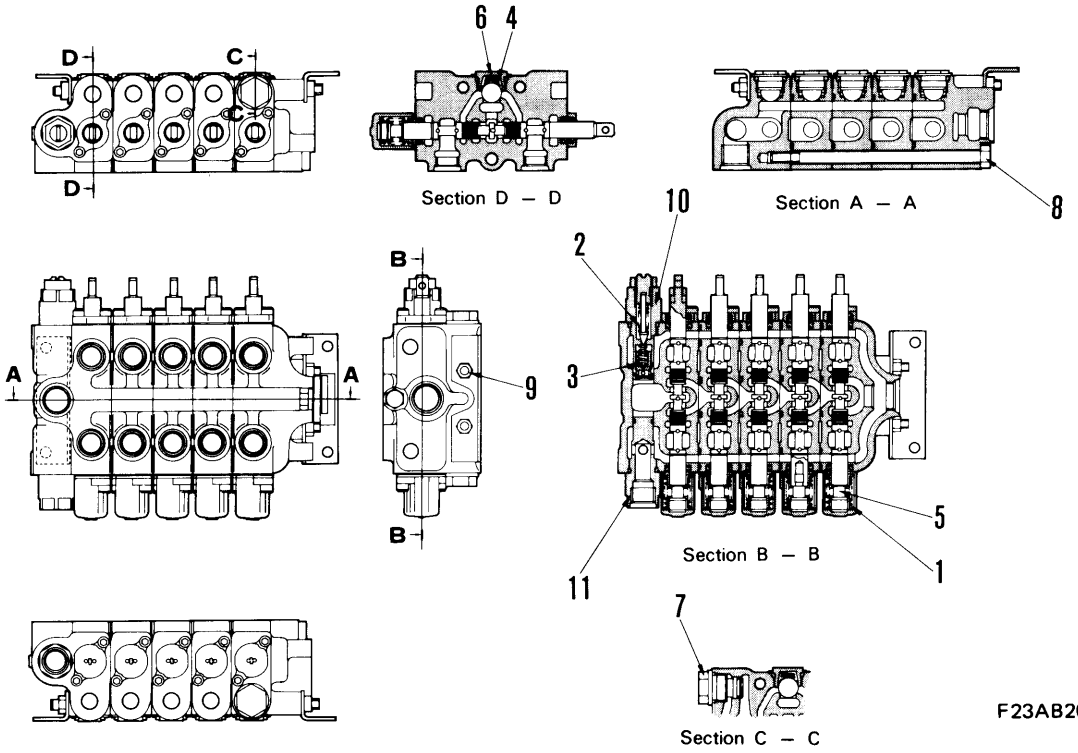


F23B068-1

Unit: mm

No.	Check Item	Criteria					Remedy
		Standard size			Repair limit		
1	Spool return spring	Free length x O.D.	Installed length	Installed load	Free length	Installed load	Replace spring
		55.7 x 22.3	26.5	10 kg	–	8 kg	
2	Poppet spring	29.6 x 9.5	26.5	12.6 kg	–	10.1 kg	
3	Main valve spring	23.3 x 7.2	19	2 kg	–	1.6 kg	
4	Check valve spring	18.0 x 12.5	7.5	0.2 kg	–	0.16 kg	
5	Plug tightening torque	1.5 ± 0.5 kgm					Adjusting
6	Plug tightening torque	7 ± 1 kgm					
7	Plug tightening torque	7 ± 1 kgm					
8	Body joint bolt tightening torque	5.75 ± 0.75 kgm					
9	Bolt tightening torque	2.75 ± 0.75 kgm					
10	Main relief valve tightening torque	5.5 ± 0.5 kgm					
11	Plug tightening torque	7 ± 1 kgm					

GD705A-4
5-SPOOL

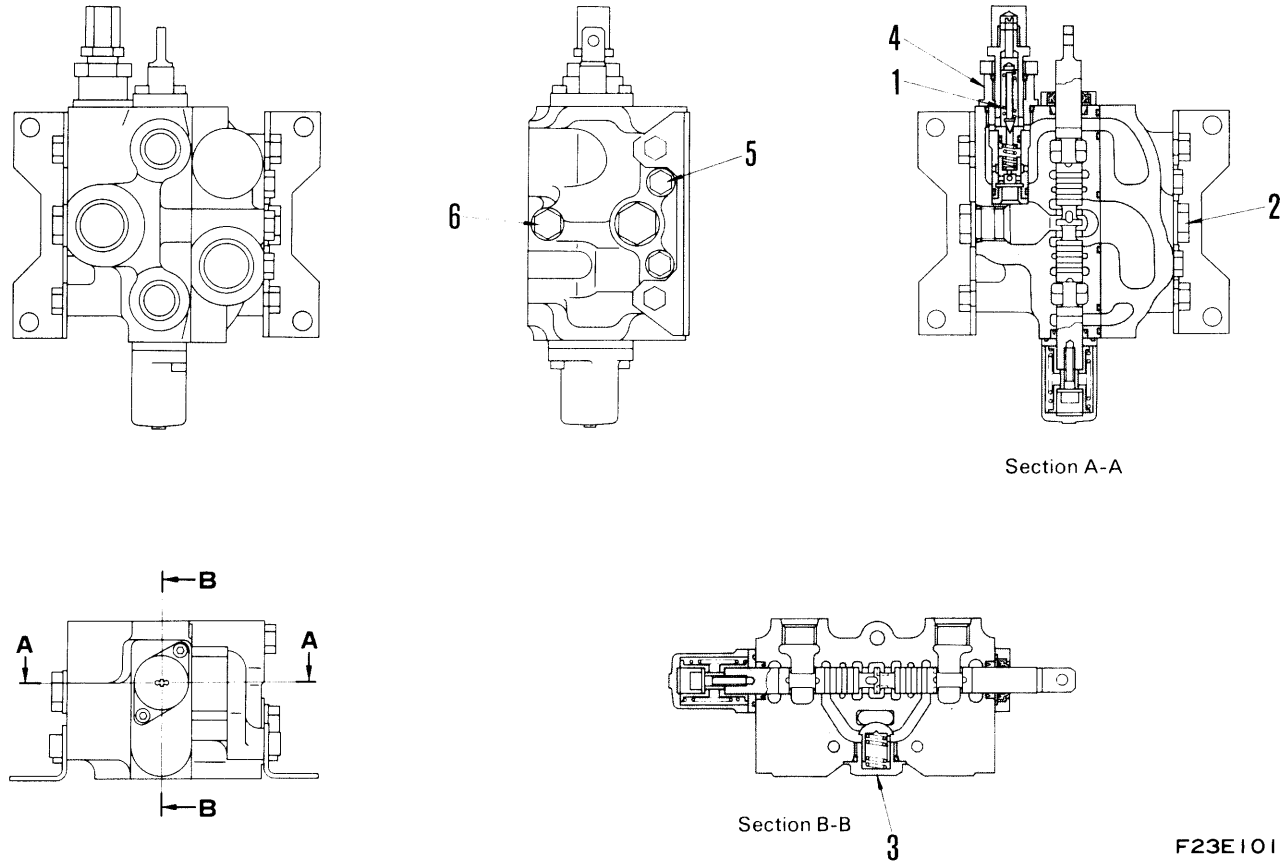


F23AB206-1

Unit: mm

No.	Check Item	Criteria					Remedy
		Standard size			Repair limit		
1	Spool return spring	Free length x O.D.	Installed length	Installed load	Free length	Installed load	Replace spring
		55.7 x 22.3	26.5	10 kg	–	8 kg	
2	Poppet spring	29.6 x 9.5	26.9	12.6 kg	–	10.1 kg	
3	Main valve spring	23.3 x 19.2	19	2 kg	–	1.6 kg	
4	Check valve spring	18.0 x 1.25	7.5	0.2 kg	–	0.16 kg	
5	Plug tightening torque	1.5 ± 0.5 kgm					Adjusting
6	Plug tightening torque	7 ± 1 kgm					
7	Plug tightening torque	7 ± 1 kgm					
8	Body joint bolt tightening torque	5.75 ± 0.75 kgm					
9	Bolt tightening torque	2.75 ± 0.75 kgm					
10	Main relief valve tightening torque	5.5 ± 0.5 kgm					
11	Plug tightening torque	7 ± 1 kgm					

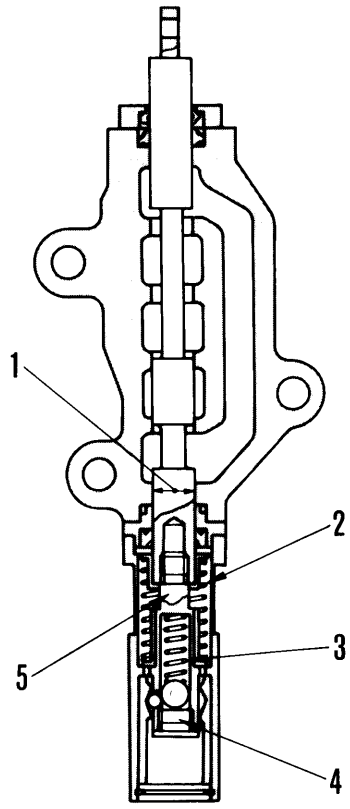
GD705A-4
CIRCLE ROTATION



Unit: mm

No.	Check Item	Criteria					Remedy
		Standard size			Repair limit		
1	Main relief valve spring	Free length x O.D.	Installed length	Installed load	Free length	Installed load	Replace
		41.1 x 11.8	34	22 kg	39.7	17.6 kg	
2	Tightening torque of plug	7.0 ± 1 kgm					Adjusting
3	Tightening torque of check valve plug	10.75 ± 1.75 kgm					
4	Tightening torque of main relief valve	8.5 ± 1.5 kgm					
5	Tightening torque of body joint bolt	6 ± 1 kgm					
6	Tighteining torque of body joint bolt	9 ± 1 kgm					

GD705A-4
MODE CONTROL

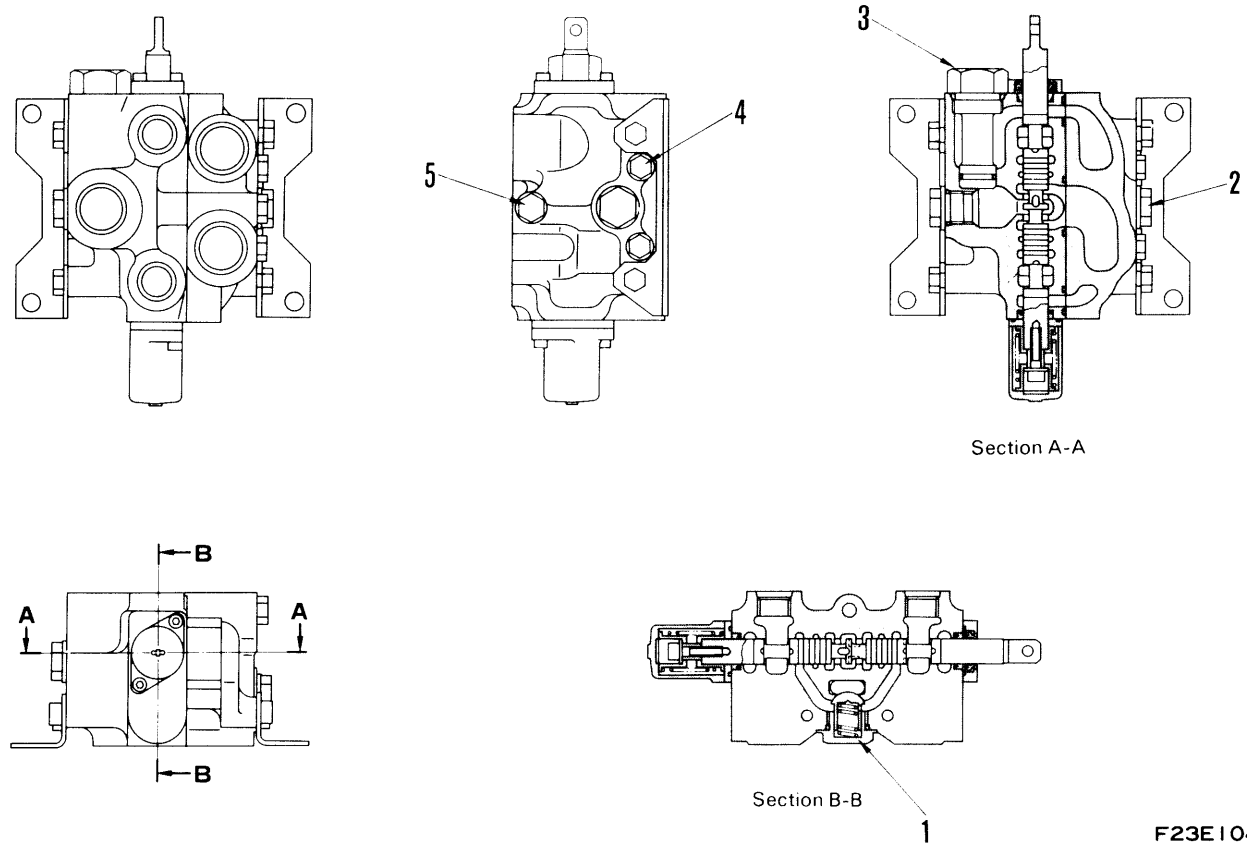


F23E103

Unit: mm

No.	Check Item	Criteria					Remedy
1	Clearance between spool and valve body	Standard size					Replace
		14					
2	Spool return spring	Standard size			Repair limit		
		Free length x O.D.	Installed length	Installed load	Free length	Installed load	
		53.3 x 23.3	10 kg	33.5	–	8 kg	
3	Detent spring	30.7 x 7.7	5 kg	23	–	4 kg	
4	Tightening torque of detent plug	1.5 ± 0.5 kgm					Adjusting
5	Tightening torque of plug	0.75 ± 0.25 kgm					

GD705A-4
RIPPER (If equipped)

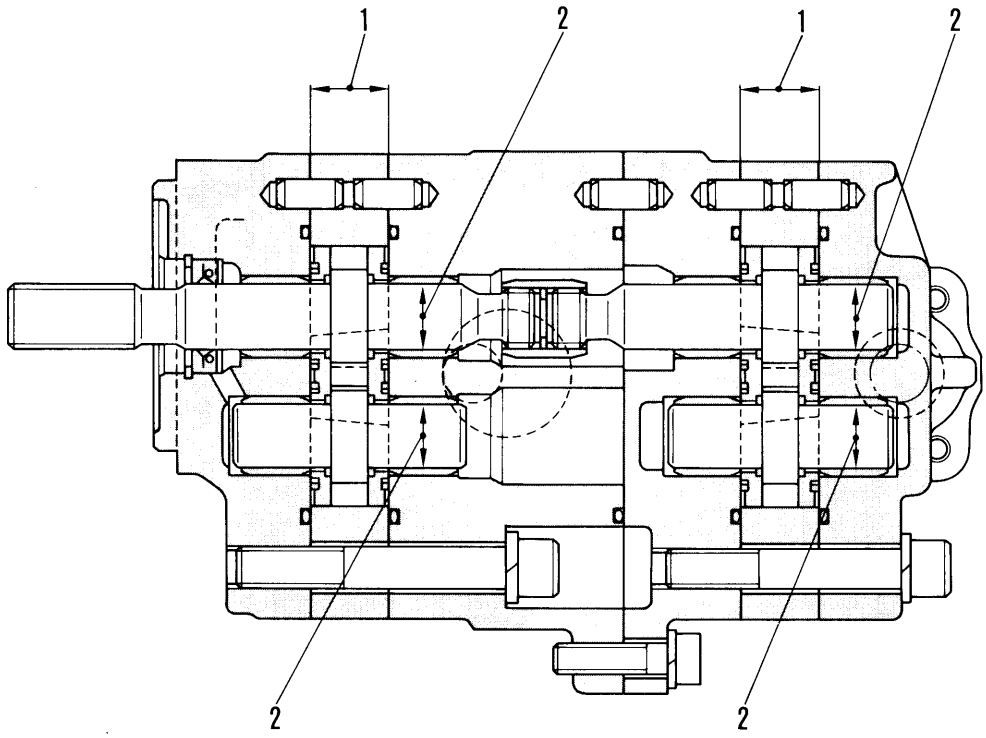


Unit: mm

No.	Check Item	Criteria	Remedy
1	Tightening torque of check valve plug	10.75 ± 1.75 kgm	Adjusting
2	Tightening torque of plug	7.0 ± 1 kgm	
3	Tightening torque of plug	8.5 ± 1.5 kgm	
4	Tightening torque of body joint bolt	6 ± 1 kgm	
5	Tightening torque of body joint bolt	9 ± 1 kgm	

HYDRAULIC PUMP

FOR WORK EQUIPMENT (LAR020 + LAR020) GD705R-4
(SAR050 + SAR050) GD705A-4

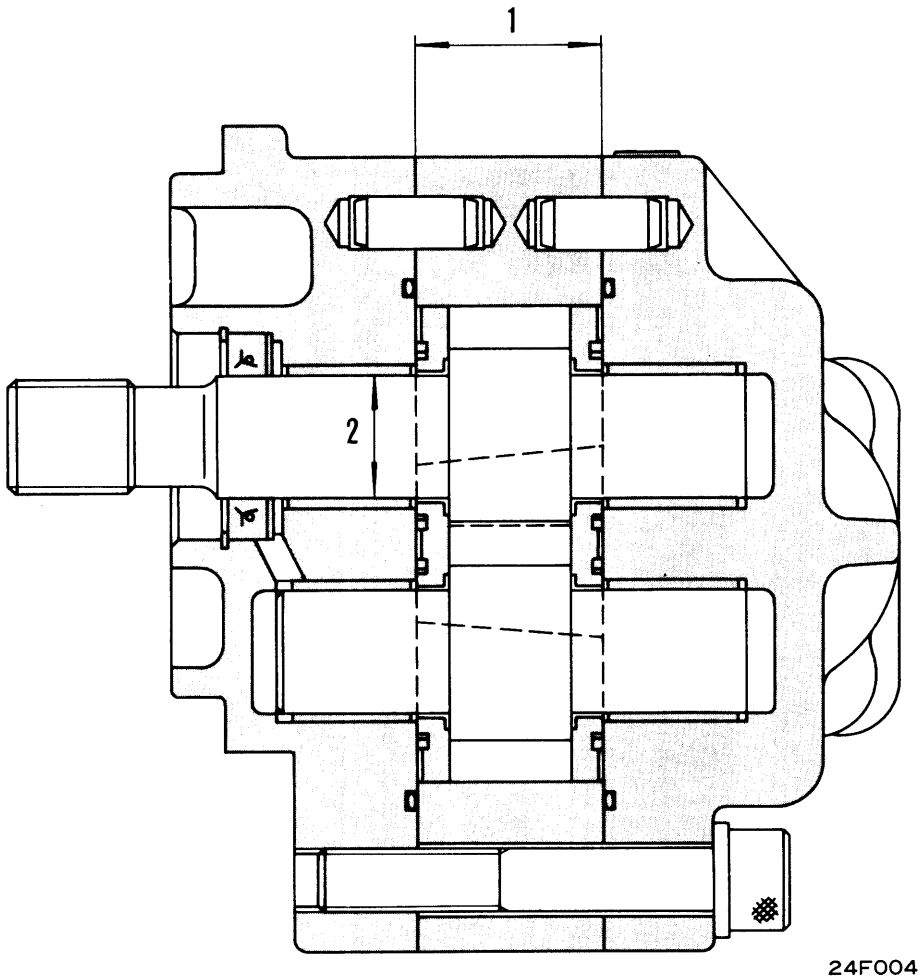


F23B03020

Unit: mm

No.	Check Item	Criteria				Remedy
1	Gear case to gear clearance	Standard clearance		Repair limit		
		0.1 – 0.15		0.19		
2	Bushing I.D. to gear shaft clearance	0.06 – 0.119		0.20		
3	SAE10, Class CD at 50 ± 5°C	Standard value		Repair limit		
		Pump speed (rpm)	Delivery (ℓ/min.)	Pump speed (rpm)	Delivery (ℓ/min.)	
	175 kg/cm² LAR020 + LAR020	3500	67	3500	61	
	210 kg/cm² SAR050 + SAR050	3000	138	3000	120	

FOR WORK EQUIPMENT (SAR050) GD705A-4



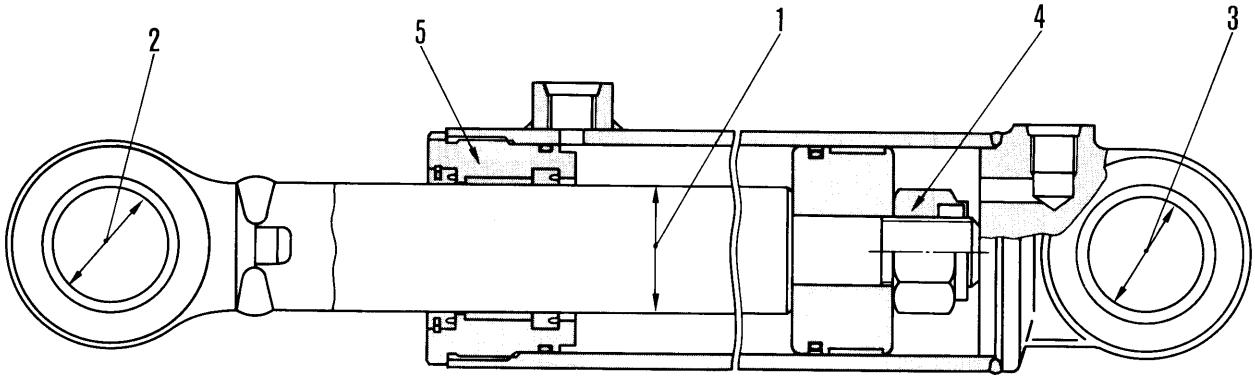
24F004

Unit: mm

No.	Check Item	Criteria				Remedy
1	Clearance between gear case and gear	Standard clearance		Clearance limit		
		0.10 – 0.15		0.19		
2	Clearance between bearing I.D. and gear shaft O.D.	0.06 – 0.166		0.20		
3	SAR050 (E010-CD, 50°C, 210 kg/cm²)	Standard size		Repair limit		
		Pump speed (rpm)	Delivery (ℓ/min.)	Pump speed (rpm)	Delivery (ℓ/min.)	
		3000	138	3000	120	

HYDRAULIC CYLINDER

GD705R-4



F23E04058

Unit: mm

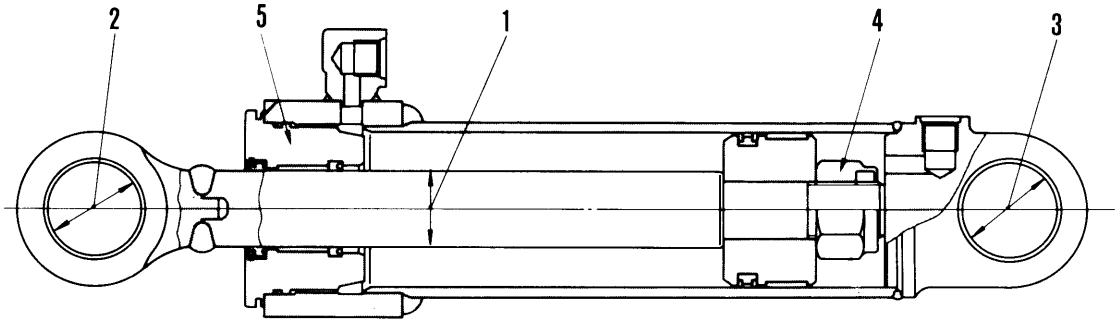
No.	Check Item		Criteria					Remedy
			Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between piston rod and bushing	Blade lift	55	−0.100 −0.174	+0.163 +0.006	0.106 – 0.337	0.6	Replace
		Blade side shift	50	−0.080 −0.142	+0.164 +0.007	0.087 – 0.306	0.6	
		Drawbar side shift	50	−0.100 −0.174	+0.163 +0.006	0.106 – 0.337	0.6	
		Leaning	50	−0.080 −0.142	+0.164 +0.007	0.087 – 0.306	0.6	
		Scarifier (If equipped)	55	−0.100 −0.174	+0.163 +0.006	0.106 – 0.337	0.6	

Unit: mm

No.	Check Item		Criteria					Remedy
			Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
2	Clearance between cylinder head support shaft and bushing	Blade lift	90	−0.05 −0.15	± 0	0.05 – 0.150	1	Replace
		Blade side shift	45	−0.025 −0.064	+0.142 +0.080	0.105 – 0.206	1	
		Drawbar side shift	80	−0.05 −0.15	± 0	0.050 – 0.150	1	
		Leaning	45	−0.025 −0.064	+0.142 +0.080	0.105 – 0.206	1	
		Scarifier (If equipped)	50	−0.025 −0.064	+0.142 +0.080	0.105 – 0.206	1	
3	Clearance between cylinder bottom shaft and bushing	Blade lift	70	−0.100 −0.174	+0.074 0	0.100 – 0.248	0.6	
		Blade side shift	45	−0.025 −0.064	+0.142 +0.080	0.105 – 0.206	1	
		Drawbar side shift	80	−0.05 −0.15	± 0	0.050 – 0.150	1	
		Leaning	45	−0.025 −0.064	+0.142 +0.080	0.106 – 0.206	1	
		Scarifier (If equipped)	50	−0.025 −0.064	+0.142 +0.080	0.105 – 0.206	1	
4	Tightening torque for piston nut	Blade lift	80 ± 8 kgm (Width across flats: 46)					Retighten
		Blade side shift	63 ± 6.3 kgm (Width across flats: 41)					
		Drawbar side shift	63 ± 6.3 kgm (Width across flats: 41)					
		Leaning	63 ± 6.3 kgm (Width across flats: 41)					
		Scarifier (If equipped)	80 ± 8 kgm (Width across flats: 46)					
5	Tightening torque for cylinder head	Blade lift	69 ± 6.9 kgm					
		Blade side shift	60 ± 6 kgm					
		Drawbar side shift	60 ± 6 kgm					
		Leaning	60 ± 6 kgm					
		Scarifier (If equipped)	69 ± 6.9 kgm					

HYDRAULIC CYLINDER

GD705A-4



F23E04059

Unit: mm

No.	Check Item		Criteria					Remedy
			Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between piston rod and bushing	Blade lift	55	−0.100 −0.174	+0.163 +0.006	0.106 – 0.337	0.6	Replace
		Blade side shift	55	−0.100 −0.174	+0.163 +0.006	0.106 – 0.337	0.6	
		Drawbar shift	55	−0.100 −0.174	+0.163 +0.006	0.106 – 0.337	0.6	
		Leaning	45	−0.030 −0.019	+0.007 +0.152	0.026 – 0.182	0.6	
		Articulate	55	−0.100 −0.174	+0.163 +0.006	0.106 – 0.337	0.6	
		Power tilt	50	−0.030 −0.142	+0.164 +0.007	0.037 – 0.306	0.6	
		Ripper (If equipped)	70	−0.100 −0.174	+0.271 +0.075	0.175 – 0.445	0.6	
		Scarifier (If equipped)	55	−0.100 −0.174	+0.163 +0.006	0.106 – 0.337	0.6	
2	Clearance between piston rod support shift (ball joint) and bushing (rod end)	Blade lift	90	–	–	–	–	Replace
		Blade side shift	50	−0.05 (−0.025) −0.15 (−0.064)	+0.142 +0.080	0.130 – 0.292 (0.105 – 0.250)	1.0	
		Drawbar shift	90	–	–	–	–	
		Leaning	50	−0.025 −0.064	+0.142 +0.080	0.105 – 0.206	1.0	
		Articulate	60	−0.030 −0.076	+0.174 +0.100	0.130 – 0.350	1.0	
		Power tilt	60	0 −0.019	0 −0.015	0 – 0.004	0.6	
		Ripper (If equipped)	75	+0.035 0	+0.174 +0.100	0.065 – 0.174	1.0	
		Scarifier (If equipped)	50	−0.025 −0.064	+0.142 +0.080	0.105 – 0.206	1.0	

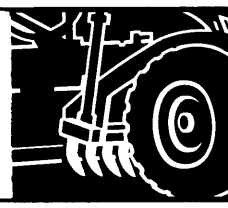
( ): For Serial No. 21086 and up

Unit: mm

No.	Check Item		Criteria					Remedy
			Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
3	Clearance between cylinder bottom yoke (Support, support shaft, support ball joint) and bushing (rod end)	Blade lift	70	−0.100 −0.174	+0.271 +0.095	0.195 – 0.445	1.0	Replace
		Blade side shift	70	−0.100 −0.174	+0.271 +0.095	0.195 – 0.445	1.0	
		(Blade side shift)	(50)	(+0.025 +0.064)	(+0.142 +0.080)	(0.105 – 0.206)	(1.0)	
		Drawbar shift	90	–	–	–	–	
		Leaning	50	−0.025 −0.064	+0.163 +0.006	0.031 – 0.227	1.0	
		Articulate	60	−0.030 −0.076	+0.174 +0.100	0.130 – 0.350	1.0	
		Power tilt	75	−0.100 −0.174	+0.074 0	0.100 – 0.248	1.0	
		Ripper (If equipped)	90	+0.035 0	+0.207 +0.120	0.085 – 0.207	1.0	
		Scarifier (If equipped)	50	−0.025 −0.064	+0.142 +0.080	0.105 – 0.206	1.0	
4	Tightening torque for piston nut	Blade lift	145 ± 14.5 kgm (80 ± 8 kgm)					Retighten
		Blade side shift	145 ± 14.5 kgm (80 ± 8 kgm)					
		Drawbar shift	145 ± 14.5 kgm (80 ± 8 kgm)					
		Leaning	110 ± 11.0 kgm (80 ± 8 kgm)					
		Articulate	145 ± 14.5 kgm					
		Power tilt	145 ± 14.5 kgm					
		Ripper (If equipped)	405 ± 40.5 kgm					
		Scarifier (If equipped)	145 ± 14.5 kgm					
5	Tightening torque for cylinder head	Blade lift	69 ± 6.9 kgm					
		Blade side shift	69 ± 6.9 kgm					
		Drawbar shift	69 ± 6.9 kgm					
		Leaning	69 ± 6.9 kgm					
		Articulate	95 ± 9.5 kgm					
		Power tilt	80 ± 8.5 kgm					
		Ripper (If equipped)	94.5 ± 10.5 kgm					
		Scarifier (If equipped)	69 ± 6.9 kgm					

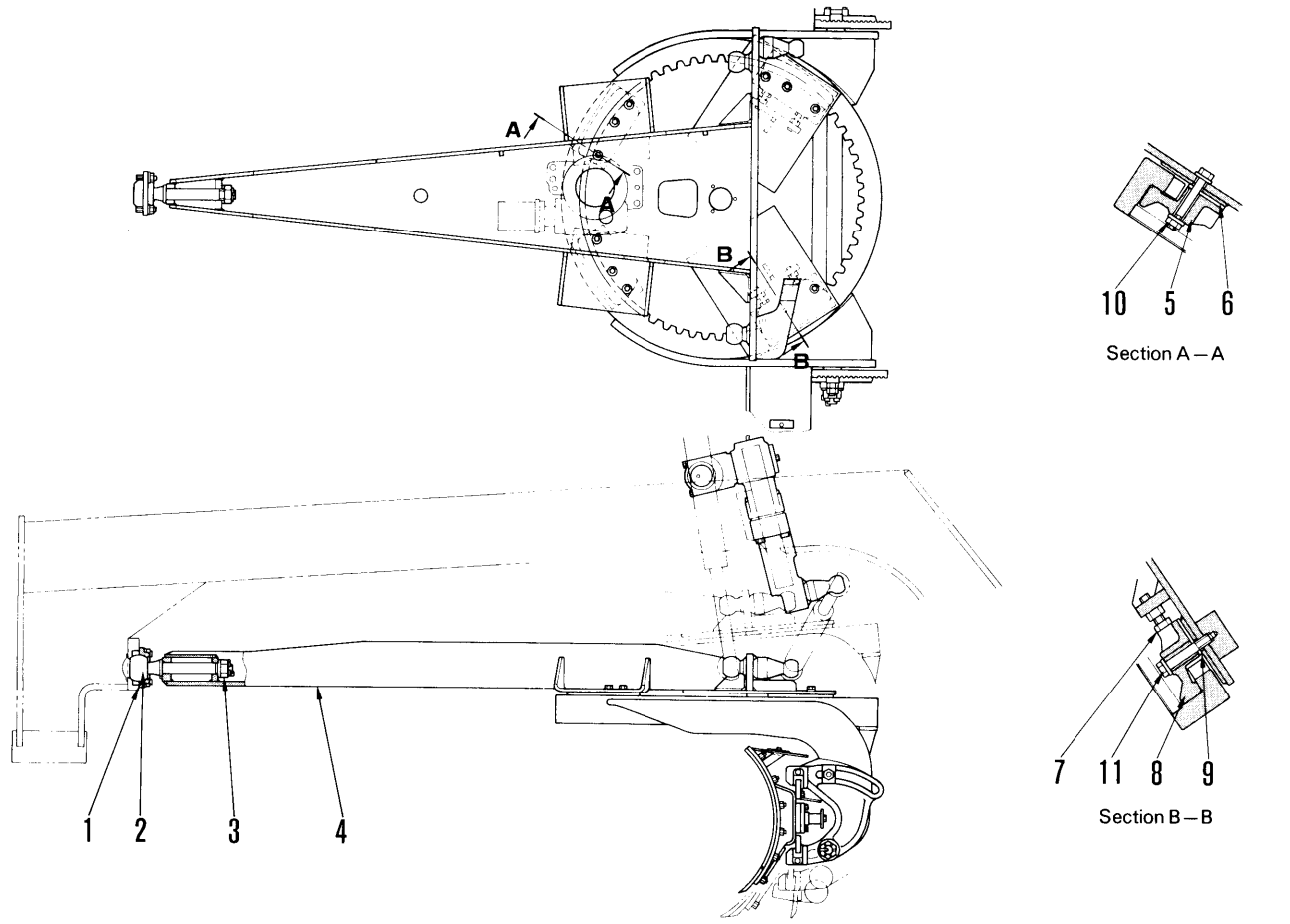
( ): For Serial No. 21086 and up

WORK EQUIPMENT
71 STRUCTURE AND FUNCTION



DRAWBAR

GD705R-4



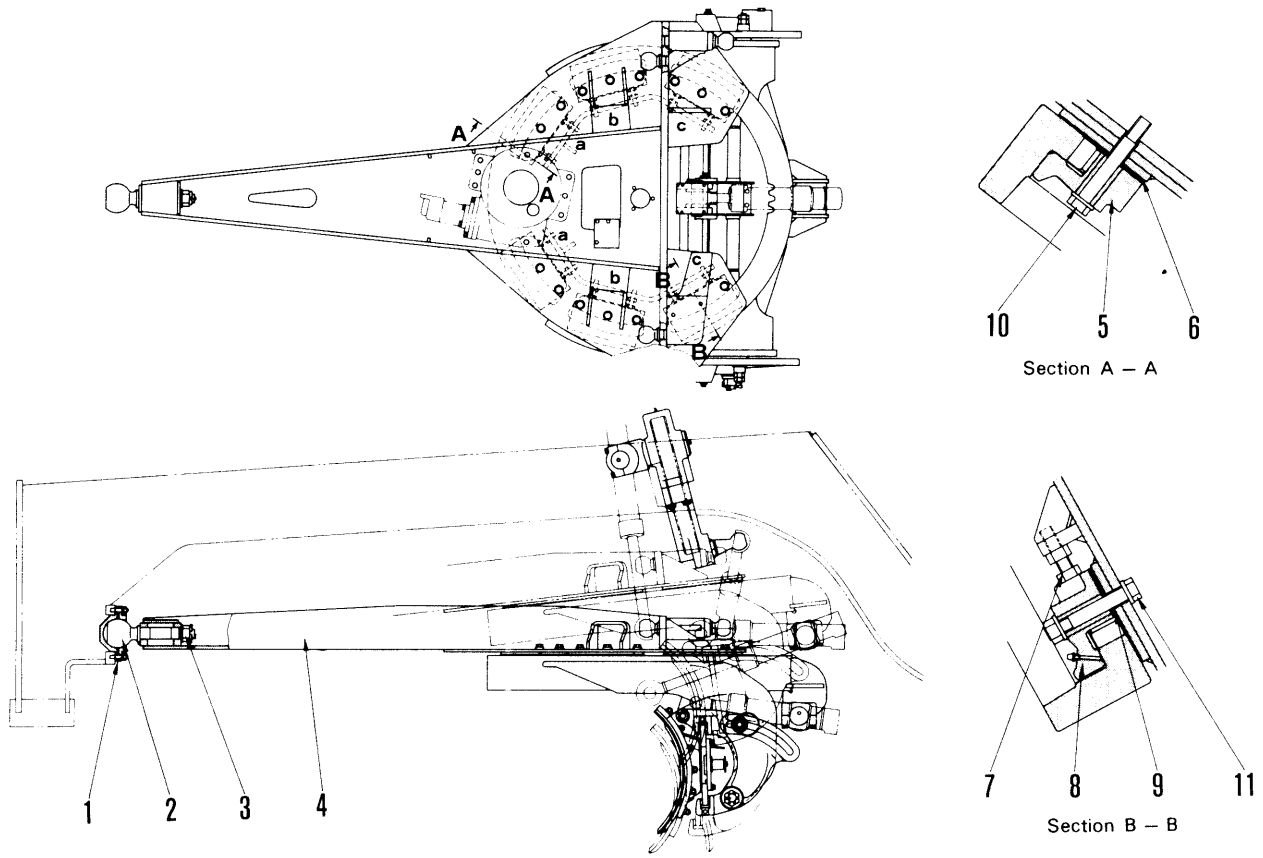
F23E04060

The drawbar is an important device to support the circle and blade. When there is ball joint (2) wear, a shim (1) is used to adjust the clearance of the joint so that there will not be a large gap. The guides (8), (5) are in contact with the circle during revolutions at (a), (b),and (c).

Adjustment of the clearance of contacting parts is done by shims (9), (6) and adjustment bolt (7).

1. Shim
2. Ball joint
3. Nut
4. Drawbar
5. Guide
6. Shim
7. Bolt
8. Guide
9. Shim
10. Bolt
11. Bolt

GD705A-4

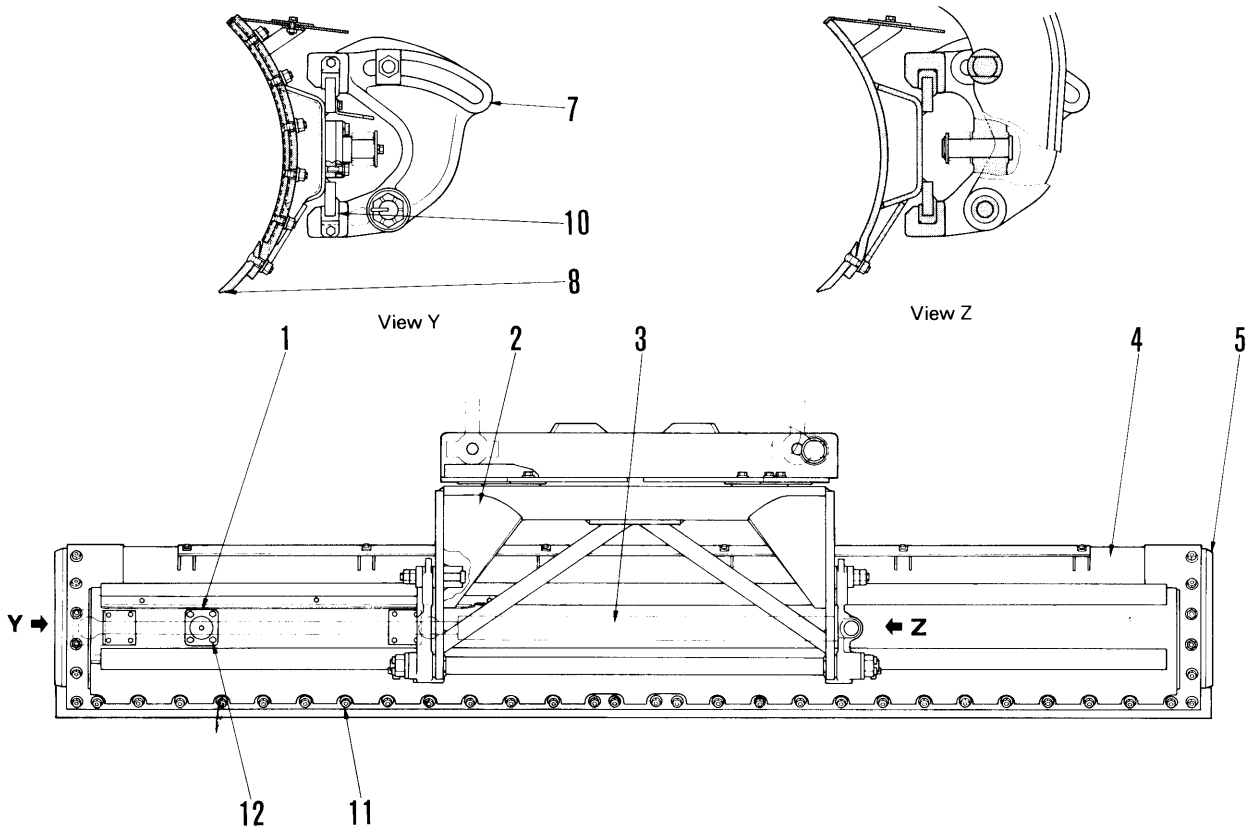


F23404023

1. Shim
2. Ball joint
3. Nut
4. Drawbar
5. Guide
6. Shim
7. Bolt
8. Guide
9. Shim
10. Bolt
11. Bolt

BLADE AND CIRCLE

GD705R-4

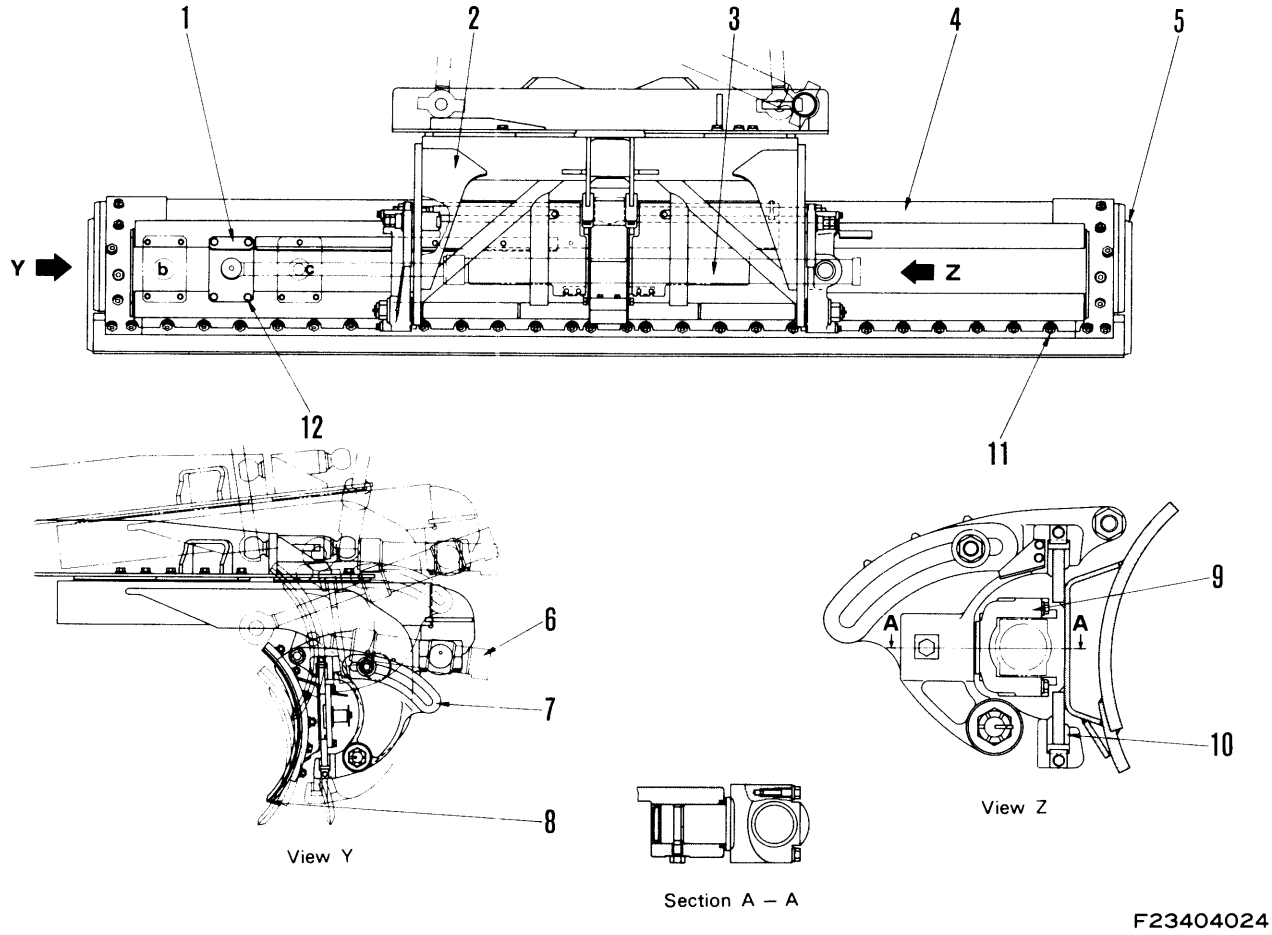


F23E04061

End bits (5) installed on the blade are designed so that they can be used twice. This is done by reversing them and installing them at the other end of the blade.
The cutting angle of the blade can be adjusted freely by sliding adjuster (7) using the lever in the operator's compartment.
Guide (10) acts as a bushing for the sliding parts when the blade is shifted to the side. If the clearance from the sliding parts is too large to allow precise finishing, replace the guide.
The amount of side shift of the blade can be adjusted by sliding bracket (1) to positions "**b**" or "**c**".

1. Bracket
2. Support
3. Blade shift cylinder
4. Blade
5. End bit
6. Power tilt cylinder
7. Adjuster
8. Cutting edge
9. Yoke
10. Guide
11. Nut
12. Bolt

GD705A-4

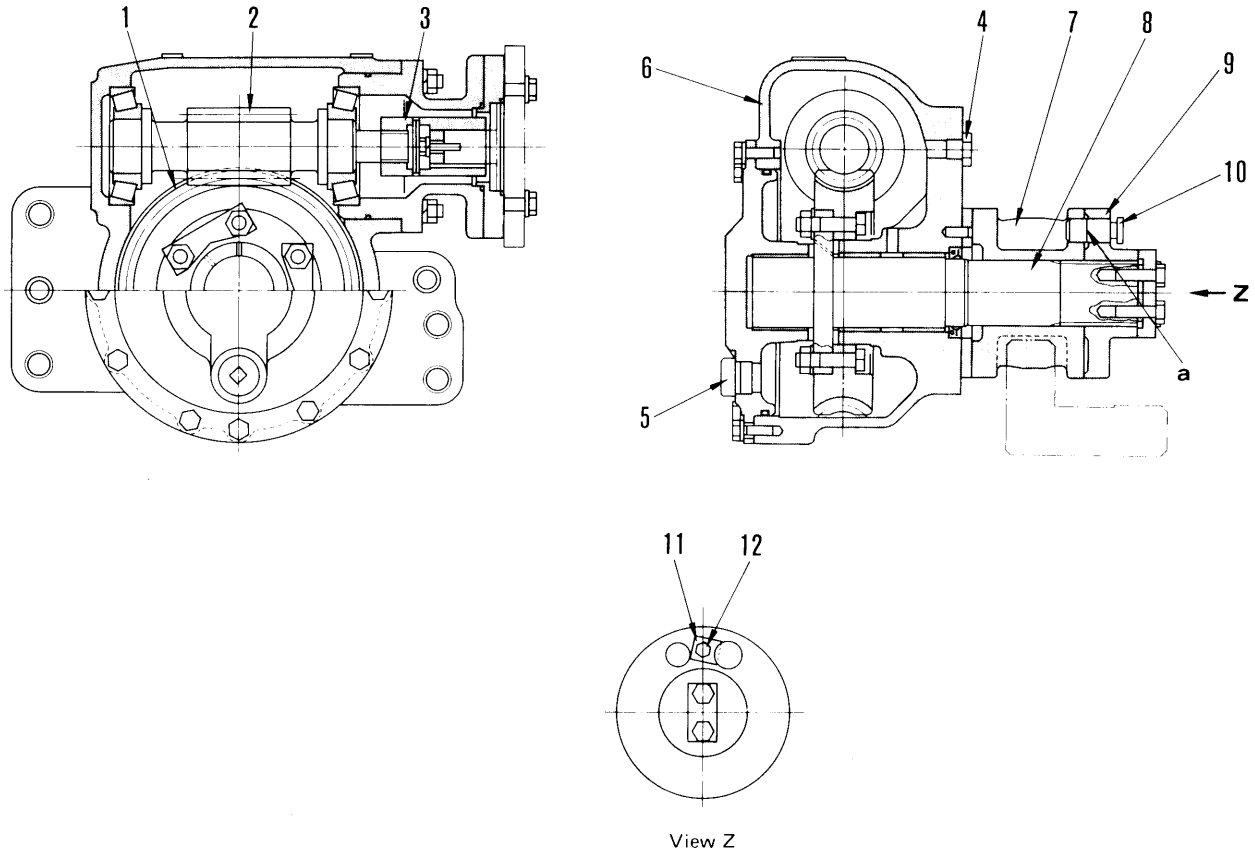


F23404024

1. Bracket
2. Support
3. Blade shift cylinder
4. Blade
5. End bit
6. Power tilt cylinder
7. Adjuster
8. Cutting edge
9. Yoke
10. Guide
11. Nut
12. Bolt

CIRCLE ROTATION GEAR

GD705R-4

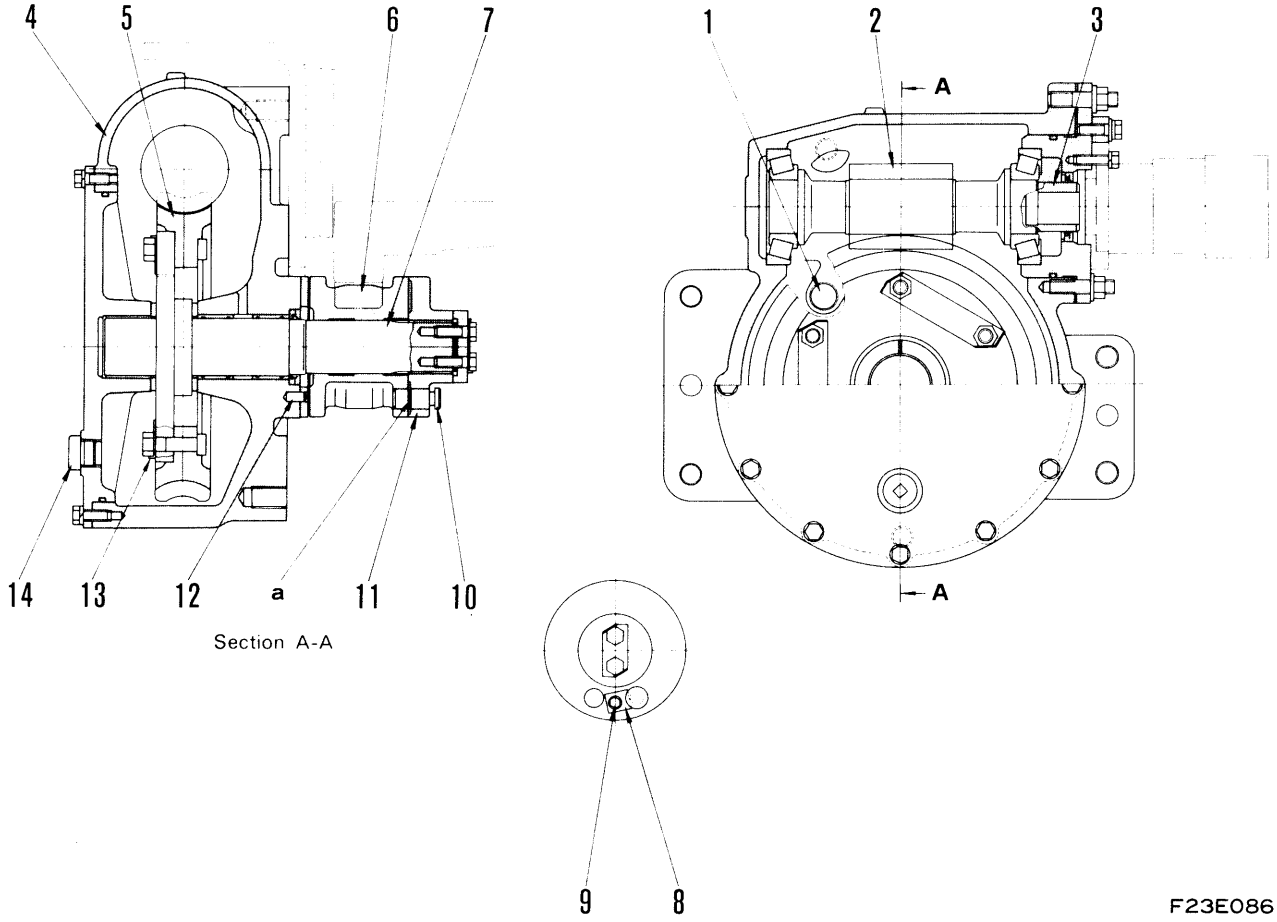


F23B047A-1

The circle rotation gear is driven by an oil motor through coupling (3).
The joint (9) and circle pinion gear (7) are connected by a shear pin (10). If an abnormal torque is transmitted from the blade, the shear pin (10) is cut through at (a) and prevents breakage of the blade system.

1. Worm wheel
2. Worm gear
3. Coupling
4. Drain plug
5. Oil filler and oil level plug
6. Case
7. Gear (circle pinion gear)
8. Shaft
9. Joint
10. Shear pin
11. Plate
12. Bolt

GD705A-4



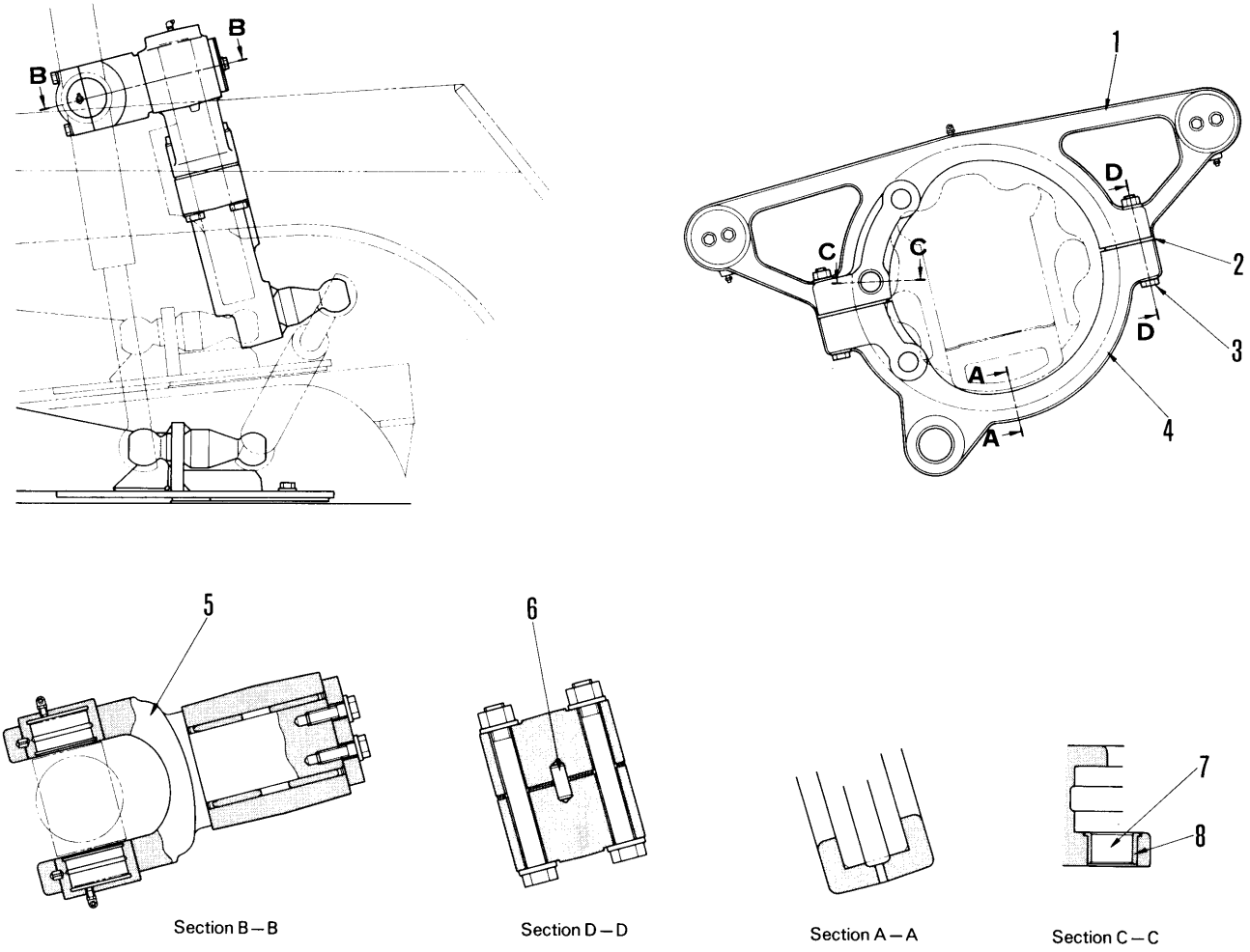
★ Use CLASS-CD SAE90 gear oil for all seasons.

The circle rotation gear is driven by an oil motor through coupling (3).
The joint (11) and circle pinion gear (6) are connected by a shear pin (10). If an abnormal torque is transmitted from the blade, the shear pin (10) is cut through at (a) and prevents breakage of the blade system.

1. Drain plug
2. Worm gear
3. Coupling
4. Case
5. Worm wheel
6. Gear (circle pinion gear)
7. Shaft
8. Plate
9. Bolt
10. Shear pin
11. Joint
12. Pin
13. Lock plate
14. Oil filler plug

LIFTER

GD705R-4



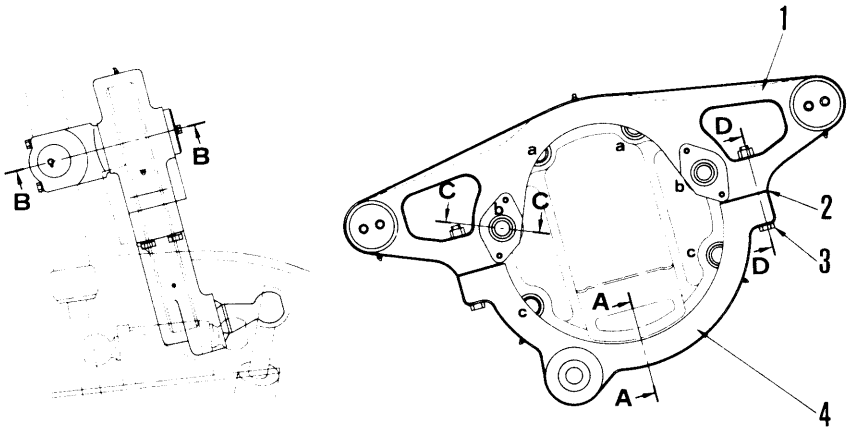
F23E04063

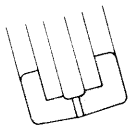
There is a cylinder installed in the lifter for moving the blade device. Brackets (1) and (4) are installed by the guide which is welded to the main frame. They can be revolved by revolving the guide by extracting a pin (8) controlled from the operator's seat. There are three insertion holes altogether for the pin (8) stopping revolution. Holes (a) and (c) are used for the blade to make a bank cut to left or right.

This (b) gets used much more than other holes and a bushing (7) is used in it to make the clearance between the pin and the hole at a minimum. (This clearance amplifies the up and down movement of the blade.) Also, the clearance between the bracket and the guide welded to the frame can be adjusted with shims (2). Pin (6) combined with bolt (3) tightening force prevents bracket up and down slippage.

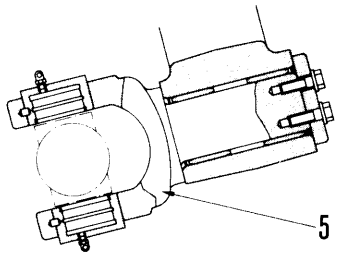
1. Bracket (Upper)
2. Shim
3. Bolt
4. Bracket (Lower)
5. Yoke
6. Pin
7. Bushing
8. Pin

GD705A-4

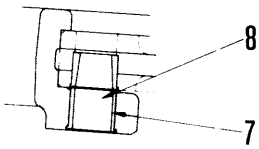




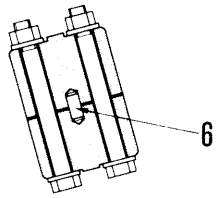
Section A – A



Section B – B



Section C – C



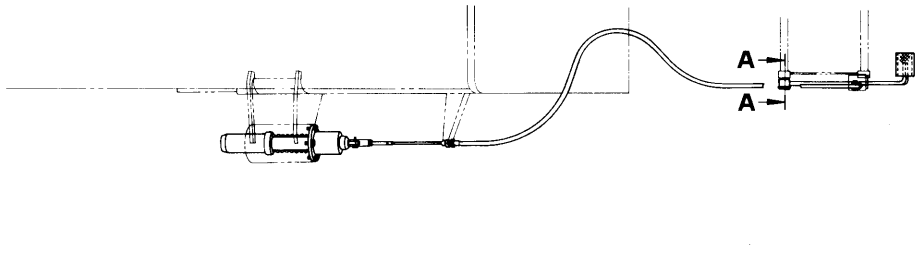
Section D – D

F23404025

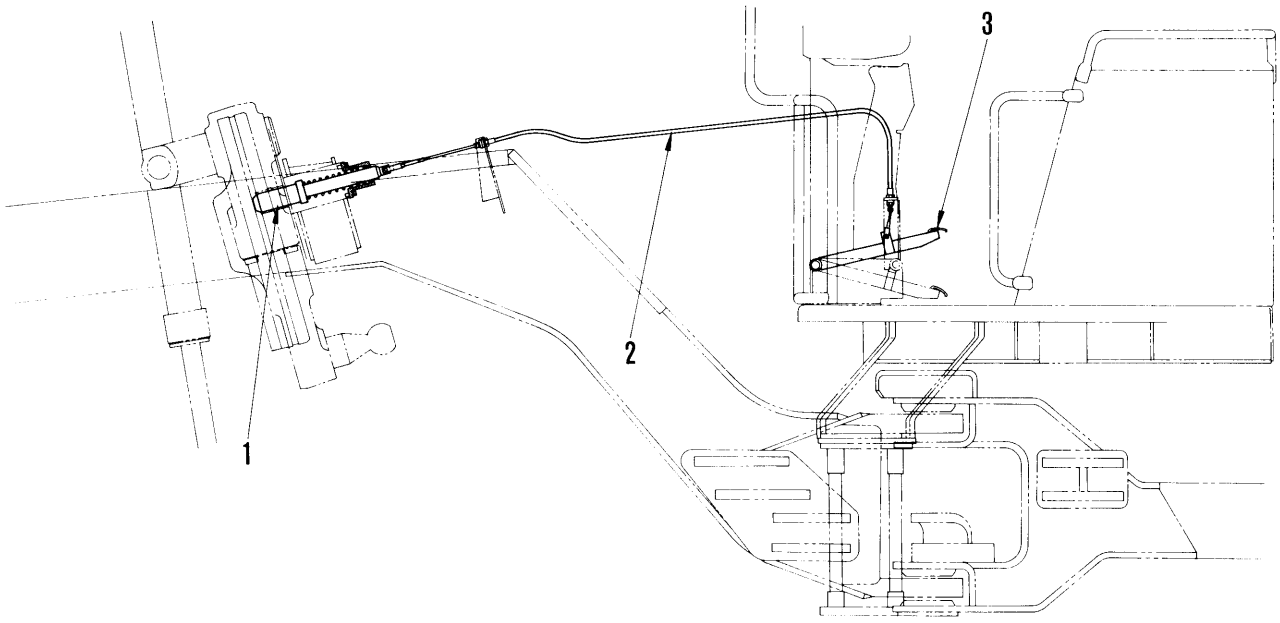
1. Bracket (Upper)
2. Shim
3. Bolt
4. Bracket (Lower)
5. Yoke
6. Pin
7. Bushing
8. Pin

LIFTER BRACKET CONTROL

GD705R-4



Section A–A

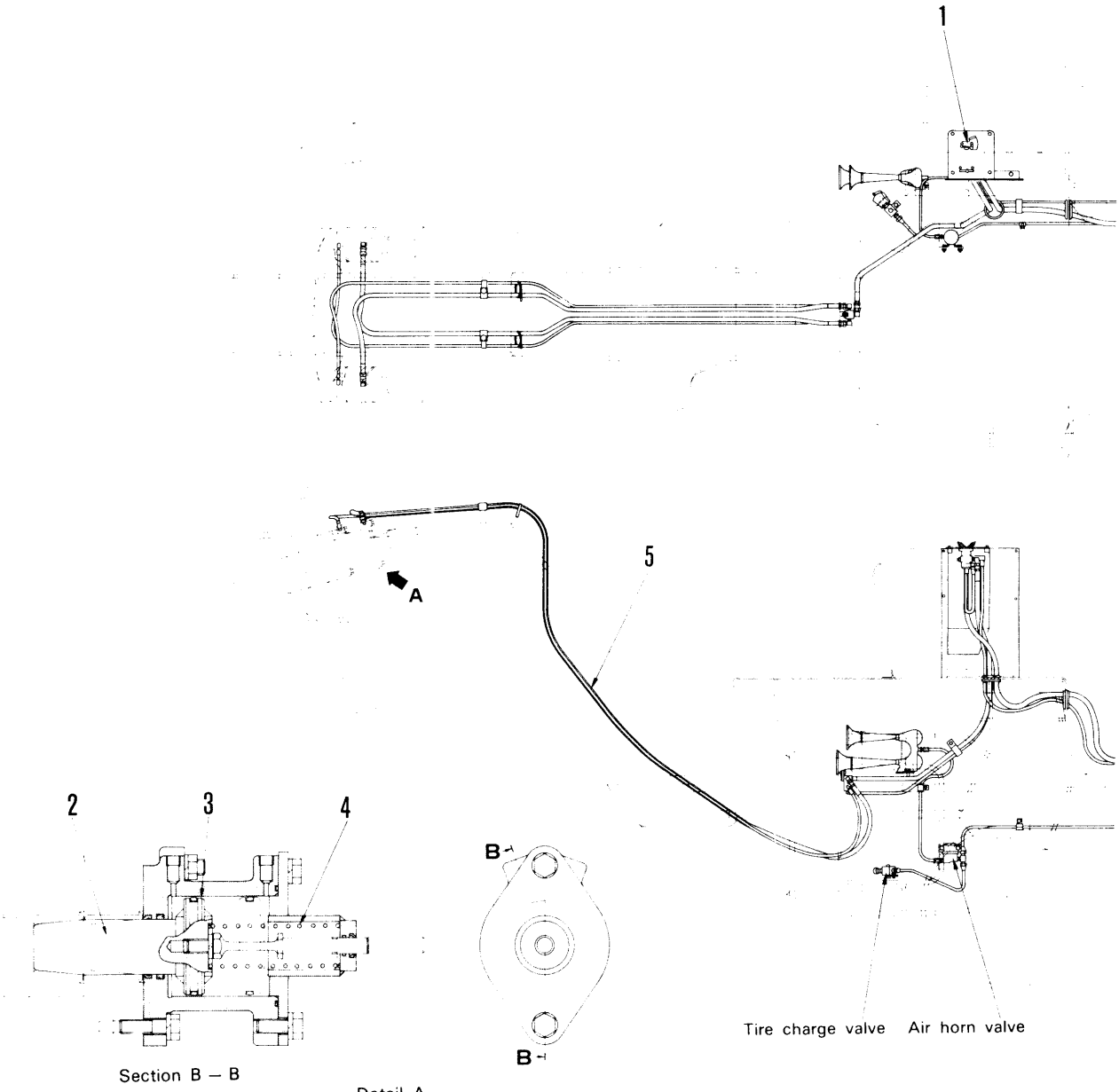


232F141

The lifter bracket is secured to the main frame lifter bracket guide by pin (1). For bank-cutting operations, depress pedal (3), remove the pin, and turn the lifter bracket.

1. Pin
2. Cable
3. Pedal

GD705A-4



Section B – B

Detail A

F23404027

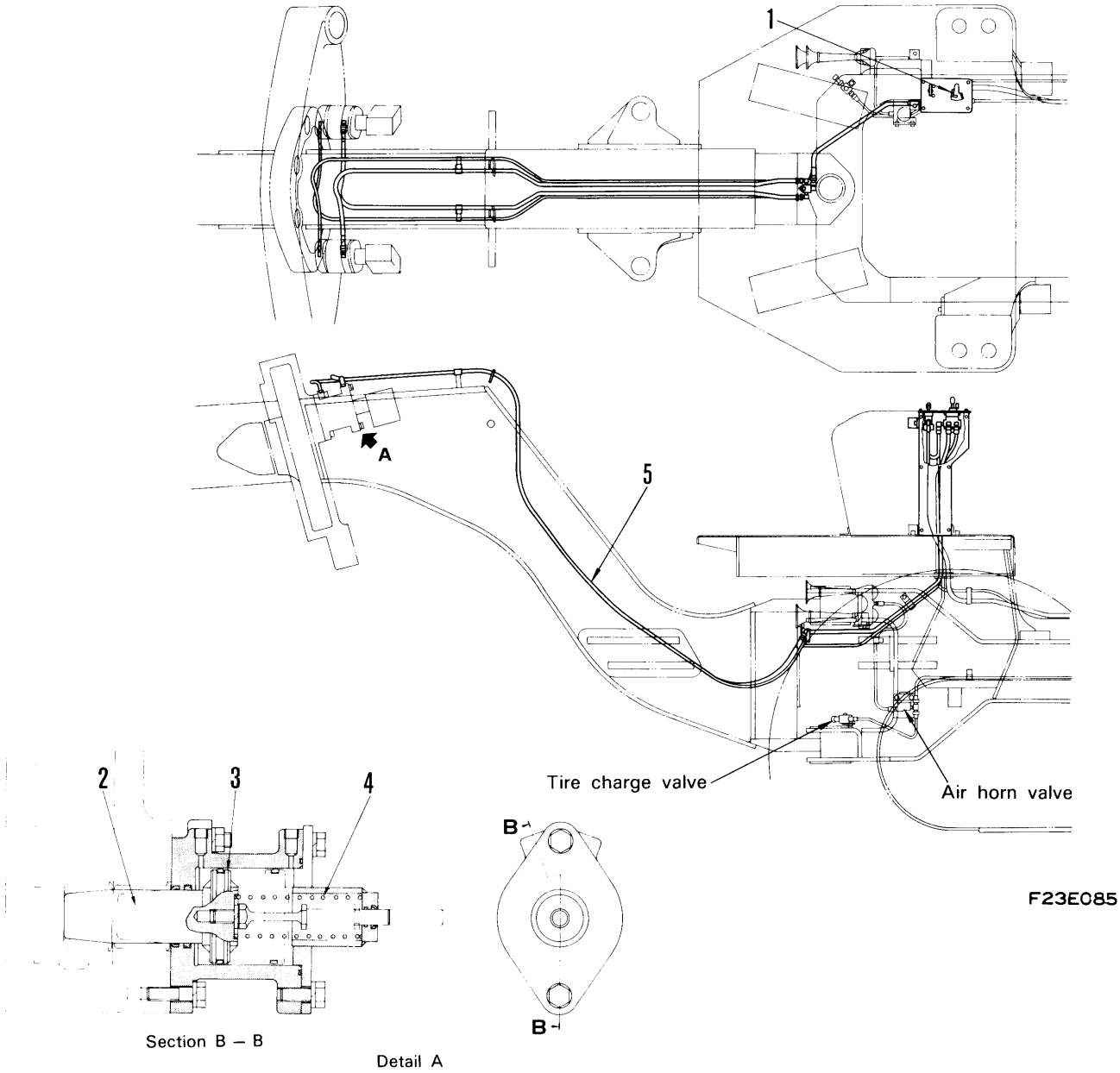
F23404026

The lifter bracket is fixed by pin (2). When setting in the bank cutting position, operate control lever (1). This uses compressed air to push piston (3). The pin can be removed and the bracket can then be rotated.

1. Lever (for bank control pin)
2. Pin
3. Piston
4. Spring
5. Air tube

LIFTER BRACKET CONTROL

GD705A-4 (Serial No. 31001 and up)



F23E085

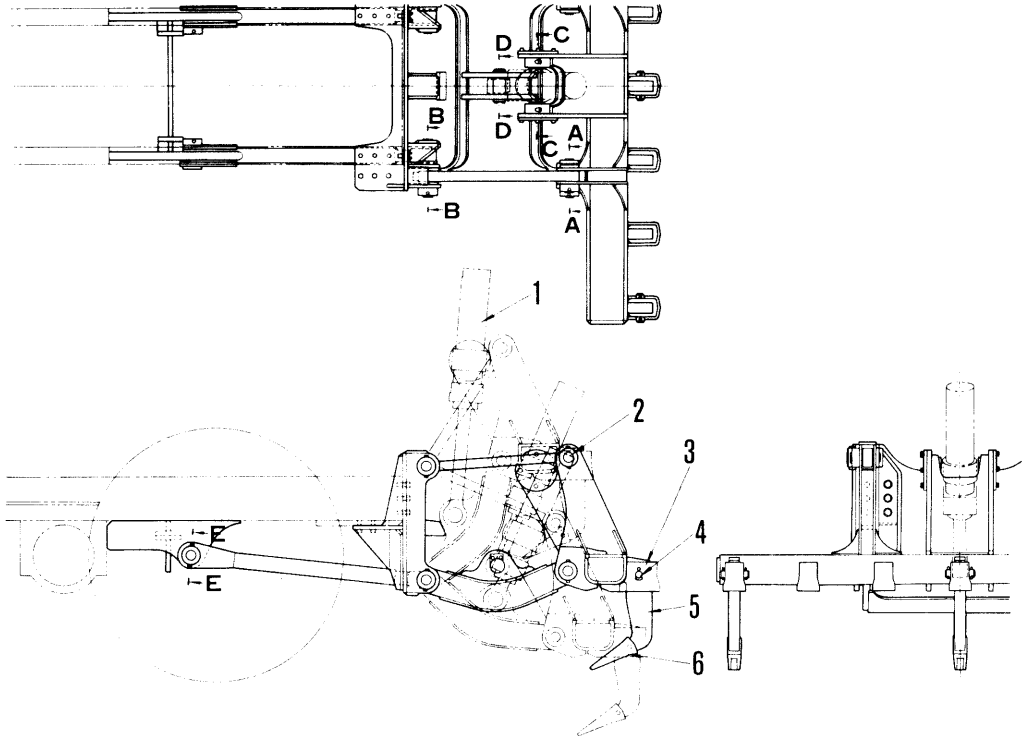
F23404027

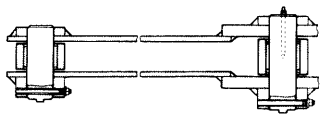
The lifter bracket is fixed by pin (2). When setting in the bank cutting position, operate control lever (1). This uses compressed air to push piston (3). The pin can be removed and the bracket can then be rotated.

1. Lever (for bank control pin)
2. Pin
3. Piston
4. Spring
5. Air tube

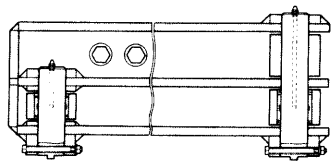
REAR MOUNT RIPPER (If equipped)

GD705A-4

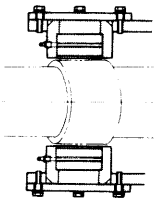




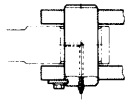
Section A-A



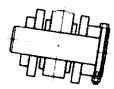
Section B-B



Section C-C



Section D-D



Section E-E

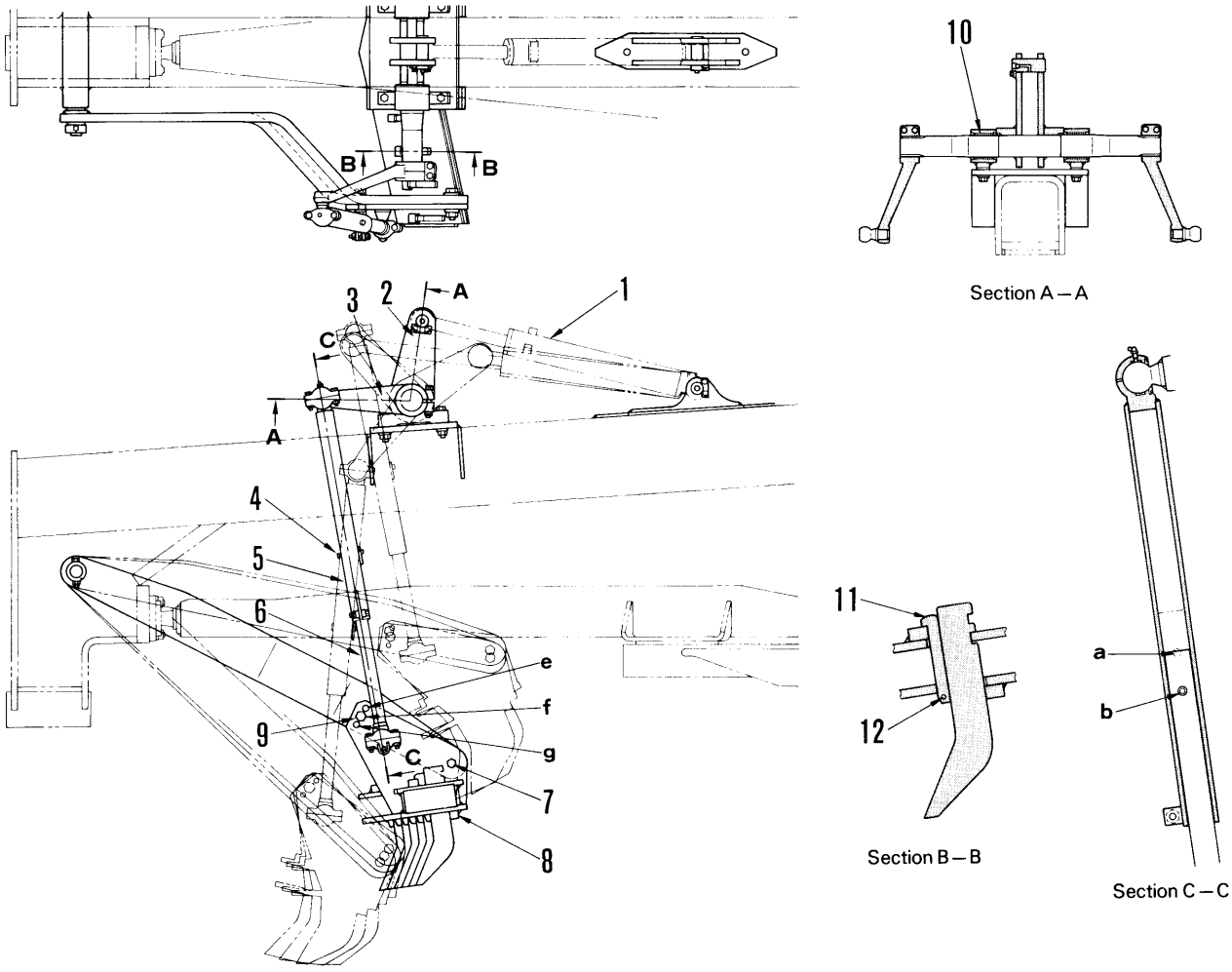
F23E087

Ripper lifting height and digging height can be adjusted with hydraulic cylinder (1). Since the point tips cut into the ground under the load of the ripper's heavy weight, the ripper easily performs heavy-duty digging work which cannot be done by the scarifier. Two kinds of points are selectively used: A short point for heavy-duty work and a long point for ordinary work.

1. Ripper cylinder
2. Pin
3. Bracket
4. Shank pin
5. Shank
6. Point

SCARIFIER (If equipped)

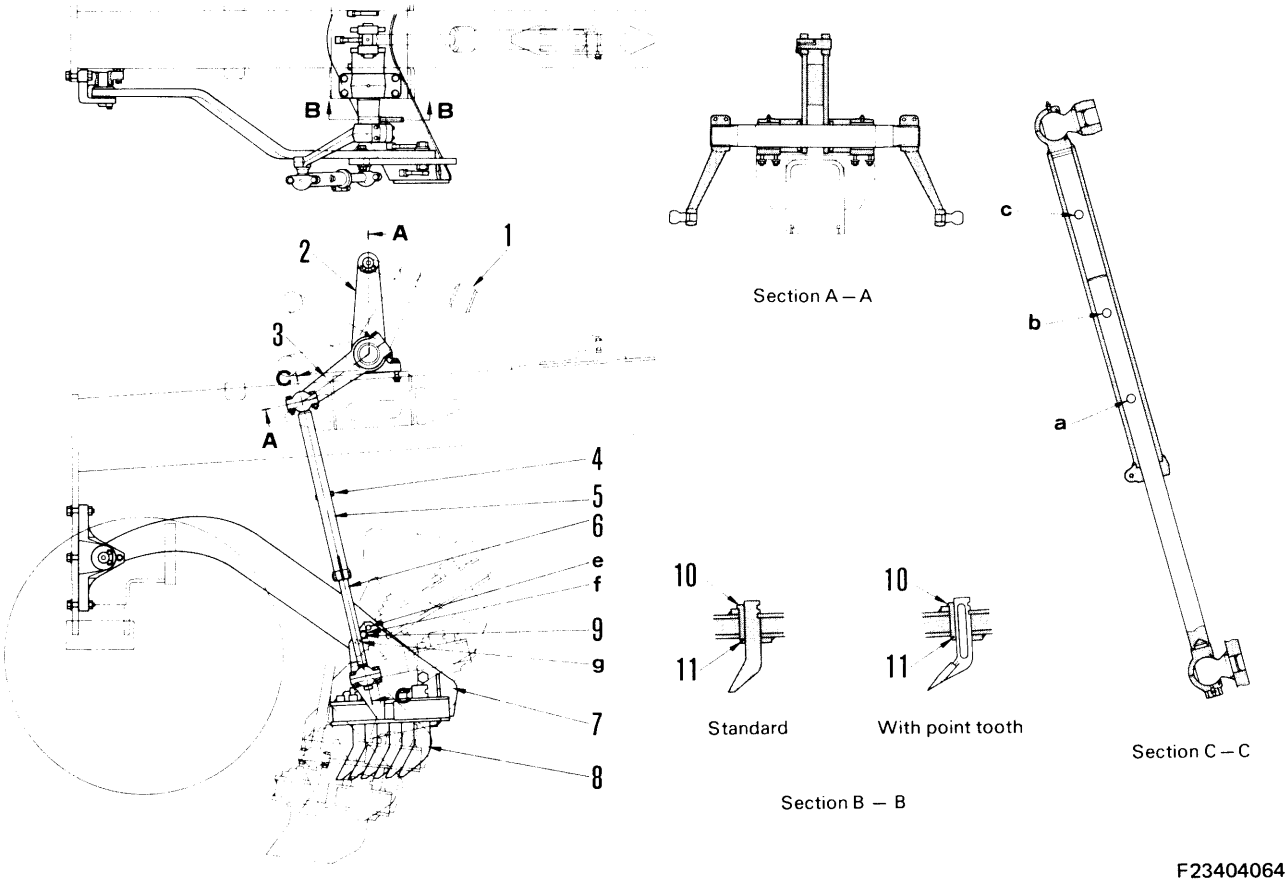
GD705R-4



The lifting height and digging depth of the scarifier can be changed by moving the connecting holes (a) and (b) of the rod (5) and pipe (6).
Also, the digging angle, lifting height and digging depth of the scarifier teeth (8) can be changed by moving bolt (9) into holes (e), (f) or (g) on the scarifier body. When in (g) position especially, the blade can be revolved 360°, when the scarifier teeth are extracted and the scarifier raised up.
Oiless bushing for bushing (10) is used.

1. Scarifier cylinder
2. Arm
3. Scarifier lift arm
4. Pin
5. Rod
6. Pipe
7. Scarifier body
8. Scarifier teeth
9. Bolt
10. Bushing
11. Wedge
12. Pin

GD705A-4



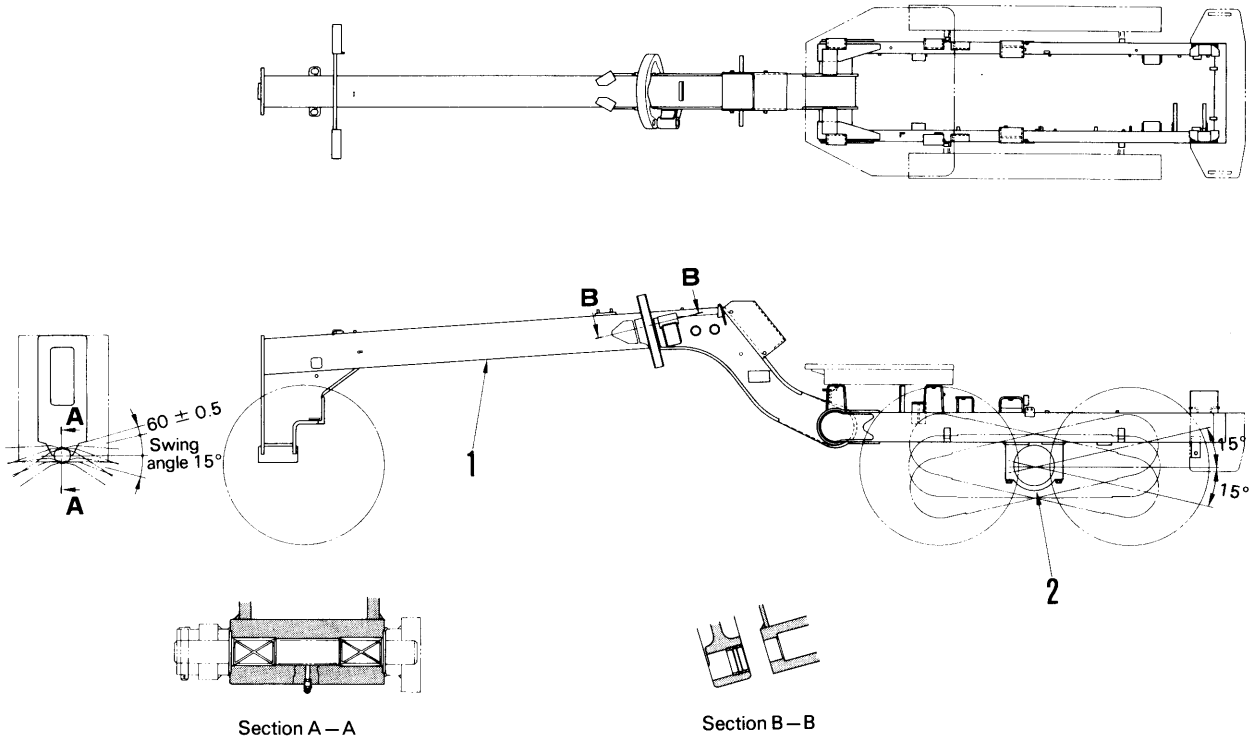
F23404064

The lifting height and digging depth of the scarifier can be changed by moving the connecting holes (a), (b) and (c) of the rod (5) and pipe (6).
Also, the digging angle, lifting height and digging depth of the scarifier teeth (8) can be changed by moving bolt (9) into holes (e), (f) or (g) on the scarifier body. When in (g) position especially, the blade can be revolved 360°, when the scarifier teeth are extracted and the scarifier raised up.

1. Scarifier cylinder
2. Arm
3. Scarifier lift arm
4. Pin
5. Rod
6. Pipe
7. Scarifier body
8. Scarifier teeth
9. Bolt
10. Wedge
11. Pin

MAIN FRAME

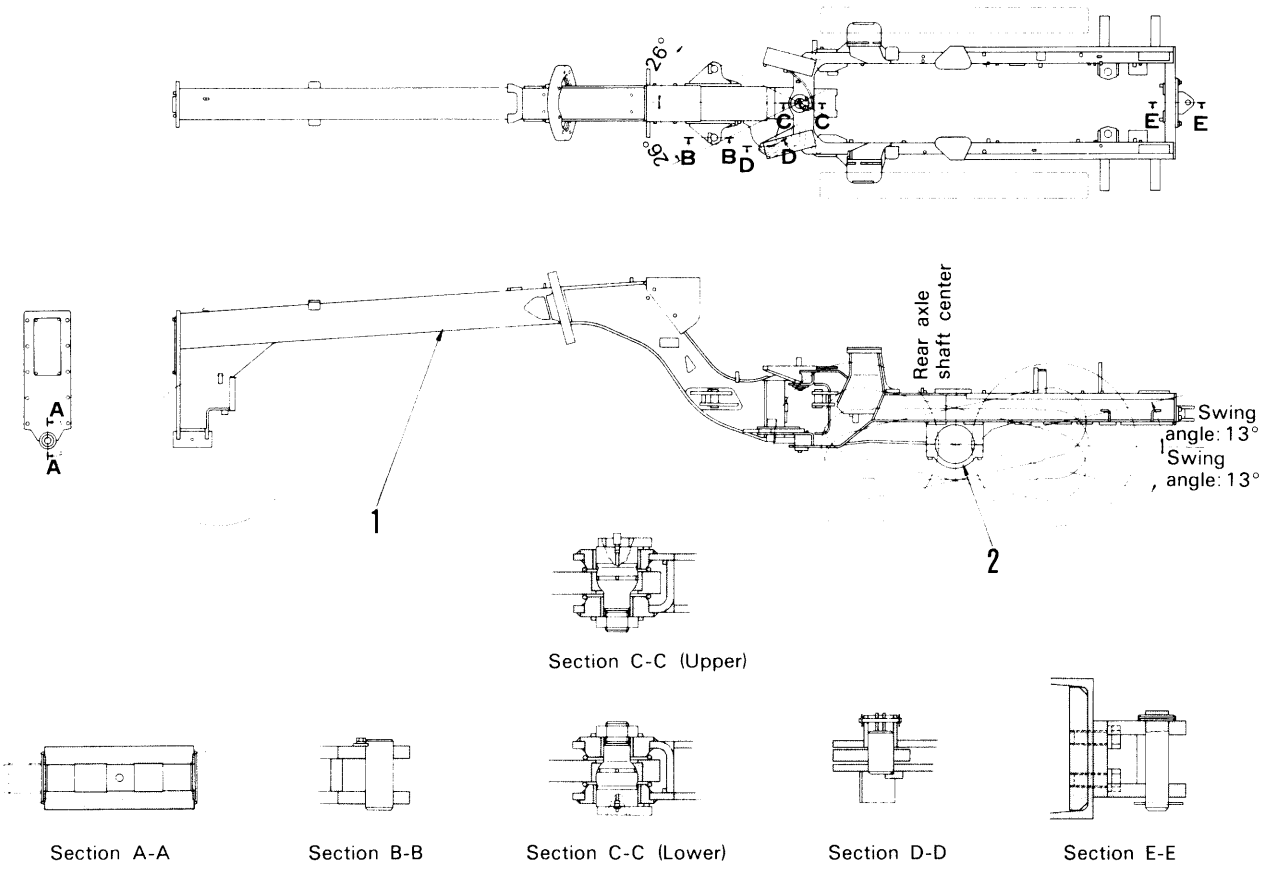
GD705R-4



F23E04065

1. Main frame
2. Cap

GD705A-4



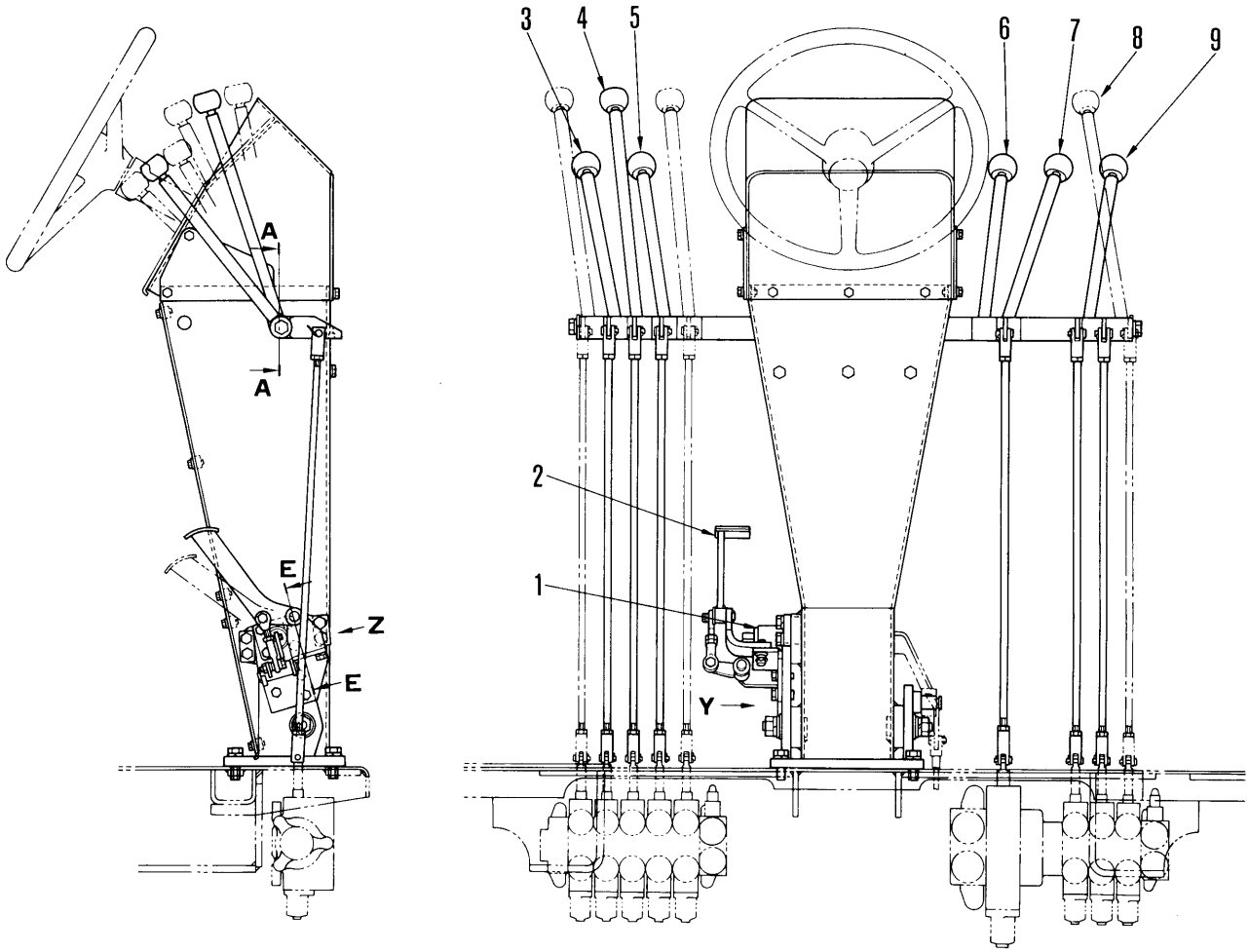
F23E088

The frame can be articulated 26° both to right and left of the center by the articulate cylinder. (The articulater stopper is on the side of the frame.) Articulation is useful for reducing turning radius, for offset work, for getting out of mud and for the various corner operations.
Also, because the front frame is one unit the visibility of the work equipment is good.

1. Main frame
2. Cap

HYDRAULIC CONTROL LINKAGE

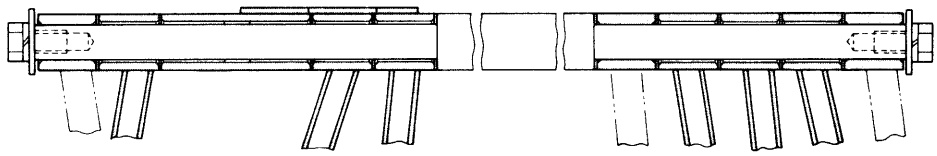
GD705R-4



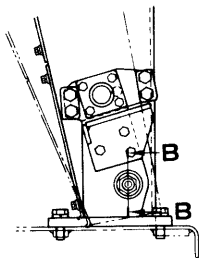
F23E04066

When the steering post and tilt pedal (2) are pressed, it is possible to extract lock pin (1) and adjust the post for either a standing or sitting position.

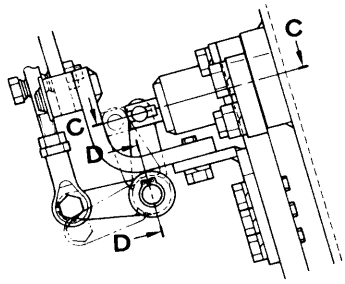
1. Lock pin
2. Steering post tilt pedal
3. Blade lift R.H. lever
4. Leaning lever
5. Blade side shift lever
6. Drawbar shift lever
7. Circle reverse lever
8. Scarifier (If equipped)
9. Blade lift L.H. lever



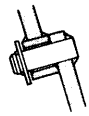
Section A – A



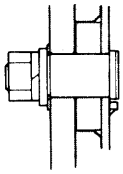
View Y



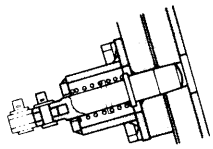
View Z



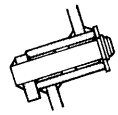
Section E – E



Section B – B



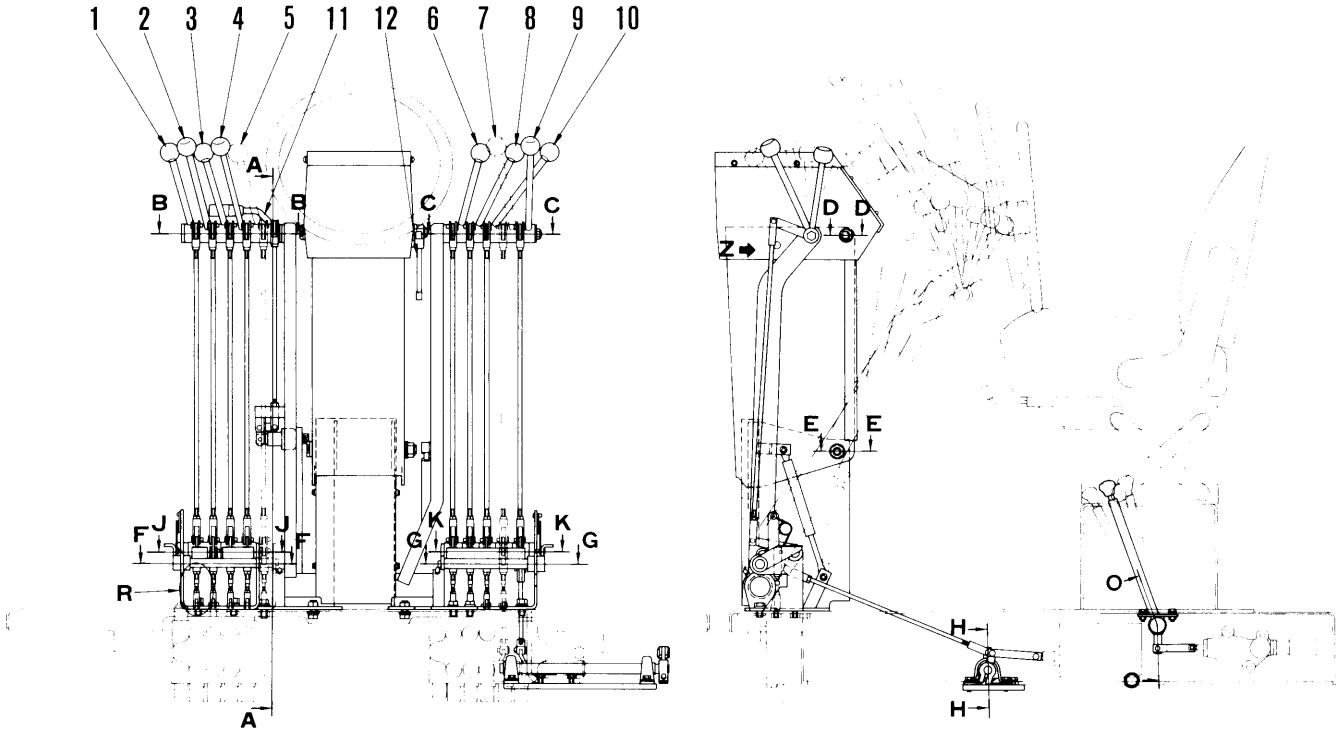
Section C – C



Section D – D

F23E04067

GD705A-4 (Serial No. 21027 and up)

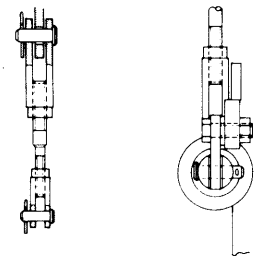


F23C01001

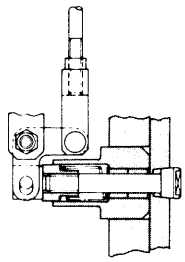
- Steering wheel and instrument panel tilting mechanism:
  Rotate tilt lever (12) to loosen the lock, move to a suitable position, then tighten the lever.
  The tilting angle can be adjusted steplessly 10°.
- Console box tilting mechanism:
  Depress pedal to remove the dowel pin, and the console box can be adjusted in five stages.
- Control lever tilting mechanism:
  Push down tilt lever (11) to remove the dowel pin, and the control lever can be adjusted in six stages.

In this way, the steering wheel and control levers can be set to the optimum position for the operator.

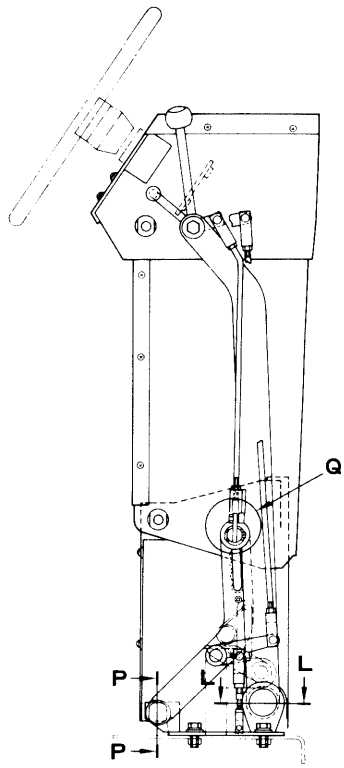
1. Blade lift R.H. lever
2. Leaning lever
3. Blade shift lever
4. Power tilt lever
5. OP lever
6. Articulate lever
7. Scarifier or Ripper lever (if equipped)
8. Drawbar shift lever
9. Circle rotation lever
10. Blade lift L.H. lever
11. Tilt lever
12. Tilt lever



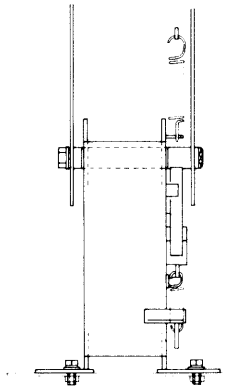
Detail R

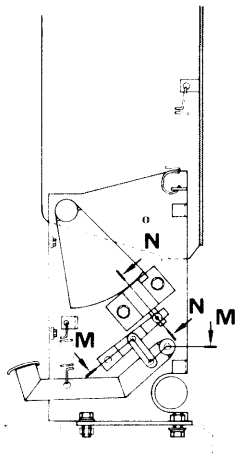


Detail Q



Section A–A

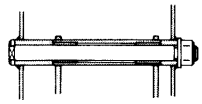




Section B–B

Section C–C

Section D–D

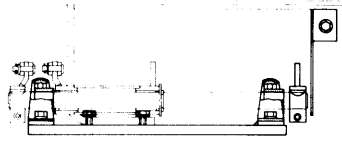


Section E–E

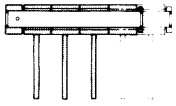
Section F–F

Section G–G

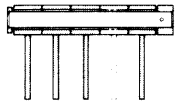
Section H–H



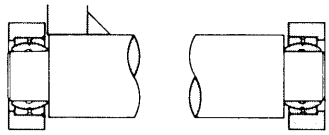
Section H–H



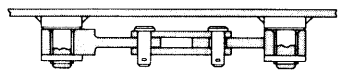
Section J–J



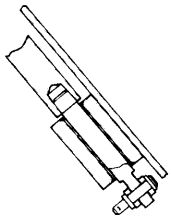
Section K–K



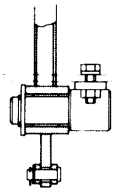
Section L–L



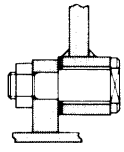
Section M–M



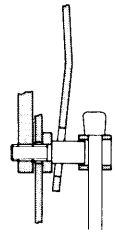
Section N–N



Section O–O



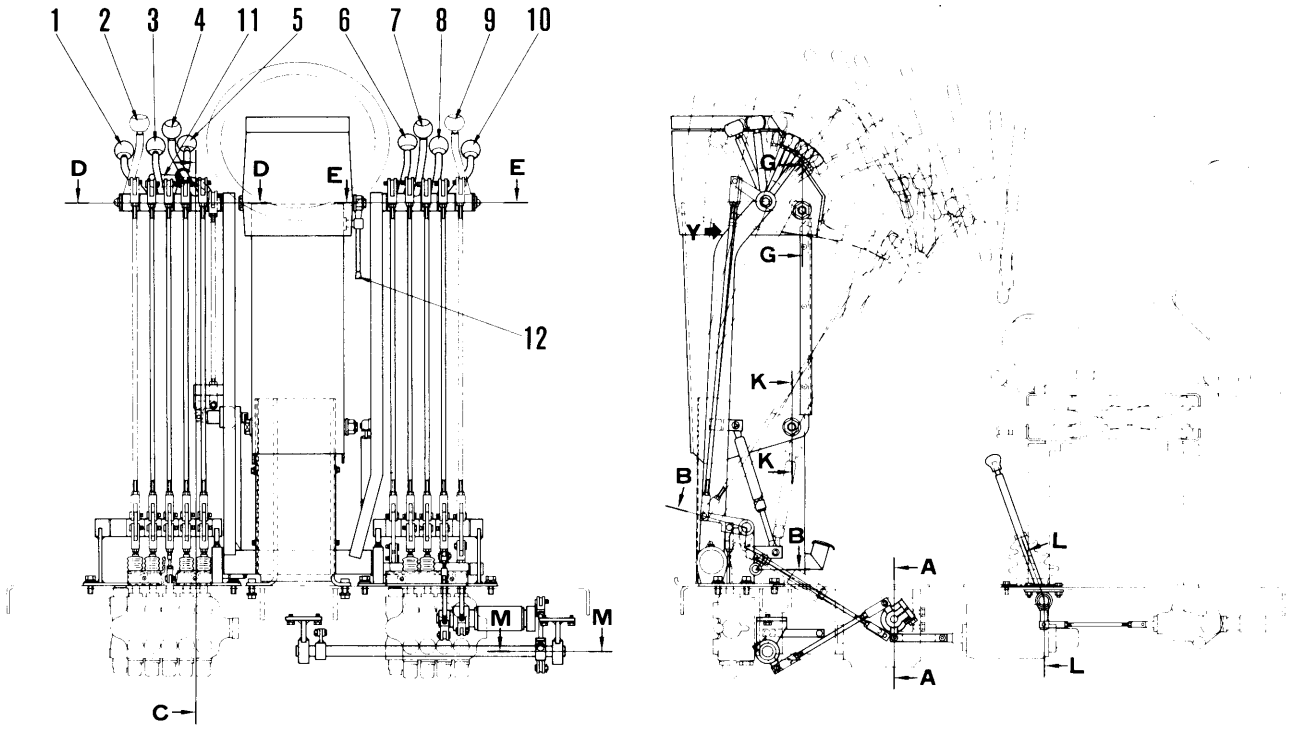
Section P–P



View Z

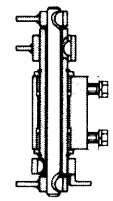
F23C01002

GD705A-4 (Serial No. 31040 and up)

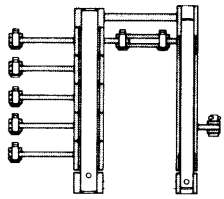


F23C01003

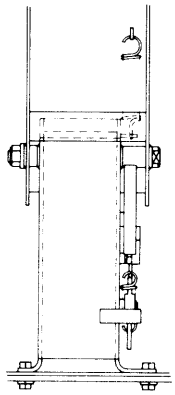
1. Blade lift R.H. lever
2. Scarifier lever (if equipped)
3. Leaning lever
4. Articulate lever
5. Drawbar shift lever
6. Circle rotation lever
7. Power tilt lever
8. Blade shift lever
9. Ripper lever (if equipped)
10. Blade lift L.H. lever
11. Tilt lever
12. Tilt lever

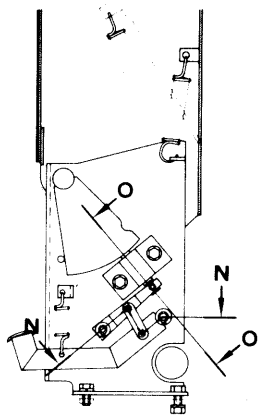


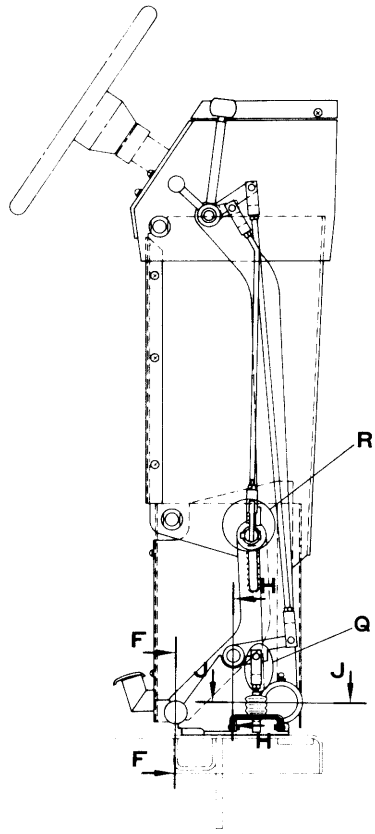
Section A – A



Section B – B



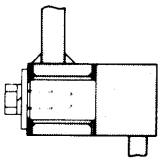




Section C – C

Section D – D

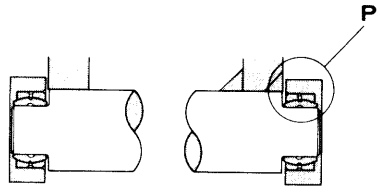
Section E – E



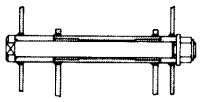
Section F – F

Section G – G

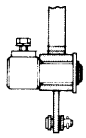
Section H – H



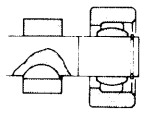
Section J – J



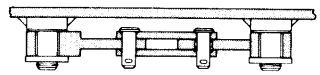
Section K – K



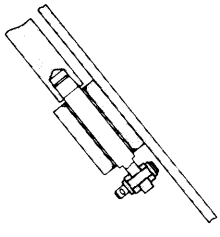
Section L – L



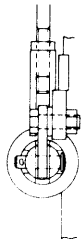
Section M – M

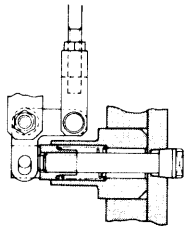


Section N – N

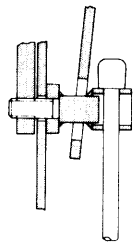


Section O – O

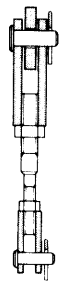




Detail R



View Y



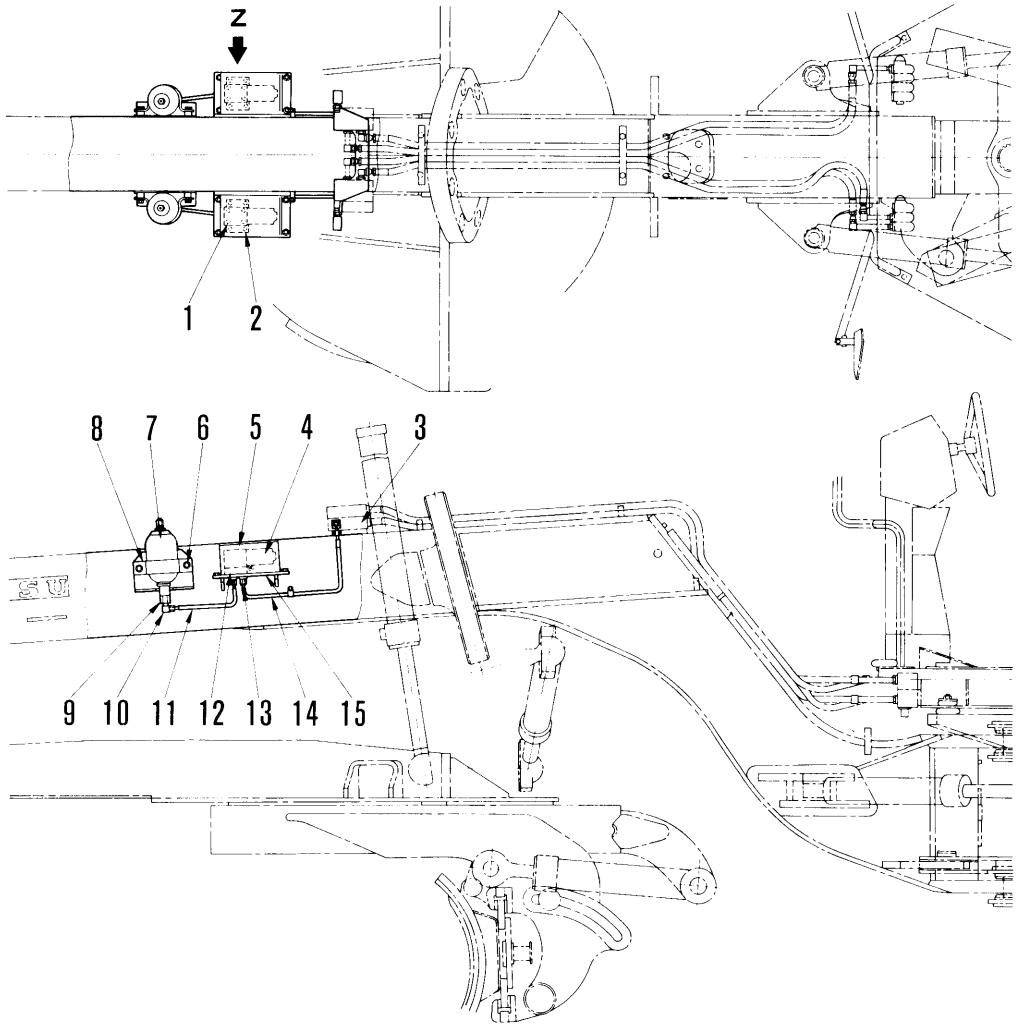
Detail Q

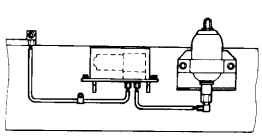
F23C01004

BLADE ACCUMULATOR SYSTEM (If equipped)

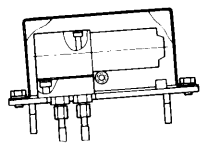
GD705A-4

NAMES OF COMPONENT PARTS





View Z

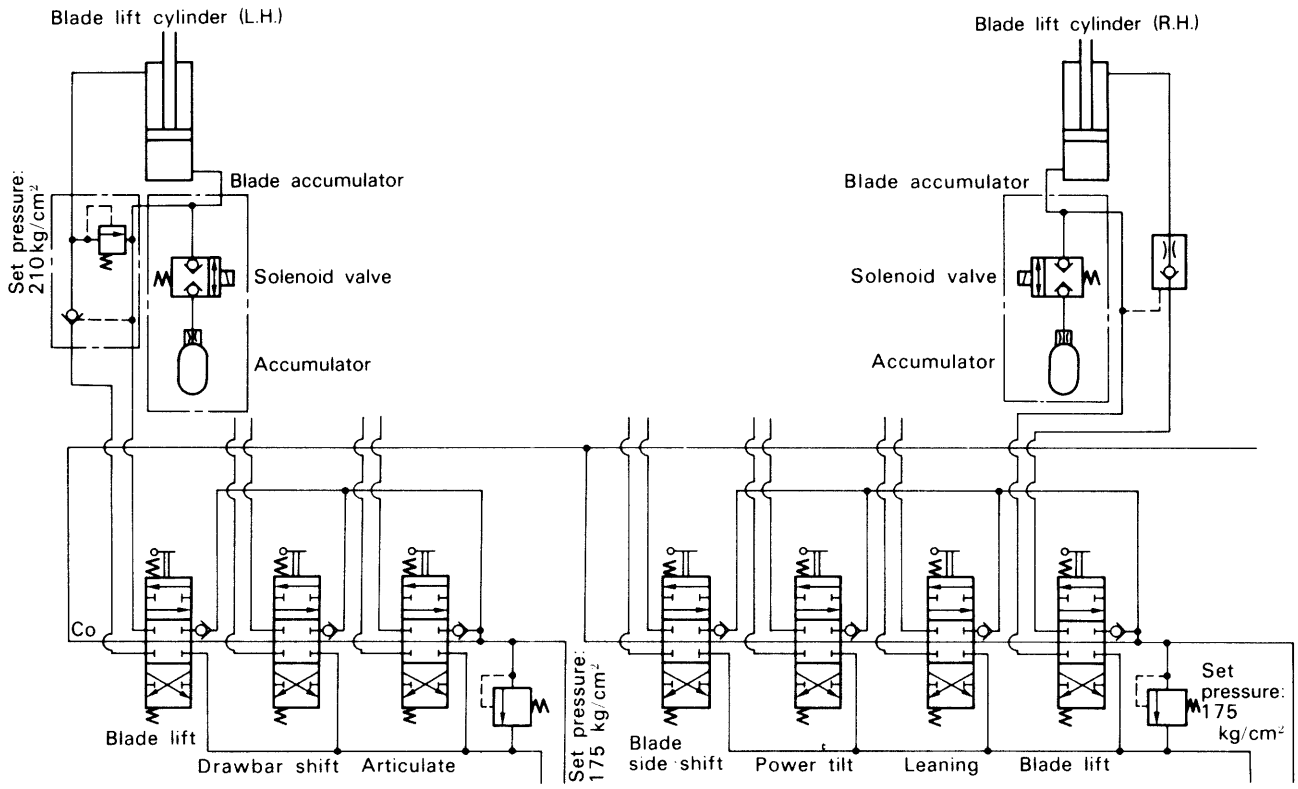


Detail solenoid valve

F23E078

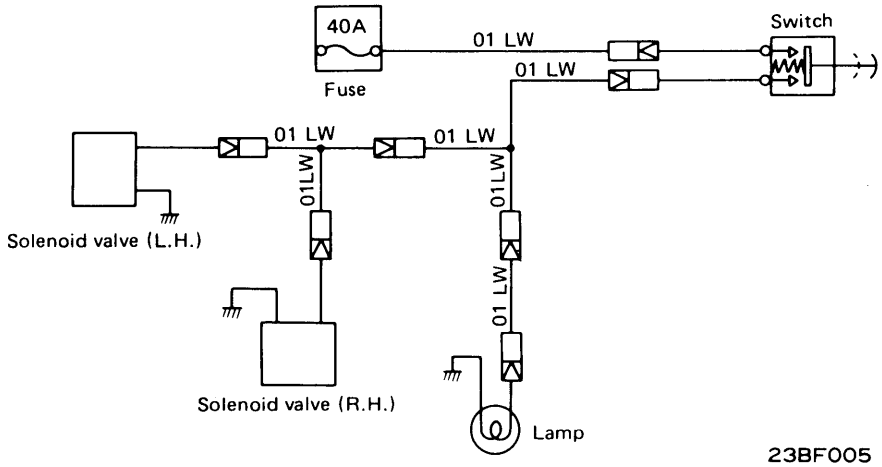
1. Bolt
2. Bolt
3. Pilot check valve
4. Solenoid valve
5. Cover
6. Bolt
7. Accumulator
8. Clip
9. Valve
10. Nipple
11. Tube
12. Bracket
13. Nipple
14. Tube
15. Bracket

ACCUMULATOR HYDRAULIC CIRCUIT DIAGRAM

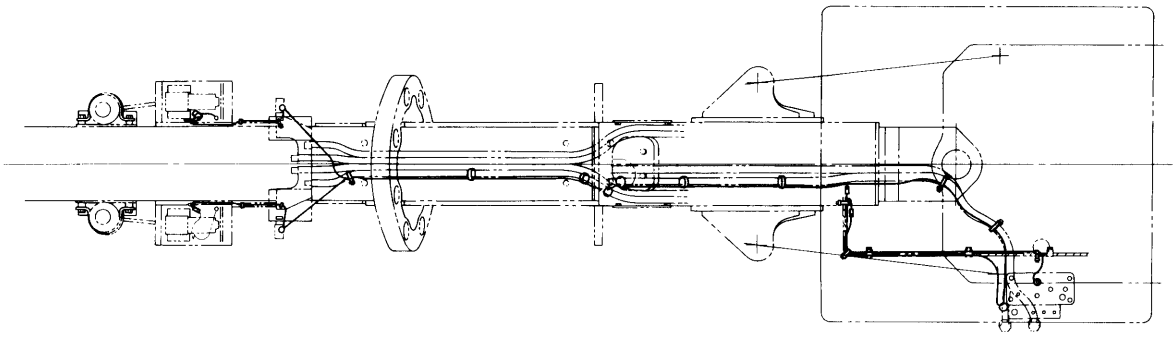


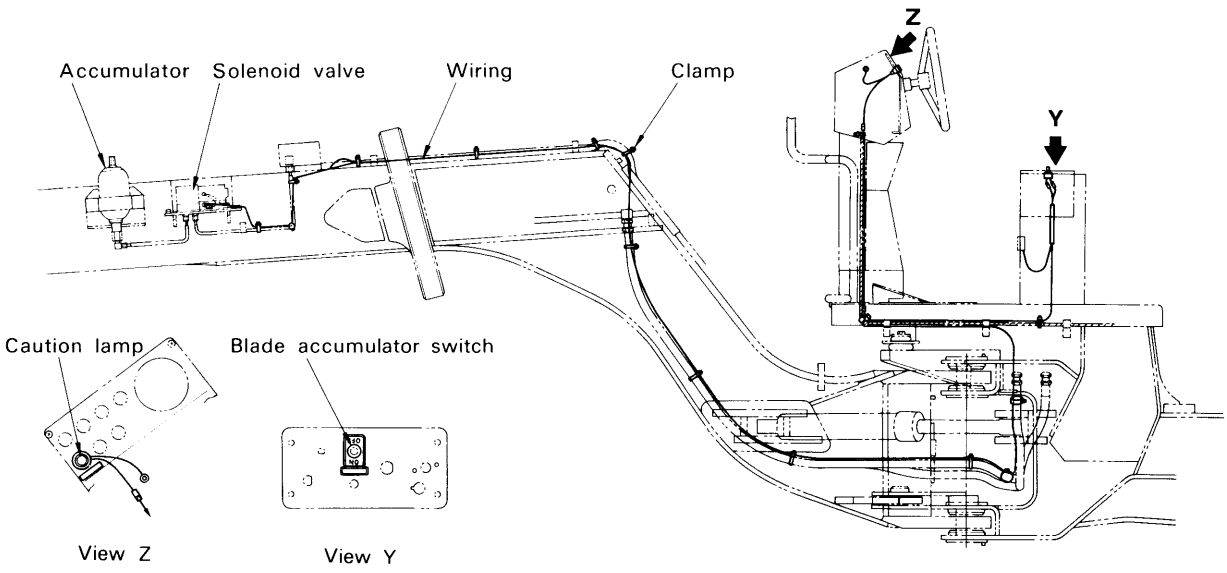
F23E079

ACCUMULATOR WIRING DIAGRAM



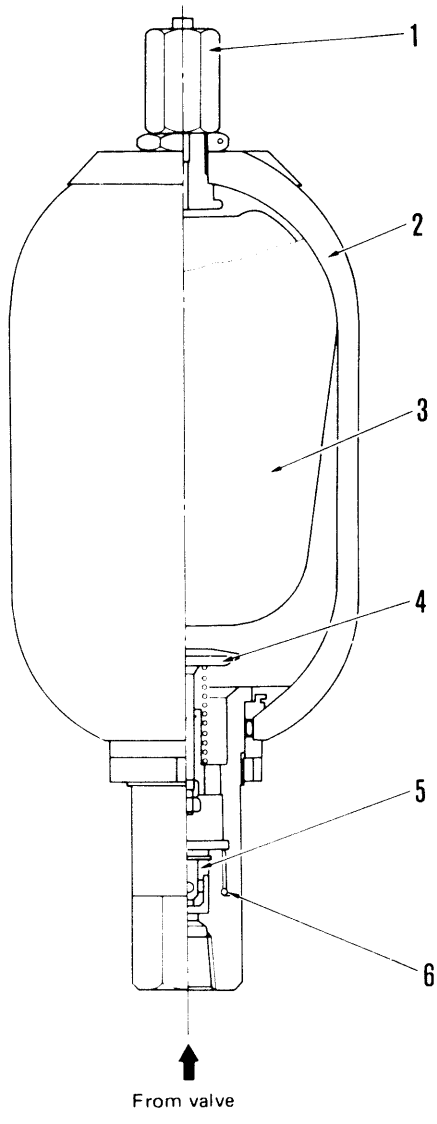
23BF005





F23E081

STRUCTURE AND FUNCTION

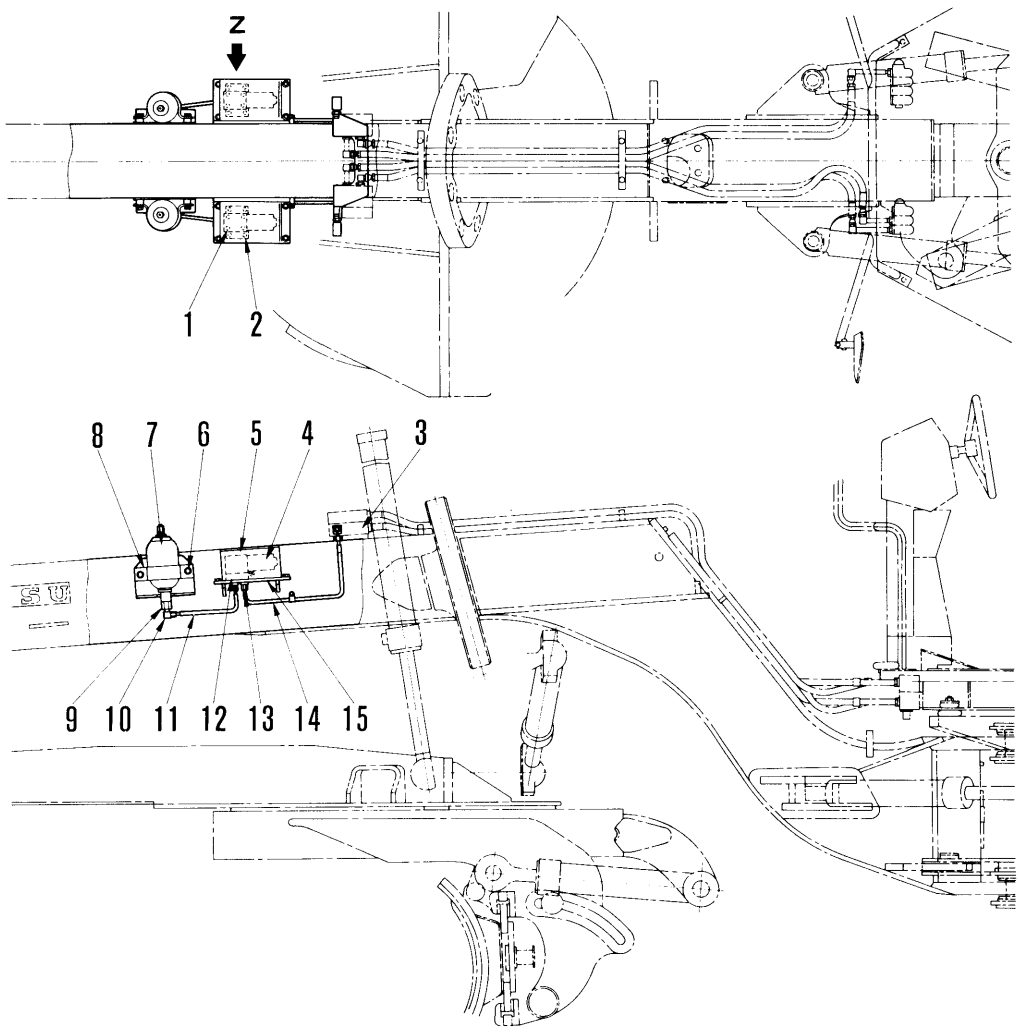


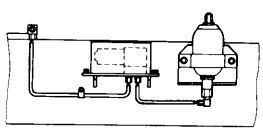
23BF008

FUNCTION

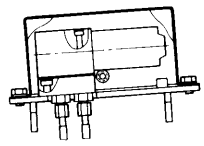
When oil pressure is applied from the blade cylinder, the pressurized oil flows to the accumulator through the solenoid valve, pushing valve (6). This in turn pushes valve (4), allowing the oil to flow into shell (2) from the blade cylinder. Thereby, bladder (3) is compressed.
Consequently, the shock imposed on the blade cylinder is reduced by the compressible amount of the bladder.
When the oil pressure in the cylinder drops, the bladder expands by the gas pressure in bladder (3), allowing the oil in the shell to drain out until the oil pressure in the shell balances that from the blade cylinder side. At this time, valve (5) on the underside of the accumulator closes throttling the return oil. This prevents the oil in shell (2) from flowing out abruptly and prevents the bladder from striking against the inside of the shell.
The flow of oil in the accumulator hydraulic circuit is repeated smoothly to reduce the shock imposed on the blade.

INSTALLATION PROCEDURE





View Z



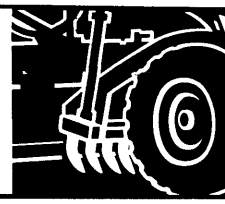
Detail solenoid valve

F23E078

INSTALLATION PROCEDURE

1. Install valve (9) and elbow on accumulator body (7).
2. Hold the accumulator body with clip (8) and temporarily attach the accumulator body to the frame with bolts (6) and washers.
3. Temporarily attach solenoid valve bracket (12) to the frame bracket (15) with bolts (2) and washers.
4. Connect nipple (13), which has nipples for tubes (14) and (11) on the underside of solenoid valve bracket, to nipple in advance, and tighten them together.
5. Since the system set up according to this procedure must be provided on each side of the frame, follow the above procedure again to form the same system on the other side of the frame.
6. After connecting the piping, tighten the temporarily attached portions positively.
7. Secure solenoid valve (4) to the solenoid valve bracket (12).
8. Provide the electrical wiring, referring to the accumulator wring diagram on page 61-64.

WORK EQUIPMENT
72 TESTING AND ADJUSTING



INSPECTION TABLE

( ): GD705A-4 Serial No. 31001 and up

	Item		Test Condition	Standard	
				GD705R-4	GD705A-4
Stroke	Work equipment control lever	Blade lift left, right	Engine stopped, stroke at the tip of the lever	40 ± 5 mm	40 ± 10 mm
		Blade side shift	Engine stopped, stroke at the tip of the lever	40 ± 5 mm	40 ± 10 mm
		Drawbar shift	Engine stopped, stroke at the tip of the lever	40 ± 5 mm	40 ± 10 mm
		Circle rotation	Engine stopped, stroke at the tip of the lever	42 ± 5 mm	45 ± 10 mm (40 ± 10 mm)
		Power tilt	Engine stopped, stroke at the tip of the lever	–	45 ± 10 mm
Operating force	Work equipment control lever		Maximum value until just before stroke end	Max. 5 kg	Max. 5 kg
Performance	1. Blade 1-1. Blade lifting speed (rising)		Oil temperature: 40 ± 5°C When engine at rated rotation, the speed of lifting or lowering the blade with the lower edge of the blade 50 – 150 mm above the ground.	237 ± 9.5 mm/s	210 ± 8.4 mm/s
	1-2. Blade lifting speed (lowering)			144 ± 5.8 mm/s	140 ± 5.6 mm/s
	1-3. Speed of cross-feed by circle movement - left		When engine at rated rotation and the height of the lower edge of the blade 100 mm, speed of left and right side shifting by a level circle movement of 200 mm under standard position.	215 ± 8.6 mm/s	120 ± 4.8 mm/s
	1-4. Speed of cross-feed by circle movement - right			124 ± 5.0 mm/s	180 ± 7.2 mm/s
	1-5. Speed of side shift in rotation to circle - left		When engine at rated rotation and the height of the lower edge of the blade 100 mm, speed of the left and right side shifting in rotation to a circle of a level distance of 200 mm under standard position.	130 ± 5.2 mm/s	140 ± 5.6 mm/s
	1-6. Speed of side shift in rotation to circle - right			210 ± 8.4 mm/s	220 ± 8.8 mm/s
	1-7. Turning speed by circle rotation		Angle speed with engine at rated rotation speed	11 ± 0.66°/s	14.5 ± 0.87°/s
	1-8. Hydraulic drift of blade (hanging down)		Amount of lowering of cylinder when the blade is suspended symmetrically perpendicular to the machine	Max. 10 mm/10 min.	Max. 10 mm/10 min.
	1-9. Hydraulic drift of machine (support by blade)		Amount of cylinder sinking when the lower edge of the blade is in contact with the ground and the front wheels floating	Max. 20 mm/10 min.	Max. 20 mm/10 min.

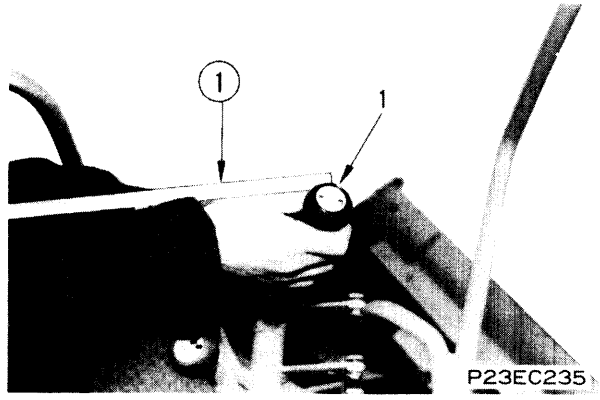
WORK EQUIPMENT CONTROL LEVER STROKE AND OPERATING FORCE

WORK EQUIPMENT CONTROL LEVER STROKE CHECK AND ADJUSTMENT

Use a convex rule ① and measure the operating length from the center of the knob of lever (1).

★ Measure with engine stopped.

★ The stroke of work equipment control lever is determined by the spool stroke of the control valve, but the neutral position of each lever is adjusted by each rod.

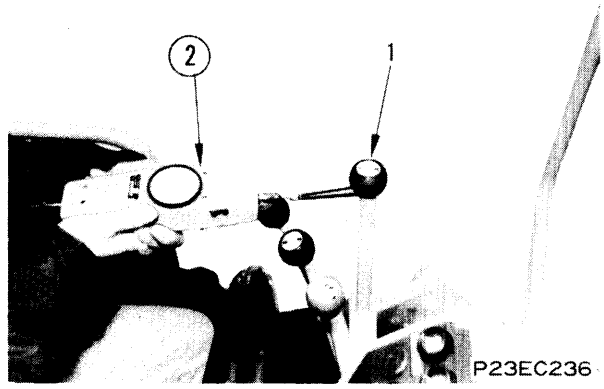


CHECK AND ADJUSTMENT OF EACH WORK EQUIPMENT CONTROL LEVER OPERATING FORCE

Use push-pull scale ② to measure maximum value from the tip of lever (1) to just before the stroke end.

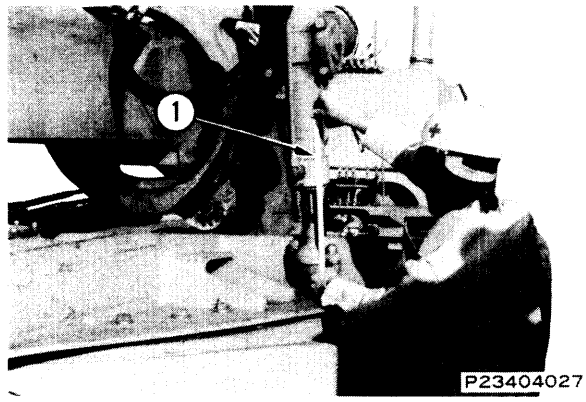
★ Measure with engine stopped.

★ The operating force of the work equipment control lever is determined by the spring load of the spool on the control valve side. When the operating force is outside standard value, check the movement of the connecting rod. If it is normal disassemble the control valve and check the movement of the spool.



HYDRAULIC DRIFT OF BLADE

1. Start engine and after the pressure test, bring hydraulic oil temperature to the 40 ± 5°C range.
2. Raise the blade 300 mm from the ground and at right angles to the machine and equidistant to right and left.
3. Stop the engine and leave for 10 minutes.
   Use a convex rule ① to measure the amount the cylinder piston rod has dropped.



MEASURING BLADE SINKING AMOUNT

1. Start engine after the pressure test, bring hydraulic oil temperature to the 40 ± 5°C range.
2. Lower blade until its bottom edge touches the ground, push the cylinder and float the front wheels about 300 mm off the ground.
3. Stop the engine and leave for 10 minutes.
   Use a convex rule ① to measure at the cylinder the amount of sinkage.

CHECKING HYDRAULIC OIL PRESSURE

Special tool

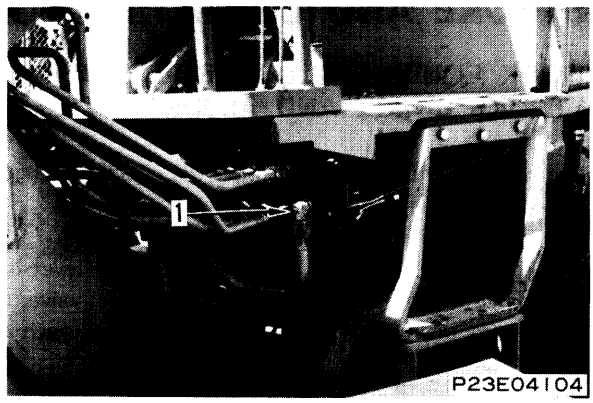
	Part number	Part name	Q'ty
A	790-301-1103	Hydraulic tester	1

After stopping the engine, loosen slowly the cap of the hydraulic tank to release the remaining oil pressure from the hydraulic tank.

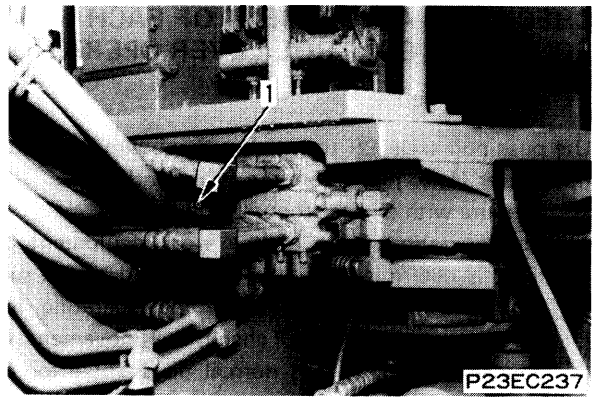
1. Remove measuring plugs (1), (2) and install oil pressure gauge **A** (for 350 kg/cm^2).
   ★ In order to prevent oil spurting out when the plug is removed, remove after operating the control lever.

2. Start engine and when the hydraulic oil temperature enters 35 to 45°C range, operate the lever of the circuit to be measured and measure the relief pressure.

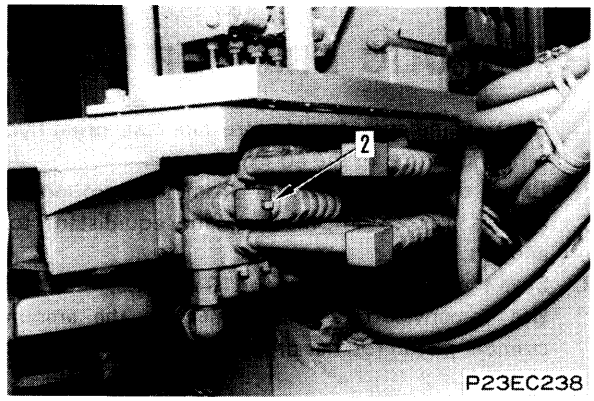
GD705R-4



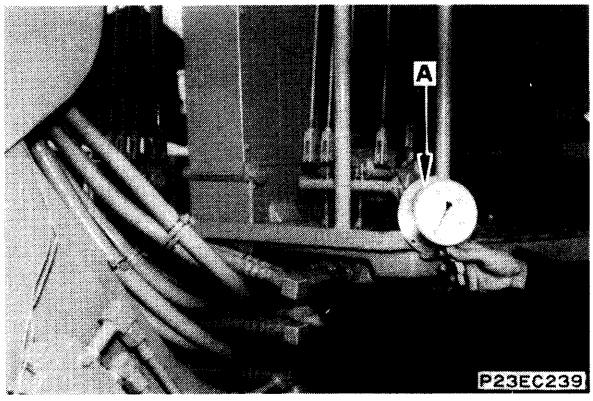
GD705A-4



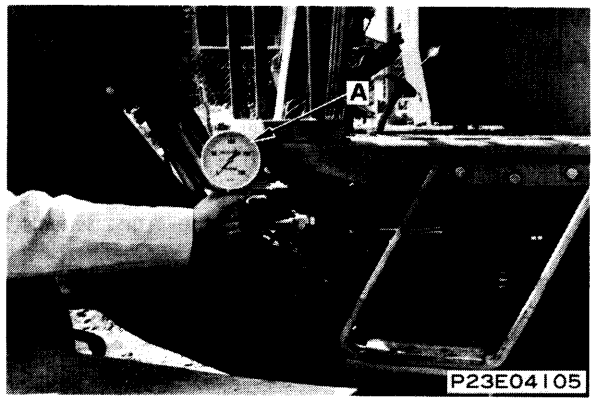
GD705A-4



GD705A-4



GD705R-4



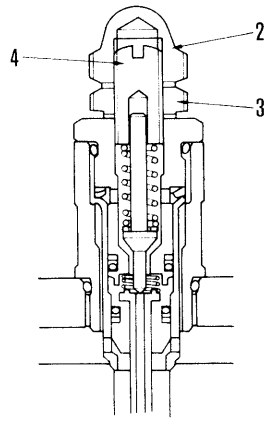
ADJUSTING OIL PRESSURE

GD705R-4

★ If hydraulic pressure is not the standard value (175 kg/cm^2), adjust as follows.

★ Remove the cap nut (2), loosen the lock nut (3), and confirm that a few threads of the adjustment screw (4) are screwed into the pilot section. Using a screwdriver, set the adjustment screw (4) as follows.

1. Run the pump at a low speed of about 1/4 of its maximum rpm. However, the pump must be kept at a reasonable speed when the relief set pressure is applied to the pump.
2. Move one plunger of the control valve through its full stroke and read the pressure from the pressure gauge.
3. Turn the adjustment screw (4) CLOCKWISE until the required set pressure is attained.
4. While pressing the adjustment screw, tighten the lock nut (3). Install the cap nut (2) and tighten it.
5. The pressure set in the above manner can be obtained when the pump is checked on the machine with the engine running at full speed.

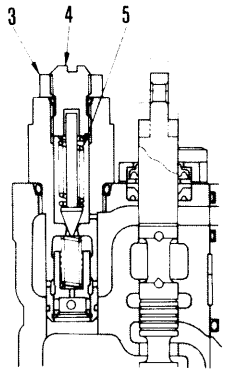


F23E04075

GD705A-4

★ When hydraulic pressure is outside standard value (175 kg/cm^2), adjust according to the following procedure.

1. Loosen nut (3), turn adjusting screw (4) and adjust the pressure of the internal spring (5).
   ★ When turned to the right, hydraulic pressure rises. When turned to the left, hydraulic pressure falls.
2. After adjustment follow the procedure of the item on checking work equipment hydraulic pressure to confirm that hydraulic pressure is within standard value.

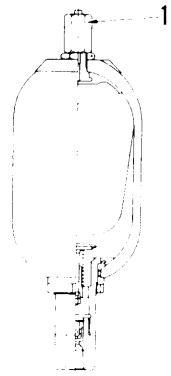


F23BB025

CHARGING BLADE ACCUMULATOR WITH GAS

Special tool

	Part number	Part name	Q'ty
A	792-610-1700	Charging assembly	1



234FI144

⚠ Always use nitrogen when charging the accumulator with gas.

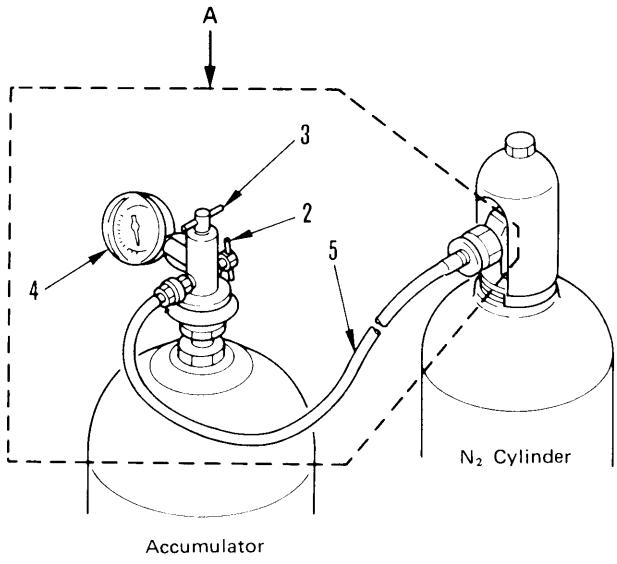
1. Remove plug (1) from the accumulator, then install charging assembly **A**.
   Size of joint for connecting accumulator: TV8

2. When installing the charging valve, tighten valve (2) fully and open valve (3) fully.

3. After installing charging valve assembly **A**, tighten valve (3) gradually and the charging pressure of the gas in the accumulator will be shown on pressure gauge (4).

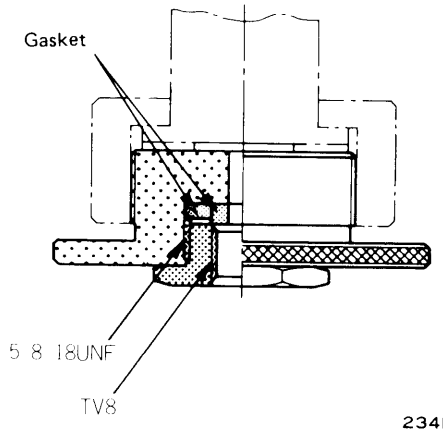
   ⚠ Charging pressure: $20\ ^{+1}_{0}$ kg/cm^2

   If pressure gauge (4) does not reach 20 kg/cm^2, loosen valve (2) gradually, and charge with gas from the cylinder until pressure gauge (4) reaches 20 kg/cm^2.
   If the pressure gauge registers above 20 kg/cm^2, remove hose (5). Then gradually loosen valve (2) to release gas from the accumulator into the atmosphere and adjust to 20 kg/cm^2.



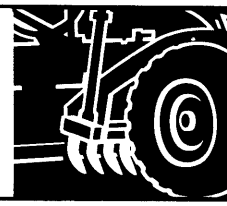
234FI145

Accumulator joint



234FI146

WORK EQUIPMENT
73 DISASSEMBLY AND ASSEMBLY



REMOVAL OF BLADE ASSEMBLY

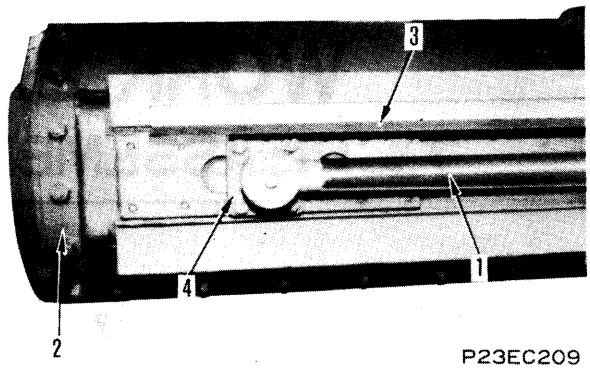
⚠ Start engine, operate the control lever to raise the work equipment (approx. 200 mm).
Set a block (approx. 780 mm) under the circle to support it securely.

1. Operate the control lever and extend blade side shift cylinder piston rod (1) to pull out blade (2).
2. Remove cover (3).
3. Sling center of blade side shift cylinder, disconnect bracket (4) from blade, and fully retract piston rod.

★ Support piston rod of blade cylinder with block ② to prevent it from being damaged.

4. Raise blade (2) with a crane, slide the sling position of the wire to the center of the blade, and dismount it.

kg Blade assembly: Approx. 900 kg (GD705R-4)
Approx. 850 kg (GD705A-4)



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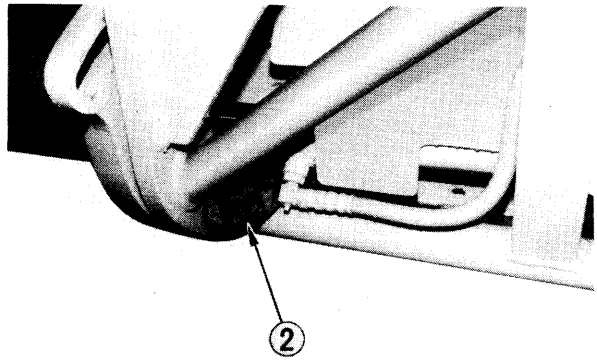


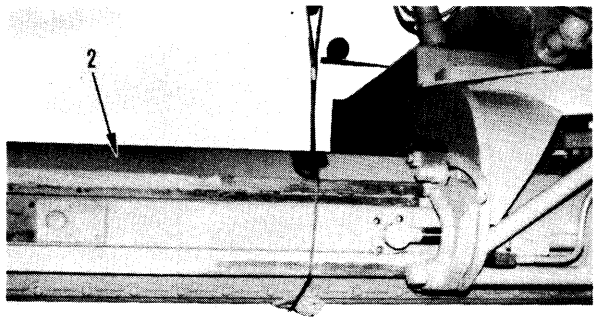
P23BB180

INSTALLATION OF BLADE ASSEMBLY

1. Raise center of blade (2) and set position it to blade support part.
2. While sliding the wire, operate the control lever to extend the cylinder piston rod, and push it in until it reaches a position where it can be connected.

Blade guide rail (upper, lower): Grease (G2-LI)

3. Raise blade side shift cylinder with a crane, start engine and operate the control lever to extend piston rod (1).
4. Install bracket (4) on blade (2).
5. Raise blade and pull out block.



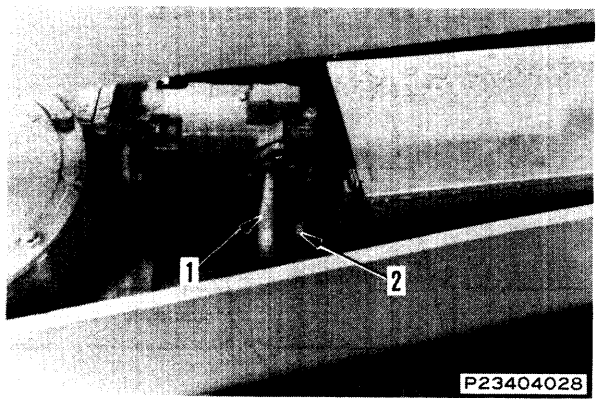
P23BB181

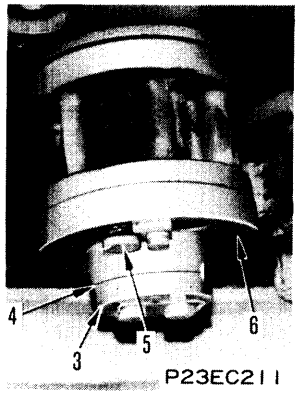
REMOVAL OF CIRCLE ROTATION GEAR AND HYDRAULIC OIL MOTOR ASSEMBLY

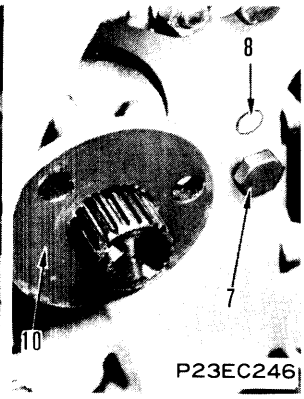
1. Disconnect tube (1), (2).
2. Remove holder (3) and shim (4).
3. Remove shear pin (5) and remove joint (6).
4. Remove mounting bolt (7) and tap dowel pin (8) out from below.
5. Using eye bolt ① (Thread dia. = 10 mm, Pitch = 1.5 mm), raise circle rotation gear • hydraulic oil motor assembly (9) and remove it.

   ⚠ Hold the circle rotation gear • hydraulic oil motor assembly by hand.

   kg Circle rotation gear • hydraulic oil motor assembly: Approx. 100 kg (GD705R-4)
   Approx. 176 kg (GD705A-4)
6. Remove spacer (11).



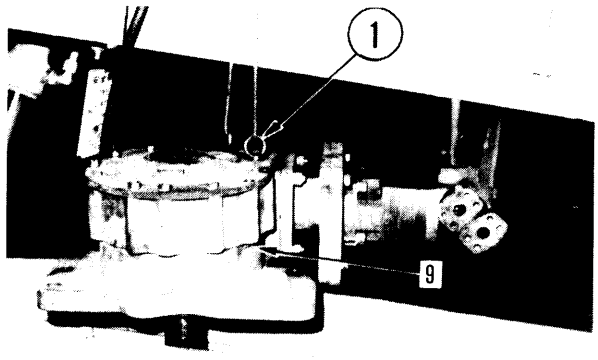


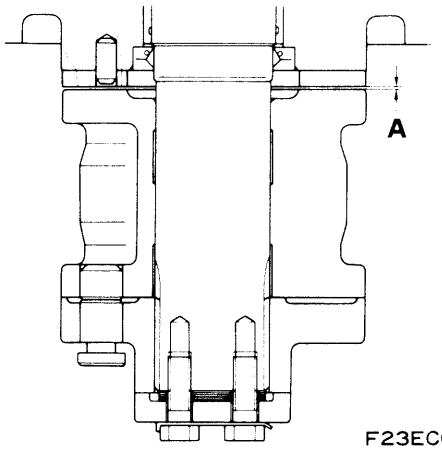


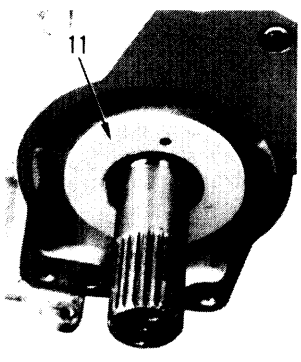
INSTALLATION CIRCLE ROTATION GEAR AND HYDRAULIC OIL MOTOR ASSEMBLY

1. Install spacer (11) on circle rotating gear • hydraulic oil motor assembly (9).
2. Screw in eye bolt ① to circle rotation gear • hydraulic oil motor assembly (9), raise it with a crane, align it to gear (10) and slowly mount ass'y.
3. Tighten mounting bolt (7) and tap in dowel pin (8).
4. Install joint (6) and fix it to shear pin (5).
5. Install holder (3).
   ★ Adjust length A with shims dimension:
   1.0 mm (GD705R-4)
   0.1 to 0.5 mm (GD705A-4)

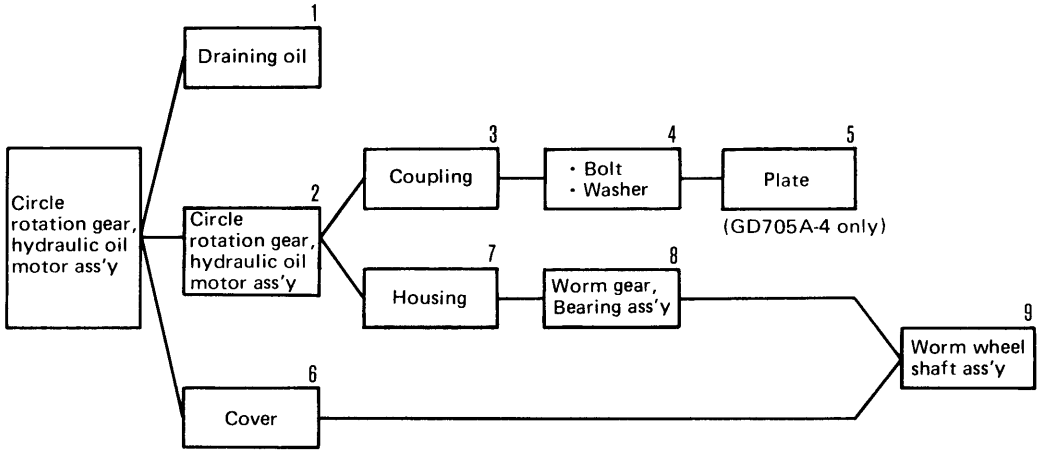
   ★ Bend lock plate securely.
6. Connect tubes (2), (1).







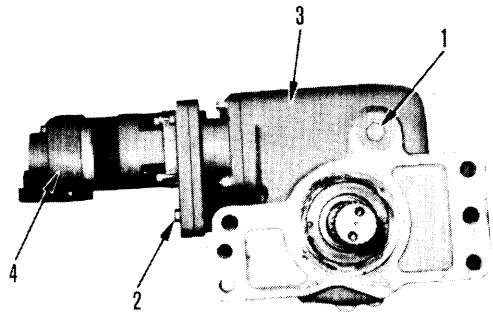
DISASSEMBLY OF CIRCLE ROTATION GEAR AND HYDRAULIC OIL MOTOR ASSEMBLY



1. **Draining oil**
   Remove plug (1) and drain oil

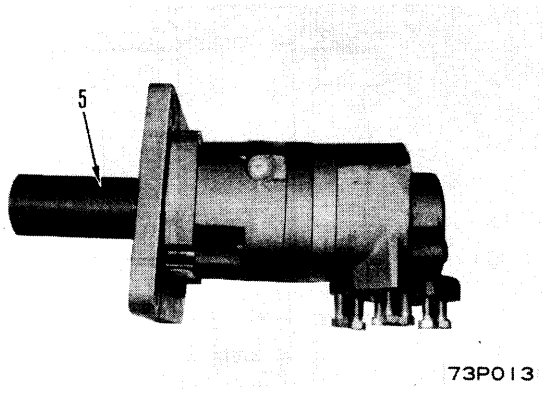
   Circle rotation gear: Approx. 4ℓ

2. **Circle rotation gear · hydraulic oil motor ass'y**
   Remove bolt (2), and dismount hydraulic oil motor assembly (4) from circle rotation gear assembly (3).



233P170

3. **Coupling**
   Remove coupling (5).



73P013

4. **Bolt, washer**
   Remove bolt (6) and washer (7) from shaft of hydraulic oil motor ass'y.

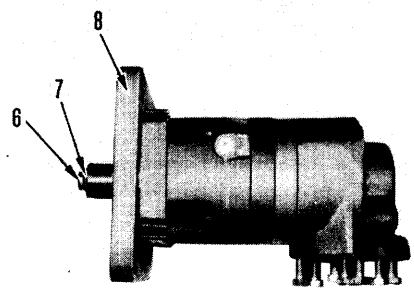
5. **Plate (GD705A-4 only)**
   Remove plate (8).

6. **Cover**
   Remove cover (9).

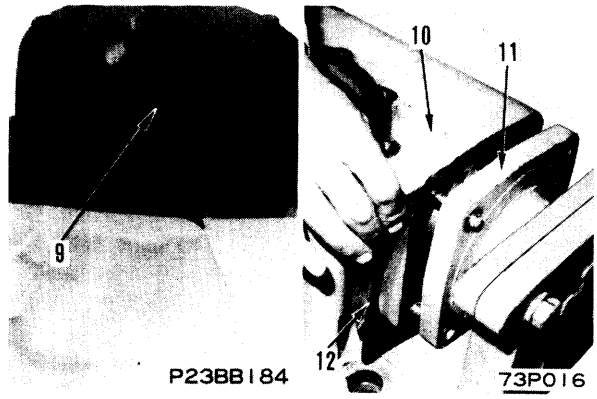
7. **Housing**
   Remove shim (12) and housing (11) from case (10).

8. **Worm gear · Bearing ass'y**
   1) Remove worm gear · bearing ass'y (13).
   2) Remove bearing (15) from shaft (14).

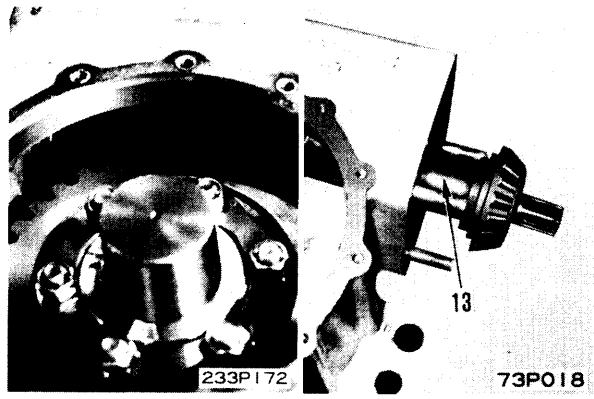
9. **Worm wheel shaft ass'y**
   1) Remove worm wheel shaft assembly (16).
   2) Remove lock plate and remove gear (18) from shaft (17).



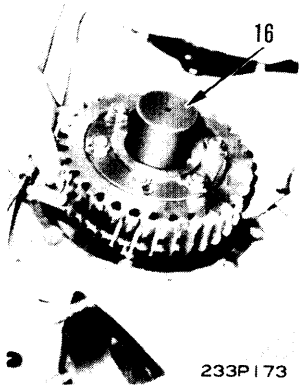
73P014



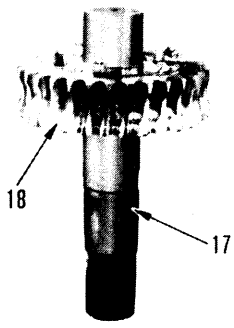
P23BB184 73P016



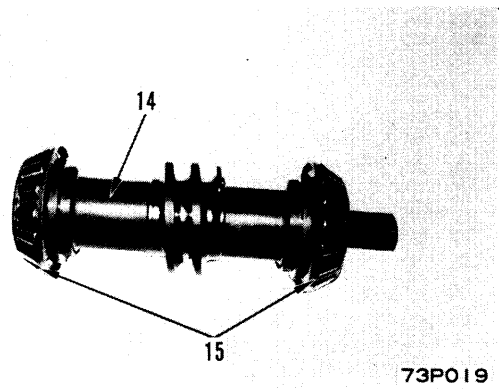
233P172 73P018



233P173

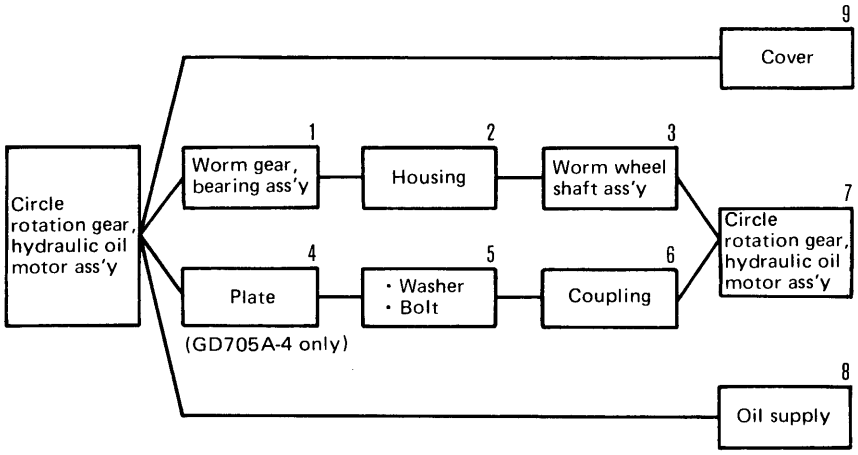


233P174



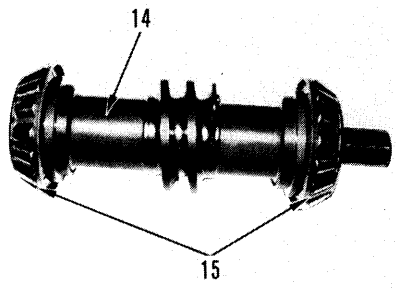
73P019

ASSEMBLY OF CIRCLE ROTATION GEAR AND HYDRAULIC OIL MOTOR ASSEMBLY



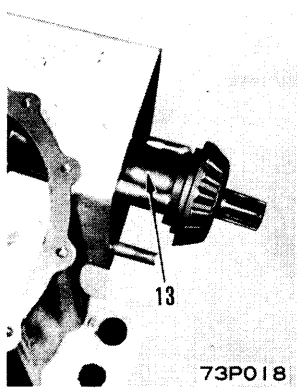
F23EC037

1. **Worm gear · bearing assembly**
   1) Using press-fit tool (ϕ50), press fit bearing (15) on shaft (14).

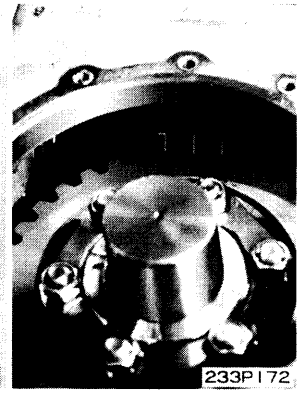


73P019

   2) Insert worm gear · bearing ass'y (13) into case.



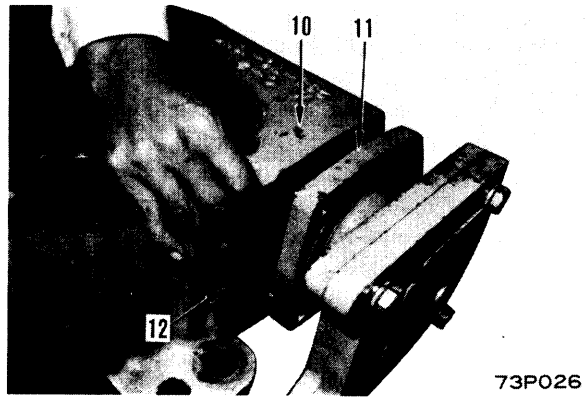
73P018



233P172

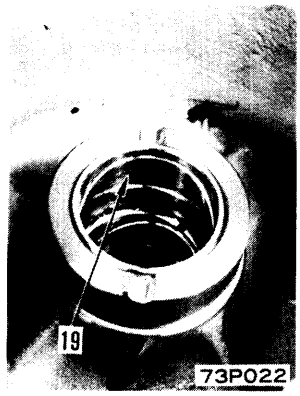
2. Housing

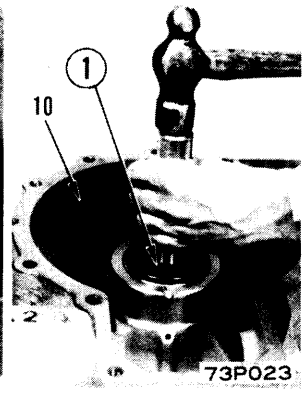
1) Attach shim (12) to housing (11) and install it in case.
   - ★ Fix O-ring in housing.
   - ★ Adjust rotating torque with shim.
   - ★ Rotating torque: 0.35 to 0.8 mm
2) Check the number of shims, loosen bolt of housing side, and pull out housing from case a little.
   - ★ Remove worm gear • bearing ass'y from outer race of bearing.

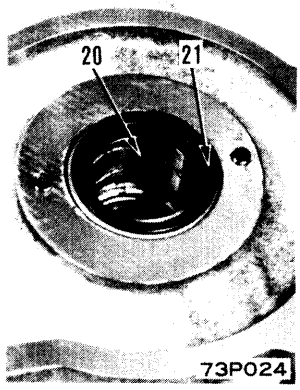


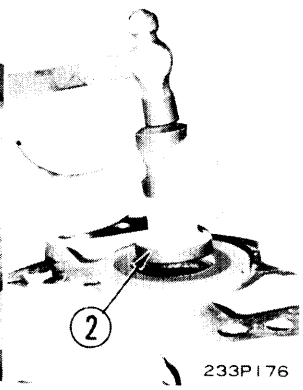
3. Worm wheel shaft assembly

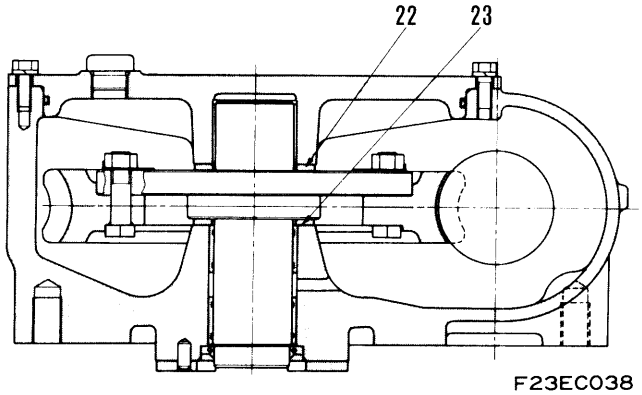
1) Using push tool kit ① (φ65), press fit bushing (19) to case (10).
2) Using push tool kit ①, press fit bushing (20). Again using push tool kit ② (φ62), press fit oil seal (21).
   - ★ Oil seal lip: Grease (G2-LI)
3) Install gear (18) to shaft (17) and fix it with a lock plate.
   - ★ Bend lock plate securely.
4) Install worm wheel shaft assembly (16).
   - ★ Mesh teeth of the worm gear and worm wheel, tighten bolt on the housing side.
   - ★ Insert washers (22), (23) securely above and below the worm wheel shaft.

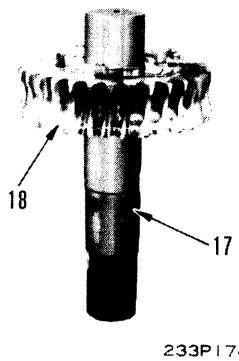


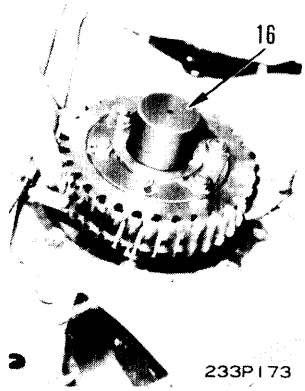




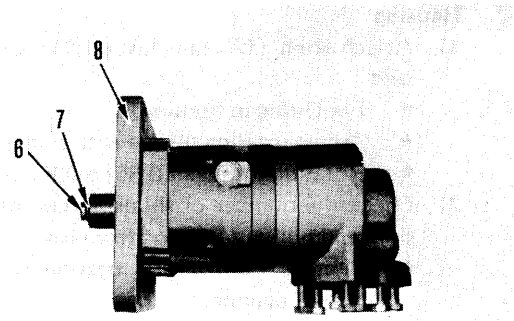








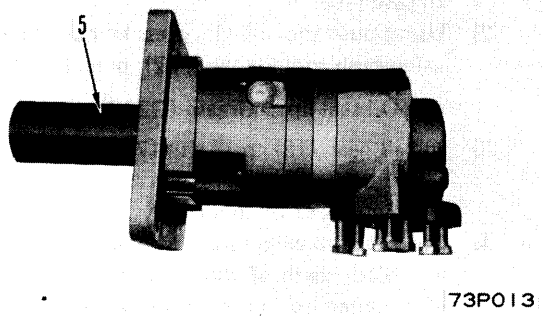
4. **Plate (GD705A-4 only)**
Install plate (8) on hydraulic oil motor assembly (4).
★ Fix O-ring to plate.
★ From the plate side, attach a gasket (t = 0.8 mm), shim (t = 0.5 mm), and gasket (t = 0.3 mm) in order between plate and hydraulic oil motor.
Coat liquid gasket (LG-1) so that the gasket (t = 0.8 mm) will contact only the face of the plate.



73P014

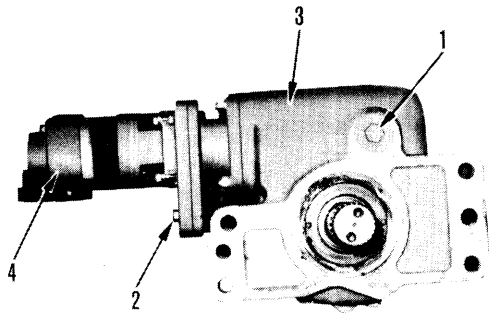
5. **Washer · bolt**
Install washer (7) and bolt (6) to hydraulic oil motor assembly.

6. **Coupling**
Install coupling (5) to shaft.
★ Insert spring pin in coupling hole.



73P013

7. **Circle rotation gear · hydraulic motor assembly**
Fix circle rotation gear assembly (3) and hydraulic oil motor assembly (4) with bolt (2).

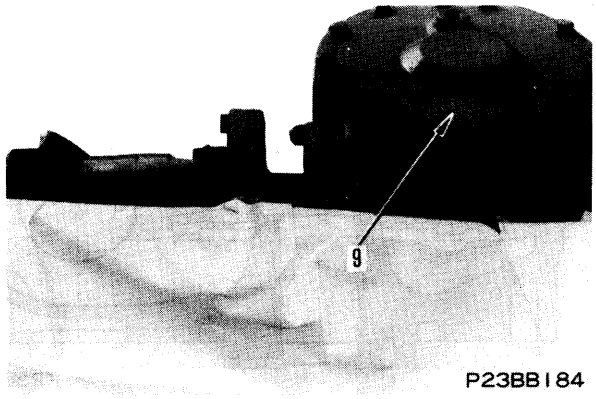


233P170

8. **Oil supply**
Tighten drain plug (1) and refill engine oil to specified level.

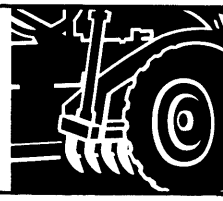
Circle rotation gear case: Approx. 4ℓ

9. **Cover**
Fix O-ring and install cover (9).
★ Coat liquid gasket (LT-2) bolts of case tap protrusion part at worm gear side.



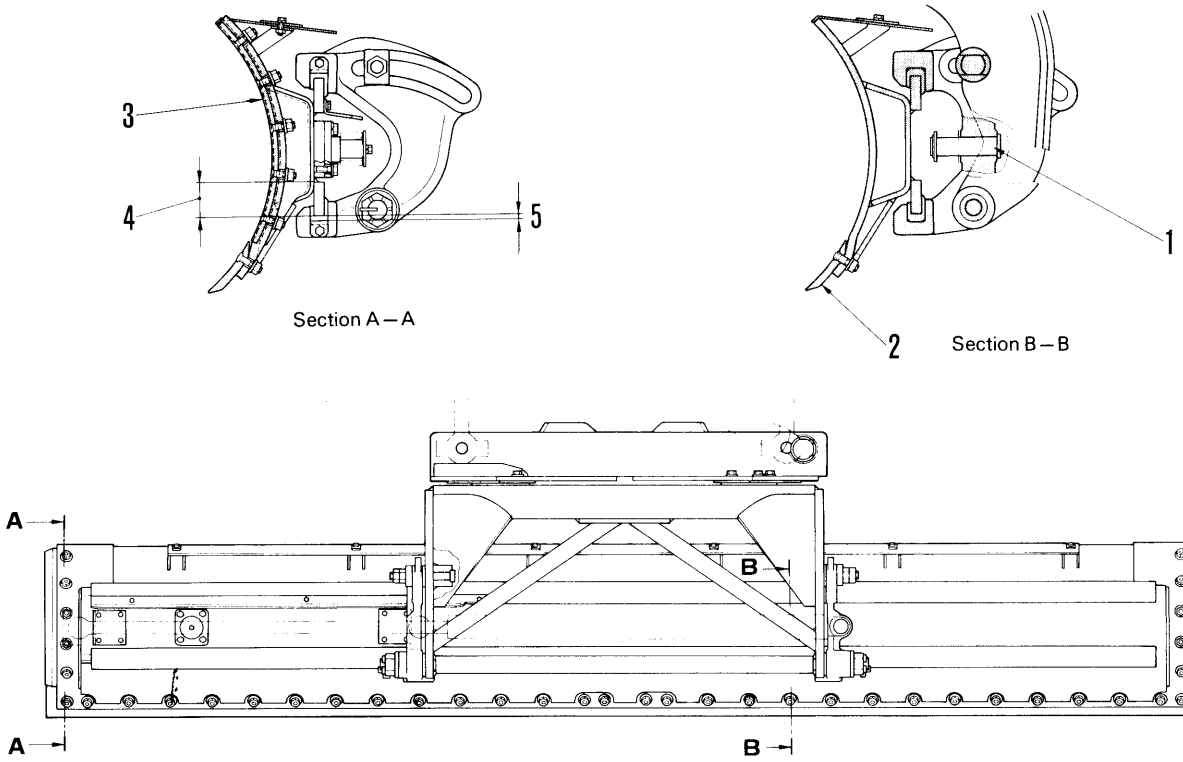
P23BB184

WORK EQUIPMENT
74 MAINTENANCE STANDARD



BLADE AND CIRCLE

GD705R-4

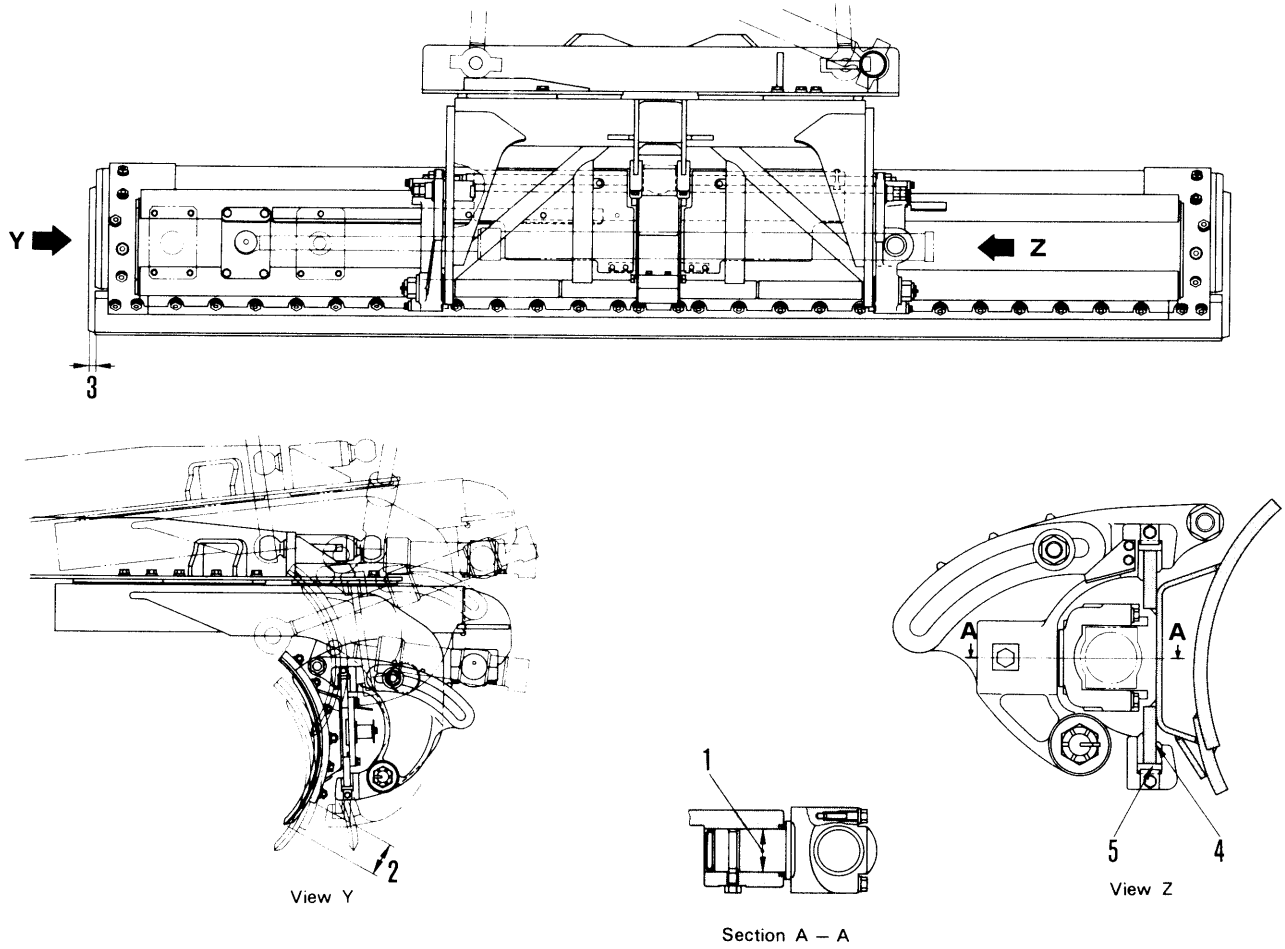


F23E04068

Unit: mm

No.	Check Item	Criteria				Remedy
1	Clearance between blade shift cylinder shaft and adjuster	Standard size	Tolerance		Standard clearance	Clearance limit	Replace shaft or adjuster
			Shaft	Hole			
		45	−0.025 −0.064	+0.039 0	0.025 – 0.103	0.5	
2	Wear of cutting edge	From moldboard to edge: Max. 10					Replace
3	Wear of side edge	Repair limit: Side surface: 22 From moldboard to edge: Max. 10					Replace
4	Wear of blade rail	Repair limit: Height: 75 Thickness: 22					Replace
5	Wear of blade rail guide	Repair limit: 10					

GD705A-4



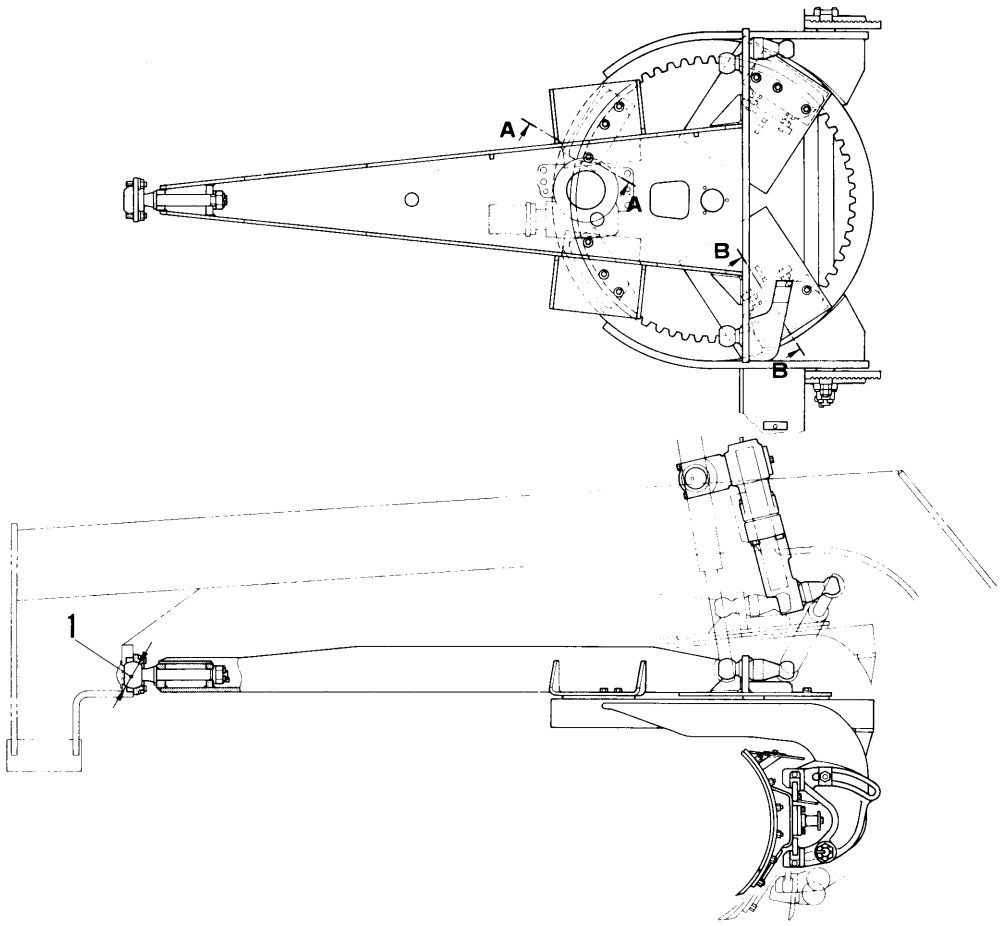
F23404029

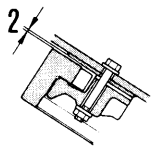
Unit: mm

No.	Check Item	Criteria					Remedy
1	Clearance between blade shift cylinder support yoke and adjuster	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		80	–0.030 –0.076	+0.030 0	0.030–0.106	0.5	
2	Wear of cutting edge	Max. 10 mm (from blade base)					Replace
3	Wear of side edge	Clearance limit: Side face 25 Max. 10 mm (from blade base)					
4	Wear of blade rail	Repair limit: Height 105 Thickness 22					
5	Wear of blade rail guide	Repair limit: 10					

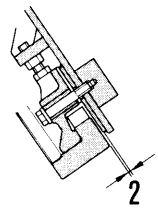
DRAWBAR

GD705R-4





Section A—A



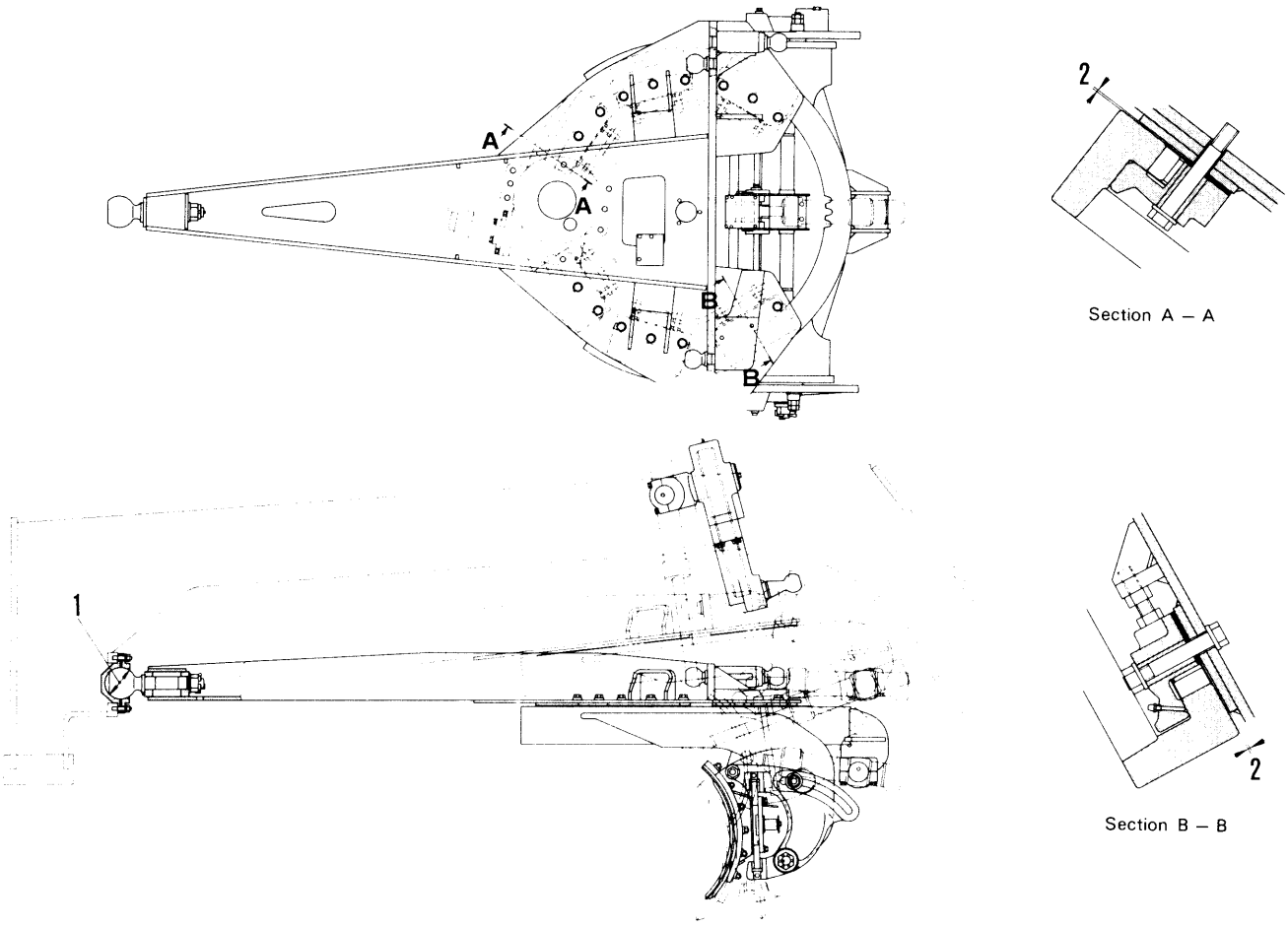
Section B—B

F23E04069

Unit: mm

No.	Check Item	Criteria					Remedy
1	Wear of drawbar ball joint end	Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
		120	−0.120 −0.297	+0.180 0	0.12 – 0.477	–	
2	Clearance between circle and drawbar	Standard clearance		Clearance limit			
		1.5		1.0 – 2.0			

GD705A-4



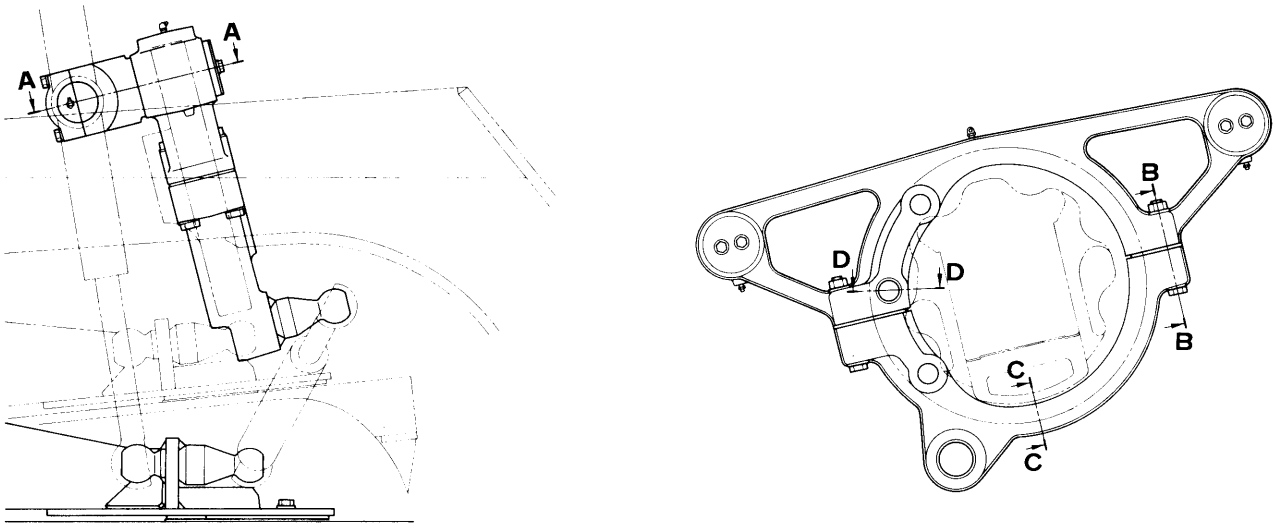
F23404028

Unit: mm

No.	Check Item	Criteria					Remedy
1	Wear of drawbar ball joint end	Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
		150	−0.05 −0.15	+0.1 0	0.05 – 0.25	–	
2	Clearance between circle and drawbar	Standard clearance		Clearance limit			
		1.5		1.0 – 2.0			

BLADE LIFTER BRACKET

GD705R-4

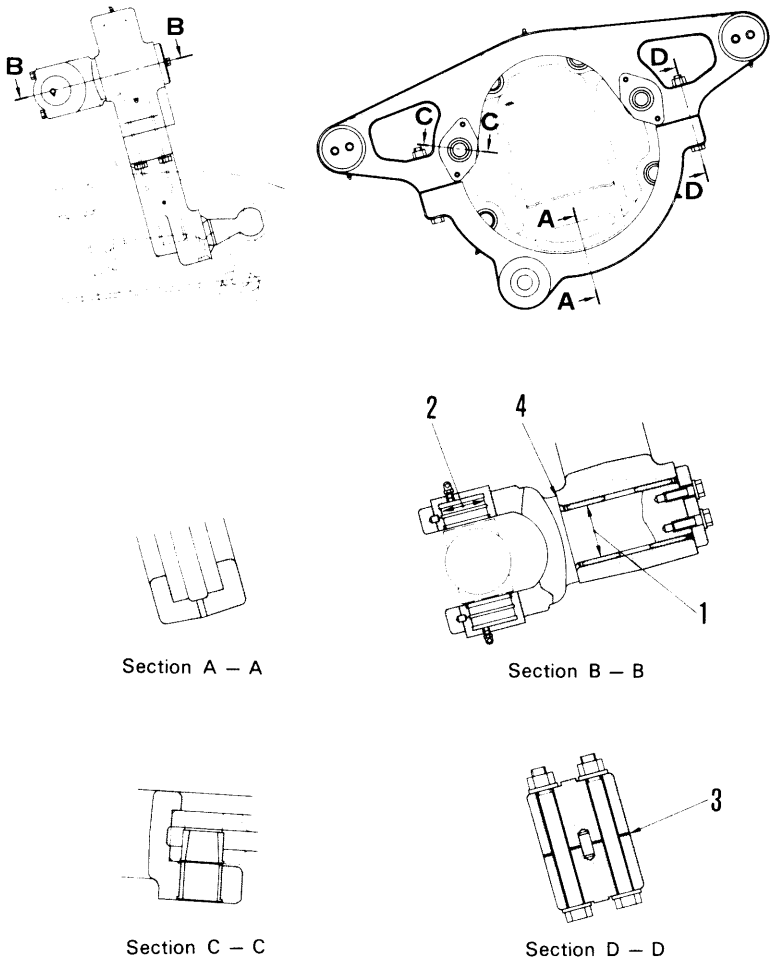


F23E04070

Unit: mm

No.	Check Item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between yoke and bushing	85	−0.036 −0.090	+0.207 +0.120	0.156 – 0.297	0.6	Replace bushing
2	Clearance between blade cylinder (bottom side) yoke and bushing	70	−0.100 −0.174	+0.074 0	0.100 – 0.248	0.5	
3	Wear of lifter bracket	Standard shim thickness: 2.0					Adjust or replace bracket

GD705A-4



Section A – A

Section B – B

Section C – C

Section D – D

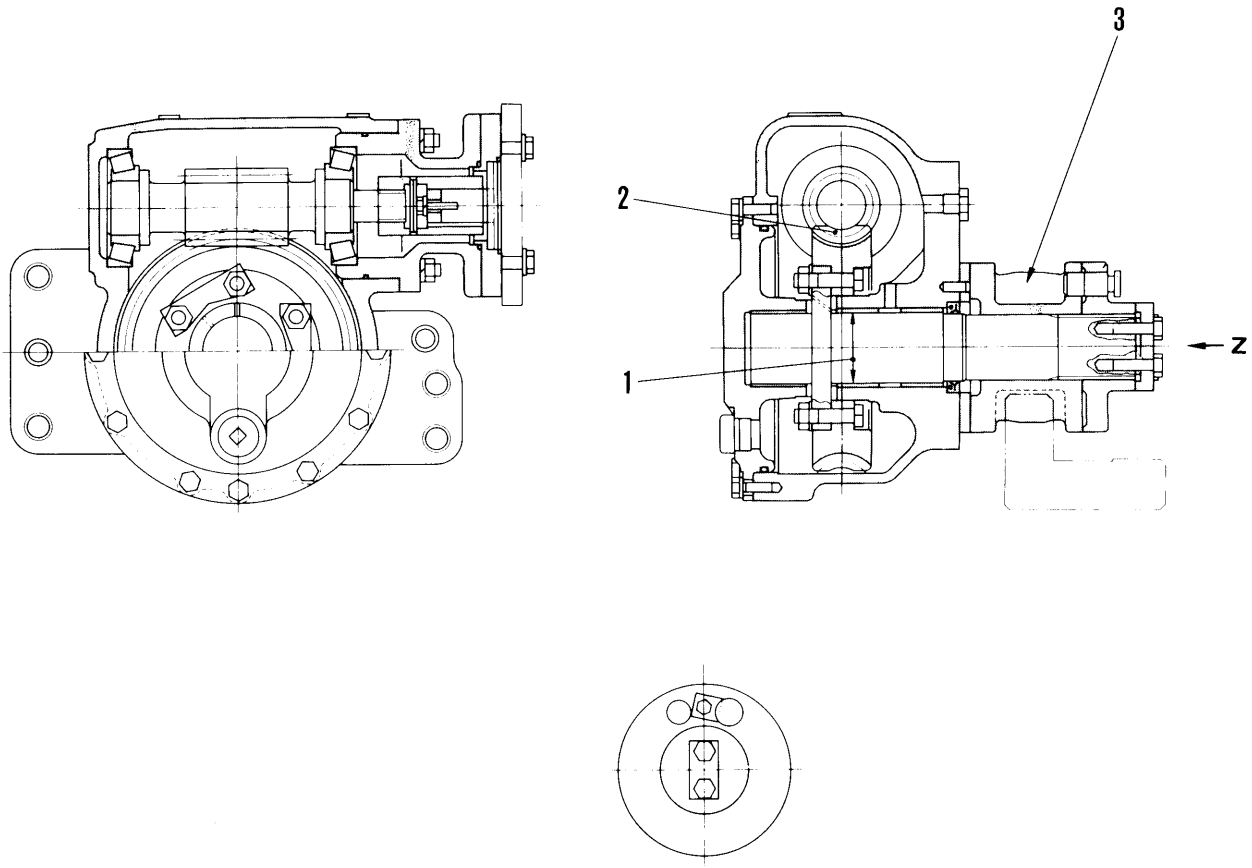
F23404030

Unit: mm

No.	Check Item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between yoke and bushing	85	−0.036 −0.090	+0.071 +0.001	0.037 – 0.161	0.6	Replace
2	Clearance between blade side shift cylinder bottom side yoke and bushing	70	−0.100 −0.174	+0.074 0	0.100 – 0.248	1.0	
3	Wear of lifter	Standard thickness of shim: 2					Replace
4	Axial clearance of yoke	Standard clearance			Clearance limit		Replace
		0.3 – 0.8			1.7		

CIRCLE ROTATION GEAR

GD705R-4

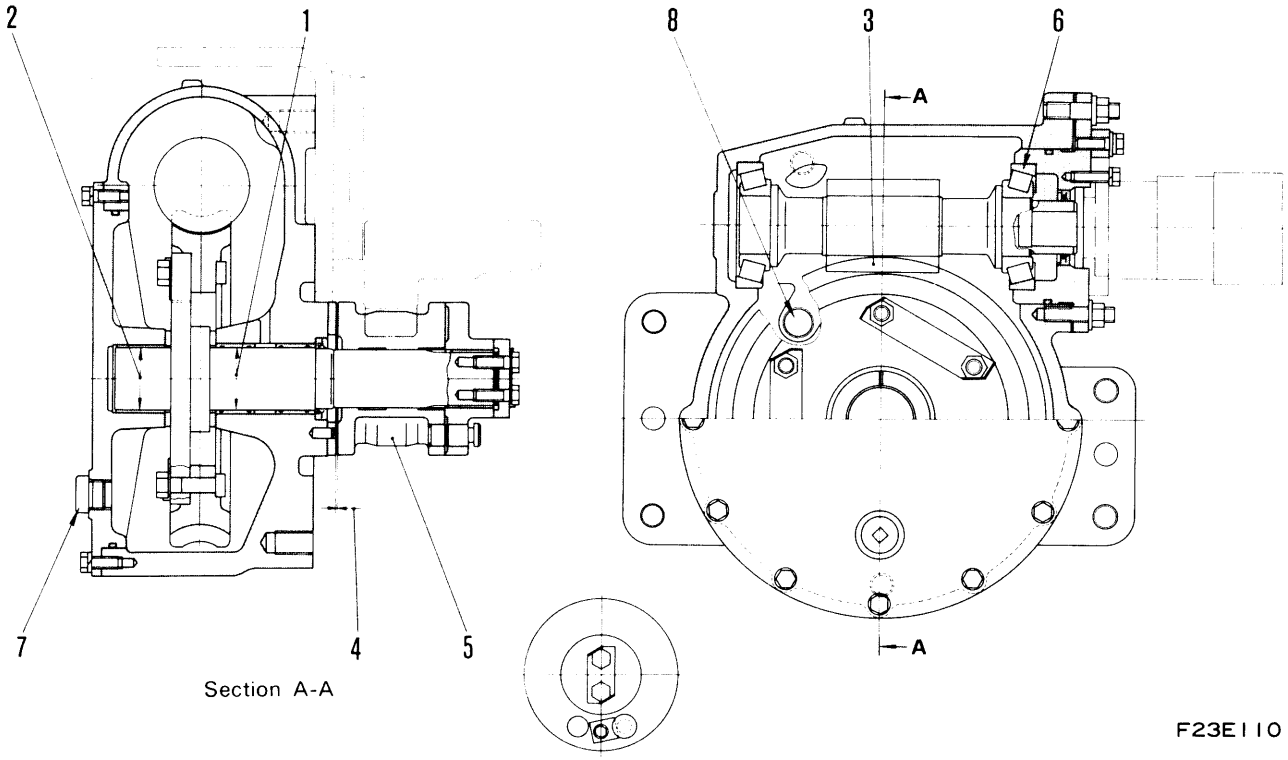


F23B047A-1

Unit: mm

No.	Check Item	Criteria					Remedy
1	Clearance between worm wheel shaft and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole			
		65	−0.030 −0.060	+0.057 +0.010	0.040 – 0.117	0.5	
2	Backlash between worm and worm wheel	Standard clearance		Clearance limit			Replace worm wheel
		0.3 – 0.4		2.0			
3	Wearing of pinion pin	Standard size		Repair limit			Replace
		25		20			

GD705A-4



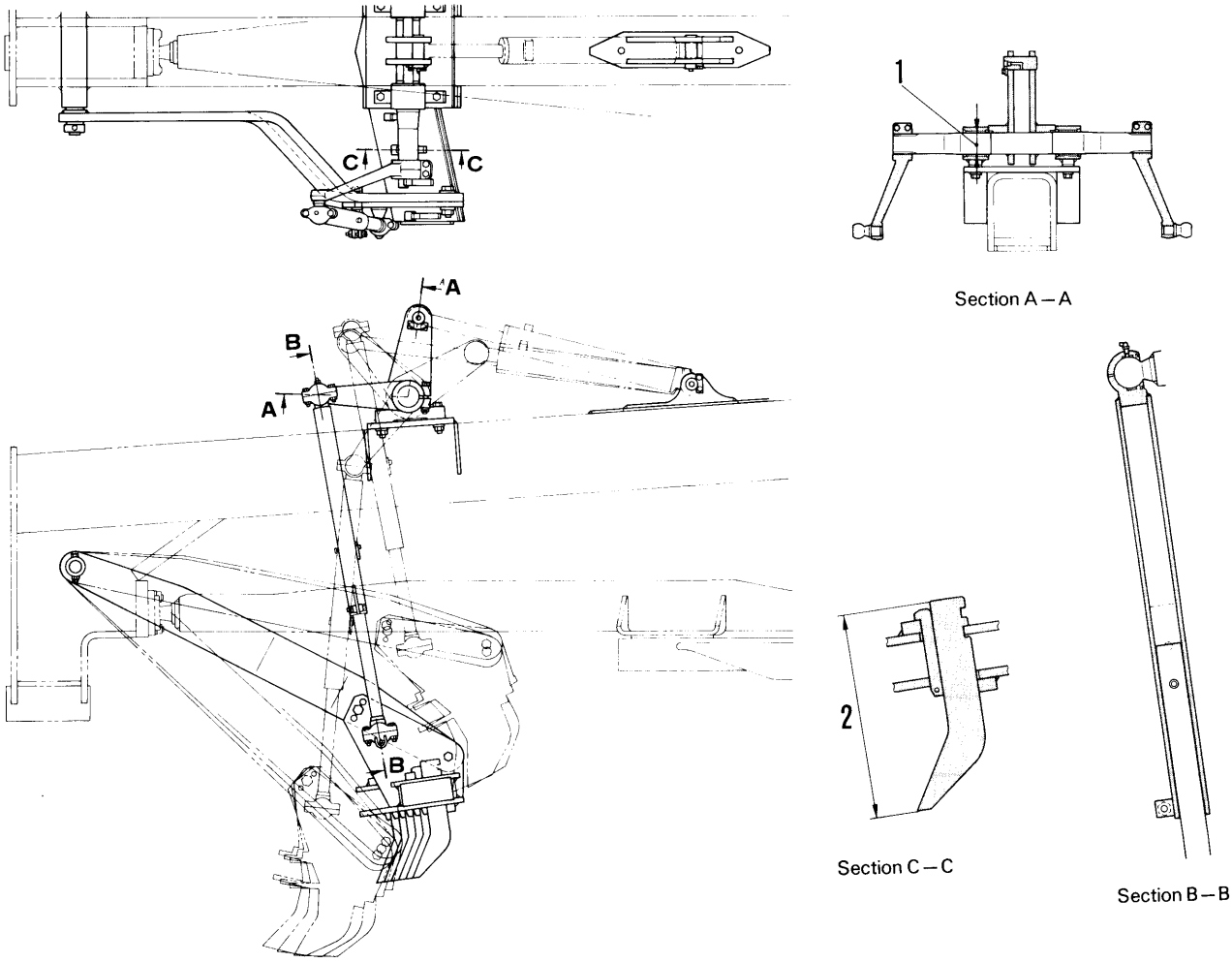
F23E110

Unit: mm

No.	Check Item	Criteria					Remedy
1	Clearance between worm gear shaft and bushing	Standard size	Tolerance		Standard clearance	Repair limit	Replace
			Shaft	Hole			
		65	−0.030 −0.060	+0.057 +0.010	0.040−0.117	0.3	
2	Clearance between worm gear shaft and bushing	65	+0.035 +0.005	+0.226 +0.069	0.035−0.221	0.3	
3	Backlash between worm and worm wheel	Standard clearance		Clearance limit			Replace
		0.3 − 0.5		2.0			
4	Clearance between pinion and wear plate	0.1 − 0.5		0.6			Adjust
5	Wear of pinion gear	Standard size		Repair limit			Replace
		25		20			
6	Preload of worm shaft bearing	Starting torque 0.5 − 1.0 kgm (when worm wheel is not meshed)					Adjust
7	Tightening torque of filler plug	9.5 − 12.5 kgm					
8	Tightening torque of drain plug	9.5 − 12.5 kgm					

SCARIFIER (If equipped)

GD705R-4

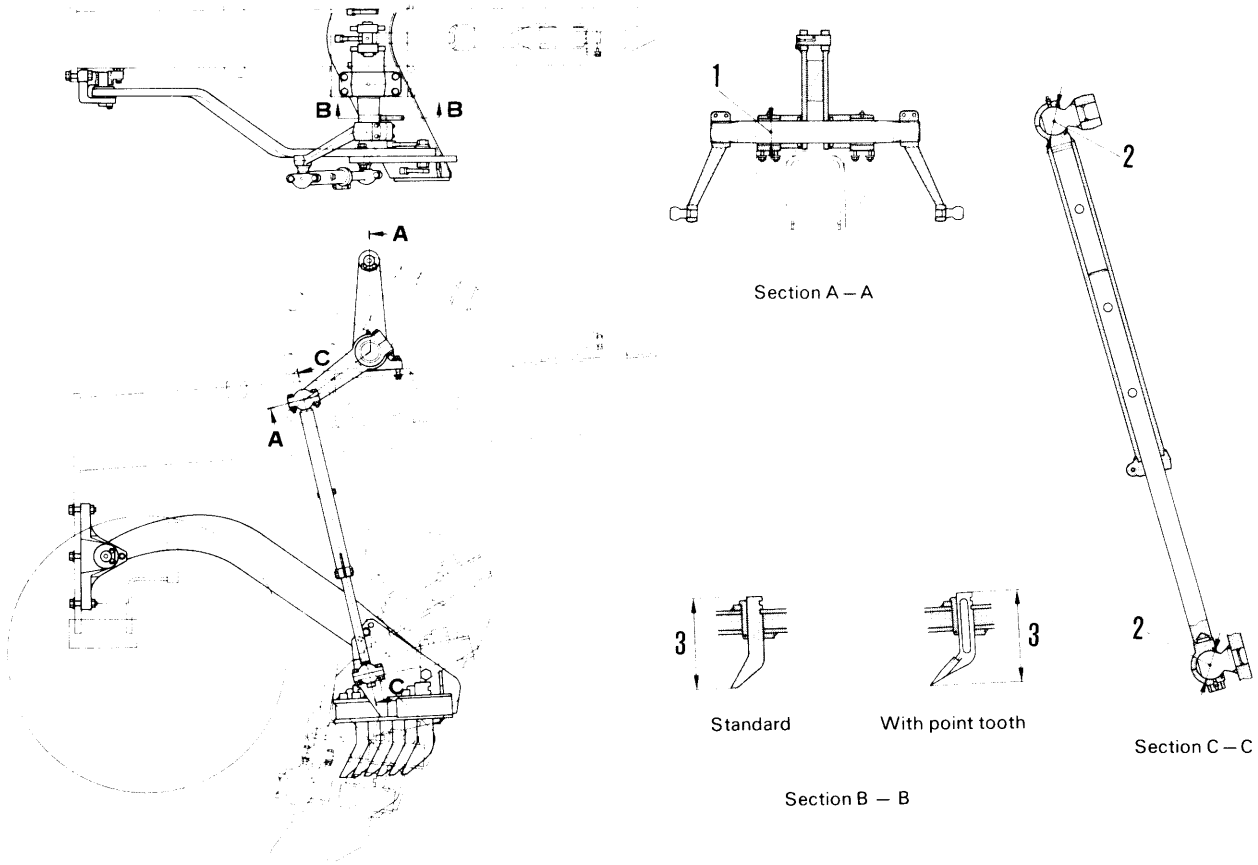


F23E04072

Unit: mm

No.	Check Item	Criteria					Remedy
1	Clearance between shaft and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole			
		90	−0.036 −0.090	+0.035 0	0.036 – 0.125	0.7	
2	Wear of tooth	Standard size		Repair limit			Replace tooth
		450		330			

GD705A-4



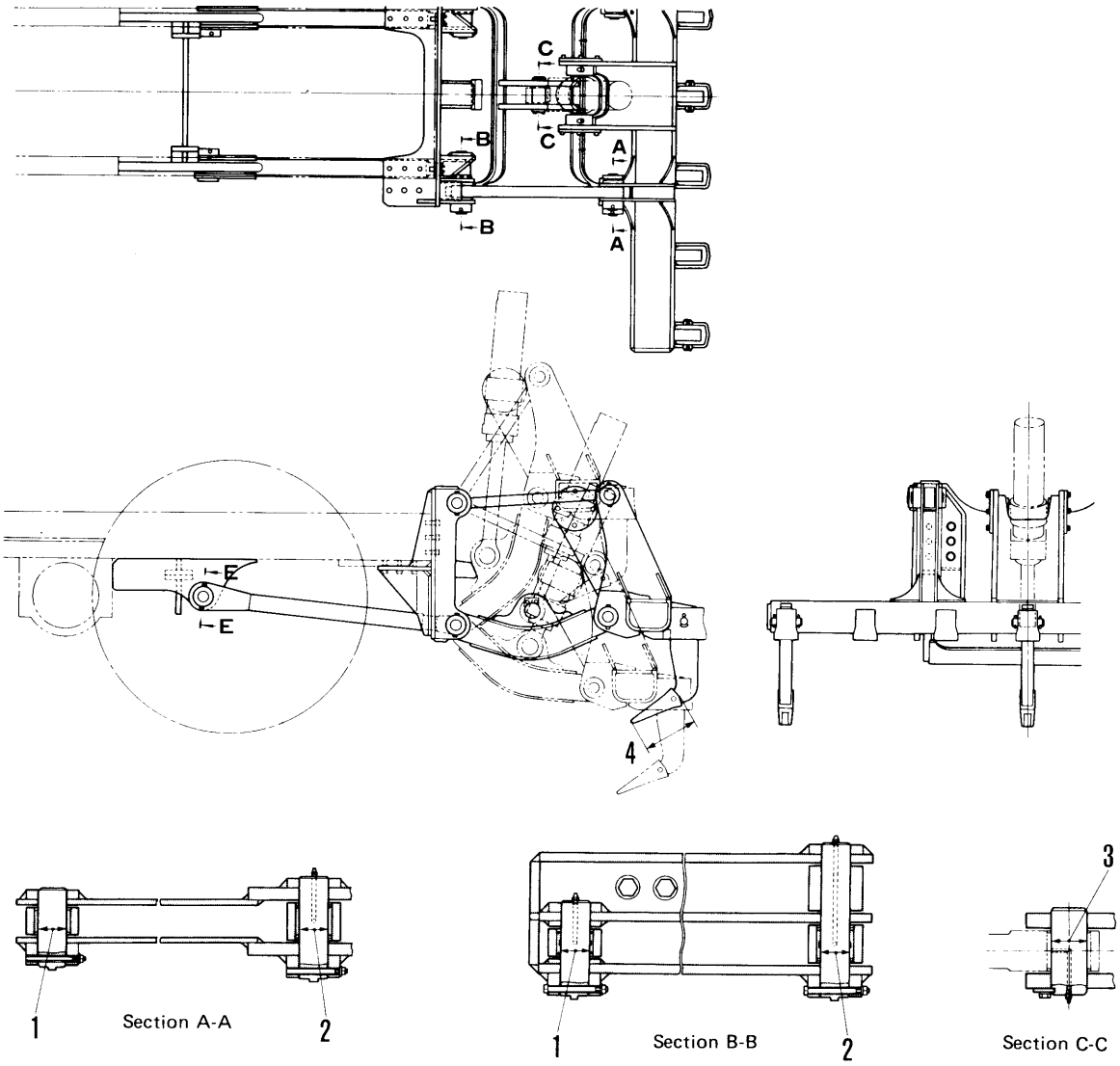
F23404065

Unit: mm

No.	Check Item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between shaft and bushing	110	−0.036 −0.090	+0.207 +0.120	0.156 – 0.297	0.7	Replace bushing
2	Wear of ball joint	70	−0.05 −0.15	+0.1 0	0.05 – 0.25	0.5	Adjust shim
3	Wear of tooth		Standard size		Repair limit		Replace tooth
		Standard	450		330		
		With point tooth	450		410		

REAR MOUNT RIPPER (If equipped)

GD705A-4

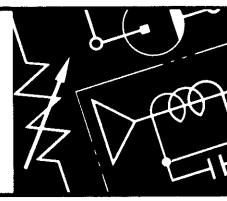


F23E1 1 1A

Unit: mm

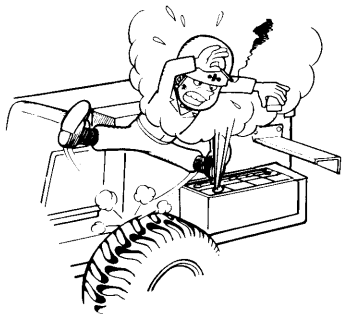
No.	Check Item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between pin and bushing	60	−0.025 −0.055	+0.046 0	0.025–0.101	0.5	Replace
2	Clearance between pin and bushing	60	−0.025 −0.055	+0.046 0	0.025–0.101	0.5	Replace
3	Clearance between pin and bushing	75	−0.030 −0.076	+0.089 +0.035	0.065–0.165	0.5	Replace
4	Wear of point	Standard size		Repair limit			Replace
		290		150			

81 ELECTRIC SYSTEM



BATTERY HANDLING

- Coat vaseline or grease on the battery terminals after connecting cords to the terminal posts. Do not allow vaseline or grease to adhere to the contact surfaces between the terminal posts and cords. Poor contact due to vaseline or grease will make it difficult for the engine to start.
- ★ When a battery removed from the machine is to be reinstalled, wipe the terminals with a clean cloth to thoroughly remove vaseline or grease.
- Fix the battery securely to the machine body.
  If loosely fitted to the machine, the battery will dance during running of the machine on rough ground, thus causing damage to the electrodes and early deterioration of the battery. On the other hand, excessive tension to the battery mounting bolts may cause breakage of the electrolyte container.
  "No Fire"
- When connecting a charger to the battery, connect the charger positive lead to the battery positive terminal and the charger negative lead to the battery negative terminal.
- During battery charging, the cathode issues hydrogen gas and the anode issues oxygen gas, both of which are scattered in the air through a small hole in the electrolyte filler plug for each cell. The mixture of the two gases is explosive and should be kept far away from fire.



F23AB077

- ★ Do not attempt under any circumstances to light a match or a lighter to check the electrolyte level in a battery in a dark place.
- "No Sparking"
  The battery may spark if a tool is carelessly placed on the battery over two terminals. If a spark occurs, an instantaneous large current flow will cause damage to the electrodes. Causing a battery to spark intentionally to check the degrees of battery charge, which may sometimes be performed by uniformed persons, should be absolutely avoided.
- When the battery is not used for a long time, remove the battery from the machine and store it indoors. Check the specific gravity of the battery from time to time during storage and, if necessary, recharge it. A battery in storage loses its charge due to its self-discharge property and, therefore, must be recharged monthly in summer or every two months in winter.
- Specific gravity of the electrolyte
  Battery charging rate can be determined by measuring the specific gravity of the electrolyte.
- When connecting a booster battery, be certain to connect the negative battery terminals together and the positive battery terminals together.

ELECTRIC WIRE CODE

In the wiring diagrams, various colors and symbols are employed to indicate thickness of wires.

Example: 05WB indicates a cable having a nominal number 05 and white coating with black stripe.

Classification by thickness

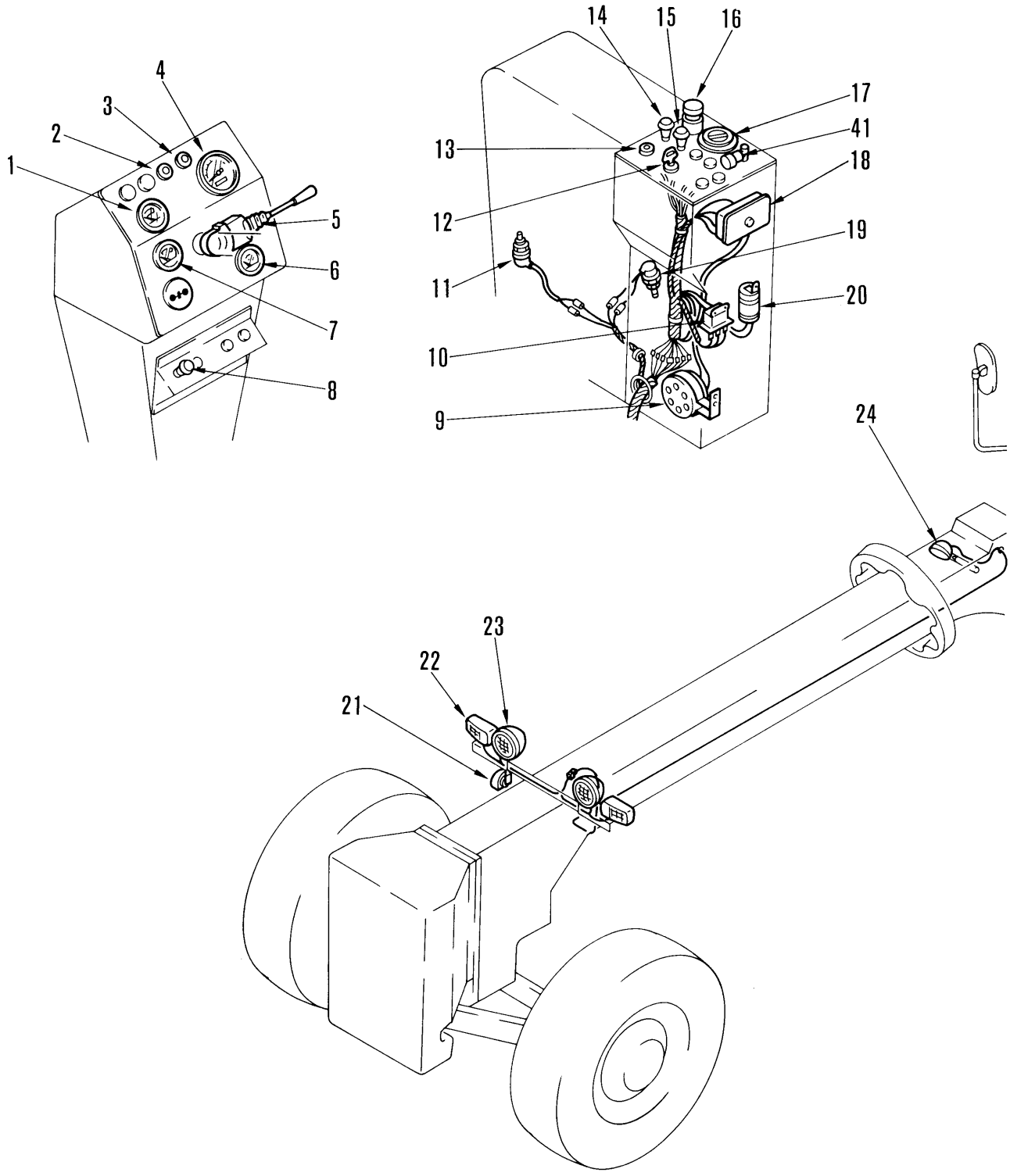
Nominal number	Copper wire			Cable O.D. (mm)	Current rating (A)	Circuits applied
	Number of strands	Dia. of strand (mm)	Cross section (mm^2)			
01	11	0.32	0.88	2.4	12	Starting, lighting, signal and instrument
02	26	0.32	2.09	3.1	20	Lighting, signal and instrument
05	65	0.32	5.23	4.6	37	Charging and signal
15	84	0.45	13.36	7.0	59	Starting (Glow plug)
40	85	0.80	42.73	11.4	135	Starting
60	127	0.80	63.84	13.6	178	Starting
100	217	0.80	109.1	17.6	230	Starting

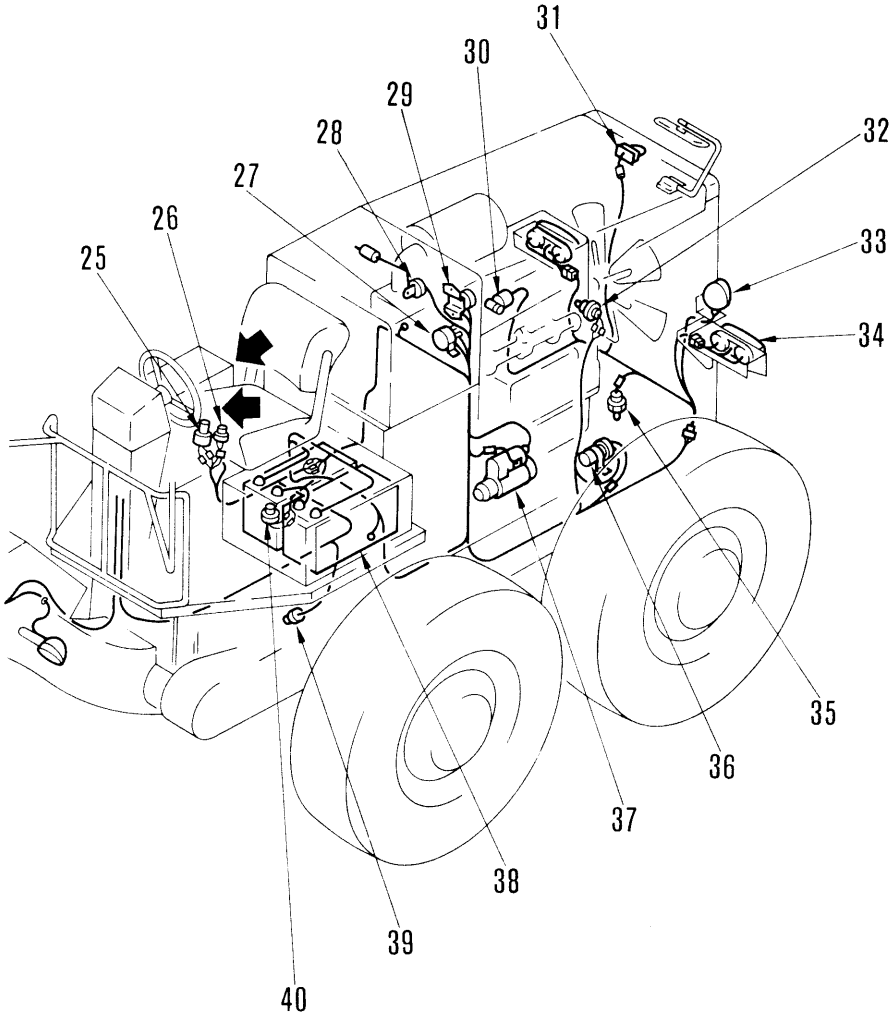
Classification by color and code

Priority	Classification \ Circuits		Starting circuit	Charging circuit	Lighting circuit	Signal circuit	Instrument circuit	Other
1	Primary	Code	**B**	**W**	**R**	**G**	**Y**	**L**
		Color	Black	White	Red	Green	Yellow	Blue
2	Auxiliary	Code	**BW**	**WR**	**RW**	**GW**	**YR**	**LW**
		Color	Black & White	White & Red	Red & White	Green & White	Yellow & Red	Blue & White
3		Code	**BY**	**WB**	**RB**	**GR**	**YB**	**LR**
		Color	Black & Yellow	White & Black	Red & Black	Green & Red	Yellow & Black	Blue and Red
4		Code	**BR**	**WL**	**RY**	**GY**	**YG**	**LY**
		Color	Black & Red	White & Blue	Red & Yellow	Green & Yellow	Yellow & Green	Blue & Yellow
5		Code	–	**WY**	**RG**	**GB**	**YL**	**LB**
		Color	–	White & Yellow	Red & Green	Green & Black	Yellow & Blue	Blue & Black
6		Code	–	**WG**	**RL**	**GL**	**YW**	
		Cblor	–	White & Green	Red & Blue	Green & Blue	Yellow & White	

ELECTRICAL WIRING DIAGRAM

GD705R-4



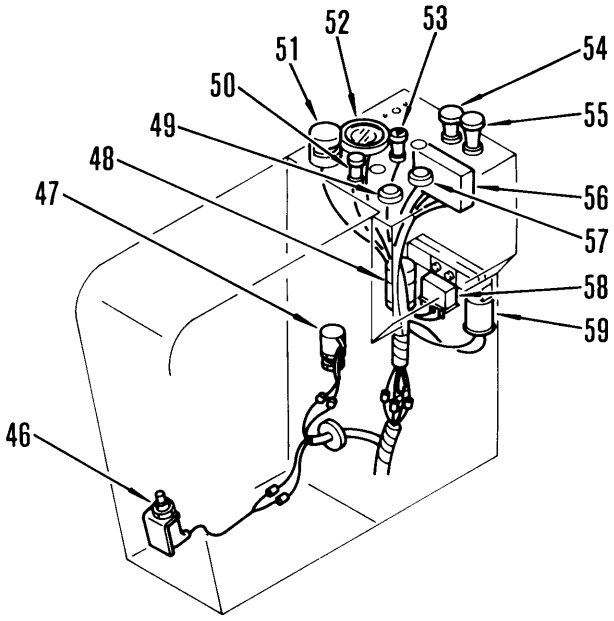


F23E04073

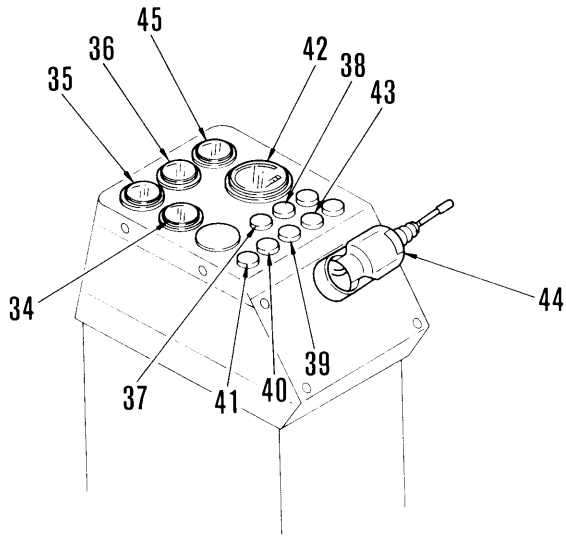
1. Water temperature gauge
2. Battery charging lamp
3. Parking brake pilot lamp
4. Speedometer
5. Turn signal, Dimmer switch (If equipped)
6. Fuel gauge
7. Engine oil pressure gauge
8. Head lamp switch
9. Buzzer
10. Horn relay
11. Safety switch
12. Starting switch
13. Heater signal
14. Working lamp switch (If equipped)
15. Yellow rotating lamp switch (If equipped)
16. Panel lamp
17. Service meter
18. Fuse box
19. Back-up lamp switch (If equipped)
20. Turn signal relay (If equipped)
21. Horn
22. Turn signal
23. Combination lamp (Front) (If equipped)
24. Working lamp (If equipped)
25. Parking brake switch
26. Buzzer switch
27. Heater relay
28. Fuel gauge unit
29. Battery relay
30. Oil pressure gauge unit
31. License plate lamp (If equipped)
32. Water temperature gauge
33. Back-up lamp (If equipped)
34. Combination lamp (Rear) (If equipped)
35. Vacuum switch
36. Back-up buzzer (If equipped)
37. Starting motor
38. Battery
39. Speedometer take out part
40. Stop lamp switch
41. Dust indicator

ELECTRICAL WIRING DIAGRAM

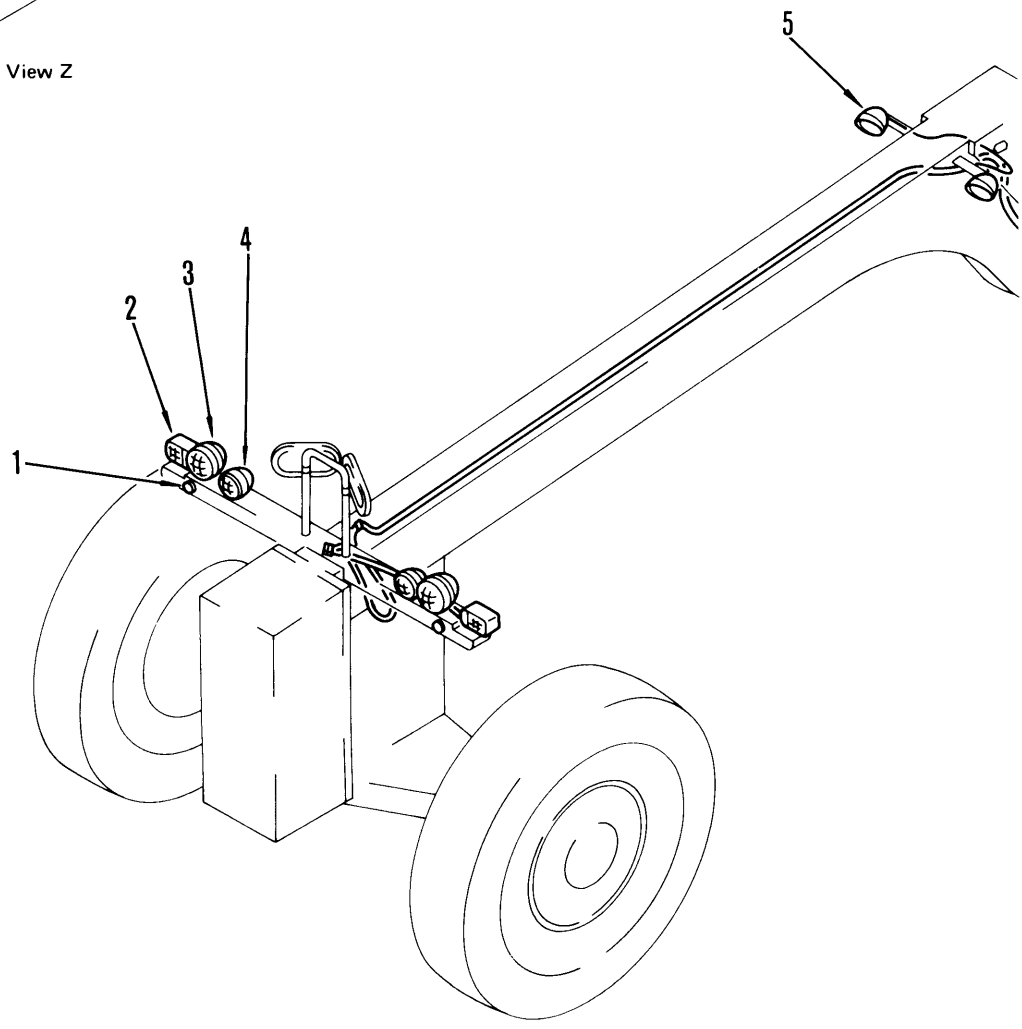
GD705A-4
Serial No. 21027 and up
Serial No. 31040 and up

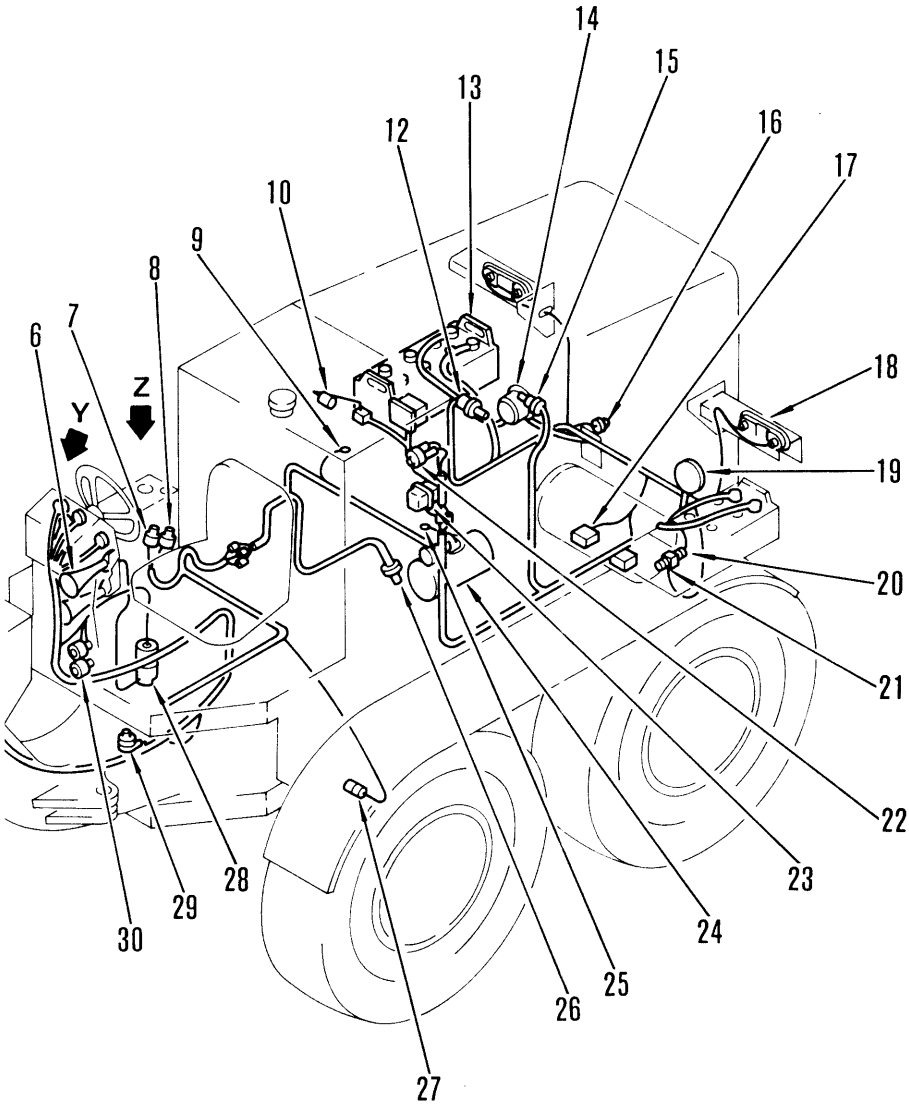


View Z



View Y



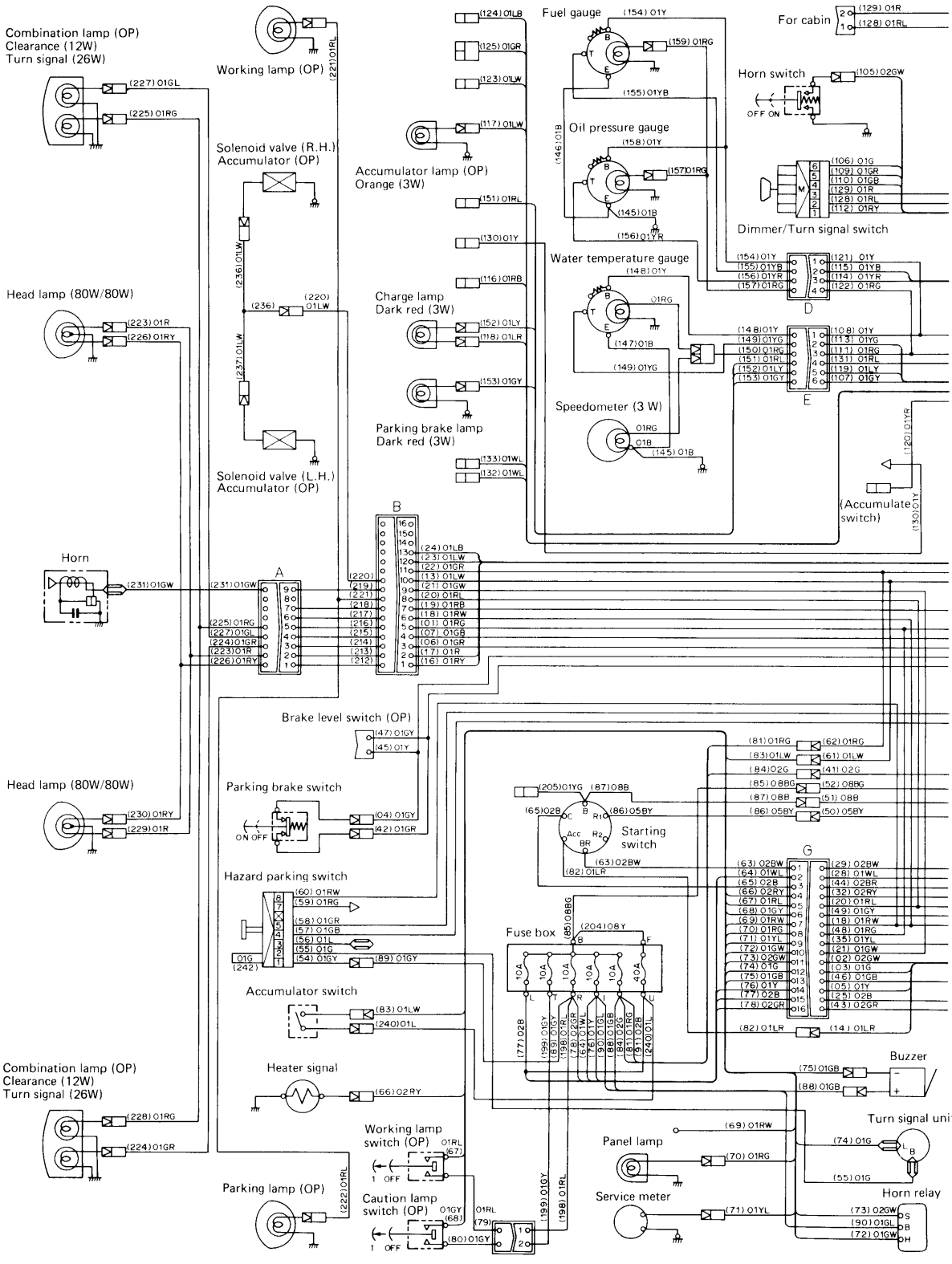


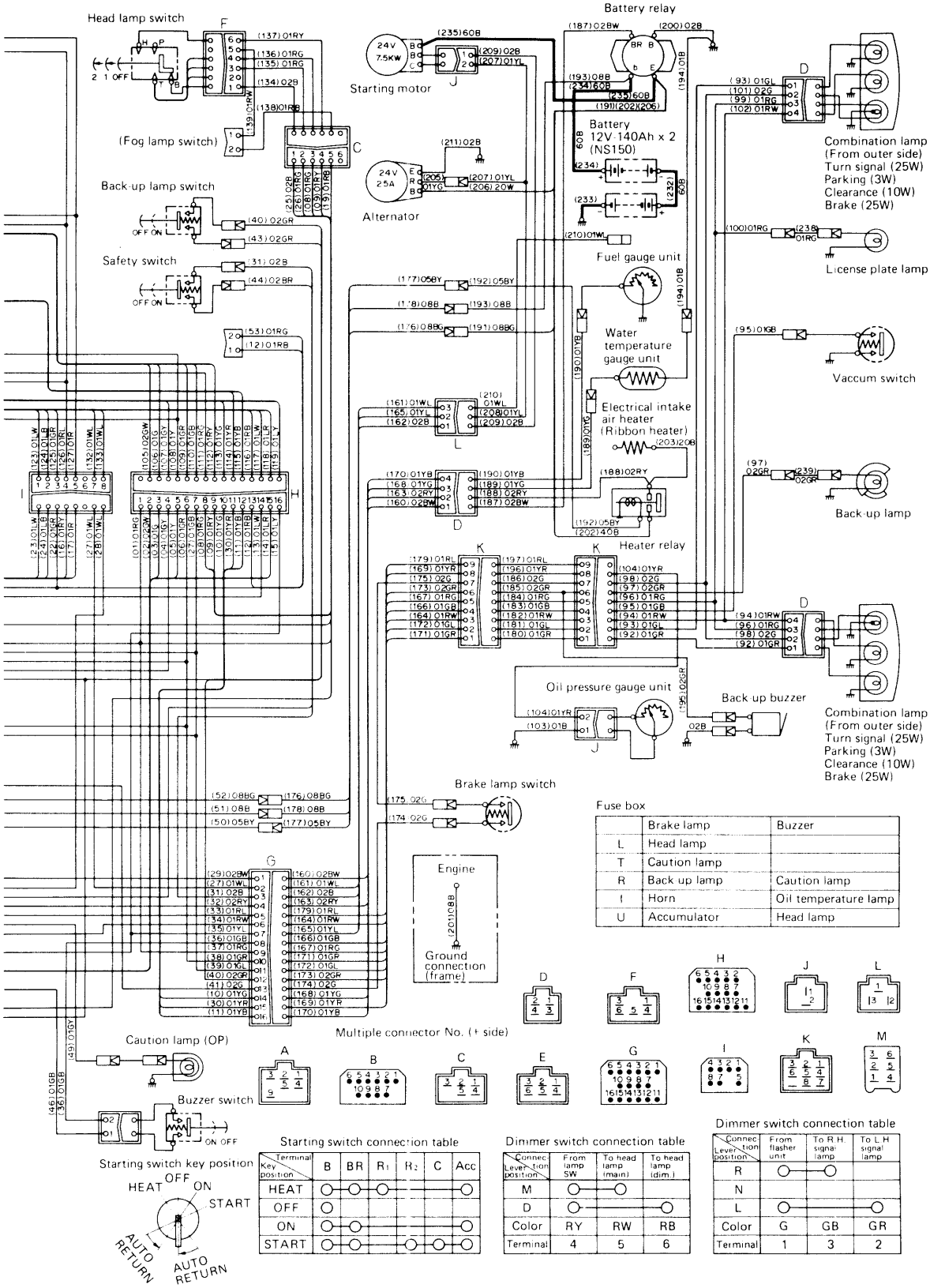
F23404032-1

1. Parking lamp (If equipped)
2. Front combination lamp (If equipped)
3. Head lamp
4. Fog lamp (If equipped)
5. Working lamp (If equipped)
6. Air horn
7. Parking brake switch
8. Buzzer switch
9. Electrical air intake heater (Ribbon heater)
10. Fuel gauge unit
12. Oil pressure gauge unit
13. Battery
14. Back-up buzzer
15. Water temperature gauge
16. License plate lamp (If equipped)
17. Automatic drain heater (If equipped)
18. Rear combination lamp (If equipped)
19. Back-up lamp (If equipped)
20. Air pressure gauge unit
21. Low pressure switch
22. Heater relay
23. Battery relay
24. Starting motor
25. Oil temperature sensor
26. Differential lock indicator switch
27. Speedometer take out part
28. Air horn valve
29. Articulate switch
30. Stop lamp switch
33. Head lamp switch
34. Air pressure gauge
35. Engine oil pressure gauge
36. Water temperature gauge
37. High beam pilot lamp (If equipped)
38. Articulation lock pilot lamp (If equipped)
39. Differential lock pilot lamp
40. Parking brake pilot lamp
41. Battery charging lamp
42. Speedometer
43. Engine oil temperature warning lamp
44. Turn signal, dimmer switch
45. Fuel gauge
46. Safety switch
47. Back-up lamp switch
48. Turn signal relay
49. Heater signal
50. Working lamp switch (If equipped)
51. Panel lamp
52. Service meter
53. Hazard warning lamp switch (If equipped)
54. Car heater switch (If equipped)
55. Cigarette lighter (If equipped)
56. Fuse box
57. Starting switch
58. Horn relay
59. Hazard turn signal relay

ELECTRICAL CIRCUIT DIAGRAM

GD705R-4





Fuse box

	Brake lamp	Buzzer
L	Head lamp	
T	Caution lamp	
R	Back up lamp	Caution lamp
I	Horn	Oil temperature lamp
U	Accumulator	Head lamp

Starting switch connection table

Key position \ Terminal	B	BR	R1	R2	C	Acc
HEAT	○					○
OFF	○					
ON	○					○
START	○			○	○	○

Dimmer switch connection table

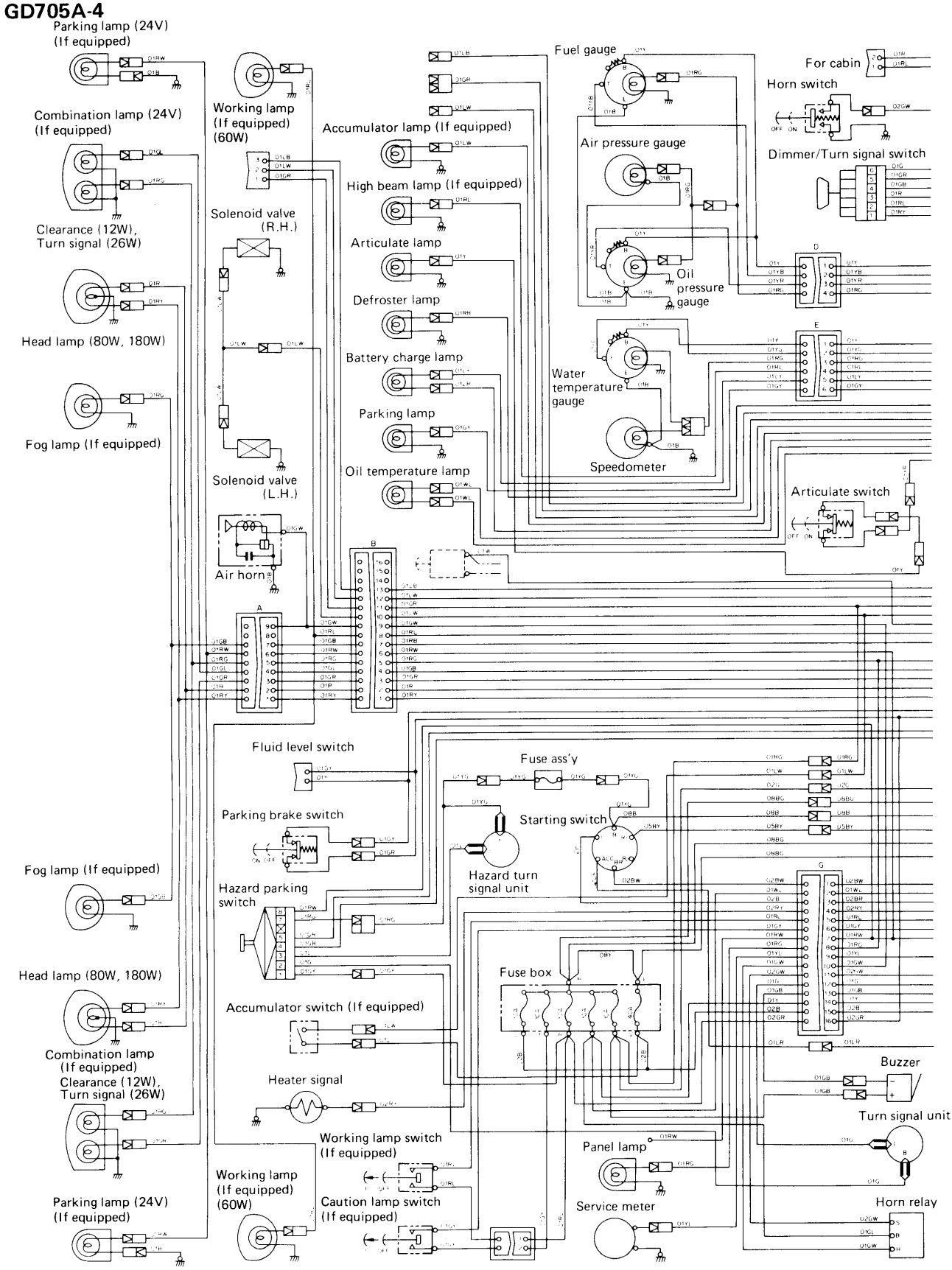
Connection \ Lever position	From lamp SW	To head lamp (main)	To head lamp (dim.)
M	○	○	
D	○		○
Color	RY	RW	RB
Terminal	4	5	6

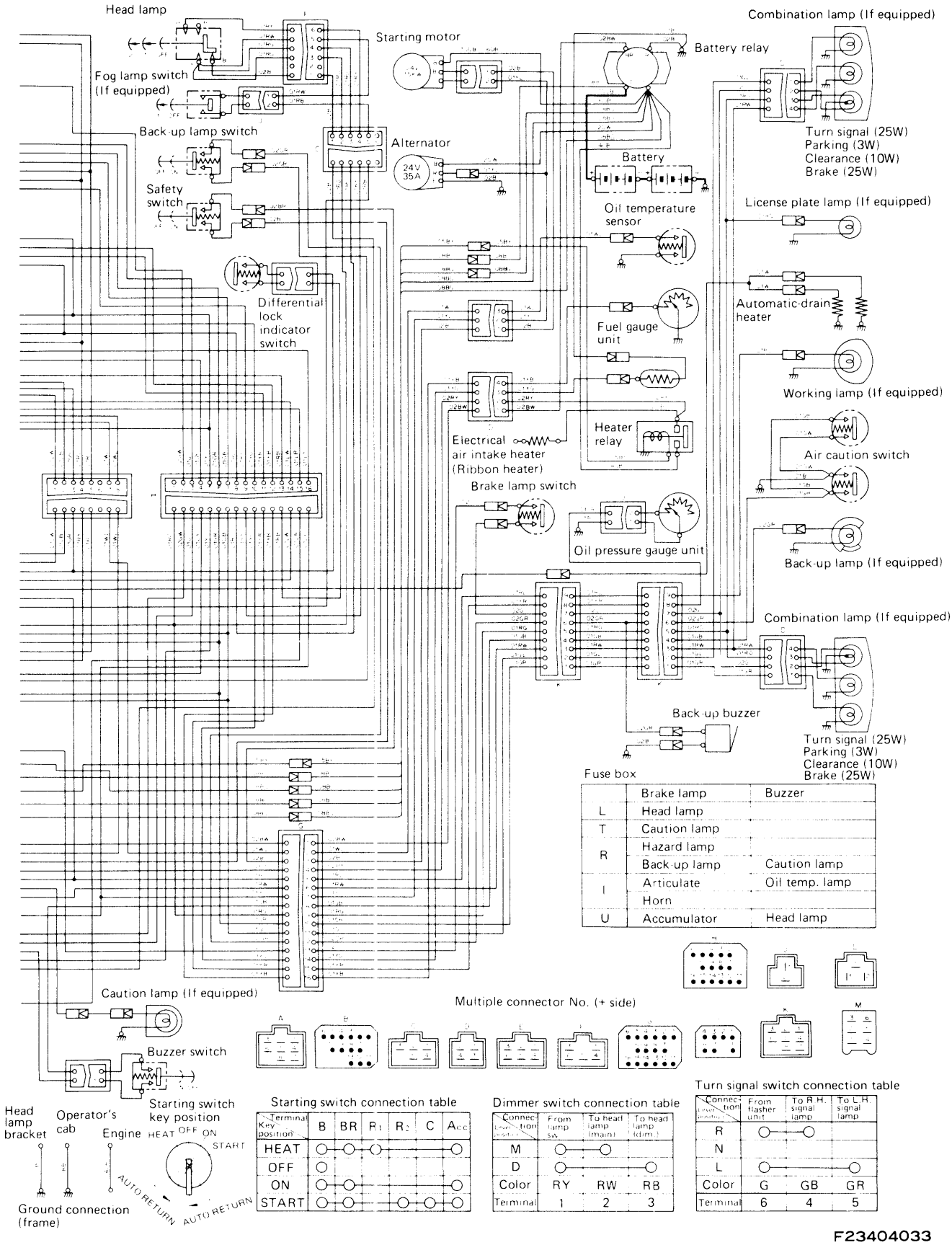
Dimmer switch connection table

Connection \ Lever position	From flasher unit	To R.H. signal lamp	To L.H. signal lamp
R	○	○	
N			
L	○		○
Color	G	GB	GR
Terminal	1	3	2

F23E04074

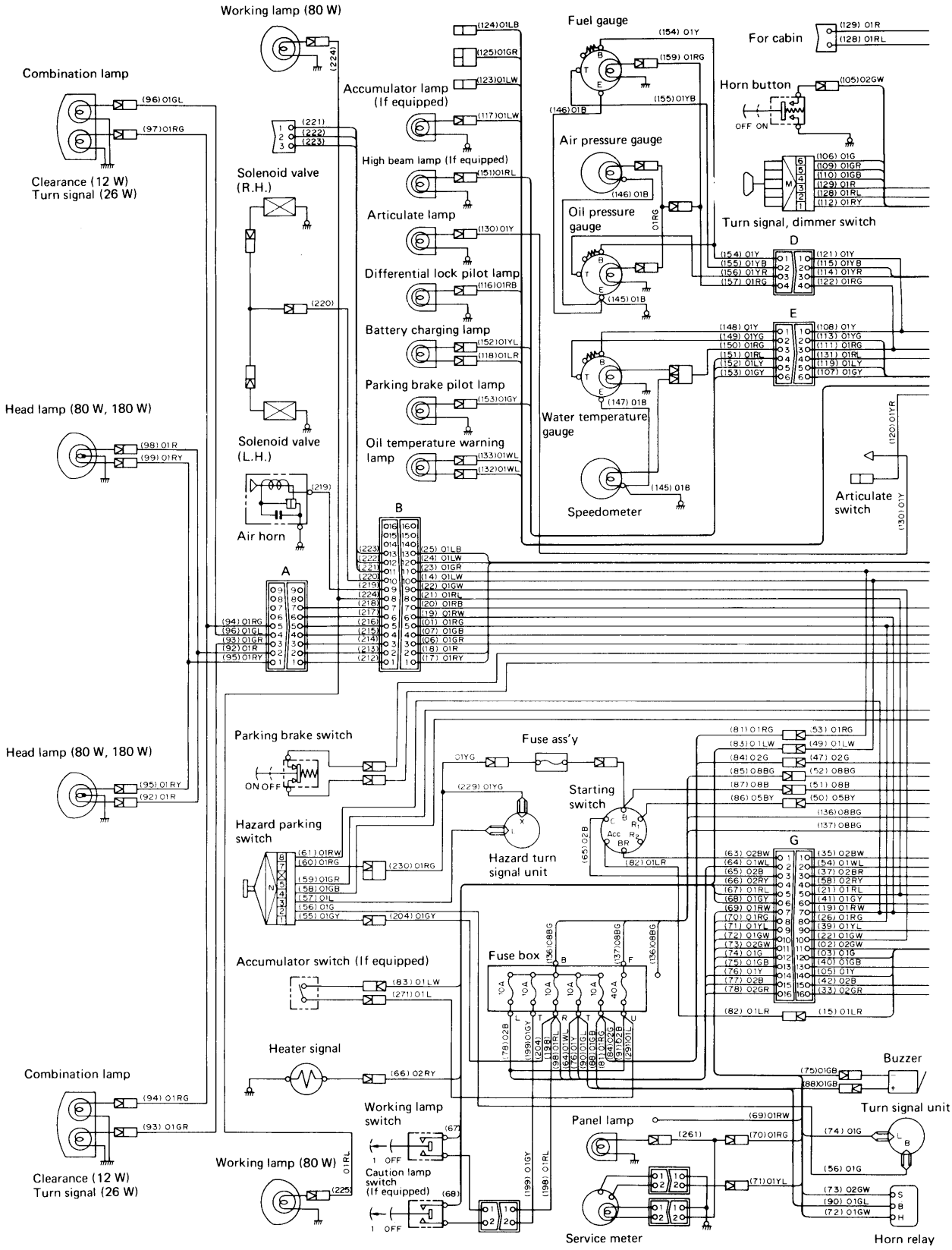
GD705A-4

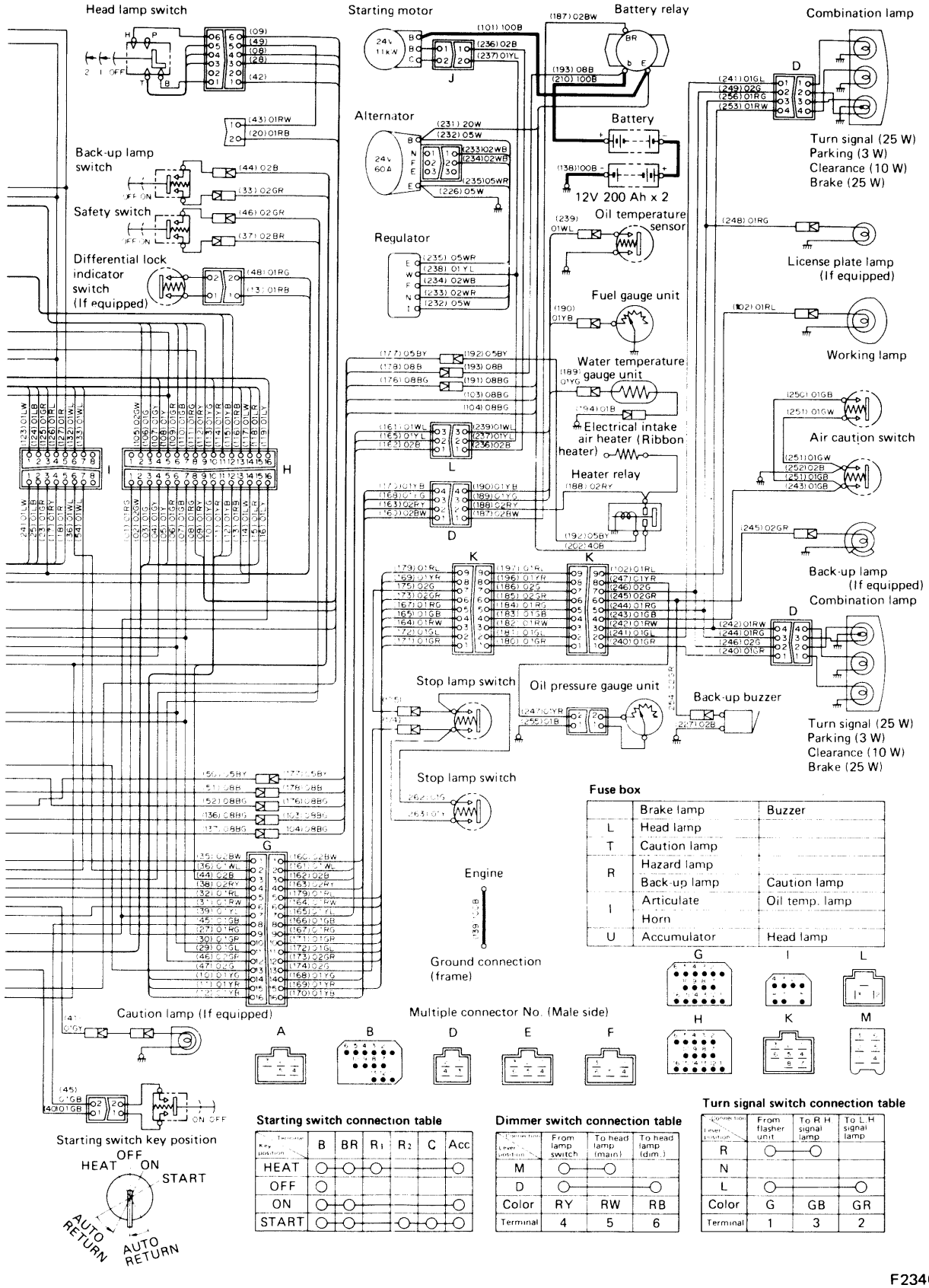

Parking lamp (24V)
(If equipped)
Combination lamp (24V)
(If equipped)
Clearance (12W),
Turn signal (26W)
Head lamp (80W, 180W)
Fog lamp (If equipped)
Working lamp
(If equipped)
(60W)
Solenoid valve
(R.H.)
Solenoid valve
(L.H.)
Air horn
Accumulator lamp (If equipped)
High beam lamp (If equipped)
Articulate lamp
Defroster lamp
Battery charge lamp
Parking lamp
Oil temperature lamp
Fuel gauge
Air pressure gauge
Oil
pressure
gauge
Water
temperature
gauge
Speedometer
For cabin
Horn switch
Dimmer/Turn signal switch
Articulate switch
Fluid level switch
Parking brake switch
Hazard parking
switch
Accumulator switch (If equipped)
Heater signal
Working lamp switch
(If equipped)
Caution lamp switch
(If equipped)
Fuse ass'y
Starting switch
Hazard turn
signal unit
Fuse box
Panel lamp
Service meter
Buzzer
Turn signal unit
Horn relay


Head lamp
Fog lamp switch (If equipped)
Back-up lamp switch
Safety switch
Differential lock indicator switch
Starting motor
Alternator
24V 35A
Battery relay
Battery
Oil temperature sensor
Fuel gauge unit
Electrical air intake heater (Ribbon heater)
Heater relay
Brake lamp switch
Oil pressure gauge unit
Combination lamp (If equipped)
Turn signal (25W)
Parking (3W)
Clearance (10W)
Brake (25W)
License plate lamp (If equipped)
Automatic-drain heater
Working lamp (If equipped)
Air caution switch
Back-up lamp (If equipped)
Back-up buzzer
Caution lamp (If equipped)
Buzzer switch
Starting switch key position
Head lamp bracket
Operator's cab
Engine
HEAT OFF ON START
AUTO RETURN
AUTO RETURN
Ground connection (frame)
Fuse box
Brake lamp
Buzzer
Head lamp
Caution lamp
Hazard lamp
Back-up lamp
Caution lamp
Articulate
Oil temp. lamp
Horn
Accumulator
Head lamp
Multiple connector No. (+ side)
Starting switch connection table
Terminal / Key position
B BR R1 R2 C Acc
HEAT
OFF
ON
START
Dimmer switch connection table
Connection
From lamp SW
To head lamp (main)
To head lamp (dim.)
M
D
Color RY RW RB
Terminal 1 2 3
Turn signal switch connection table
Connection
From flasher unit
To R.H. signal lamp
To L.H. signal lamp
R
N
L
Color G GB GR
Terminal 6 4 5

F23404033

GD705A-4 (Serial No. 31001 and up)





Fuse box

	Brake lamp	Buzzer
L	Head lamp	
T	Caution lamp	
R	Hazard lamp	
	Back-up lamp	Caution lamp
I	Articulate	Oil temp. lamp
	Horn	
U	Accumulator	Head lamp

Starting switch connection table

Terminal / Key position	B	BR	R_1	R_2	C	Acc
HEAT	○	○	○			○
OFF	○					
ON	○	○				○
START	○	○		○	○	○

Dimmer switch connection table

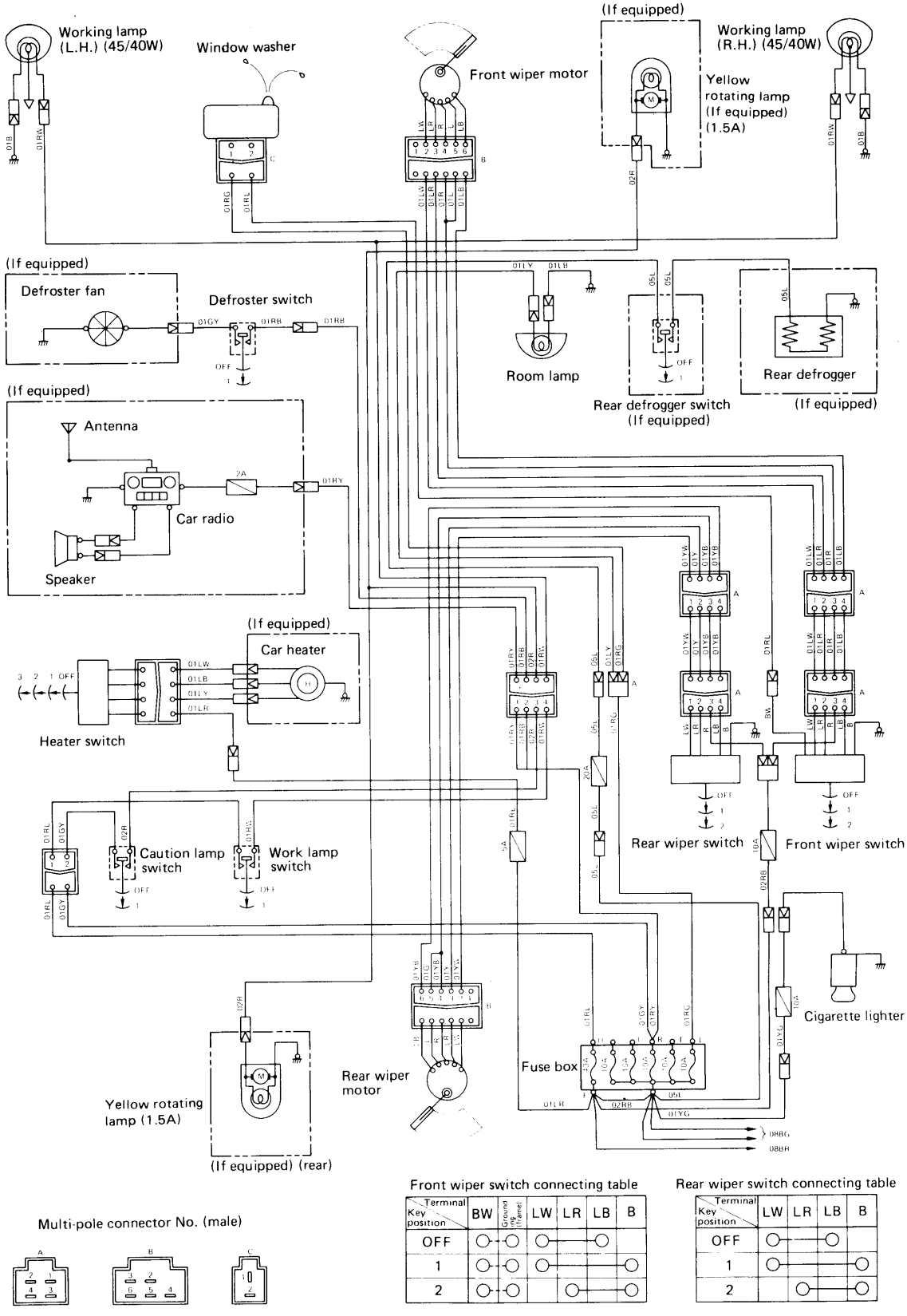
Connection / Lever position	From lamp switch	To head lamp (main)	To head lamp (dim.)
M	○	○	
D	○		○
Color	RY	RW	RB
Terminal	4	5	6

Turn signal switch connection table

Connection / Lever position	From flasher unit	To R.H signal lamp	To L.H signal lamp
R	○	○	
N			
L	○		○
Color	G	GB	GR
Terminal	1	3	2

F23404066

ELECTRICAL CIRCUIT DIAGRAM FOR CAB



Front wiper switch connecting table

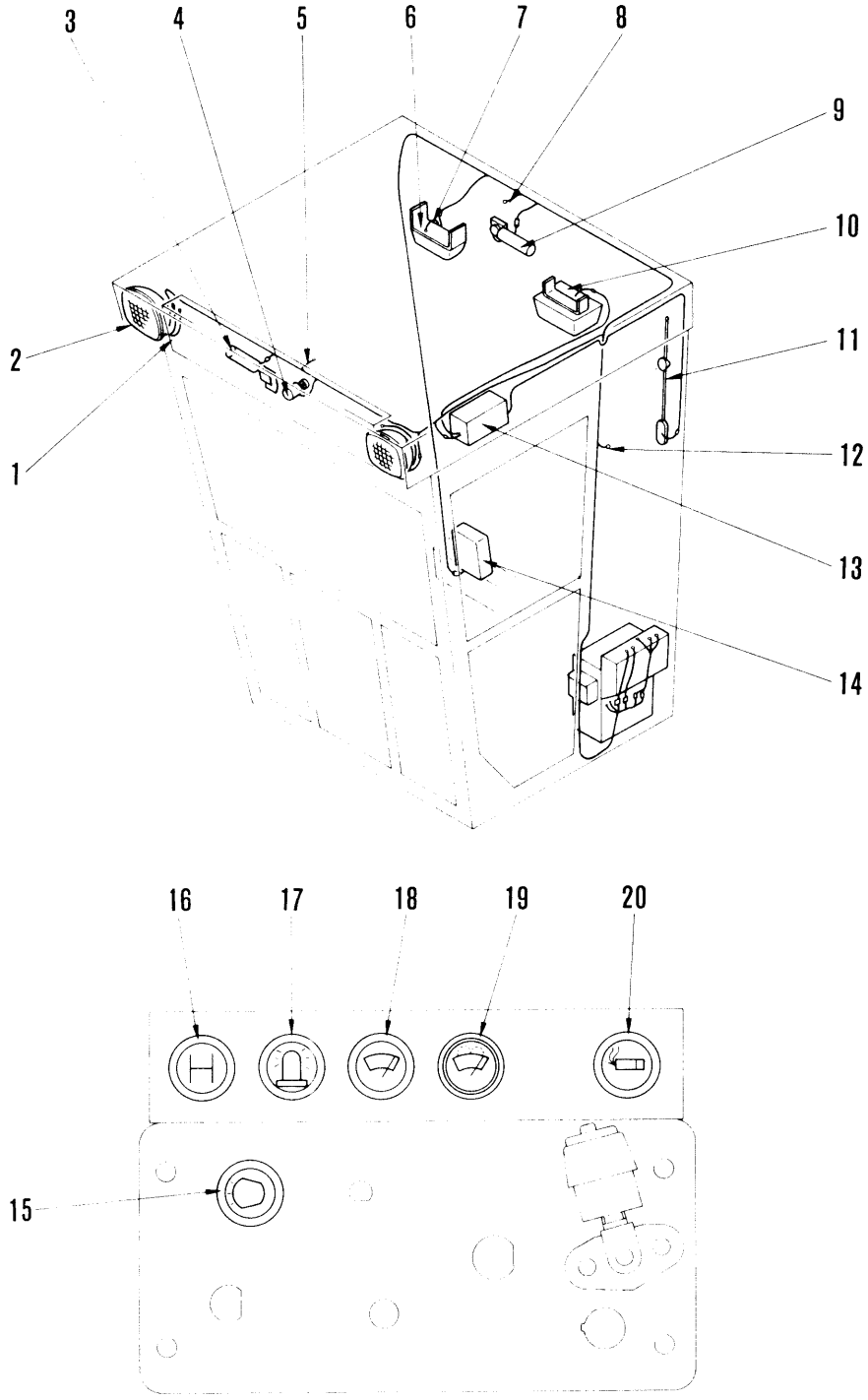
Terminal / Key position	BW	Ground (Panel)	LW	LR	LB	B
OFF	○	○				
1	○	○	○		○	
2	○	○		○	○	

Rear wiper switch connecting table

Terminal / Key position	LW	LR	LB	B
OFF	○		○	
1	○			○
2		○		○

F23404067

WIRING DIAGRAM FOR CAB



F23404068

1. Ground connection
2. Working lamp
3. Front wiper motor
4. Heated windshield switch
5. From front warning lamp
6. Room lamp
7. Ground connection (for room lamp)
8. From rear warning lamp
9. Rear wiper motor
10. Speaker
11. Antenna
12. From defroster fan
13. Radio
14. Wind washer
15. Working lamp switch
16. Car heater switch
17. Yellow rotating lamp switch
18. Rear wiper switch
19 Front wiper switch
20. Cigarette lighter