KOMATSU

D55S-3

DOZER SHOVEL

SHOP MANUAL

D55S-2008 up

GENERAL

INDEX

FOREWORD

This MANUAL is published for the information and guidance of shop personnel charged with the task of servicing the KOMATSU D55S-3 Dozer Shovel, and provides instructions to be adhered to in disassembling and re-assembling machines of this model in the shop. The instructions are given mainly in the form of procedures, and, in each section of the MANUAL, are preceeded by an outline description of each major component in respect to mechanical construction, function and other pertinent items.

TERMINOLOGY

Effort has been made in the preparation of this MANUAL to use the most common shop terms in order to avoid ambiguity and equivocation. Some key terms used, however, require precise agreement in advance between the writer and the reader as to their meanings, as the clarity of what are aimed at in shop work depends largely on these terms. Throughout this MANUAL, the major key terms are used with following meanings.

(1) Clockwise (C.W.) and Counterclockwise (C.C.W.)

A circular direction, C.W. or C.C.W., is in the mind of the viewer standing in front and ahead of the machine, except when a driven component is discussed.

Such a component as the oil pump, the component is considered singly and as viewed from its driving side.

(2) Terms of Servicing Criteria

BASIC SIZE: This term is universally defined as the theoretical or nominal standard size (diameter, length, thickness, etc.) from which variations are made, and is used in this sense throughout.

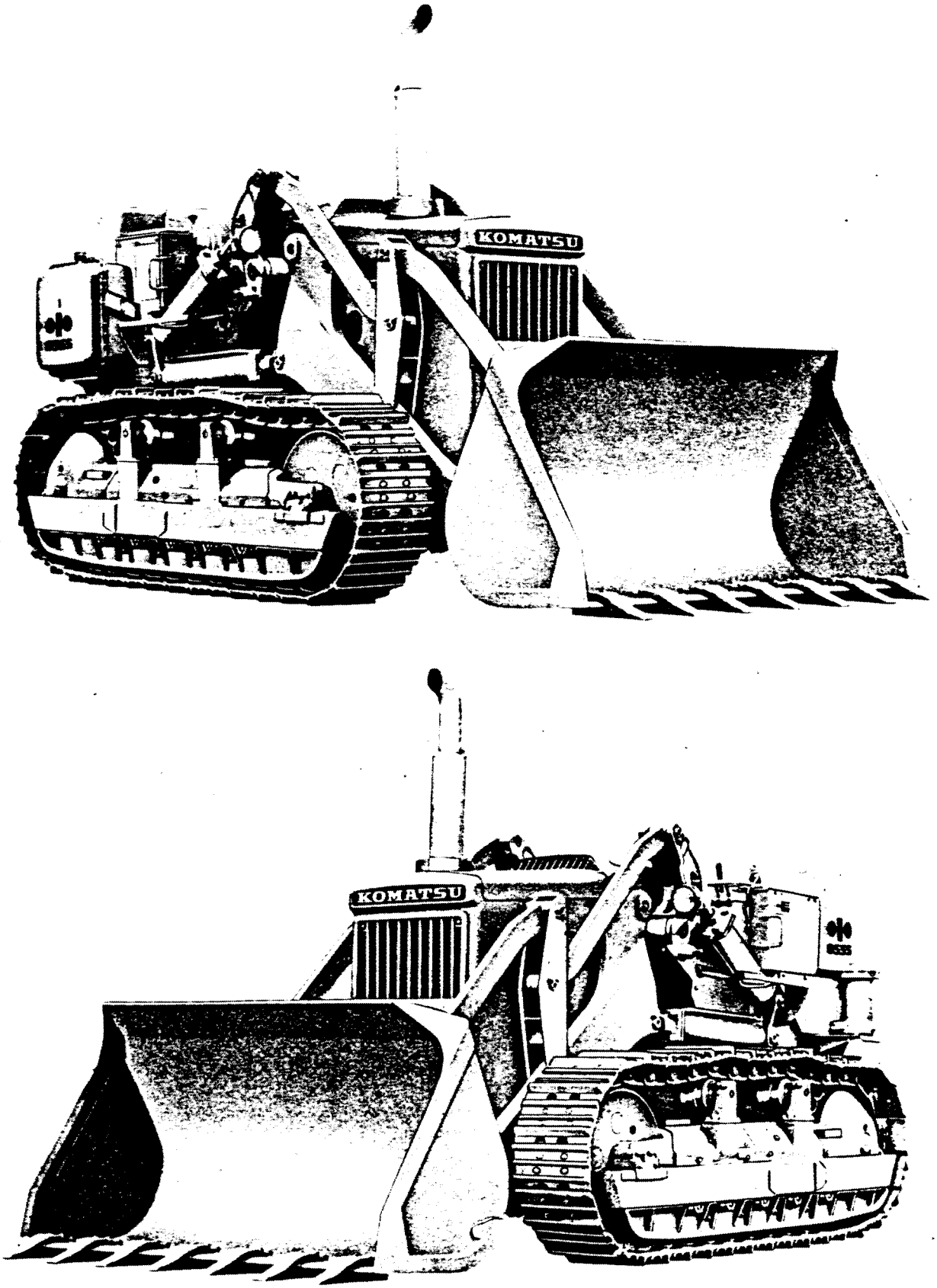
ASSEMBLY STANDARD: This is a dimensional value or a range of dimensional values to be adhered to in assembling components. An assemblage is required to satisfy the assembly standard specified for it.

STANDARD CLEARANCE: This refers to a clearance range, within which a distance of separation occurring in a full assembly or sub-assembly of replacement parts must take its value.

Such an assembly or sub-assembly is permitted to be installed or mounted in place only when this requirement is satisfied.

CLEARANCE LIMIT (maximum allowable clearance): A running clearance between a shaft and its hole, for instance, will increase as the shaft or hole wears progressively. A clearance limit is provided for each critical or important clearance and, if such a clearance is found to have increased upon disassembling beyond the clearance limit specified for it, the parts associated with that clearance must be corrected to take a value within the limit.

SERVICE LIMIT: An extra stock is provided in some parts subject to wear, so that these parts may be repaired upon disassembling. There are many such parts that can be re-used repeatedly until their extra stock is used up by grinding, cutting, etc. A service limit is the minimum or the maximum dimension (thickness, diameter, etc.) specified for such a part. Any part found to have exceeded its service limit is not repairable: its serviceability has ended and a replacement part must be used in reassembling.



D55S-3 DOZER SHOVEL

SPECIFICATIONS

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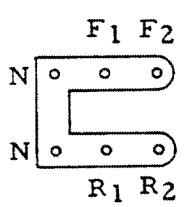
SPECIFICATIONS

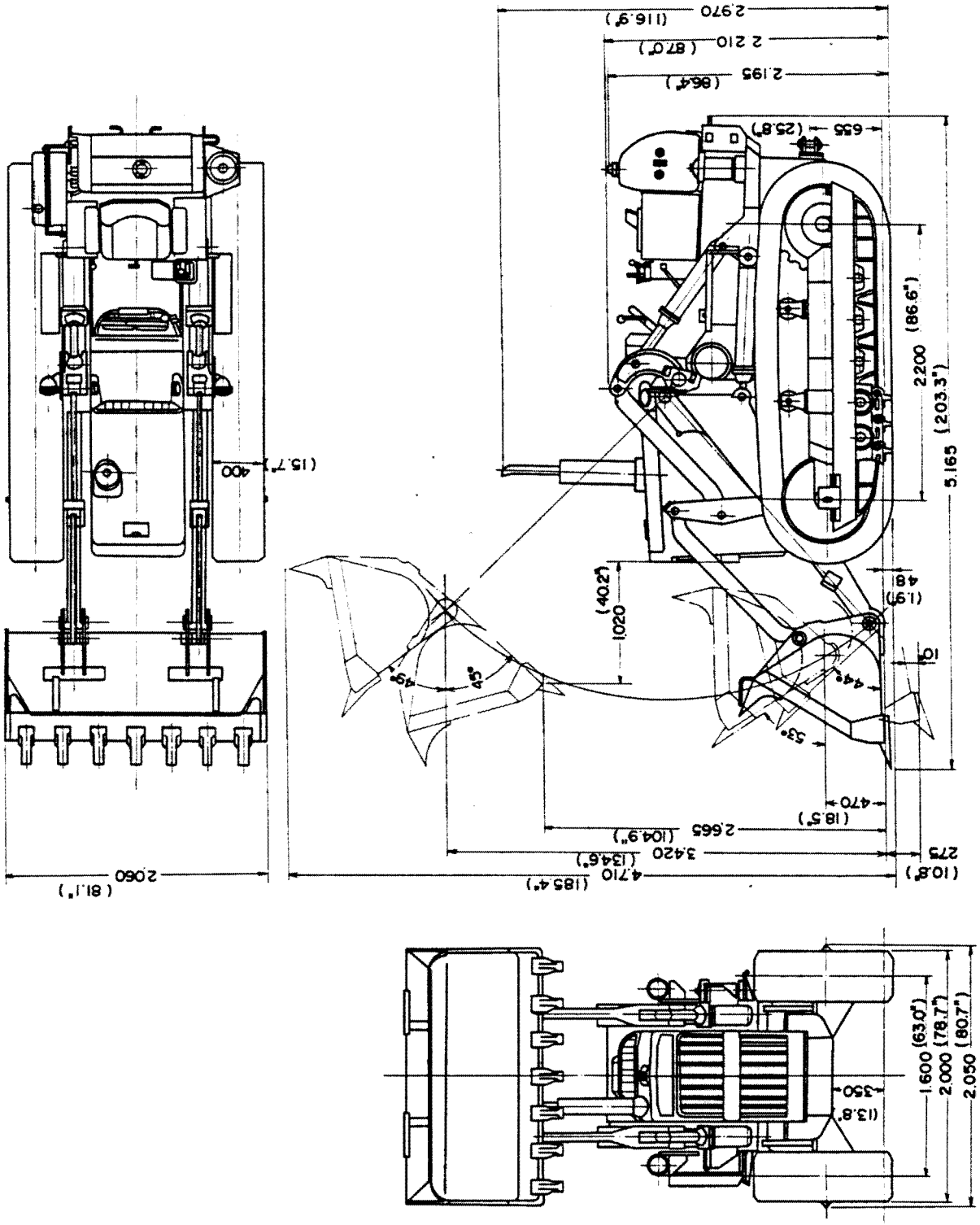
MACHINE MODEL				D55S-3 DOZER SHOVEL (TORQFLOW)
Operating weight				13300 kg (29,320 lb)
DIMENSIONS	Overall length			5165 mm (203.3 in)
	Overall width, w/o bucket			2050 mm (80.7 in)
	Bucket width			2060 mm (81.1 in)
	Overall height (Top of exhaust pipe) (Shovel link)			 2970 mm (116.9 in) 2210 mm (87.0 in)
	Shoe width			400 mm (15.7 in)
	Track gauge			1600 mm (63.0 in)
	Length of track on ground			2200 mm (86.6 in)
	Ground pressure			0.76 kg/cm^2 (10.81 PSI)
	Ground contact area.			17600 mm^2(2730 sq.in)
	Ground clearance			350 mm (13.8 in)
	Height of drawbar above ground			655 mm (25.8 in)
PERFORMANCE	Travelling speed	Forward Low	1st	0 - 3.3 km/h (0 - 2.1 MPH)
			2nd	0 - 6.1 km/h (0 - 3.8 MPH)
		Forward High	1st	0 - 4.8 km/h (0 - 3.0 MPH)
			2nd	0 - 8.8 km/h (0 - 5.5 MPH)
		Reverse Low	1st	0 - 4.2 km/h (0 - 2.6 MPH)
			2nd	0 - 4.8 km/h (0 - 4.8 MPH)
		Reverse High	1st	0 - 6.0 km/h (0 - 3.7 MPH)
			2nd	0 - 11.0 km/h (0 - 6.8 MPH)
	Max. rated drawbar pull			16100 kg (35,490 lb)
	Turning radius			2.7 m (8.9 ft)
	Grade ability			30°
ENGINE	Model			KOMATSU S4D120-11
	Type			Water cooled, 4 cycle, vertical pre-conbustion chamber type, turbocharged diesel with air compressor
	No. of cylinders - bore x stroke			4 - 120 mm x 160 mm (4.72 in x 6.30 in)
	Piston displacement			7240 cc (442 cu.in)
	Rated RPM			1900
	Flywheel horsepower			125 HP
	Max. torque			55.5 kg.m (401 ft.lb)/1200 RPM
	Fuel consumption ratio			180 g (0.40 lb)/HP.h

MACHINE MODEL			D55S-3 DOZER SHOVEL (TORQFLOW)
ENGINE	Fuel specification		Diesel gas oil (ASTM D975-60T No. 2D) Cetan No. over 45
	Governor		Mechanical, all speed control
	Lubrication system	Lubrication method	Gear pump, forced lubrication
		Filter	Full-flow type
		Oil cooler	Water cooled
	Cooling system		Forced circulation by centrifugal water pump
	Air cleaner		Dry, centrifugal type
	Elec. system	Generator	24V, 0.3 KW
		Battery	24V (12V x 2) - 150 Ah
	Starting method		By electric starting motor 24V, 7.4 KW
TRANSMITTING SYSTEM	Torque converter	Type	TCS36-1A 4-element, single-stage, 3-phase
		Oil specification	Engine oil (SAE No. 10W)
		Cooling method	Water cooled
	Torqflow transmission	Type	Hydraulically actuated, planetary-gear multi-disc type
		Shift speeds	2 speeds forward, 2 speeds reverse
		Shift lever pattern	
		Lubrication	Pressure feed type
	Range transmission	Range transmission type	Spur-gear sliding shift type, high-low shift
		Type	Spiral bevel type, single reduction
		Lubrication	Splash type
	Steering clutch		Wet, multiple disc, foot operated, full hydraulic actuated
	Final drive gear	Type	Spur gear, double reduction
		Lubrication	Splash type

MACHINE MODEL			D55S-3 DOZER SHOVEL (TORQFLOW)
UNDERCARRIAGE	Suspension		Semi-rigid equalizer bar type
	No. of carrier rollers		2, each side
	No. of track rollers		5, each side
	Shoe	Type	Assembled, semi-double grouser
		Grouser height	48 mm (1.9 in)
		No. of shoes	36, each side
		Width	400 mm (15.7 in)
		Pitch	190 mm (7.5 in)
BUCKET ATTACHMENT	Max. loading capacity		2800 kg (6,170 lb)
	Bucket capacity		1.4 m^3 (1.8 cu.yd)
	Max. lift		3420 mm (134.6 in)
	Max. dumping height		2665 mm (104.9 in)
	Max. digging depth		275 mm (10.8 in)
	Reach		1020 mm (40.2 in)
	Max. tilt back angle		44°
HYDRAULIC SYSTEM	Max. oil pressure		140 kg/cm^2 (2,000 PSI)
	Hyd. cyl.	No. of lift cylinder-bore	2 - 140 mm (5.51 in)
		No. of dump cylinder-bore	2 - 130 mm (5.12 in)
	Hydraulic oil pump		Gear pump
	Control valve	Location	Within hydraulic oil tank
		Type	Double spool type
		Operating control position	Lift valve: RAISE, HOLD, LOWER, FLOAT Dump valve: DUMP, HOLD, TILT
	Hydraulic tank	Type	Equipped with built-in control valve
		Capacity	92 liters (24.3 U.S.Gal)
		Location	Right side of operator's seat
		Oil specification	Engine oil (SAE 10W)
	Filter		Full-flow type
DRAWBAR	Location		Rear-end center
	Height of drawbar above ground		655 mm (25.8 in)
	Type		Pin fixed type

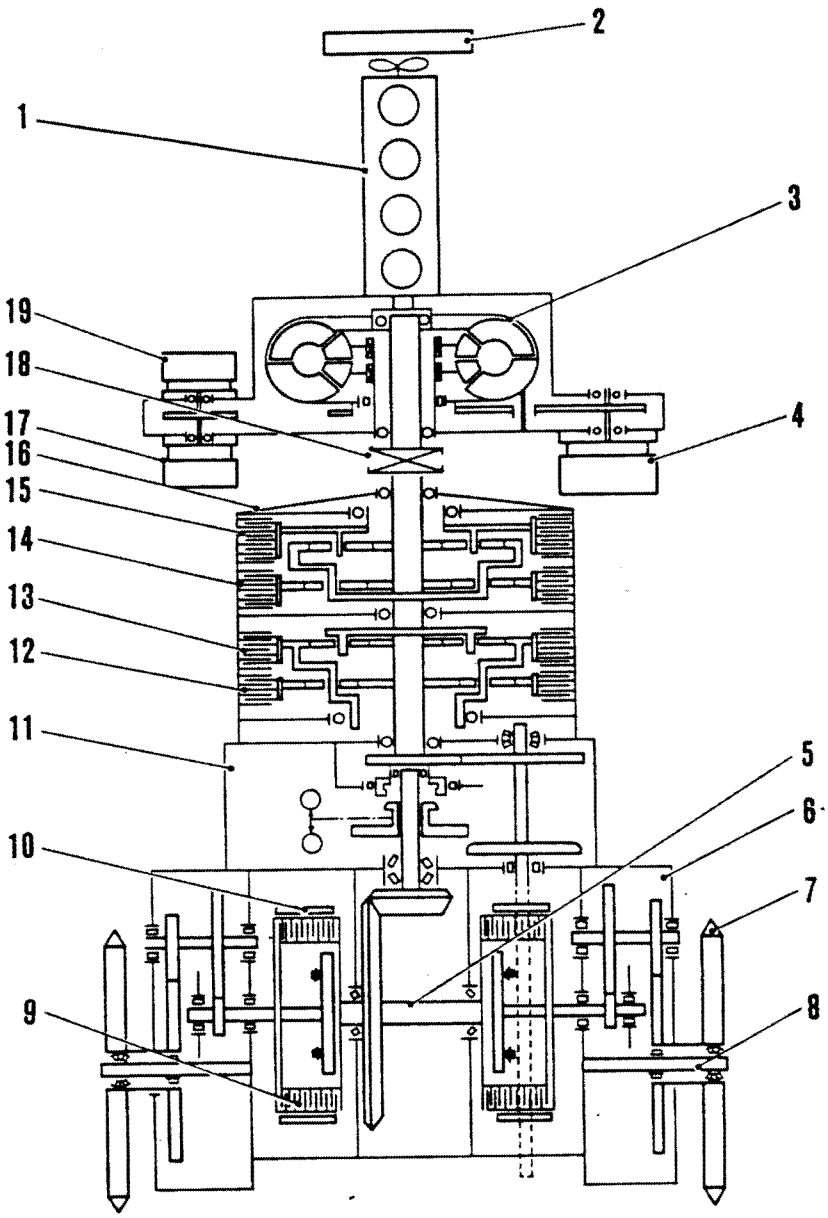
MACHINE MODEL		D55S-3 DOZER SHOVEL (TORQFLOW)
CAPACITIES	Cooling water	53 liters (14 U.S.Gal)
	Fuel tank	240 liters (63 U.S.Gal)
	Engine	18 liters (4.8 U.S.Gal)
	Torque converter Transmission	38 liters (10 U.S.Gal)
	Bevel gear drive Steering case	65 liters (17 U.S.Gal)
	Final drive case (each)	12 liters (3.2 U.S.Gal)
	Hydraulic oil	92 liters (24.3 U.S.Gal)

Specifications are subject to change without notice.



D55S-3 DOZER SHOVEL

POWER TRAIN



1. Engine
2. Radiator
3. Torque converter
4. Pump
5. Bevel gear shaft
6. Final drive
7. Sprocket
8. Sprocket shaft
9. Steering clutch
10. Steering brake
11. Range transmission
12. No. 4 clutch pack
13. No. 3 clutch pack
14. No. 2 clutch pack
15. No. 1 clutch pack
16. Torqflow transmission
17. Transmission and torque converter pump
18. Universal joint
19. Steering clutch pump

Direction	Speed		Clutch pack blocked
Forward	Low	1st	No. 2→No. 4
		2nd	No. 2→No. 3
	High	1st	No. 2→No. 4
		2nd	No. 2→No. 3
Reverse	Low	1st	No. 1→No. 4
		2nd	No. 1→No. 3
	High	1st	No. 1→No. 4
		2nd	No. 1→No. 3

Power developed by the engine (1) is transmitted to the right and left sprockets through the drive line consisting of torque converter (3), universal joint (18), torqflow transmission (16), range transmission (11), bevel gear shaft (5), steering clutches (9), and final drive (6), in that order. The power-shift transmission provides four speeds, two for forward and two for reverse,and the range transmission modifies the gearshift selection by transmitting drive according as the high-low lever is in HIGH or LOW.

Drive divides crosswise into two paths at the spiral bevel pinion and gear, and passes onto the right and left steering clutches. Each steering clutch is followed by the final drive gearing in which the drive is slowed down further through two stages of reduction before actuating the sprocket. The engine mounts are bolted to the main frame, which is welded to the bevel gear shaft case to form a rigid chassis construction. The steering clutches, range transmission and bevel gear drive are housed in the bevel gear shaft case, to the ends of which are bolted the final drive cases.

GENERAL INSTRUCTIONS

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GENERAL INSTRUCTIONS

INSTRUCTIONS FOR DISASSEMBLING WORK

(1) Before starting to disassemble any part of the machine, study the Parts Book and Service Manual, giving particular attention to the servicing criteria and standards indicated in these publications, to gain a full understanding of the mechanical component to be disassembled. Knowledge of the construction and functions of the component is an essential factor of successful servicing work.

(2) When draining out lubricants and hydraulic oil, be sure to take note of the color, viscosity and cleanliness with which the oil comes out. Oil in service often suggests the condition of the parts served, particularly when the oil lubricates gears or bearings.

(3) It is advisable and often mandatory to put match marks across mating joint lines before separating or removing parts, and to scribe identification marks on identical parts such as pistons and valves in the engine.

This provision that you make at the time of disassembling will greatly facilitate your re-assembling work.

(4) Disassembly assumes that you carefully note the orientation or position of each part, as necessary, and the sequence of taking one part after another from the machine. What you have so noted at the time of disassembling will be an assurance of your restoring or re-assembling the parts correctly.

(5) Be sure to use the special disassembling tool wherever its use is specified in the procedure. If the special tool is not available, some tool similar to it should be used. Use of a special tool is prescribed where common tools can cause damage of one type or another to the parts involved.

(6) Tapered parts or press-fitted parts are expected to be tight in place and not to yield easily to hand pulling. If such a part is noted to be loose, be sure to inspect it for wear with greater care.

(7) Parts taken off upon disassembling should be washed clean and set aside in an orderly manner, making proper provision to protect them against dust.

Use two kinds of washing fluid, one for removing dirt and one for clean washing. Filters, magnetic plugs and breathers are the parts that must be cleaned particularly carefully.

(8) Make shim stock available in all thickness for use at the time of re-assembling.

(9) There are some components that should be serviced at specialized shops because use of specialized equipment and instruments is necessary in servicing them. They are injection pumps, governors, starting motors, generators, regulator units, batteries and the like.

INSTRUCTIONS FOR RE-ASSEMBLING WORK

(1) Before starting to assemble, make sure all parts are clean. Replacement parts are usually coated with an anti-rust compound; remove the compound by wiping or washing.

(2) Installation of bearings, bushings, oil seals and the like requires the use of special driving-in or forcing tool in most cases. Driving such a part into its position by directly hitting it with

a hammer is a bad practice: always use a piece of wood or soft metal to transmit the hammer blow to the part.

(3) Spring, plain, tongue or toothed washers, cotter pins and locking wires are highly important parts but, because of their small size, are liable to be forgotton at the time of re-assembling.

When fitting such fastening parts as bolts and nuts, check to be sure whether locking means are specified or not for the fastening parts.

(4) Use a torque wrench wherever its use is prescribed or a torque limit is specified. When securing a cover or similar part having many bolts, be sure to adhere to the standard shop practice of tightening the securing bolts gradually to distribute the pressure evenly.

(5) Match marks are not the marks for identifying mating parts: they are meant to be indexed and aligned as accurately as possible. Ignoring this fact may result in a costly major repair.

(6) Clean tools, clean work benches and tables are keys to successful assembling work. Cleanliness saves working time and promotes accurate assembling.

INSTRUCTIONS FOR ADJUSTING WORK

(1) Most of assembling operations are terminated with adjusting work. Be sure to check your list so that none of such components will be left unadjusted. Engine oil pressure, track tension, control linkage end play and injection timing are typical items of adjustment that demand your greater attention in re-assembling work.

(2) Check to be sure that components serviced at specialized shops, such as the injection pump, governor, regulator unit and the like, carry notes certifying to the effect that the components are properly adjusted and qualified for re-use.

INSTRUCTIONS FOR USE OF HAND TOOLS

(1) Use good and correct hand tools.

Use of defective or wrong hand tools is a sure way of improperly assembling or damaging the parts.

(2) Never use any special tool for other purposes than the one for which it is intended, or you will damage the machine or the tool.

INSTRUCTIONS FOR HANDLING BEARINGS IN DISASSEMBLING/RE-ASSEMBLING WORK

(1) Dust is one of the common enemies of all bearings. Dust can often be a cause of bearing noise and accelerates deterioration of the lubricating oil in service.

(2) When replacing a bearing, unpack the replacement bearing only when all preparatory steps for bearing installation have been completed.

(3) In installing a bearing, be sure to position it properly, forcing it all the way against the wall (stepped shoulder or seat).

(4) Use of a number of bearing pullers (some of which serve also as installers) is involved in general disassembling / re-assembling work. Be sure to use these tools where their use is

specified. DRIVING a bearing in with a HAMMER is, in most cases, the same thing as driving a sure cause of trouble into the machine.

(5) For the washing fluid to be used in cleaning bearings, benzine or benzol is recommendable. Kerosene and diesel fuel oil may be used if compressed air is available for blowing dust off, but, with these oils alone fine dust entrapped within a bearing is hard to remove.

(6) Upon washing and cleaning bearings, and pending their installation, coat them lightly with grease.

(7) Spherical roller bearings should be installed with particular attention to positioning. Secure them correctly to eliminate excessive clearance at either end face, or the bearings will wear off prematurely in service.

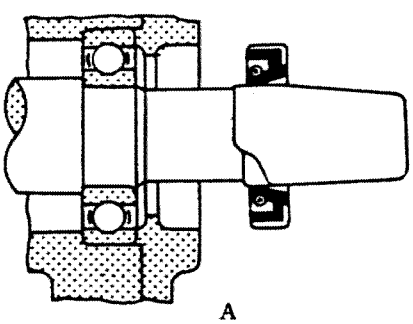
INSTRUCTIONS FOR HANDLING OIL SEALS

(1) In installing an oil seal, make sure the oil seal is so positioned as to bring its lip to the correct side.

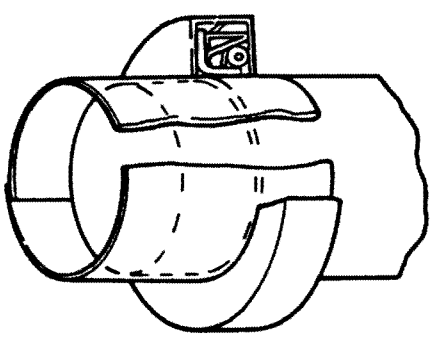
(2) The lip of an oil seal in place is required to present a sharp tip angle for satisfactory sealing action. Thus, it is highly essential to handle oil seals carefully, in order to protect their lips against damage. For instance, winding the wire of a tag around an oil seal is a bad practice and should never be attempted.

Oil the seal just before forcing it into the bore at the time of installing it, or the seal might become scarred due to the friction of dry rubbing faces during initial operation.

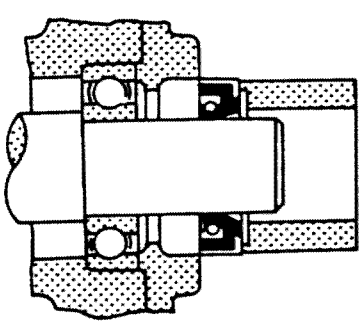
Use a guide to slip the seal into bore when installing it, as shown in Fig. A. If such a guide is not available, prepare a makeshift guide with a sheet of brass, as shown in Fig. B. Use of the guide is particularly necessary where the shaft has a keyway or a



A



B



C

shoulder.

(3) Fig. C illustrates the proper way of forcing the oil seal into the bore. Note that an adapter is used to apply pressure uniformly to the end face of the seal. The forcing adapter should be 0.5-1 mm (0.0197 – 0.039") smaller in diameter than the bore, and its free end should be shaped to take blows from a mallet or hammer. The surface of the shaft, upon which the seal is mounted, must be smooth and free of any scratch mark.

INSTRUCTIONS FOR HANDLING SNAP RINGS

(1) In handling a snap ring, be careful not to twist it nor to deform its corners and ends. Try to preserve its springiness: never expand and contract it in rapid succession. After fitting it to the shaft, check to be sure the ring is properly seated.

(2) Always use the ring expander in removing and installing snap rings.

INSTRUCTIONS FOR HANDLING GASKETS AND PACKINGS

(1) A copper packing removed from the machine should not be re-used. However, a packing of this type, found to be in good condition after it is annealed, may be re-used.

(2) Sealing sheets, packings, gaskets and the like are not to be re-used.

(3) Leather packings, before installation, should be soaked in oil so that they will become pliable.

(4) Protect the surfaces of "O" rings and "V" packings against damage. Winding wires directly around them is a bad practice.

(5) A gasket should be fitted at the time of re-assembling, with its both surfaces coated with an adhesive compound.

WEIGHTS OF MAJOR ASSEMBLIES

Unit: kg (lb)

Operating weight	13300 (29,320)
Engine assembly	1010 (2,227)
Fuel tank (filled up to level)	300 (661)
Radiator	130 (287)
Battery	61 (134)
Torque converter	140 (309)
Torqflow transmission	480 (1,058)
Final drive case	55 (121)
Sprocket	78 (172)
Final drive gear and hub	65 (143)
Steering clutch	70 (154)
Steering clutch case and main frame	1080 (2,381)
Brake (excl. brack band, each)	35 (77)
Bevel gear and bevel gear shaft	45 (99)
Undercarriage (excl. shoes, each)	1130 (2,491)
Track frame	420 (926)
Idler cushion	140 (309)
Front idler	170 (375)
Carrier roller	38 (84)
Track roller	48 (106)
Track (each)	950 (2,094)
Equalizer bar	120 (265)
Hydraulic oil tank (w/control valve)	155 (342)
Lift cylinder	87 (192)
Dump cylinder	61 (134)
Bucket	920 (2,028)
Bucket link	1100 (2,425)
Side frame	600 (1,323)

TORQUE LIMIT CHART

Nominal Size mm (in)	Pitch mm (in)	Torque kg.m (ft.lb)
6 (0.236)	1 (0.039)	1.0 to 1.5 (7 to 11)
8 (0.314)	1.25 (0.049)	2.5 to 3.5 (19 to 25)
10 (0.394)	1.5 (0.059)	5.5 to 7.5 (40 to 54)
	1.25 (0.049)	
12 (0.472)	1.75 (0.069)	9.5 to 12.5 (69 to 90)
	1.5 (0.059)	11.0 to 14.5 (80 to 105)
14 (0.551)	2 (0.079)	15.0 to 20.0 (108 to 145)
	1.5 (0.059)	17.0 to 22.5 (123 to 163)
16 (0.630)	2 (0.079)	23.5 to 31.5 (170 to 228)
	1.5 (0.059)	25.5 to 34.5 (184 to 250)
18 (0.709)	2.5 (0.098)	32.5 to 43.5 (235 to 315)
	1.5 (0.059)	38.5 to 52.0 (278 to 376)
20 (0.787)	2.5 (0.098)	45.5 to 62.0 (329 to 448)
	1.5 (0.059)	53.5 to 72.5 (387 to 524)
22 (0.866)	2.5 (0.098)	64.5 to 84.5 (467 to 611)
	1.5 (0.059)	71.0 to 96.0 (518 to 694)
24 (0.945)	3 (0.118)	79.0 to 105 (571 to 759)
	1.5 (0.059)	94.0 to 125 (680 to 964)
27 (1.063)	3 (0.118)	110 to 150 (796 to 1,085)
30 (1.181)		145 to 195 (1,049 to 1,410)
33 (1.299)		190 to 250 (1,374 to 1,808)
36 (1,417)		230 to 310 (1,664 to 2,242)

ENGINE

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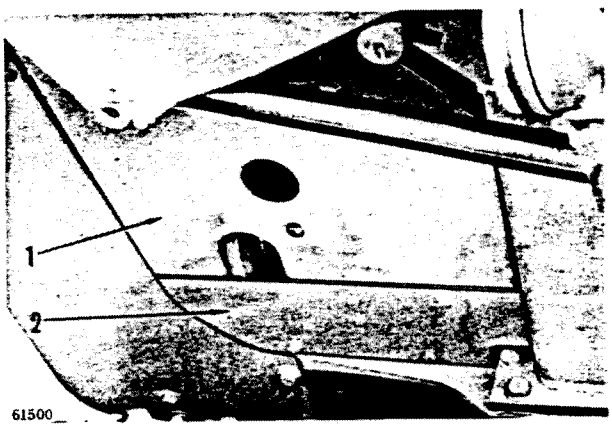
ENGINE

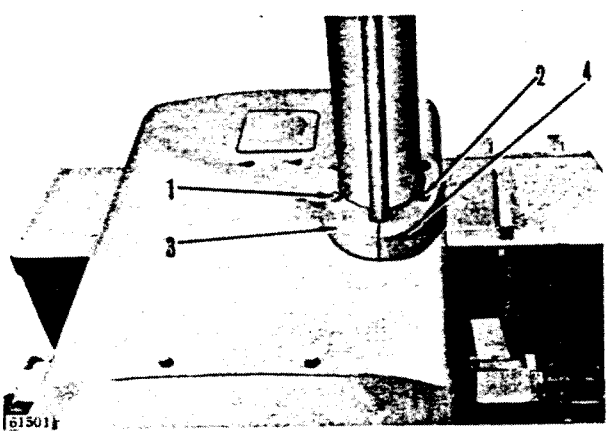
RADIATOR

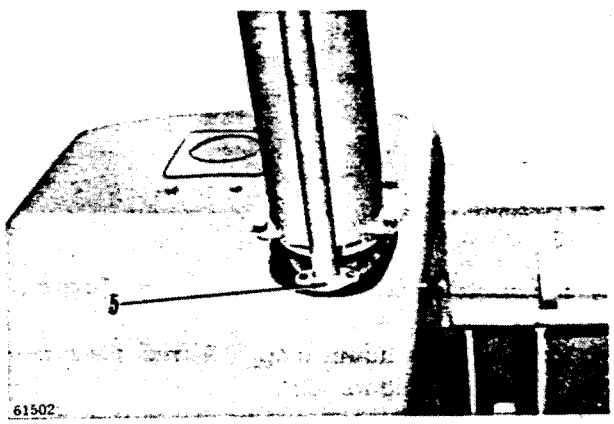
REMOVAL

(1) Remove side cover (1) and (2).

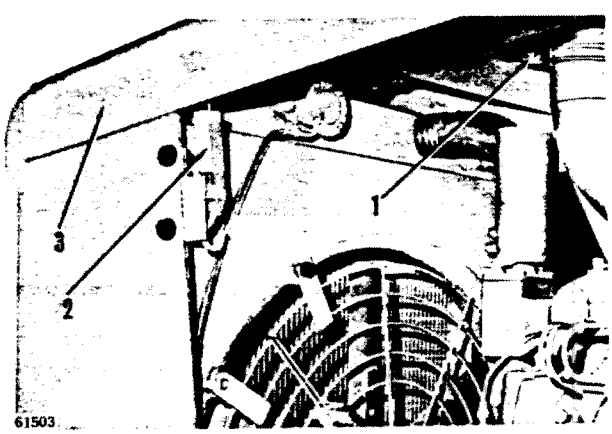


(2) Loosen off the bolt (1) and (2) then remove the cover (3) (4), and disconnect the flange (5).



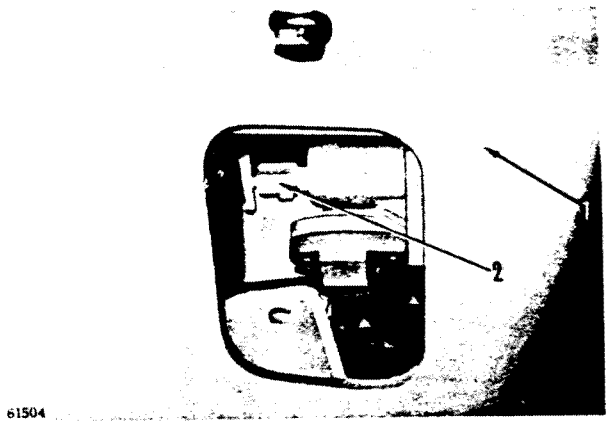


(3) Loosen the pipe clip (1) and take the exhaust pipe. Back off the bolts and remove the bonnet catch (2) on each side and take off the bonnet (3).



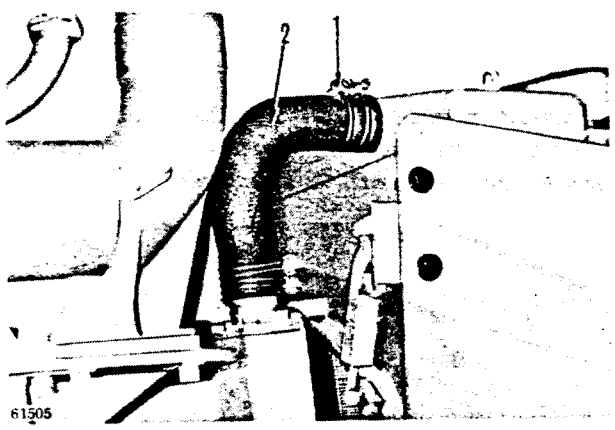
REMOVAL

(4) Remove cover from front guard (1). Drain radiator by opening the cock (2). Take down front guard (1).

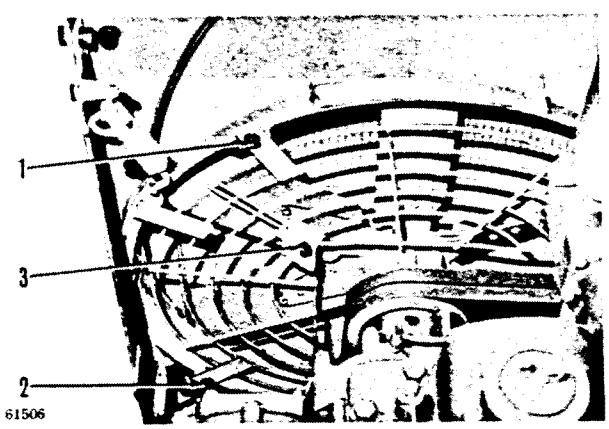


(5) Remove drain cock under radiator.

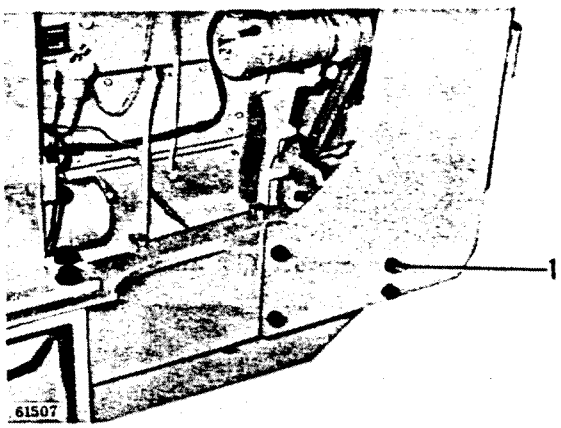
(6) Loosen the hose clip (1) and disconnect rubber hose (2).

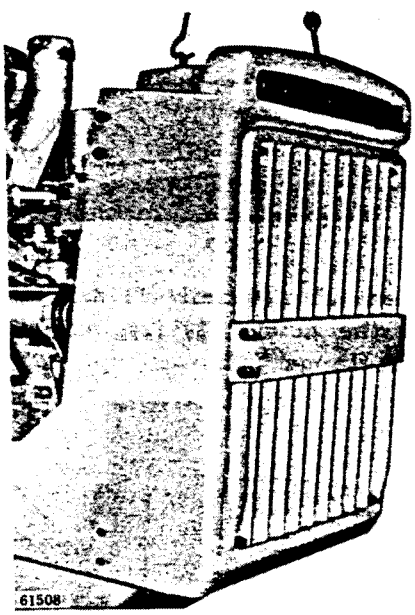


(7) Loosen the bolts (1) (2) and remove fan guard (3).



(8) Loosen the bolts (1), and lift radiator assembly up and out.





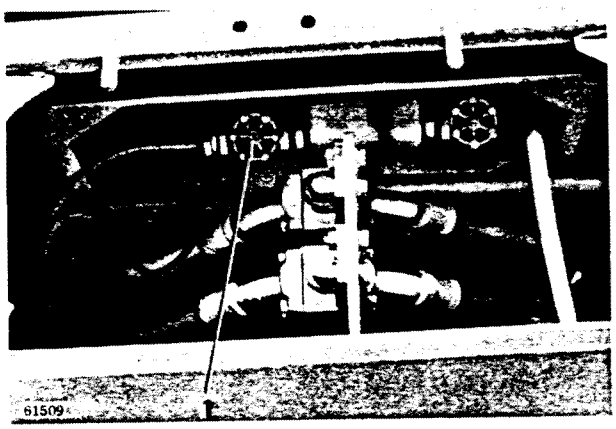
INSTALLATION

(1) Install the radiator assembly to the main frame.
(2) Attach the fan shrouds to the radiator.
(3) Connect the drain pipe the bottom of radiator.
(4) Clamp the cooling water line (hose) on the radiator.
(5) Install the front guard.
(6) Close the drain valve and fill the radiator with cooling water uniformly.
(7) Install the bonnet.
(8) Install the exhaust pipe into place, then tighten and lock the pipe band.
(9) Connect the flange.
(10) Install the exhaust pipe cover.
(11) Install the side cover on each side.
(12) Start the engine and let the engine idle for ten minutes.
During this idling, take the safety pin out of place, then lower the lift arm all the way down.
(13) Stop the engine and refill the radiator up to the specified level.

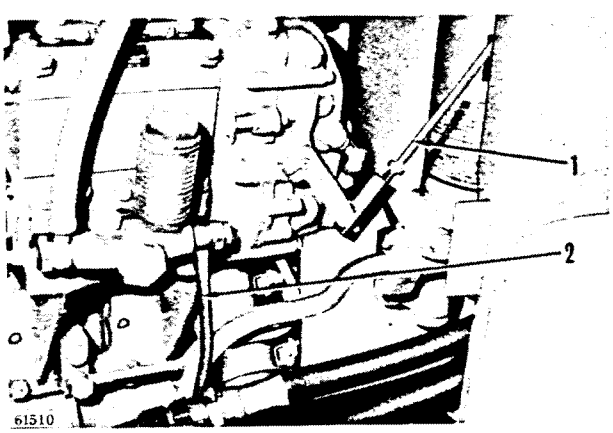
ENGINE

REMOVAL (Including the Torque Converter)

(1) Close fuel valve (1)



(2) Remove fuel control lever rod (1).
Disconnect fuel tube (2).

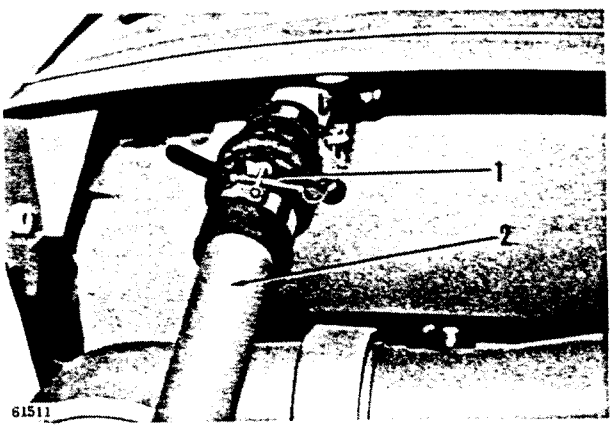


(3) Disconnect the flange and take the exhaust pipe. Remove the bonnet catch on each side and take off the bonnet.
Disconnect the cooling water line (hose). Take down front guard.
(Refer to RADIATOR removal procedure.)

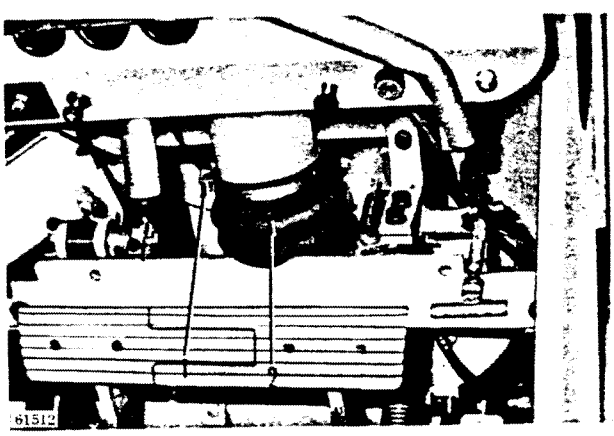
(4) Disconnect electrical wires from the engine.
(Refer to SIDE FRAME removal procedure.)

(5) Disconnect oil pipings from torque converter.
(Refer to TORQUE CONVERTER removal procedure.)

(6) Loosen the pipe band (1) and disconnect the pipe (2).

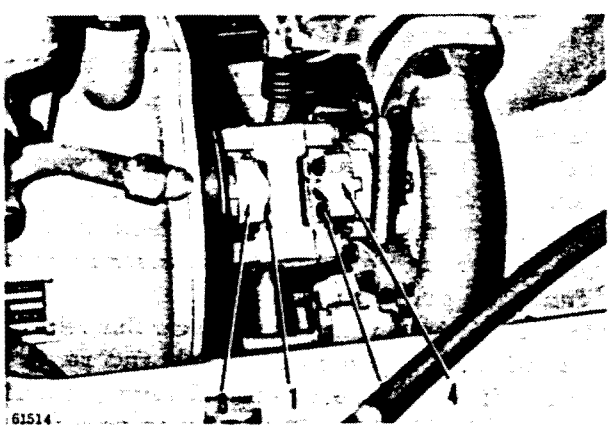


(7) Loosen the pipe band (1) and disconnect the hose (2).

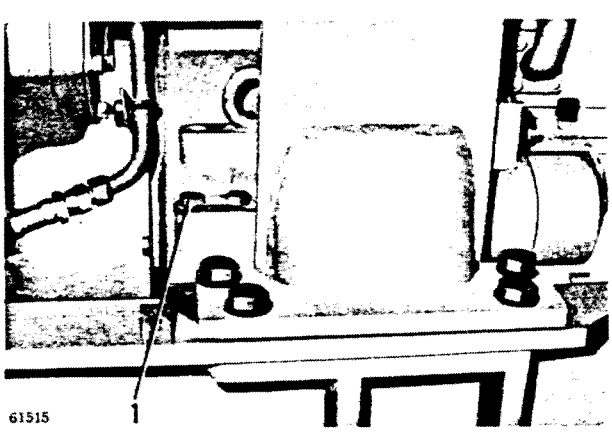


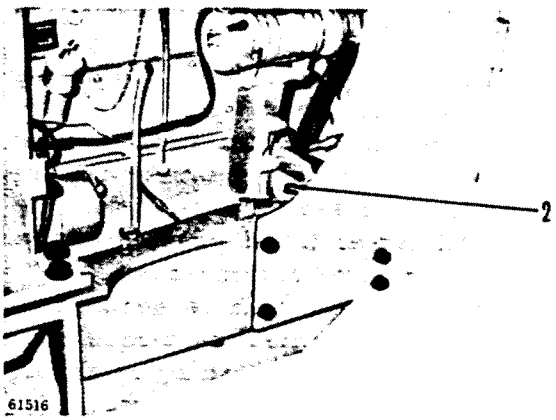
(8) Disconnect the hose (1).
Loosen band, detach the flange (2), and remove air filter (3).

(9) Loosen the bolts (1) (2), draw out bearing (3) (4), and remove the joint assembly.



(10) Remove engine mounting bolts (1) (2).





(11) Take a hitch on the engine by passing the sling under engine cylinder head and torque converter, and remove the engine unit by lifting it with a hoist.

NOTES:

1) Before starting to lift the engine, mark sure there are sufficient clearances around the engine, and take care not to bounce the engine against any other part. Lift the engine very slowly.
2) Use a wire sling, free from kinks or breakage of any strand.
3) Recover the adjusting shims from engine mounts after the engine is taken down, and set them aside for re-use, with an identifying mark provided on each for the mount from which it was recovered.
4) Rest the removed engine securely on blocks laid out on the floor, and take the sling off after making sure the engine is stable on the blocks.

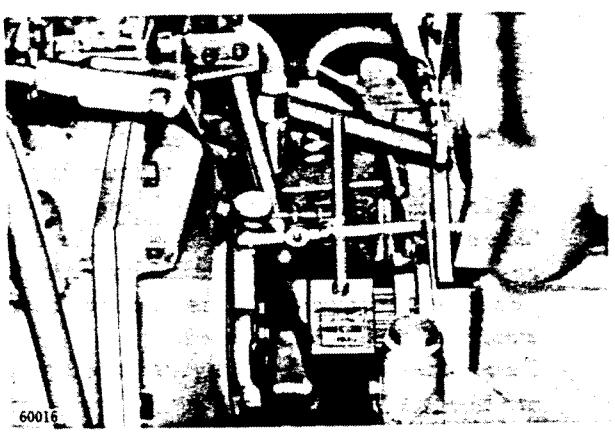
INSTALLATION

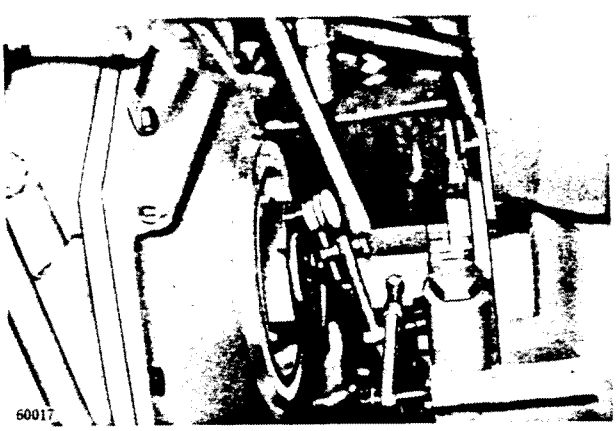
(1) Be sure to restore the adjusting shims to the engine mounts.

Secure the mounts tentatively to the frame, and check their geometrical arrangement to be sure, roughly, that the engine will center itself properly when it is positioned to the mounts.

(2) After the engine unit is secured to the main frame, center the torque converter to the transmission by referring to the transmission main shaft.

Attach a dial indicator to the torque converter shaft with the spindle on the transmission shaft flange. Then, turn the transmission shaft to center the engine. The engine may be considered to be properly centered if the two run-outs measured are within 0.25 mm (0.00984"): if not, re-position the engine in place by increasing or decreasing the adjusting shims used in engine mounts.





(3) Tighten the engine mount bolts equally and gradually, passing the wrench from one mount to another and completing the tightening by torquing each bolt up to 25-28 kg-m (180-202 ft-lb).

Before tightening, these bolts should be applied with "Loctite" (bonding compound).

(4) Install the universal joint.

(5) Install the piping, wiring and rods relative to the engine.

(6) Attach the clamps on the cooling water line (hose).

(7) Install the air filter and connect the air filter hose and dust indicator hose.

(8) Connect the piping between the air cleaner and the exhaust pipe.

(9) Connect the fuel tube.

(10) Install the bonnet and exhaust pipe.

(11) Install the front guard.

(12) Open the fuel valve.

(13) Fill the hydraulic tank and torque converter with oil up to their respective specified level.

(14) Fill the radiator with cooling water uniformly.

(15) Start the engine and check to see if the torque converter and instruments function properly.

(16) Stop the engine and check the levels of oil in the hydraulic tank and radiator. If below the specified level, refill the tank or the radiator up to the specified level.

TORQUE CONVERTER

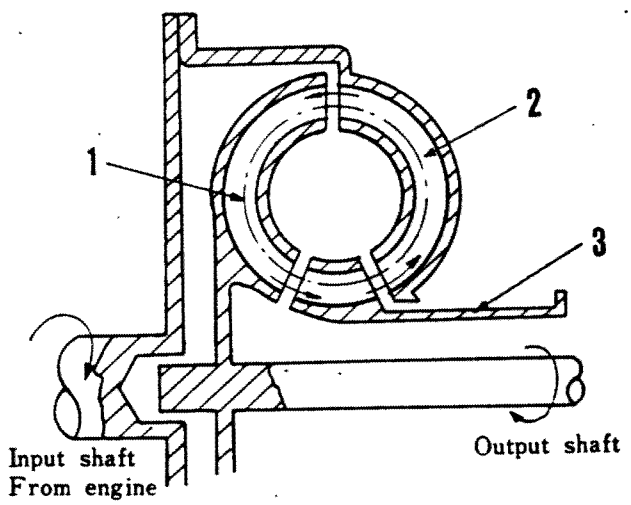
INDEX

TORQUE CONVERTER

DESCRIPTION

The torque converter has three kinds of element: a pump (impeller), a turbine (runner) and two stators (reactor).

These elements are vane-wheels rotating around a common axis and housed in the converter case. The forward end of turbine shaft is piloted by the flywheel, and the converter case is supported by the stator shaft.



Torque Converter

1. Turbine
2. Pump
3. Stator

The oil pump drive gear (for driving transmission oil pump, steering oil pump and hydraulic oil pump) is driven from the main drive gear through the idle gear. The scavenging pump drive gear is directly driven by the main drive gear. Drive from the engine is transmitted to the torque converter directly through the flywheel. Since the driving plate is engaged with the flywheel through the inner gear teeth of the flywheel, the drive case and impeller rotate together. The motion of impeller is such that it throws oil against the turbine, thereby transmitting power to turbine hydraulically.

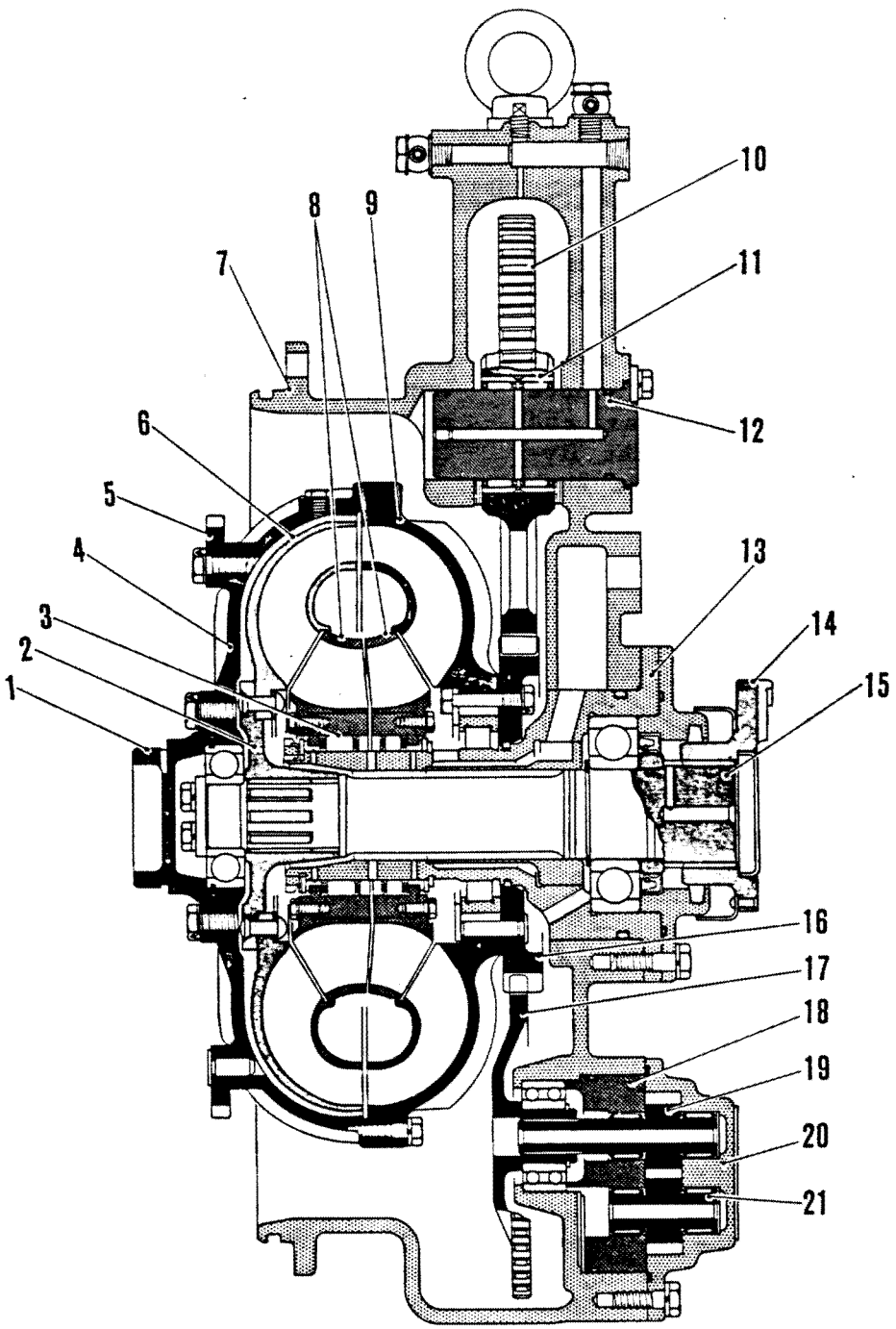
Oil flowing out of turbine vanes strikes the vanes of primary and secondary stators. The stators redirect the oil into the inlet side of impeller in a direction assisting the rotation of impeller. The stators are mounted on overrunning clutches (free-wheel mechanism), such that these members run only in one direction with respect to the shaft. When higher speeds are reached, the stators begin to free-wheel and thereby cease their redirecting action.

Oil pump and Oil Piping

The oil pump draws oil from the pump provided in the powershift (hydraulic shift) transmission case and forces the oil through the filter to supply it to the transmission control valve. This valve is a means of hydraulically selecting the gear ratio for the desired speed. The oil used in this control is returned to the torque converter.

The oil leaving the torque converter is cooled by the oil cooler. Part of the cooled oil goes to the transmission and the remainder to the driving shafts of various oil pumps for lubricating their shafts. The oil discharged by the torque converter scavenging pump is returned to the torqflow transmission oil reservoir.

DESCRIPTION



Sectional View of Torque Converter

1. Pilot
2. Hub
3. Freewheel
4. Drive case
5. Drive plate
6. Turbine
7. Torque converter case
8. Stator
9. Pump
10. Idler gear
11. Needle roller bearing
12. Idler gear shaft
13. Stator shaft
14. Coupling
15. Turbine shaft
16. Main drive gear pump
17. Scavenging pump drive gear
18. Pump case cover
19. Scavenging pump drive gear
20. Pump case
21. Scavenging pump driven gear

REMOVAL

(1) Lift the machine off the floor by putting 3-40 cm (11.8-15.7") high blocks under the tracks.

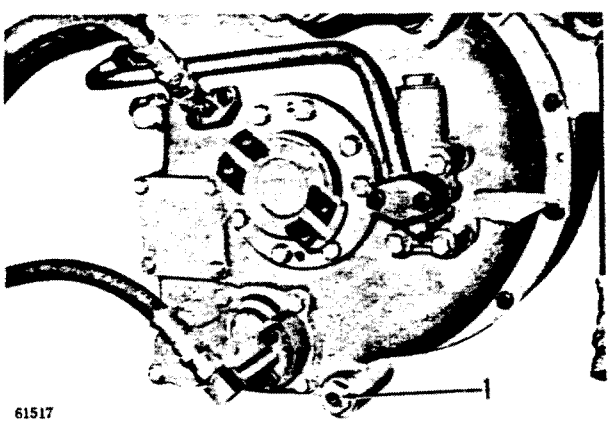
(2) Drain hydraulic oil tank by loosening its drain plug.
(Refer to CONTROL VALVE removal procedure.)

(3) Remove all floor plates.
(Refer to TORQFLOW TRANSMISSION removal procedure.)

(4) Remove side cover.
(Refer to ENGINE removal procedure.)

(5) Remove underguard.
(Refer to ENGINE removal procedure.)

(6) Drain torque converter by loosening plug (1).



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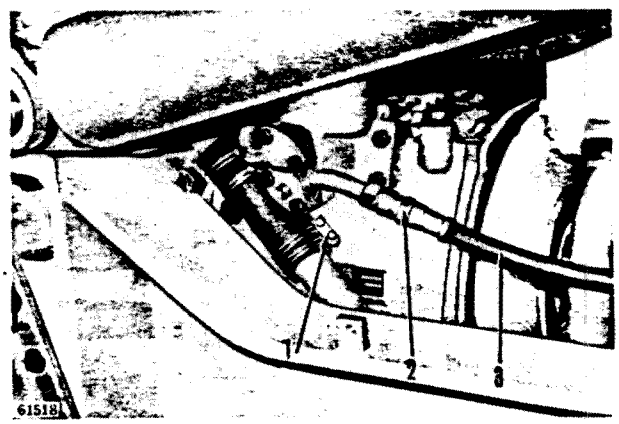
(7) Disconnect from the converter the oil pipes leading to and from oil pump.
1) Loosen pipe clip (1).
2) Remove nipple (2) and disconnect rubber hose (3).



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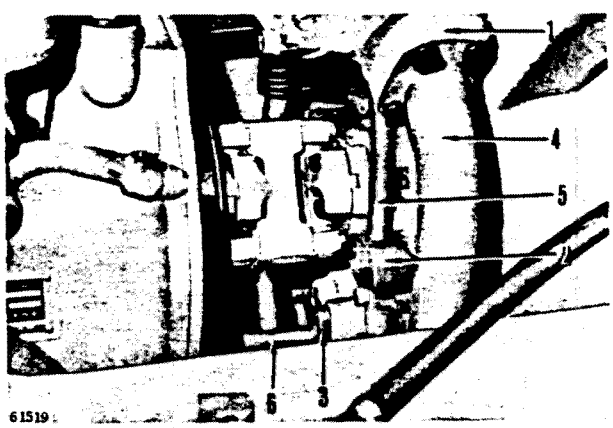
3) Detach flange (1) (2) (3) and disconnect pipes (4) (5) (6).



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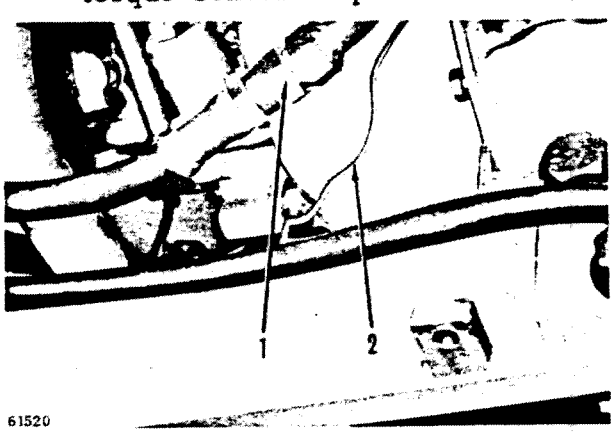
4) Loosen nipple (1) and disconnect torque converter pressure tube (2).



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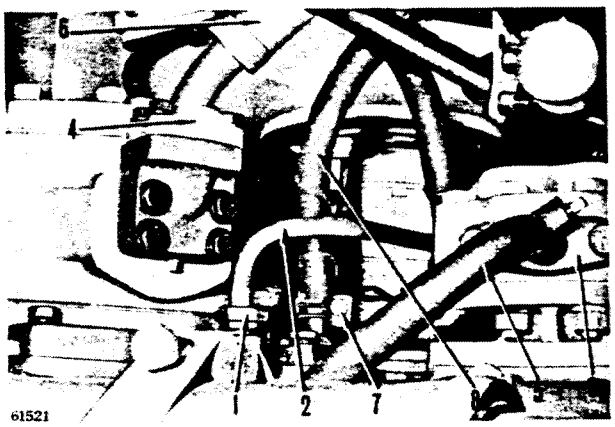
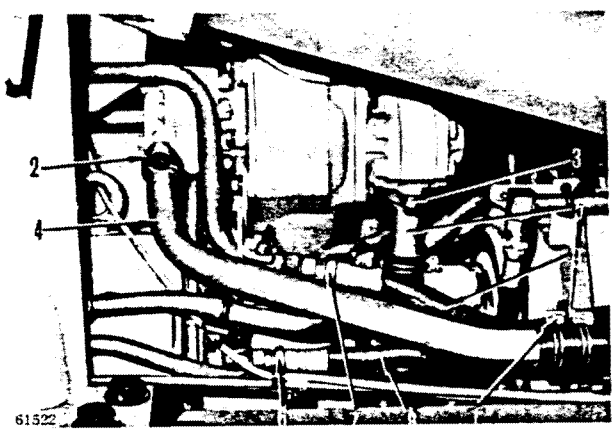
REMOVAL

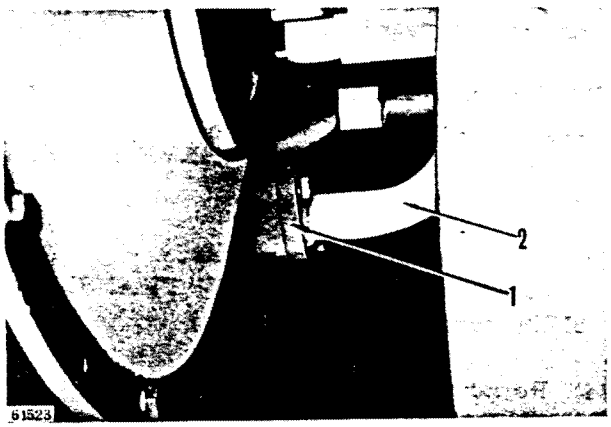
5) Loosen nipple (1) and disconnect pipe (2).
6) Detach flange (3) (4) and disconnect pipe (5) and rubber hose (6).
7) Loosen pipe clip (7) and disconnect rubber hose (8).



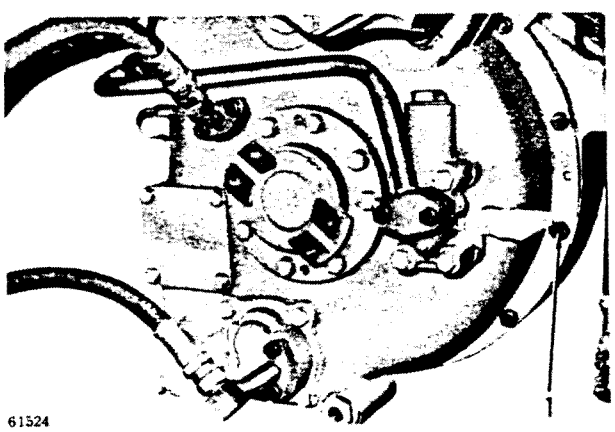
8) Loosen pipe clip (1).
Detach flange (2) (3) and disconnect pipes (4) (5).
9) Loosen nipple (6) (7) and disconnect rubber hose (8) (9).



10) Detach flange (1) and disconnect pipe (2) from the torqflow transmission.

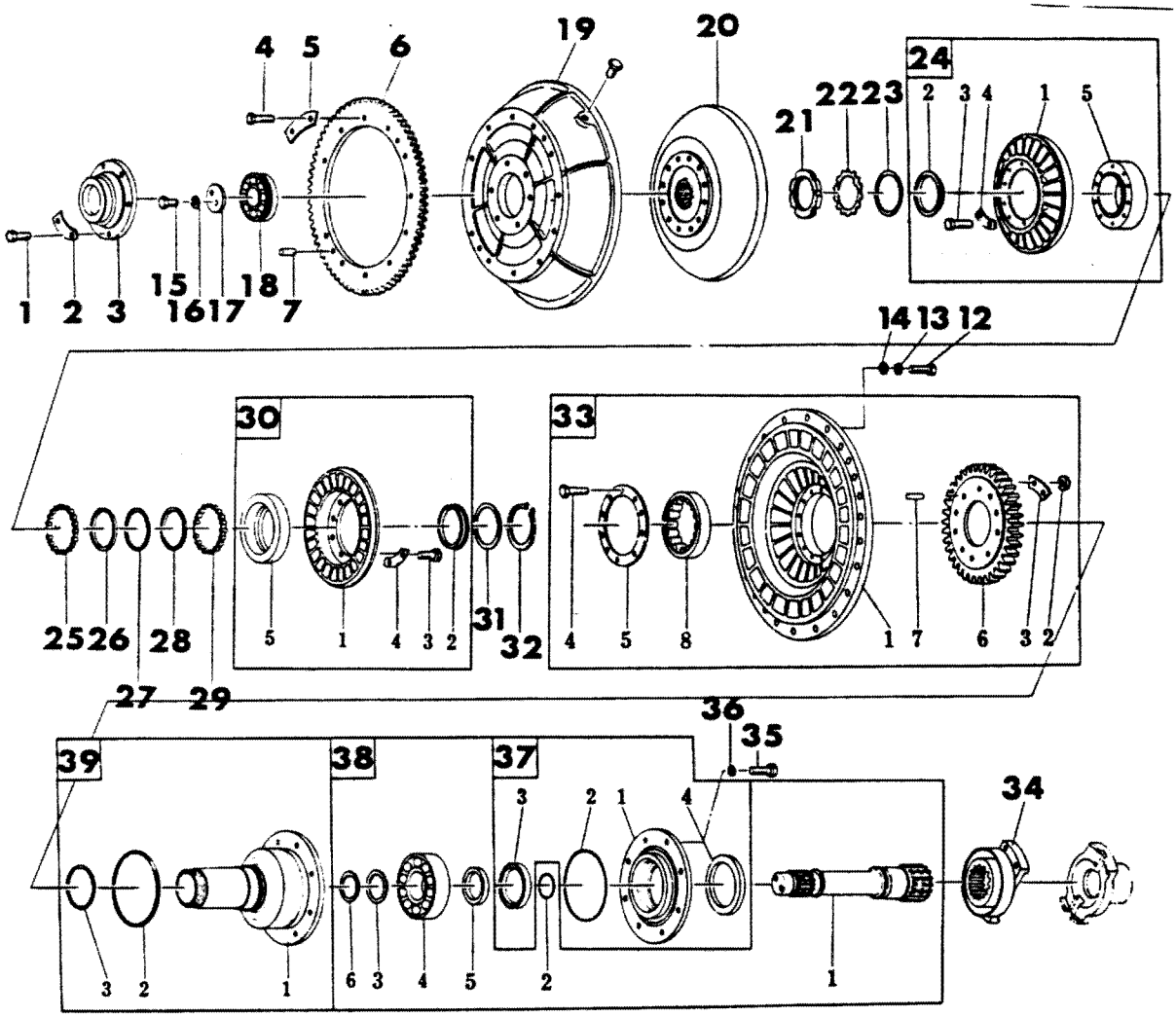


(8) Remove the universal joint between torque converter and torqflow transmission.
(9) Loosen bolts (1) securing torque converter in place. (Have the weight of the converter take up with a lifting sling so that removal of bolts (1) will free the converter in floating condition.)
Detach torque converter from the engine.



(10) Lower torque converter in suspended condition to the floor directly under the chassis.

DISASSEMBLING



1. Bolt
2. Lock washer
3. Pilot
4. Bolt
5. Lock washer
6. Driving plate
7. Dowel pin
8. Bolt
9. Spring washer
10. Cover
11. Gasket
12. Bolt
13. Spring washer
14. Washer
15. Bolt
16. Spring washer
17. Retainer
18. Ball bearing
19. Drive case
20. Turbine
21. Lock nut
22. Lock washer
23. Side plate
24-1. First stator
24-2. Bush
24-3. Bolt
24-4. Lock washer
24-5. First outer race
25. First sprag
26. Bush
27. Center plate
28. Bush
29. Second sprag
30-1. Second stator
30-2. Bush
30-3. Bolt
30-4. Lock washer
30-5. Second outer race
31. Side plate
32. Snap ring
33-1. Pump
33-2. Nut
33-3. Lock washer
33-4. Bolt
33-5. Side plate
33-6. Drive gear
33-7. Dowel pin
33-8. Roller bearing
34. Coupling
35. Bolt
36. Spring washer
37-1. Seal retainer
37-2. "O" ring
37-3. Oil seal
37-4. Felt packing
38-1. Turbine shaft
38-2. "O" ring
38-3. Snap ring
38-4. Ball bearing
38-5. Seal seat
38-6. Seal ring
39-1. Stator shaft
39-2. "O" ring
39-3. Seal ring

Parts are enumerated in the sequence of disassembling.

SPECIAL DISASSEMBLING INSTRUCTIONS

(1) Remove the bolts (8) (9), spring washers (1), cover (10), and gasket (11) from the exterior of the torque converter housing. Rotate the turbine and remove the bolts (12), one after another, until all bolts are removed.

(2) Remove the first stator (24) by drawing it out with both hands while turning it gently clockwise. The second stator (26) is to be removed similarily.

It is not necessary to remove the stators unless some internal trouble has developed.

(3) Seal ring (29-2) is located on that part of the turbine shaft (29-11) into which the seal seat is inserted. This seal is not to be disassembled unless absolutely necessary.

(4) Seal ring (32-1) on the stator shaft (32-6) should not be removed except where the ring has to be renewed.

ASSEMBLING

(1) Assemble the stator shaft (32) and the turbine shaft (29) together, and secure the assembled until to the torque converter case with the bolts (30).

Before mounting the coupling flange (29-9), be sure to have splines washed thoroughly clean and grease the splines fully.

(2) Fit the pump (28) to the stator shaft properly, and secure with the snap ring (27).

(3) Fit the stators (24) (26) to the stator shaft properly. After mounting the stators, check to be sure the stators can be rotated in clockwise direction but not in counterclockwise direction.

This check is highly important and, in no case, should be neglected. Sprags are provided with "O" marks. When fitting the sprag to the stator, be sure to position it so as to bring its zero mark to the matched mark. Failure to follow this instruction will result in unsatisfactory converter performance.

(4) Install the side plate (23), lock washer (22) and tighten the parts with the nuts (21) securely.

(5) Re-mount the turbine (20) in place.

Tighten the drive case (19) and the pump (28) with the mounting bolts (12) through the hole.

(6) Install the bearing (18) and bearing retainer (17). Attach the drive plate (6) and secure the pilot (3) to the drive case.

NOTE:

Packings, seal rings and O-rings must be handled with care so as not to damage them in any manner. Use of replacement parts for these sealing parts at the time of assembling is preferable to re-use of removed parts.

To mount the assembled torque converter, reverse the removal procedure.

After the converter is installed in place, be sure to fill it with oil.

INSTALLATION

(1) Take up the weight of the torque converter from the underside of the machine with the use of an overhead crane, and install the converter on the flywheel case securely. Before tightening the mounting bolts, make sure the converter pilot and the drive plate are securely positioned in the flywheel.
(2) Align the torque converter shaft and the torqflow transmission shaft by referring to the engine centering procedure outlined in the preceeding paragraph.
(3) Mount the universal joint securely in place.
(4) Connect all pipings to the torque converter and the pump.
(5) Mount the under-guard on the chassis properly.
(6) Install all floor plates.
(7) Fill the hydraulic oil tank with the hydraulic oil to the specified level.

Run the engine at an idling speed for a while. Stop the engine, and check the level of oil in the tank. If necessary, replenish the tank with oil to the specified level.

(8) Remove the blocks from under the tracks.

TORQFLOW TRANSMISSION

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TORQFLOW TRANSMISSION

The TORQFLOW transmission used in this machine comprises two groups of components: the power transmitting group through which the power output of the engine is conveyed to the range transmission for driving the bevel gear shaft, and the control valve group whose function is to control the multidisc clutches provided in the transmission.

In the following, the transmission will be described as consisting of those two groups.

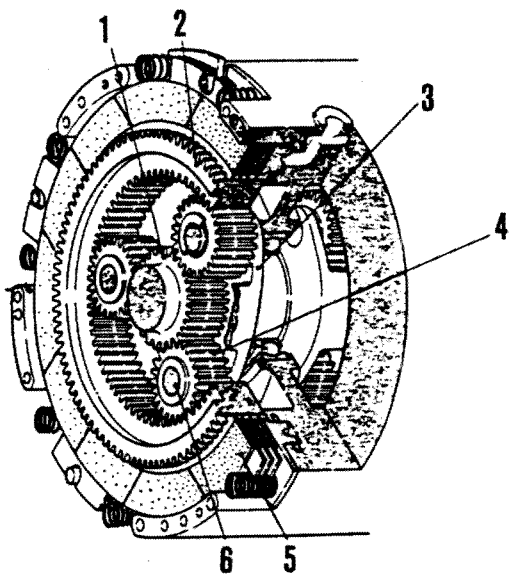
DESCRIPTION

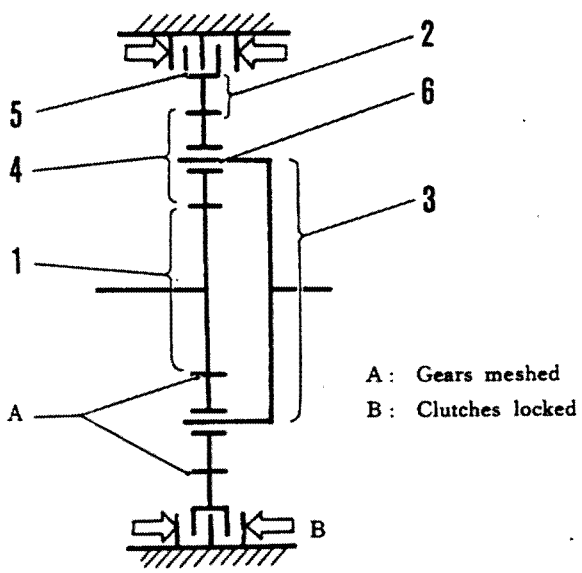
POWER TRANSMITTING GROUP

A. Operating Principle of the Planetary Gearing

Before attempting to understand the manner of operation of the TORQFLOW transmission, it may be in order to consider the basic principles involved in planetary gear drive. Refer to the accompanying sketch, in which a single system of planetary gear is represented by a graphic pattern and a cutaway view.

The system consists of 1) sun gear (the central gear rigidly mounted on the shaft), 2) ring gear (often called the internal gear ring – because it has teeth on its inner surface – and provided with teeth or serrations on the outer surface for engagement with the bore of a clutch





Planetary Gearing

1. Sun gear
2. Ring gear
3. Planetary carrier
4. Planetary pinion
5. Clutch disc
6. Planetary pinion shaft

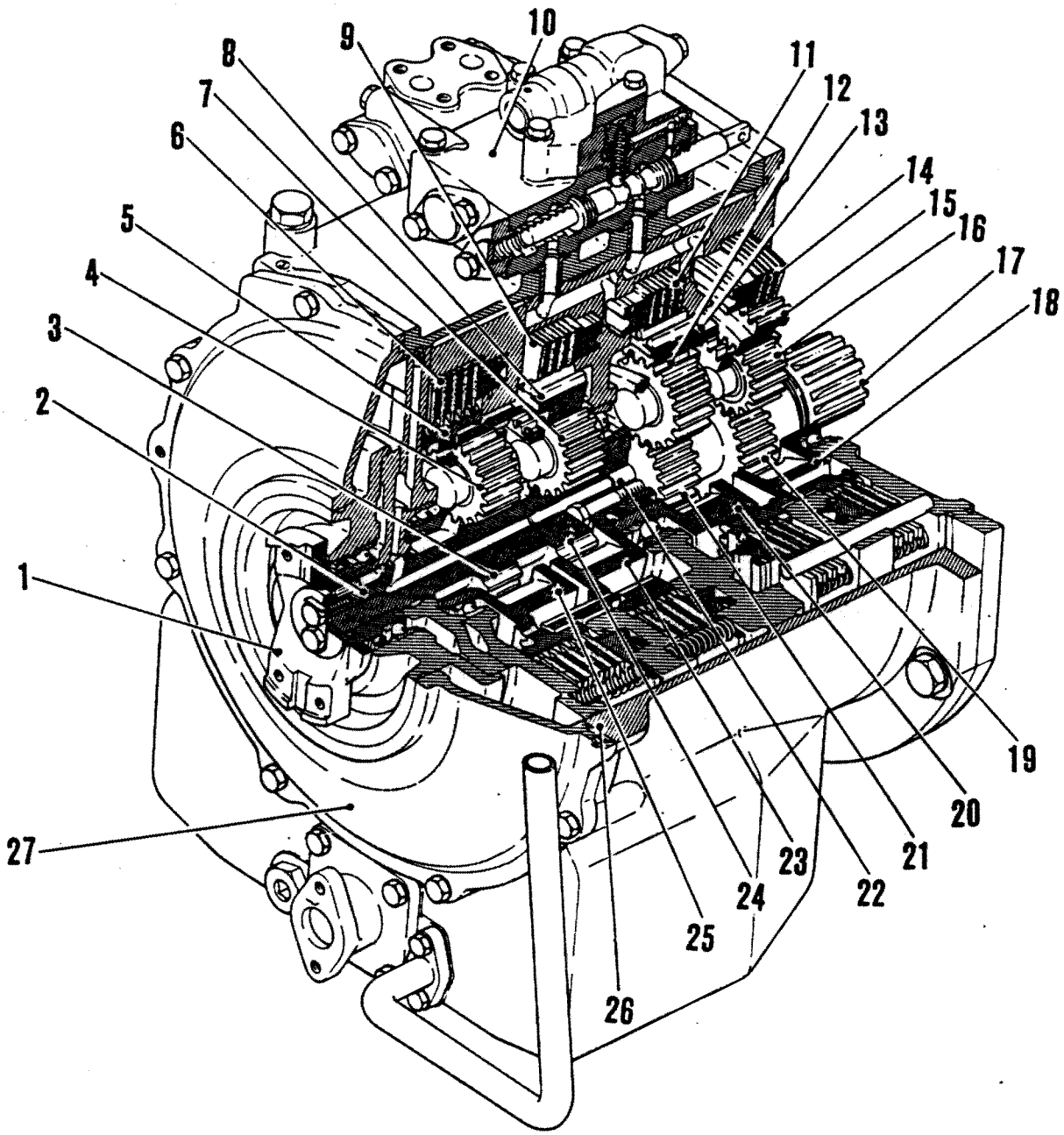
DESCRIPTION

lining), 3) planetary carrier (the disc integral with two or more shafts for carrying planetary pinions), 4) planetary pinions (each of which is mounted rotatably on the shaft and interposed between sun gear and ring gear), 5) clutch disc, and 6) planetary pinion shafts.

Suppose the sun gear is made to rotate in either direction, while both the ring gear and the planetary gear are held free: planetary carrier and ring gear will rotate in the same direction because of the planetary pinions being engaged with both. Suppose, just then, that a braking force is applied to ring gear to hold it standstill: this will cause planetary pinions to "walk around" inside the ring gear, making the planetary carrier to continue its rotation but with a speed determined by the number of teeth on ring gear and sun gear.

Speaking generally, three rotary elements are involved in the planetary gear system: namely, SUN GEAR, PLANETARY CARRIER and RING GEAR. (Planetary carrier is regarded as comprising the planetary pinions.) When any two of these are given rotary motions with given speeds, the rotating direction and speed of the remaining one become automatically determined. Here, rotating speed includes zero speed (0 rpm).

In the TORQFLOW transmission, four of such planetary gearing are used in combination to modify the torque converter output and thereby provide a variety of speed-torque-direction combinations.



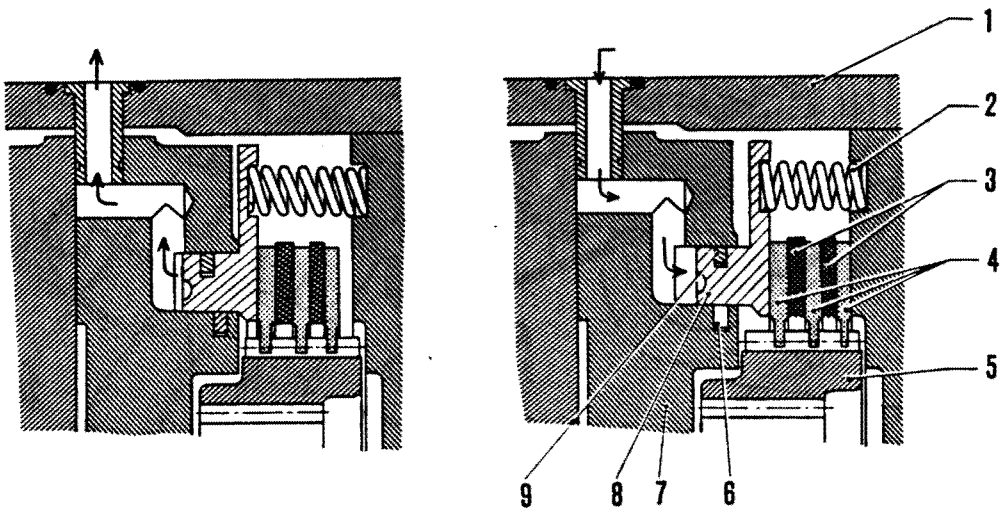
Partial Cutaway View of Torqflow Transmission

1. Universal joint coupling
2. Torqflow transmission shaft
3. No. 1 sun gear
4. No. 1 planetary gear
5. No. 1 ring gear
6. No. 1 clutch
7. No. 3 planetary gear
8. No. 2 ring gear
9. No. 2 clutch pack
10. Torqflow transmission control valve
11. No. 3 clutch pack
12. No. 3 planetary gear
13. No. 3 ring gear
14. No. 4 clutch pack
15. No. 4 ring gear
16. No. 4 planetary gear
17. Output shaft
18. No. 4 carrier
19. No. 4 sun gear
20. No. 3 carrier
21. No. 3 sun gear
22. Oil tube
23. No. 2 carrier
24. No. 2 sun gear
25. No. 1 carrier
26. Transmission case
27. Front cover

B. Construction and Function

A cross-section view of the first group (power transmitting group) is shown in the accompanying sketch above. A graphic representation of power train involved in this group is shown in next figure, together with a list of gear ratios and traveling speed ranges. For the purpose of illustration, the clutches and planetary gears are designated, starting from the input side, as No. 1, No. 2, No. 3 and No. 4. No. 1 and No. 2 clutches are directional clutches; and No. 3 and No. 4 clutches are speed clutches. Other designations of these clutches are: No. 1 clutch is REVERSE (R) clutch; No. 2, FORWARD (F) clutch; No. 3, SECOND (2nd) clutch; and No. 4, FIRST (1st) clutch. Thus, to give a certain speed-torque-direction combination to the output shaft, it is necessary to engage one each of direction clutch and speed clutch. There are a total of four possible combinations for either setting (HIGH or LOW)

SPEED		CLUTCH COMBINATION
Forward	1st	2 – 4
	2nd	2 – 3
Reverse	1st	1 – 4
	2nd	1 – 3



Sectional Views of Clutch Pack

1. Transmission case
2. Return spring
3. Plates
4. Discs
5. Ring gear
6. Seal ring
7. Housing
8. Piston
9. Seal ring

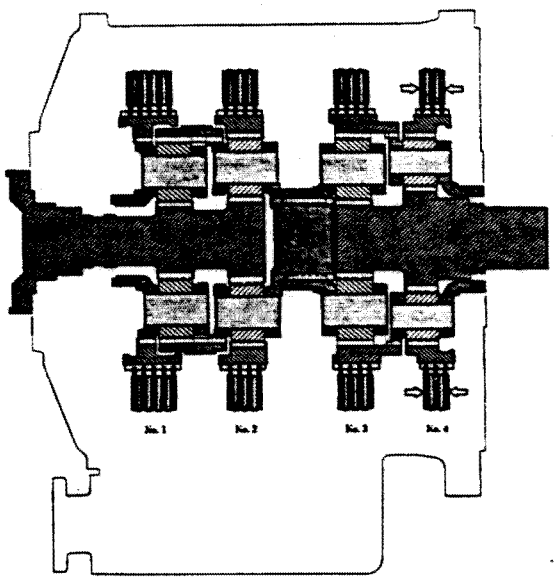
of the range transmission, as indicated by the transmission reduction ratios listed in Table above.

Refer to Figs. above, wherein a cross section of the clutch is shown in illustrate the clutch operation. Most of the parts shown in this cross-section view are annular (ring-like) and surround the ring gear of planetary gearing. A stack of alternate layers of clutch linings (engaged with the periphery of the ring gear) and clutch plates is sandwiched between the piston and the solid wall. The cavity or chamber next to and outside of the piston leads to the control valve. The piston is loaded with a number of compression coil springs, which push on the piston to keep the stack loose. As the transmission control valve is operated to admit hydraulic oil into the chamber, the piston as hydraulically forced to compress the coil springs and press the stack of linings and plates against the solid wall, thus preventing the linings from sliding between the plates on account of the friction: as a result, the stack as a whole stays rigid under this condition and holds the ring gear immovable. When the oil pressure in the chamber is relieved, the coil springs move the piston back and away from the stack, thus freeing the ring gear.

C. Selective Paths of Power Through Transmission

(1) Neutral

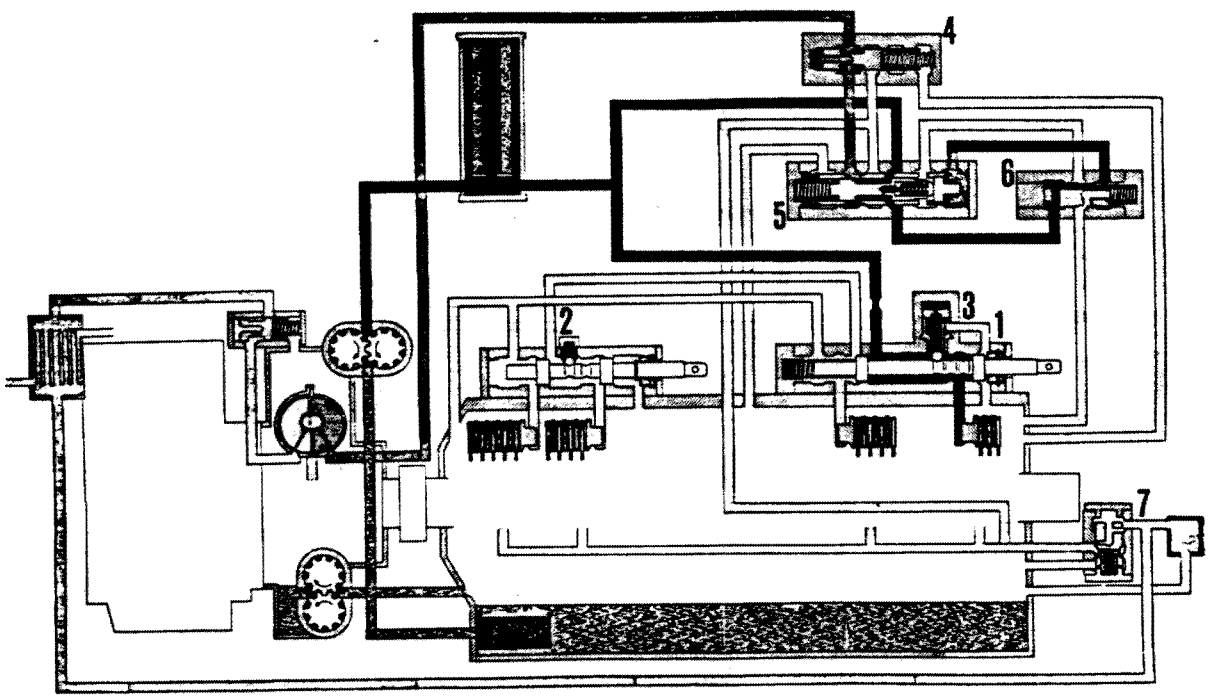
In a TORQFLOW transmission in neutral condition, No. 4 (FIRST)clutch alone is in engaged condition. With the engine running, and only No. 4 clutch kept engaged, No. 4 planetary pinions may be merely revolving around a standstill sun gear on the output shaft.



Neutral

(2) Forward First

Figure shows the flow of power through the transmission for forward-first combination. Note that No. 2 clutch and No. 4 clutch are in engagement. Power flows from input shaft to No. 2 sun gear and pinions. Since No. 2 ring gear is held immovable by its clutch, these pinions walk around inside the ring gear, making No. 2 carrier rotate in the same direction as input shaft but with a reduced speed.



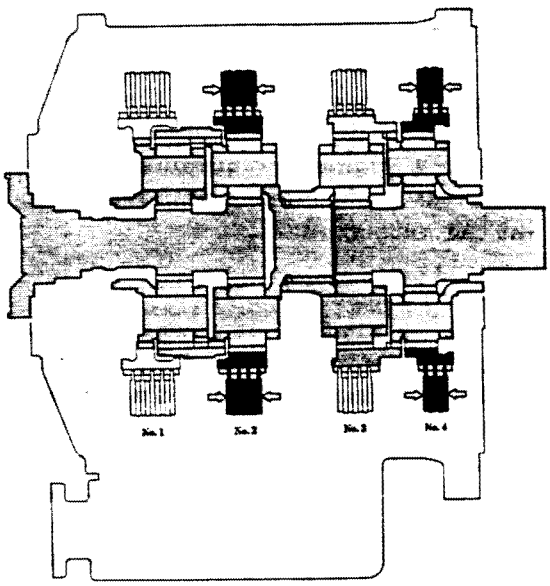
Neutral - Engine Running with Vehicle Stationary

1. Speed Valve
2. Directional Valve
3. Safety Valve
4. Torque Converter Relief Valve
5. Modulation Relief Valve
6. Quick Return Valve
7. Transmission Lubricating Relief Valve

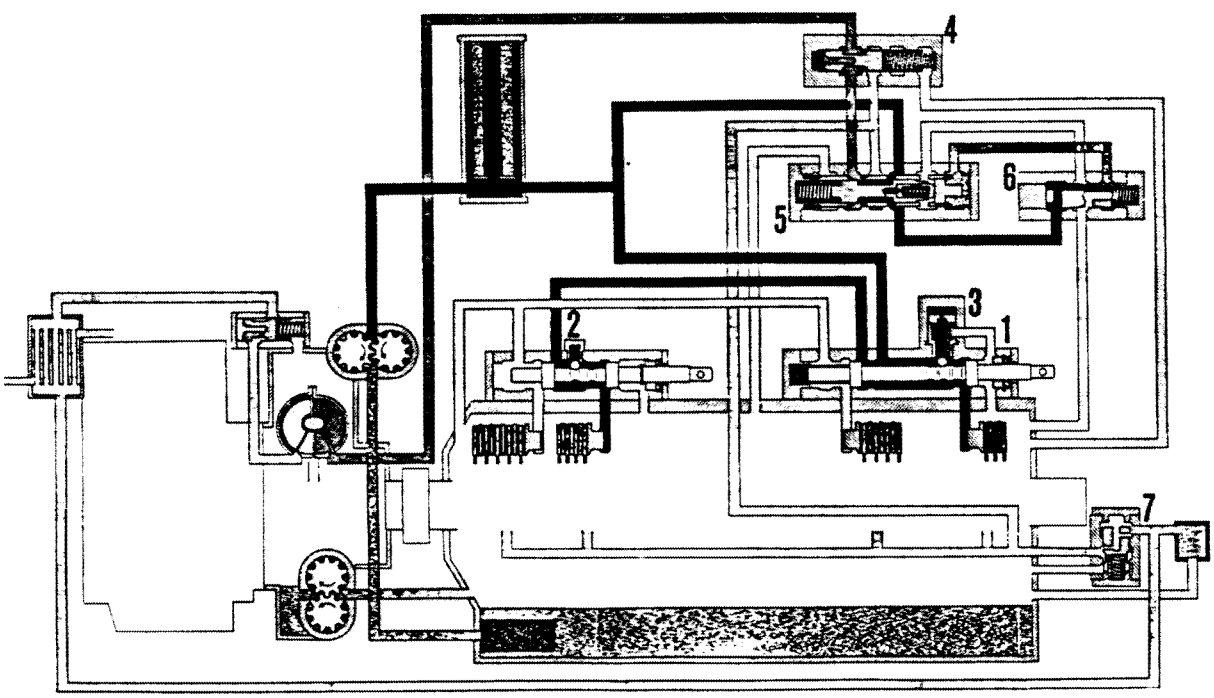
Pressure oil
Lubricating oil
Torque converter oil (relief)
Drain oil
Back pressure (1)
Non-pressure oil
Back pressure (2)

DESCRIPTION

No. 2 carrier is permanently connected with No. 3 carrier through spline engagement, and No. 3 ring gear is similarly connected with No. 4 carrier through serration engagement. Note that there is a looped path of power flow, formed between No. 3 and No. 4 planetary gears: No. 3 carrier – No. 3 pinions – No. 3 sun gear – output shaft – No. 4 sun gear – No. 4 pinions – No. 4 carrier – No. 3 ring gear – and back to No. 3 carrier. Since No. 4 ring gear, in the present case, is fixed, the rotation of No. 3 carrier will drive No. 3 sun gear and No. 4 carrier (through No. 3 ring gear, as No. 3 clutch is not engaged). No. 4 carrier, with its pinions, drives No. 4 sun gear and output shaft (because No. 4 ring gear is immovable). In other words, the flow of power from No. 3 carrier may be considered to divide into two paths – 1) No. 3 sun gear and output shaft, and 2) No. 4 carrier, No. 4



Forward 1st



Forward 1st - Engine Accelerated with Vehicle just About to Start Off

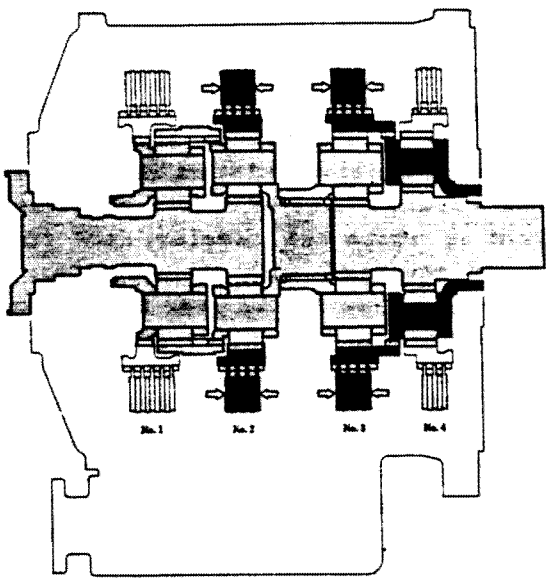
1. Speed Valve
2. Directional Valve
3. Safety Valve
4. Torque Converter Relief Valve
5. Modulation Relief Valve
6. Quick Return Valve
7. Transmission Lubricating Relief Valve

Pressure oil
Torque converter oil (relief)
Back pressure (1)
Back pressure (2)
Lubricating oil
Drain oil
Non-pressure oil

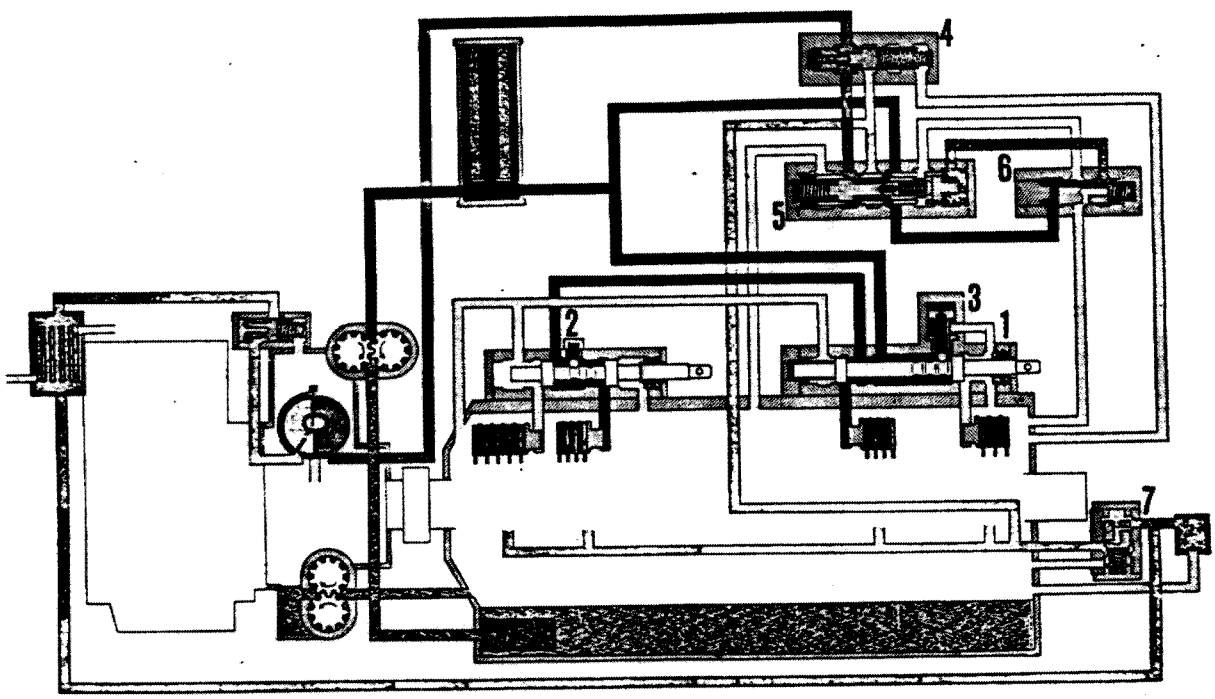
planetary pinions, No. 4 sun gear and output shaft – which join together in one shaft, the output shaft.

(3) Forward Second

Engaging the two clutches, No. 2 and No. 3, shafts the transmission into FORWARD SECOND position, as will be noted in the figure on the right. Power flows from input shaft to No. 2 sun gear and its planetary pinions. Since No. 2 ring gear is held immovable. No. 2 carrier causes No. 3 carrier to rotate, as in the case of FORWARD FIRST; but since No. 3 ring gear is held fixed, No. 3 carrier (by its pinions) drives only No. 3 sun gear and output shaft. In this case, the speed of output shaft, as referred to the speed of No. 3 carrier, is higher than when No. 3 carrier drives output shaft through two paths (as in the case of FORWARD FIRST).



Forward 2nd



Forward 2nd - Engine Accelerated with Vehicle Starting

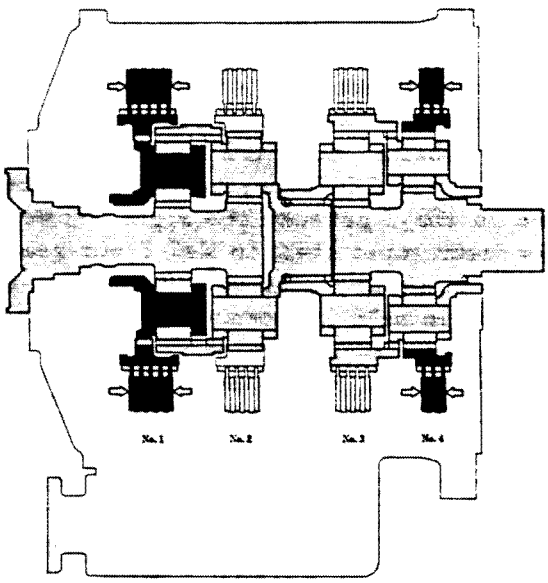
1. Speed Valve
2. Directional Valve
3. Safety Valve
4. Torque Converter Relief Valve
5. Modulation Relief Valve
6. Quick Return Valve
7. Transmission Lubricating Relief Valve

Pressure oil
Lubricating oil
Torque converter oil (relief)
Drain oil
Back pressure (1)
Non-pressure oil
Back pressure (2)

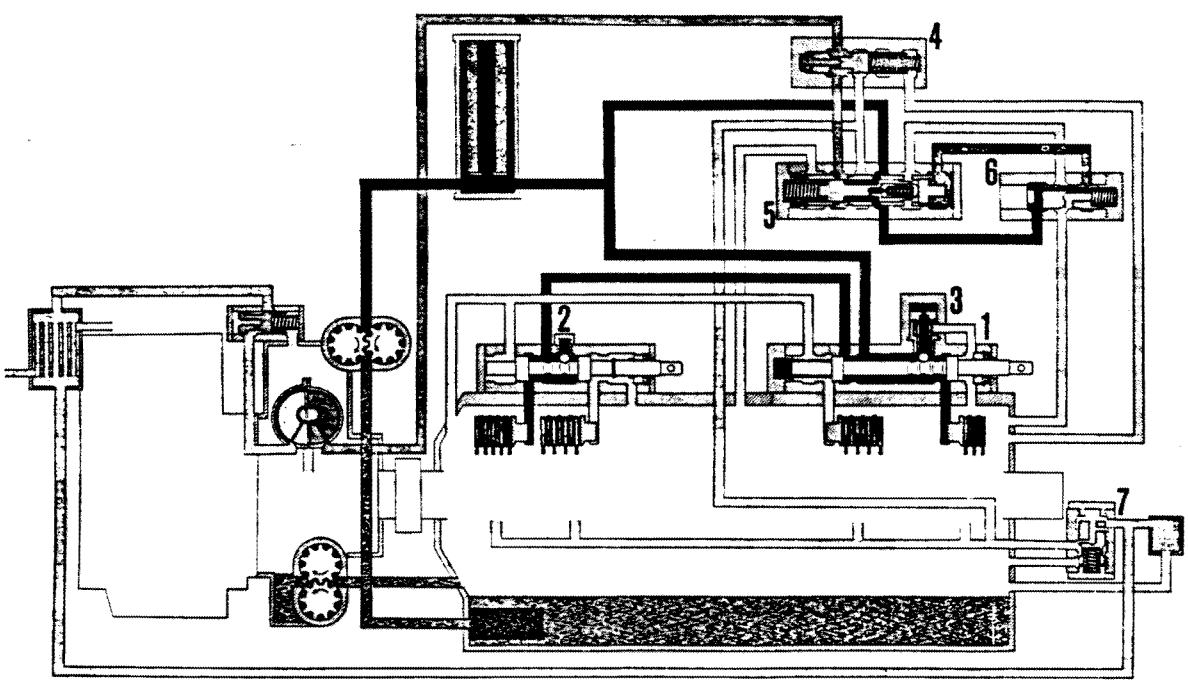
DESCRIPTION

(4) Reverse First

Fig. on the right shows the transmission in REVERSE FIRST position, with No. 1 clutch and No. 4 clutch kept engaged to lock No. 1 carrier and No. 4 ring gear. It is important to note here that the reversal of rotation is achieved by the arrangement of No. 1 planetary system in which the carrier, not ring gear, is equipped with a clutch — No. 1 clutch — with No. 1 ring gear being connected with No. 2 carrier. Since No. 1 carrier is here locked, its planetary pinions act as idle gears interposed between No. 1 sun gear and No. 1 ring gear. The rotation of No. 1 ring gear is opposite to that of No. 1 sun gear. No. 2 carrier is thus driven by No. 1 ring gear, and thereafter the flow of power takes the same course as in the last half of FORWARD FIRST power flow outlined above.



Reverse 1st



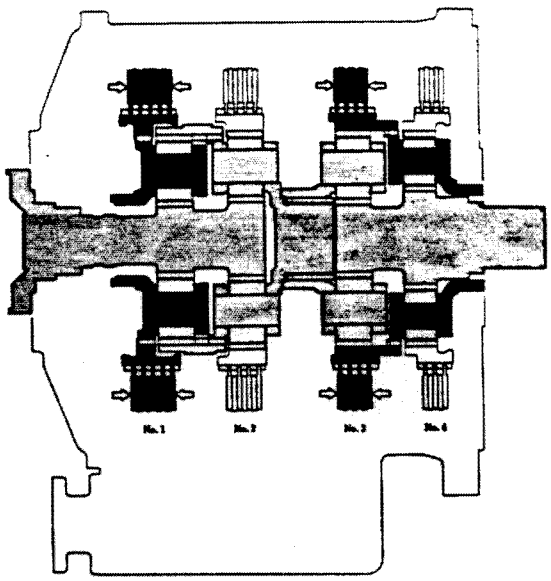
Reverse 1st - Engine Accelerated with Vehicle Driving

1. Speed Valve
2. Directional Valve
3. Safety Valve
4. Torque Converter Relief
5. Modulation Relief Valve
6. Quick Return Valve
7. Transmission Lubricating Relief Valve

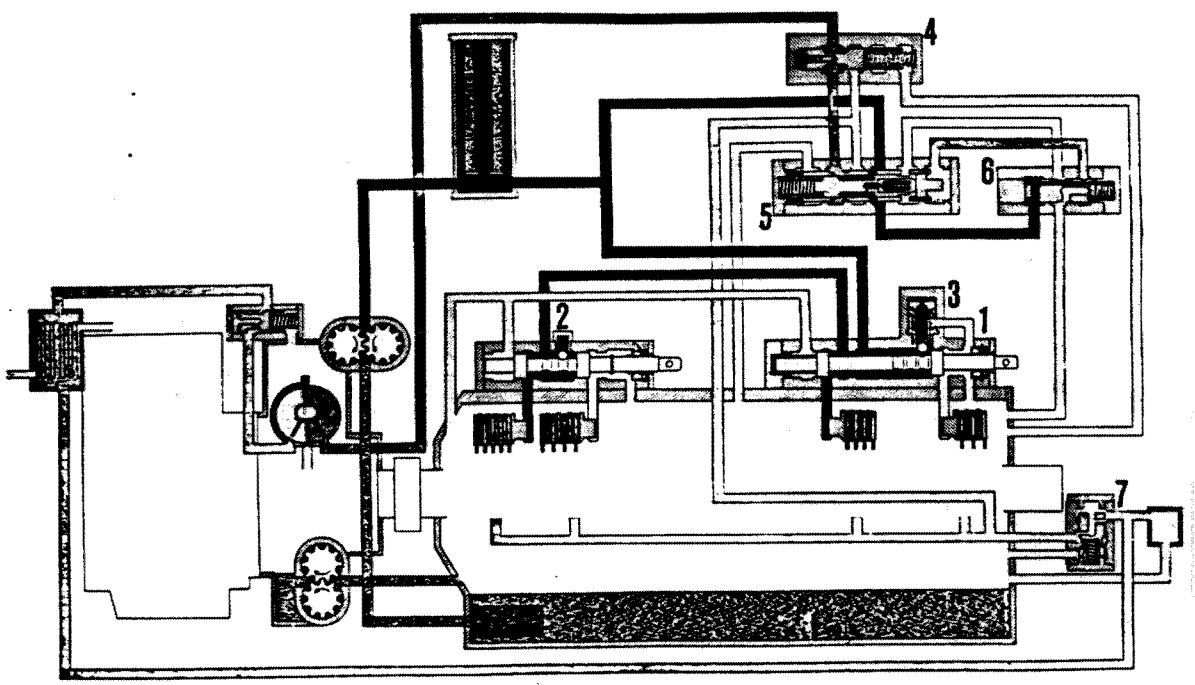
Pressure oil
Lubricating oil
Torque converter oil (relief)
Drain oil
Back pressure (1)
Non-pressure oil
Back pressure (2)

(5) Reverse Second

Refer to the accompanying sketch on the right. The transmission has its No. 1 clutch and No. 3 clutch engaged, to guide the flow of power as in the first half of REVERSE FIRST and as in the last half of FORWARD SECOND.



Reverse 2nd



Engine Just Stopped

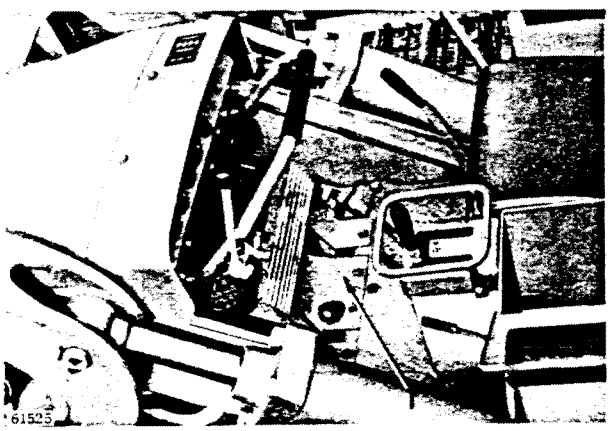
1. Speed Valve
2. Directional Valve
3. Safety Valve
4. Torque Converter Relief Valve
5. Modulation Relief Valve
6. Quick Return Valve
7. Transmission Lubricating Relief Valve

Pressure oil
Torque converter oil (relief)
Back pressure (1)
Back pressure (2)
Lubricating oil
Drain oil
Non-pressure oil

REMOVAL

(1) Lift the machine off the floor by putting 30 - 40 cm (11,8 - 15.7") high blocks under the tracks.

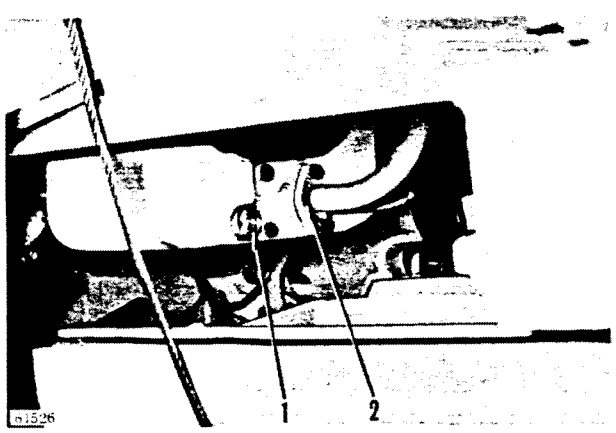
(2) Remove all floor plate (1)



(3) Remove underguard.

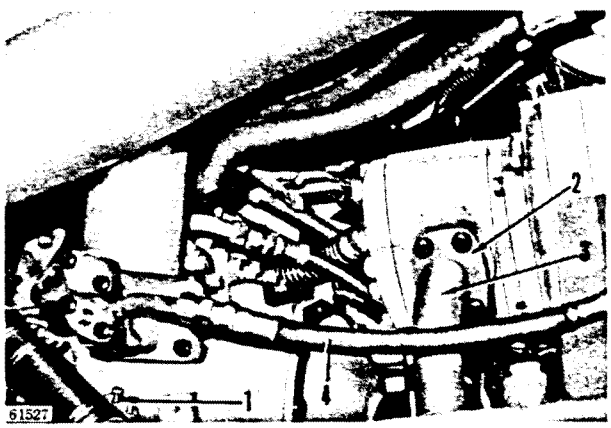
(4) Drain steering case by loosening its drain plug. (Refer to STEERING SYSTEM removal procedure.)

(5) Drain torqflow transmission case by loosening its drain plug (1).
Detach flange (2).

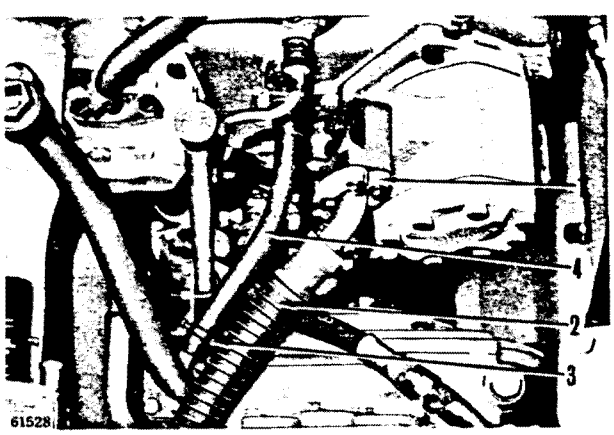


(6) Drain hydraulic oiltank by loosening its drain plug.
(Refer to CONTROL VALVE removal procedure.)

(7) Loosen pipe clip (1) and detach flange (2) and disconnect pipe (3).
Loosen nipple and disconnect rubber hose (4).

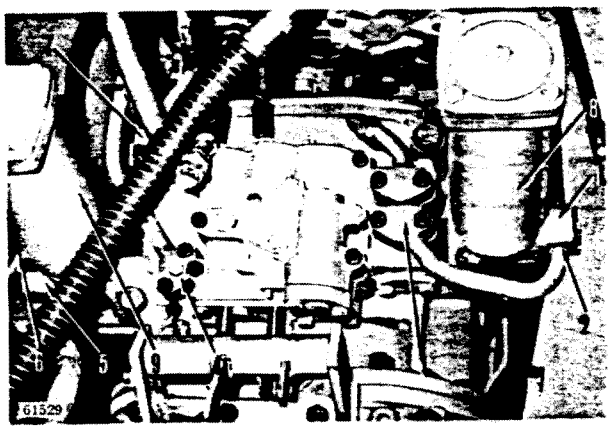


(8) Detach flange (1) and disconnect rubber hose (2). Loosen pipe clip (3) and disconnect rubber hose (4).



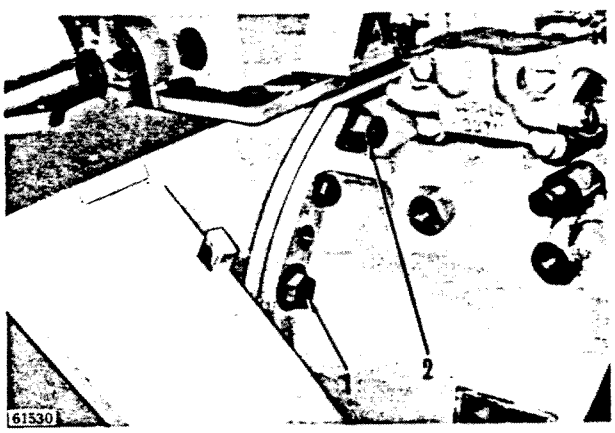
(9) Detach flanges (1) (2) (3) (4) (5) (6) (7) and disconnect the pipes. Remove oil filter on the right (8) and left (9) sides of the transmission case.

Disconnect links (10) (11) of transmission control lever.



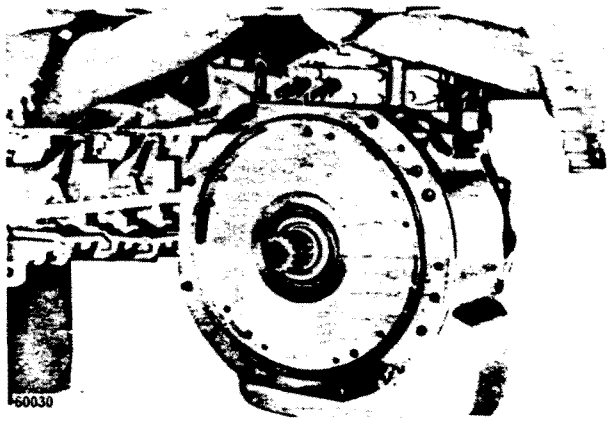
(10) Undo the universal joint between torque converter and torqflow transmission.

(11) Take up the weight of transmission in place with a lifting sling and remove bolts (1) and nuts (2).

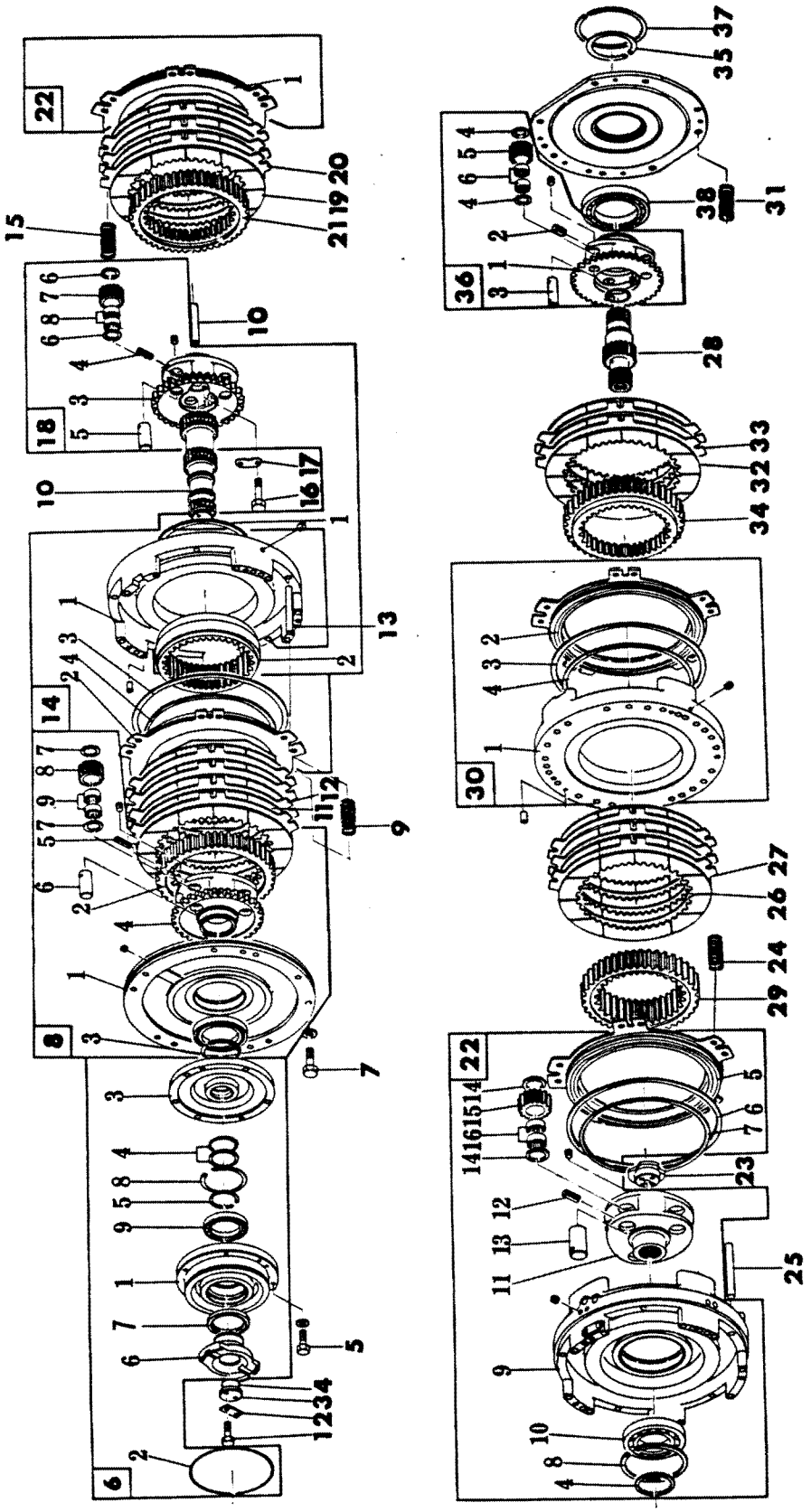


(12) Ease out torqflow transmission forward, withdrawing the transmission shaft from range transmission.

(13) Lower the transmission, complete with control valve, down to the floor in suspended condition.



DISASSEMBLING



1. Bolt
2. Lock
3. Holder
4. "O" ring
5. Bolt

6-1. Bearing cage
6-2. "O" ring
6-3. Retainer
6-4. Seal ring
6-5. Snap ring
6-6. Coupling
6-7. Oil seal
6-8. Snap ring
6-9. Bearing

7. Bolt

8-1. Front plate
8-2. Ring gear
8-3. Snap ring
8-4. Carrier (A)
8-5. Roll pin
8-6. Shaft
8-7. Thrust washer
8-8. Planetary gear
8-9. Bearing

9. Spring
10. Transmission shaft
11. Clutch disc
12. Rear cushion plate
13. Pin

14-1. Housing
14-2. Piston
14-3. Seal ring
14-4. Seal ring

15. Spring
16. Bolt
17. Lock

18-1. Snap ring
18-2. Ring gear
18-3. Carrier (B)
18-4. Roll pin
18-5. Shaft
18-6. Washer
18-7. Planetary gear
18-8. Bearing

19. Clutch disc
20. Rear cushion plate
21. Ring gear

22-1. Piston
22-2. Seal ring
22-3. Seal ring
22-4. Spacer
22-5. Piston
22-6. Seal ring
22-7. Seal ring
22-8. Snap ring
22-9. Housing
22-10. Bearing
22-11. Carrier (C)
22-12. Roll pin
22-13. Shaft
22-14. Washer
22-15. Planetary gear
22-16. Bearing

23. Retainer
24. Spring
25. Pin
26. Clutch disc
27. Rear cushion plate
28. Range transmission shaft
29. Ring gear

30-1. Housing
30-2. Piston
30-3. Seal ring
30-4. Seal ring

31. Spring
32. Clutch disc
33. Rear cushion plate
34. Ring gear (D)
35. Snap ring

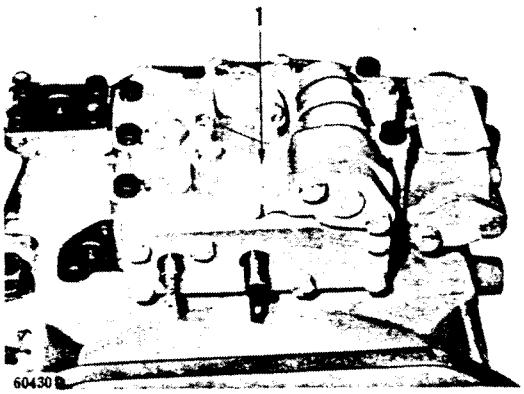
36-1. Carrier (D)
36-2. Roll pin
36-3. Bearing
36-4. Washer
36-5. Planetary gear
36-6. Bearing

37. Snap ring
38. Bearing

Parts are enumerated in the sequence of disassembling.

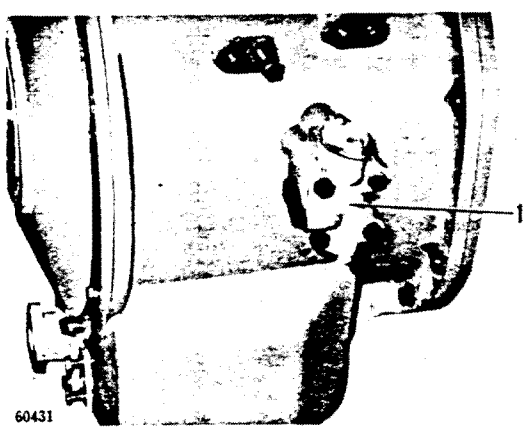
DISASSEMBLING

(1) Remove the control valve assembly (1) from the torqflow transmission.

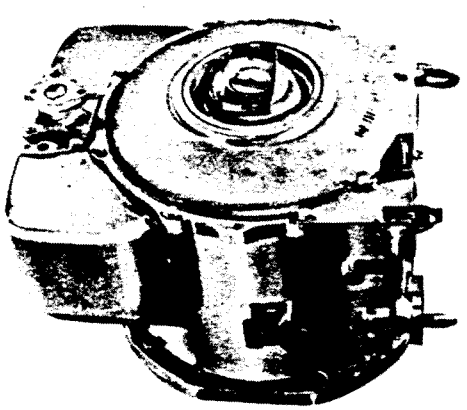


(2) Extract the O-rings and sleeves from the control valve seats on the case.

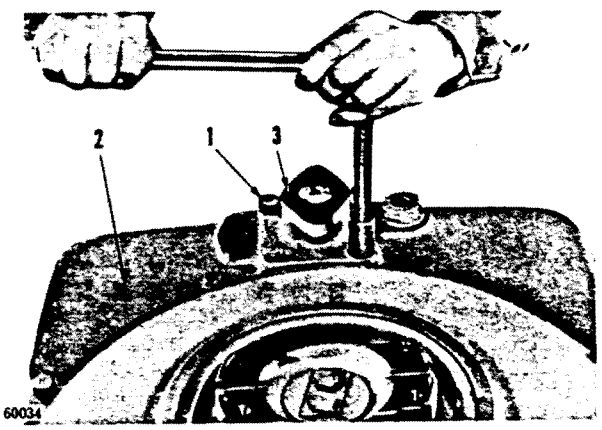
(3) Remove the lube relief valve (1).

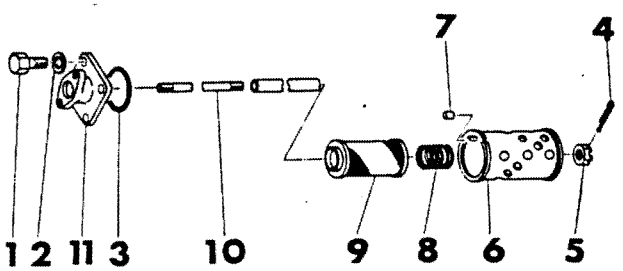


(4) Lay down the torqflow transmission on its end, keeping the shaft end clear of the floor surface. Rest the transmission on stable blocks.

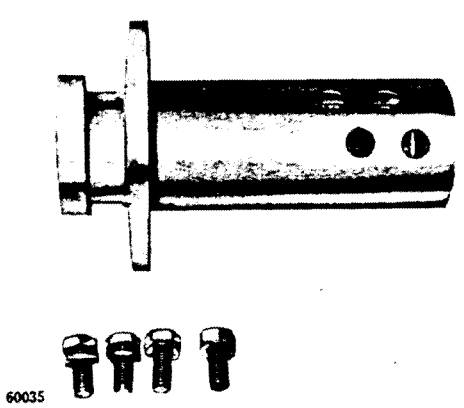


(5) Remove the bolts (1), and take the oil strainer (3) out of the transmission case (2).

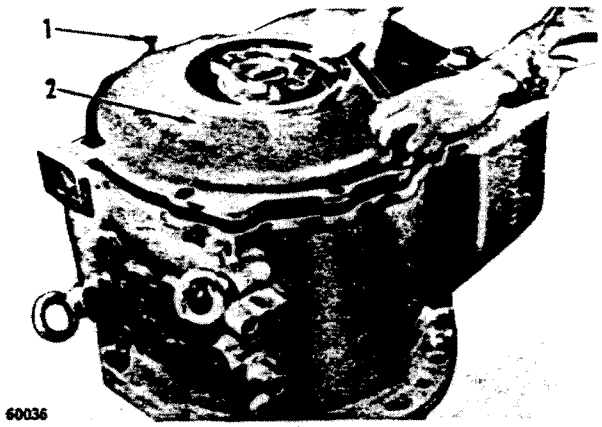




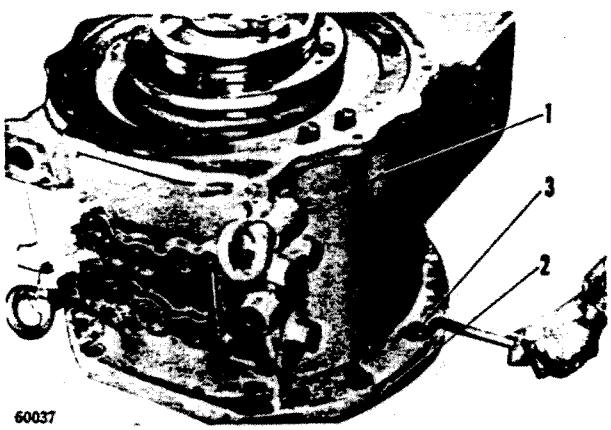
1. Bolt
2. Spring washer
3. "O" ring
4. Cotter pin
5. Nut
6. Baffle
7. Pin
8. Spring
9. Oil filter
10. Stud, oil filter
11. Cover, oil filter



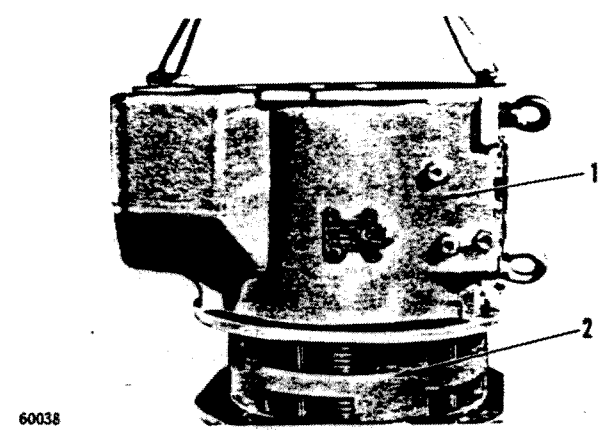
(6) Remove the front cover securing bolts and, by tightening the jacking bolts (1), detach the cover.



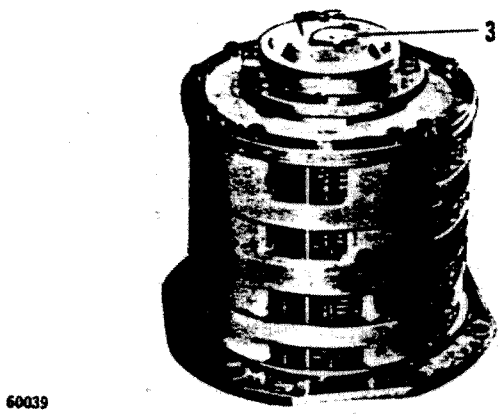
(7) Remove the bolts (3) securing the rear plate (2) to the torqflow transmission case (1).



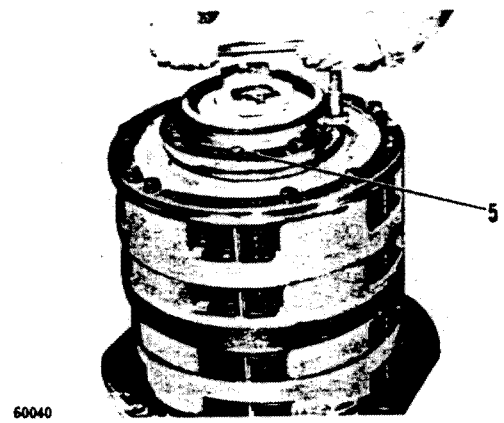
(8) Take up the weight of the torqflow transmission case (1) with an overhead crane to separate it from transmission assembly (2).



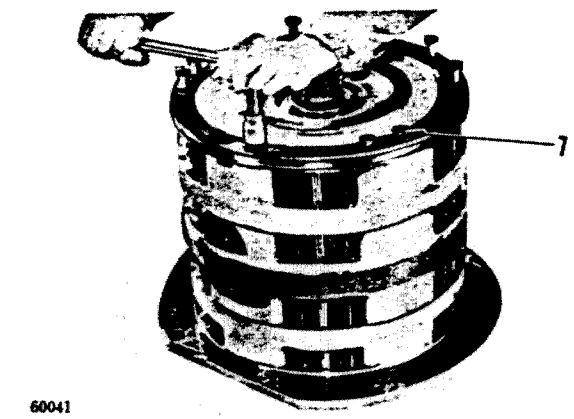
(9) Unfasten the lock, and remove the O-ring holder (3). (This will permit the parts numbered (1) (2) (3) (4) to come off.)



(10) Remove the bolts (5) securing the bearing cage. (Remove the sub-assembly consisting of the parts numbered (6-1) through(6-9).)

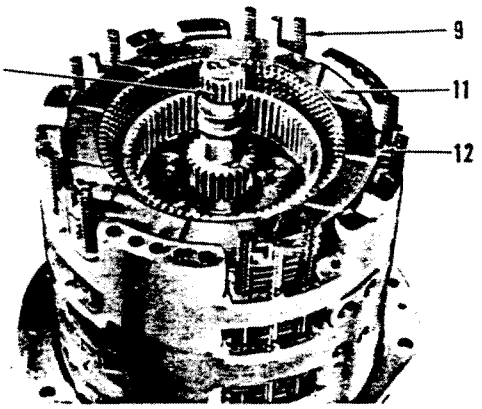


(11) Remove the bolts (7) securing the front plate to the housing. (Take out the sub-assembly consisting of the parts numbered (8-1) through (8-9) in this order).



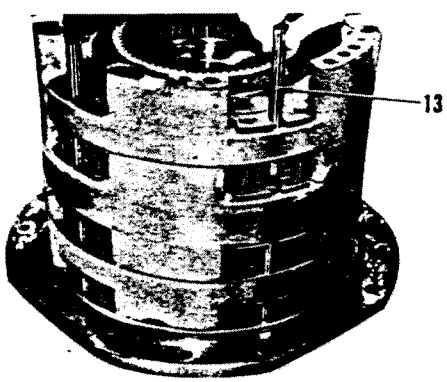
DISASSEMBLING

(12) Remove the springs (9), transmission shaft (10) clutch discs (11) and rear cushion plate (12).



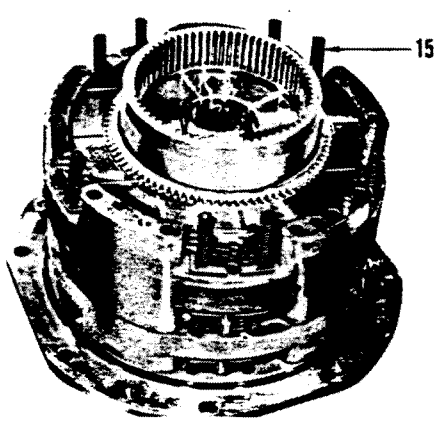
60042

(13) Remove the pins (13), and take off the housing. (Remove the sub-assembly consisting of the parts numbered (14-1) through (14-4) in that order.)



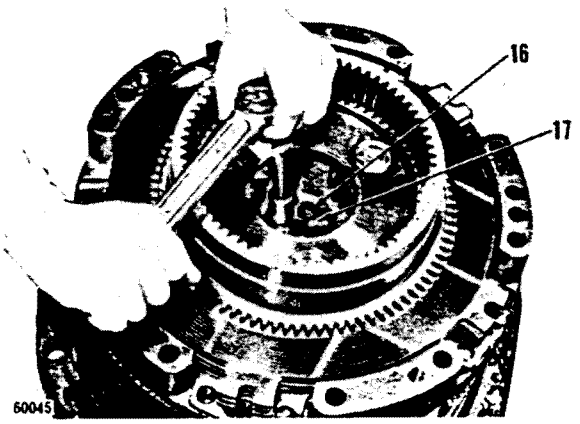
60043

(14) Take out the springs (15).



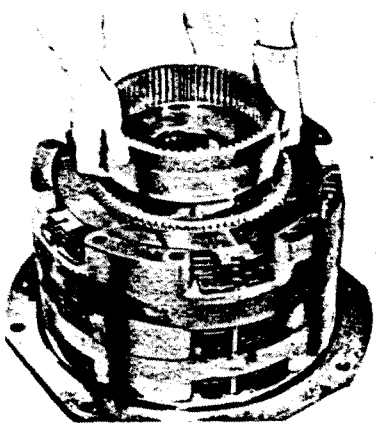
60044

(15) Unfasten the lock, and remove the planetary carrier (B), and remove the retainer securing bolts (16). Remove the lock (17).

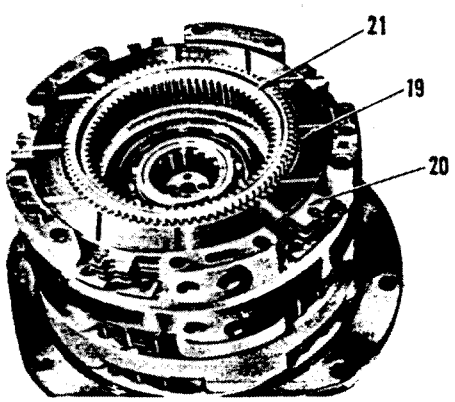


60045

(16) Remove the ring gear and carrier (B). (Remove the sub-assembly consisting of the parts numbered (18-1) through (18-8) in that order.)

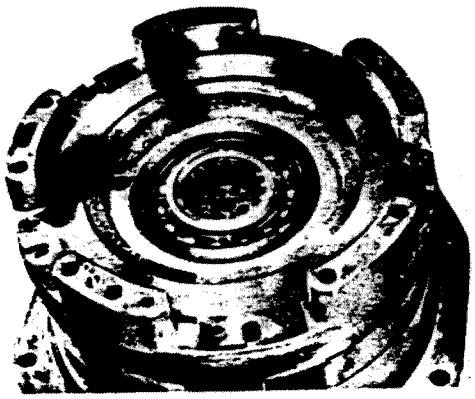

60046

(17) Remove the clutch discs (19), rear cushion plate (20) and ring gear (B) (21).



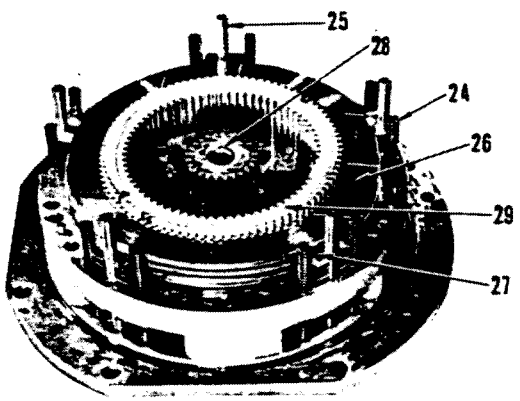
60047

(18) Take off the housing complete with clutch piston and planetary carrier (C). (Remove the sub-assembly consisting of the parts (22-1)through(22-16).)



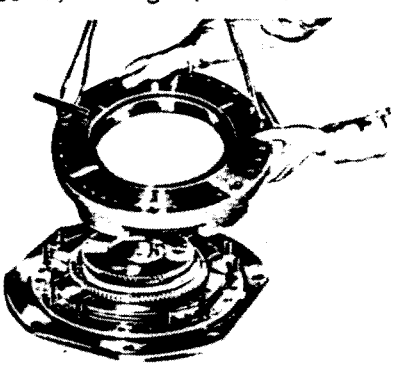
60048

(19) Remove the retainer, spring (24), pins (25), clutch discs (26), rear cushion plate (27), transmission shaft (28) and ring gear (C) (29).



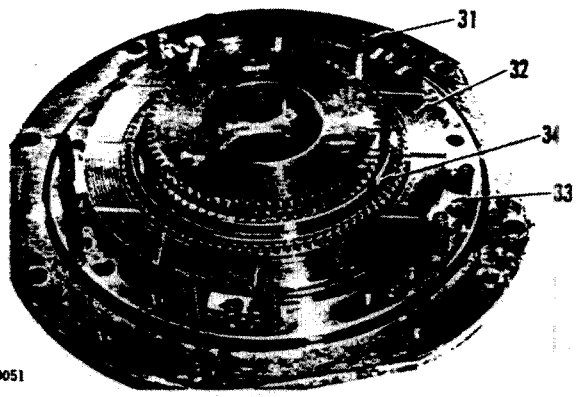
60049

(20) Take off the housing. (Remove the sub-assembly consisting of the parts numbered(30-1)through (30-4)



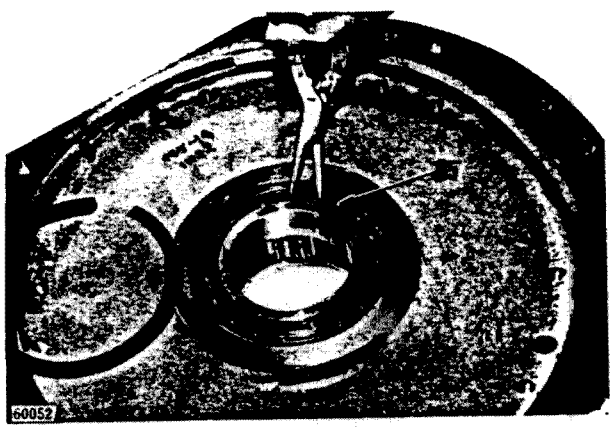
60050

(21) Remove the springs (31), clutch discs (32), rear cushion plate (33) and ring gear (D) (34).



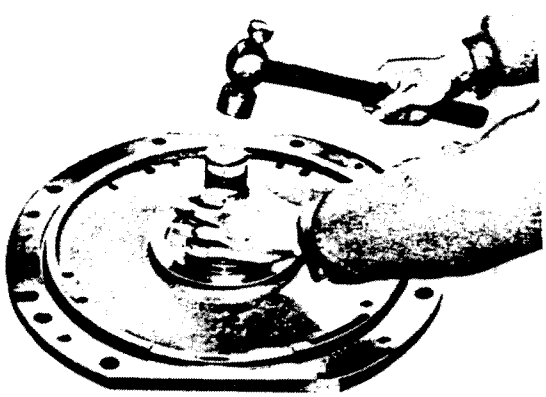
60051

(22) Turn over the rear plate, and extract the snap ring (35).



60052

(23) Drive the planetary carrier out of place. Take off the snap ring (37) and draw out the bearing (38). (Remove the sub-assembly consisting of the parts numbered(36-1)through(36-6)

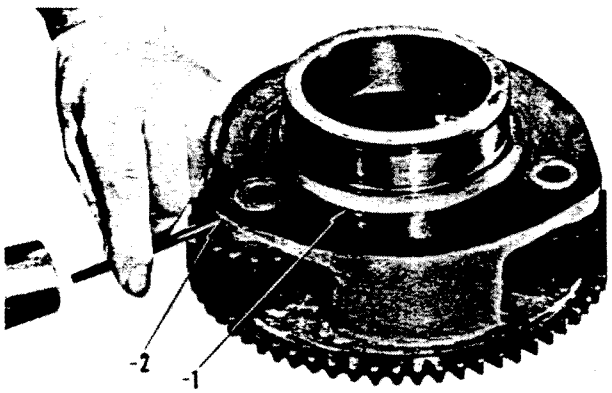


60053

DISASSEMBLING

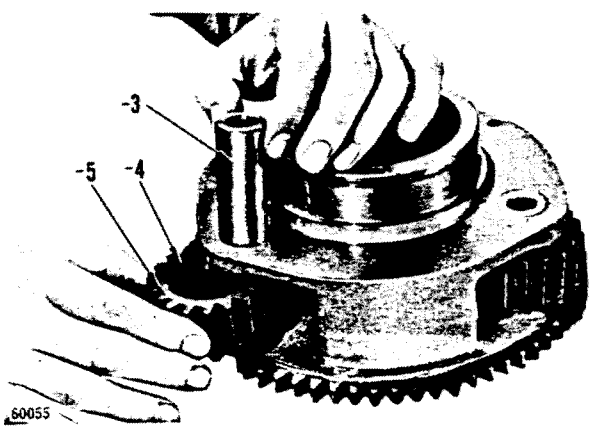
(24) Disassembly the planetary carrier (36), as follows:

1) Remove the carrier (-1) and roll pin (-2) on the shaft.



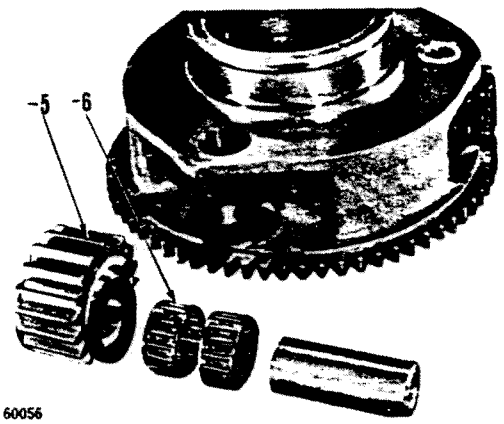
60054

2) Draw out the shaft (-3), and remove the washers (-4) and planetary gears (-5).



60055

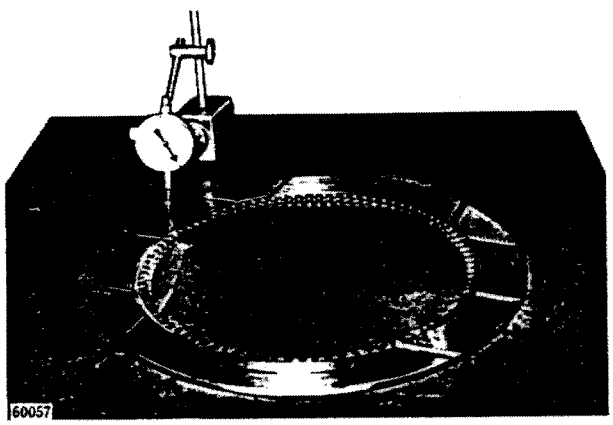
3) From each planetary gear (-5), draw out the needle roller bearing (-6).



60056

CLEANING AND INSPECTION

(1) Check the gear teeth of the planetary gears, planetary carriers and ring gears for wear or damage.
(2) Inspect the gear teeth and splines of the transmission shafts for wear or damage. Check the oil seal faces for wear.
(3) Inspect the friction surfaces of the clutch discs and rear cushion plates for wear, groove marks or any other damage. Also check for runout.



(4) Check the gear teeth of the clutch disc for wear or any sign or malcondition.
(5) Examine the sliding surfaces of the piston and housing for wear or damage.
(6) Inspect the seal rings for wear.
(7) Check the piston and seal ring grooves for wear or any sign of malcondition.
(8) Check the rear cushion springs for elastic condition.

ASSEMBLING

Build up the torqflow transmission by reversing the disassembling procedure and adhering to the following notes:
(1) When combining a housing and a piston, use care not to stress the seal ring.
(2) Oil the mating surfaces of the clutch disc and plate before assembling these parts together.
(3) Build up the transmission. Before installing the transmission case in place, blow with compressed air against the pistons and clutches through the oil hole to make sure that each part can be actuated properly.

INSTALLATION

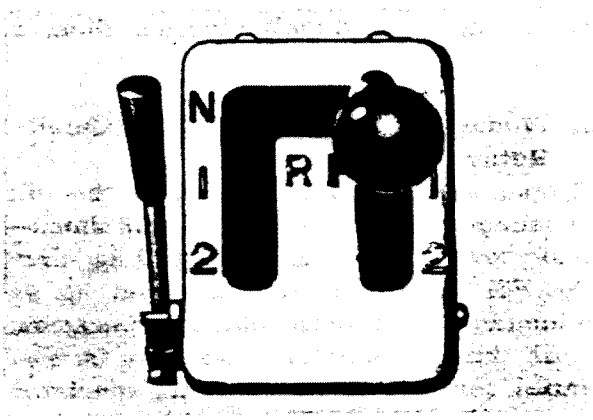
(1) Take up the weight of the torqflow transmission from the underside of the machine with the use of an overhead crane, and install the transmission on the steering case securely. Before tightening the mounting bolts, make sure the transmission drive shaft are securely positioned in the range transmission.
(2) Align the torque converter and the torqflow transmission shaft by refering to the engine centering procedure outlined in the preceding paragraph.
(3) Mount the universal joint securely in place.
(4) Mount the oil filter on the right and left sides of the transmission securely in place.
(5) Connect all piping to the torque converter, pump, control valve and torqflow transmission.
(6) Mount the underguard on the chassis properly.
(7) Install all floor plates.
(8) Fill by hydraulic oil tank, transmission and steering case with the hydraulic oil to the specified level. Run the engine at an idling speed for a while. Stop the engine, and check the level of oil in the tank. If necessary, replenish the tank with oil to the specified level.
(9) Remove the blocks from the under the tracks.

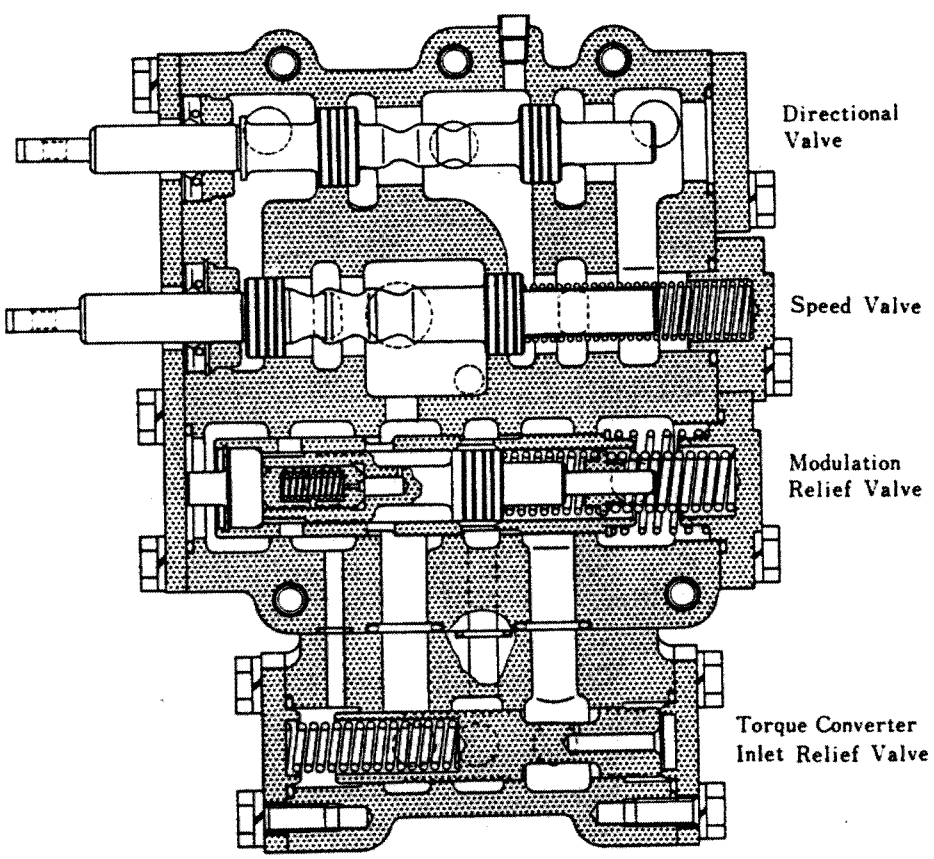
CONTROL VALVE

DESCRIPTION

The transmission control valve is an assembly of five valve elements – speed valve, directional valve, modulation relief valve, quick return valve and safety valve. It is operated by a lever located at left front of operator's seat.

The first three (speed, directional and modulation, relief) of the above-named valves are contained in a single valve body. On and above this body is secured another body, which contains the remaining two (quick-return valve over the modulation relief valve, and safety valve over the speed valve). On the side of the speed valve body is located one other relief valve, which is in the inlet line to the torque converter. There is still another relief valve—transmission-lubrication relief valve-secured to the side face of the transmission case.





Section View of Control Valve

A. Valve Functions

(1) Speed Valve and Directional Valve

The speed valve is for selectively admitting hydraulic oil to speed clutches (No. 4 and No. 3). Except when the transmission is in neutral, it passes oil also onto the directional valve. The directional valve is to control hydraulic oil to the directional clutches Nos. 1 and 2.

(2) Modulation Relief Valve and Quick-Return Valve

These valves serve to permit the oil pressure to build up smoothly and shocklessly to the prescribed limit 20 kg/cm^2 (284 PSI) in the clutches engaged, so as to insure the smooth shifting operation at all times. Shockless shifting is essential for the comfort of the operator and for avoiding undue stresses in the power-line components.

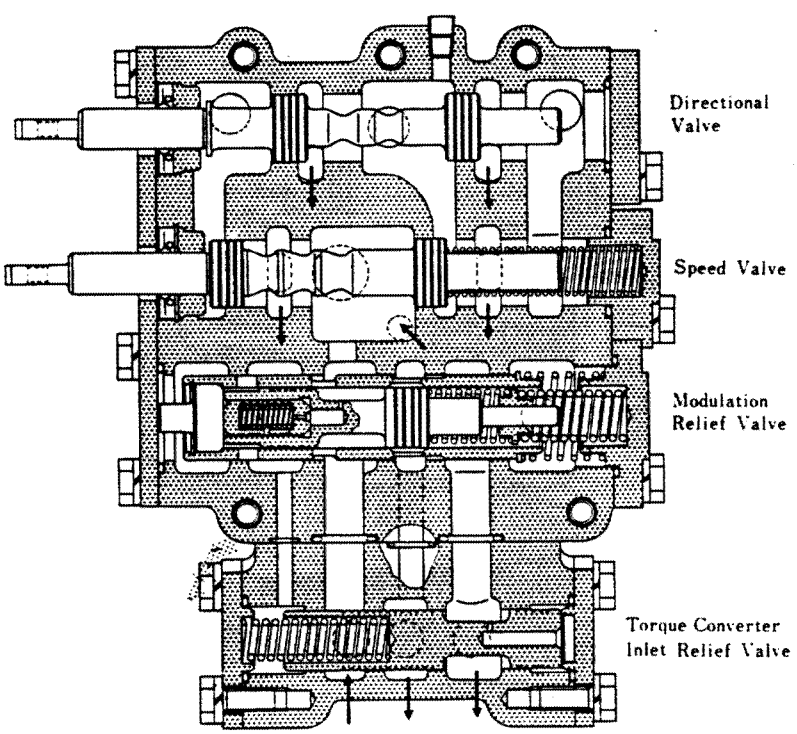
(c) Safety Valve

Whenever the engine stops or is stopped, the safety valve operates automatically to return the speed valve into the position for neutral condition of the transmission. When this happens, the control lever too trips back into its neutral position. This feature safeguards the machine against the possibility of darting upon engine re-starting.

B. Hydraulic Oil Flows

(1) Neutral

The spool in the speed valve takes the position indicated in the accompanying sketch below when the system is in neutral. Under this condition, hydraulic pressure is applied to No. 4 (First) clutch and also to the modulation relief valve, quick-return valve and safety valve, the pressure being completely shut off on the directional valve so that the transmission will assume the state previously obtained. The modulation relief valve prevents this pressure from exceeding the described limit 20 kg/cm^2 (284 PSI) by bleeding the oil into the relief valve located in the torque converter inlet line.



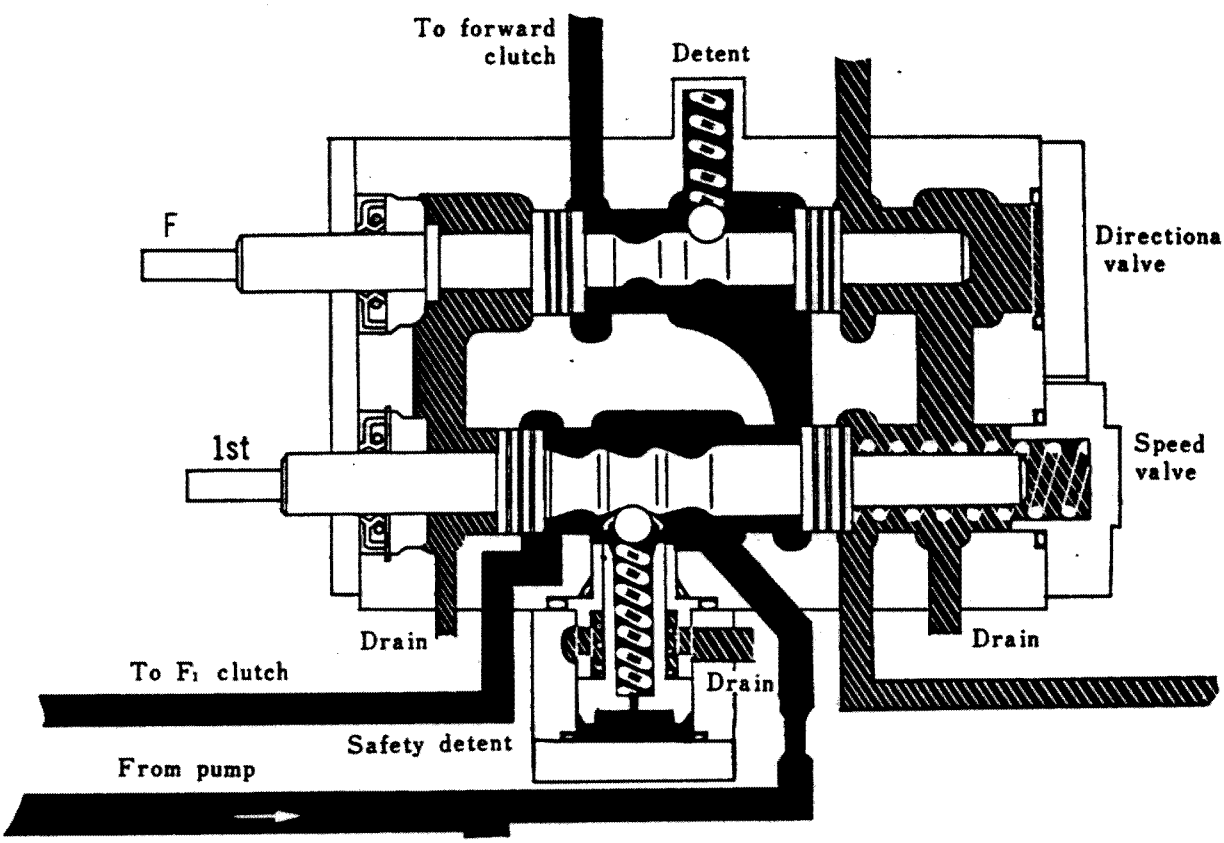
Oil Flow in Neutral

(2) Forward 1st

As the lever is placed in forward 1st speed position, the spool of the speed valve is moved to the right as shown in the sketch below.

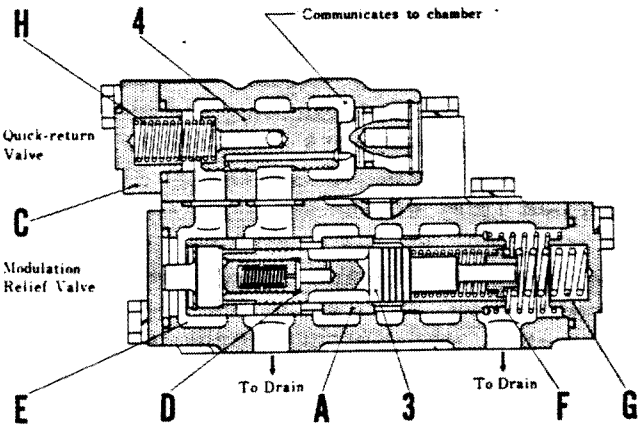
Hydraulic oil flows into the lines leading to the pressure chambers of First and Forward clutches. Until these chambers become completely filled with oil, the pressure to the pistons remains at naught (0 kg/cm^2). Under this condition, the modulation relief valve and quick-return valve take the positions as indicated in the accompanying figure below.

The moment the chambers are filled up, the pressure begins to build up rapidly but without shocking the pistons. Though this pressure build-up is very rapid, the rate of pressure rise is damped (just before the prescribe limit is reached) by the combined action of the modulation relief valve and quick-return valve. Were it not for this damping action, the clutches might "grab" to subject the power-line components to momentary but undue mechanical stresses.



Oil Flow in Forward 1st

DESCRIPTION



The figure shown next serves to illustrate the way the modulation relief valve and quick-return valve respond to the rising line pressure and, just before the 20 kg/cm^2 (284 PSI) level is reached, damp or slow down the rate of pressure rise.

The quick-return valve is a single-piston spring-loaded valve, in which spring (H) holds piston (4) all the way to the right when there is no pressure in the line (that is, in its main oil passage).

In this condition of the valve, the internal oil passage provided in its piston communicates the back-pressure chamber (E) (of modulation relief valve) to the drain passage. The modulation relief valve is a composite multi-spring-loaded valve in which an innermost piston (3) is carried in a movable sleeve (A) whose left end is closed. Piston (3) contains a small spring-loaded piston valve forming an inner chamber designated as (D).

Suppose the pressure is rising in the pressure chambers of the clutches under consideration. Through the internal oil passage provided in piston (3), the line pressure leaks into chamber (D) to push on the small piston against its spring.

After this spring is fully compressed, the rising pressure in chamber (D) pushes on piston (3) toward the right against spring (G). As the line pressure keeps rising toward the 20 cm/kg^2 (284 PSI) level, piston (3) thus moves far enough to unseat the port provided in sleeve (A) and bleed the oil into the drain passage leading to the transmission lube system.

In the quick-return valve, the rising line pressure forces piston (4) against its spring (H) and drain passage, but re-communicates this chamber to the main oil passage through a bleed hole and throtting port (C) cut in piston (4).

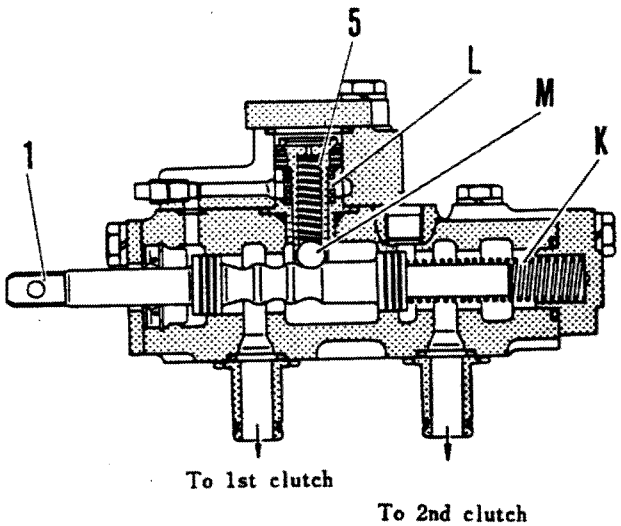
Thus, the line pressure bleeds into chamber (E), causing the back-pressure to follow the rising line pressure and to increasingly force sleeve (A) toward the right against its spring (F). As sleeve (A) so moves, the relieving port tends to close – because piston (3) is somewhat independent of sleeve (A) – and permits the line pressure to rise faster.

The resultant rise in line pressure, however causes piston (3) to move farther to the right to unseat the port wider and, with some time lag, increases the back-pressure to move sleeve (A) again and farther toward the right. In this manner, the combined movements of piston (3) and sleeve (A) relieve some rising pressure to slow down the rate of pressure rise in the underside vicinity of the limit, until sleeve (A) comes to its stroke end (limited by a stopper) at which the 20 kg/cm^2 (284 PSI) limit will have been reached.

Once this limit is reached, piston (3) unseats the port more or less to curb the line pressure to that limit by relieving the oil now into the drain passage leading to the torque converter inlet relief valve. If the control lever is shifted from Forward First to some other speed position, the pressure in the lines to the clutches thus far engaged instantly falls to zero. This loss of pressure restores piston (4) to the original position because of its spring (H), thereby bleeding the back-pressure in chamber (D) into the drain passage and, consequently, allowing springs (F) (G) to force piston (3) and sleeve (A) back to the positions.

(3) Safety Valve

The function of the safety valve is related to the line pressure, as will be seen in accompanying sketch, wherein



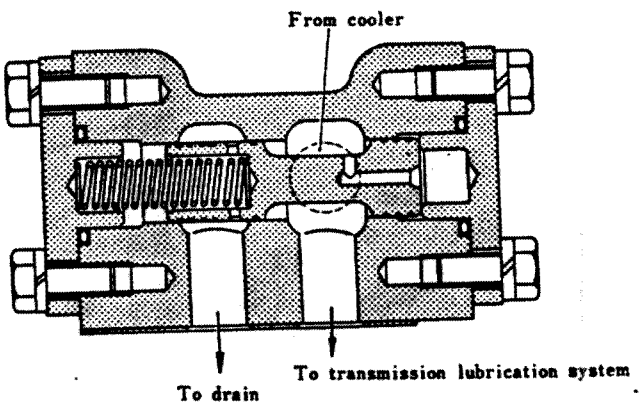
the spool (1) of the speed valve is shown in relation to the safety valve. The piston (5) of this valve carries an arresting or detent ball (M) held with a coil spring. Into the space above the closed end of the piston (5), the line pressure is admitted to hold the piston down all the way against its spring (L) so that spool (1) becomes locked in its current operating position. Suppose the the engine stops for one reason or another, or is stopped intentionally: a moment later the line pressure will fall to zero, allowing the piston to rise because of its spring (L). Since spool (1) is spring-loaded by the spring (K) in the direction toward the left, this upward movement of piston (5) takes pressure off detent ball (M) and permits the spool (and control lever too) to snap back to its neutral position.

C. Torque Converter Inlet Relief Valve

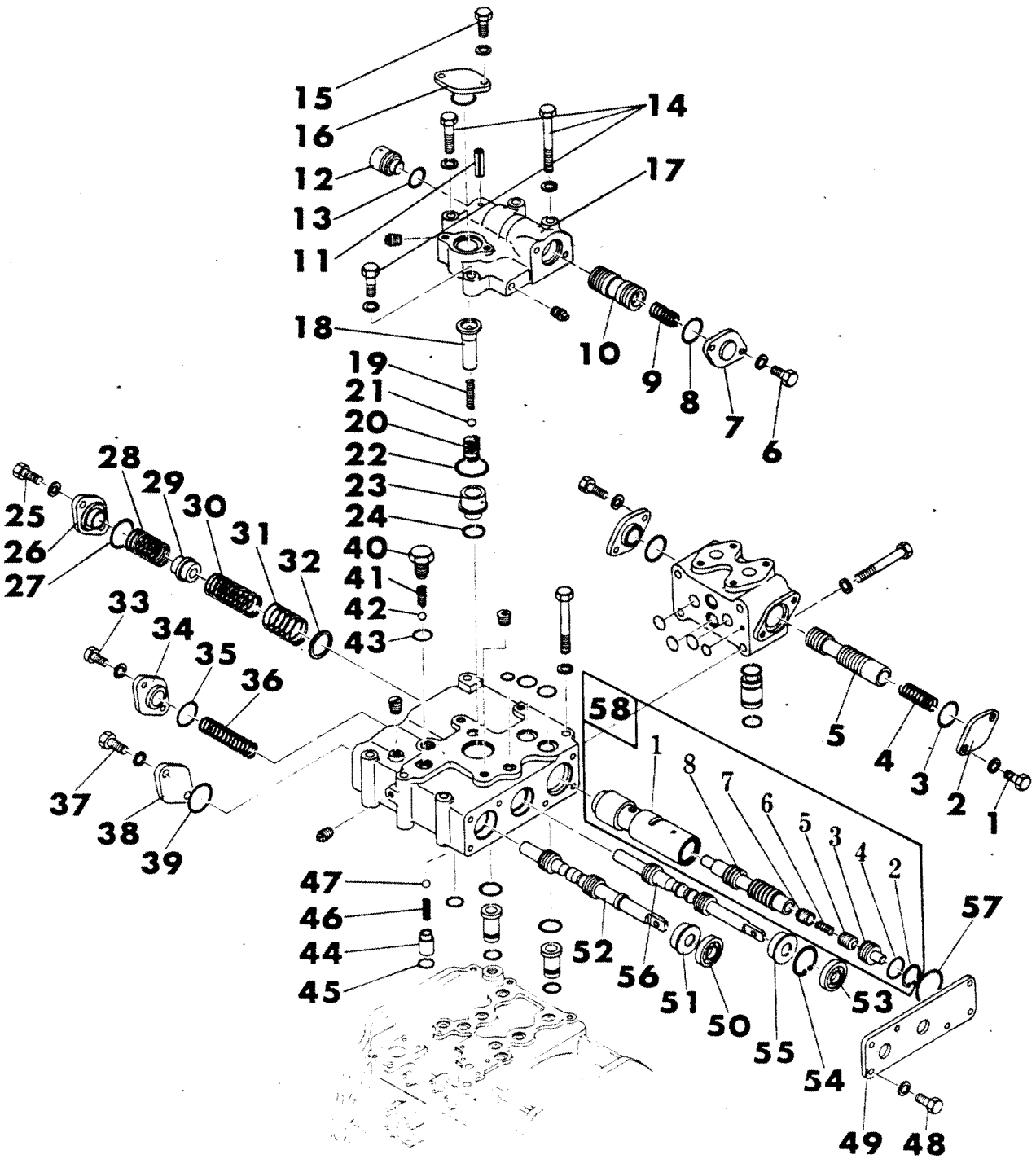
This relief valve limits the torque converter inlet pressure to anywhere between 5.5 kg/cm^2 (78 PSI) and 6.5 kg/cm^2 (92 PSI). Oil spilled from this valve flows into the transmission lube oil system.

D. Transmission Lubrication Relief Valve

This relief valve keeps the transmission lubricating oil pressure to and within the 1.6 kg/cm^2 (23 PSI) limit. Oil spilled from this valve flows into the drain circuit.



DISASSEMBLING



1.	Bolt	23.	Bushing	45.	O-ring
2.	Cover	24.	O-ring	46.	Spring
3.	O-ring	25.	Bolt	47.	Ball
4.	Spring	26.	Cover	48.	Bolt
5.	Valve	27.	O-ring	49.	Cover
6.	Bolt	28.	Spring	50.	Oil seal
7.	Cover	29.	Seat	51.	Bushing
8.	O-ring	30.	Spring	52.	Spool
9.	Spring	31.	Spring	53.	Oil seal
10.	Valve	32.	Washer	54.	Snap ring
11.	Roll pin	33.	Bolt	55.	Bushing
12.	Stopper	34.	Cover	56.	Spool
13.	O-ring	35.	O-ring	57.	O-ring
14.	Bolt	36.	Spring	58-1.	Valve
15.	Bolt	37.	Bolt	58-2.	Snap ring
16.	Cover	38.	Cover	58-3.	Stopper
17.	Valve body	39.	O-ring	58-4.	O-ring
18.	Detent	40.	Retainer	58-5.	Valve
19.	Spring	41.	Spring	58-6.	Spring
20.	Spring	42.	Ball	58-7.	Valve
21.	Ball	43.	O-ring	58-8.	Valve
22.	O-ring	44.	Retainer		

Parts are enumerated in the sequence of disassembling.

(1) Remove the bolts (1) securing the cover (2), and detach the cover.
Draw out the valve (5) complete with the O-ring (3) and spring (4).

(2) Remove the bolts (6) and take off the cover (7).
Draw out the valve (10) complete with the O-ring (8) and spring (9).
Pull out the roll pin (11) and remove the stopper (12) and O-ring (13).

(3) Loosen the bolts (14) (15), and take off the cover (16). Remove the sub-assembly consisting of the valve body (17), detant (18), springs (19) (20), ball (21), O-ring (22), bushing (23) and O-ring (24).

(4) Loosen the bolts (25) and take off the cover (26).
Remove the O-ring (27), spring (28), seat (29), spring (30), (31), and washer (32).

(5) Loosen the bolts (33) and take off the cover (34).
Remove the O-ring (35) and spring (36).

(6) Loosen the bolts (37) and take off the cover (38).
Remove the O-ring (39).

(7) Remove the retainer (40), spring (41), ball (42) and O-ring (43).

(8) Remove the retainer (44), O-ring (45), spring (46) and ball (47).

(9) Loosen the bolts (48) and take off the cover (49).
Draw out the spool (52) complete with oil seal (50) and bushing (51).
Draw out the spool (56) complete with the oil seal (53), snap ring (54) and bushing (55). Remove the O-ring (57) and draw out the sub-assembly consisting of the parts numbered (58-1) through (58-8).

CLEANING AND INSPECTION

(1) Check the sliding surfaces of the spools for rusting or signs of erractic sliding contact.
(2) Inspect the valve body for cracks or any other damage, and check running clearance around each spool in the bore.
(3) Check the springs for elastic property by measuring the free length, as-installed length and preload. Also inspect each spring for any sign of damage.

RANGE TRANSMISSON

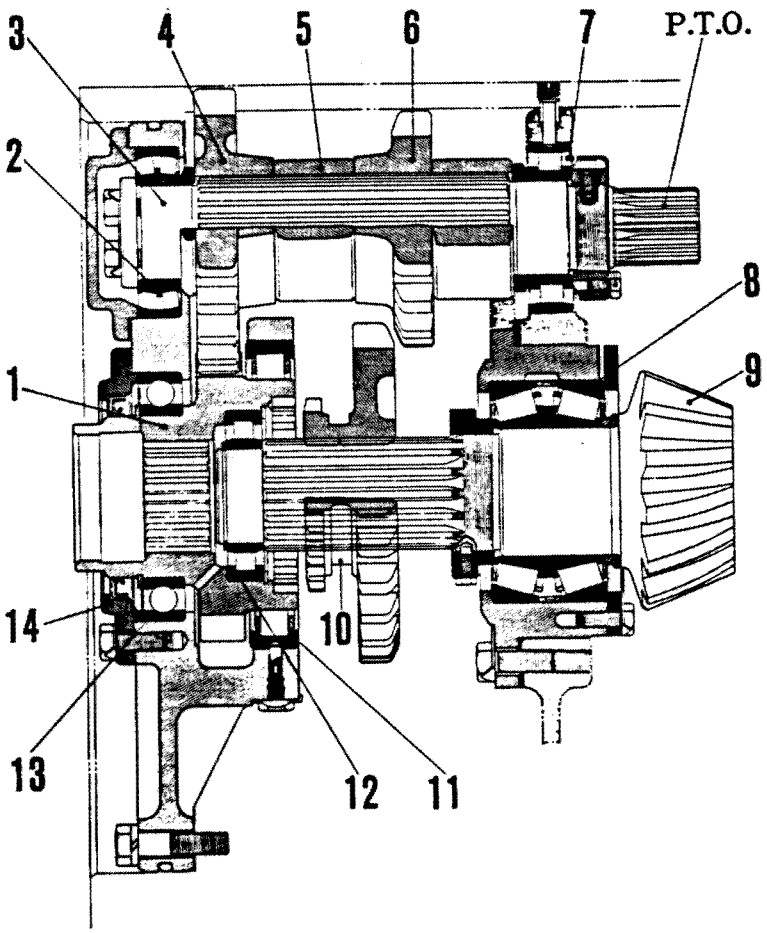
INDEX

RANGE TRANSMISSION

DESCRIPTION

A. Construction of Range Transmission

The range transmission provides two gear shifts, HIGH and LOW. Selection between HIGH and LOW is effected by moving a sliding gear (range gear). Its shafts are held by rolling-contact bearings (tapered roller bearing, straight roller bearing and ball bearing).



Neutral

1. Range transmission gear
2. Bearing
3. Range transmission shaft
4. Gear
5. Collar
6. Gear
7. Bearing
8. Bearing
9. Pinion shaft
10. Gear
11. Bearing
12. Bearing
13. Bearing
14. Cage

DESCRIPTION

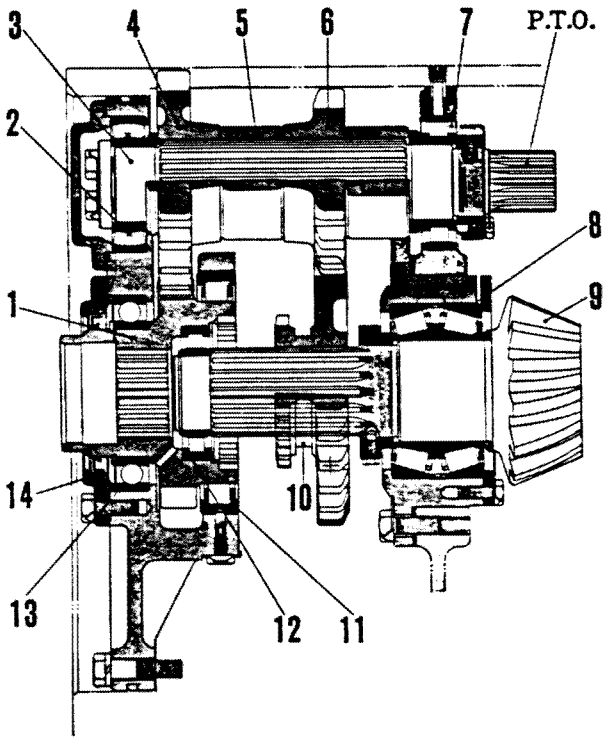
The output of the powershift transmission enters the range transmission through the gear (1) which is splined to the powershift transmission output shaft and is constantly meshed with gear (4) splined to the shaft (3).

The high-low range gear (10) is capable of sliding on and along the pinion shaft, and is actuated by the shifter fork. Shaft (3) extends out of the range transmission compartment so that it can be utilized to drive accesory components mounted on the rear end of the machine.

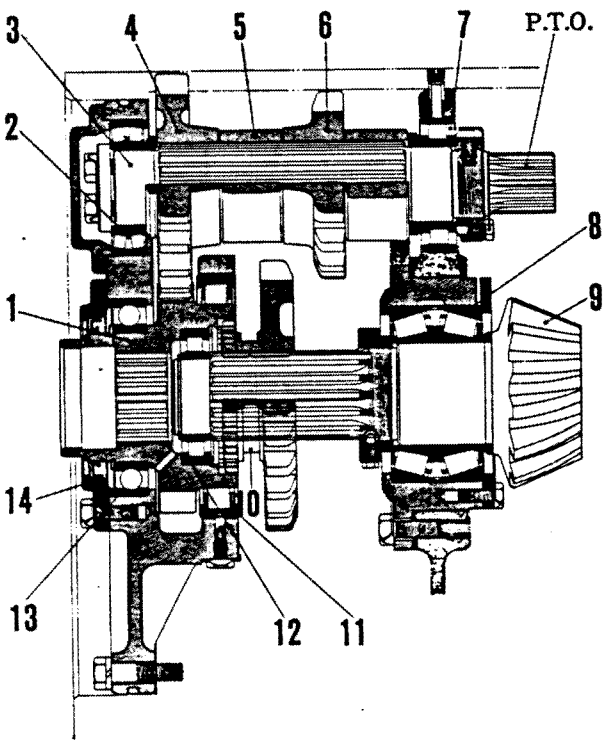
Gear (15) is fitted to the bevel pinion shaft and meshes with the LOW part of range gear. Shifter fork is secured to shifter shaft: this shaft is actuated from the high-low lever located to the right and in front of the operator's seat. A system of linkage transmits control motion from the high-low lever to the shifter shaft.

As the high-low lever is shifted to HIGH, shifter fork moves the range gear on the pinion shaft and meshes its low part with gear (6) on range transmission shaft for driving the bevel pinion in the HIGH range. Shifting the high-low lever to LOW causes the range gear to move forward to transmit drive directly to the bevel pinion.

With the high-low lever in neutral position, range gear remains off and drive is interrupted in the range transmission.



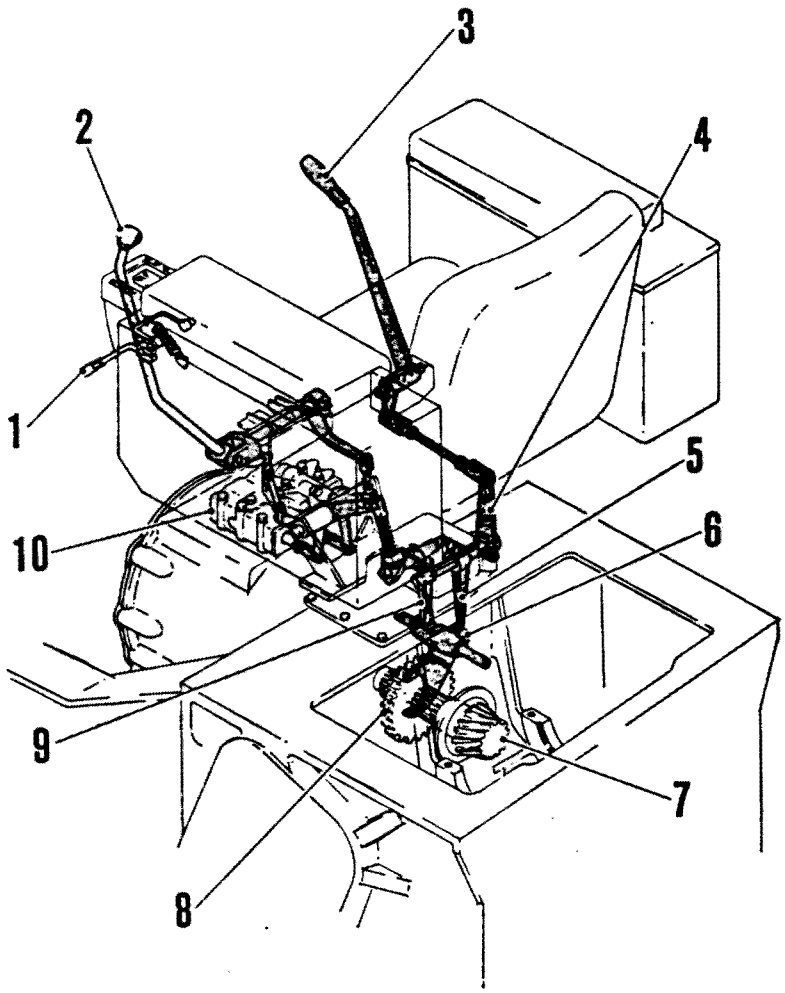
Low



High

B. Shifter Fork

Shifter shaft is mounted in a casing fixed to the top of the bevel gear shaft case. Fork shaft is held rigidly by the retainer, and fork is arranged to slide on this shaft in fore-aft direction. Three arresting positions are provided for neutral, high and low positions of the range transmission. Arresting action is accomplished by means of dents cut on the shaft and a spring-loaded plunger.



Shifter Fork

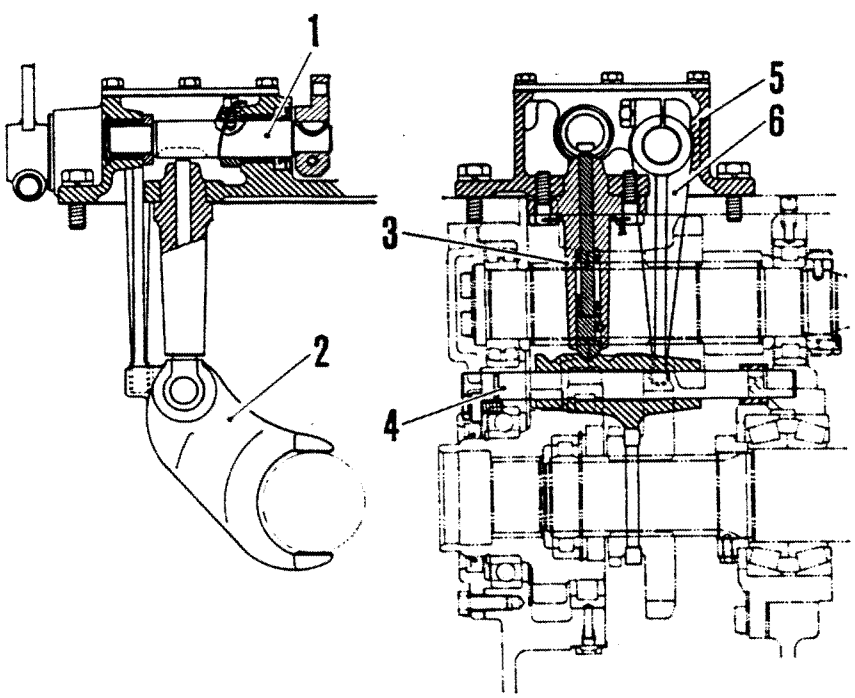
1. Safety lever
2. Change lever
3. High-low selector lever
4. Lever
5. Fork lever
6. Fork
7. Pinion shaft
8. Range transmission gear
9. Plunger
10. Torqflow transmission control valve

DESCRIPTION

C. Interlock

The interlock mechanism consists of a) the spring-loaded plunger (3) which engages with the dents provided on the shifter fork, b) the high-low lever interconnected through a linkage to the powershift transmission shift lever, and c) the interlock shaft to which the high-low lever is attached. Interlock shaft restricts plunger movement except when the shift lever (of powershift transmission) is in neutral. This shaft serves to prevent the fork from sliding out of the arresting position.

Moving the shift lever into neutral position (N) causes the linkage to rotate the interlock shaft, thereby bringing its slit to and above the plunger. With the slit positioned overhead, the plunger is free to extend upward and lift out of the dent. Under this condition, the range transmission can be shifted; moving the range gear from its current position forces the plunger out of the dent. Thus, range transmission shifting is possible only when the powershift transmission shift lever is in neutral. The spring on the plunger exerts a force large enough to keep the shifter fork arrested.



Interlock

1. Shaft
2. Fork
3. Plunger guide
4. Fork shaft
5. Range transmission case
6. Lever

REMOVAL

(1) Drain the steering case by loosening the drain plug located on the bottom of the case.
(Refer to STEERING SYSTEM removal procedure.)

(2) Drain the hydraulic oil tank by loosening the drain plug.
(Refer to CONTROL VALVE removal procedure.)

(3) Dismount the side frame assemblage consisting of the operator's seat, fuel tank, battery, oil filter and hydraulic oil tank.
(Refer to SIDE FRAME removal procedure.)

(4) Disconnect and remove all control linkage members associated with the control levers.
(Refer to SIDE FRAME removal procedure.)

(5) Remove the control linkage and components for the right and left steering brakes.
(Refer to RANGE TRANSMISSION SHIFTER removal procedure.)

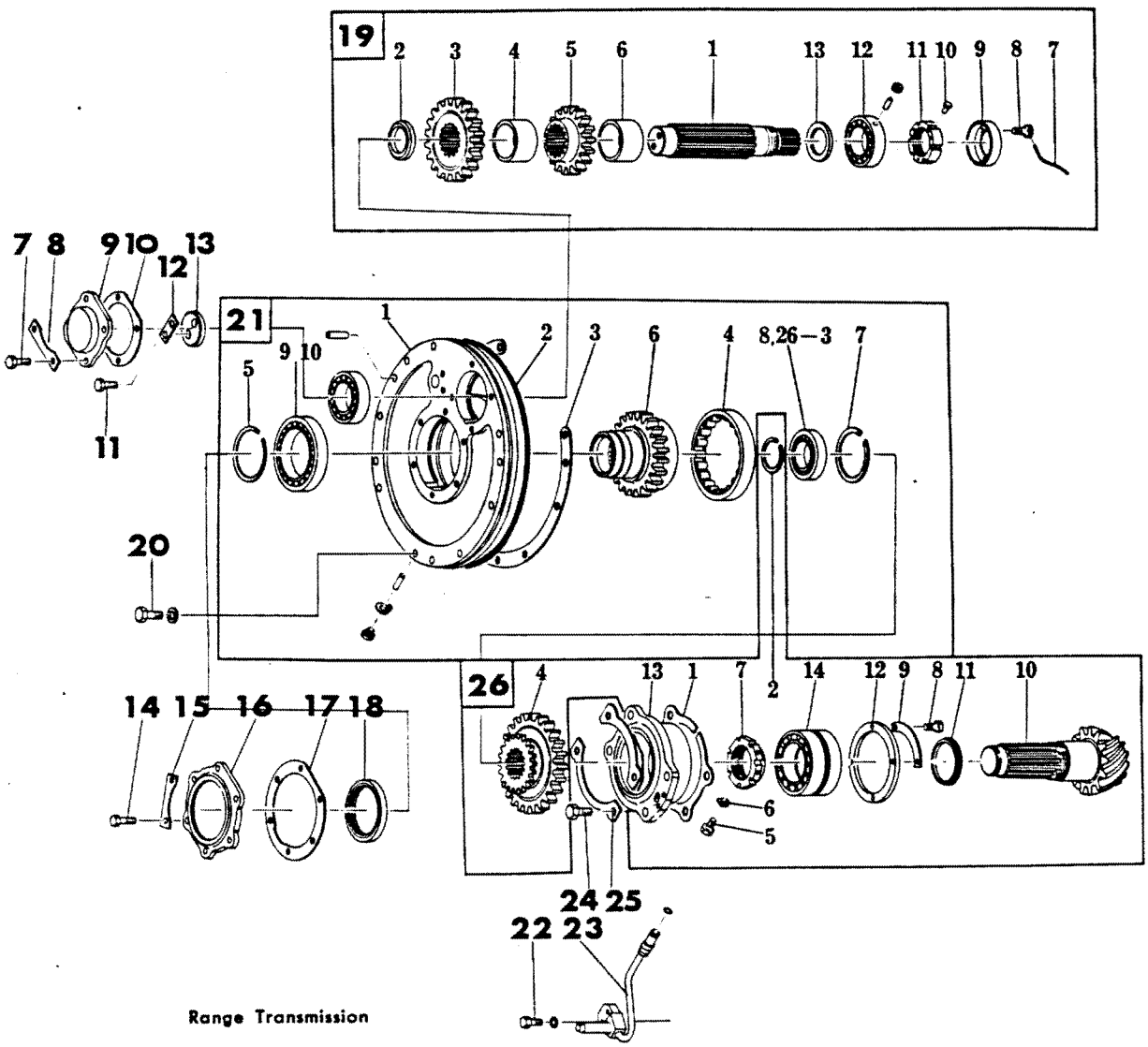
(6) Remove all pipes located on the top of the bevel gear case.

(7) Remove the shifter assembly.
(Refer to RANGE TRANSMISSION SHIFTER removal procedure.)

(8) Take down the torqflow transmission.
(Refer to TORQFLOW TRANSMISSION removal procedure.)

(9) Remove the covers from the top of the bevel gear case.
(Refer to STEERING SYSTEM removal procedure.)

DISASSEMBLING

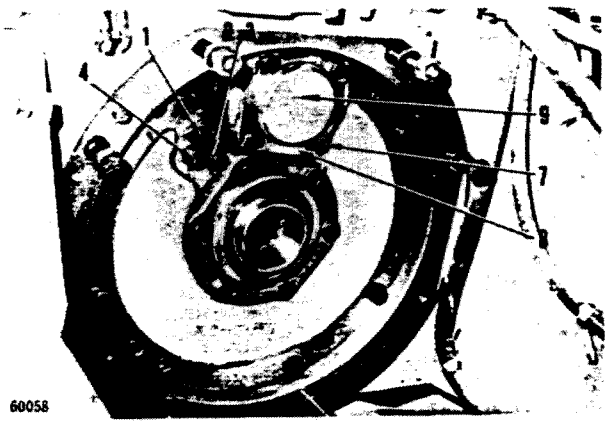


Range Transmission

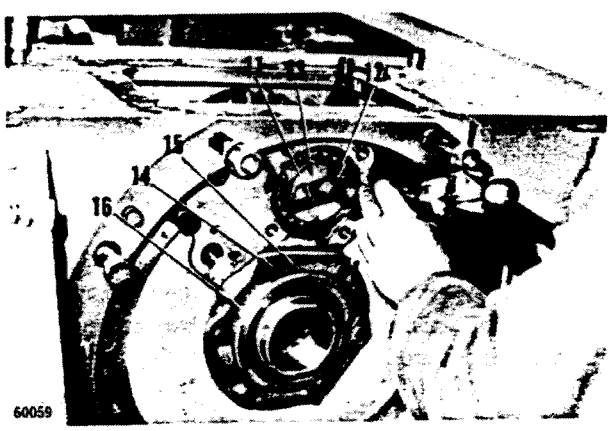
1. Bolt	16. Cage	19-13. Spacer	25. Lock
2. Lock	17. Gasket	20. Bolt	26-1. Shim
3. Key plate	18. Oil seal	21-1. Retainer	26-2. Snap ring
4. Shaft	19-1. Shaft	21-2. "O" ring	26-3. Bearing
5. "O" ring	19-2. Spacer	21-3. Gasket	26-4. Gear
6. Fork	19-3. Gear	21-4. Bearing	26-5. Bolt
7. Bolt	19-4. Collar	21-5. Snap ring	26-6. Washer
8. Lock	19-5. Gear	21-6. Gear	26-7. Nut
9. Bearing cage	19-6. Collar	21-7. Snap ring	26-8. Bolt
10. Gasket	19-7. Wire	21-8. Bearing outer race	26-9. Lock
11. Bolt	19-8. Bolt	21-9. Bearing inner race	26-10. Pinion
12. Lock	19-9. Cover	21-10. Bearing outer race	26-11. Spacer
13. Holder	19-10. Pin	22. Bolt	26-12. Holder
14. Bolt	19-11. Nut	23. Tube	26-13. Bearing cage
15. Lock	19-12. Bearing	24. Bolt	26-14. Bearing

Parts are enumerated in the sequence of disassembling

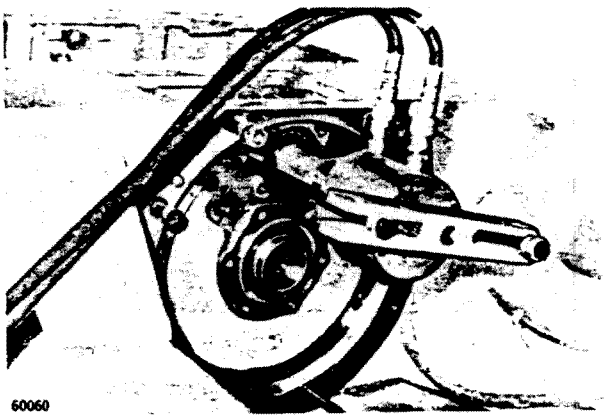
(1) Loosen the bolts (1) and remove the lock (2), key plate (3) and shaft (4).
Loosen the bolts (7) and remove the lock (8), bearing cage (9) and gasket (10).



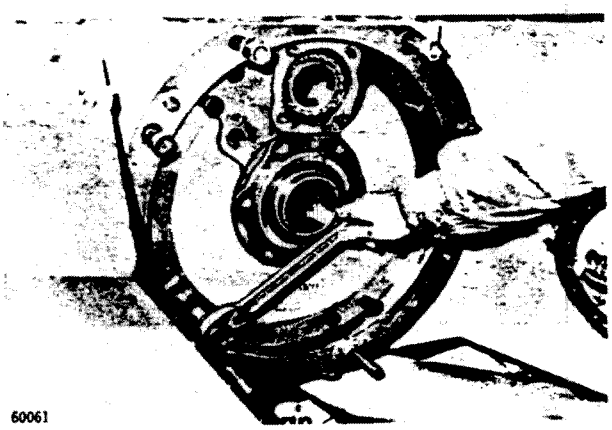
(2) Unfasten the lock, loosen the bolts (11) and take out the lock (12) and holder (13). Loosen the bolts (14) and remove the lock (15), cage (16), gasket (17) and oil seal (18).



(3) With the use of the special tool, draw out the shaft from the bevel gear case side. This involves the job of removing the sub-assembly consisting of the parts numbered (19-1) through (19-13).

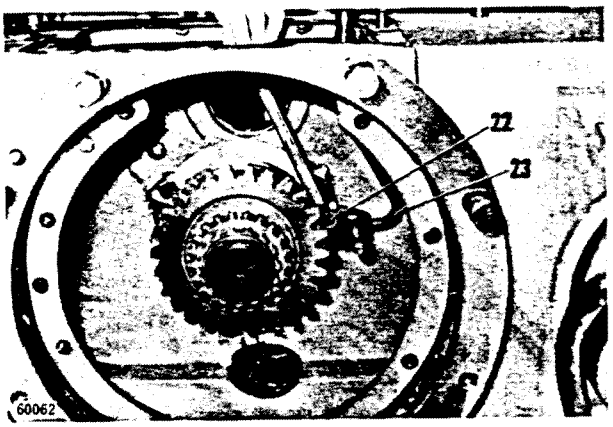


(4) Loosen the bolts (20), and detach the retainer by tightening the jacking bolts. Remove the sub-assembly consisting of the parts numbered (21-1) through (21-10).

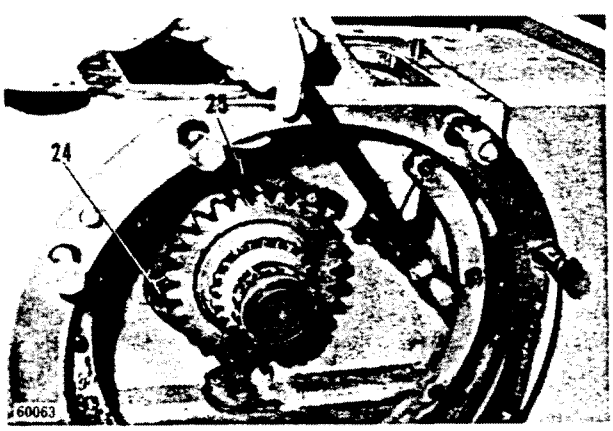


DISASSEMBLING

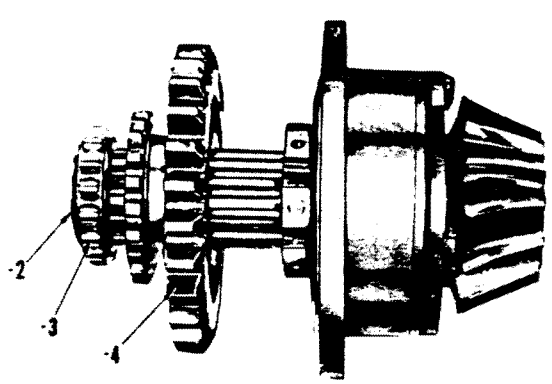
(5) Loosen the bolt (22) and disconnect the tube (23).



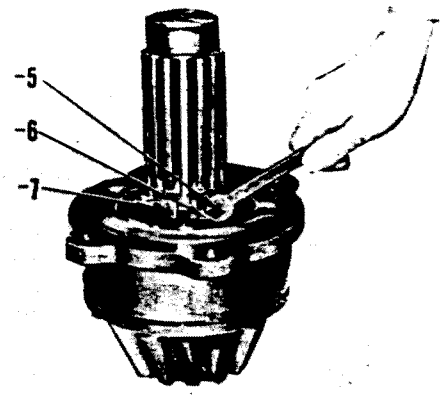
(6) Unfasten the lock, loosen the bolts (24) and remove the lock (25). Draw out the pinion shaft, removing the parts numbered (26 - 1) through (26 - 14), as follows:



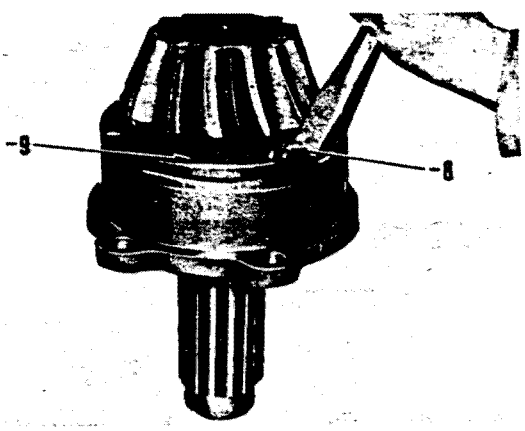
a) Take off the shims (-1), snap ring (-2) and bearing (-3). Remove the gear (-4).



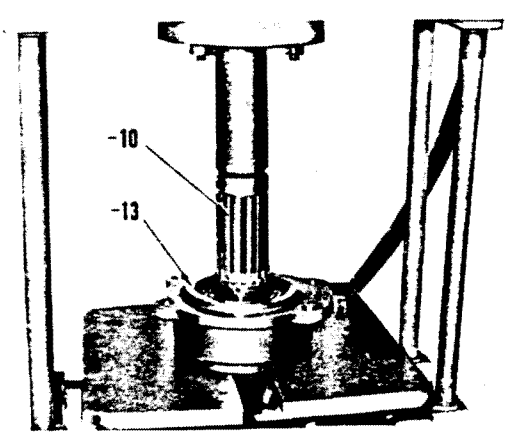
b) Remove the bolts (-5), washers (-6) and nut (-7).



c) Unfasten the lock and remove the bolt (-8) and lock (-9).



d) Draw the pinion shaft (-10) out of the bearing cage (-13) by using the special tool.



CLEANING AND INSPECTION

(1) Check the range transmission gears and the bevel pinion gear for wear of gear teeth and for any sign of damage.

(2) Examine the splines of the pinion shaft and range transmission shaft for condition, and inspect the oil seal surfaces of these shafts for wear.

ASSEMBLING

Build up the range transmission by reversing the disassembling procedure and adhering to the following notes:

(1) Thoroughly clean the interior of the range transmission case before commencing to assemble.

(2) After building up the range transmission, be sure to check and adjust the gear backlash and tooth contact pattern in the bevel gear and pinion of cross drive.

(3) In assembling the range transmission, be sure to install the oil seal (18) so that the spring is pointing toward the inside of the range transmission.

INSTALLATION

(1) Mount the top of the bevel gear case covers securely in place.

(2) Install the shifter assembly.

(3) Mount the torqflow transmission securely in place.

(4) Connect all pipes located on the top of the bevel gear case.

(5) Connect the control linkage and components for the steering brakes.

(6) Connect all control linkage members associated with the control levers.

(7) Mount the side frame assemblage consisting of the operator's seat fuel tank, battery, oil filter and hydraulic oil tank.

(8) Fill by hydraulic oil tank, transmission and steering case with the hydraulic oil to the specified level.

Run the engine at an idling speed for a while. Stop the engine, and check the level of oil in the tank. If necessary, replenish the tank with oil to the specified level.

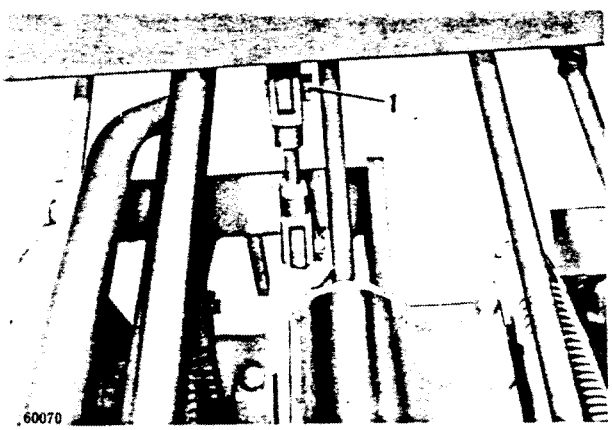
RANGE TRANSMISSION SHIFTER

REMOVAL

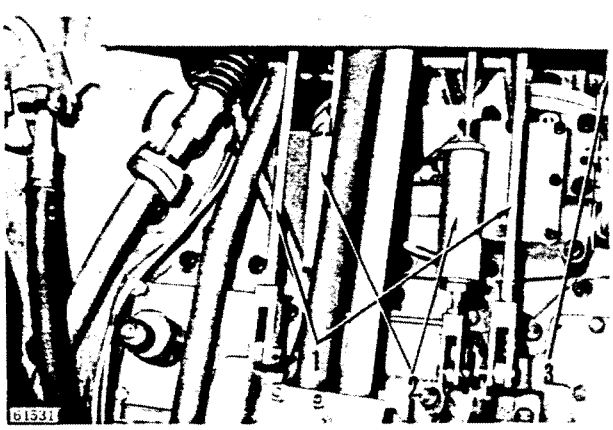
(1) Removal all floor plate.
(Refer to TORQFLOW TRANSMISSION removal procedure.)

(2) Take down the assemblage of operator's seat, battery, and fuel tank.
(Refer to SIDE FRAME removal procedure.)

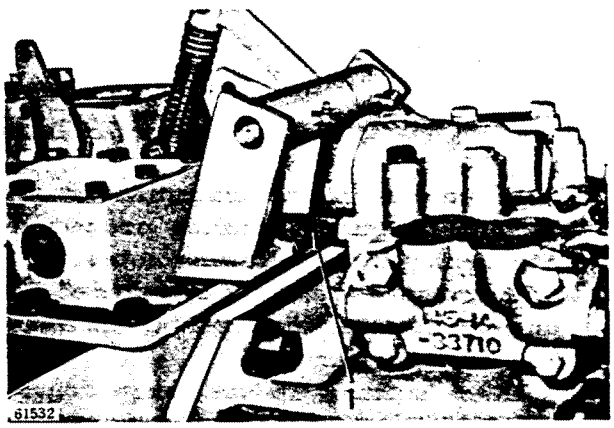
(3) Disconnect range transmission control rod (1).



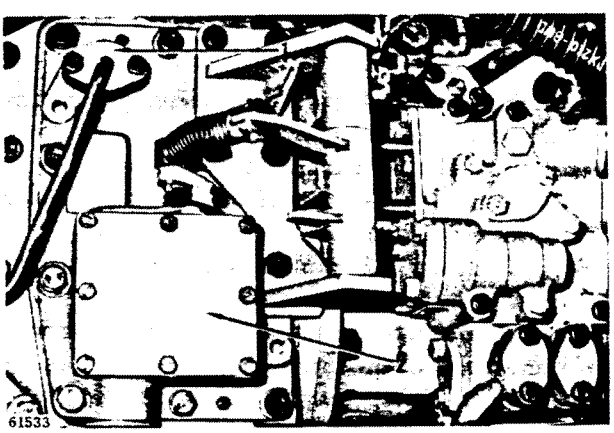
(4) Remove steering brake control rods (1), steering clutch control rods (2), and range shift control rod (3).



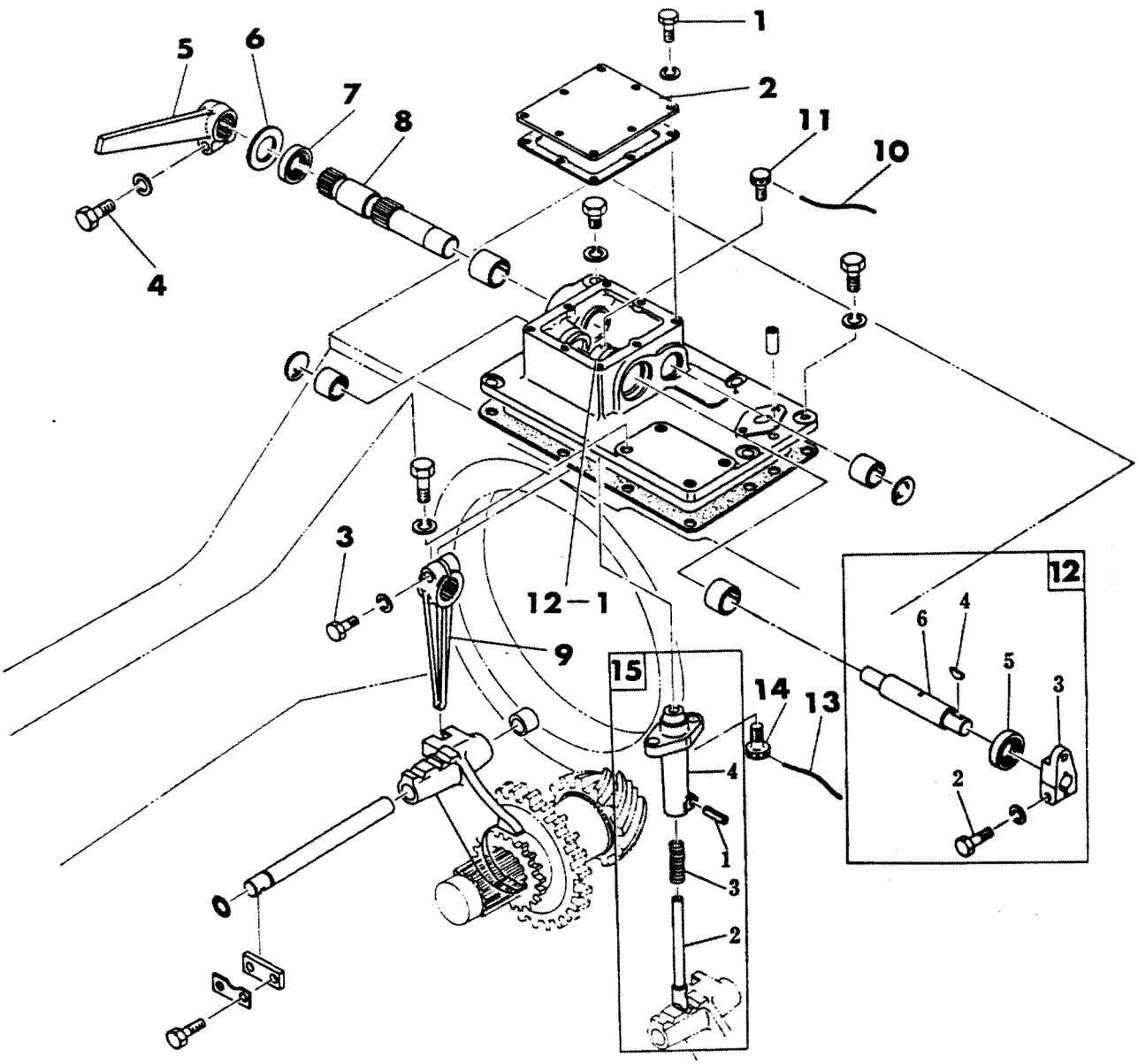
(5) Disconnect torqflow transmission control linkages (1).



(6) Remove flange (1).
Remove the range transmission shifter assembly (2).



DISASSEMBLING



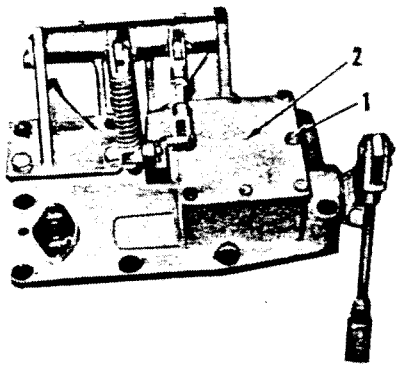
Range Transmission Shifter

1. Bolt	7. Oil seal	12-2. Bolt	14. Bolt
2. Cover	8. Shaft	12-3. Lever	15-1. Roll pin
3. Bolt	9. Lever	12-4. Key	15-2. Plunger
4. Bolt	10. Wire	12-5. Oil seal	15-3. Spring
5. Lever	11. Bolt	12-6. Shaft	15-4. Guide
6. Washer	12-1. Collar	13. Wire	

Parts are enumerated in the sequence of disassembling

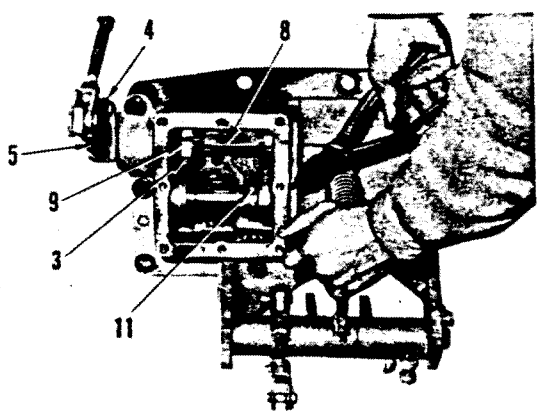
DISASSEMBLING

(1) Loosen the bolts (1) and take off the cover (2).



60074

(2) Loosen the bolt (3) on the lever (9). Loosen the bolt (4) on the lever (5), and disconnect the lever. Remove the washer (6), draw out the shaft (8) and take out the oil seal (7). Remove the wire (10), loosen the set screw (11) and draw out the shaft. (The shaft sub-assembly consists of the parts numbered (12-1) through (12-6) in that order.)



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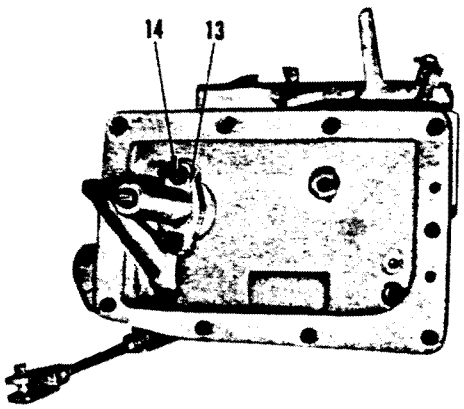
(3) Remove the wire (13) and bolts (14). Remove the plunger assembly out of the place. (Remove the parts numbered (15-1) through (15-4) in that order.)



60076

CLEANING AND INSPECTION

(1) Thoroughly clean all parts.
(2) Examine the plunger tip for wear or any sign of damage.
(3) Examine the springs for fatigue or any other damage.
(4) Inspect the oil seal faces of various parts for wear or any scar or groove marks.

ASSEMBLING

(1) Install the plunger sub-assembly (15) consisting of the parts(15-1)through (15-4)in that order. Be sure to secure the mounting bolds(14)with lock wires.
(2) Assemble the oil seal (12-5) to the shifter case, andinsert the shaft (12-6) in the case, with the collar (12-1) and spacer on the shaft. Install the key (12-4) and the lever (12-3) in place.
Lock the collar mounting bolts (11) with the lock wire (10).
(3) Assembly the oil seal (7) to the shifter case, and insert the shaft (8) in the case. Secure the shaft in position with the bolts. Install the shift lever (9) in place on the shaft, and secure with the bolts (3). Install the washer (6) and lever (5) in place. Be sure to align the lever by referring to the disassembling procedure.
(4) After the lever is securely installed in place, check to see if the lever is actuated smoothly. Install the cover (2). Apply the cover gasket with a gasket-cement on both faces, and install it in position.

NOTE: Just before installing the oil seals of various parts, be sure to apply a thin coat of oil to its faces.

INSTALLATION

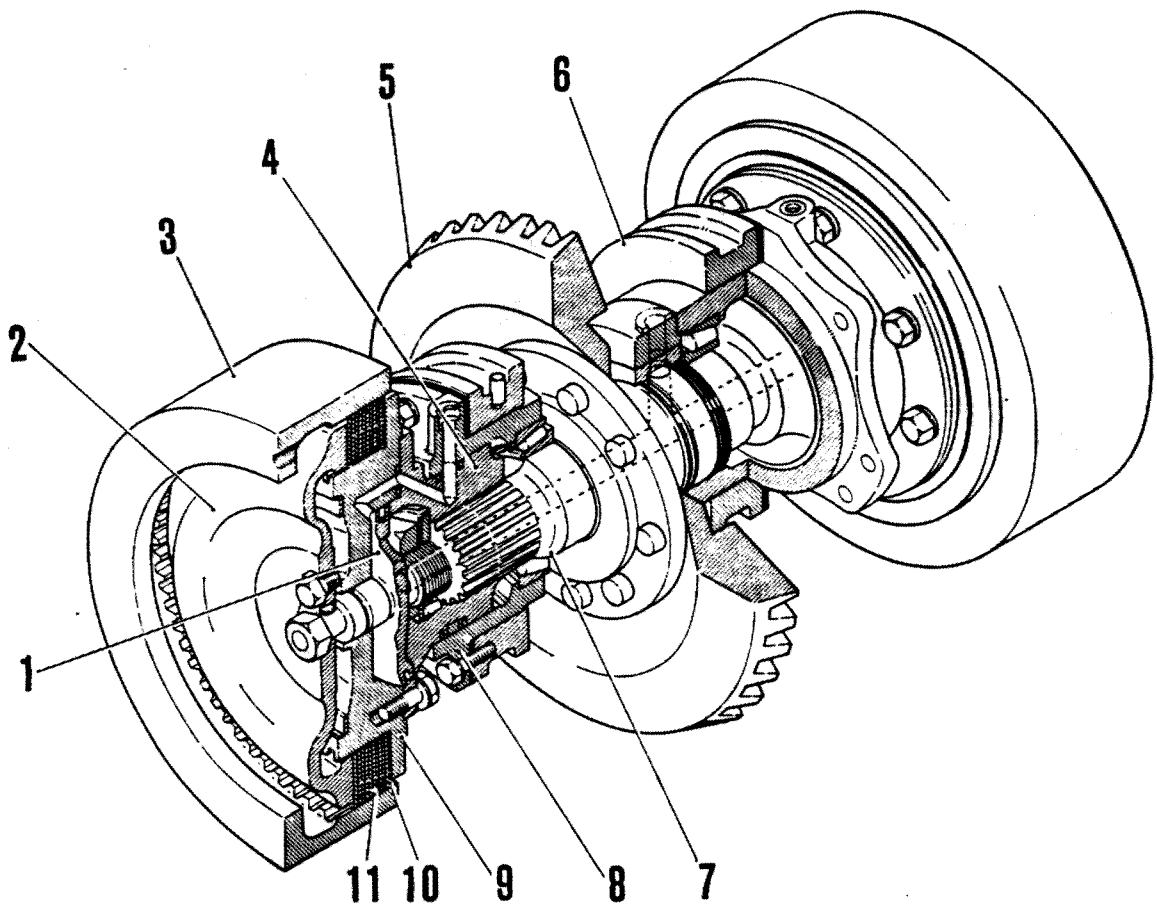
(1) Re-mount the range transmission assembly in the steering cases. Apply a coat of oil to the gasket to prevent an oil leakage through the contacting surfaces of these assemblies.
(2) Affix the flange to the shifter case, taking care not to fold the tip of the O-ring.
(3) Install the control linkage (for the torqflow transmission control valve).
(4) Connect the control rods for various components. Check to see if the pedals and levers are smoothly and positively actuated. If necessary, adjust.
(5) Install the rear frame assembly in position.
(6) Install all floor plates.

BEVEL GEAR AND BEVEL GEAR SHAFT

INDEX

BEVEL GEAR AND BEVEL GEAR SHAFT

DESCRIPTION



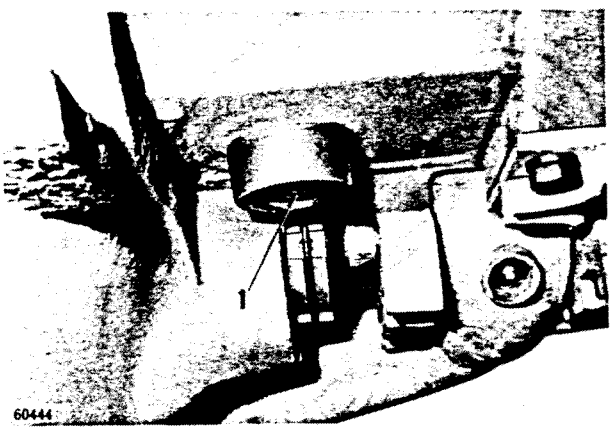
Partial Cutaway View of Bevel Gear and Shaft

1. Piston
2. Pressure plate
3. Brake drum
4. Hub
5. Bevel gear
6. Collar
7. Bevel gear shaft
8. Bearing cage
9. Inner drum
10. Disc
11. Plate

The bevel gear shaft extends sideways or in transverse direction to the right and left steering clutches. The bevel pinion and gear are the branching point at which the output of the range transmission is divided in two paths. Bevel gear is secured to bevel-gear shaft with 8 reamer bolts. The shaft is held by tapered roller bearings. The engagement between pinion and gear is adjusted by displacing the cages or tapered roller bearings for proper tooth contact pattern and backlash. Shims are provided on the cages so that, by reducing or increasing the shim thickness, the cages can be displaced in transverse direction.

REMOVAL

(1) Open each track chain and spread the tracks on the floor.
Lift the machine to permit the sprokets to rotate. Drain the steering case by loosening drain plug (1).



(2) Drain the hydraulic oil tank by loosening its drain plug.
(Refer to CONTROL VALVE removal procedure.)

(3) Take down the side frame assembly. (operator's seat, fuel tank, battery, oil filter and hydraulic oil tank.)
(Refer to SIDE FRAME ASSEMBLY removal procedure.)

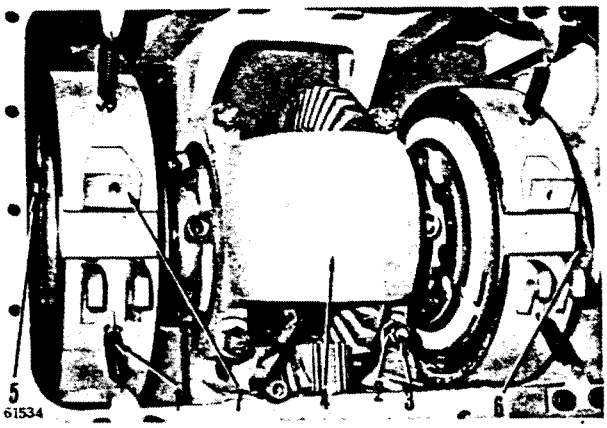
(4) Remove all pipes on the top of steering case.

(5) Remove all control linkages, including those for steering brakes.

(6) Remove the steering control valve.
(Refer to STEERING CONTROL VALVE removal procedure.)

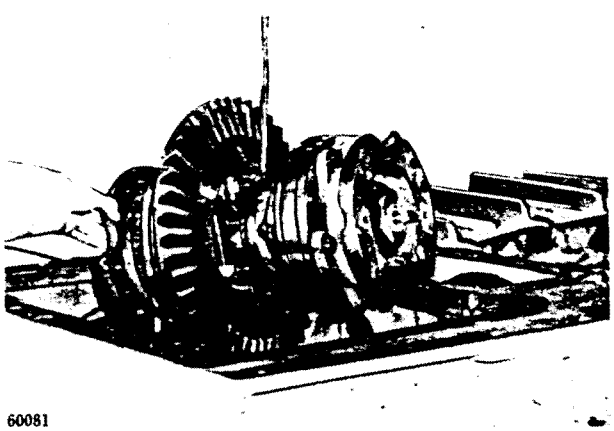
(7) Remove the steering case top cover.

(8) Remove the spring (1).
Pull of cotter pin (2), remove nut (3) and diagonal brace cap (4).

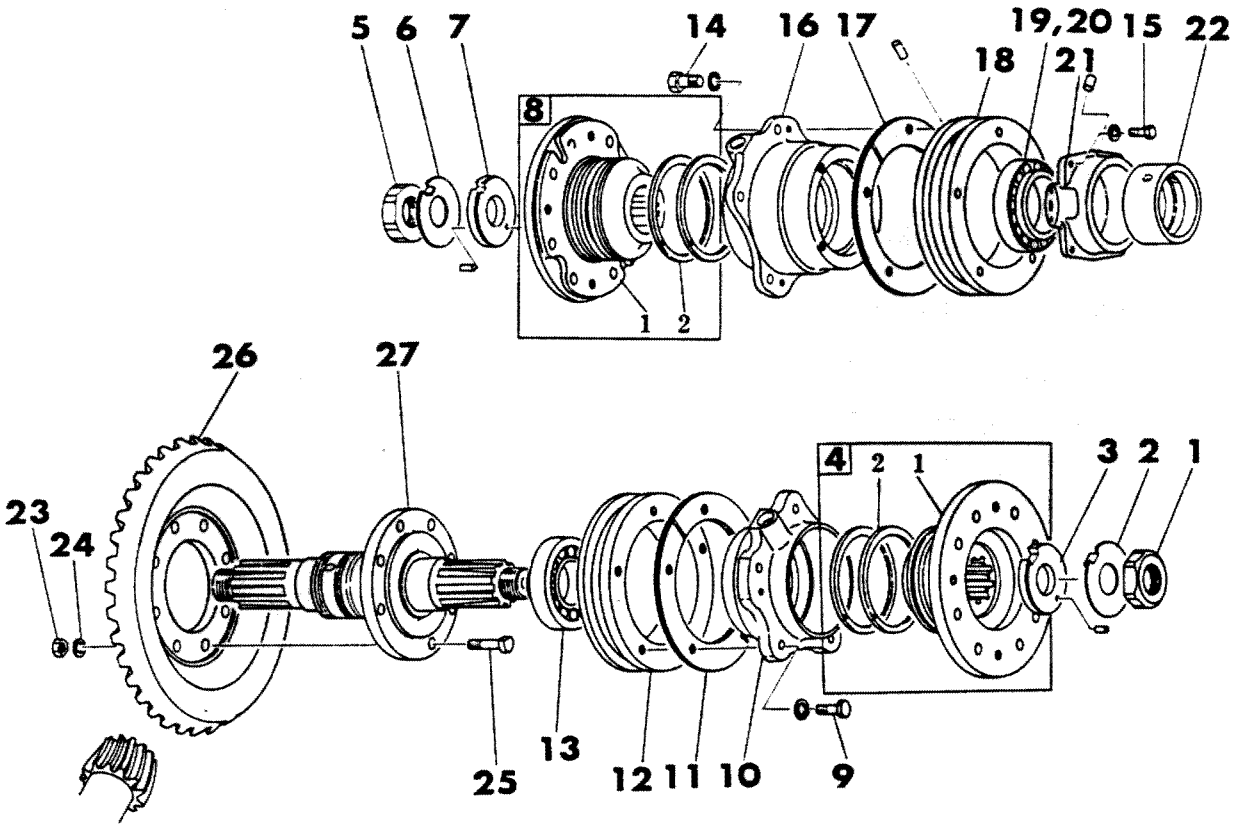


NOTE: Have the cape match-marked in advance.
Remove bolts (5) (6) and take out the steering clutch brake assembly (7).

(9) Lift the bevel gear and shaft out of the case.



DISASSEMBLING



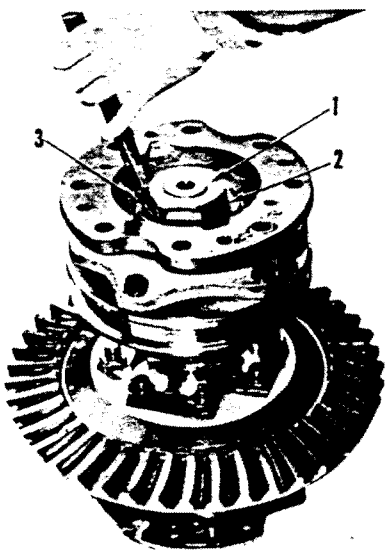
Bevel Gear and Bevel Gear Shaft

1. Nut
2. Washer
3. Collar
4-1. Bearing hub
4-2. Seal ring
5. Nut
6. Washer
7. Collar
8-1. Bearing hub
8-2. Seal ring
9. Bolt
10. Bearing cage
11. Shim
12. Collar
13. Bearing
14. Bolt
15. Bolt
16. Bearing cage
17. Shim
18. Collar
19. Bearing outer race
20. Bearing inner race
21. Flange
22. Bushing
23. Nut
24. Washer
25. Reamer bolt
26. Bevel gear
27. Shaft

Parts are enumerated in the sequence of disassembling.

DISASSEMBLING

(1) Unfasten the lock, and remove the nut (1), washer (2) and collar (3).



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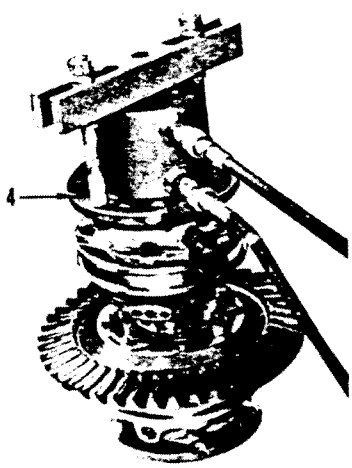
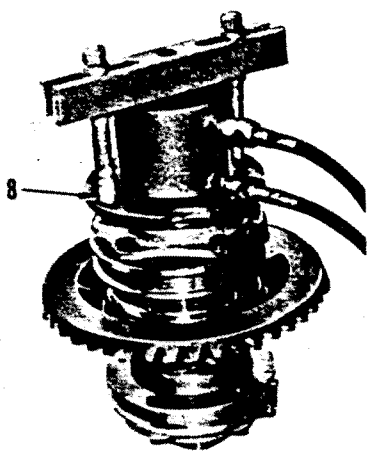
(2) Draw out the bearing hub (4), using the special tool. This removal involves the parts (4-1) and (4-2).



60083

(3) Turn over the bevel gear shaft assembly and repeat the foregoing step (5) to remove the nut, washer and collar on the other side. Using the special tool, pull out the other bearing hub (8).
(This removal involves the parts (8-1) and (8-2).



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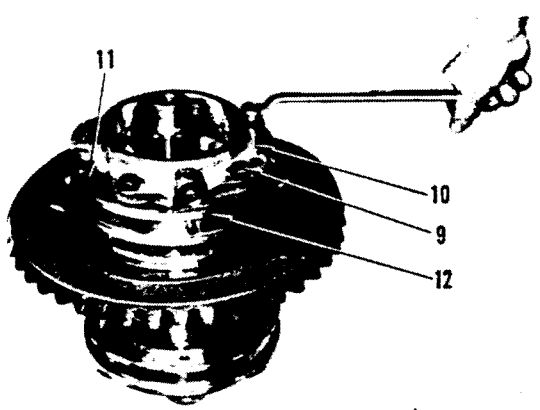
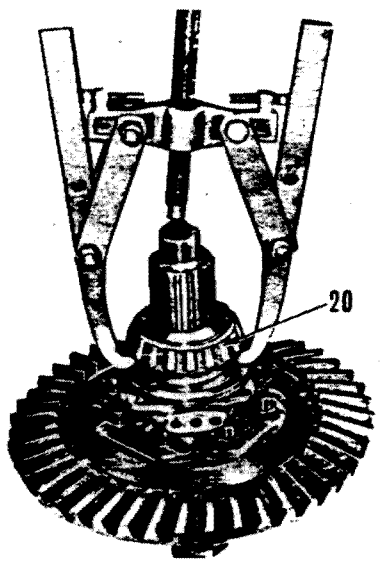
(4) Loosen the bolts (9), and remove the bearing cage (10), shim (11), collar (12) and bearing (13).
Using the bearing puller, remove the bearing cage (16), shim (17), collar (18) and bearing outer race (19) by backing off the bolts (14) and bolts (15) in place.



60085

(5) Remove the bearing inner race (20), using the bearing puller. Remove the other bearing inner race in the same way.



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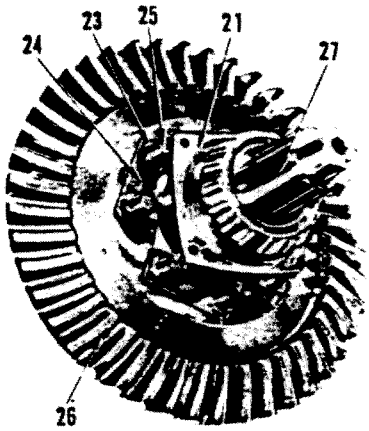
(6) Remove the flange (21) and bushing (22). Take the bevel gear (26) out of the shaft (27) by removing the nuts (23), washers (24) and reamer bolts (25) in place.



60087

CLEANING AND INSPECTION

(1) Clean bevel gear and check it for gear tooth wear, spalling or any other damage.

(2) Inspect the splines of bevel gear shaft for damage.

(3) Inspect the fit of bevel gear shaft in bearings for any signs of malcondition.

(4) Check the bevel gear shaft for runout, as follows:

Support the shaft, as shown, with bevel gear mounted on it. Turn the shaft and measure the amount or runout at its mid-section with a dial gauge.

If the limit on runout is exceeded, straighten the shaft in a press.

(5) Also check the bevel gear for runout with the dial indicator.

A bevel gear exhibiting any excessive face runout must be replaced by a new one.

The re-use limit on bevel gear face runout is 0.05 mm (0.002") (as mounted on the bevel-gear shaft).

Backlash is required to be within 0.19 mm (0.007") at any part of the gear.

NOTES:

1) Before building up the bevel gear group at the time of assembling, thoroughly clean the steering clutch cases and bevel gear case.

2) Inspect the case for cracks by the dye penetrant method or magnetic-particle method.

Repair cracks, if any, by welding.

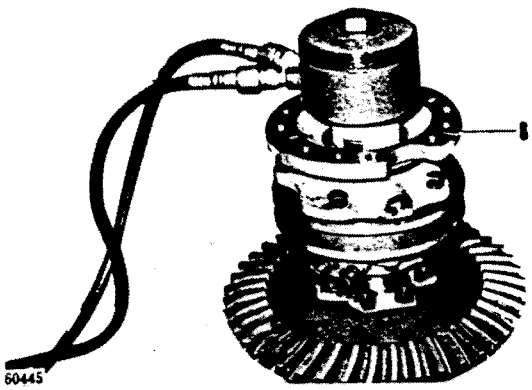
3) When mounting the bevel-gear shaft in the case, be sure to have shims fitted to the shaft at its right and left sections.

4) In installing the bearing cage, be sure to position it correctly as guided by the positioning slot provided on the steering clutch case, to which the positioning pin of the cage is to be fitted.

ASSEMBLING

(1) Install the bevel gear shaft (27) and bevel gear (26) in place. Be sure to lock the mounting nuts with lock washers.
(2) Install the bushing (22), flange (21), bearing (20), collar (18), shim (17), bearing case (16) onto the shaft in this order. Secure the flange (21) to the bearing case (16) with the bolts (15), and the collar (18) to the bearing cage (16) with the bolts (14).
(3) Install the bearing (13), collar (12), shim (11) and bearing cage (10) onto the bevel gear shaft, and secure the collar (12) to the bearing cage (10) with the bolts (9).
(4) Press-in the bearing hub (8) securely, using the special tool. Install the other bearing hub (4) in the same way, and secure with the nuts (1) (5).

Be sure to lock the nuts with the lock washers (2) (6).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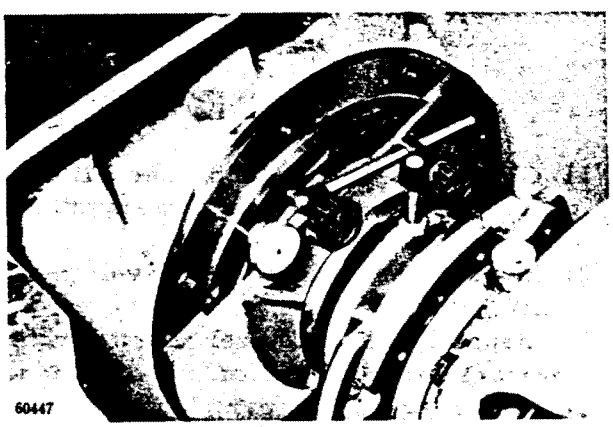
INSTALLATION

(1) Before building up the bevel gear shaft assembly, be sure to clean the interior of the case thoroughly.
(2) Install the bevel gear assembly in the case securely. After re-installing the diagonal brace cap, check the bevel gear and bevel pinion for tooth contact pattern and gear backlash. When mounting the bevel gear shaft in the case be sure to have shims (11) (17) fitted to the shaft at its right and left sections. After correct adjustment having made on the shaft, retighten the cap mounting nuts and lock with the cotter pin.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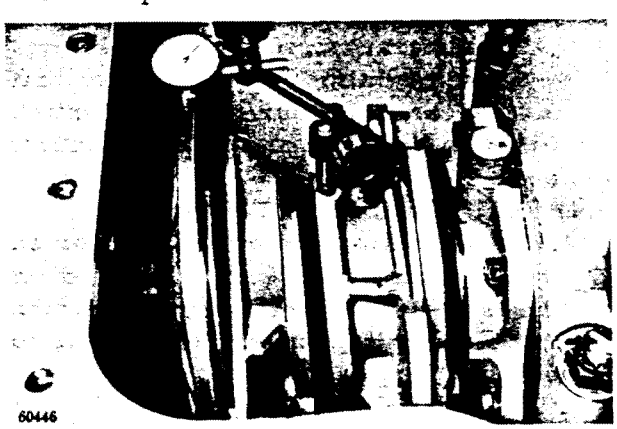

60446

(3) Before installing the steering clutch assembly in place, check the flanges on the side of the final drive and the bevel gear side for face run-out.
(4) Install the steering clutch assembly in place.
(5) Install the steering clutch top cover. Connect all pipes for actuating the steering clutch control.
(6) Mount the clutch control valve in position.
(7) Connect all pipes and rods for steering clutch control lever.

(8) Mount the side frame and rear frame assemblies in place.
(9) Refill the hydraulic oil tank and steering clutch case with hydraulic oil to the prescribed level.
(10) Couple the track chain. Remove the block placed under the chassis for the sprockets to be floated off the floor.

ADJUSTMENT

(1) Before adjusting the bevel pinion and gear for backlash and tooth contact pattern, it is necessary to adjust the tightness of tapered roller bearings located at the right and left ends of bevel-gear shaft. This adjustment is to be effected by using shims on each bearing cage to introduce a preload on the bevel-gear shaft. Put in such an amount of shims as will preload the shaft to an extent of requiring a 1.5-2 kg-m (11-14 ft-lb) torque to hand-turn it. With this much preload, the shaft will readily rotate when turned by hand.
(2) The specified tooth contact pattern is to be introduced all around in the mesh between pinion and gear. The contacting area is prescribed to take the shape shown and be within the following ranges:

"a"-Width of contact area 30-50%
"b"-Center of contact area 25-40%

The contact area should be entered on the pitch line, without extending to the toe or heel, and should not cover the full area of face or flank. This requirement applies to both leading (forward driving) and trailing (reverse driving) sides of the gear tooth.

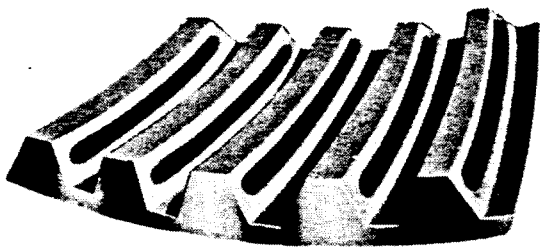
The procedure of advancing or receding the pinion and gear is as follows:

i) To advance the pinion, reduce the amount of shims located next to the bearing cage behind the range transmission shaft. Increasing the shim thickness recedes the pinion.
ii) To measure the backlash between pinion and gear, roll a piece of fuse stock into the mesh to flatten it, and mike the thickness of the flattened fuse stock. To adjust the backlash to the specification 0.25-0.33 mm (0.01-0.013 in), advance or recede the pinion and gear as in i) and ii) above.

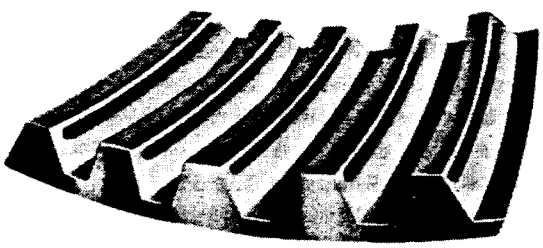
NOTE:

1) An amount of shim taken from one side for reducing the shim thickness there must be added to the shims on the other side.
2) In making adjustment with nuts, be sure to turn the nuts by equal amount and in the same direction at both sides.
3) To measure the bearing preload on bevel gear shaft, use a spring scale and a string, as shown, and read the scale indication when the shaft begins to turn. The string is to be hitched to one of securing nuts.

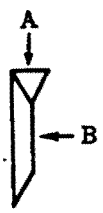
TOOTH CONTACT ADJUSTMENT



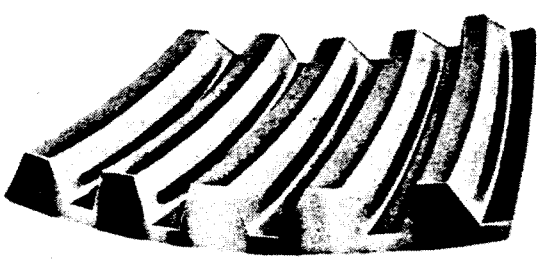
Tooth contact pettern is uniform and extends about 80% of the tooth face from the toe.



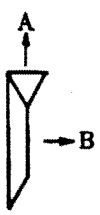
High Contact



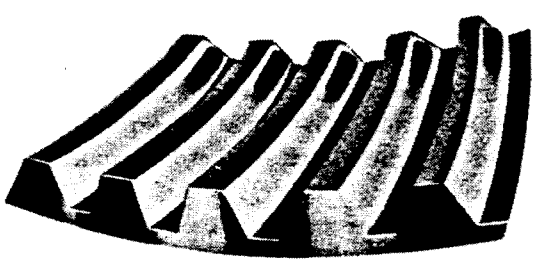
Move pinion closer to gear. Backlash will decrease. Increase the backlash by moving gear away from pinion. Move pinion away from gear.



Low Contact

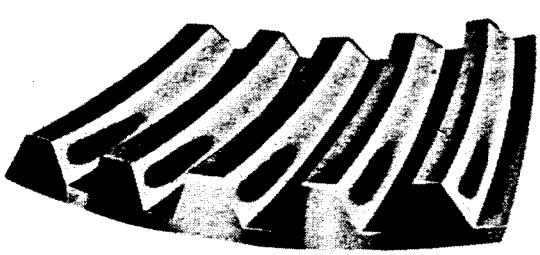


Move pinion away from gear. Backlash will increase. Decrease the backlash by moveing gear closer to pinion.

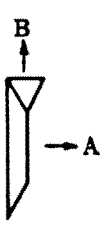


Toe Contact

Move gear away from pinion. Backlash will increase. Decrease the backlash by moving pinion closer to gear



Heel Contact



Move gear closer to pinion. Backlash will decrease. Increase the backlash by moving pinion away from gear.

STEERING SYSTEM

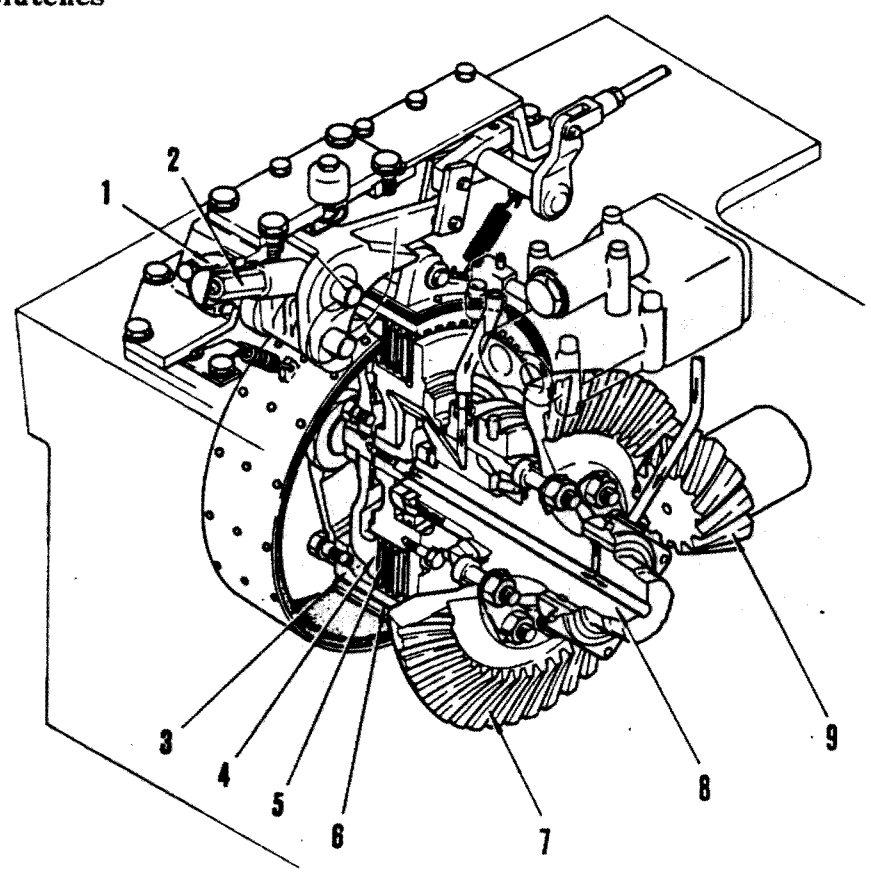
INDEX

STEERING SYSTEM

STEERING CLUTCHES AND BRAKES

DESCRIPTION

A. Steering Clutches



Steering Clutch

1. Cover
2. Adjust bolt
3. Drum
4. Pressure plate
5. Lining
6. Brake lining
7. Bevel gear
8. Bevel gear shaft
9. Pinion shaft

Each steering clutch is housed in the end portion of the steering case.

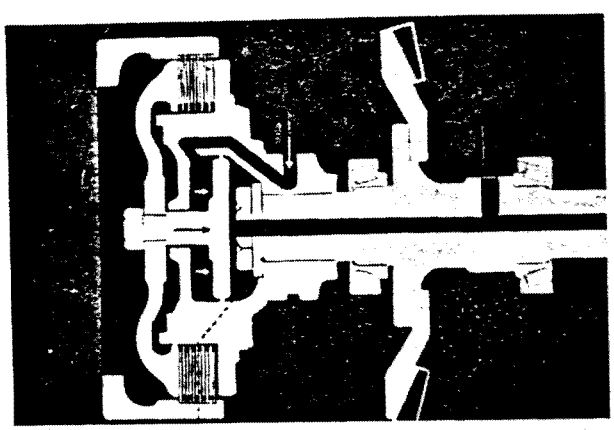
It is accessible through an opening provided in the case and normally covered with a plate. This plate is designated as the steering clutch cover. The clutches are of hydraulically-actuated multi-disc wet type consisting, essentially, of disc, plates, a drum, a piston and springs.

DESCRIPTION

(1) Clutch Engaged

With the machine in normal traveling condition, a hydraulic pressure of 25 kg/cm^2 (356 PSI) (set at the steering control valve) applies to the inner side of piston while its outer side (bevel gear side) receives a pressure 0.5 - 1.0 kg/cm^2 (7 - 14 PSI) (this pressure is constantly applied to the piston).

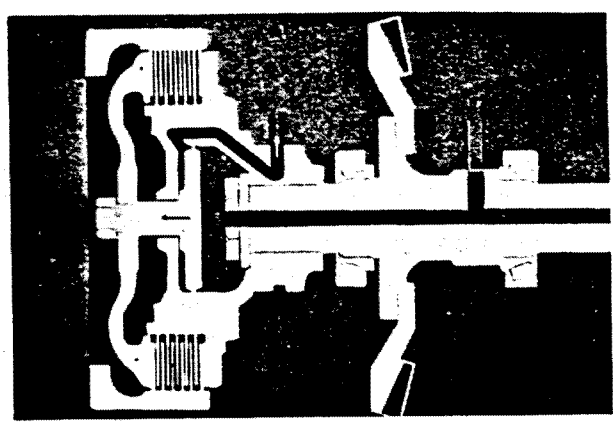
Under this condition, the piston pulls on the pressure plate to compress the stack of discs and plates, thereby transmitting drive through the now tight pack of discs and plates to the final drive.



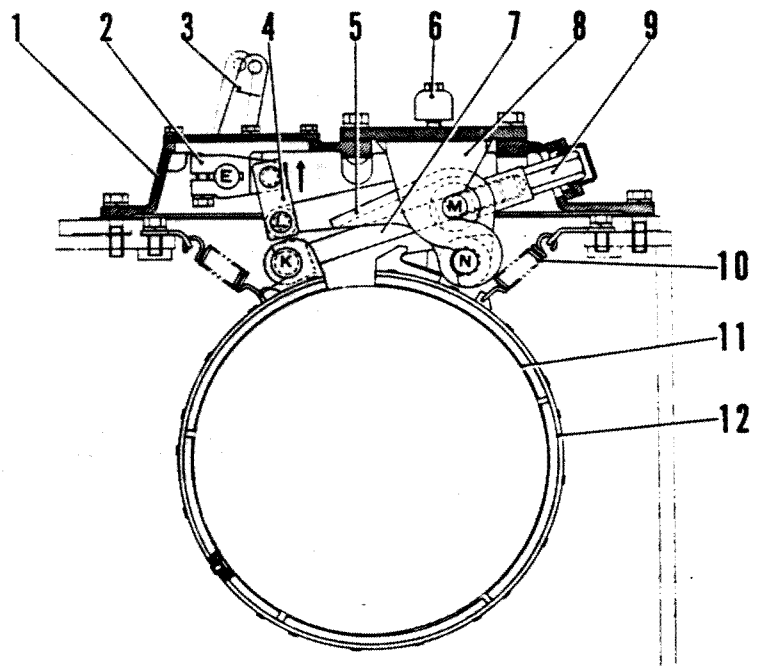
(2) Disengaging Action

Lightly depressing the steering clutch pedal (right or left) actuates the control valve to shut off the 25 kg/cm^2 (356 PSI) oil from the clutch on that side. The 0.5 - 1.0 kg/cm^2 (7 - 14 PSI) pressure, which is constantly transmitted through the bevel-gear shaft, causes piston to move in releasing direction. This movement releases plate and loosens the stack of discs and plates so that discs and plates slide with respect to each other, thereby interrupting the flow of drive to the final drive.

The constantly-applied 0.5 - 1.0 kg/cm^2 (7 - 14 PSI) oil is bled out of hole provided in the drum. This oil wets the disc surfaces and brake lining to cool these friction members for increasing their durability.



B. Steering Brakes



Brake Mechanism

1. Cover	5. Lever	9. Adjusting nut
2. Lever	6. Breather	10. Spring
3. Lever shaft	7. Rod	11. Brake lining
4. Link	8. Bracket	12. Brake band

The steering brakes are of wet type designed to apply braking force by tightening a lined band around a rotating drum. Each brake is actuated from the steering pedal through a linkage. The brake band is effective for both directions of rotation of the brake drum. As the traveling direction changes, the anchoring point of the brake band shifts from one end to the other, but the band itself is tightened for braking by the force acting on the two ends simultaneously. The lever turns around point (E).

As the level turns, point (L) shifts upward, but point (M) remains in its position so that point (N) moves to the right.

The end shift around point (M) in the direction for tightening the brake band and thereby applies braking force.

In the released condition, the steering brake is prescribed to have a certain amount of clearance between the brake band and the drum.

The standard value of this clearance is 0.3 mm (0.0118"). To adjust the brake for a proper clearance, remove the cover located at the top rear section of the steering clutch case so gain access to the adjusting screws.

This screw is to be tightened for reducing, and loosened for increasing, the band-to-drum clearance. The standard clearance will automatically result when the adjusting screw is backed away one and a half (1-1/2) rotations from its fully screwed-in position (at which the band bears against the drum).

REMOVAL

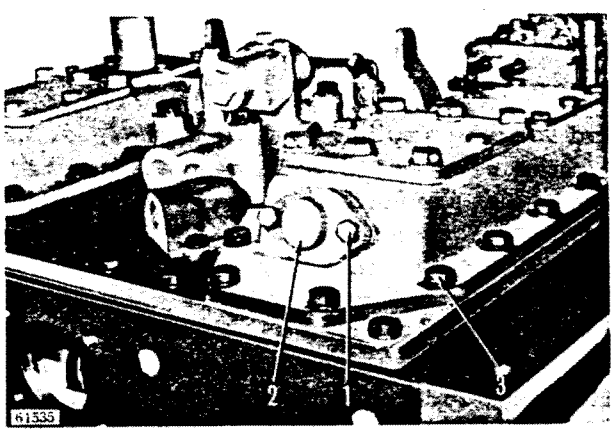
In removing and re-mounting the steering system, be sure to handle the complete assembly of clutch and brake as a unit. Removal of brake band only is permissible when the band alone is to be replaced, or otherwise serviced off the machine.

(1) Take down the rear frame assembly (fuel tank, battery and operator's seat). (Refer to SIDE FRAME removal procedure.)

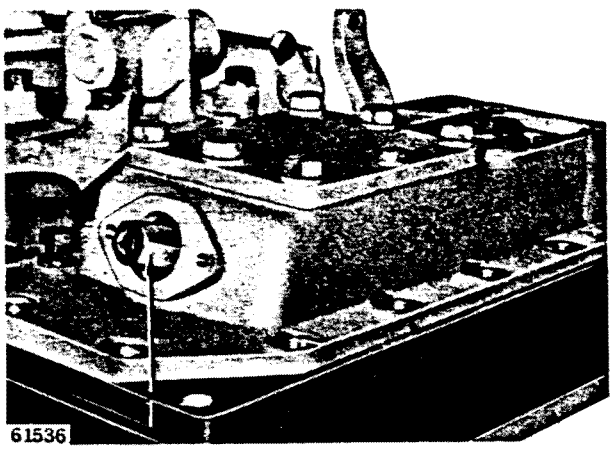
(2) Remove all floor plate. (Refer to TORQFLOW TRANSMISSION removal procedure.)

(3) Disconnect and remove those pipes on the top of steering case which interfere with removal of the steering clutch assembly. (Have the hydraulic system drained in advance.) Disconnect the steering brake actuating rod at each clutch, in accordance with RANGE TRANSMISSION removal procedure.)

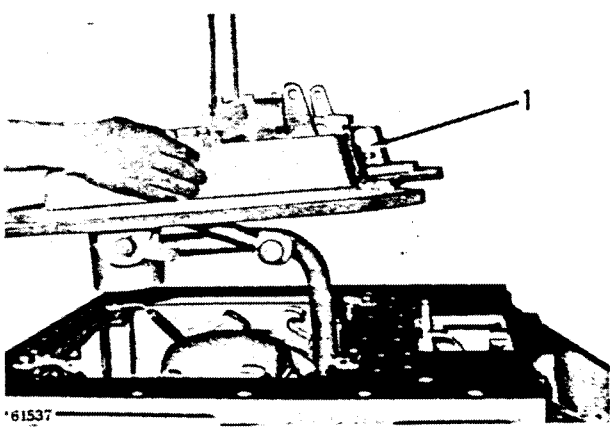
(4) Loosen bolts (1) and remove cover (2).
Loosen bolts (3).



(5) Loosen the brake lining adjusting bolt (1).

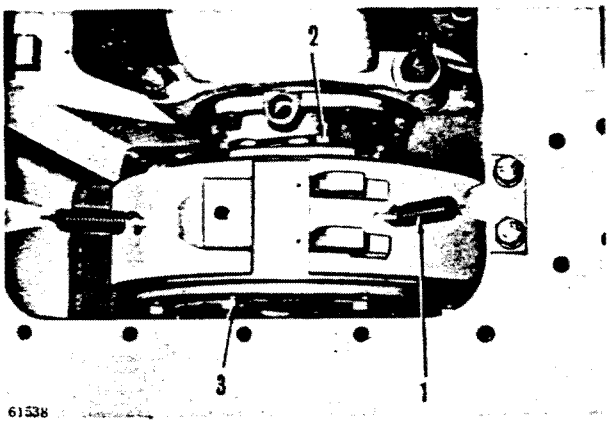


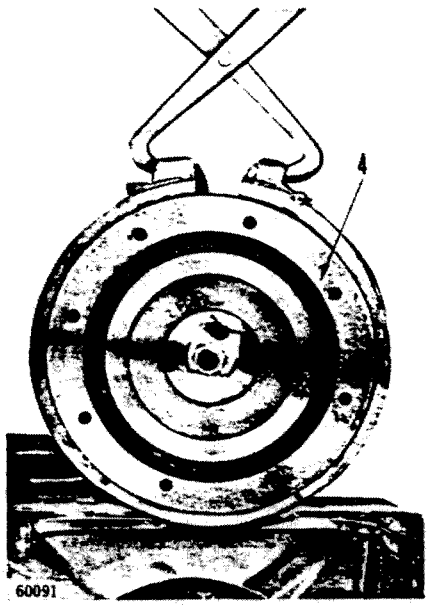
(6) Dismount the steering brake cover (1).



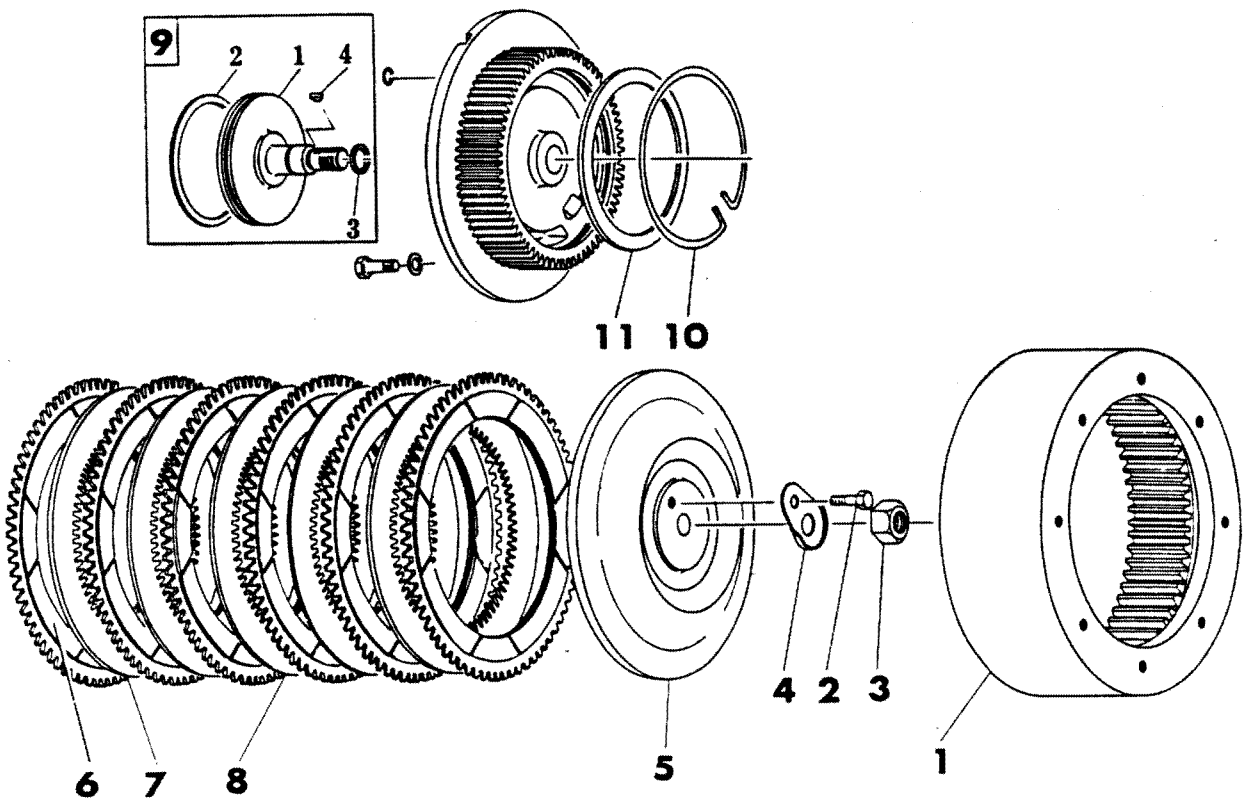
(7) Remove the spring (1), and loosen the clutch mounting bolts (2) (3), one at a time, by gradually rotating the sproket unitl all bolts are removed.

Using an overhead hoist, take up the weight of the clutch assembly (4).





DISASSEMBLING



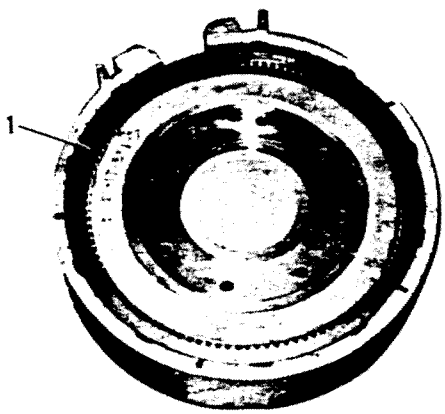
Steering System

1. Drum	5. Plate	9-1. Piston	9-4. Key
2. Bolt	6. Lining	9-2. Seal ring	10. Snap ring
3. Nut	7. Disc (A)	9-3. Seal ring	11. Plate
4. Lock	8. Disc (B)		

Parts are enumerated in the sequence of disassembling.

(1) Remove brake band and clutch drum (1).

(2) Remove bolt (2), nut (3) and lock (4). Take off plate (5), lining (6), disc (A) (7) and disc (B) (8).



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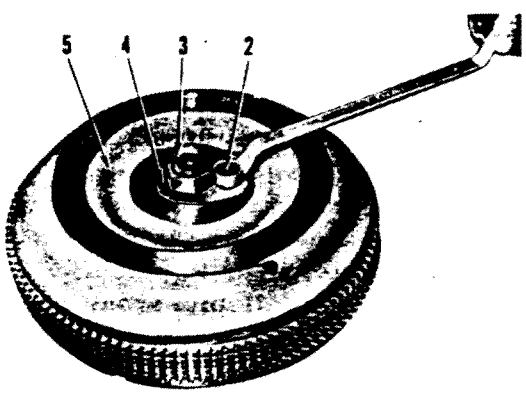

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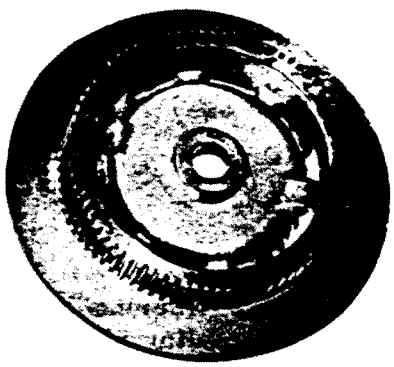
(3) Draw piston (9) off drum (1), removing all the parts (9-1) through (9-4).



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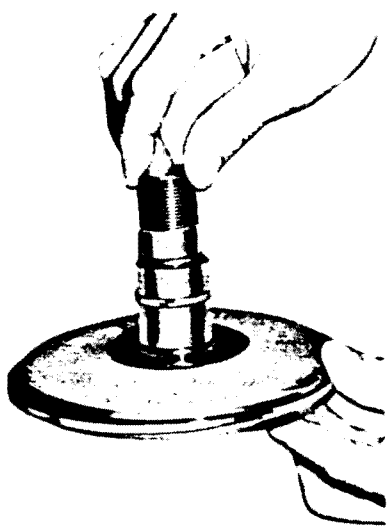

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CLEANING AND INSPECTION

(1) Inspect clutch linings for wear or contact pattern.
(2) Examine the clutch plates and discs for wear, deformation, erratic wear pattern, including stepped or uneven wear, or scar or groove marks. Clean these parts thoroughly.
(3) Examine the toothed parts of drum, plate and disc for wear or damage.
(4) Inspect the adjusting screw tip for wear or damage.
(5) Inspect the brake lining for contact pattern or wear, and check the lining rivets for tightness.
(6) Inspect the brake band for damage.
(7) Examine the friction surface of drum for wear or damage.
(8) Examine the piston, particularly the piston ring grooves, for wear or damage.

(9) Inspect the piston rings for wear.
(10) Check the piston and drum for damage or wear of sliding surfaces.
(11) Inspect the piston oil seal for wear or damage.
(12) Inspect the brake control linkage for wear or damage.

ASSEMBLING

To assemble the steering brake, reverse the disassembling procedure outlined above. When securing the piston to the plate, be sure to lock the securing nut in place.

INSTALLATION

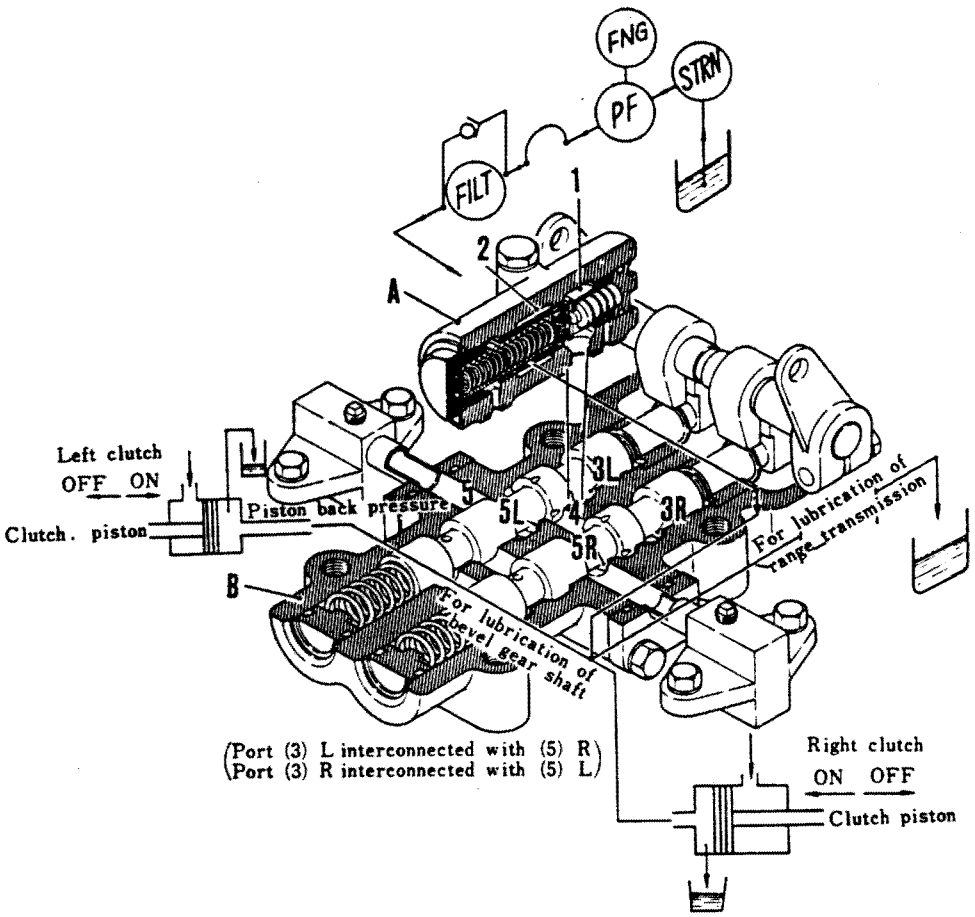
(1) Install the clutch assembly on the flanges at the final drive and bevel gear device, aligning the oil groove for lubricating the clutch piston with that provided on the bevel gear shaft compartment. Re-tightening the mounting bolts may be done in the same manner as outlined in the preceeding paragraph, "that is", by rotating the sprocket and by tightening the bolts, one by one, until all bolts tightened in place.
(2) Install the link support in place by aligning the link support pawl with its receptacle provided on the brake band correctly. Restore the spring adequately.
(3) Brake band may be adjusted for correct actuation by means of the brake adjusting bolts. After adjustment, install the cover, connect the linkage and the job is done.
(4) Make sure that the brake linkage and lever is adequately actuated. Install the peep hole cover in place.
(5) Re-connect all pipes on the top of the cover. Couple the control rods securely.
(6) Re-mount the rear frame assembly in position.
(7) Install all floor plates in place.

ADJUSTMENT

(1) Remove the adjusting cover.
(2) Tighten the brake adjusting bolt all the way to bring the brake band into fullface contact with the brake drum.
(3) Turn out the bolt 2-1/2 turns from the above position and see if the band-to-drum clearance is held within 0.3 mm (0.0118").

STEERING CONTROL VALVE

DESCRIPTION



Control Valve

The steering control valve unit is mounted on the top of the steering clutch case, and consists of three valve elements; a pressure adjusting valve (A) and two control valves (B). Valve (A) receives pressurized oil from the gear pump and limits the pressure rise in the lines leading to the pistons in the right and left steering clutches. Control valves (B) are means of applying oil pressure to respective steering clutch pistons, and are actuated from the steering clutch pedals. The pedal is depressed to move the control valve (B) into the position for shutting off the supply of pressurized oil to the piston. Upon loss of this pressure, the piston moves in the clutch disengaging direction as has been outlined.

In each steering clutch case the oil falls into its sump, from which the gear pump lifts oil and forces it through the filter. Passing the filter, the oil enters valve (A) and leaves this valve through its port (1) for the ports (4) (5) of control valves (B). Port (5L) is for the left clutch, and port (5R) is for the right clutch.

When control valve (B) is actuated into the position for engaging the clutch, the pressure in the line to the piston builds up. As the pressure reaches

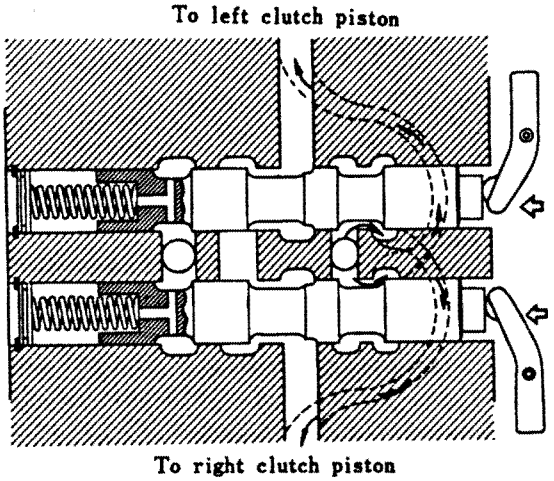
25 kg/cm^2 (356 PSI), valve (A) starts bleeding more of the oil through its part (2), thereby limiting the pressure rise to 25 kg/cm^2 (356 PSI). As long as the gear pump is in operation, a certain amount of oil is bleed out by valve (A).

Part of this bleed-out flows in the oil passage provided through the center of the bevel gear shaft and goes to the cavity on the back of the clutch piston to apply a force to the piston in the disengaging direction and wets the clutch discs and brake band to cool these friction members. The remaining part of the oil lubricates the range transmission and bearings, and returns to the steering case.

The force which the constantly bled-out oil exerts to the back of the piston is at a much lower value than the 25 kg/cm^2 (356 PSI) pressure (for engaging the clutch). When the clutch is in engaged condition, these two pressure are acting on the piston but it is the difference between these two that keeps the clutch engaged.

(1) Both Clutches Engaged

(both pedals left in normal condition)

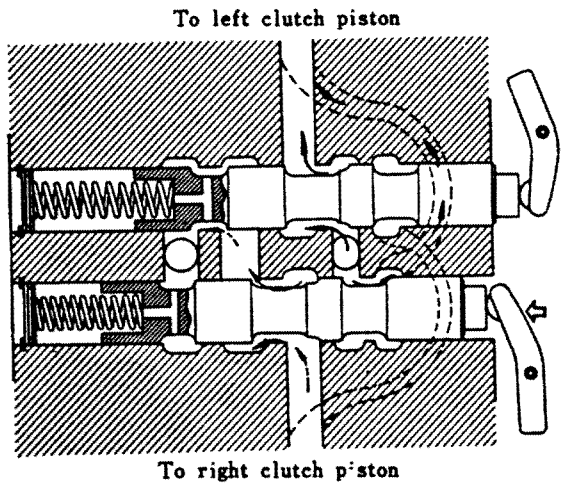


Both pedals depressed
(Both clutches engaged)

With the right and left steering clutch pedals left in normal condition, the control valve unit is in such a state that the pressurized oil supplied from the gear pump is passed through ports (5R) (5L) to the respective pistons. Under this condition, the 25 kg/cm^2 (356 PSI) pressure acts on both pistons to keep the clutches engaged.

(2) Left Clutch Engaged

(right pedal depressed)



Right pedal depressed
(Right clutch disengaged)
(Left clutch engaged)

Depressing the right steering clutch pedal causes the right control valve (B) to move in the direction of the arrow indicated and drain the oil that has been passed onto the right clutch. This removes the 25 kg/cm^2 (356 PSI) pressure off the right piston to disengage the right clutch. No change occurs to the hydraulic pressure being applied to the left piston, and the left clutch remains in engaged condition.

(3) Right Clutch Engaged

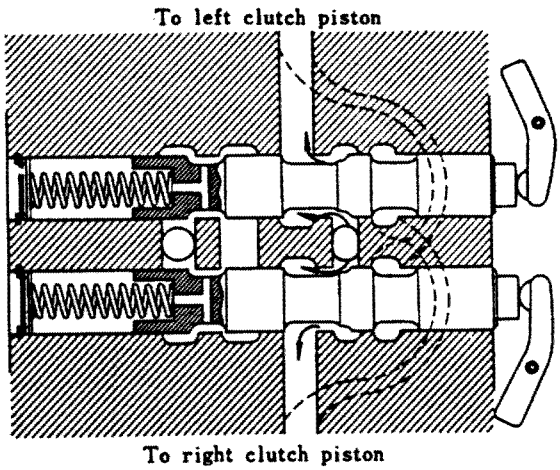
(left pedal depressed)

Depressing the left steering clutch pedal affects the left clutch in the same manner as above to disengage this clutch.

(4) Both Clutches Engaged

(both pedals depressed)

When both pedals are depressed, as shown, the two control valves (B) move similarly to admit the pressurized oil to both pistons. Under this condition both clutches remain engaged.

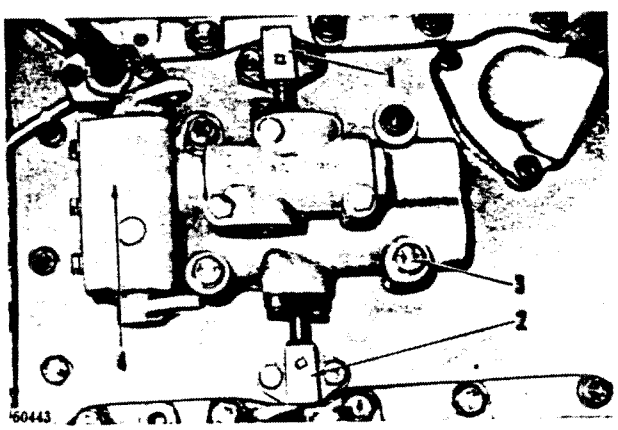


Both pedals depressed
(Both clutches engaged)

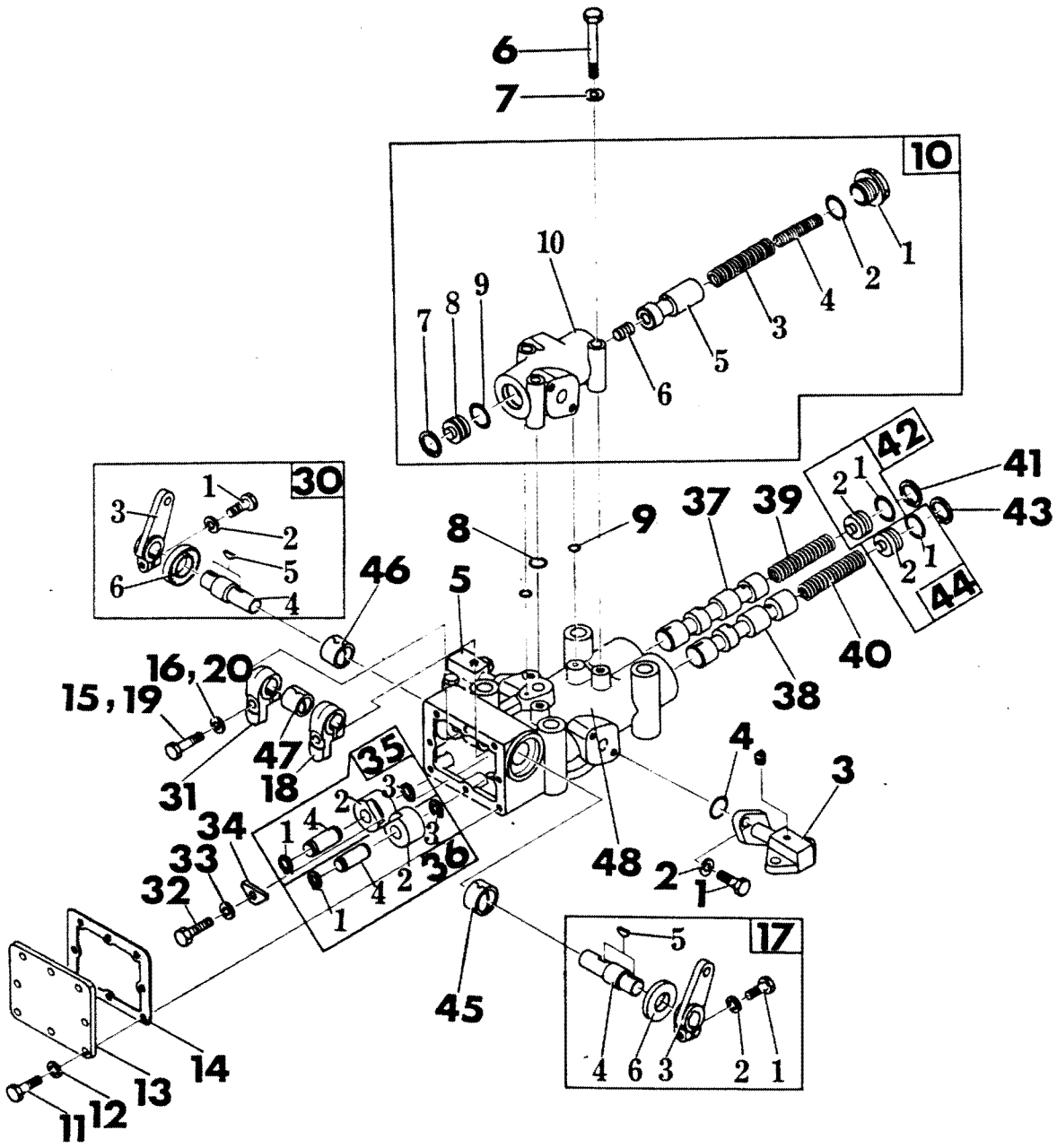
REMOVAL

(1) Remove the steering clutch assemblies and those parts on the top of the steering case.

(2) Remove the flanges (1) (2), loosen the bolts (3) and dismount the control valve (4).



DISASSEMBLING



Steering Control Valve

1. Bolt
2. Spring washer
3. Tube
4. "O" ring
5. Tube
6. Bolt
7. Spring washer
8. "O" ring
9. "O" ring
10-1. Plug
10-2. "O" ring
10-3. Spring
10-4. Spring
10-5. Valve
10-6. Piston
10-7. Snap ring
10-8. Plug
10-9. "O" ring
10-10. Valve body
11. Bolt
12. Spring washer
13. Cover
14. Gasket
15. Bolt
16. Spring washer
17-1. Bolt
17-2. Spring washer
17-3. Lever
17-4. Shaft
17-5. Key
17-6. Oil seal
18. Lever
19. Bolt
20. Spring washer
30-1. Bolt
30-2. Spring washer
30-3. Lever
30-4. shaft
30-5. Key
30-6. Oil seal
31. Lever
32. Bolt
33. Spring washer
34. Lock
35-1. Snap ring
35-2. Bushing
35-3. Snap ring
35-4. Plunger
36-1. Snap ring
36-2. Bushing
36-3. Snap ring
36-4. Plunger
37. Valve
38. Valve
39. Spring
40. Spring
41. Snap ring
42-1. "O" ring
42-2. Plug
43. Snap ring
44-1. "O" ring
44-2. Plug
45. Bushing
46. Bushing
47. Bushing
48. Valve housing

Parts are enumerated in the sequence of disassembling.

CLEANING AND INSPECTION

(1) Thoroughly clean all removed parts in an approved solvent, and dry with compressed air.
(2) Inspect the valve, noting the condition of sliding and seating contacts and examine the valve internals for sign of rusting.
(3) Inspect the spring for weakness or any other damage.
(4) Inspect the valve plunger head for wear or any other damage.
(5) Inspect contacting surface of the plunger actuating lever and the plunger. Also check for wear or any other malcondition.

ASSEMBLING

(1) Install each bushing in the valve housing (1). These bushings are for the parts of (45), (46) and (47). Connect the plugs for the parts (42) (43) and lock with the snap rings (41) (43).
(2) Install the springs (39) (40) and valves (37) (38) by inserting these parts through the peep hole. Also install the plungers (35) (36) in the same manner as above, and secure with the lock (34) with its mounting bolts (32).
(3) Install the lever (31) by inserting these parts throught the same peep hole and secure it to the shaft. Install the lever shaft (30) in the same manner in advance.
(4) In the same manner as outlined in step 3 above, install the lever (18) and lever shaft (17) through the peep hole.
(5) After these parts are properly installed in position, make sure each lever is controlled smoothly, install the cover (13) of the peep hole.
(6) Apply a coat of an approved oil to the both sides of gasket and install in place.
(7) Install the plug (10-8) into the valve body (10-10), and lock with the snap ring (10-7). Install the piston, valve and spring, and tighten the plug (10-1) securely.
(8) Secure the valve (10) to the steering control valve housing with the mounting bolts (6).
(9) Install and connect the tubes (3) (5) in position.

INSTALLATION

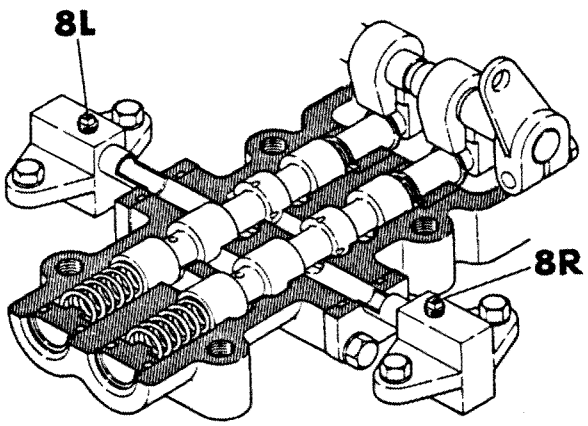
(1) Secure the valve to the steering case top cover.
(2) Re-connect all pipes of various parts of the clutch assembly in the same manner. (Refer to "STEERING CLUTCH REMOVAL AND INSTALLATION".)

ADJUSTMENT

Whenever the steering clutches begin to operate erratically, inspect the components of hydraulic drive for steering clutches and make necessary adjustments. The procedures to be followed are as follows.

Stop the engine; remove screw plugs (8R) (8L); install test pressure gauges (complete with PT 1/8 screw connections) in the vacated holes; start up the engine; and operate it at full throttle.

If the pressure gauge indications are below the 20-30 kg/cm^2 (284-427 PSI) range, unsatisfactory clutch operation may be due to any of the following possible causes;



(1) Control linkage is out of adjustment. In particular, clutch rods are to blame.
(2) Leakage has developed in the steering clutches, likely due to some worn seal rings.
(3) Spring in the pressure adjusting valve has lost its elasticity due to fatigue.
(4) The gear pump is in defective condition: its gears are worn excessively or gear teeth galled.
(5) The control valve unit is internally leaky due to excessive wear or scoring of critical parts.

If the pressure gauge indications are within the 20-30 kg/cm^2 (284-427 PSI) range, the gear pump must be assumed to be in good condition. In this case, pump the steering clutch pedals up and down rapidly to see if the pressure gauge indication fluctuates in step to this pedal pumping: if not, unsatisfactory clutch operation may be due to any of the following possible causes:

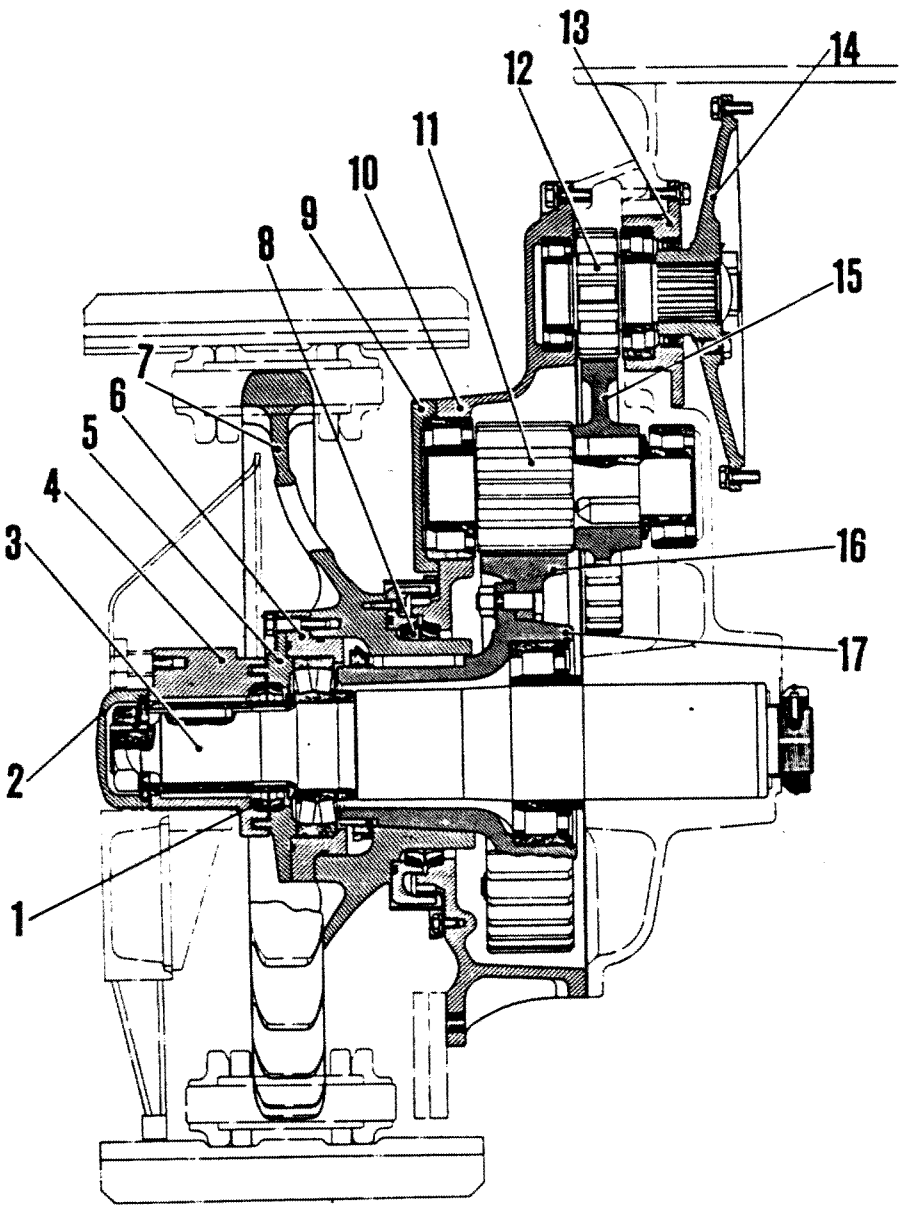
(1) Control linkage is out of adjustment. In particular, clutch rods are likely to blame.
(2) The control valve unit is internally leaky due to excessive wear or scoring of critical parts.
(3) Springs in the control valve unit are broken or fatigued.

FINAL DRIVE

INDEX

FINAL DRIVE

DESCRIPTION



Final Drive

1. Floating seal
2. Cap
3. Sprocket shaft
4. Bearing
5. Bearing retainer
6. Bearing cage
7. Sprocket
8. Floating seal
9. Cover
10. Cover
11. 2nd pinion
12. 1st pinion
13. Bearing cage
14. Flange
15. 1st reduction gear
16. 2nd reduction gear
17. Hub

FINAL DRIVE

DESCRIPTION

The final drive gearing, consisting of four spur gears lowers the speed of steering clutch output through two stages of reduction to drive the sprocket wheel.

These gears are first pinion, integral with input shaft; first gear and 2nd pinion on the intermediate shaft; and 2nd gear which is bolted to the sprocket wheel boss (a sleeve-like member enclosing the outer portion of the sprocket wheel shaft (axle) with roller bearings in between). The sprocket wheel, located outside the final drive case, is rigidly mounted on the same boss. The sprocket wheel shaft extends through the case and its inboard end is rigidly secured to the underside of bevel gear case.

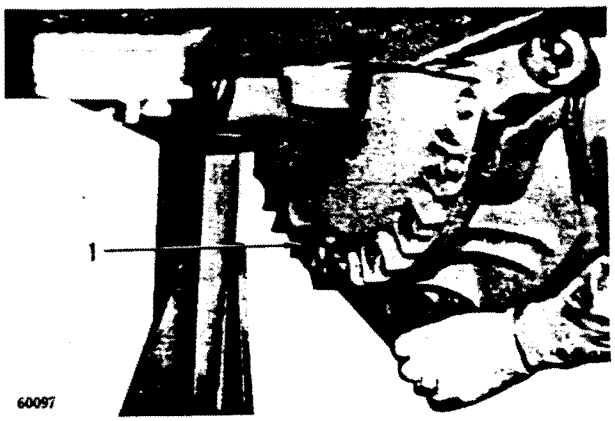
The running clearance between final drive case and rotating members (sprocket wheel and hub) is tightly sealed by means of seal rings of floating type. A similar sealing arrangement is provided at the distal end of sprocket wheel shaft to seal the clearance between shaft (stationary) and rotating member. Lubricating oil is pooled in the final drive case to provide splash lubrication to all gears and bearings, including those bearings between sprocket hub and sprocket wheel shaft.

REMOVAL

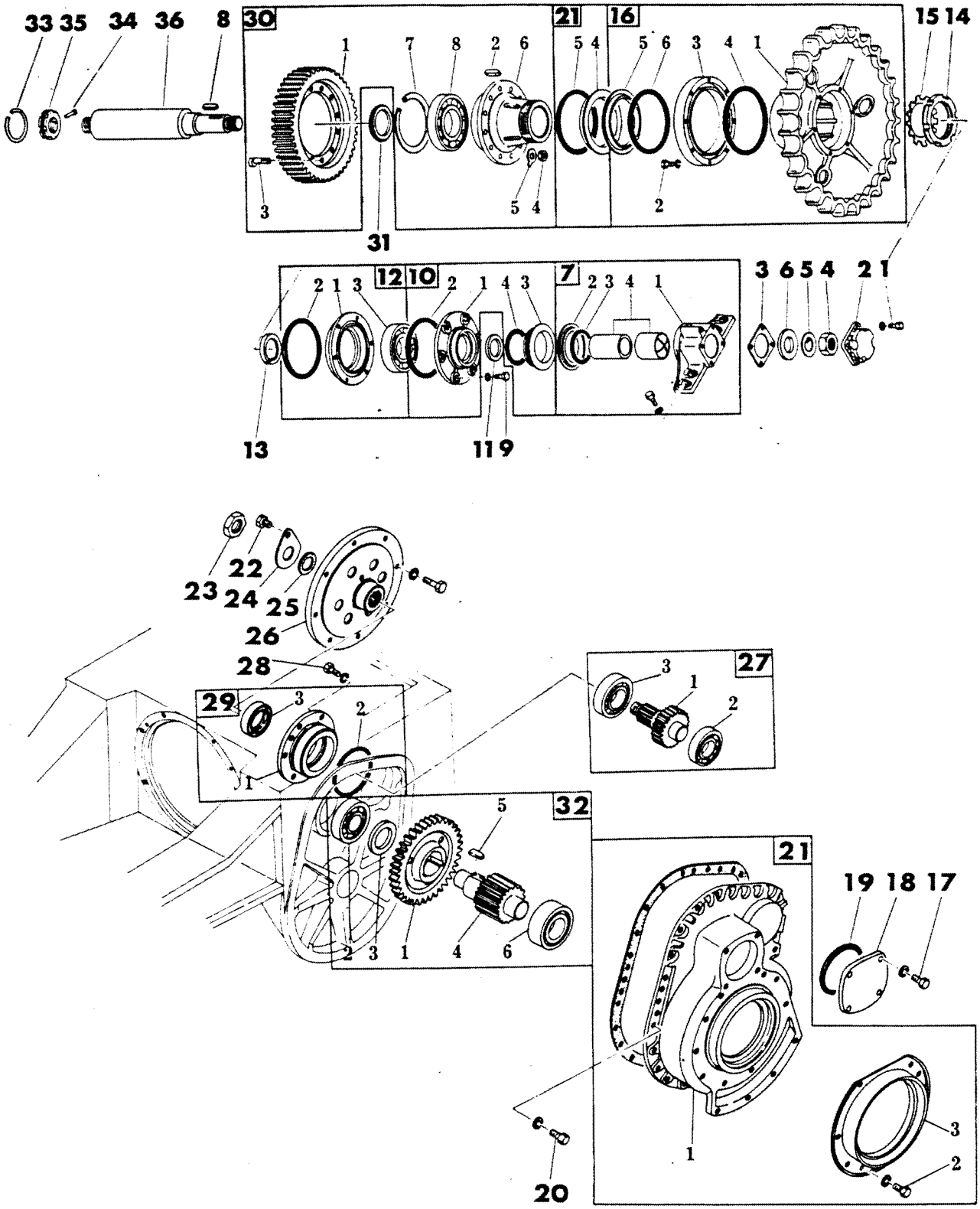
(1) Remove the track-frame groups from the chassis. (Refer to TRACK REMOVAL and TRACK-GROUP REMOVAL).

(2) Remove the bevel gear shaft group including steering clutch assemblies. (Refer to REMOVAL OF BEVEL GEAR SHAFT GROUP.)

(3) Drain each final-drive case by loosening its drain plug (1).



DISASSEMBLING



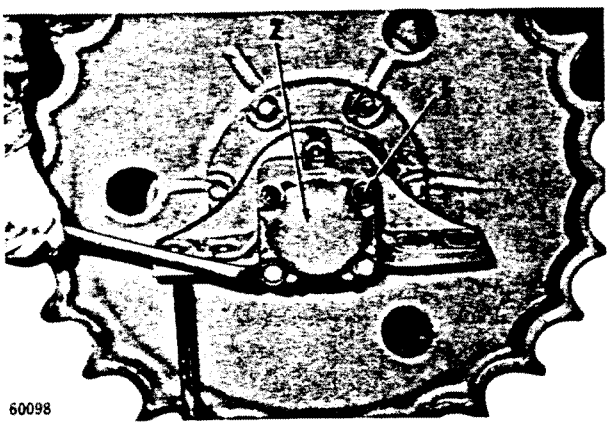
Final-drive Group

1. Bolt
2. Bearing cap
3. Gasket
4. Nut
5. Lock
6. Washer
7-1. Bearing
7-2. Seal
7-3. "O" ring
7-4. Bush
8. Key
9. Bolt
10-1. Bearing retainer
10-2. "O" ring
10-3. Seal
10-4. "O" ring
11. Collar
12-1. Bearing cage
12-2. "O" ring
12-3. Bearing
13. Collar
14. Nut
15. Lock
16-1. Sprocket
16-2. Bolt
16-3. Guard
16-4. "O" ring
16-5. Floating seal
16-6. "O" ring
17. Bolt
18. Retainer
19. "O" ring
20. Bolt
21-1. Case
21-2. Bolt
21-3. Guard
21-4. Floating seal
21-5. "O" ring
22. Bolt
23. Nut
24. Lock
25. Packing
26. Flange
27-1. Pinion
27-2. Outer bearing
27-3. Inner bearing
28. Bolt
29-1. Bearing cage
29-2. "O" ring
29-3. Oil seal
30-1. Gear
30-2. Key
30-3. Bolt
30-4. Nut
30-5. Lock
30-6. Hub
30-7. Snap ring
30-8. Bearing outer race
31. Collar
32-1. Gear
32-2. Bearing inner race
32-3. Spacer
32-4. Pinion
32-5. Key
32-6. Bearing
33. Ring
34. Pin
35. Nut
36. Shaft

Parts are enumerated in the sequence of disassembling.

DISASSEMBLING

(1) Loosen bolts (1) and remove bearing cap (2). Remove gasket.



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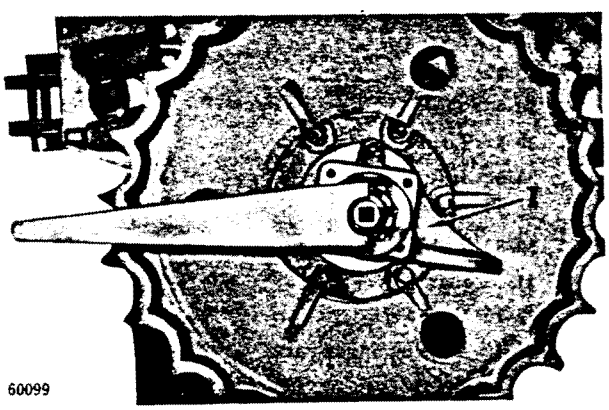
(2) Remove nut (4), take off lock (5) and washer (3), and draw off sprocket bearing (7). This removal involves parts (7-1) through (-4).



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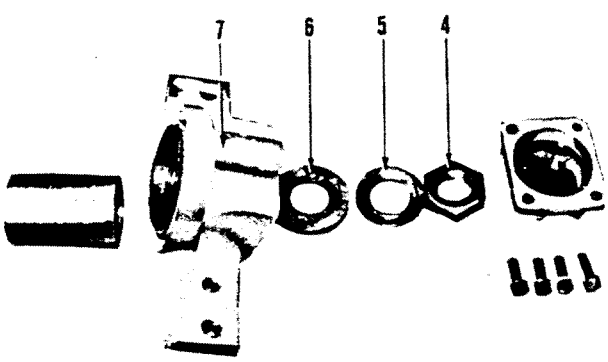
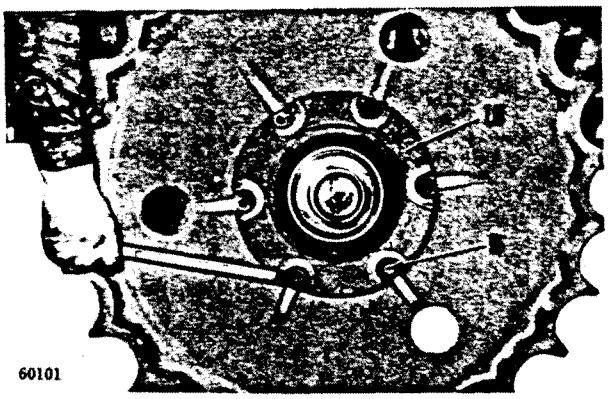


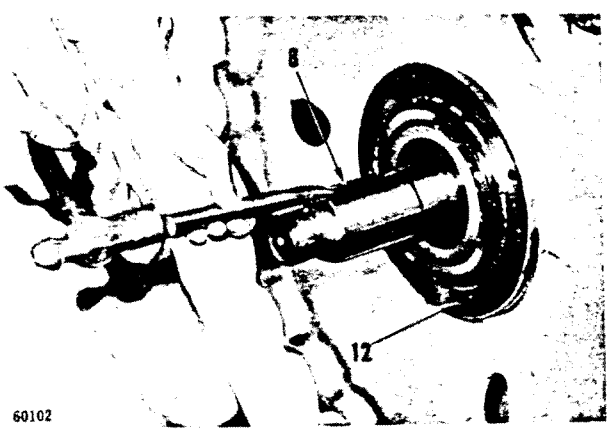
60100

(3) Loosen bolts (9) and detach bearing retainer (10) by removing parts (10-1) through (-4).



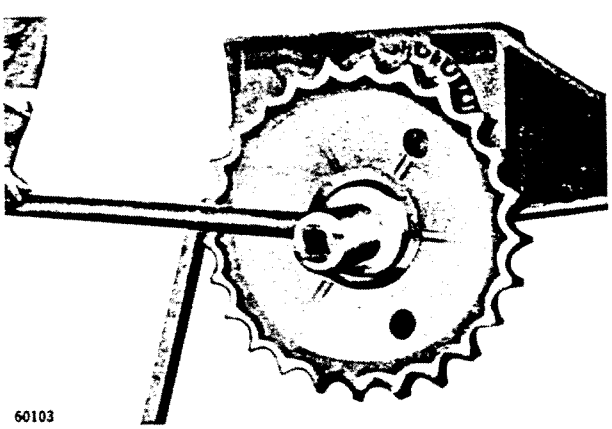
60101

(4) Force key (8) out of place and jack out bearing cage (12) by screwing jacking bolts into the cage. Parts (12-1) through (-3) come out in this operation.



60102

(5) Using the special wrench, loosen and remove sprocket nut (14).



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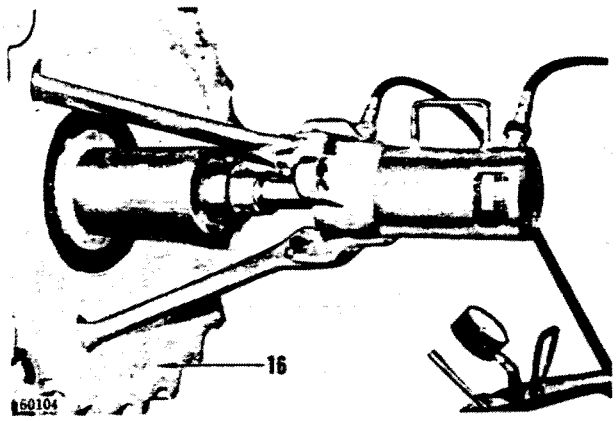
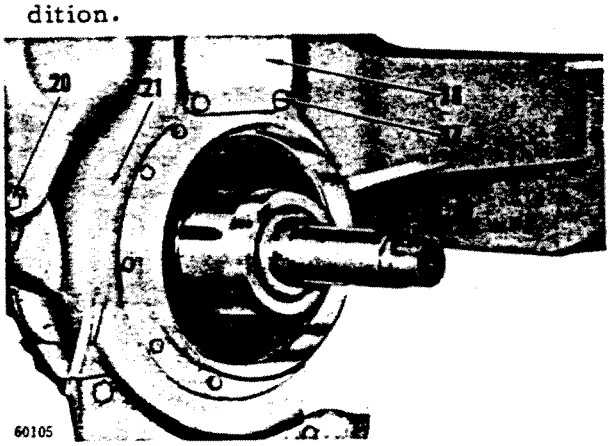
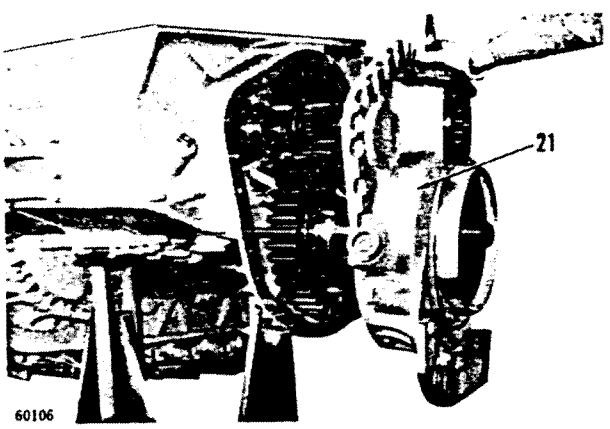
(6) Draw sprocket (16) off the hub with the use of the special tool. Parts (16-1) through (-6) are to be removed.

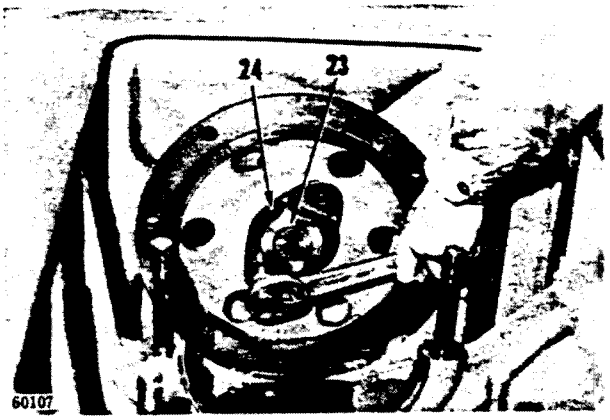


(7) Loosen bolts (17) and remove retainer (18). Loosen bolts (20) and detach (21). Parts (21-1) through (-5) are to be removed. Hang the case from above by taking a hitch to a bolt screwed into one of retainer bolt holes, and remove the case in suspended condition.

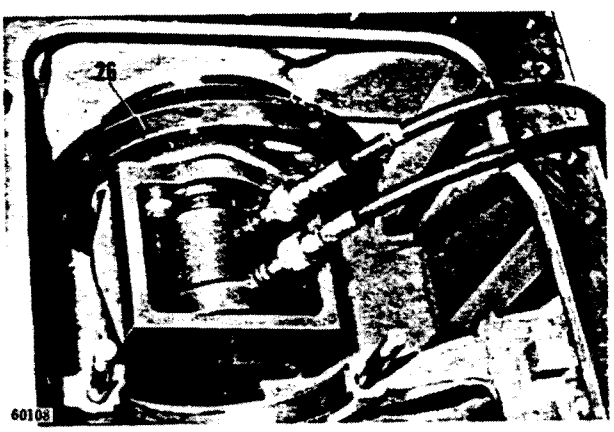




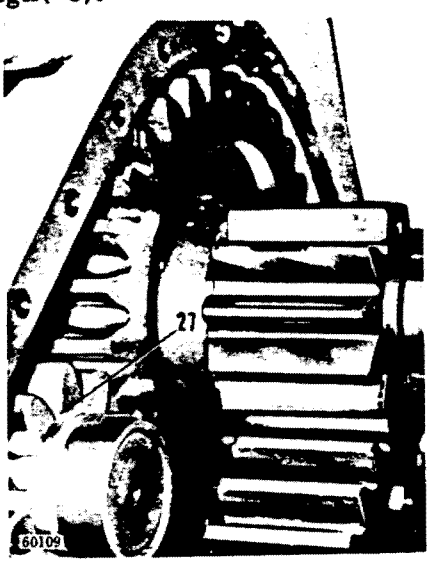
(8) Loosen bolts (22), remove nut (23) and lock (24), and take out packing (25).



(9) Using the special tool, draw the flange (26) off the input shaft.

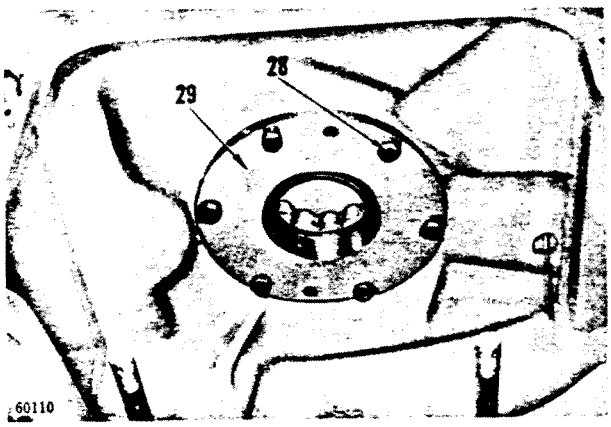


(10) Draw out pinion (27). This operation involves removal of parts (27-1) through (-3).

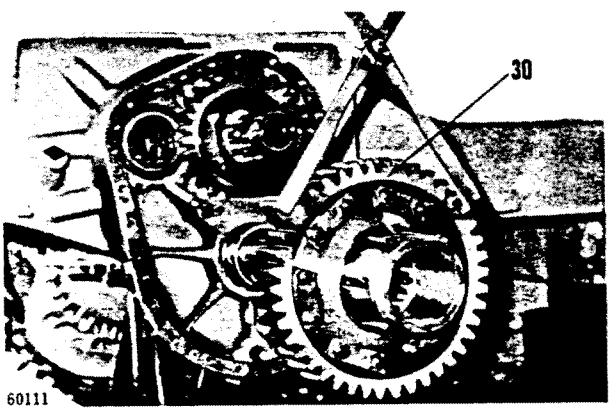


DISASSEMBLING

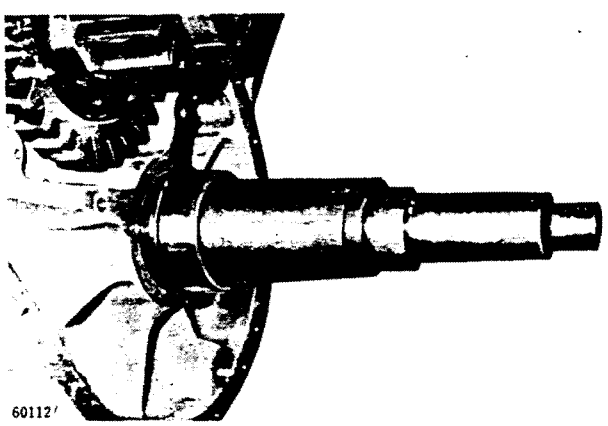
(11) Loosen bolts (28) and draw bearing cage (29) out by using jacking screws.
Parts (29-1) through (-3) come out in this operation.



(12) Draw out gear (30), removing parts (30-1) through (-8). The inner races of two roller bearings will remain on the sprocket shaft.

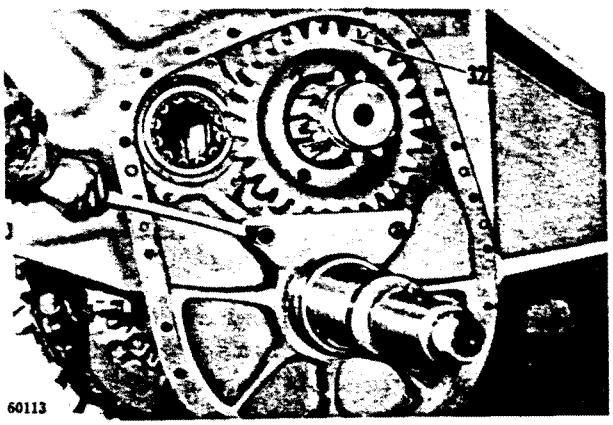


(13) Draw each bearing inner race off the sprocket shaft.

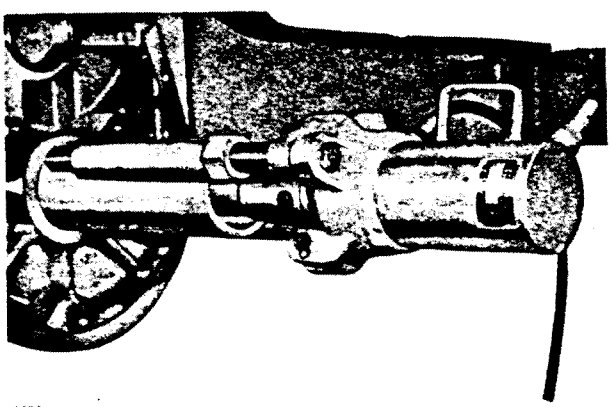


NOTE: Pour hot oil over the inner race while pulling it.

(14) Remove the plate, by which an oil bath is formed for gear (32). Draw out gear (32), removing parts (32-1) through (-6).



(15) Using the special tool, draw out sprocket shaft (36). (Normally this shaft need not be removed.)



CLEANING AND INSPECTION

(1) Wash all removed parts clean, and dry them with compressed air.
(2) Inspect each final-drive case for cracks or any other damage. Repair or replace the case as necessary.
(3) Check the gear teeth for wear, and measure gear backlash in each mesh of teeth in final-drive gear train.
Inspect the gear teeth for contact pattern.
(4) Check for wear of the reamer bolts, with which the last gear is secured to the sprocket hub, and inspect the bolts and holes for damage.
(5) Check the sprocket shaft for straightness. Repair or replace the shaft as necessary.
(6) Check the teeth of sprocket wheel for radial wear by using the contour gauge. Measure the tooth width to determine the extent of lateral wear.
Repair the teeth, or replace the sprocket wheel, as necessary.

ASSEMBLING

Instructions to be followed in assembling and re-mounting the final-drive groups are as follows:
(1) Before installing the final-drive case in place, make sure that the gasket between this case and steering case is of the prescribed thickness. Never use too thin or too thick gaskets.
(2) Where a replacement final-drive case is to be installed, tentatively build the final-drive gear train with the replacement case in place, making sure each gear is properly aligned, and then fix the position of the final-drive case anew with respect to the steering case by doweling.
(3) When re-mounting sprocket wheels, center the wheel relative to sprocket shaft and push the wheel slowly onto the sprocket hub so as not to disturb the sealing rings in place.
(4) Before fitting the sealing rings (between sprocket wheel and final-drive case and at the outboard end of sprocket hub), make sure that rings are all clean. Apply oil to the lapped faces of rings just before putting them in place.
(5) Apply grease to oil seals and O-rings before fitting them in place.
(6) The surfaces of shaft, whether they are splined or not, must be coated lightly with MOLYCOTE or its equivalent if the surfaces are to mate with bore surfaces in press-fit. The parts to be so coated are:
a) The splined end of input shaft (1st pinion) onto which the hub of the connecting flange is fitted.
b) The shaft of 2nd pinion onto which 1st gear is fitted.
c) That part of sprocket hub carrying sprocket wheel.
d) Those parts of sprocket shaft fitting to bores provided in the case.
(7) The connecting flange (splined to the input shaft) must be sured by tightening its nut to a torque of 40 to 70 kg-m (289-506 ft.lb) and its face and radial runouts (at the flanged peripheral part) must be kept within 0.15 mm (0.006") (face) and 0.2 mm (0.079") (radial).

UNDERCARRIAGE

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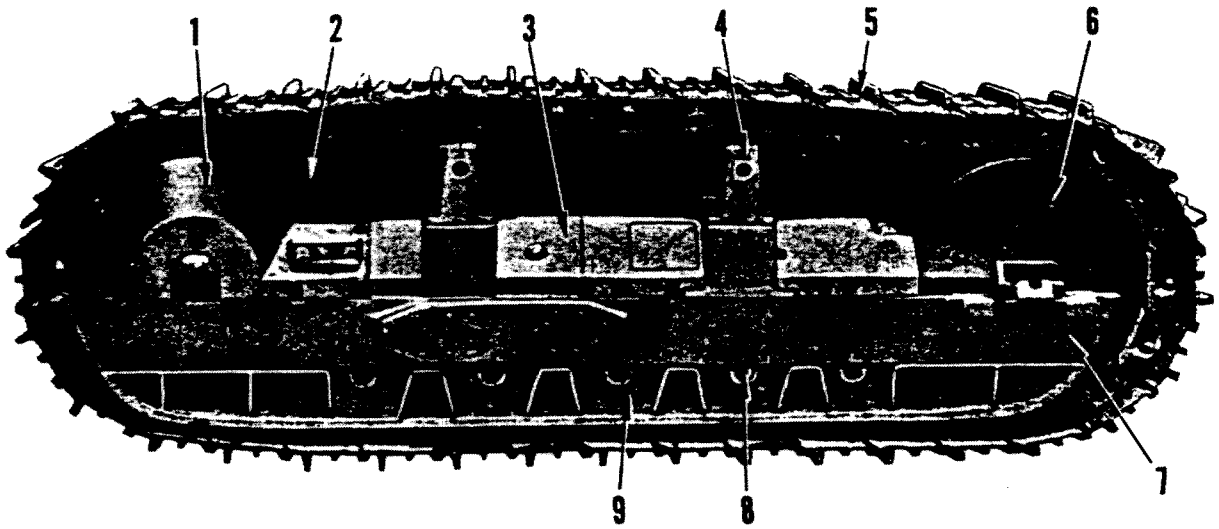
UNDERCARRIAGE

GENERAL



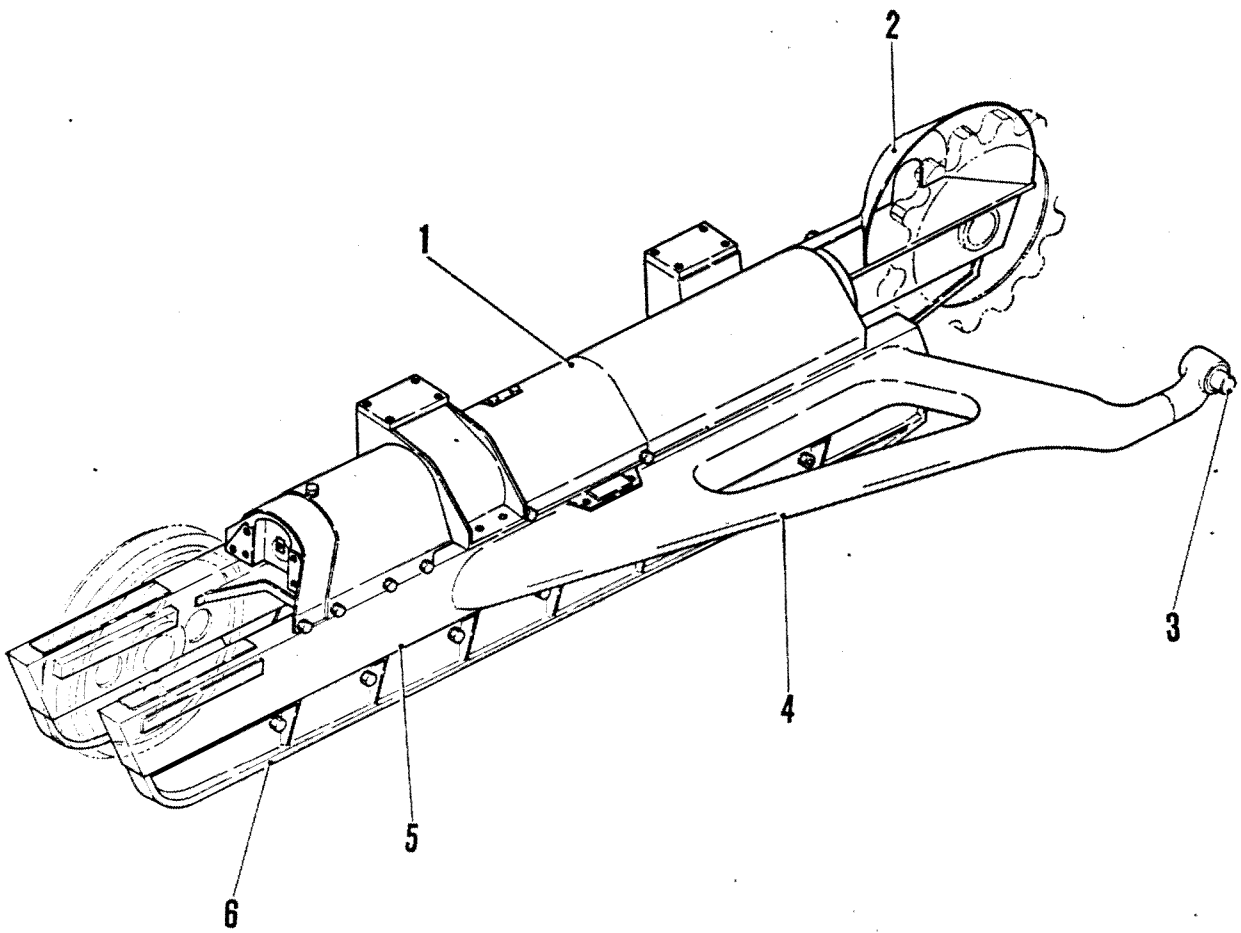
Track Group

1. Sprocket cover
2. Sprocket
3. Recoil spring cover
4. Carrier roller
5. Track
6. Idler
7. Track frame
8. Track roller
9. Guiding guard

By the term "undercarriage (crawler)" are meant the right and left track frame groups, each consisting of an endless track chain and a frame structure on which rollers are mounted. The track chain is laid forward by the front idler, and the machine rides on the track by the track rollers, with the drive being transmitted from the sprocket. The front idler is backed by a recoil spring (compression spring) whose compression can be varied to adjust the track tension. During operation, the front idler yields back and recoils forward when the track rides over an obstruction, thereby preventing excessive shock stresses from occurring in the track chain and frame.

TRACK FRAME

DESCRIPTION



Track Frame

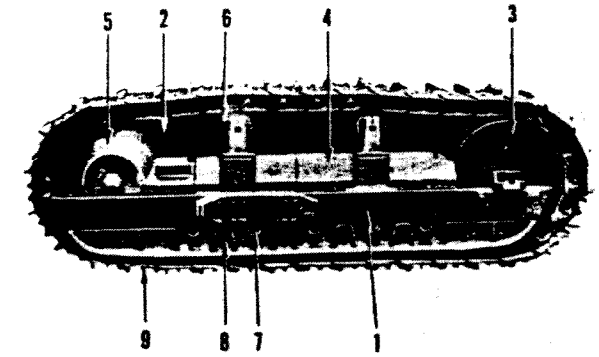
1. Recoil spring cover
2. Sprocket cover
3. Diagonal brace pivot shaft
4. Diagonal brace
5. Track frame
6. Guiding guard

The frame is a welded steel structure, fabricated with channels and plates and designed substantial enough to withstand the large dynamic stresses encountered by it in heavy-duty earthmoving work.

The diagonal brace, a solid steel casting triangular in shape, has its one side welded to the track frame and inboard end secured rotatably to the underside of bevel gear case. This end is capable of turning on the axis of the sprocket wheel shaft, such that the track frame is kept parallel to the chassis but is allowed to present a rocking motion around the sprocket wheel shaft.

On the top of track frame are mounted the carrier rollers, recoil spring, front idler and bearing for supporting the sprocket wheel shaft. On the bottom are mounted the track rollers and roller guard.

REMOVAL



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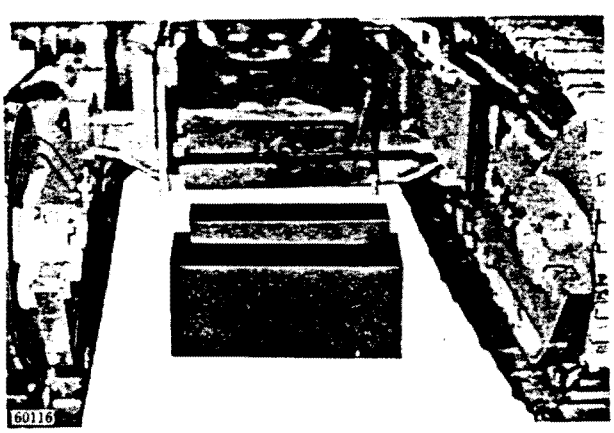
1. Track frame
2. Sprocket wheel
3. Front idler
4. Recoil-spring cover
5. Sprocket side cover
6. Carrier roller
7. Track rollers
8. Guard
9. Track chain

(1) Open the tracks. (Refer to TRACK REMOVAL.)

(2) Lift the chassis off the floor with hydraulic jacks or an overhead crane, and block up the chassis. The blocks are to be placed against the equalizer bar to hold up the front end and against the embossed parts of steering case through which sprocket shafts extend (rear end). Use of such a supporting stand as is shown in the photo is recommended for supporting the rear end. Loosen bolts (1) and remove sprocket side cover (2).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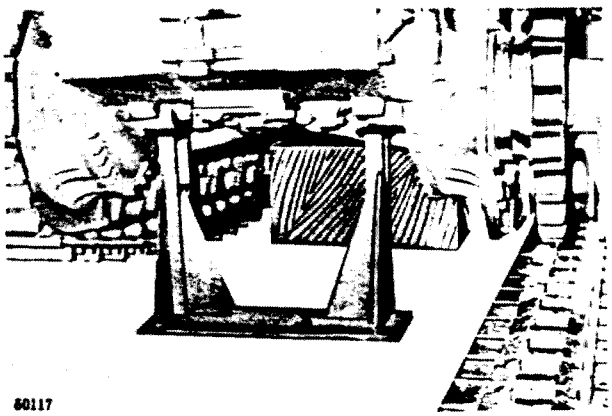
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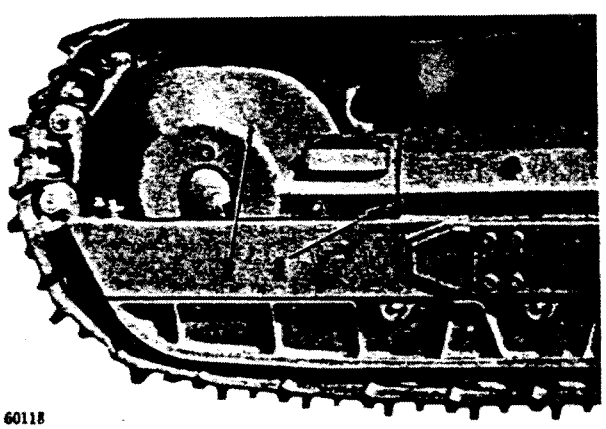
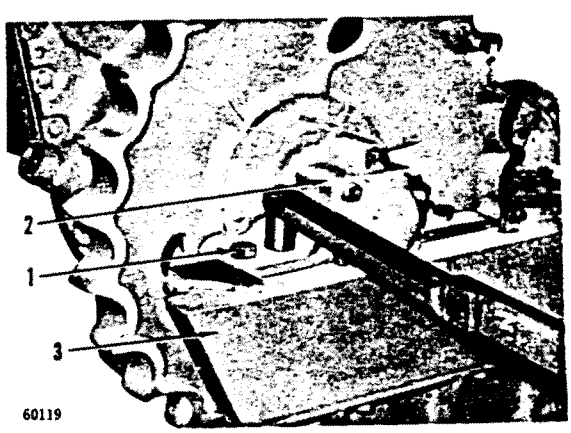
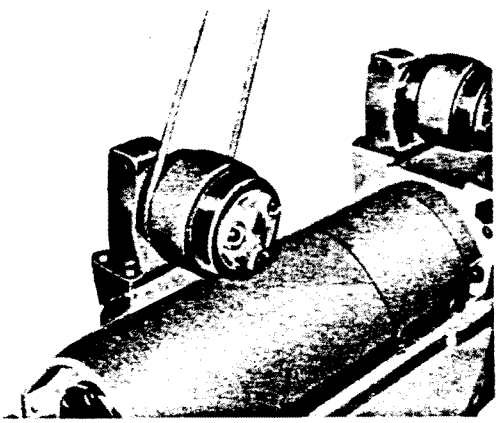

60118

(3) Remove bolts (1) to detach sprocket shaft bearing (2) from track frame (3).



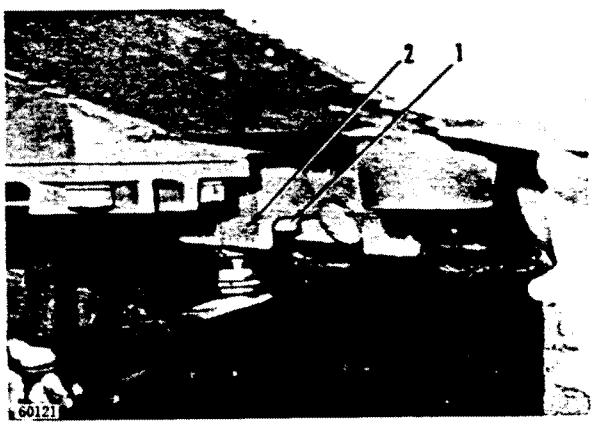
60119

(4) Hang the track frame from above by hitching a lifting tool to the carrier roller.



60120

(5) Loosen bolts (1) and remove diagonal brace cap (2). The track frame assembly is now ready to be carried away in suspended condition.



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INSTALLATION

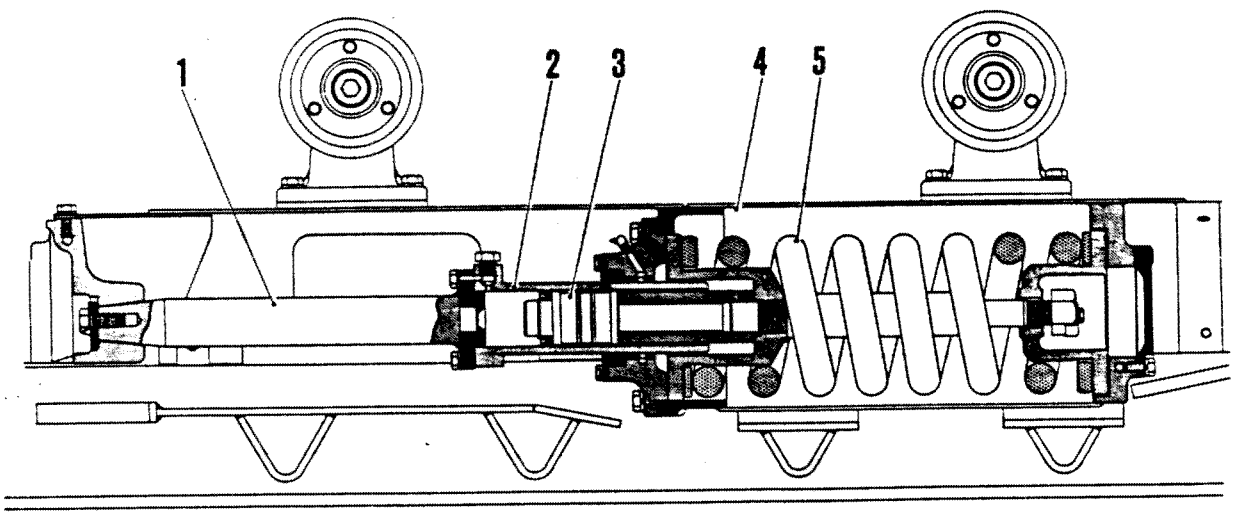
To re-connect the track-frame groups to the chassis, reverse the removal procedure and adhere to the following instructions:

(1) Torque limits are specified for the bolts securing the diagonal brace caps to steering case and the sprocket shaft bearings to track frames. Be sure to torque these bolts up to the specified limits.

(2) Before securing the sprocket shaft bearings in place, check to be sure the center-to-center distance between front idlers is 1600+11mm (63" ±0.433").

RECOIL SPRING

DESCRIPTION



Recoil Spring

1. Rod
2. Idler adjusting cylinder
3. Piston
4. Recoil spring cylinder
5. Recoil spring

Each recoil spring (consisting of an inner and an outer spring) is part of the system for elastically backing the front idler whose supports are slidably mounted on the track frame. The spring is located around a push rod whose forward end is in yoke shape, and is connected with the idler supports, so that the horizontal movement of the idler on and along the frame is restrained by the track chain on the front side and by the push rod on the rear side.

A screw connection is provided on the push rod so that the amount of spring compression can be increased or decreased, as desired, to–tension the track chain more or less.

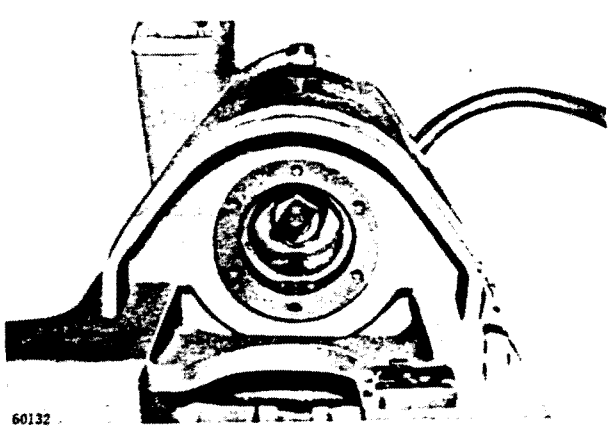
REMOVAL

(1) Open the tracks. (Refer to TRACK REMOVAL.)

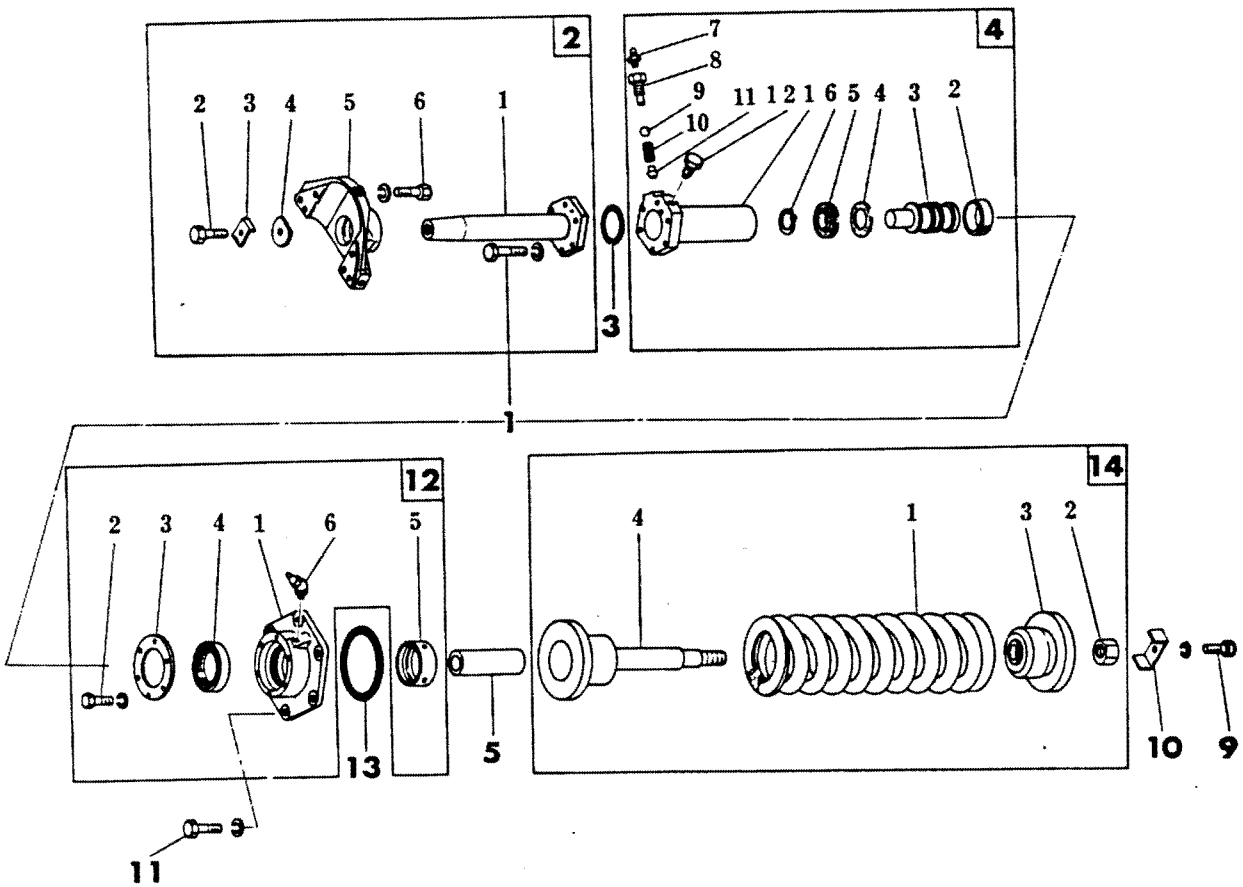
(2) Separate the track-frame groups from the chassis. (Refer to REMOVAL OF TRACK-FRAME GROUPS.)

(3) Take down the front idler assembly from each track frame.

(4) Remove the plug, and pump out the oil in the recoil spring chamber.



DISASSEMBLING

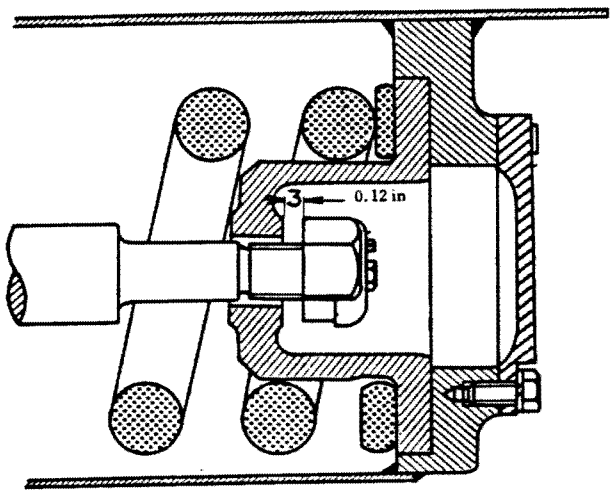


Recoil Spring

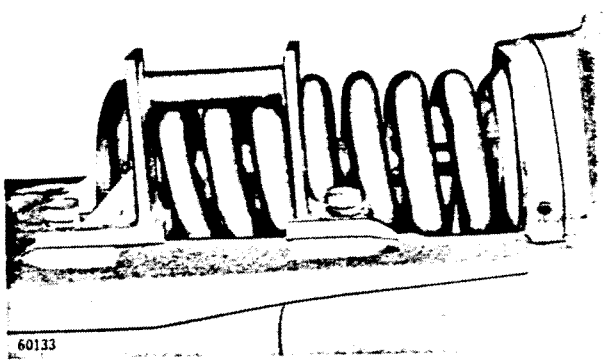
1. Bolt
2-1. Rod
2-2. Bolt
2-3. Lock
2-4. Washer
2-5. Yoke
2-6. Bolt
3. "O" ring
4-1. Cylinder
4-2. Snap ring
4-3. Piston
4-4. Gasket
4-5. Gasket
4-6. Snap ring
4-7. Grease fitting
4-8. Seat
4-9. Steel ball
4-10. Spring
4-11. Plunger
4-12. Plug
5. Collar
6. Bolt (not shown)
7. Cover (not shown)
8. Gasket (not shown)
9. Bolt
10. Lock
11. Bolt
12-1. Cover
12-2. Bolt
12-3. Cover
12-4. Oil seal
12-5. Bush
12-6. Grease fitting
13. "O" ring
14-1. Spring
14-2. Nut
14-3. Pilot
14-4. Bolt

Parts are enumerated in the sequence of disassembling.

(1) Turn in the nut (14-2) to obtain a clearance of 3mm (0.12") between it and recoil spring pilot (14-3).



(2) Remove cover (12-1), and push on the spring from rear end with a rod or bar to force it out forward.



(3) To detach recoil spring from pilot, use a press to compress the spring, remove the nut, and slacken the press gradually to free spring from pilot.

INSPECTION

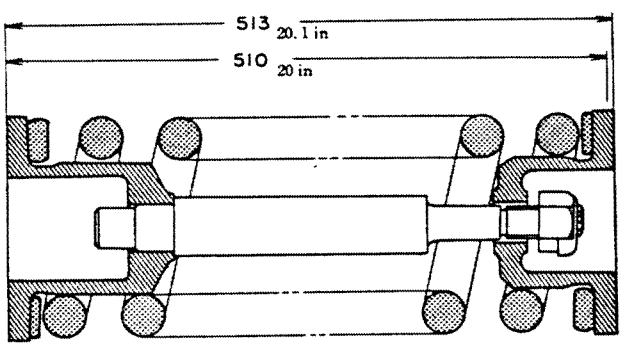
(1) Inspect each recoil spring for damage, and check its free length, as-installed preload and squareness to determine the extent of fatigue in the spring.

(2) Inspect the tensioning cylinder for wear or damage on its internal and external surfaces. Check the bush inside recoil spring cover for wear.

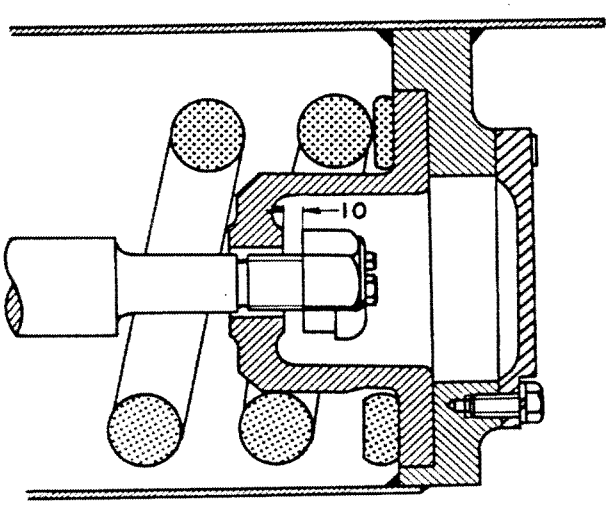
ASSEMBLING

Build the recoil spring assemblies on track frames according to the following instructions:

(1) Use a press to combine recoil spring and seat. With the spring compressed to a length of 513mm(20.1")(as against the specified spring length of 510mm (20")) by means of the press, tighten the nut until it bears against the seat, and insert the assembly into the recoil spring cylinder.



After the cylinder cover is put on, turn back the nut until it becomes flush with the end face of the rod: This will introduce the specified clearance of 10mm (0.39") between seat and nut.



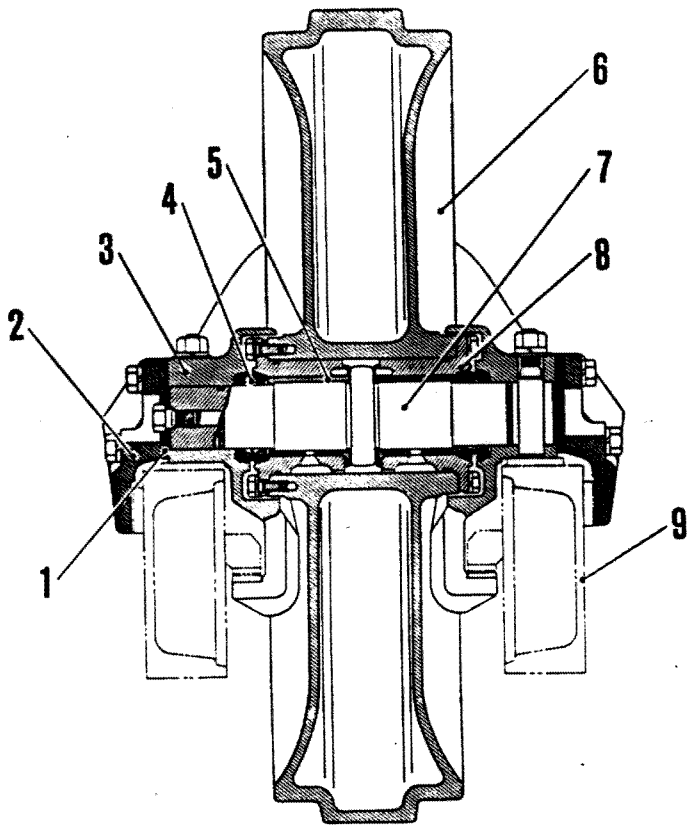
(2) Before inserting the piston into the bore of tensioning cylinder, have the cylinder stuffed with a proper amount of grease and apply grease to the sliding face of piston and to the cylinder bore. The piston rings in place must be so positioned as to stagger ring gaps.

(3) When positioning the grease fitting on tensioning cylinder, be sure to point its nipple toward the inspection opening provided in the cover, so as to make the nipple accessible to a charging nozzle through the opening.

(4) After the recoil spring has been re-assembled in place on the track frame, add 4 to 6 liters (1.0-1.6 U. S. Gal.) of engine oil into its spring chamber formed by the cover. This oil serves to prevent the spring from rusting.

FRONT IDLERS

DESCRIPTION



Idler

1. Shim
2. Guide
3. Idler shaft bearing
4. Floating seal
5. Bushing
6. Idler
7. Idler shaft
8. Bushing
9. Track frame

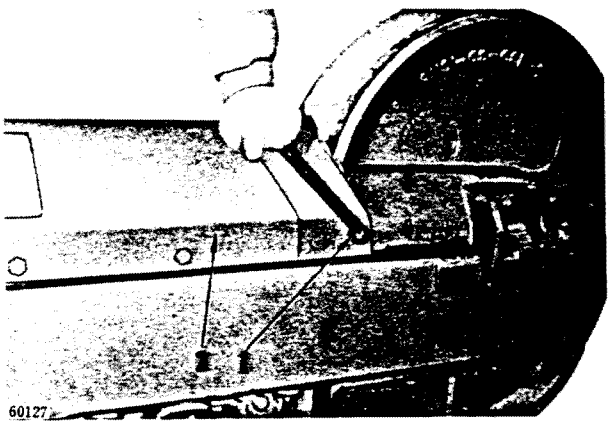
The supports (or bearings) on both sides of each front idler are so constructed that they are capable of sliding, as guided, in fore-aft direction on the frame without jumping out of the bifurcated forward portion of the track frame.

The shaft upon which the front idler rotates is held rigidly by the supports, and the running clearance between the bore of idler hub and this shaft is filled with lubricant, there being sealing rings of floating type fitted to both ends of this bore to contain the lubricant hermetically.

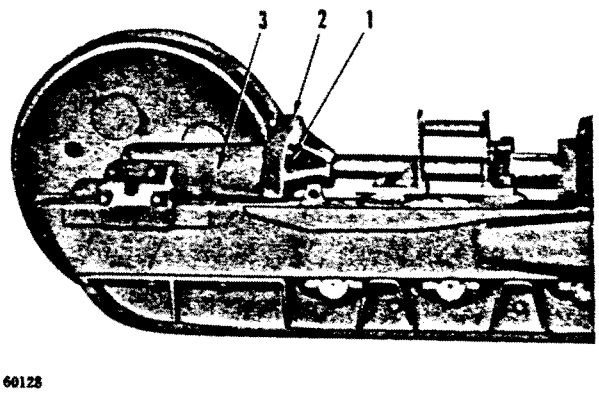
REMOVAL

(1) Open the tracks. (Refer to TRACK REMOVAL.)

(2) Remove bolts (1) and take off cover (2).

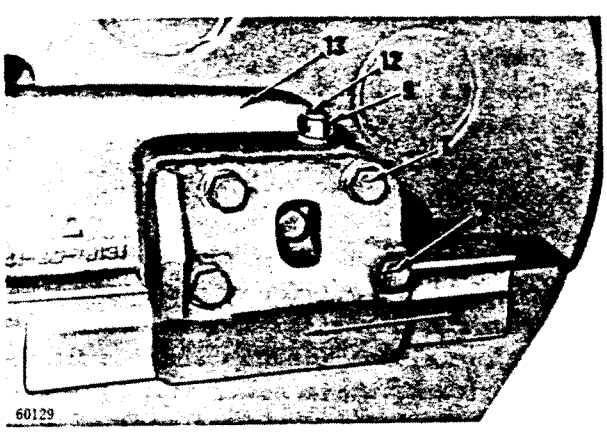


(3) Loosen bolts (1) and disconnect idler shaft bearing (3) from yoke (2).
Take down the idler assembly from the track frame.

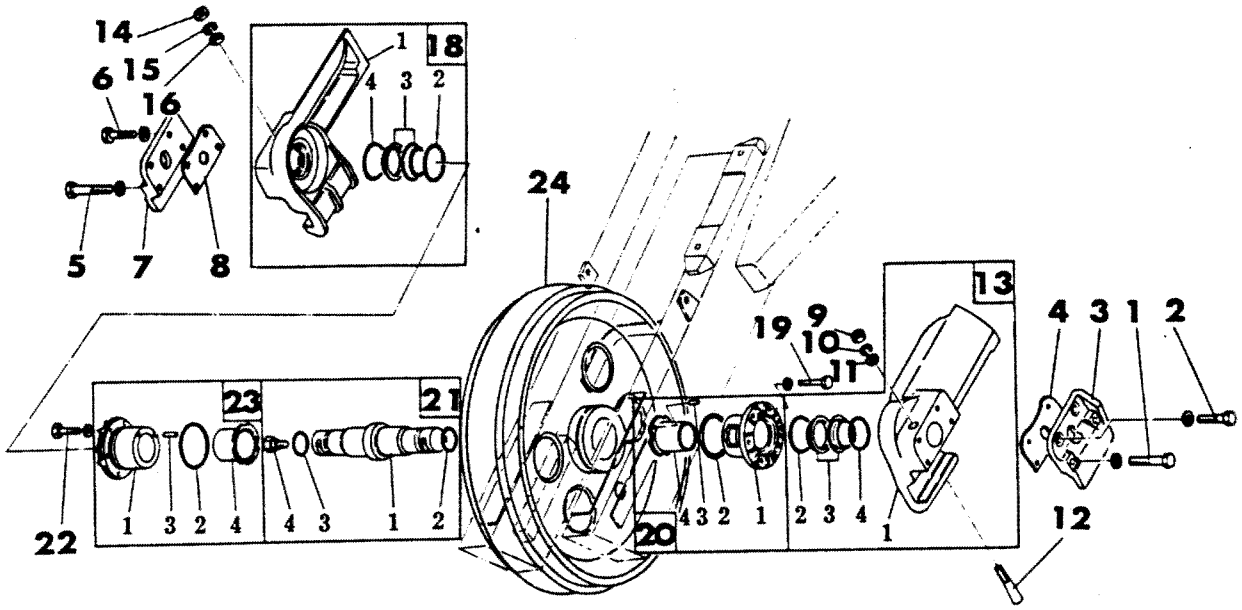


DISASSEMBLING

(1) Loosen bolts (1) (2) and remove guide (3). Loosen nut (9). Remove bolt (12), and take out bearing (13).



(2) Loosen bolts (19) and drive out shaft (21) toward bush (20). The bush will come out together with the shaft.



Front Idler

1 Bolt	11. Washer	18-1. Bearing	21-2. "O" ring
2. Bolt	12. Bolt	18-2. "O" ring	21-3. "O" ring
3. Guide	13-1. Bearing	18-3. Seal ring	21-4. Plug
4. Shim	13-2. "O" ring	18-4. "O" ring	22. Bolt
5. Bolt	13-3. Seal ring	19. Bolt	23-1. Bush
6. Bolt	13-4. "O" ring	20-1. Bush	23-2. "O" ring
7. Guide	14. Nut	20-2. "O" ring	23-3. Roll pin
8. Shim	15. Spring washer	20-3. Roll pin	23-4. Bush
9. Nut	16. Washer	20-4. Bush	24. Idler
10. Spring washer	17. Bolt (same as 12)	21-1. Shaft	

Parts are enumerated in the sequence of disassembling.

CLEANING AND INSPECTION

(1) Inspect the idler for cracks or any other damage. Check its O.D. and the width of its peripheral land to determine the amount of wear.

(2) Check shaft O.D. and bush I.D. to determine the amount of wear. Check shaft for runout (deflection). Clean and clear the oil ways and grooves of the shaft by blowing with compressed air.

ASSEMBLING

To re-assemble the front idlers, reverse the disassembling procedure and adhere to the following instructions:

(1) The bushes of front idlers and track rollers are to be forced into the bore with the use of the same press.

When fitting the idler bushes, first position each bush with its bolt holes aligned to those in the idler and then start pushing it into the bore. Of the two bushes for each idler, one is to be forced in from outboard side and the other from inboard side.

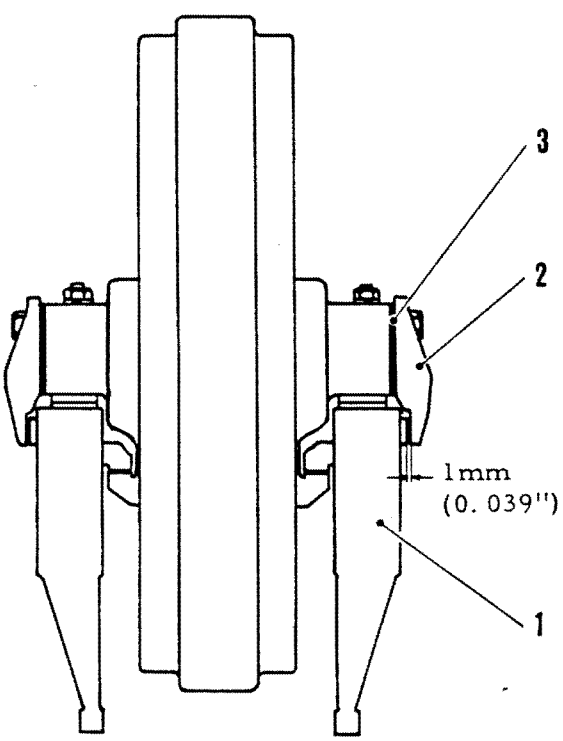
(2) Before installing the idler shaft set bolts, apply LOCKTIGHT to these bolts, and tighten them to a 25-28kg-m (180-230ft.lb.) torque.

INSTALLATION

Reverse the removal procedure to remount the front idlers, adhering to the following instructions:

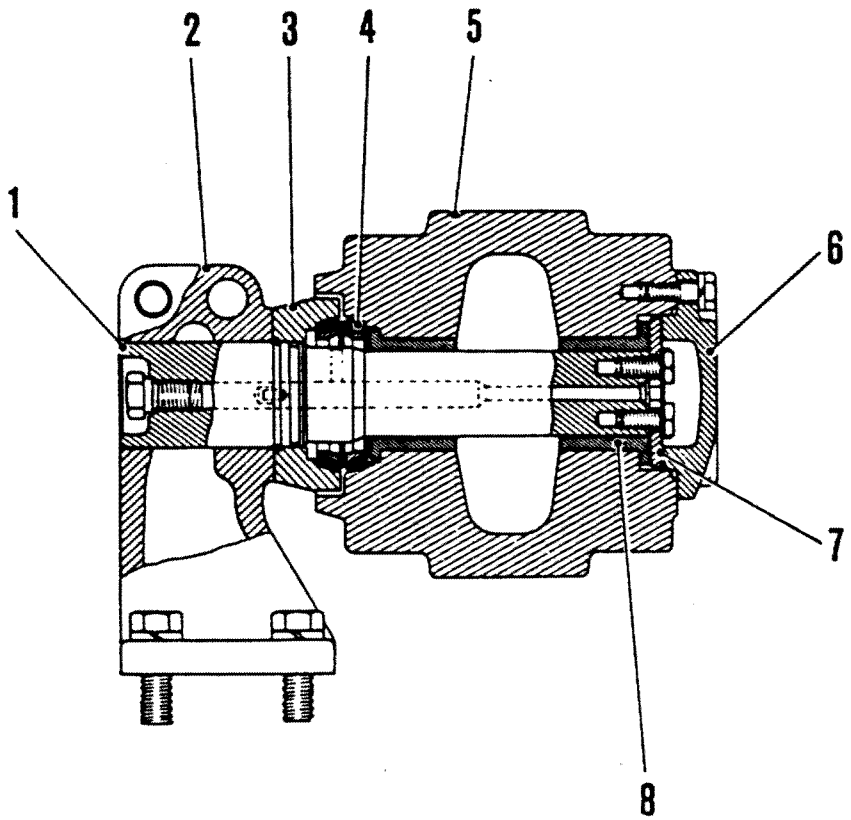
(1) Adjust the thickness of shim (3) to obtain a clearance of not more than 1 mm(0.039")between idler shaft guide (2) and track frame (1).

(2) Each idler shaft is to be so positioned as to bring its lubricant-charging end to outboard side.



CARRIER ROLLER

DESCRIPTION



Carrier Roller

1. Carrier roller shaft
2. Support
3. Retainer
4. Floating seal
5. Carrier roller
6. Cover
7. Retainer
8. Bush

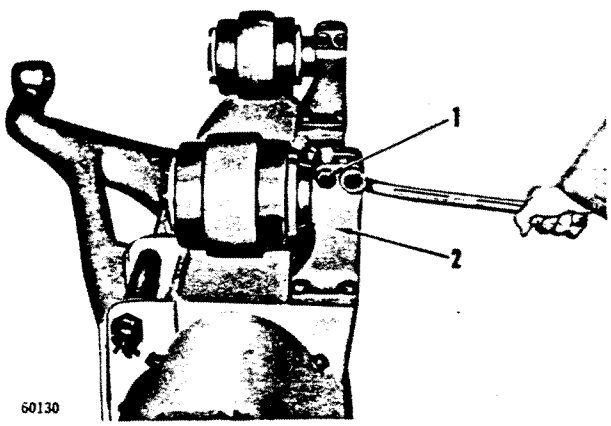
Two carrier rollers are employed in each track frame group. The carrier roller is a forged steel in material.

It is rotatably mounted on a shaft which is press-fitted to the supporting structure. The shaft support is bolted to the top face of track frame. Sealing rings of floating type are fitted to the inboard end of each carrier roller in order to hermetically contain the lubricant with which the running clearance around the shaft in the roller bore is filled.

REMOVAL

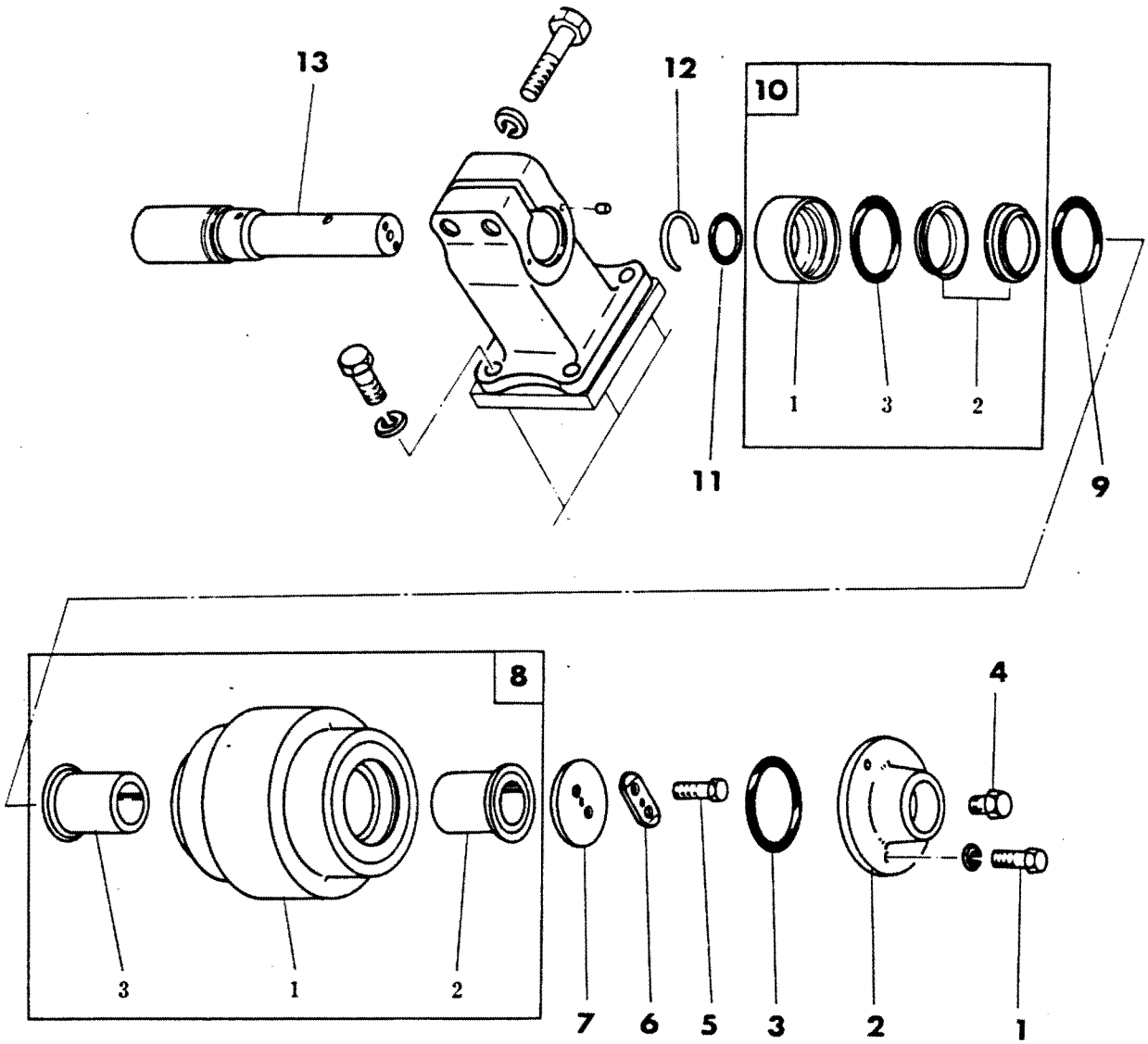
(1) Open the tracks. (Refer to TRACK REMOVAL.)

(2) Loosen bolts (1) securing the roller shaft, and remove the roller assembly from support (2). If the shaft will not come off the support, lightly tap on the bearing side to shake the shaft loose.



(3) The carrier roller can be removed without opening the track chain. This can be accomplished by slackening the track as much as possible, and by jacking up the upper span of track from underside with an oil jack set on the recoil spring cover.

DISASSEMBLING



Carrier Roller

1. Bolt
2. Shaft cover
3. "O" ring
4. Plug
5. Bolt
6. Lock
7. Plate
8-1. Roller
8-2. Bush
8-3. Bush
9. "O" ring
10-1. Collar
10-2. Seal ring
10-3. "O" ring
11. "O" ring
12. Snap ring
13. Shaft

Parts are enumerated in the sequence of disassembling.

CLEANING AND INSPECTION

(1) Check the riding faces and land width of each carrier roller for wear.
(2) Measure roller shaft O. D. and bush I. D. to determine the amount of wear, and clean the shaft with compressed air, making its oil ways and grooves perfectly free from any dirt.
(3) Inspect the thrust faces of collar and bushes for wear.
(4) Inspect the support for cracks, distortion or any other malcondition.

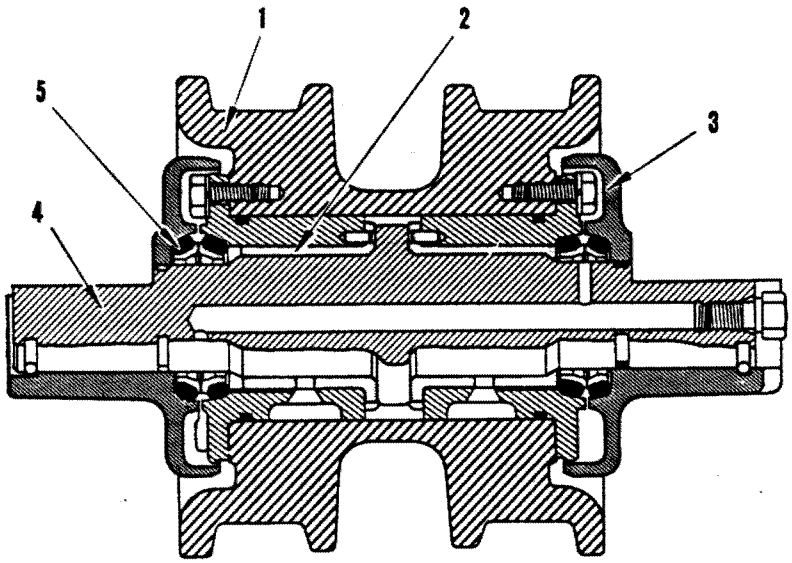
INSTALLATION

Reverse the removal and disassembling procedures.

When mounting the carrier roller on the support, position the roller shaft to make the engraved line on its end face points upward, and tighten the bolts on the support with the roller shaft held in that position.

TRACK ROLLERS

DESCRIPTION



Track Rollers

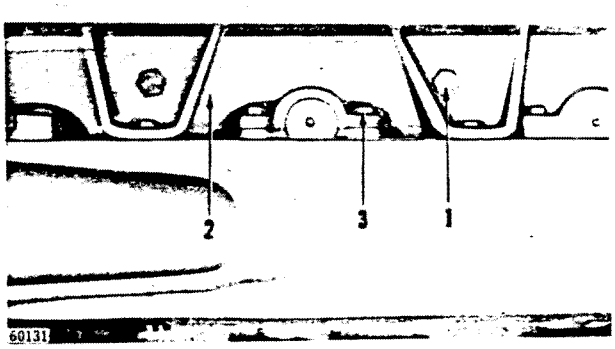
1. Roller
2. Bushing
3. Collar
4. Shaft
5. Floating seal

The track roller is a special-steel casting in material. It rotates on its shaft, and the track frame rests on both ends of this shaft. The weight of the machine is supported by a total of 10 track rollers. In other words, the machine rolls on two tracks, right and left, by these rollers located under the track frames. As counted from the front side, 2nd and 4th track rollers are of double-flange type, while 1st, 3rd and last rollers are of single-flange type: the two kinds of rollers are used to prevent them from getting off the track during turning, particularly pivot-turning. Sealing rings of floating type are fitted to both ends of each track roller, in order to hermetically contain the lubricant with which the running clearance around the shaft in the roller bore is filled.

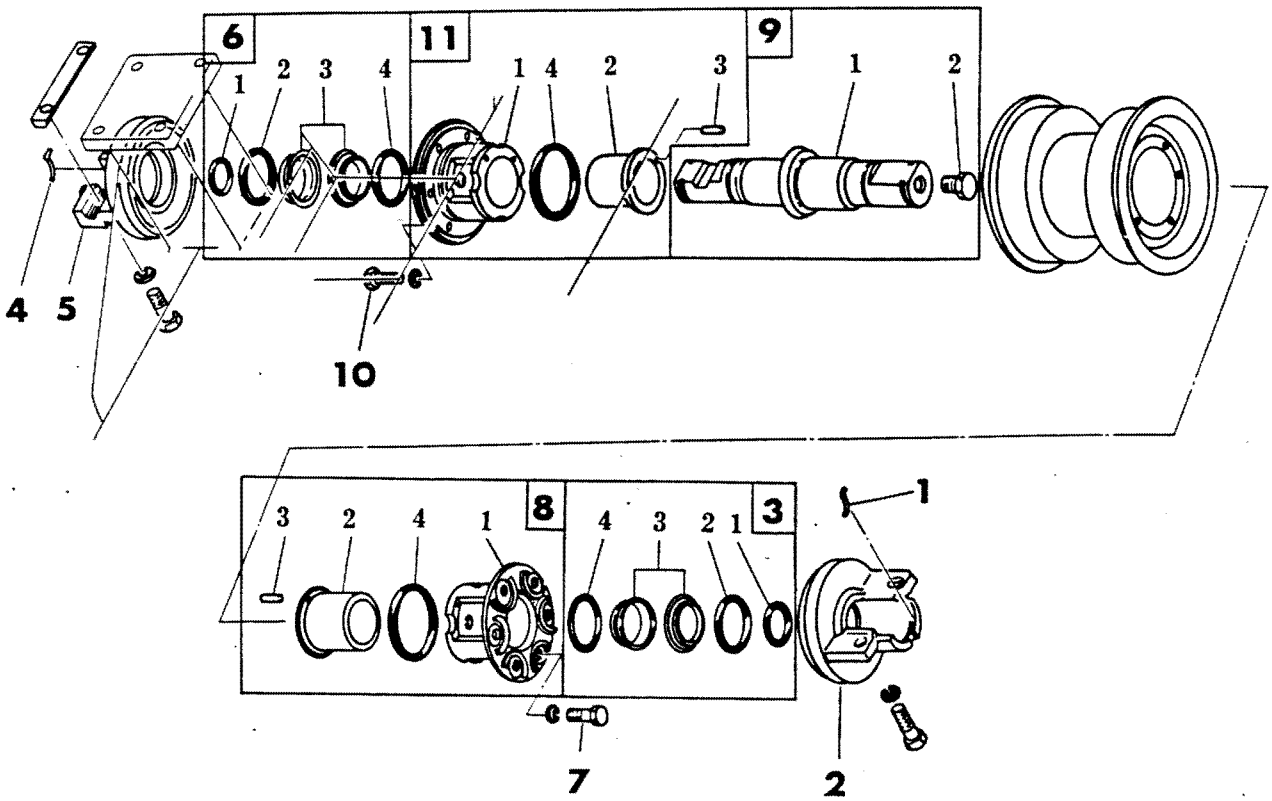
REMOVAL

(1) Open the tracks, and detach each track-frame group from the chassis.
Set the remove track-frame group upside down on the floor.

(2) Loosen bolts (1) and remove guard (2). Remove each track roller assembly from the track frame by loosening its securing bolts (3).



DISASSEMBLING



Track Rollers

1. Ring	4. Ring	7. Bolt	9-2. Plug
2. Collar	5. Collar	8-1. Bush	10. Bolt
3-1. "O" ring	6-1. "O" ring	8-2. Bush	11-1. Bush
3-2. "O" ring	6-2. "O" ring	8-3. Roll pin	11-2. Bush
3-3. Seal ring	6-3. Seal ring	8-4. "O" ring	11-3. Roll pin
3-4. "O" ring	6-4. "O" ring	9-1. Shaft	11-4. "O" ring

Parts are enumerated in the sequence of disassembling.

CLEANING AND INSPECTION

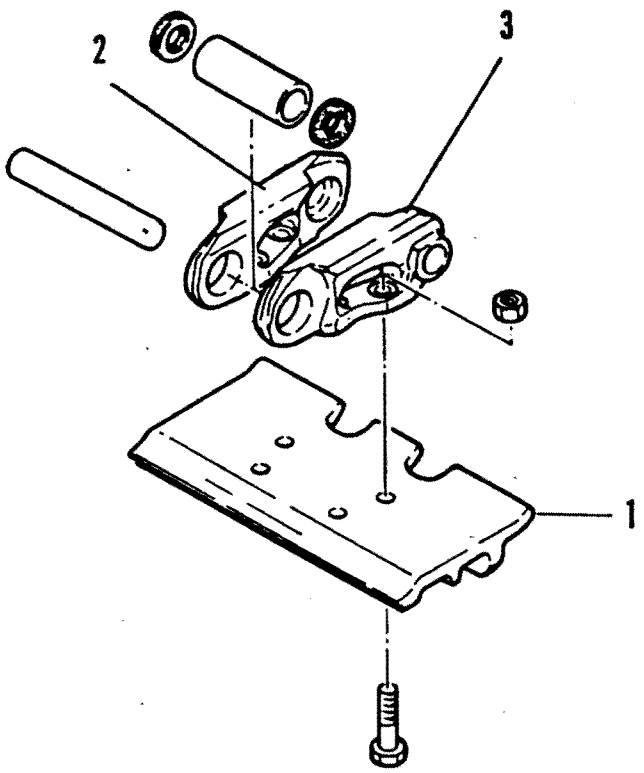
(1) Check the wear of each track roller by measuring collar O. D. at the riding faces and flange thickness.
(2) Inspect the track roller shaft for damage, and check its runout (deflection).
(3) Measure shaft O. D., bush I. D. and thickness of the center flange (of the shaft) to determine the amount of wear. Clean the shaft and roller, and clear the oil passage through shaft with compressed air.
(4) Inspect roller-shaft collars for damage.

INSTALLATION

Reverse the removal and disassembling procedures outlined above. Use the press to install the bushes in the roller as outlined for carrier rollers.

TRACKS

DESCRIPTION



Track Shoe

1. Track shoe
2. Link (L)
3. Link (R)

A single loop of track is composed of 36 segments for D55S-3. It is either integrally cast type or built-up type.

The integrally cast segment is a special-manganese steel in material, and excels in resistance to abrasive wear.

The pin holes in each segment are formed by machining for loose fit. Pins inserted in these holes for connecting track segments are locked in place by means of split pins.

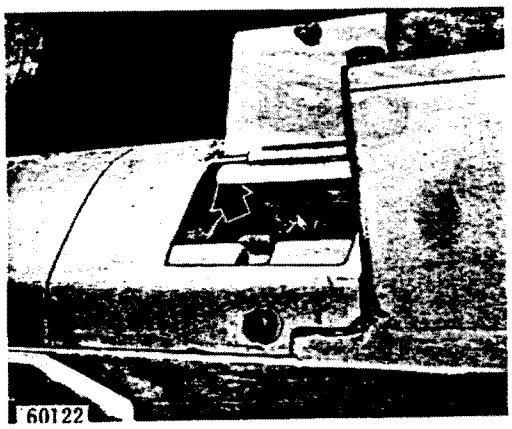
The built-up segment consists of a shoe, two parallel links, a pin and a bush. The leading ends of two parallel links for each segment are press-fitted onto the bush and the trailing ends of the two links of the preceding segment are press-fitted onto the pin inserted through that bush, such that, in the end-to-end connection of two segments in a row, each end of the pin extends through two overlapped link ends. The shoe is bolted to the two parallel links to form a complete segment. A dust seal is fitted to each end of the bush in place in order to keep foreign matters off the clearance between pin and bush. Two segments in each track chain are provided with master pins, which are special pins designed for easier installation and removal. The loop of track is to be made (closed) or unmade (opened) by inserting or withdrawing these pins.

Shoes are available in different types in regard to the grouser. The most commonly used shoes are single-grouser and double and triple grouser.

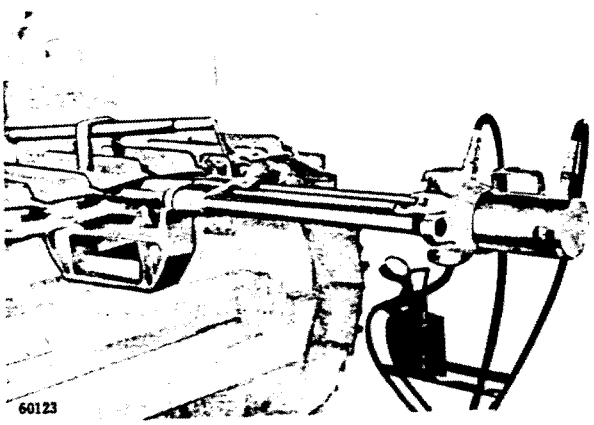
REMOVAL

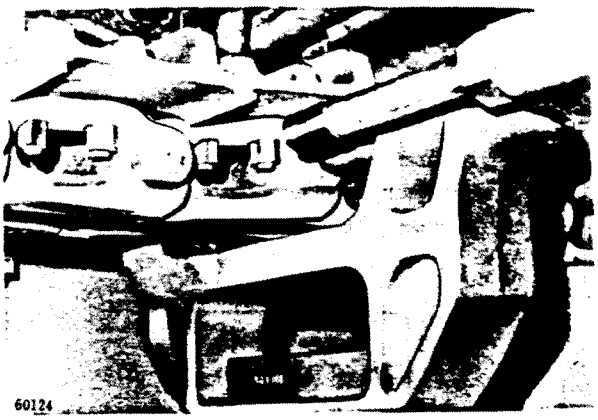
(1) Loosen plug to relieve the pressure (grease) in the tensioning cylinder in order to slacken the track chain.

NOTE: If no grease bleeds out, drive the machine back and forth in jerking manner: this will force some grease out and slacken the track chains.



(2) Using a hydraulic cylinder, force the master pin out to break the chain there. After both track chains have been opened, drive the machine backward to lay the tracks down on the floor.

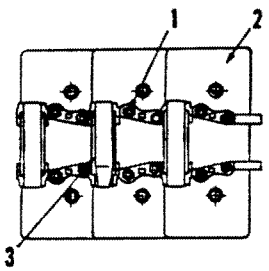




(3) Where the existing tracks are to be replaced by another set of tracks, line up the replacing tracks on the floor to form extension of the ones to be replaced, and drive the machine over to the replacing tracks.

DISASSEMBLING

(1) Loosen shoe bolts (1) and remove shoe (2). Repeat this process to remove all shoes.
(2) Using the press, force out one pin after another, starting from the end where master bush (3) is located.



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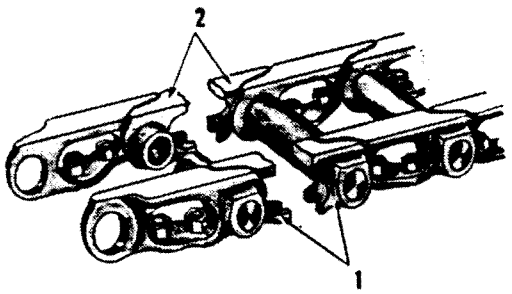
NOTES:
1) Before pushing each pin out, make sure it will slide out without galling the bore in the link. If the pin in place is noted to have stepped wear pattern, smoothen the worn surface to insure smooth removal.
2) If press equipment for disassembling tracks is not available, the track may be cut with a cutting torch to remove any portion of the track for renewal. The flame-cutting procedure is as follows:

i) Cut the pair of links in the middle. (This produces four half links.)



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ii) Remove a 15-cm (5.9") long mid-portion of each bush by flame cutting. (A pin is within each bush).
iii) To remove the half pin from the preceding link, apply flame to the embossed end of the link and drive the half pin out.
iv) Remove other half links (1) (2) from the following links.
v) When connecting new links to take the place of the pair removed by flame cutting, be sure to use dust seals at both ends of each new bush.

INSPECTION

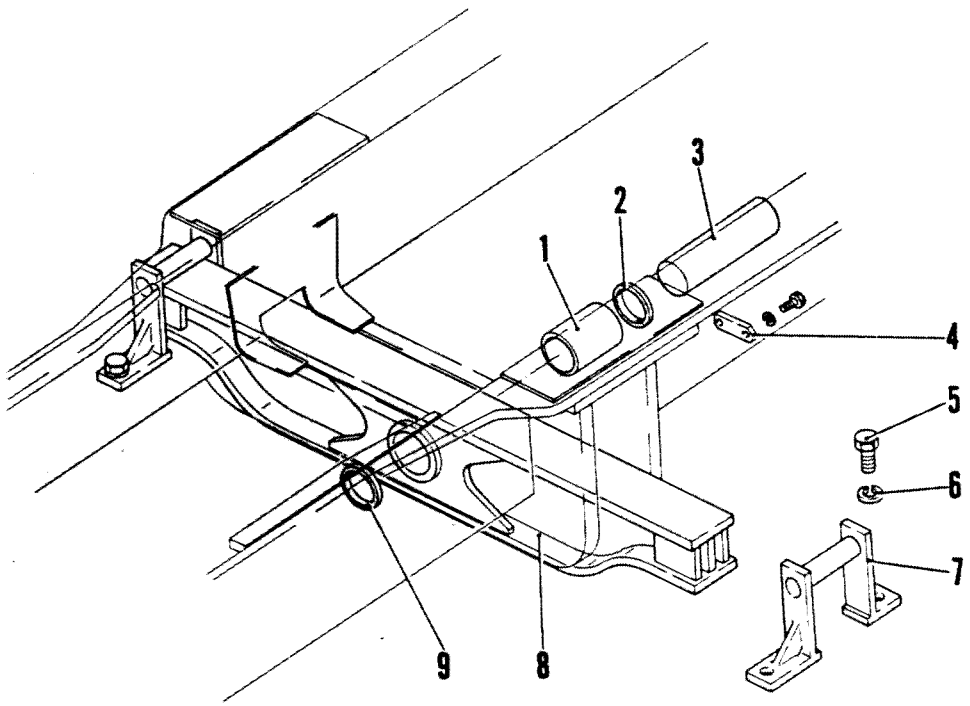
(1) Inspect each track shoe for cracks or wear of its grouser and ground-bearing face.
(2) Inspect the links, bushes and dust seals for wear, and check the link height and bush O.D. Also check the overall stretch, if any, in each track chain.
(3) Check the bolts for tightness. Replace excessively worn bolts.

ASSEMBLING

Reverse the disassembling procedure. Apply oil to bushes and pins before press-fitting them into links.

SUSPENSION

DESCRIPTION



Equalizer Bar

1. Bushing	4. Key plate	7. Bracket
2. Dust seal	5. Bolt	8. Equalizer bar
3. Pin	6. Spring washer	9. Dust seal

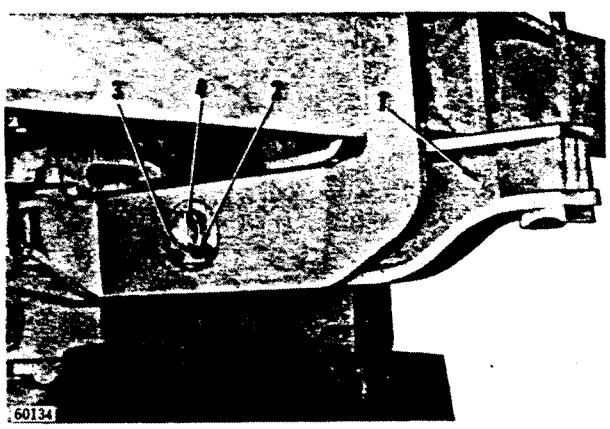
The rear end of the chassis rigidly loads on the track frames through sprocket wheel shafts, but the front end is suspended, that is, flexibly supported. The front-end suspension is formed with the equalizer bar, whose center point is pivotally pinned to the chassis and whose ends are supported and held by brackets built on the track frames. This arrangement allows the forward part of each track frame to move vertically, independent of the other track frame, without so much raising or lowering the chassis. If one of the tracks rides over an obstruction on the ground, that track frame will turn up around the sprocket shaft and the equalizer bar will rock on its pivot, thereby transferring some of the load to the other track frame. This is an equalizing action calculated to prevent occurrence of excessive stress in the load carrying members. An added advantage of this arr angement is that the rolling and pitching motion of the chassis is reduced for increased operator's riding comfort.

REMOVAL

(1) Remove the underguards below engine and transmission. (Refer to ENGINE REMOVAL.)

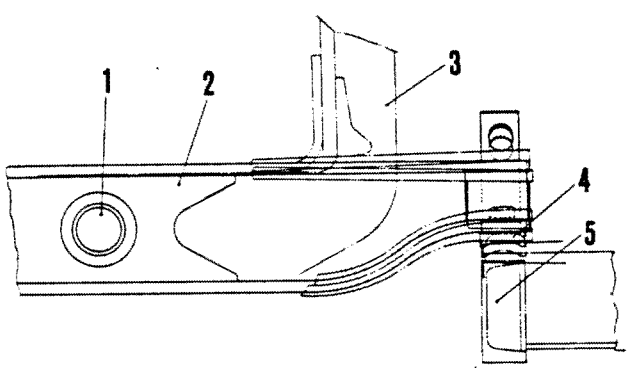
(2) Open the tracks, and separate one track-frame group from the chassis. (Refer to TRACK REMOVAL and REMOVAL OF TRACK-FRAME GROUPS.)
Block up the main frame under the radiator to hold the front end raised above the floor and thereby permit the equalizer bar to rock in place.

(3) Hang one end of equalizer bar (1) with a sling; loosen bolts (2); remove plate key (3); and draw out pivot pin (4). Lower the hanging end of equalizer bar and carry it out of the machine for removal.



INSPECTION

(1) Inspect equalizer bar for cracks, damage or any signs of fatigue.
(2) Check the bush (in which the pivot pin is held) for wear.
(3) Inspect the resting face at each end of equalizer bar for wear or galling.



Equalizer Bar

1. Center pivot pin
2. Equalizer bar
3. Main frame
4. Cushion seat
5. Track frame

INSTALLATION

Reverse the removal procedure to remount the equalizer bar. Note that the pivot pin is to be inserted into the bush from rear side.

FUEL TANK

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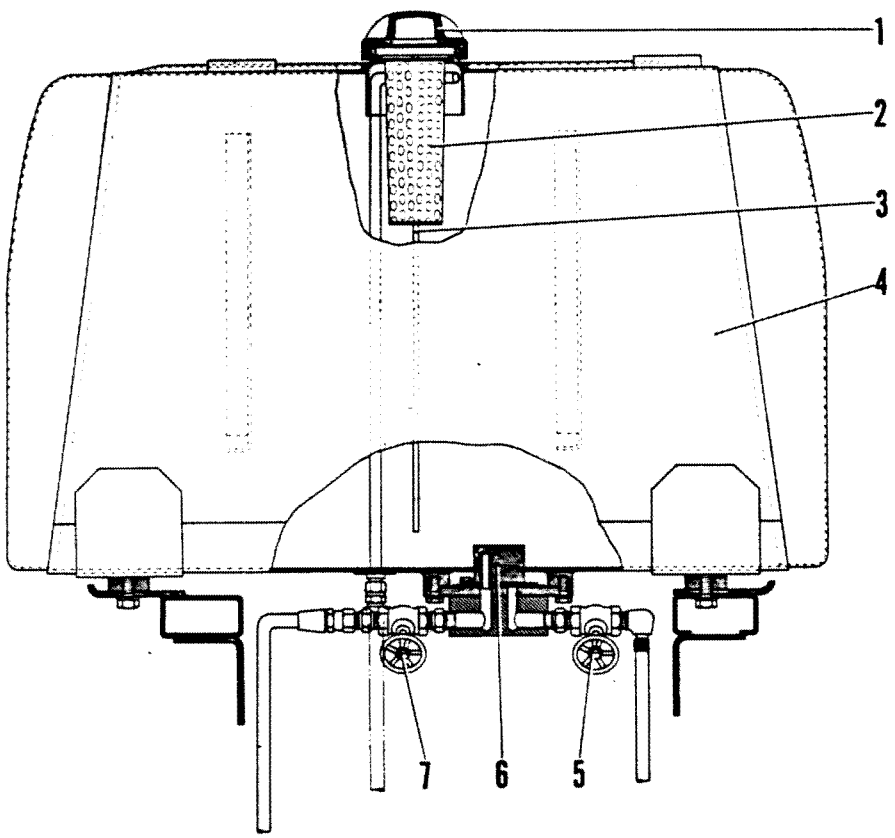
FUEL TANK

DESCRIPTION



Fuel Tank

1. Fuel filler cap
2. Strainer
3. Fuel level gauge
4. Fuel tank
5. Shaft off valve
6. Fuel strainer
7. Drain valve

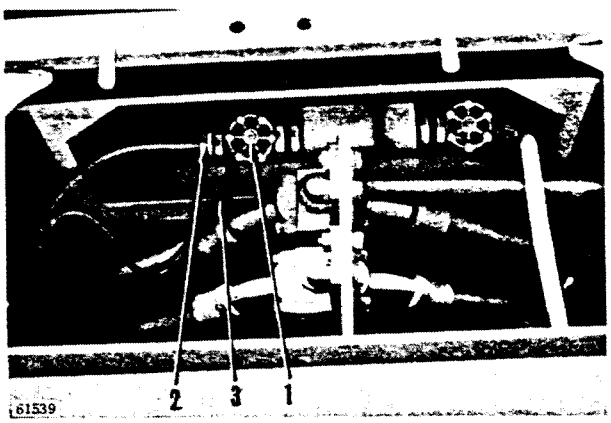
The fuel tank is located directly behind the operator's seat and is mounted on the rear frame. There are two valves (A) (B) under the tank. Valve (A) is in the line leading to the engine through the fuel filter. Valve (B) is for draining the tank. The fuel filter, located stop the tank, is complete with a strainer and a stick for checking the fuel level.

A strainer is provided in the bottom of the tank. This strainer can be removed without necessitating draining of the tank, so that the strainer can be cleaned any time.

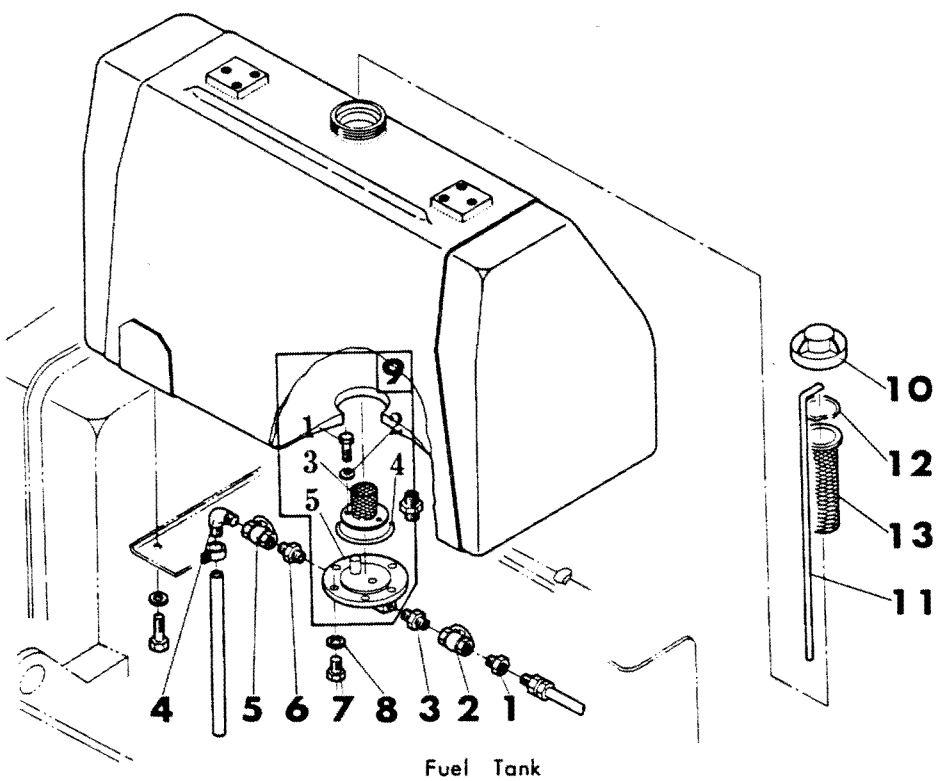
REMOVAL

(1) Close valve (1) under tank, and disconnect the joint (2).

(2) Disconnect the joint (3) of oil return pipe extending from the engine side.
Loosen bolts and remove the fuel tank assembly.



DISASSEMBLING



Fuel Tank

1.	Nipple	7.	Bolt	9-5.	Flange
2.	Valve	8.	Spring washer	10.	Cap
3.	Nipple	9-1.	Bolt	11.	Gauge
4.	Elbow	9-2.	Spring washer	12.	Ring
5.	Valve	9-3.	Strainer	13.	Strainer
6.	Nipple	9-4.	O-ring		

Parts are enumerated in the sequence of disassembling.

CLEANING AND INSPECTION

(1) Inspect the fuel tank for cracks or damage. Clean the tank interior.

(2) Clean strainers.

ASSEMBLING

Reverse the disassembling procedure, adhering to the following rules:

(1) Do not re-use the removed gaskets and O-rings: use new ones in assembling the tank.

(2) Make sure the strainers and flanges are perfectly clean before installing these parts.

ELECTRICAL EQUIPMENT

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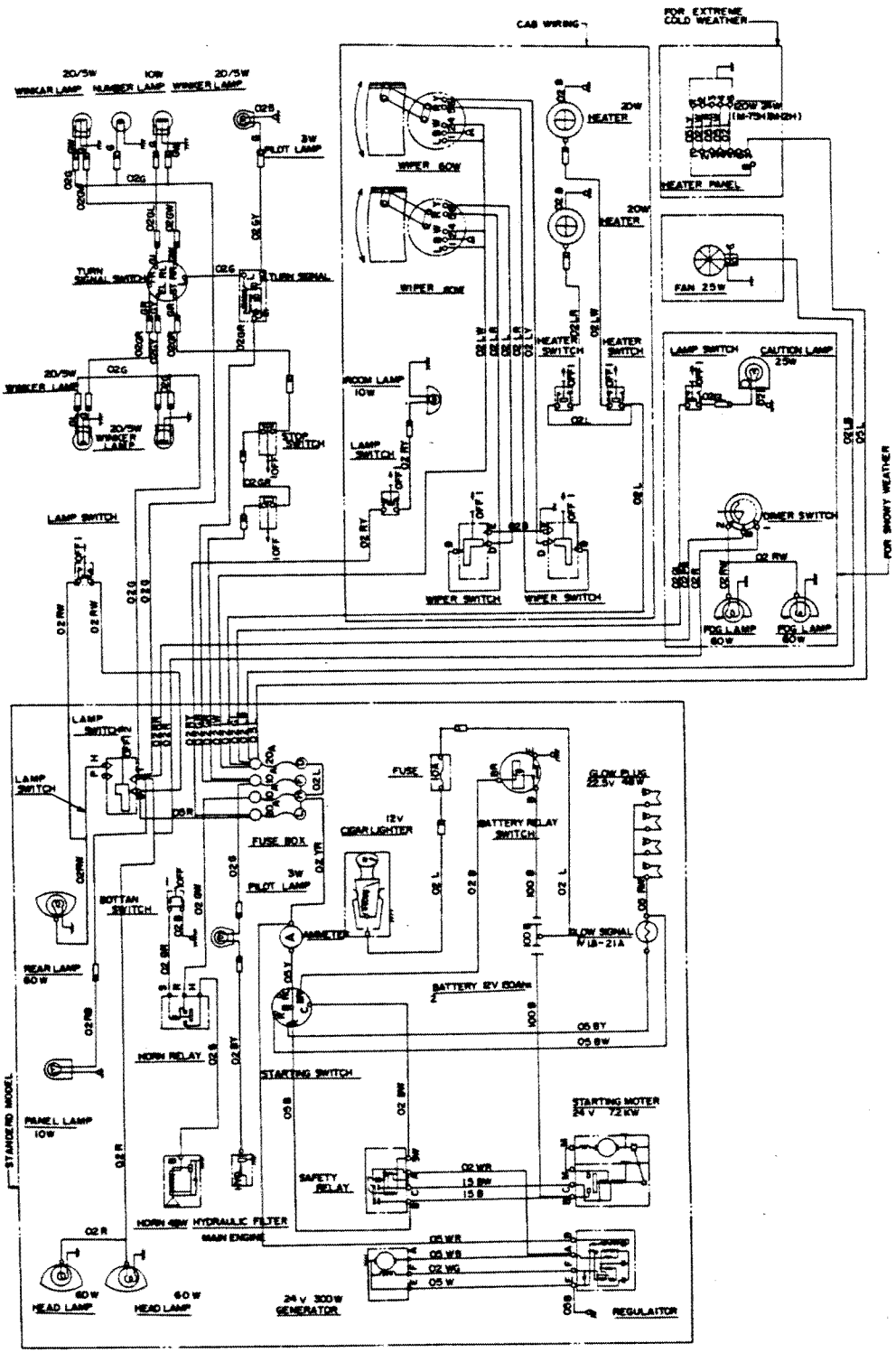
ELECTRICAL EQUIPMENT

The electrical wiring diagram is shown below.

Maintenance and servicing of electrical equipment are dealt with separately in another KAMATSU manual.

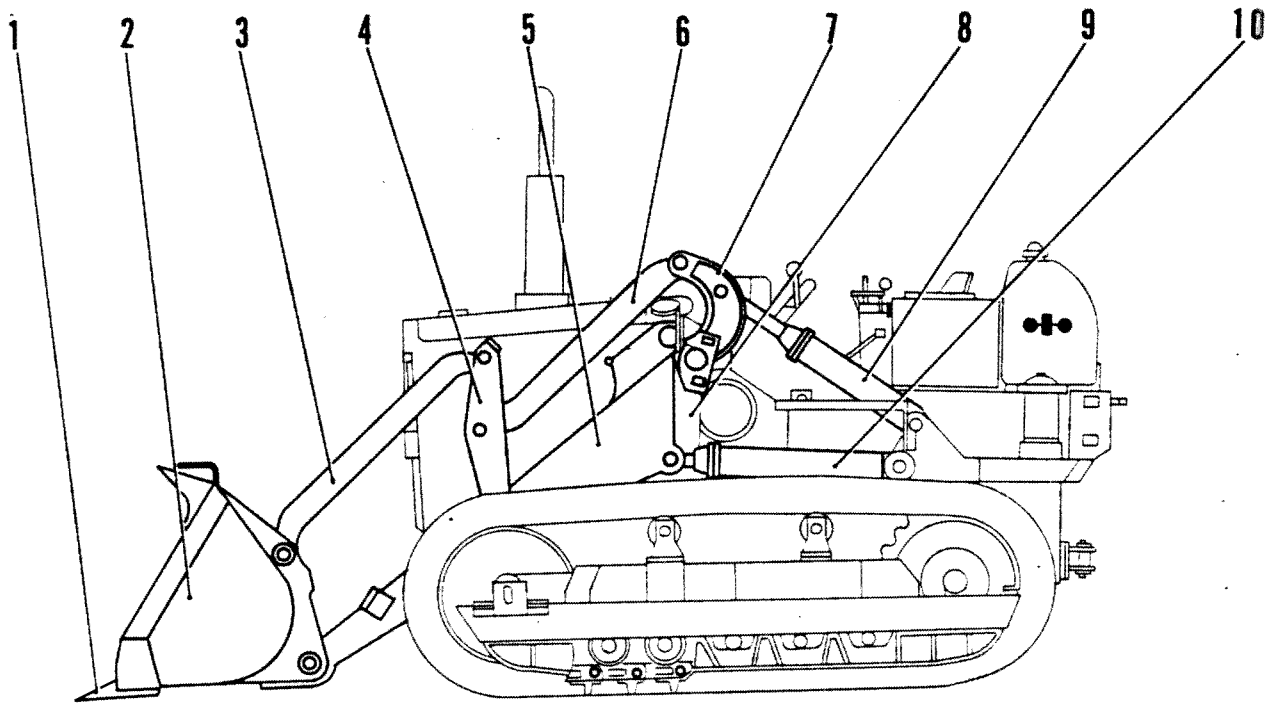


DOZER GROUP

INDEX

DOZER GROUP

DESCRIPTION



Bucket Group

1.	Bucket tooth	5.	Lift arm	8.	Side frame
2.	Bucket	6.	Tilt rod	9.	Dump cylinder
3.	Tilt rod	7.	Bellcrank	10.	Lift cylinder
4.	Tilt lever				

The bucket is a welded structure, fabricated with steel plate by welding.

It is so shaped that little or no spillage occurs when the machine is in traveling condition, hauling the material in the bucket. The standard bucket capacity is 2.0 cubic meters (2.6 cu. yd.). The cutting edge of the bucket is formed by welding high-strength wear-resistant edge pieces to the bucket. These edges are made of a special alloy steel.

A total of 7 cutting teeth, made of a special alloy steel, are bolted to these edges.

The lift-arm structure is fabricated mainly with steel plate in combination with castings. The arm is a box-section fabricated member and has its forward

end shaped into a box-section connector.

The two rear ends are connected to the supporting member with a single hollow shaft. A rod extends through this hollow shaft and, by means of the nuts at its both ends, holds the two arm ends tightly together so that the arm pivoting section so formed has plenty of strength for withstanding large stresses occurring in this connecting part during loading or unloading operation.

The tilting motion of the bucket, originating from the two cylinders, is transmitted through a double linkage consisting of two tilt rods, front and rear, and an intermediate lever (tilt lever) for each half of the arm structure. Three kinds of stopper are provided. The first stopper is at the forward end of the arm structure and limits the tilt-back angular stroke of the bucket. The other two are at the rear end: both are for limiting the dumping stroke of the bucket. Of these two, one is effective when the lift arm is at or above the horizontal, and the other when the arm is below the horizontal.

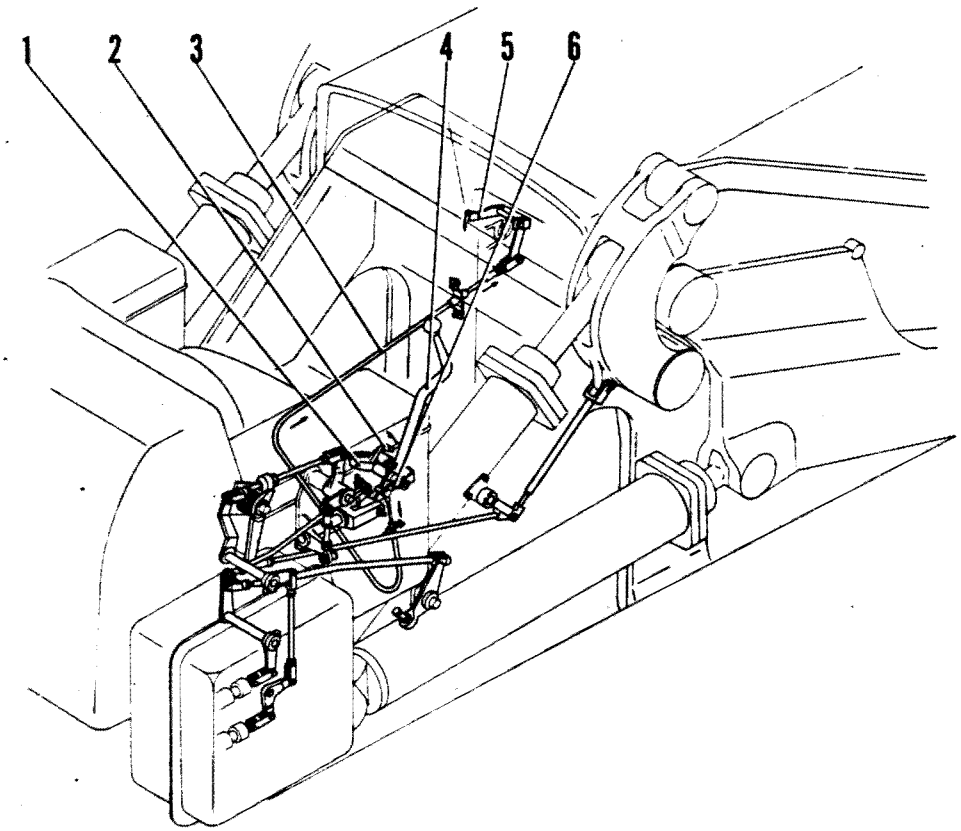
SAFETY DEVICE FOR SHOVEL ATTACHMENT

The safety pins are for holding the shovel attachment — lift arms, tilt rods, bucket and all — in raised position so as to permit the serviceman to work on the parts of the machine that can be serviced or worked on only when the bucket is raised high, often while the engine is running.

As contrasted to the safety pin arrangement hitherto used, the safety device of the present machine is characterized by an additional feature, which completely eliminates the possibility of the bucket control valve getting accidentally operated when the bucket is so held. Without this feature, the possibility of accidentally actuating the hydraulic cylinders would exist whenever the engine is running under such a condition.

Inserting safety pins into the holes to keep the bucket raised high automatically locks the bucket control lever, and the lever will not move as long as the pins are in place — this is the essence of the feature included in this machine.

The safety device is to be used in the following manner.



Safety Device

1.	Lever B	3.	Cable	5.	Lever A
2.	Safety lever	4.	Control lever	6.	Lever C

(1) Locking

Push down lever (A) by hand, and insert safety pins.

Lever (A) is interconnected to lever (B) by means of a wire. As lever (A) is pushed down, the wire pulls on lever (B) to raise the safety lever into locking position. At the same time, the protrusion of lever (C) engages into the hole of lever (B) fixed to the control lever, thereby locking the control lever in neutral position.

(2) Unlocking

Push down the safety lever by hand, move the control lever into "UP" position to raise the bucket slightly farther up, and darw out the safety pins.

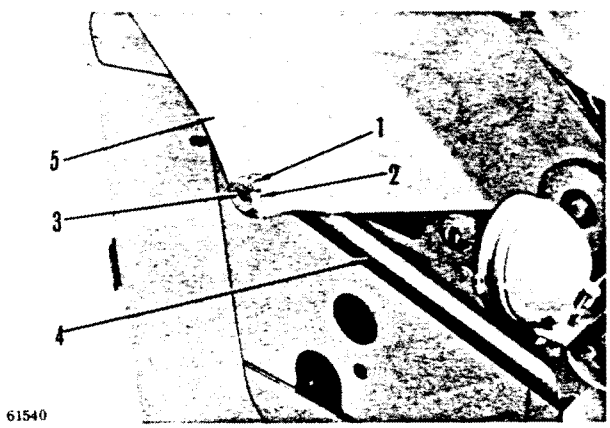
Pushing the safety lever down against spring load causes lever (B) to rise a little and disengages the protrusion of lever (C) from the hole.

This allows the control lever to be moved but into "UP" position.

REMOVAL

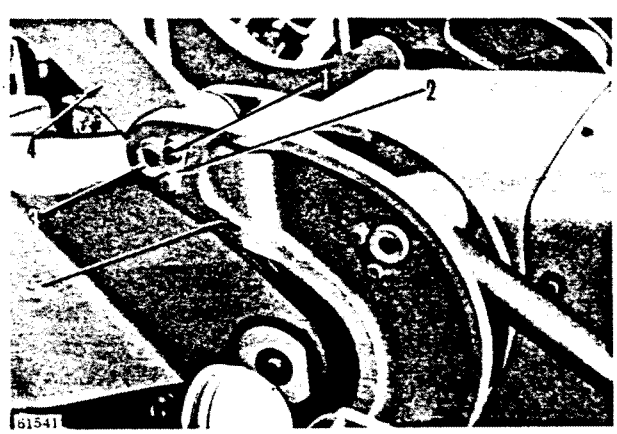
(1) Hold the bucket in dumping position and take up the weight of bucket in place with a lifting sling.

(2) Loosen bolts (1) and remove lock plate (2); draw out pin (3) to disconnect lift cylinder (4) from lift arm (5).

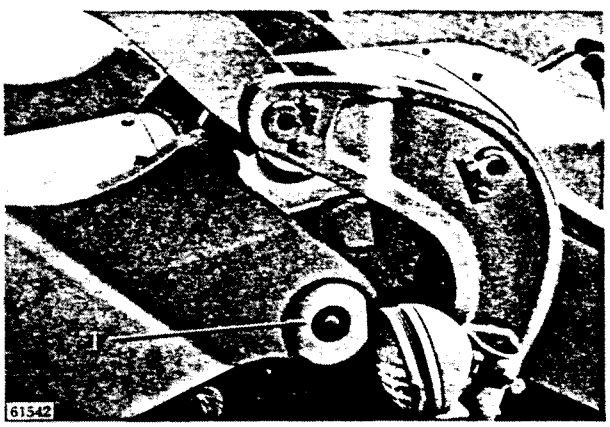


(3) Loosen bolts (1) and remove lock plate (2); draw out pin (3) to disconnect tilt rod (4) from bellcrank (5).

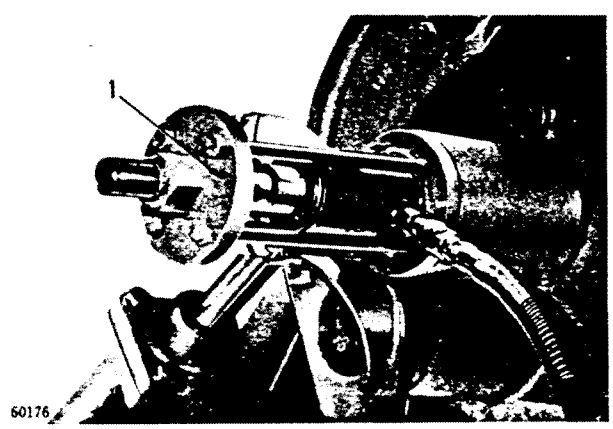
Remove the plug and draw out the bolts from the bucket shaft.



(4) Remove the bucket shaft nut (1).

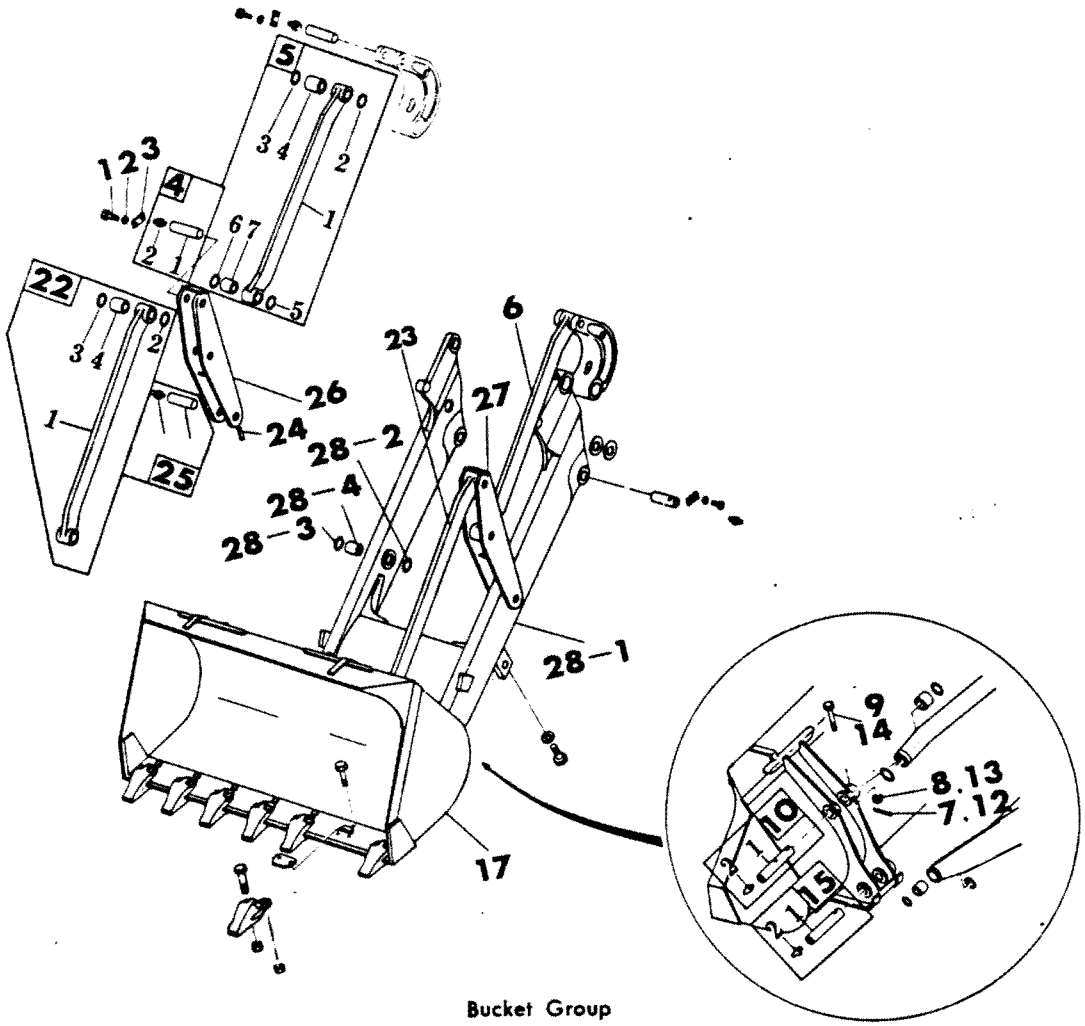


(5) With the special tool (1), draw the the bucket shaft out.



(6) Carry the lift arm and bucket assembly forward in suspended condition.

DISASSEMBLING



Bucket Group

1. Bolt
2. Spring washer
3. Lock
4-1. Shaft
4-2. Grease fitting
5-1. Tilt rod
5-2. Dust seal
5-3. Dust seal
5-4. Bush
5-5. Dust seal
5-6. Dust seal
5-7. Bush
6. Remove the left tilt rod in the same way
7. Pin
8. Nut
9. Bolt
10-1. Shaft
10-2. Grease fitting
11. Remove the left shaft in the same way (10)
12. Pin
13. Nut
14. Bolt
15-1. Shaft
15-2. Grease fitting
16. Remove the left shaft in the same way (15-1)
17. Bucket
18. Bolt (1)
19. Spring washer (2)
20. Lock (3)
21-1. Shaft (4-1)
21-2. Grease fitting (4-2)
22-1. Tilt rod (5-1)
22-2. Dust seal (5-1)
22-3. Dust seal (5-3)
22-4. Bush (5-4)
23. Remove the left side part in the same way
24. Roll pin
25-1. Shaft
25-2. Grease fitting
26. Tilt lever
27. Remove the left side part in the same way
28-1. Lift arm
28-2. Dust seal
28-3. Dust seal
28-4. Bush

Parts are enumerated in the sequence of disassembling.

INSPECTION

(1) Inspect the bucket for cracks, deformation or any other damage. Examine the welds with particular care for any evidence of breakage.

(2) Inspect the bucket teeth and tooth securing bolts for wear or damage.

(3) Check each link pin clearance in the bore.

ASSEMBLING

Reserve the disassembling procedure, adhering to the following rules:

(1) When securing the teeth to the bucket edge, be sure to coat the screw threads of each bolt with LOCKTIGHT before using the bolt. The tooth securing bolts are to be tightened to 54 ± 3 Kg.m (391 ± 22 ft.lb) torque.

(2) Be sure to correctly discriminate the left tilt rod from the right one. (These rods should be given identification marks before removal.)

ADJUSTMENT

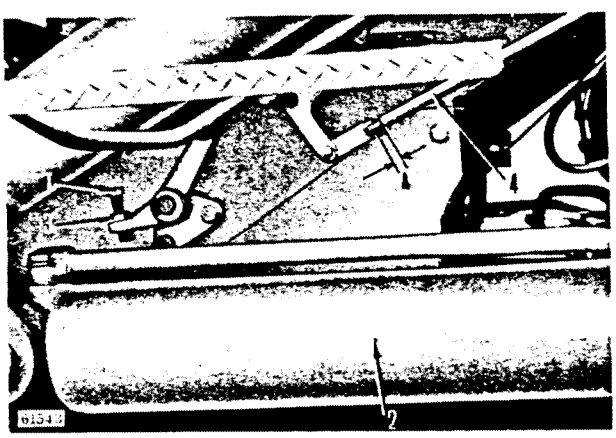
A. Kickout Adjustment

Kickout adjustment is to be effected in the following manner:

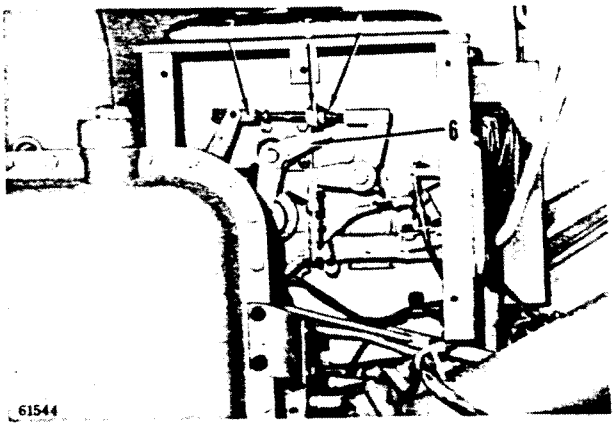
Park the machine on flat level ground, raise the bucket to the desired elevation, and keep the control lever in lift position.

Loosen the lock nut, and screw in adjusting bolt (1) until it bears against lift cylinder (2) stopper. Tighten the lock nut. (3) If adjusting bolt (1) will not reach the stopper, extend rod (4).

After the above adjustment has been made, start up the engine and operate the bucket upward. While the bucket is ascending, check to be sure the control lever automatically snaps back into hold position the moment the bucket comes to the desired level.



B. Position Adjustment



Lower the bucket and rest it on ground. Tilt the bucket into the desired digging position, stop the engine and proceed as follows:

Remove the cover located to the right of the operator's seat, right next to the arm rest.

Disconnect yoke (7) from lever (6), move the control lever into tilt position, turn the stopper (5) until lever (6) begins to interfere with further motion, and tentatively secure the stopper in that position by making the lock nut (4) finger-tight. Operate the lever to see if it will smoothly move back into hold position. The adjustment should be completed in such a way that vibration during travelling will not release the lever from its arrested position.

After adjusting as above, tighten lock nut (4) hard and move the lever into hold position.

Push the rod all the way until it presents a sudden rise of resistance.

Hold the rod in that position, and adjust the yoke (7) to bring its pin center into alignment with that of lever (6). Turn it back 8 or 7 rotations (to make it long) and secure yoke (7) and lever (6) in place.

Upon adjusting, raise and dump the bucket; pull the control lever fully into tilt position. After the lever returns (after the lever is restored), push the control lever into down position. When the bucket comes down to the ground, it should automatically take the position for the desired digging angle.

HYDRAULIC SYSTEM

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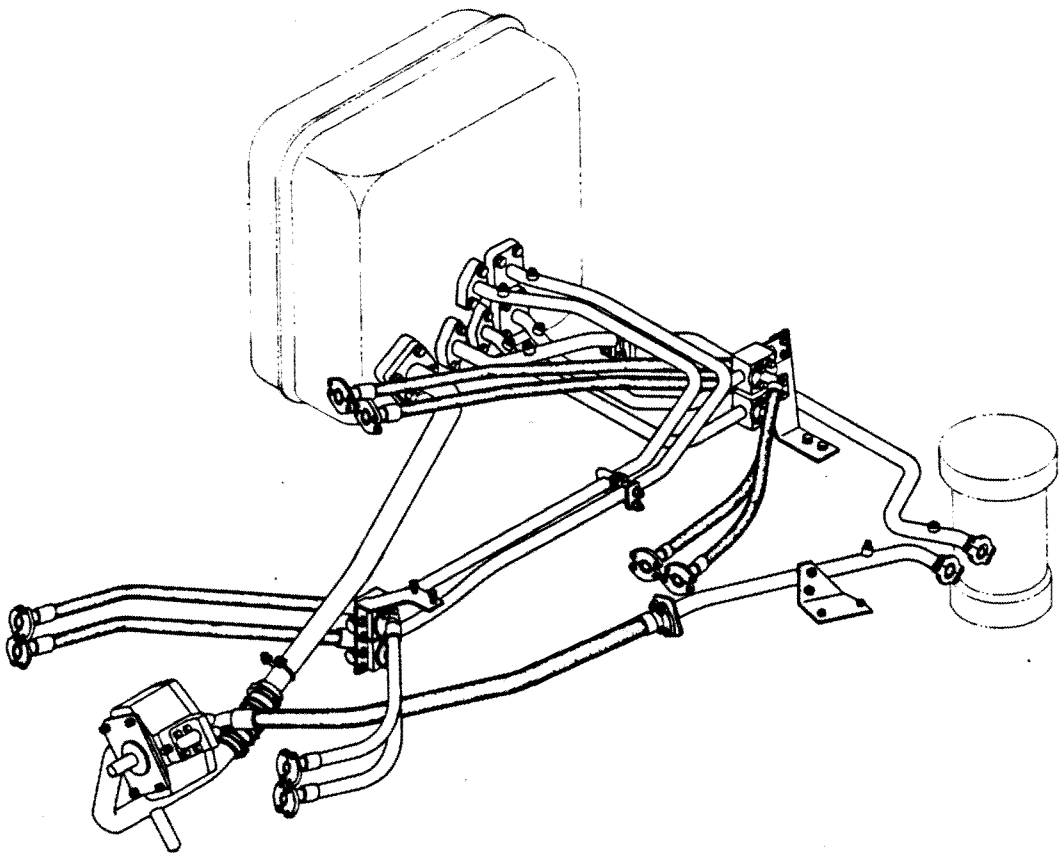
HYDRAULIC SYSTEM

GENERAL



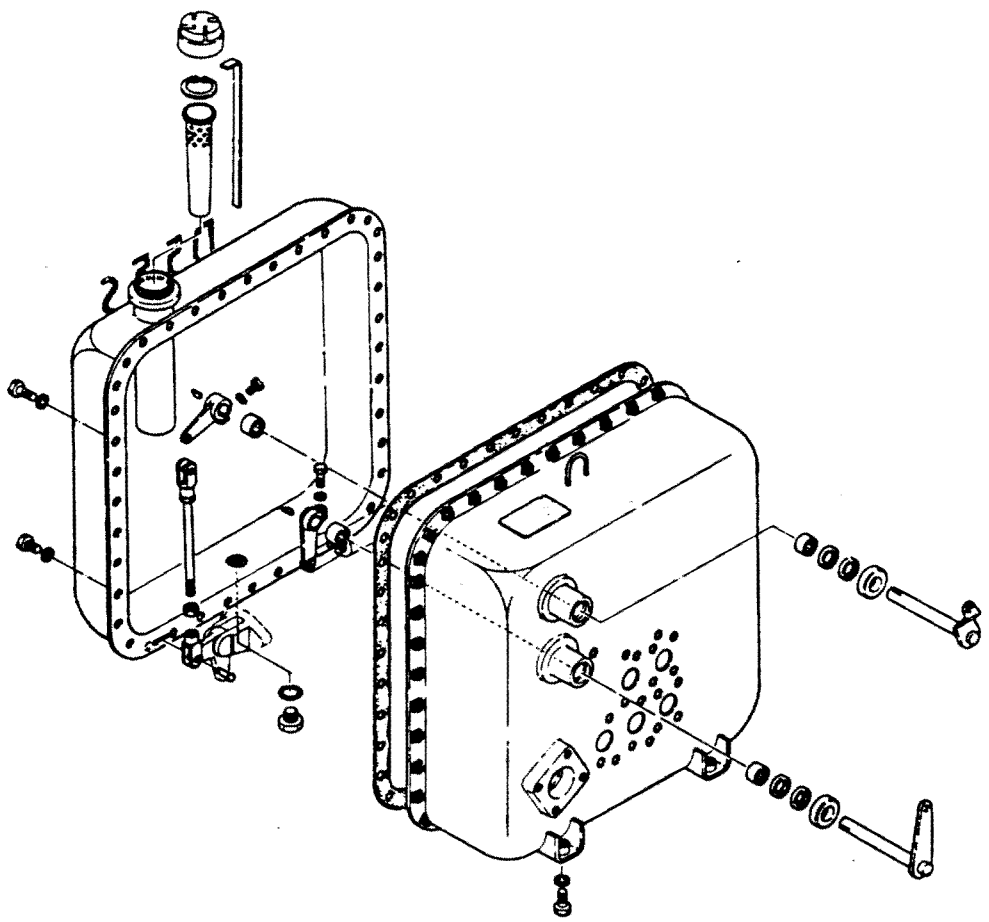
Hydraulic System

The major components of the hydraulic system are the gear pump installed on the torque converter housing; the full-flow filter which filters the oil being supplied under pressure from the gear pump; the control valve and safety valve installed within the hydraulic tank, four hydraulic cylinders (two dump cylinders and two lift cylinders) pinned to the side frames; and the hydraulic tank serving as the reservoir of oil.

The gear pump draws oil from the hydraulic tank and pumps it to the control valve through the full-flow filter. The hydraulic pressure is transmitted to the respective cylinders under pressure from the control valve which is a combination of two valves, tilt valve and lift valve. The former valve has three control positions, and the latter four control positions. The extending end (piston rod end) of each tilt cylinder pushes or pulls the bucket to make it turn on its hinge pin. The force is transmitted through the bellcrank and two rods, as described previously. The lift cylinders have their piston rod ends pinned directly to the rear ends of lift arms.

HYDRAULIC TANK

DESCRIPTION



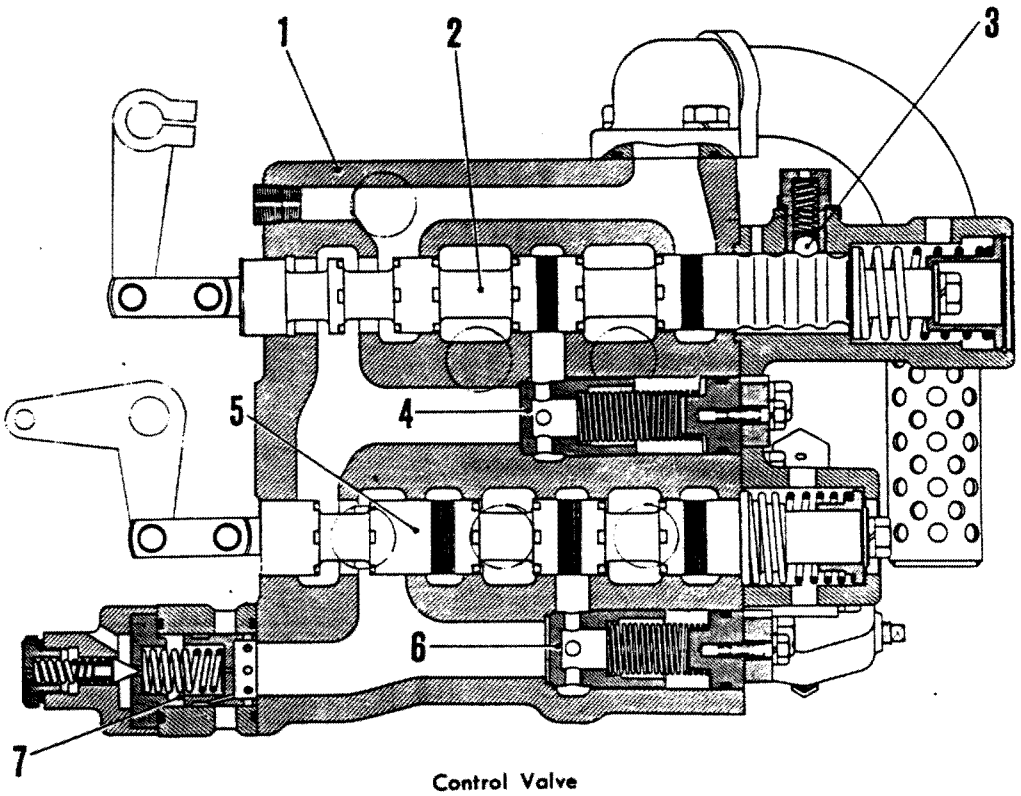
Hydraulic Tank

The tank is mounted behind and at the right of the operator's seat. The control valve and safety valve are within this tank.

The filter located on the top of the tank, is provided with a gauge rod for checking oil level and also a strainer for filtering the oil at the time of filling the tank. The drain outlet of the tank is located on its bottom.

CONTROL VALVE

DESCRIPTION



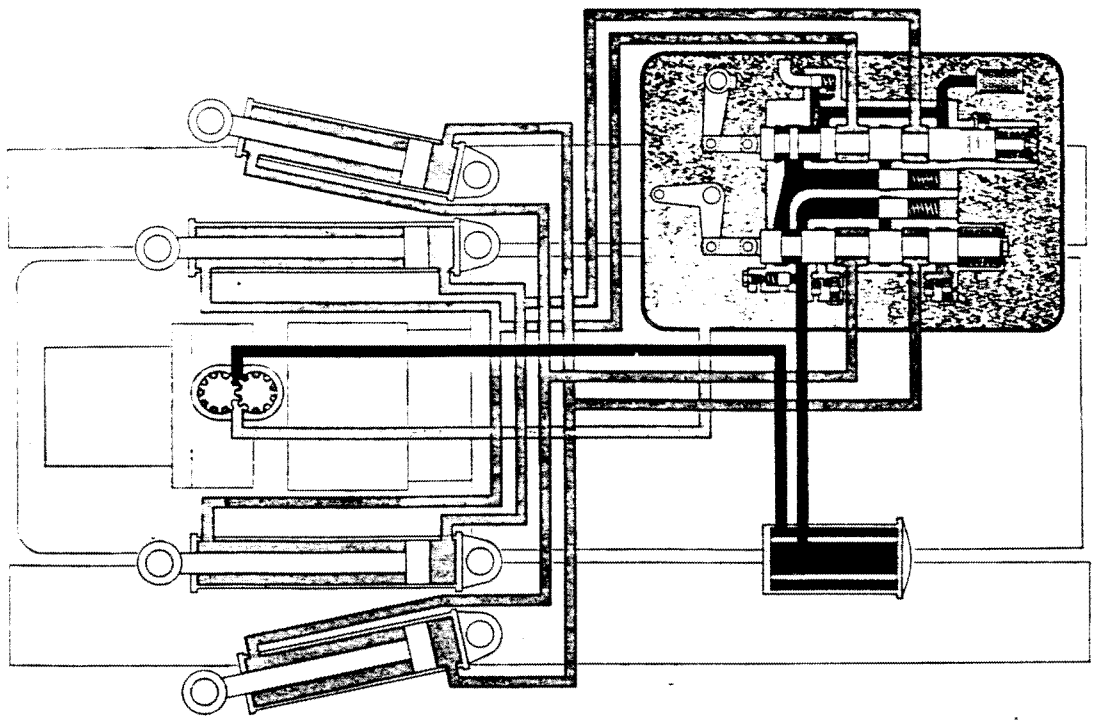
Control Valve

1. Valve housing
2. Lift spool
3. Position finding steel ball
4. Check valve
5. Tilt spool
6. Check valve
7. Pressure regulating valve

The control valve is a with spool valve mounted within the hydraulic oil tank. Its two valve elements are actuated from a single control lever and serve as means of separately controlling the dump and the lift cylinders. The valve element for the dump cylinders has safety valves on the supply and return circuits, one safety valve on each circuit, in order to prevent abnormal pressure rise in the oil circuit. This valve element has three control positions, DUMP, HOLD and TILT. The other valve element it for the lift cylinders and has four control positions. LOWER; RAISE, HOLD and FLOAT. The control lever is located to the right of the operator's seat. The bucket can be tilted at any lift elevation.

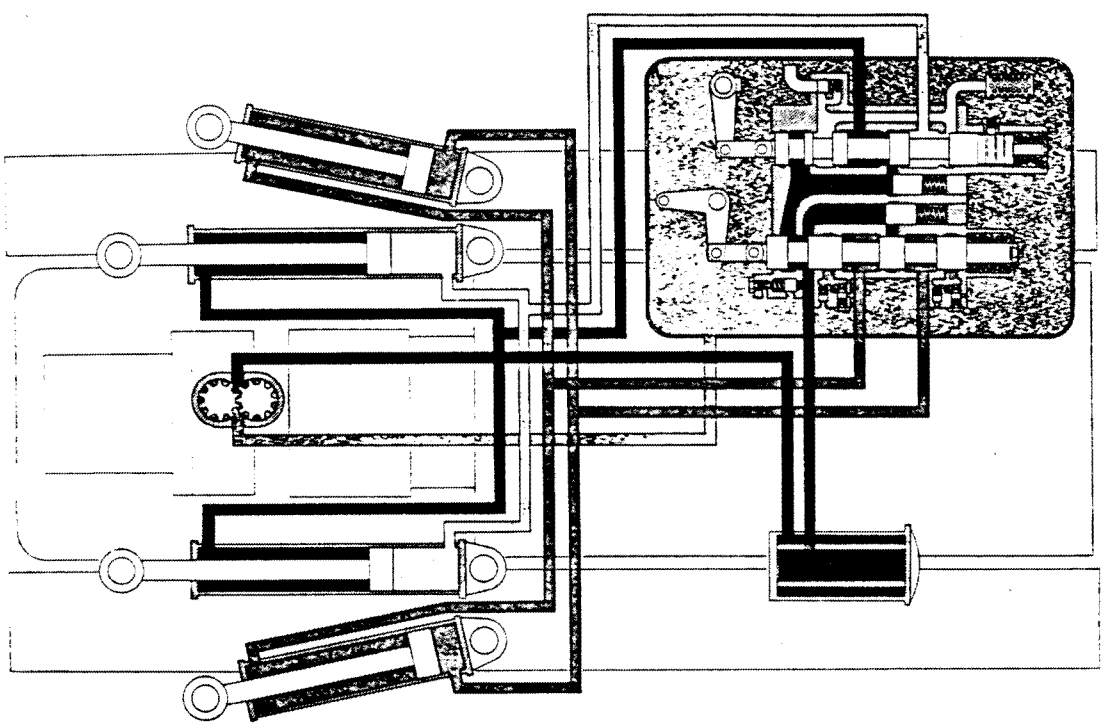
The positional relationship between the control valve and the bucket is diagramatically illustrated below. With the lever in hold position, the bucket stays fixed in its current position. With the lever in float position, the bucket is hydraulically released to yield to external force.

DESCRIPTION



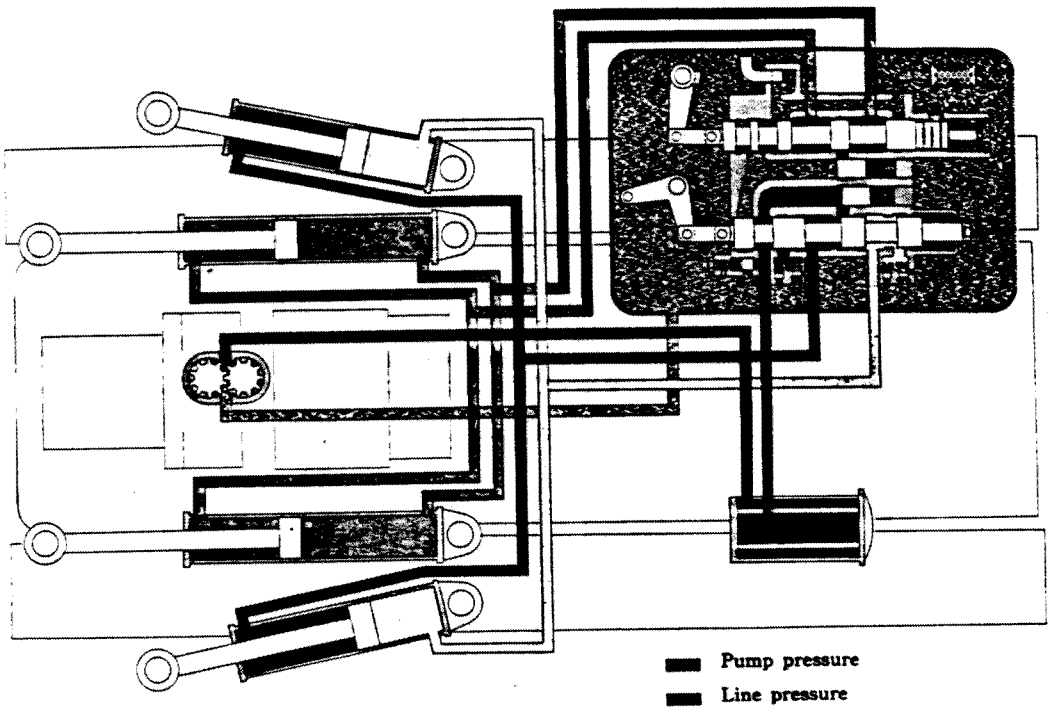
Neutral

Pump pressure
Line pressure
Holding pressure
Drain circuit

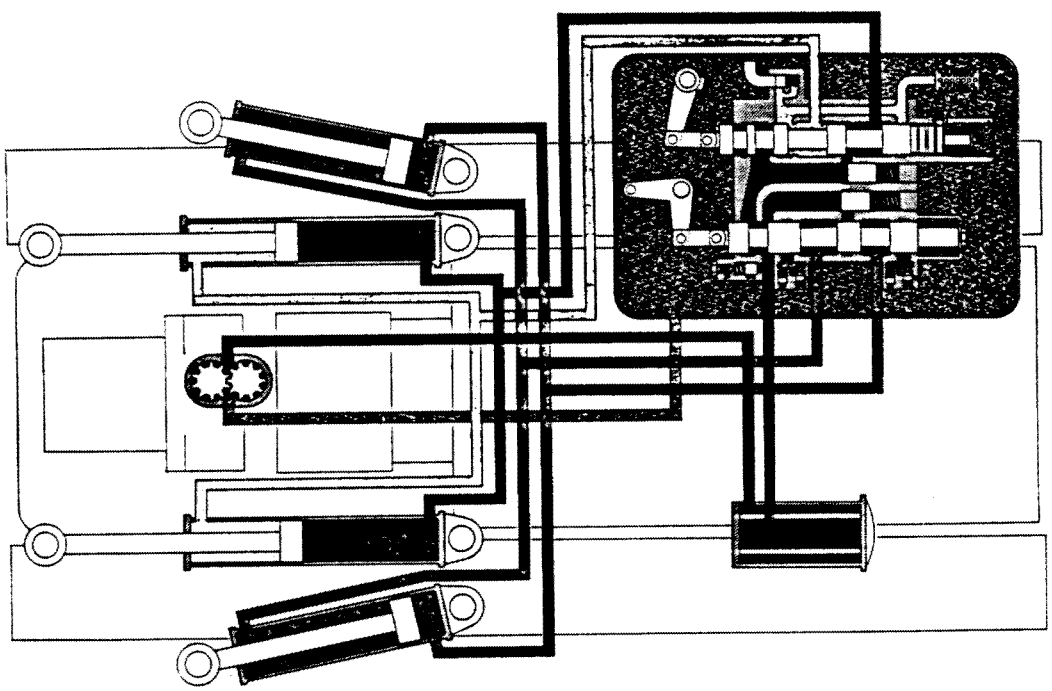


Lift cylinder: Lower
Lift cylinder: Raise

Pump pressure
Line pressure
Holding pressure
Return circuit
Drain circuit

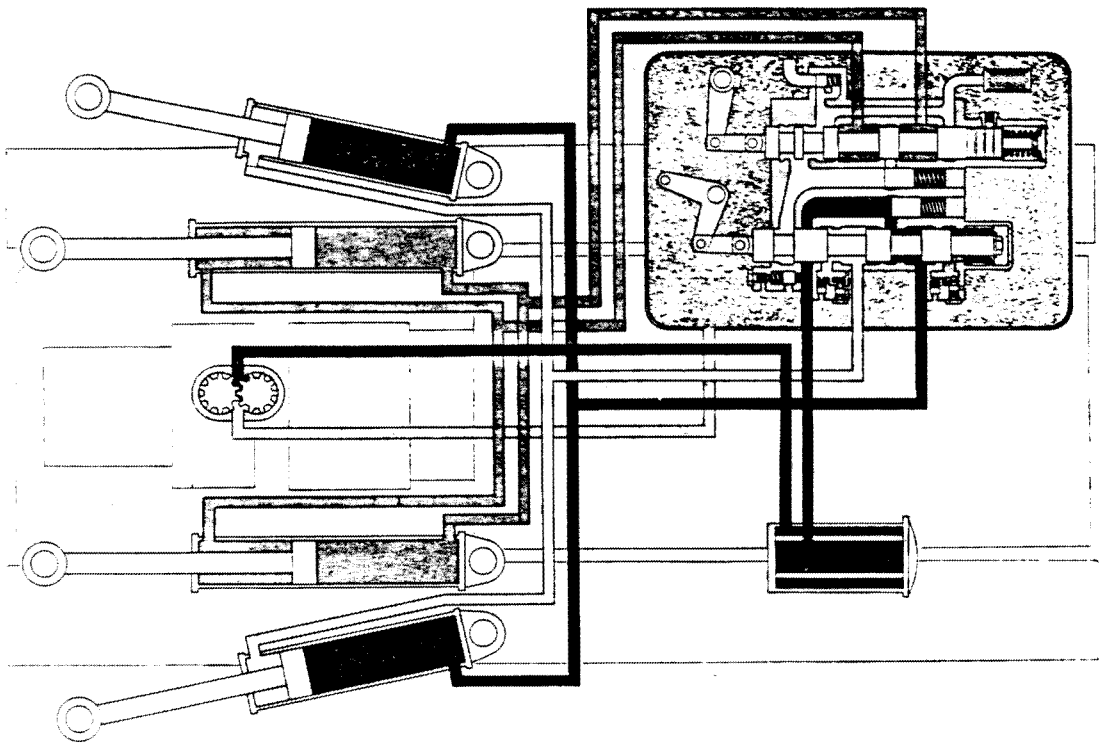


Lift cylinder: Raise
Tilt cylinder: Hold



Tilt cylinder: Tilt
Lift cylinder: Hold

DESCRIPTION

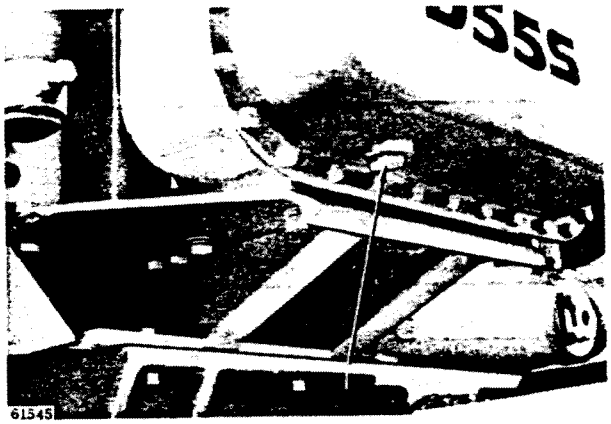


Tilt cylinder: Dump
Lift cylinder: Hold

- Pump pressure
- Line pressure
- Holding pressure
- Return circuit
- Drain circuit

REMOVAL

(1) Drain the hydraulic oil tank by loosening drain plug (1).



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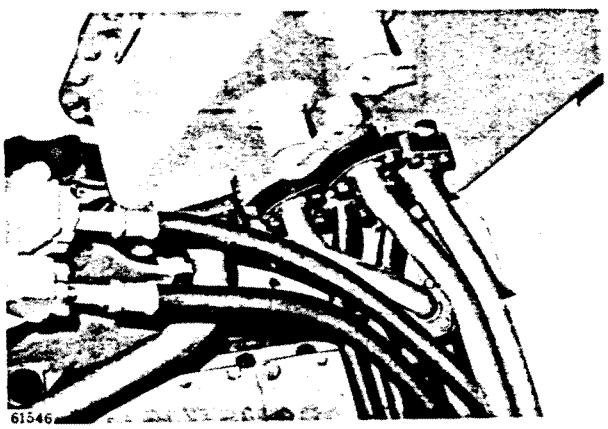
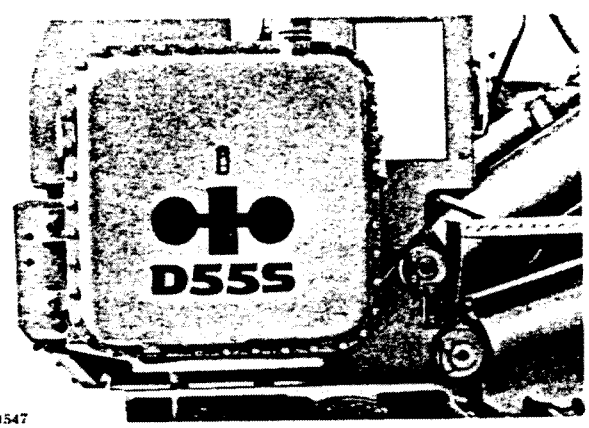
(2) Disconnect oil pipes and control linkage from the hydraulic oil tank.

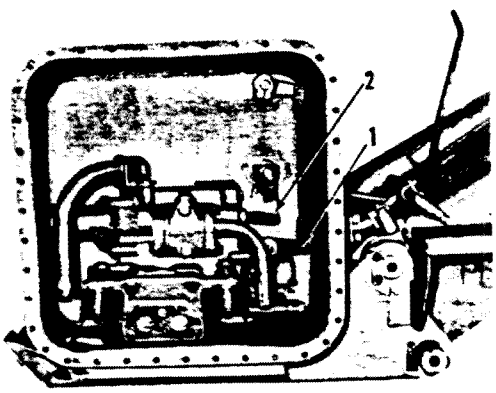

61546

(3) Loosen bolts (1) joining the two tank halves together, and remove the outer half.



61547

(4) Disconnect the control levers (1) (2) from control valve. Loosen the valve securing bolts inside the tank half, and remove the control valve.



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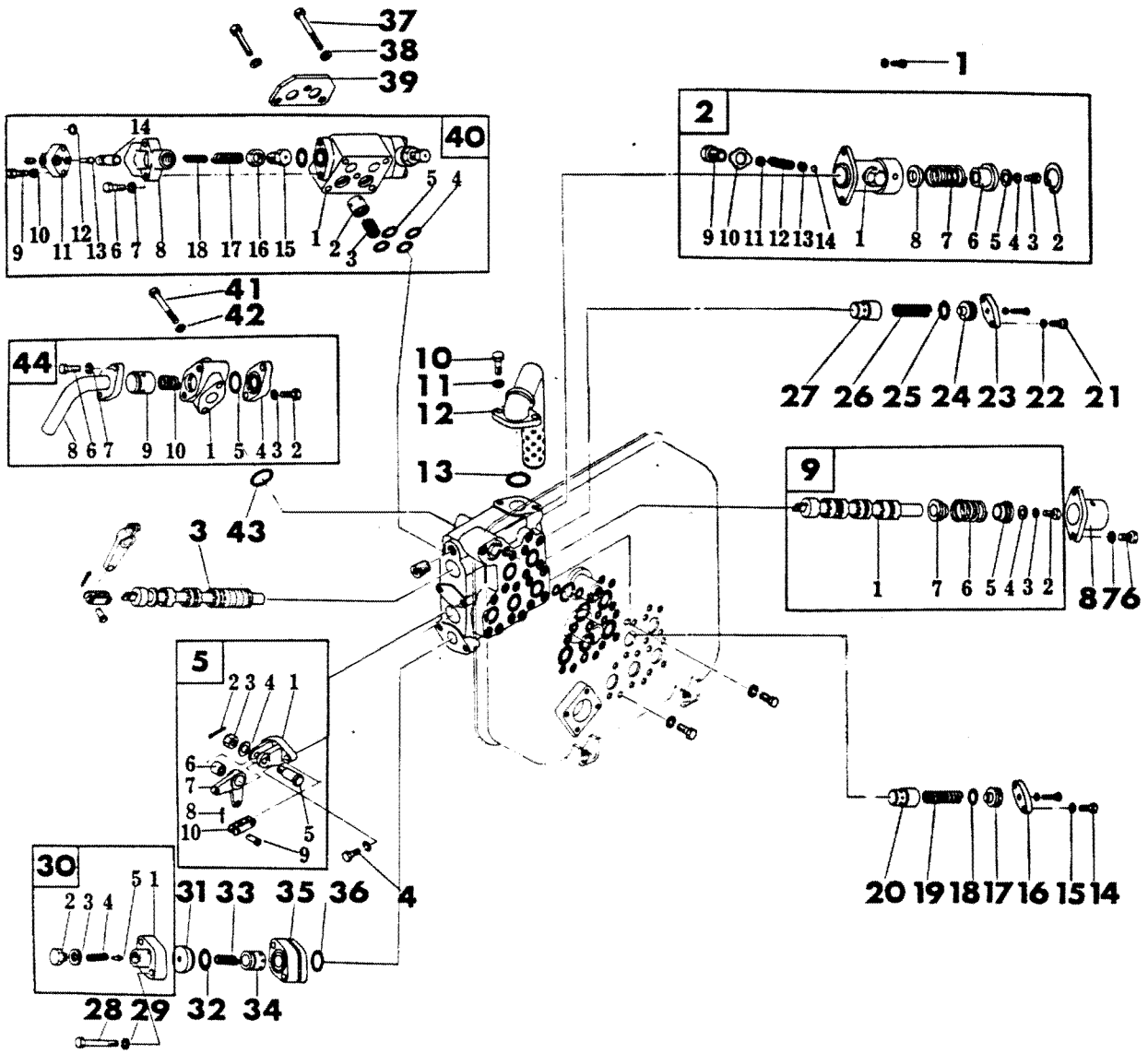
DISASSEMBLING



Control Valve

1. Bolt
2-1. Retainer
2-2. Snap ring
2-3. Bolt
2-4. Spring washer
2-5. Washer
2-6. Spacer
2-7. Spring
2-8. Spacer
2-9. Retaine
2-10. Lock
2-11. Shim
2-12. Spring
2-13. Seat
2-14. Ball
3. Spool
4. Bolt
5-1. Bracket
5-2. Pin
5-3. Nut
5-4. Washer
5-5. Shaft
5-6. Bearing
5-7. Lever
5-8. Pin
5-9. Pin
5-10. Yoke
6. Bolt
7. Spring washer
8. Retainer
9-1. Spool
9-2. Bolt
9-3. Spring washer
9-4. Washer
9-5. Spacer
9-6. Spring
9-7. Spacer
10. Bolt
11. Spring washer
12. Baffle
13. "O" ring
14. Bolt
15. Spring washer
16. Plate
17. Seat
18. "O" ring
19. Spring
20. Valve
21. Bolt
22. Spring washer
23. Plate
24. Seat
25. "O" ring
26. Spring
27. Valve
28. Bolt
29. Spring washer
30-1. Valve body
30-2. Plug
30-3. Shim
30-4. Spring
30-5. Valve
31. Seat
32. "O" ring
33. Spring
34. Valve
35. Housing
36. "O" ring
37. Bolt
38. Spring washer
39. Cover
40-1. Housing
40-2. Valve
40-3. Spring
40-4. "O" ring
40-5. "O" ring
40-6. Bolt
40-7. Spring washer
40-8. Housing
40-9. Bolt
40-10. Spring washer
40-11. Cover
40-12. "O" ring
40-13. Piston
40-14. Valve
40-15. Plug
40-16. Nut
40-17. Spring
40-18. Spring
41. Bolt
42. Spring washer
43. "O" ring
44-1. Housing
44-2. Bolt
44-3. Spring washer
44-4. Cover
44-5. "O" ring
44-6. Bolt
44-7. Spring washer
44-8. Tube
44-9. Valve
44-10. Spring

Parts are enumerated in the sequence of disassembling.

CLEANING AND INSPECTION

(1) Check spools to note the condition of sliding and other critical surfaces, paying particular attention to any signs of erratic contact or of rusting.
(2) Inspect the valve body for cracks or any damage, and check the clearance around each spool in the bore.
(3) Measure the free length, as-installed length and preload of each valve spring, and inspect it for any damage.
(4) Inspect each valve element for seating contact pattern.

INSTALLATION

(1) Install the control valve on the tank half.
(2) Connect the valve on the tank half.
(3) Join the two tank halves together, and tighten with the bolts.
Be sure to apply the gasket cement on both sides of the gasket just before installing it in place.
(4) Connect all oil pipes and control linkage to the hydraulic oil tank.
Fill the tank with hydraulic oil to the prescribed level.
(5) Remove the drain plug from the hydraulic oil filter and, in its vacant place, connect an oil pressure gauge securely as shown. The use of an oil pressure gauge is necessary whenever oil pressure is to be measured.
When checking the oil pressure, be sure to run the engine at an isling speed.
(6) Operate the control lever (bucket) to see if any parts present malcondition.

ADJUSTMENT FOR HYDRAULIC PRESSURE

A. The machine is shipped form the factory with its hydraulic pressure adjusting valve set for a pressure of 140 Kg/cm^2 (1991 PSI).

No re-adjustment of this valve is required in field except where:

(1) Not enough force is developed by hydraulic cylinders in controlling the bucket in loaded condition (IMEDIATE CAUSE: hydraulic pressure too low), or

(2) Packings or hoses fail prematurely (IMMEDIATE CAUSE: hydraulic pressure too high).

B. How to restore hydraulic pressure to the prescribed value:

A plug (PT 1/8, 28 threads) is provided on the discharge flange of the shovel pump located on the right-hand top side of the torque converter case.

Remove this plug, screw a test pressure gauge into the vacated tapped hole, and proceed as follows:

(1) Check the hydraulic pressure available, as indicated by the test pressure gauge. Drain the hydraulic oil tank, and detach one tank half from the other half by loosening all bolts and nuts around the joint.

Take down the outer tank half.

(2) Remove plug on the pressure adjusting valve body. Take out the shims, spring and valve disc; be careful not to allow any dirt to enter the valve interior when removing these parts.

(3) The relationship between shim thickness and pressure setting is 0.1mm (0.004 in) (shim thickness) for each 2.5 Kg/cm^2 (36 PSI) of hydraulic pressure. This relationship means that compressing the valve spring by 0.1 mm (0.004 in) increases the pressure by 2.5 Kg/cm^2 (36 PSI) (approx.). Find the difference between the checked pressure value and the prescribed value (140 Kg/cm^2) (1991 PSI), and divide the difference by 2.5 Kg/cm^2 (36 PSI), to find the amount of shim to be added to or taken from the existing shims. One set of shims for use in this adjustment consists of the following sizes: 0.2 mm (0.008 in), 0.3 mm (0.012 in), 0.5 mm (0.02 in) and 1.0 mm (0.039 in), two shims each.

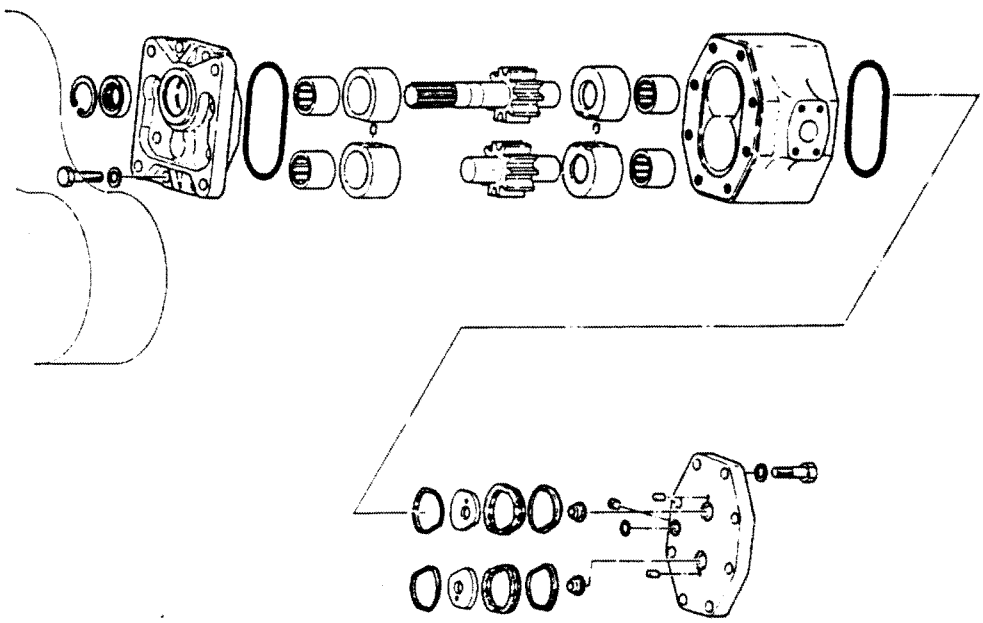
EXAMPLE: Where the checked pressure is 125 Kg/cm^2 (1776 PSI), the difference is 15 Kg/cm^2 (213 PSI). Amount to be taken from the existing shims = 0.1 mm (0.004 in)/ 15/2.5) = 0.6 mm (0.02 in).

(4) Re-assemble the pressure adjusting valve and hydraulic oil tank, and operate the shovel pump to read the available pressure on the test gauge.

CAUTION: The foregoing adjustment is not to be carried out by users.

HYDRAULIC PUMP

DESCRIPTION

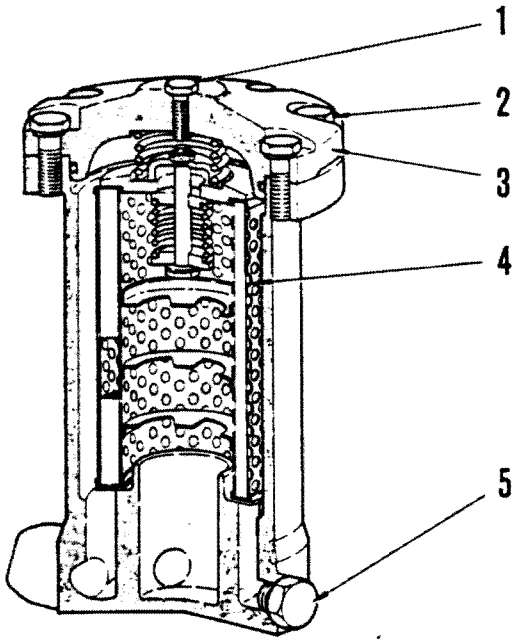


Hydraulic Pump

The hydraulic pump is a gear pump. It supplies pressurized oil to the hydraulic power system for controlling the shovel attachment. The pump is mounted on the torque converter housing under the dashboard. The pump is driven from engine crankshaft, and runs at 2300 rpm for the rated rpm (1,900) of the engine. Oil is drawn from the hydraulic oil tank, and delivered to the control valve through a filter. Pump rotors (gears) as well as the bores in which they rotate are precision machined for closer running clearances. Rotor shafts are supported by needle bearings.

HYDRAULIC FILTER

DESCRIPTION



1. Air bleeding plug
2. Bolt
3. Cover
4. Element
5. Drain plug

Hydraulic Oil Filter

The filter, a strengthened-type full-flow paper-element filter, is mounted on the left stepboard. Oil delivered from the hydraulic pump passes the thick, fine-mesh wall of filtering paper and comes out perfectly clean into the line leading to the control valve, from which it is distributed under control to hydraulic cylinders.

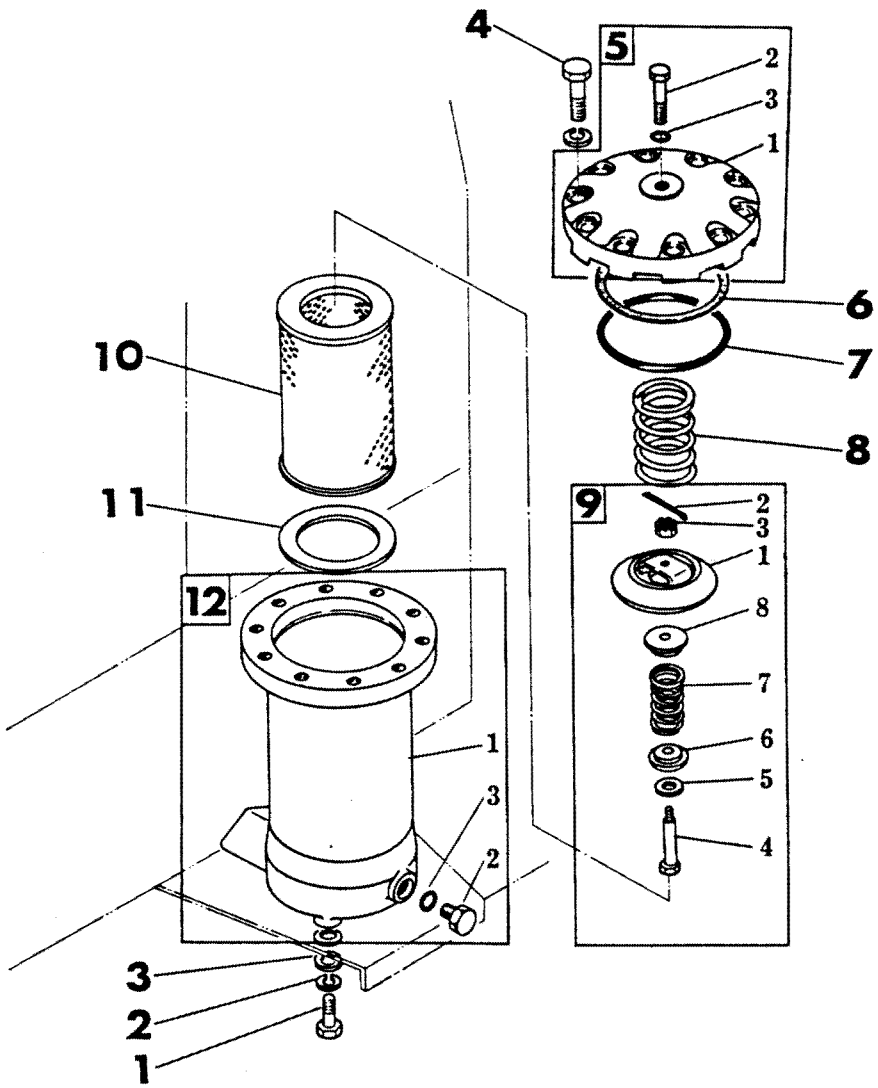
A safety valve is provided on the filter in order to protect the pressurized line (including the pump and filter) against abnormal pressure buildup which can occur if the paper element is left unattended and becomes clogged. The filter must be serviced regularly so as to avert such abnormal pressure buildup.

The safety valve, if it operates, bypasses the oil around the filtering element and sends it directly to the control valve.

REMOVAL

(1) Loosen drain plug (1) to drain the filter. Disconnect the oil pipes from the filter body.

DISASSEMBLING



1. Bolt
2. Spring washer
3. Washer
4. Bolt
5-1. Cover
5-2. Bolt
5-3. "O" ring
6. Ring
7. "O" ring
8. Spring
9-1. Cage
9-2. Pin
9-3. Nut
9-4. Bolt
9-5. Washer
9-6. Valve
9-7. Spring
9-8. Valve
10. Element
11. Washer
12-1. Housing
12-2. Plug
12-3. "O" ring

Hydraulic Oil Filter

Parts are enumerated in the sequence of disassembling.

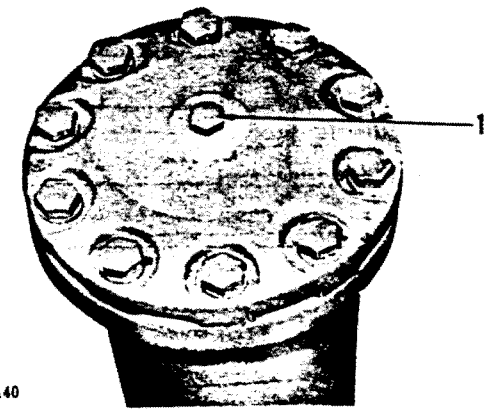
CLEANING AND INSPECTION

(1) Clean the filter element.
(2) Inspect the valve, noting the condition of sliding and seating contacts and examine the valve internals for signs of rusting.

ASSEMBLING

(1) When putting the filter cover on, be sure to apply grease to the O-ring and valve assembly.

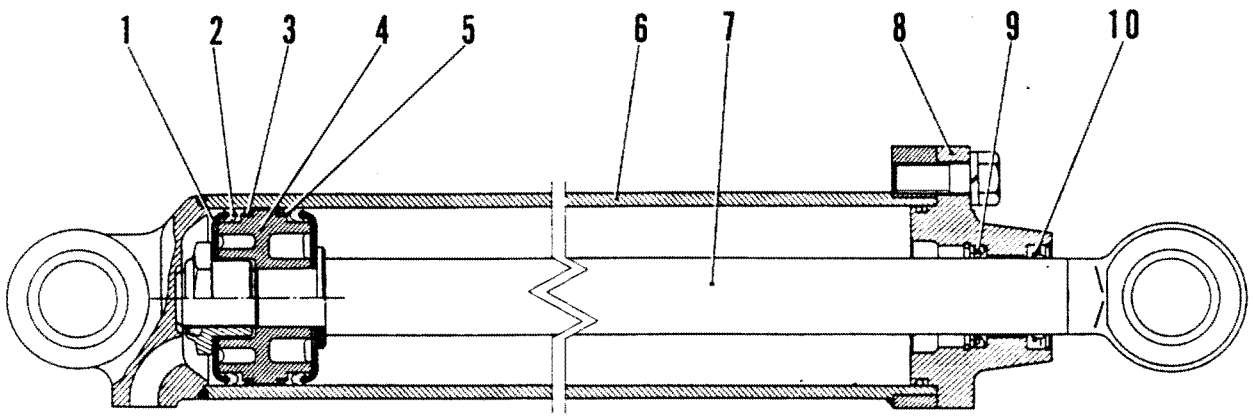
(2) After the oil filter is installed, fill it with oil completely, driving all air out of the filter through its vent hole which is normally closed with bolt (1).



60140

LIFT CYLINDER

DESCRIPTION



Lift Cylinder

1.	U-ring holder	5.	Nylon heel	8.	Cylinder head
2.	U-ring	6.	Cylinder	9.	Packing header
3.	Piston ring	7.	Piston rod	10.	Oil seal
4.	Piston				

The cylinder bore, in which the piston moves, is machined to closer tolerance.

The piston rod is plated with hard chromium for increased resistance to wear and for smoother sliding contact in the packed bore of the cylinder head through which it moves. The packing consists of U-ring located on the inner side and a dust seal on the outer side.

The cylinder head is secured to the cylinder flange with four bolts, the joint being sealed with O-ring and backup rings.

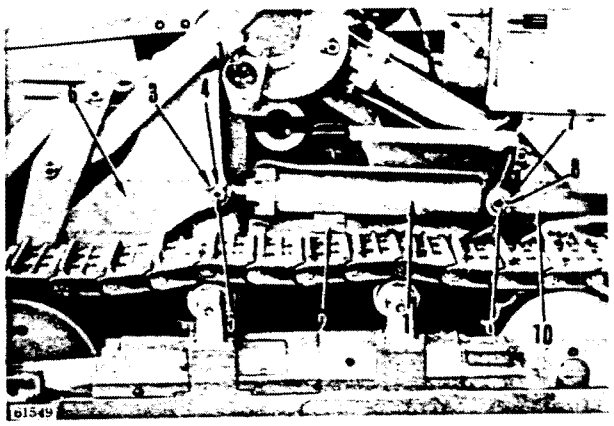
REMOVAL

(1) Support the lift cylinder (1) in contracted condition by inserting a block (2) into between the cylinder and the track.

(2) Disconnect the oil pipes from the lift cylinder (1).

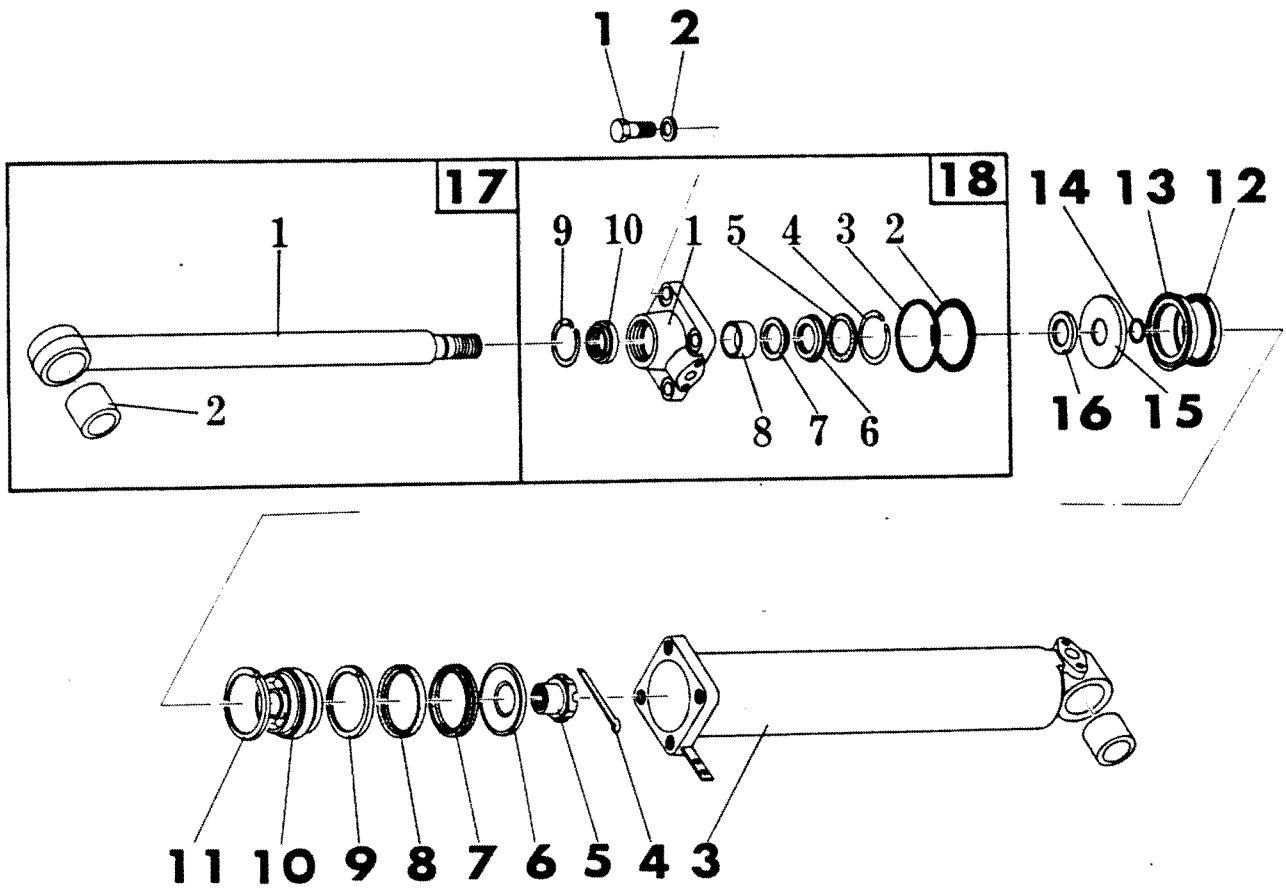
(3) Loosen bolts (3) and remove the rock plate (4); draw out pin (5) to disconnect lift arm (6) from the lift cylinder.
Loosen bolts (7) and remove the rock plate (8); draw out pin (9) to disconnect lift cylinder from the side flame (10), and take it down.

(4) Drain out all oil remaining in the lift cylinder.



CAUTION:
Be careful not to admit any dirt or dust into the oil pipes.
Wrap each disconnected end of pipe with a sheet for protection against dirt.

DISASSEMBLING



Lift Cylinder

1.	Bolt	11.	Piston ring	18-2.	O-ring
2.	Spring washer	12.	Nylon heel	18-3.	Ring
3.	Cylinder	13.	Collar	18-4.	Snap ring
4.	Pin	14.	O-ring	18-5.	Packing header
5.	Nut	15.	Holder	18-6.	U-ring
6.	Holder	16.	Collar	18-7.	Nylon heel
7.	U-ring	17-1.	Rod	18-8.	Bush
8.	Nylon heel	17-2.	Bush	18-9.	Snap ring
9.	Piston ring	18-1.	Cylinder head	18-10.	Oil seal
10.	Piston				

Parts are enumerated in the sequence of disassembling.

CLEANING AND INSPECTION

(1) Clean the cylinder bore, piston and piston rod.

(2) Inspect the piston, piston rod, cylinder bore and other parts for wear or any damage.

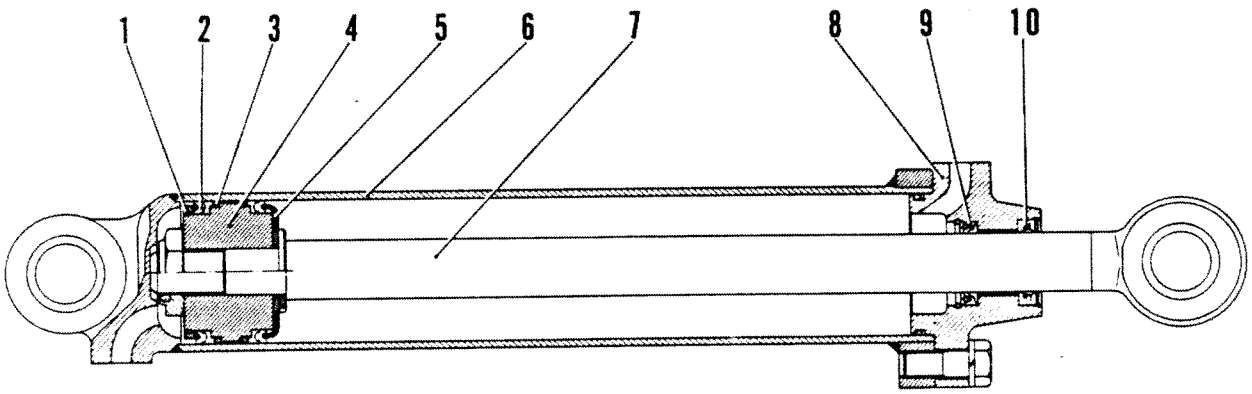
ASSEMBLING

Reverse the disassembling procedure.

When inserting the piston into the cylinder bore, make sure the U-rings slide in smoothly without folding back or cocking in place.

TILT CYLINDER

DESCRIPTION



Tilt Cylinder

1. Holder
2. U-ring
3. Piston ring
4. Piston
5. Holder
6. Cylinder
7. Piston rod
8. Cylinder head
9. Nylon heel
10. Oil seal

The cylinder bore, in which the piston moves, is machined to closer to tolerance. The piston rod is plated with chromium for increased resistance to wear and for smoother sliding contact in the packed bore of the cylinder head through which it moves. The packing of U-rings located on the inner side a dust seal on the outer side.

The cylinder head is secured to the cylinder flange with four bolts, the joint being sealed with O-ring and backup ring.

REMOVAL

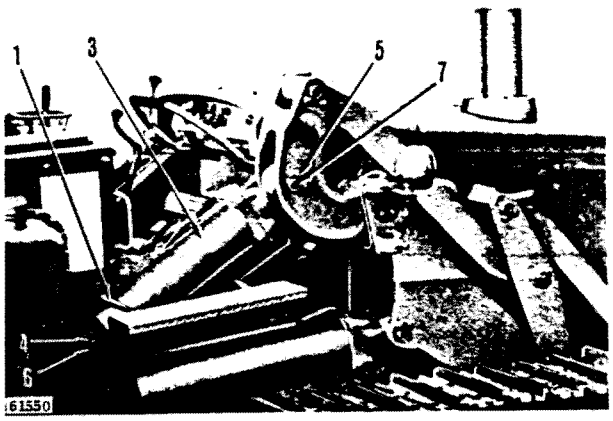
(1) Lower the lift arms and rest the bucket on the ground.

(2) Disconnect pipes (1) (2) from filt cylinder (3).
Wrap each disconnected pipe and with a sheet for protection against dirt.

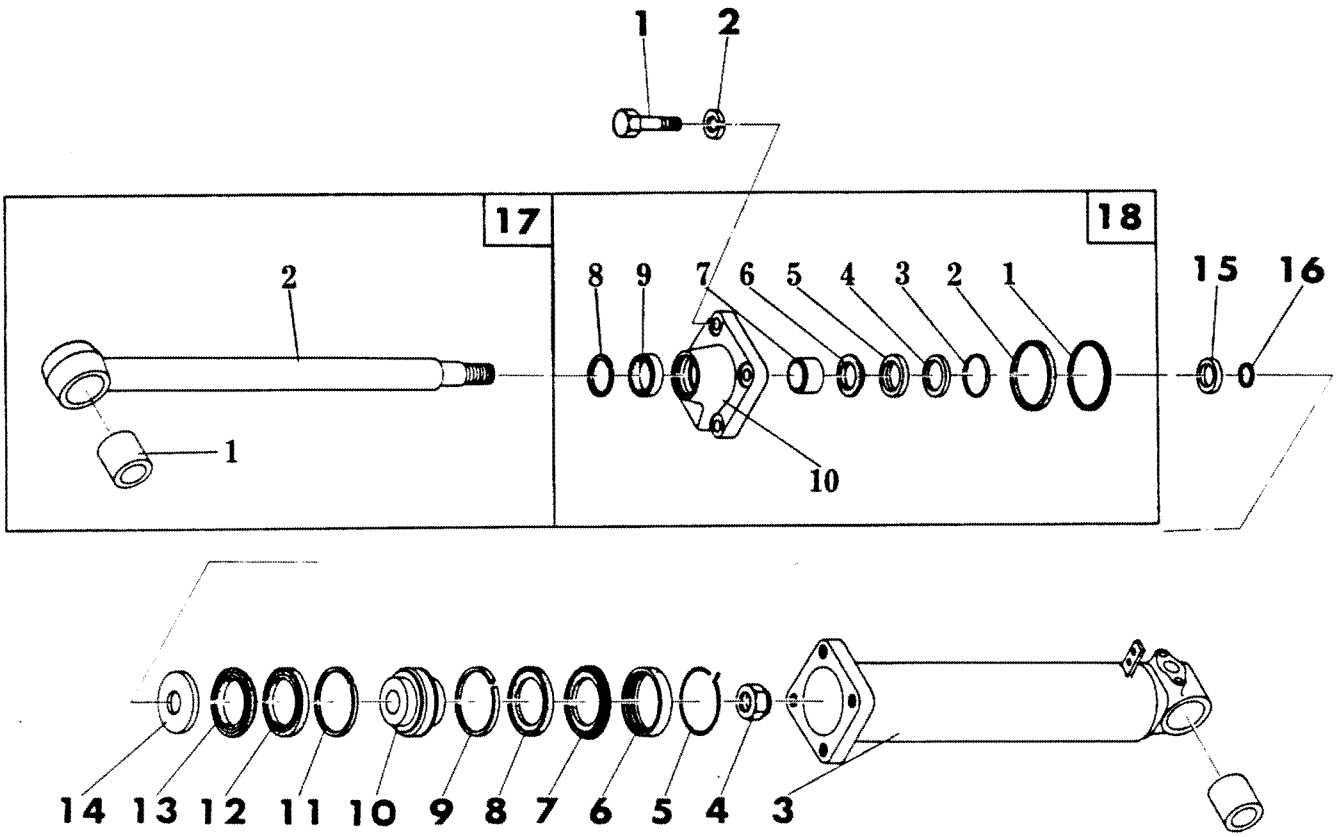
(3) Take a hitch on the cylinder with a lifting sling and take up its weight.

(4) Loosen bolts (4) (5) and remove lock plates.
Draw out linking and anchoring pins (6) (7), and take dump cylinder down.

(5) Drain out all oil remaining in the cylinder.



DISASSEMBLING



Tilt Cylinder

1.	Bolt	11.	Piston ring	18-2.	Ring
2.	Spring washer	12.	Nylon heel	18-3.	Snap ring
3.	Cylinder	13.	Ring	18-4.	Packing header
4.	Nut	14.	Holder	18-5.	Ring
5.	Stopper	15.	Washer	18-6.	Nylon heel
6.	Holder	16.	O-ring	18-7.	Bushing
7.	Ring	17-1.	Bushing	18-8.	Snap ring
8.	Nylon heel	17-2.	Piston rod	18-9.	Oil seal
9.	Piston ring	18-1.	O-ring	18-10.	Cylinder head
10.	Piston				

Parts are enumerated in the sequence of disassembling.

CAUTION:

When disassemble the piston, pull off stopper (5), and remove packing holder (6) by rotating it counter clock-wise.

ASSEMBLING

Install the piston ring and nylon heel on the piston rod. Insert one end of the stopper wire, bending it at right angle at 5 mm (0.197") from the end, into the hole on the rod. Directing another end of the wire through a hole on the packing holder (one of two holes) from inside to outside, pull it all the way toward outside. Install the holder on the rod and turn it one rotation clockwise to ring the wire inside the holder.

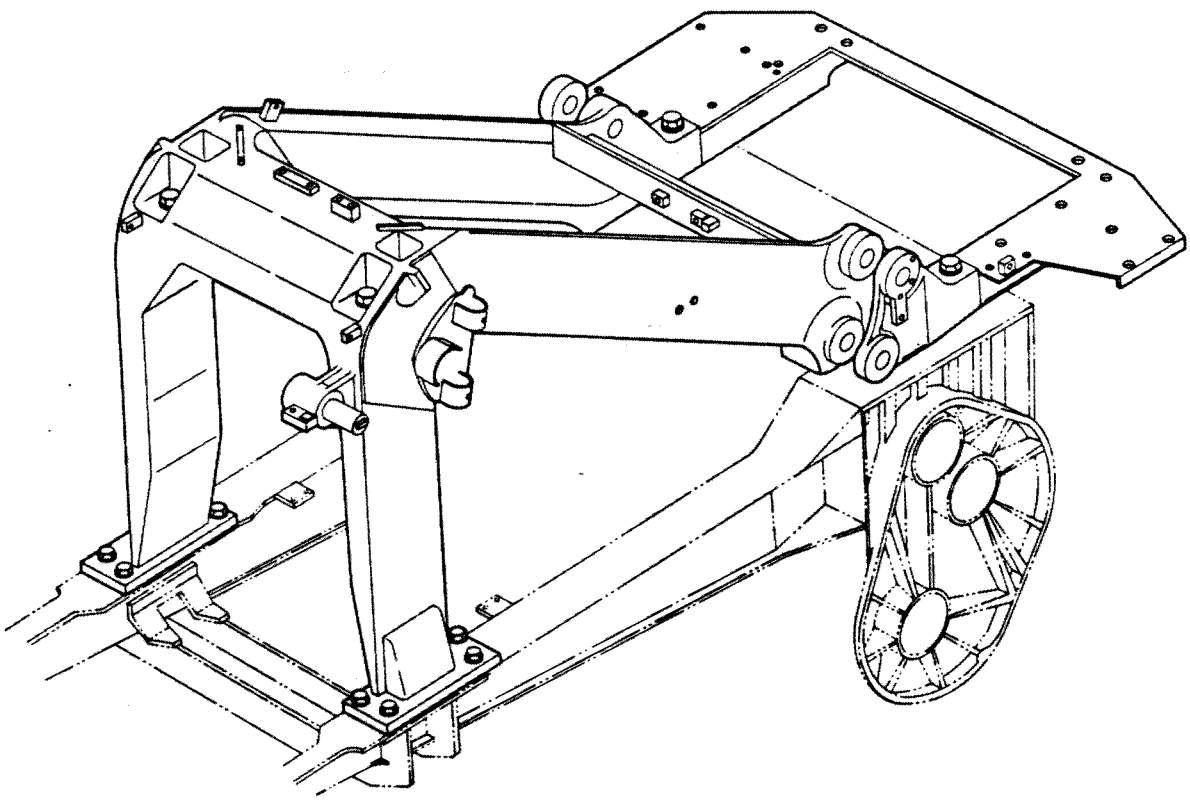
Then, lock the holder with the rod by bending the wire end remained at the outside and inserting it into the other hole on the holder.

SIDE FRAME

INDEX

SIDE FRAME

DESCRIPTION



Side Frame

The two side frames, right and left, together with the connector (a transversely extending girder-like piece), from an integrally-buildup welded structure designed rugged for supporting the moving the members of the shovel attachment and for with-standing the severest kind of load during shovel operation.

Each side frame stands on, and are bolted to, main frame and cross-drive case (steering clutch case). It provides a total of four pivot points for the lift arm and bellcrank (on the forward side) and for the lift and tilt cylinders (on the rear side), one pivot for each.

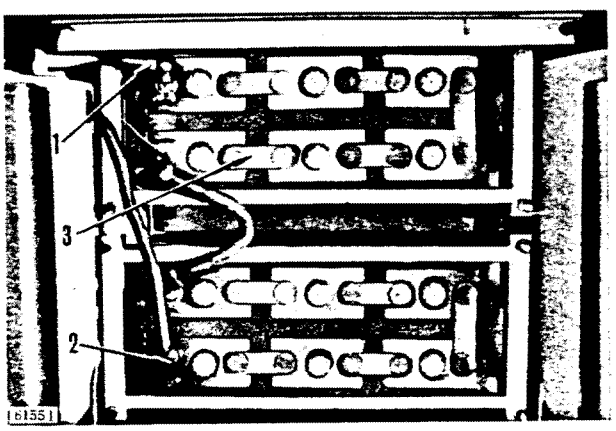
REMOVAL

(1) Take down the bucket assembly (Refer to BUCKET GROUP REMOVAL).

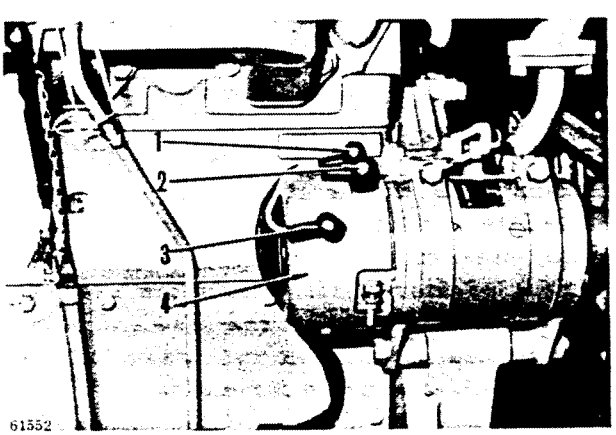
(2) Remove the hood, engine side covers, frame side covers and all floor plates.

(3) Disconnect the pipes, wires and control-linkage components for pedals and levers, as follows:

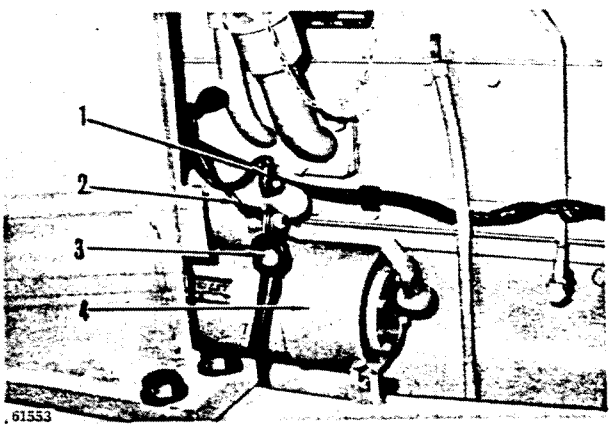
1) Disconnect the cable (1) (2) between the battery units (3) under the operator's seat.



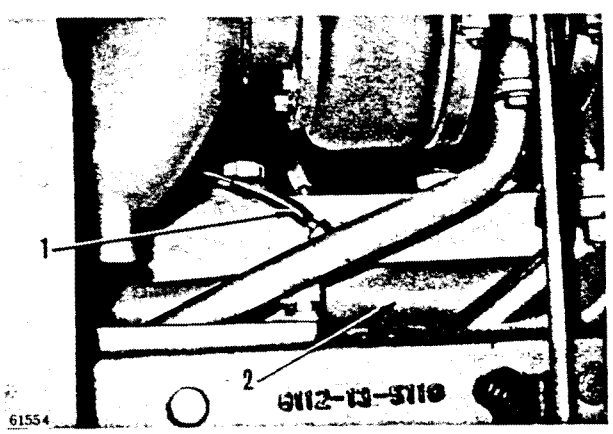
2) Disconnect the cables (1) (2) (3) from the charging generator (4).



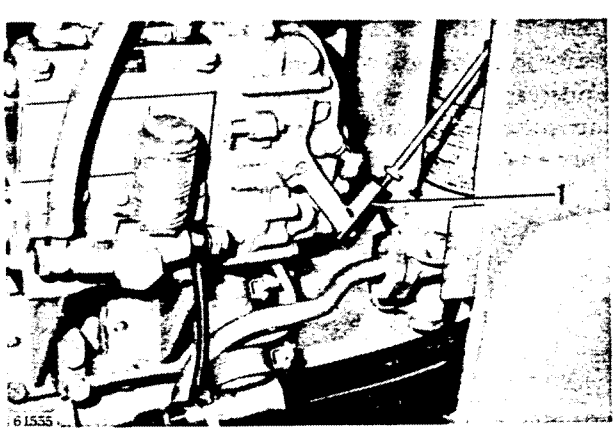
3) Disconnect the cables (1) (2) (3) from the starting motor (4).



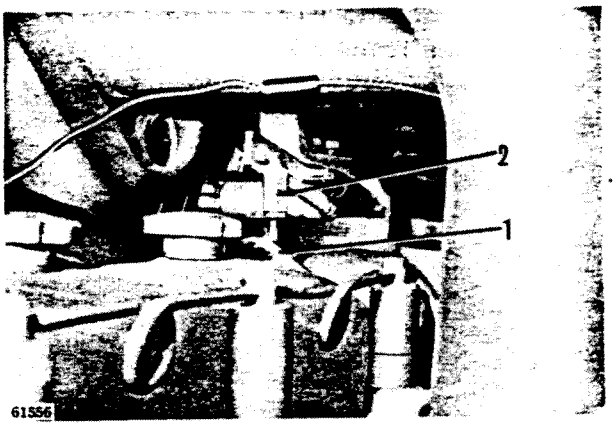
4) Disconnect the water temperature gauge pipe (1) from the water manifold (2).



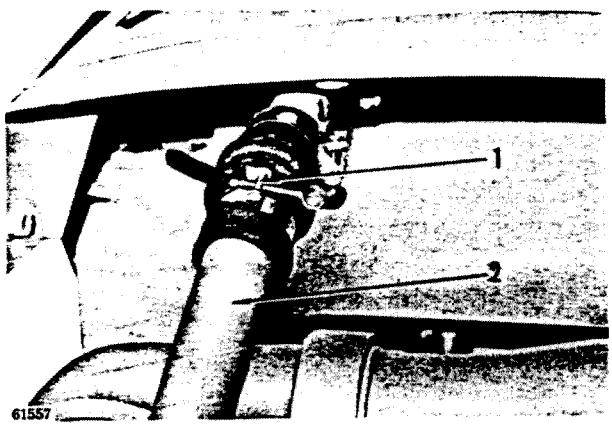
5) Disconnect the fuel control lever (1).



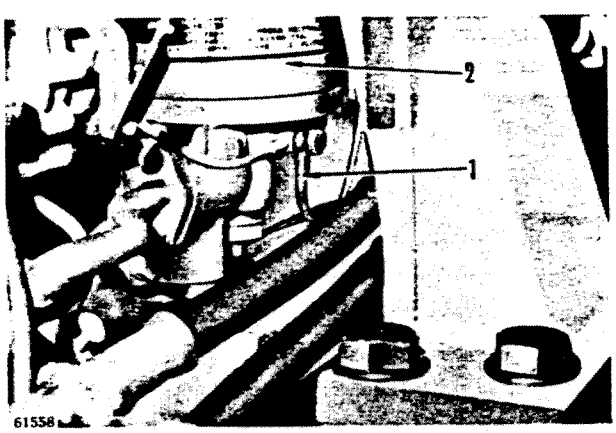
6) Disconnect the compression release lever (1) from the control rod (2).



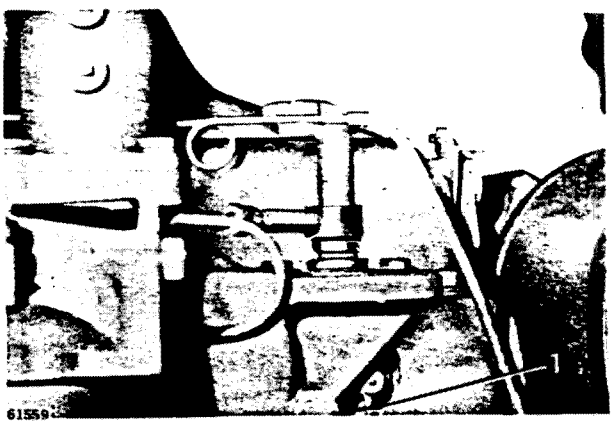
7) Loosen the hose clamp (1) and disconnect the pipe (2).



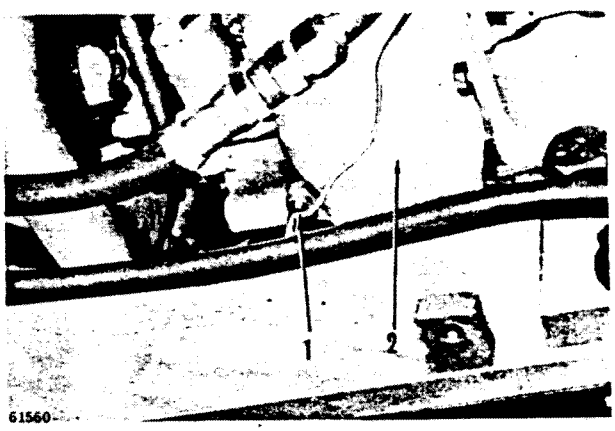
8) Disconnect the fuel oil pressure gauge pipe (1) from the filter (2).



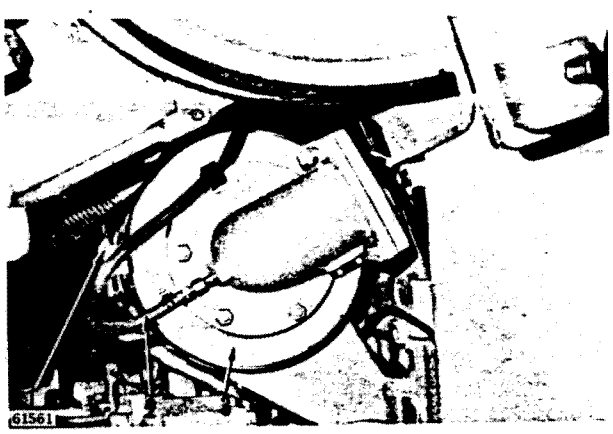
9) Disconnect the wire (1) from the glow plug.



10) Disconnect the torque converter oil temperature gauge pipe (1) from the torque converter (2).

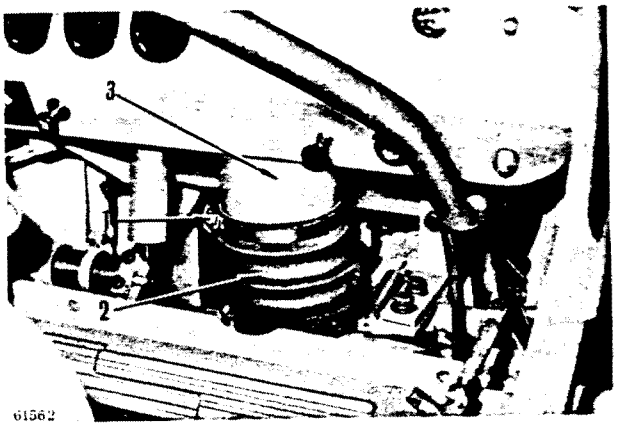


11) Loosen the clamp (1) and disconnect the dust indicator hose (2) from air cleaner pipe (3).

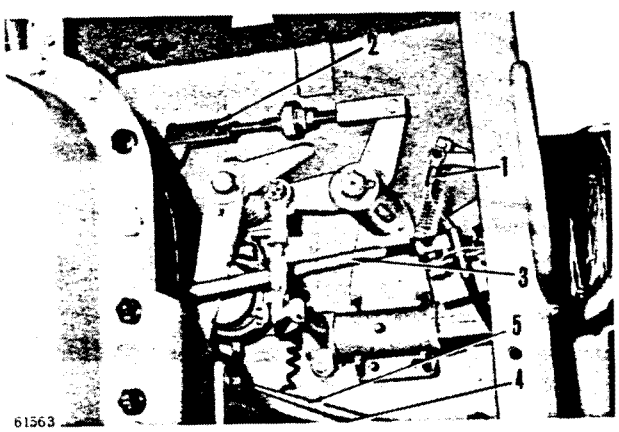


REMOVAL

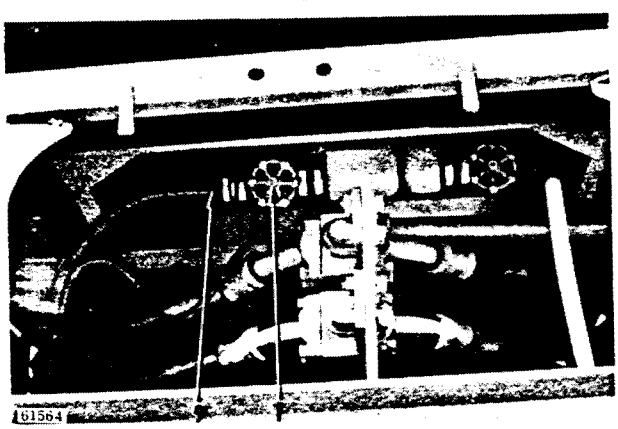
12) Loosen the hose clamp (1) and disconnect the air cleaner hose (2) from cyclone pipe (3).



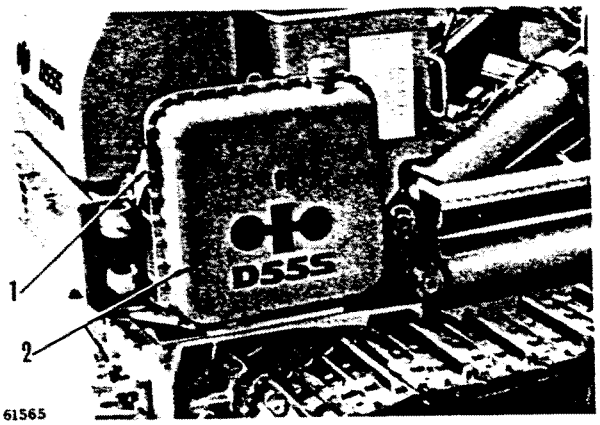
13) Separate the wire (1), hydraulic control rod (2) (3) (4) (5).



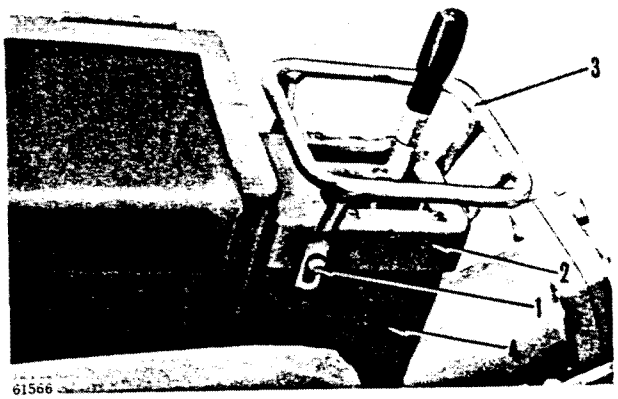
14) Close the fuel valve (1) and disconnect the fuel pipe (2).



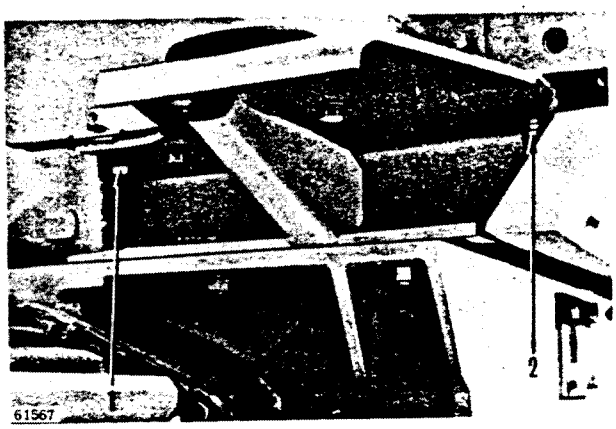
15) Loosen the bolts securing the bracket (1) between the hydraulic oil tank (2) and the rear frame, and remove both brackets.

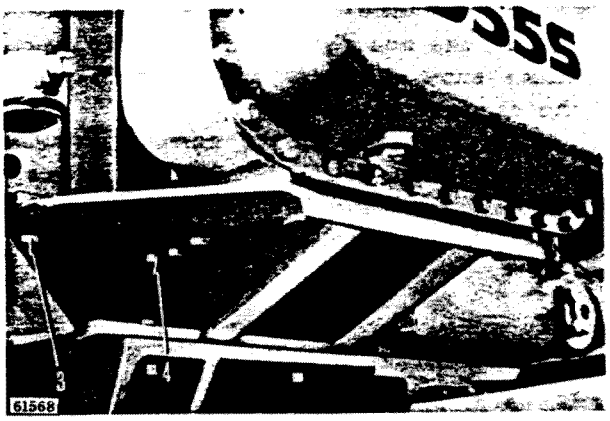


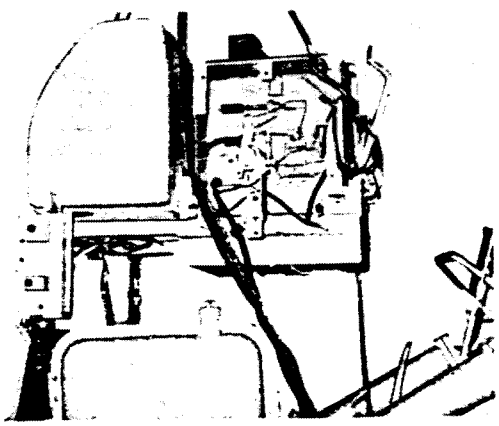
16) Loosen screw (1), remove the cover (2), hand rail (3) and cover (4).



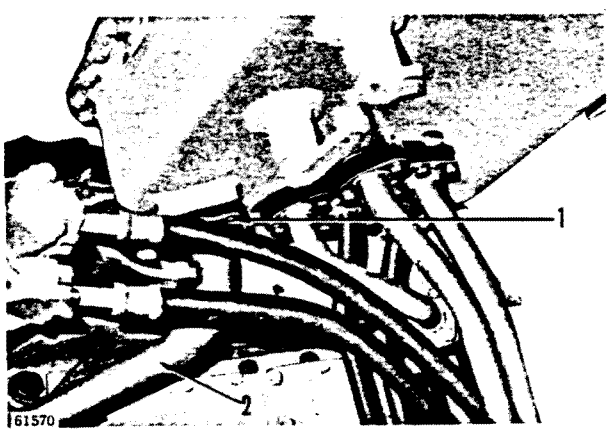
17) Remove the bolts (1) (2) (3) (4) securing the rear frame, and remove the rear frame complete with the battery, operator's seat and the fuel tank with the use of an overhead crane.



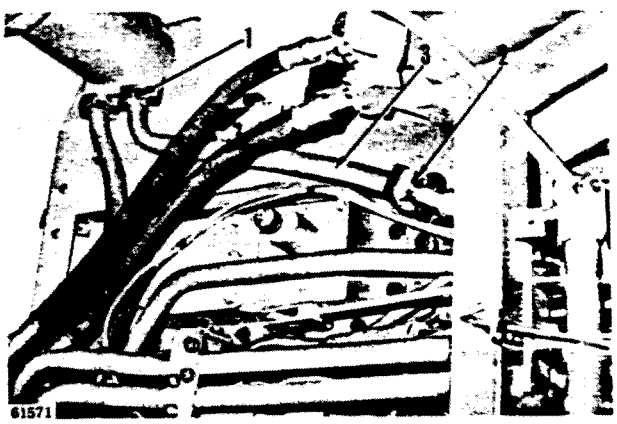




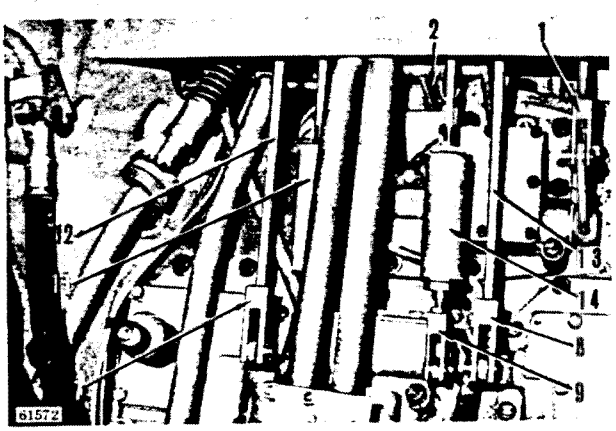
(4) Loosen bolts (1) and disconnect the hydraulic pipe (2).

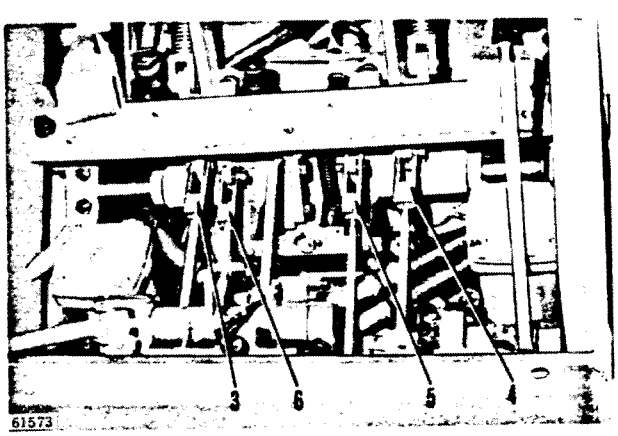


(5) Loosen bolts (1) (2) and disconnect the pipe (3).



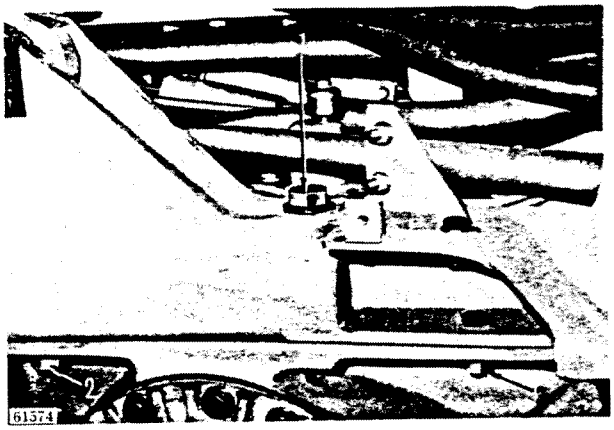
(6) Disconnect the control link (1) (2).
Disconnect the steering control rod yokes (3) (4) (5) (6) (7) (8) (9) (10) and remove the control rod (11) (12) (13) (14).

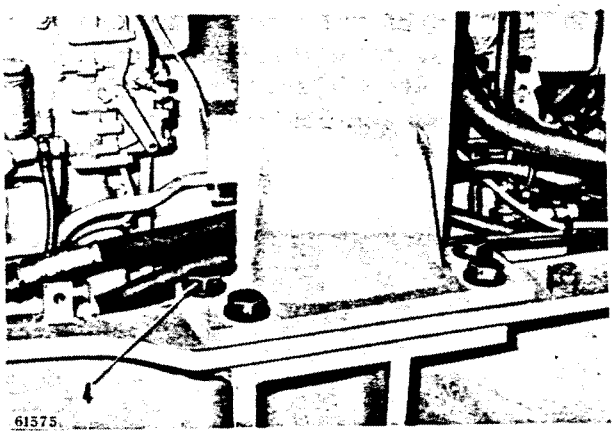




REMOVAL

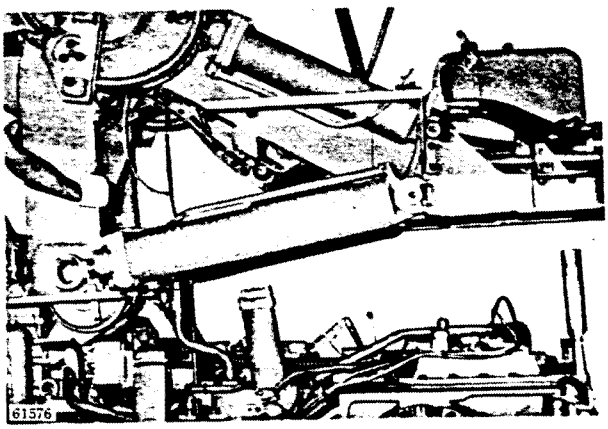
(7) Remove the bolts (1) (2) (3) (4) securing the side frame in place.





(8) Attach a wire to the bell-crank bores and to the rear side of the frame, and make sure there is no obstruction in the dangerous area.

Lift the side frame complete with the hydraulic oil filter, lift cylinders, tilt cylinders and hydraulic tank.



INSTALLATION

(1) Hoist the side frame as one unit with the hydraulic oil filter, lift cylinder, tilt cylinder and hydraulic tank, then rest the unit on the main frame the rear of the chassis.
(2) Tighten the side frame mounting bolts. At this time, coat the bolts with "Loctite".
(3) Connect the control link and steering control rod.
(4) Connect the piping to the hydraulic oil filter.
(5) Connect the piping to the hydraulic oil tank.
(6) Install the rear frame as one unit with the battery, operator's seat and the fuel tank with the use of an overhead crane.
(7) Connect such rods, piping and wiring as itemized below to the engine and side frame.
1) Install the bracket between the hydraulic oil tank and the rear frame.
2) Fuel feed tube.
3) Fuel return tube.
4) Hydraulic control valve control rod.
5) Cyclone pipe and air cleaner pipe.
6) Dust indicator hose.
7) Torque converter oil temperature gauge pipe.
8) Glow plug wire.
9) Fuel oil pressure gauge pipe.
10) Cyclone pipe and exhaust pipe.
11) Compression release lever.
12) Fuel control lever.
13) Water temperature gauge pipe.
14) Starting motor cable.
15) Charging generator cable.
16) Battery cable.
(8) Install the hood, engine side cover, frame side cover and all floor plates.

MAINTENANCE STANDARDS

MAINTENANCE STANDARDS

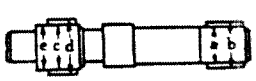
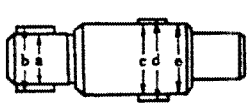
Unit: mm (in,

Unit	Items to be inspected		Basic Size	Standard Clearance or Assembly Standard	Clearance Limit	Service Limit	Remarks
TORQUE CONVERTER	Pilot O.D.		78 (3.071)			77.75 (3.06)	
	Wear on drive plate		88.455 (3.48)			88.205 (3.47)	Chordal measurement (10)
	Wear on splines of turbine shaft and coupling flange		0.1 (0.004)			2.0 (0.08)	
	Wear on startor shaft seal ring contacting face		50 (1.97)			50.5 (1.99)	
	Wear on main drive seal ring contacting face		80 (3.15)			80.5 (3.17)	
	Stator shaft seal ring		80 (3.15)				
	Seal ring	Width	3 (0.118)			2.7 (0.11)	
		Thickness	3.3 (0.13)			3.0 (0.12)	
	Turbine shaft seal ring		50 (1.969)				
	Seal ring	Width	3 (0.118)			2.7 (0.11)	
		Thickness	2.1 (0.083)			1.8 (0.07)	
	Oil seal sealing seat		68 (2.677)			67.9 (2.673)	
	Flywheel bushing I.D.		72.27 (2.845)			72.37 (2.849)	
	Stator shaft sprag contacting face		72.27 (2.845)			72.117 (2.84)	
	Outer race sprag contacting face		88.882 (3.5)			88.982 (3.50)	
	Scavenging pump	Side clearance	0.13 (0.005)			0.5 (0.02)	
		Radial clearance	0.15 (0.006)			0.6 (0.024)	
	Idler shaft O.D.		50 (1.97)			49.90 (1.965)	
	Regulator valve body-to-plunger clearance		0.054 (0.002)			0.25 (0.01)	
	Gears (Chordal measurements)	Main drive gear (5)	69.080 (2.72)			68.830 (2.71)	
		Idler gear (6)	84.475 (3.33)			84.225 (3.31)	
		Shovel pump drive gear (4)	53.833 (2.12)			53.583 (2.11)	
		Transmission pump drive gear (4)	53.693 (2.11)			53.443 (2.10)	
		Scavenging pump drive gear (4)	54.043 (2.13)			53.793 (2.12)	

Unit: mm (in)

Unit	Items to be inspected			Basic Size	Standard Clearance or Assembly Standard	Clearance Limit	Service Limit	Remarks
TORQFLOW TRANSMISSION	Shafts, carriers and gears	Backlash in sun gear and planetary gear			0.14 to 0.34 (0.006 to 0.013)		0.75 (0.03)	
		Backlash in planetary gear and ring gear (inner)			0.17 to 0.37 (0.007 to 0.015)		0.75 (0.03)	
		Backlash in ring gear (outer)and clutch disc plate			0.4 to 0.6 (0.016 to 0.024)		0.75 (0.03)	
		Backlash in ring gear and carrier gear			0.19 to 0.42 (0.007 to 0.017)		0.75 (0.03)	
		Planetary gear side clearance			0.3 to 0.7 (0.012 to 0.028)			
	Clutch spring	1st clutch pack spring	Free length	83.5 (3.29)			80 (3.15)	
			As-assembled length	70 (2.76)				
			As-assembled tension kg (lb)	11.7 (26)			8.5 (19)	
		2nd clutch pack spring	Free length	77 (3.03)			72.5 (2.85)	
			As-assembled length	59.5 (2.34)				
			As-assembled tension kg (lb)	12.7 (28)			9.5 (21)	
		3rd clutch pack spring	Free length	77 (3.03)			72 (2.83)	
			As-assembled length	59 (2.32)				
			As-assembled tension kg (lb)	13 (29)			9.5 (21)	
		4th clutch pack spring	Free length	59 (2.32)			55 (2.17)	
			As-assembled length	44.5 (1.752)				
			As-assembled tension kg (lb)	14.5 (32)			10.5 (23)	
	Cylinder piston	Cylinder-to-piston clearance		350 (13.780)	0.789 to 0.56 (0.031 to 0.022)		1.0 (0.039)	
		Cylinder-to-piston clearance		295 (11.614)	0.272 to 0.110 (0.011 to 0.004)		0.4 (0.016)	
		Thickness of piston ring		5 (0.197)	-0.01 (-0.0003) -0.04 (-0.0015)		4.5 (0.177)	
		Piston ring groove width		5 (0.197)	+0.25 (+0.0098) +0.20 (+0.0078)		5.4 (0.213)	
	Plate	Thickness of plate		5 (0.197)	+0.05 (±0.002)		4.5 (0.177)	
		Transverse warpage on plate friction surface		0.15 (0.006)		Over 0.15 (0.0059)	0.3 (0.012)	
		Thickness of clutch disc		5 (0.197)	+0.1 (±0.004)		4.4 (0.17)	

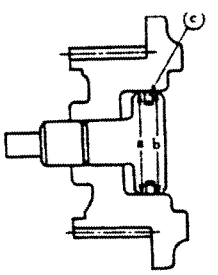
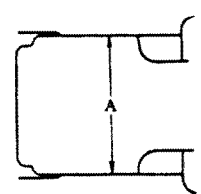
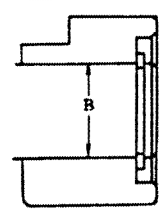
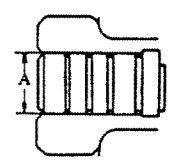
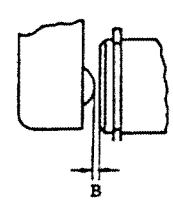
Unit: mm (in)

Unit	Items to be inspected			Basic Size	Standard Clearance or Assembly Standard	Clearance Limit	Service Limit	Remarks
TORQFLOW TRANSMISSION	Plate	Transverse warpage on clutch disc		0.2 (0.008)		Over 0.2 (0.0078)	0.4 (0.016)	
		Thickness of thrust washer		2 (0.079)	+0.10 (+0.004) -0.20 (-0.008)		1.2 (0.05)	
	Control valve	Control valve-to-housing clearance		28 (1.102)	0.035 to 0.058 (0.0014 to 0.0023)		0.08 (0.003)	
		Valve notch spring	Free length	27 (1.06)			25 (0.98)	
			As-assembled length	20 (0.79)				
			As-assembled tension kg (lb)	3.3 (7)			2.3 (5)	
		Safety valve-to-housing clearance		25 (0.984)	0.035 to 0.058 (0.0014 to 0.0023)		0.08 (0.003)	
		Torque converter set spring	Free length	70 (2.76)			68 (2.68)	
			As-assembled length	60 (2.36)				
			As-assembled tension kg (lb)	23 (51)			20 (44)	
		Lubrication valve set spring	Free length	54.5 (2.15)			51.5 (2.03)	
			As-assembled length	44 (1.73)				
			As-assembled tension kg (lb)	3.4 (7)			2.3 (5)	
RANGE TRANSMISSION	Backlash in gear				0.21 to 0.45 (0.0083 to 0.018)		0.75 (0.03)	
	Pilot shaft gear and oil seal			95 (3.74)		94.9 (3.74)	94.85 (3.73)	
	Clearance between fork shaft and gear			12 (0.47)	0.4 to 0.2 (0.016 to 0.008)		1.0 (0.039)	
	Lever shaft O.D. and bushing I.D.		a	28 (1.10)	0.142 to 0.020 (0.0056 to 0.0008)		0.15 (0.006)	
	Lever shaft O.D. and bushing I.D.		c	32 (1.26)	0.163 to 0.025 (0.0064 to 0.0009)		0.15 (0.006)	
	Lever shaft O.D. and oil seal		e	32 (1.26)		31.9 (1.26)	31.85 (1.25)	
	Interlock shaft O.D. and bushing		a	22 (0.87)	0.136 to 0.020 (0.0054 to 0.0008)		0.15 (0.006)	
	Interlock shaft bushing O.D. and case		b	32 (1.26)	0 to -0.064 (0 to -0.0025)			
	Interlock shaft O.D. and bushing I.D.		c	30 (1.18)	0.142 to 0.020 (0.0056 to 0.0008)		0.15 (0.006)	
	Interlock shaft bushing O.D. and case		d	38 (1.5)	0 to -0.064 (0 to -0.0025)			
	Interlock shaft O.D. and oil seal		e	30 (1.18)		29.9 (1.18)	29.85 (1.18)	

Unit: mm (in)

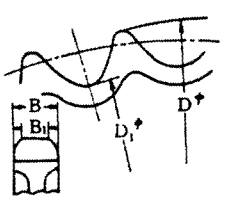
Unit	Items to be inspected		Basic Size	Standard Clearance or Assembly Standard	Clearance Limit	Service Limit	Remarks
RANGE TRANSMISSION	Interlock shaft plunger spring	Free length	60.8 (2.39)			58.2 (2.29)	
		As-assembled length	51 (2.01)				
		As-assembled tension kg (lb)	18 ± 1.8 (40 ± 4)			13.2 (0.52)	
	Drive gear shaft and oil seal		95 (3.74)	-0.040 (-0.0015) -0.087 (-0.0034)	94.9 (3.74)	94.85 (3.73)	
	Bearing 0604-06019	Drive gear shaft	95 (3.74)	-0.013 to -0.055 (-0.0005 to -0.0022)			
		Retainer	145 (5.709)	0.012 to -0.033 (0.0004 to -0.0013)			
	Bearing 145-15-11130	Drive gear shaft	135 (5.315)	0.075 to 0.030 (0.0029 to 0.0012)			
		Retainer	180 (7.087)	0.030 to -0.040 (0.0012 to -0.0016)			
	Bearing 06041-00211	Pinion shaft	55 (2.165)	-0.015 to -0.049 (-0.0006 to -0.0019)			
		Drive gear shaft	100 (3.937)	0.005 to -0.045 (0.00019 to -0.0018)			
	Bearing 145-15-11430	Pinion shaft	75 (2.953)	-0.020 to -0.054 (-0.0008 to -0.0021)			
		Cage	130 (5.118)	-0.032 to -0.054 (-0.0013 to -0.0021)			
	Bearing 145-11-11280	Countershaft	55 (2.165)	-0.020 to -0.054 (-0.0008 to -0.0021)			
		Retainer	100 (3.937)	0.015 to -0.035 (0.0006 to -0.0014)			
	Bearing 145-11-11230	Countershaft	55 (2.165)	-0.015 to -0.049 (-0.0005 to -0.0019)			
		Retainer	100 (3.937)	0.015 to -0.035 (0.0005 to -0.0014)			
BEVEL GEAR SHAFT	Backlash in bevel gears			0.25 to 0.33 (0.0098 to 0.0130)	0.75 (0.03)		M: 9 No. of teech: 43
	Tapered roller bearing 06000-32215	Fit to shaft	75 (2.953)	-0.020 to -0.054 (-0.0008 to -0.0021)			
		Fit to cage	130 (5.118)	-0.030 to -0.052 (-0.0012 to -0.0020)			
	Driven plate	Thickness	4.2 (0.17)	+0.2 (+0.008) -0.3 (-0.012)		3.4 (0.13)	
		Transverse warpage		0.3 (0.012)	Over 0.1 (0.004)		
	Drive plate	Thickness	2.3 (0.09)	+0.08 (±0.0031)			
		Transverse warpage		0.1 (0.004)	Over 0.3 (0.012)		

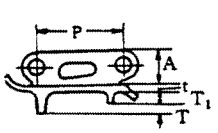
Unit: mm (in)

Unit	Items to be inspected			Basic Size	Standard Clearance or Assembly Standard	Clearance Limit	Service Limit	Remarks
BEVEL GEAR SHAFT	Pressure plate	Thickness		—	—	—	—	
		Transverse warpage		—	—	—	—	
	Brake drum O.D.			370 (14.57)	+0.5 (±0.2)		369 (14.53)	
	Backlash in brake drum and driven plate				0.3 to 0.7 (0.012 to 0.028)	1.0 (0.039)		
	Backlash in brake drum and drive plate				0.3 to 0.7 (0.012 to 0.028)	1.0 (0.039)		
	Surface runout of brake drum				Below 0.15 (0.006)	0.5 (0.02)		
	Runout of brake drum				Below 0.15 (0.006)	0.3 (0.012)		
STEERING CONTROL SYSTEM	Piston O.D.		a	139.5 (5.492)	+0.1 (±0.004)			
	Bearing hub I.D.		b	140 (5.512)	+0.040 (+0.0015) 0 0			
	Piston-to-seal ring clearance		c	4 (0.157)	0.13 to 0.06 (0.005 to 0.002)			
	Valve-to-valve body clearance			A=28 (1.1023)	0.056 to 0.034 (0.0022 to 0.0013)		0.090 (0.004)	
	Plunger-to-bushing clearance			B=18 (0.7087)	0.070 to 0.016 (0.0028 to 0.0006)		0.086 (0.003)	
	Bushing-to-case clearance			38 (1.496)	0.059 to 0.009 (0.0023 to 0.0004)		0.070 (0.003)	
	Spring 135-40-11151	Free length		99 (3.9)			96.9 (3.8)	
		As-assembled length		62 (2.44)				
		As-assembled tension kg (lb)		10.1 (22)	+0.4 (±0.88)		9.5 (21)	
	Regulator valve	Piston-to-bushing clearance		A=12 (0.4724)	0.048 to 0.025 (0.0018 to 0.0010)		0.073 (0.003)	
		Valve-to-body clearance		28 (1.10)	0.048 to 0.030 (0.0018 to 0.0012)		0.077 (0.003)	
		Spring (large) 135-40-11150	Free length	91 (3.58)			89.2 (3.51)	
			As-assembled length	62 (2.44)				
			As-assembled tension kg (lb)	14.5 (32)	±0.6 (±1.3)		13.7 (30)	
		Spring (small) 135-40-11160	Free length	86 (3.39)			84.5 (3.33)	
			As-assembled length	62 (2.44)				
			As-assembled tension kg (lb)	8.7 (19)	+0.35 ±0.771)		8.2 (18)	
	Lever-to-plunger clearance				B=1 (0.039)			

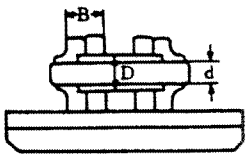
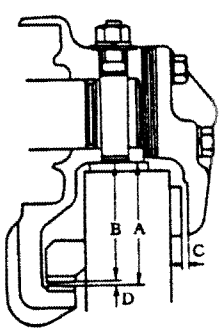
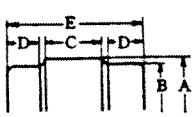
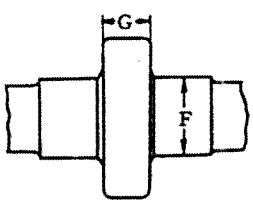
Unit: mm (in)

Unit	Items to be inspected			Basic Size	Standard Clearance or Assembly Standard	Clearance Limit	Service Limit	Remarks
FINAL DRIVE SYSTEM	Backlash in pinion and gear				No. 1 0.25 to 0.82 (0.01 to 0.033) No. 2 0.27 to 0.89 (0.011 to 0.035)		1.5 (0.06)	M: 10 No. of teeth: 11 M: 10 No. of teeth: 29 M: 10 No. of teeth: 42
	Roller bearing 06043-00313	Pinion		65 (2.559)	-0.020 to -0.054 (-0.0008 to -0.0021)			
		Cage		140 (5.512)	0.006 to -0.052 (0.0002 to -0.0020)			
	Roller bearing 06043-02213	Pinion		65 (2.559)	-0.020 to -0.054 (-0.0008 to -0.0021)			
		Case		120 (4.724)	-0.028 to -0.045 (-0.0011 to -0.0018)			
	Roller bearing 130-09-13340	Pinion		60 (2.362)	-0.015 to -0.049 (-0.0006 to -0.0019)			
		Case		130 (5.118)	0.006 to -0.052 (0.0002 to -0.0020)			
	Roller bearing 06043-02314	Pinion		70 (2.756)	-0.020 to -0.054 (-0.0008 to -0.0021)			
		Case		150 (5.905)	0.013 to -0.052 (0.0005 to -0.0020)			
	Roller bearing 06043-02224	Shaft		120 (4.724)	0.047 to -0.013 (0.0019 to -0.0005)			
		Hub		215 (8.465)	-0.003 to -0.079 (-0.0001 to -0.0031)			
	Roller bearing 06030-21318	Shaft		90 (3.543)	0.009 to -0.033 (0.0004 to -0.0013)			
		Case		190 (7.480)	-0.003 to -0.079 (-0.0001 to -0.0031)			
	Floating seal							
	Sprocket shaft bending				0 to 0.06 (0 to 0.0236)	2 (0.079)		
	Sprocket shaft collar-to-bushing clearance			95 (3.74)	0.12 to 0.228 (0.0047 to 0.009)		0.5 (0.2)	
	Sprocket	Major diameter	D	794 (31.26)		Wear on teeth: 6		
		Minor diameter	D1	703.93 (27.71)		Wear on teeth: 2~6		
		Width Face	B1	55 (2.17)				
		Width Root	B	75 (2.95)				
	Track Pitch		P	190 (7.48)			199 (7.83)	
	Track Bushing-to-link fit		D	55 (2.17)	0.214 to 0.1 (0.0084 to 0.0039)			

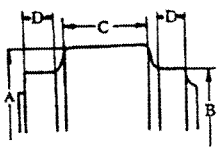
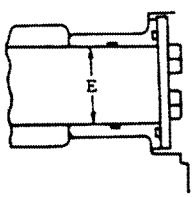
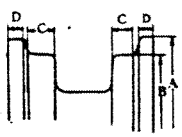
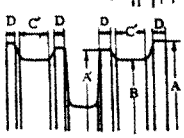
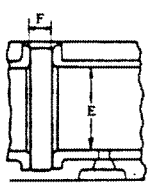




Unit: mm (in)

Unit	Items to be inspected			Basic Size	Standard Clearance or Assembly Standard	Clearance Limit	Service Limit	Remarks
UNDERCARRIAGE	Track	Pin and bushing	Shaft	38 (1.496)	-0.3 to -0.138 (-0.0118 to -0.0054)			
			Hole	37.8 (1.488)				
		Pin O.D.	d	38 (1.496)	+0.1 (+0.004) 0 (0)			
		Pin and bushing	E	38 (1.496)	0.1 to 0.7 (0.004 to 0.028)			
		Master bushing and link		55 (2.165)	-0.214 to -0.1 (-0.0084 to -0.0039)			
		Master pin and link		37.8 (1.488)	-0.078 to -0.17 (-0.003 to -0.007)			
		Master pin-to-bushing clearance		38 (1.496)	0.3 to 0.8 (0.012 to 0.315)			
		Link height	A	105 (4.13)	±0.1 (±0.004)	100 (3.94)	95 (3.74)	
		Link width	B	—	—	—	—	
		Grouser height	T	48 (1.89)		25 (0.98)		
			T1	20 (0.79)			15 (0.59)	
		Shoe thickness	t				10 (0.39)	
		Shoe bolt tightening torq. kg-m (ft-lb)		52 (2.05)	±5 (±36.2)			
	Track group			1600 (62.99)	Difference between front and rear ±11 (±0.433)			
	Guide width		A	96 (3.78)				
	Guide plate width		B	94 (3.70)			100 (3.94)	
	Cover-to-plate clearance		C		1 (0.039)	3 (0.118)	90 (3.54)	
	Bearing-to-plate clearance		D		2 (0.079)	5 (0.197)		
	Idler	Ridge O.D.	A	720 (28.35)			705 (27.76)	
		Tread O.D.	B	680 (26.77)			665 (26.18)	
		Ridge width	C	80 (3.15)			58 (2.68)	
		Tread width	D	39.5 (1.56)			45.5 (1.79)	
		Width	E	164 (6.46)			154 (6.06)	
		Idler shaft-to-bushing clearance	F	60 (2.362)	0.25 to 0.364 (0.01 to 0.014)	1.5 (0.059)		

Unit: mm (in)

Unit	Items to be inspected			Basic Size	Standard Clearance or Assembly Standard	Clearance Limit	Service Limit	Remarks
UNDERCARRIAGE	Idler	Idler shaft flange width	G	20 (0.79)				
		Idler shaft end play			0.35 to 0.80 (0.014 to 0.031)	1.5 (0.059)		
	Carrier roller	Ridge O.D.	A	190 (7.48)			180 (7.09)	
		Tread O.D.	B	165 (6.5)			150 (5.91)	
		Ridge width	C	80 (3.15)			40 (1.57)	
		Tread width	D	43 (1.69)			58 (2.28)	
		Carrier roller shaft-to-bushing clearance	E	45 (1.772)	0.150 to 0.239 (0.006 to 0.009)	1 (0.039)		
		Carrier roller-to-bushing clearance		58 (2.283)	-0.117 to -0.057 (-0.005 to -0.002)			
		Carrier roller shaft end play			0.275 to 0.100 (0.011 to 0.004)	1.5 (0.059)		
	Track group	Ridge O.D.	A	233 (9.17)			220 (8.66)	
			A'	227 (8.94)			215 (8.46)	
		Tread O.D.	B	200 (7.87)			185 (7.28)	
		Tread width	C	47 (1.85)			52 (2.05)	
			C'	43.5 (1.71)			65 (2.17)	
		Flange width	D	18 (0.71)				
		Track roller shaft-to-bushing clearance	E	60 (2.362)	0.25 to 0.364 (0.01 to 0.014)	1 (0.039)		
		Track roller shaft flange width	F	16 (0.63)			14.5 (0.57)	
		Roller-to-bushing clearance		100 (3.937)	0.017 to 0.072 (0.0007 to 0.0028)			
		Roller shaft end play			0.25 to 0.90 (0.01 to 0.035)	1.5 (0.059)		
	Recoil spring	Free length		648 (25.51)	$^{+4}_{-}$ ($\pm$0.1575)		628 (24.72)	
		As-assembled length		510 (20.08)	$^{+1}_{-}$ ($\pm$0.039)			
		As-assembled tension kg (lb)		8700 (19,180)	$^{+700}_{-500}$ $^{+600}_{-}$ ($^{+1,543}_{-1,102}$) ($^{+1,323}_{-}$)		7450 (16,424)	
	Idler adjusting cylinder-to-bushing clearance			90 (3.543)	0.101 to 0.221 (0.004 to 0.0087)	0.5 (0.02)		

Unit: mm (in)

Unit	Items to be inspected			Basic Size	Standard Clearance or Assembly Standard	Clearance Limit	Service Limit	Remarks
HYDRAULIC SYSTEM	Lift cylinder	Wear on piston ring	A	6 (0.24)	0 to 0.025 (0 to 0.0098)		1.0 (0.039)	
				140 (5.512)	0 to 0.025 (0 to 0.0098)		Below 0	
		Piston rod-to-bushing clearance		60 (2.362)	0.236 to 0.376 (0.0093 to 0.0148)		0.1 (0.039)	
		Piston bushing-to-shaft clearance		60 (2.362)	0.30 to 0.446 (0.0118 to 0.0176)		1 (0.039)	
		Piston rod bushing-to-shaft clearance		60 (2.362)	0.30 to 0.446 (0.0118 to 0.0176)		1 (0.039)	
	Dump cylinder	Wear on piston ring	A	6 (0.236)	0 to 0.05 (0 to 0.0019)		1.0 (0.039)	
				120 (4.724)	0 to 0.025 (0 to 0.0098)		Below 0	
		Piston rod-to-bushing clearance		50 (1.969)	0.162 to 0.274 (0.0063 to 0.0107)		0.7 (0.028)	
		Cylinder support-to-bushing clearance		50 (1.969)	0.195 to 0.364 (0.0077 to 0.0143)		1 (0.039)	
		Piston rod bushing-to-shaft clearance		50 (1.969)	0.195 to 0.364 (0.0077 to 0.0143)		1 (0.039)	
	Control valve	Spool-to-valve body clearance	Lift spool	40 (1.575)	0.02 to 0.025 (0.0008 to 0.001)		0.025 (0.001)	
			Tilt spool	40 (1.575)	0.025 to 0.03 (0.0010 to 0.0011)		0.03 (0.001)	
		Check valve-to-valve body	For lift circuit	40 (1.575)	0.025 to 0.066 (0.0010 to 0.0260)		0.066 (0.026)	
			For tilt circuit	40 (1.575)	0.025 to 0.066 (0.0010 to 0.0260)		0.066 (0.026)	
		Safety valve-to-valve body clearance	For lift circuit	26 (1.024)	0.025 to 0.03 (0.0010 to 0.0011)		0.03 (0.001)	
			For tilt circuit	26 (1.024)	0.025 to 0.03 (0.0010 to 0.0011)		0.03 (0.001)	
		Filter safety valve-to-valve body clearance		40 (1.575)	0.009 to 0.059 (0.0004 to 0.0023)		0.2 (0.008)	
		Relief valve-to-valve body clearance		38 (1.496)	0.009 to 0.036 (0.0004 to 0.0014)		0.04 (0.002)	
		Suction valve-to-valve body clearance	For lift circuit	36 (1.417)	0.012 to 0.038 (0.0005 to 0.0015)		0.04 (0.002)	
			For tilt circuit	36 (1.417)	0.012 to 0.038 (0.0005 to 0.0015)		0.04 (0.002)	
		Safety valve cover-to-piston clearance	Lift valve	7 (0.276)	0.015 to 0.02 (0.0005 to 0.0008)		0.02 (0.001)	
			Tilt valve	7 (0.276)	0.02 to 0.03 (0.0008 to 0.0012)		0.03 (0.001)	
		Lift spool position finding steel ball adjustment kg(lb)		19 (42)	+1 (±2)			

Unit: mm (in)

Unit	Items to be inspected		Basic Size	Standard Clearance or Assembly Standard	Clearance Limit	Service Limit	Remarks
HYDRAULIC SYSTEM	Spring 135-60-12161	Free length	45.5 (1.79)			44.5 (1.75)	
		As-assembled length	40 (1.57)				
		As-assembled tension kg (lb)	22.3 (49)	+1 (±2)		18.2 (40)	
	Spring 170-60-12730	Free length	53.5 (2.11)			51.5 (2.03)	
		As-assembled length	42 (1.65)				
		As-assembled tension kg (lb)	18.2 (40)	+0.9 (±2)		15 (33)	
	Spring 170-78-14130	Free length	119.5 (4.70)			105 (4.13)	
		As-assembled length	53 (2.09)				
		As-assembled tension kg (lb)	2.4 (5.3)	+0.2 (±0.4)		1.9 (4.2)	
	Spring 145-60-12170	Free length	161 (6.34)			140 (5.51)	
		As-assembled length	54 (2.13)				
		As-assembled tension kg (lb)	14 (31)			11.2 (25)	
	Spring 145-60-12340	Free length	106.5 (4.19)			99.3 (3.91)	
		As-assembled length	70 (2.76)				
		As-assembled tension kg (lb)	15 (33)	+1.5 (±3.3)		12 (26)	
	Spring 131-60-42160	Free length	31.55 (1.24)			30.64 (1.206)	
		As-assembled length	27 (1.06)				
		As-assembled tension kg (lb)	8.5 (19)	±1 (±2.2)		6.8 (15)	
	Spring 170-78-14380	Free length	62.4 (2.46)			59.6 (2.35)	
		As-assembled length	48.5 (1.91)				
		As-assembled tension kg (lb)	0.61 (1.3)	+0.03 (±0.1)		0.49 (1.0)	
	Spring 141-60-12571	Free length	69.4 (2.73)			68.3 (2.89)	
		As-assembled length	68 (2.68)				
		As-assembled tension kg (lb)	4 (8.8)	+0.2 (±0.4)		0.855 (1.9)	

Unit: mm (in)

Unit	Items to be inspected		Basic Size	Standard Clearance or Assembly Standard	Clearance Limit	Service Limit	Remarks
HYDRAULIC SYSTEM	Spring 141-60-12562	Free length	66.4 (2.61)			65.3 (2.57)	
		As-assembled length	62 (2.44)				
		Assassembled tension kg (lb)	16.9 (37)	+0.7 (±1.5)		12.6 (28)	
BUCKET	Lift arm bushing-to-bucket pin clearance		50 (1.969)	0.205 to 0.294 (0.0081 to 0.0116)	1 (0.039)		
	Front tilt rod bushing-to-bucket pin clearance		50 (1.969)	0.205 to 0.294 (0.0081 to 0.0116)	1 (0.039)		
	Front tilt rod bushing-to-tilt lever upper pin clearance		50 (1.969)	0.205 to 0.294 (0.0081 to 0.0116)	1 (0.039)		
	Rear tilt rod bushing-to-tilt lever center pin clearance		50 (1.969)	0.205 to 0.294 (0.0081 to 0.0116)	1 (0.039)		
	Rear tilt rod bushing-to-bell-crank upper pin clearance		50 (1.969)	0.205 to 0.294 (0.0081 to 0.0116)	1 (0.039)		
	Lift arm center bushing-to-tilt lever lower pin clearance		50 (1.969)	0.205 to 0.294 (0.0081 to 0.0116)	1 (0.039)		
	Lift arm bushing-to-pivot shaft clearance		85 (3.346)	0.216 to 0.320 (0.0085 to 0.0126)	1 (0.039)		
	Lift arm pivot shaft and side frame boss		85 (3.346)	0.036 to 0.125 (0.0014 to 0.0049)	1 (0.039)		
	Bell-crank bushing-to-pivot shaft clearance		85 (3.346)	0.216 to 0.320 (0.0085 to 0.0126)	1 (0.039)		
	Bell-crank pivot shaft and side frame boss		85 (3.346)	0.036 to 0.125 (0.0014 to 0.0049)			
	Lift cylinder pivot shaft-to-bushing clearance		60 (2.362)	0.300 to 0.446 (0.0118 to 0.0176)	1 (0.039)		
	Lift arm pin-to-lift cylinder piston rod bushing clearance			0.236 to 0.376 (0.0093 to 0.0148)			
	Dump cylinder pivot shaft-to-bushing clearance		50 (1.969)	0.195 to 0.364 (0.0077 to 0.0143)	1 (0.039)		
	Bell-crank center pin-to-dump cylinder piston rod bushing clearance		50 (1.969)	0.195 to 0.364 (0.0077 to 0.0143)	1 (0.039)		
	Wear on bucket edge		A=220 (8.66)			170 (6.69)	
	Wear on bucket tooth		B=202 (7.95)			60 (2.36)	
	Tooth bolt tightening torque kg-m (ft-lb)		54 (390)