WEBM000101

SHOP MANUAL

PC12R-8
PC15R-8

HYDRAULIC EXCAVATOR

SERIAL NUMBER

PC12R-8 F22426 in poi

PC15R-8 F31605 in poi

KOMATSU

Utility

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IMPORTANT SAFETY NOTICE

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

To prevent injury to workers, the symbols and are used to mark safety precautions in this manual. The cautions accompanying these symbols should always be carefully followed. If any danger arises or may possibly arise, first consider safety, and take necessary steps to face.

SAFETY

GENERAL PRECAUTIONS

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

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

PREPARATIONS FOR WORK

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

PRECAUTIONS DURING WORK

11. When removing the oil filler cap, drain plug or hydraulic pressure measuring plugs, loosen them slowly to prevent the oil from spurting out.
    Before disconnecting or removing components of the hydraulic circuit and engine cooling circuit, first remove the pressure completely from the circuit.
12. The water and oil in the circuits are not hot when the engine in stopped, so be careful not to get burned.
    Wait for the oil water to cool before carrying out any work on the cooling water circuits.

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

FOREWORD

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

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

The manual is divided into chapters on each main group of components; these chapters are further divided into the following sections.

STRUCTURE AND FUNCTION

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

TESTING AND ADJUSTING

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

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

DISASSEMBLY AND ASSEMBLY

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

MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

NOTICE

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

HOW TO READ THE SHOP MANUAL

VOLUMES

Shop manual are issued as a guide to carry out repairs. These various volumes are designed to avoid duplicating the same information.

DISTRIBUTION AND UPDATING

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

FILING METHOD

1. See the page number on the bottom of the page. File the pages in correct order.
2. Following examples show you how to read the page number.

   Example

10 - 3

- 10: Item number (10. Structure and function)
- 3: Consecutive page number for each item

3. Additional pages: additional pages are indicated by a hyphen (-) and number after the page number.
   Fle as in the example.
   Example:
   10-4
   10-4-1] Added pages
   10-4-2]
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REVISED EDITION MARK
(① ② ③ ....)

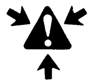
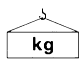
When a manual is revised, an edition mark is recorded on the bottom outside corner of the pages.

REVISIONS

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

SYMBOLS

In order to make the shop manual greatly chelpful, important points about safety and quality are marked with the following symbols.

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

HOISTING INSTRUCTIONS

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

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

2. Wire ropes

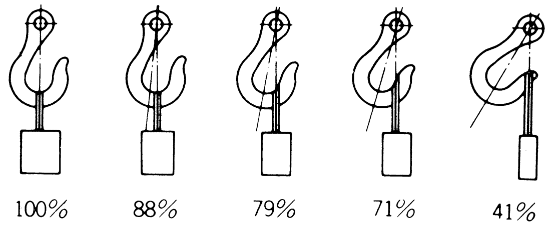
1) Use adequate ropes depending on the weight of parts to be hoisted, referring to the table below:

WIRE ROPES
(Standard «S» or «Z» twist ropes without galvanizing)

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

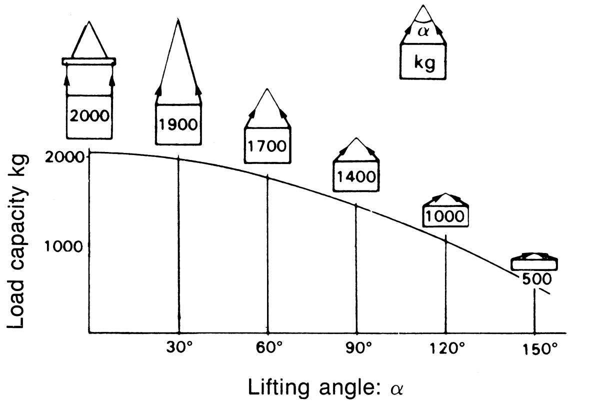
The allowable load value is estimated to be one-sixth or one-seventh of the breaking strength of the rope used.

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



3) Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound on to the load.
⚠ Slinging with one rope may cause turning of the load during hoisting, untwisting of the rope, or slipping of the rope from its original winding position on the load, which can cause dangerous accidents.

4) Do not sling a heavy load with ropes forming a wide hanging angle from the hook.
When hoisting a load with two or more ropes, the force subjected to each rope will increase with the hanging angles.
The table below shows the variation of allowable load (kg) when hoisting is made with two ropes, each of which is allowed to sling up to 1000 kg vertically, at various handing angles.
When two ropes sling a load vertically, up to 2000 kg of total weight can be suspended.
This weight becomes 1000 kg when two ropes make a 120° hanging angle.
On the other hand, two ropes are subjected to an excessive force as large as 4000 kg if they sling a 2000 kg load at a lifting angle of 150°.



Nm

STANDARD TIGHTENING TORQUE

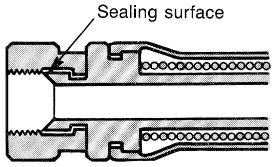
The following charts give the standard tightening torques of bolts and nuts. Exceptions are given in sections of «**Disassembly and Assembly**».

1. STANDARD TIGHTENING TORQUE OF BOLTS AND NUT

Thread diameter of bolts (mm)	Pitch of bolts (mm)	Width across flat (mm)		8.8		10.9	
		S (hex head)	S (hex socket)	kgm	Nm	kgm	Nm
6	1	10	5	0.96±0.1	9.5±1	1.3±0.15	13.5±1.5
8	1.25	13	6	2.3±0.2	23±2	3.2±0.3	32.2±3.5
10	1.5	17	8	4.6±0.5	45±4.9	6.5±0.6	63±6.5
12	1.75	19	10	7.8±0.8	77±8	11±1	108±11
14	2	22	12	12.5±1	122±13	17.5±2	172±18
16	2	24	14	19.5±2	191±21	27±3	268±29
18	2.5	27	14	27±3	262±28	37±4	366±36
20	2.5	30	17	38±4	372±40	53±6	524±57
22	2.5	32	17	52±6	511±57	73±8	719±80
24	3	36	19	66±7	644±70	92±10	905±98
27	3	41	19	96±10	945±100	135±15	1329±140
30	3.5	46	22	131±14	1287±140	184±20	1810±190
33	3.5	50	24	177±20	1740±200	250±27	2455±270
36	4	55	27	230±25	2250±250	320±35	3150±350
39	4	60	—	295±33	2900±330	410±45	4050±450

This torque table does not apply to bolts or nuts which have to fasten nylon or other parts non-ferrous metal washer.

★ **Nm (Newton meter): 1 Nm = 0.102 kgm**



2. TIGHTENING TORQUE FOR NUTS OF FLARED

Use these torques for nut part of flared.

Thread diameter of nut part (mm)	Width across flats of nut part (mm)	TIGHTENING TORQUE	
		kgm	Nm
1/2" - 20	17	2.6±0.5	25.5±4.9
9/16" - 18	17	4±0.5	39.2±4.9
3/4" - 16	22	6.7±2	65.7±19.6
7/8" - 14	27	8±2	78.5±19.6
1.$^{1}/_{16}$" - 12	32	9.7±3	95.15±29.4
1.$^{5}/_{16}$" - 12	38	17±3	166.7±29.4
1.$^{5}/_{8}$" - 12	50	20±5	196.2±49
22	27	8±2	78.5±19.6
33	41	20±5	196.2±49

COATING MATERIALS

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

Nomenclature	Code	Applications
Adhesives	Loctite 222	Used for low resistance locking of screws, check nuts and adjustment nuts.
	Loctite 242	To prevent the loosening of bolts, nuts and plugs and the leakage of oil. Used for medium resistance locking of screws and nuts of every type, and for locking keys and bearings.
	Loctite 262	Used for high resistant of threaded parts that can be removed with normal tools.
	Loctite 270	Used for high resistant locking and for sealing threaded parts, bolts and stud bolts.
	Loctite 542	Used for sealing the union threads for hydraulic tubes.
	Loctite 573	Used for sealing rather exact plane surfaces when the option of possible future dismantling is required.
	Loctite 601	Used for high resistant locking of mechanical components that can be removed only after heating
	Loctite 675	Used to lock cylindrical couplings and for the permanent locking of threaded parts, and also to lock shafts to bearings, gears, pulleys, pins, bushings, etc.
Gasket sealant	Loctite 510	Used by itself on mounting surface on the final drive and transmission cases. (Clearance between flange surfaces within 0.2 mm).
	Loctite 518	Used by itself on mounting flat surface (Clearance between surfaces within 0.5 mm)
Grease (Lithium grease)	ASL800050	Applied to bearings, sliding parts and oil seals for lubrication, rust prevention and facilitation of assembling work.
Vaseline	–	Used for protecting battery electrode terminals from corrosion.

CABLE

ELECTRIC WIRE CODE

In the wiring diagrams various colours and symbols are employed to indicate the thickness of wires.
This wire code table will help you understand WIRING DIAGRAMS.
Example: R -N 1.5 indicates a cable having a nominal number 1.5 and red coating with black stripe.

CLASSIFICATION BY THICKNESS

Nominal number	Copper wire			Cable O.D. (mm)	Current rating (A)	Applicable circuit
	Number strands	ø of strands (mm)	Cross section (mm^2)			
0.8	11	030	0.78	2.80	8	Instruments, sensor
1	14	0.30	0.99	2.80	11	Warning light, light etc.
1.5	21	0.30	1.48	3.35	14	Working beam, solenoid valve, etc.
2.5	35	0.30	2.47	3.80	20	Control panel, etc.
4	56	0.30	3.95	4.60	28	Pre-heating
6	84	0.30	5.93	5.20	37	Control panel
25	189	0.4	23.75	9.3	100	Ground - Starter motor

CLASSIFICATION BY COLOUR AND CODE

	Primary	Auxiliary							
Code	A	A – R	A/R	A – G	A/G	A – B	A/B	A – N	A/N
Colour	Light blue	Light blue - Red		Light blue - Yellow		Light blue - White		Light blue - Black	
Code	B	B – R	B/R	B – N	B/N	—	—	—	—
Colour	White	White - Red		White - Black		—		—	
Code	C	C – N	C/N	C – L	C/L	C – V	C/V	—	—
Colour	Orange	Orange - Black		Orange - Blue		Orange - Green		—	
Code	G	G – V	G/V	G – N	G/N	G – R	G/R	—	—
Colour	Yellow	Yellow - Green		Yellow - Black		Yellow - Red		—	
Code	H	H – R	H/R	H – N	H/N	H – L	H/L	—	—
Colour	Gray	Gray - Red		Gray - Black		Gray - Blue		—	
Code	L	L – R	L/R	L – B	L/B	L – N	L/N	L – G	L/G
Colour	Blue	Blue - Red		Blue - White		Blue - Black		Blue - Yellow	
Code	M	M – N	M/N	M – V	M/V	—	—	—	—
Colour	Brown	Brown - Black		Brown - Green		—		—	
Code	R	R – C	R/C	R – V	R/V	R – N	R/N	R – B	R/B
Colour	Red	Red - Orange		Red - Green		Red - Black		Red - White	
Code	S	S – N	S/N	—	—	—	—	—	—
Colour	Pink	Pink - Black		—		—		—	
Code	V	V – N	V/N	—	—	—	—	—	—
Colour	Green	Green - Black		—		—		—	
Code	Z	Z – G	Z/G	—	—	—	—	—	—
Colour	Violet	Violet - Yellow		—		—		—	

COMPOSITION OF THE COLOURS
The coloration of two-colour wires is indicated by the composition of the symbols listed.
Example: G-V = Yellow-Green with longitudinal colouring.
G/V = Yellow-Green with transversal colouring.

WEIGHT TABLE

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

Unit: kg

Machine model	PC12R-8	PC15R-8
From serial no.	F31605-	F22426-
Engine assembly (dry) • Engine • Engine support • Power train • Pump	100 77 7 8 5.3	112 77 7 8 19
Radiator - exchanger	6	6
Revolving frame	620	620
Cabin	180	180
Canopy	70	70
Seat support	37	37
Seat	17	17
Platform	5	5
Engine hood	4	4
Fuel tank (without fuel)	2.5	2.5
Hydraulic tank (without hydraulic oil)	16	16
Control valve	32	32
Rear counterweight	48	48
Lateral counterweight	23 + 23	23 + 23
Swing motor	27	27
Swivel joint	5.5	5.5
Track frame assembly	770 (720)	770 (720)
Track roller	3x6	3x6
Idler assy.	17	17
Final drive	17	17
Sprocket	5	5
Swing circle	20	20
Track shoe • Steel track shoe L = 230 mm • Rubber track shoe	 70x2 45x2	 70x2 45x2
Swing bracket	22	22
Boom	48	51
Arm • Standard • Long arm	 23 36	 25 38
Bucket (standard)	21	22
Blade	43	54
Boom cylinder	10.7	12
Arm cylinder	10	11
Bucket cylinder	9	9
Boom swing cylinder	10	10
Blade cylinder	6.8	11

(   ): For rubber track shoe

TABLE OF OIL AND COOLANT QUANTITIES

RESERVOIR	KIND OF FLUID	AMBIENT TEMPERATURE −20 −10 0 10 20 30°C	CAPACITY (ℓ) Specified	Refill
Crankcase sump		SAE 10W SAE 20W-20 SAE 30 SAE 40	2.8	2.8
Hydraulic circuit		SAE 10W	24	22
Final drive (each)		SAE 10W	0.4	0.4
Fuel tank	FUEL	✻ ASTM D975 N. 2	20	—
Engine coolant system	WATER + ANTI-FREEZE		3.2	—
	WATER		3.2	—
	PERMANENT LIQUID		3.2	—

✻ ASTM D975 N. 1

ASTM: America Society of Testing and Materials
SAE: Society of Automotive Engineers
API: American Petroleum Institute
MIL: USA Military Specification
CCMC: Common Market Constructors Committe

Specified capacity: Total amount of oil including oil for components and oil in piping.
Refill capacity: Amount of oil needed to refill system during normal inspection and maintenance.

NOTE:

(1) When fuel sulphur content is less than 0.5%, change oil in the oil pan ebery periodic maintenance hours described in operation and maintenance manual.
Change oil according to the following table if fuel sulphur content is above 0.5%.

Fuel sulphur content	Oil change interval in engine oil pan
0.5 to 1.0%	1/2 of regular interval
Above 1.0%	1/4 of regular interval

(2) When starting the engine is weathers temperature below 0°C, be sure to use engine oil SAE 10W, SAE 20W-20, even if weather temperature goes up to 10°C day time.

(3) Use classification CD as engine oil, if use classification CC, reduce the engine oil change interval to half.

(4) Use original products, which have characteristics specifically formulated and approved for the engine, the hydraulic circuit of equipment and for reductions.

GROUP 10

10 STRUCTURE AND FUNCTION

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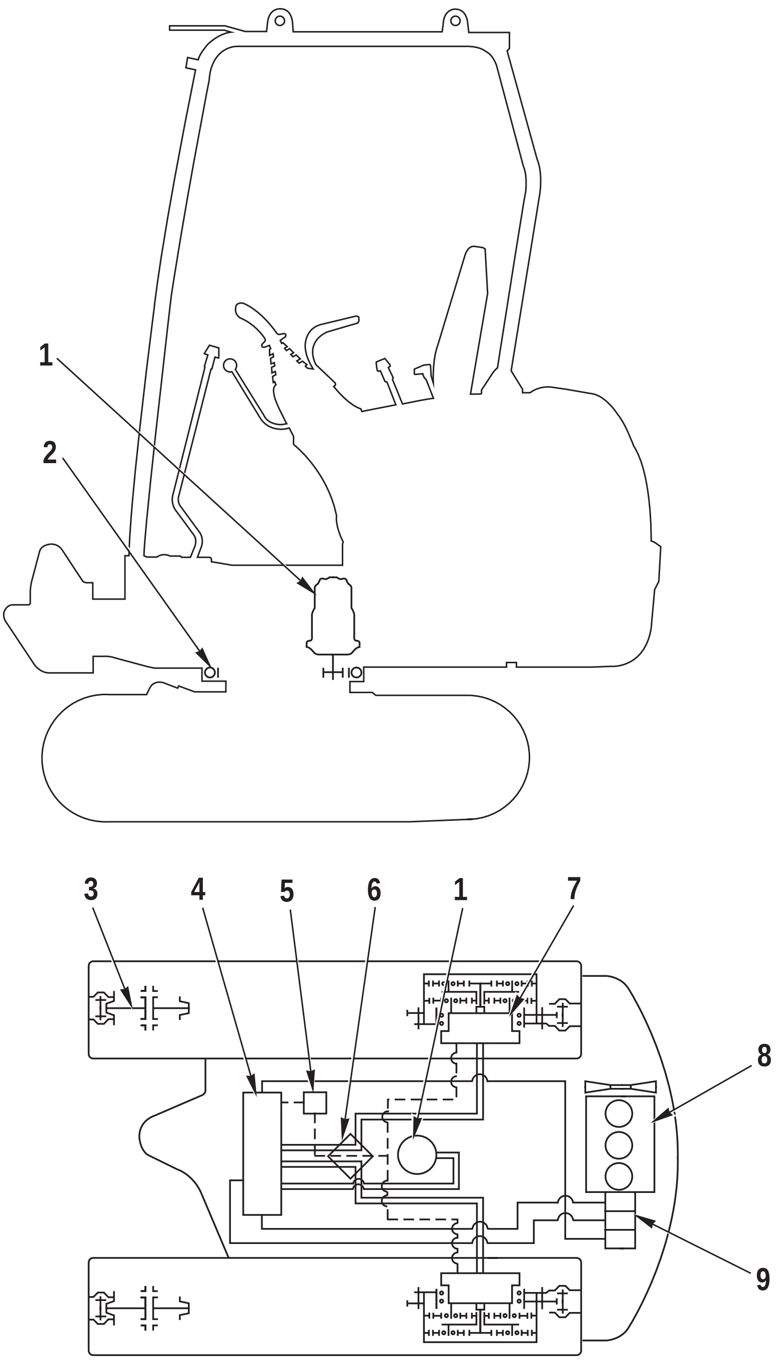
POWER TRAIN

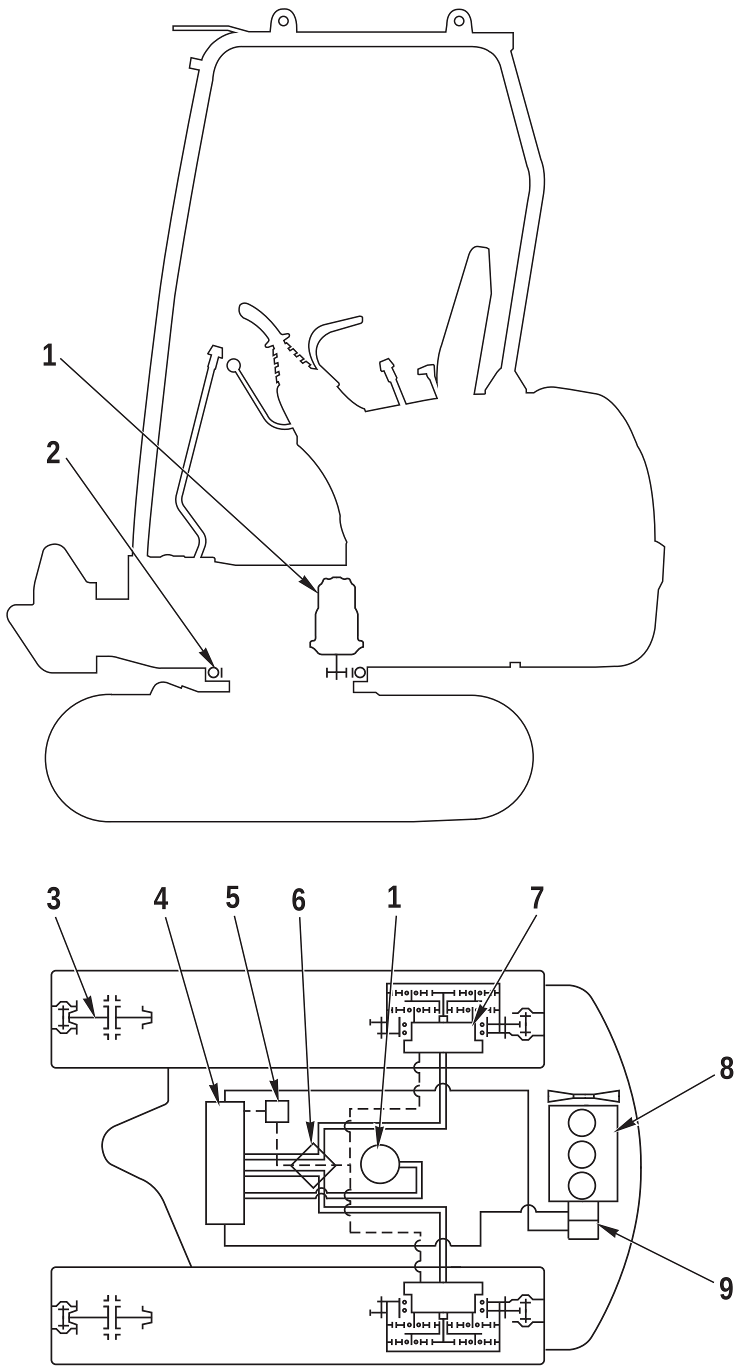
PC12R-8



RKP00010

1. Swing motor
2. Swing circle
3. Track shoe idler
4. Control valve
5. Travel increment valve (optional)
6. Swivel joint
7. Travel motor
8. Engine
9. Hydraulic pump

PC15R-8



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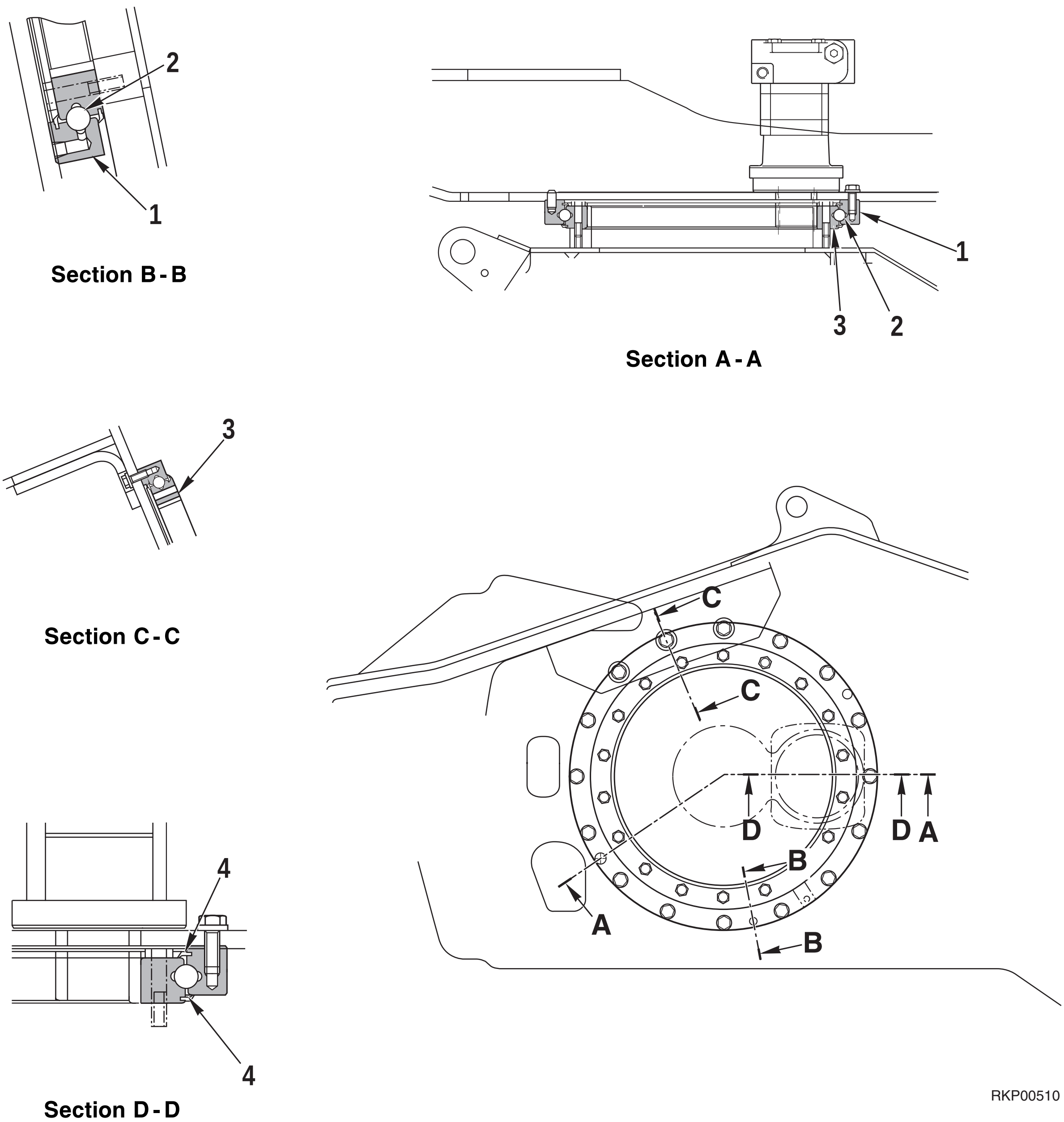
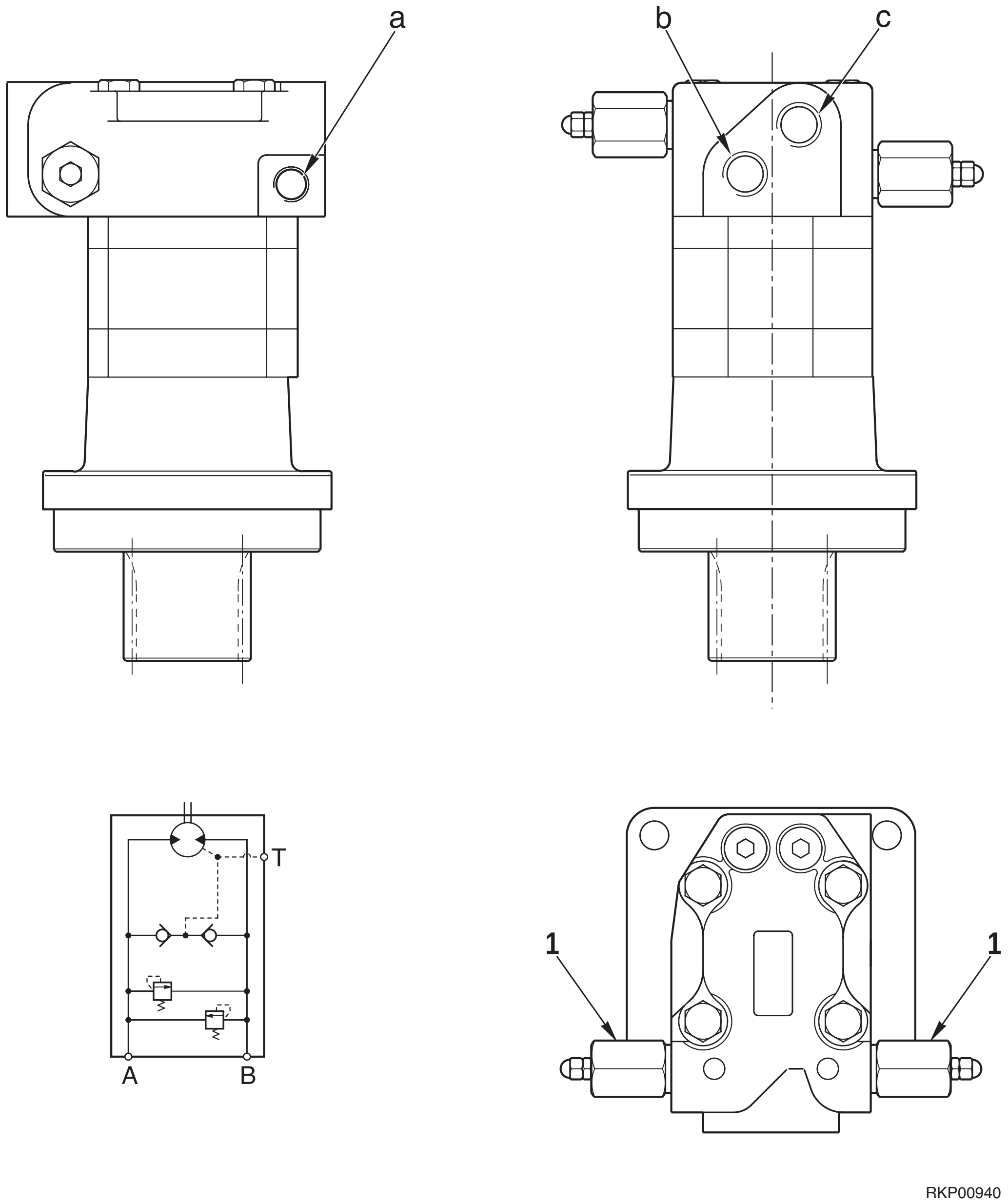
1. Swing motor
2. Swing circle
3. Track shoe idler
4. Control valve
5. Travel increment valve
6. Swivel joint
7. Travel motor
8. Engine
9. Hydraulic pump

SWING CIRCLE



1. Outer race
2. Ball bearing
3. Inner race
4. Seal

SWING MOTOR



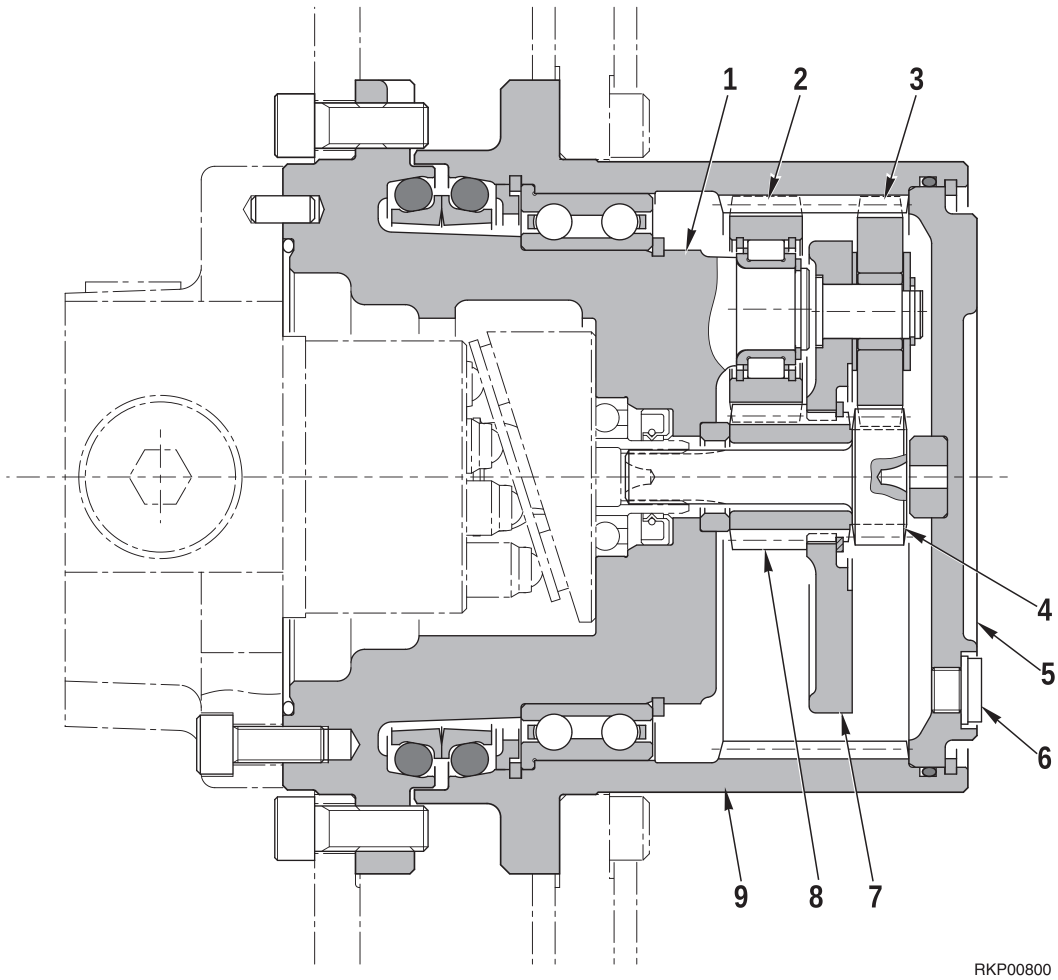
1.		Safety valve
a -	T Port	- To hydraulic tank
b -	B Port	- From control valve (B2 Port)
c -	A Port	- From control valve (A2 Port)

SPECIFICATIONS:

Displacement: 195 cc/rev.

FINAL DRIVE

(★ The figure represent PC12R-8)



1. Crankcase
2. No. 2 reduction gear
3. No. 1 reduction gear
4. No. 1 sun gear
5. Cover
6. Oil drainage plug
7. No. 1 planetary gear
8. No. 2 sun gear
9. Housing

SPECIFICATIONS

PC12R-8

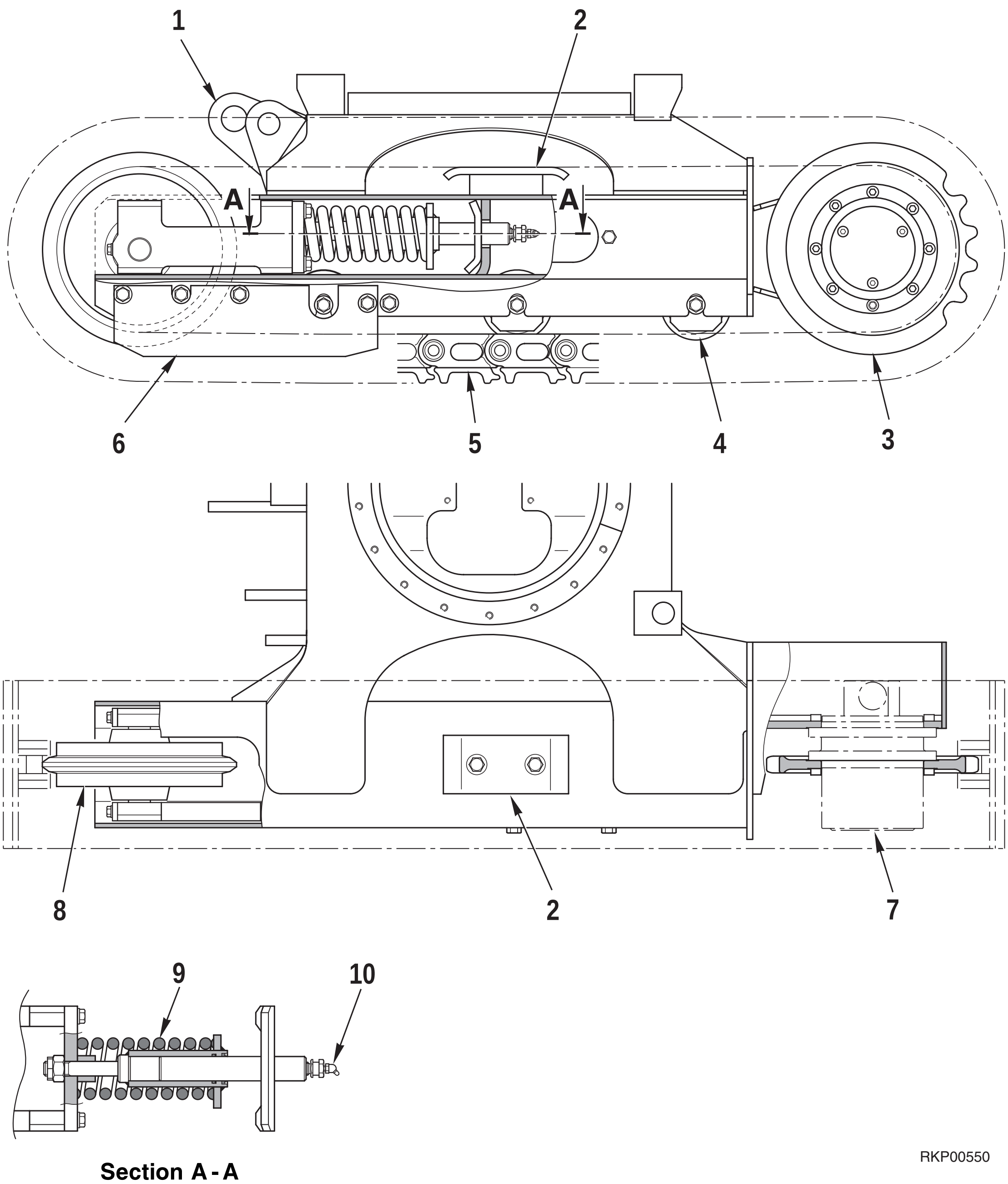
Reduction ratio: 1 – 31.77

PC15R-8

Reduction ratio: 1 – 37.22

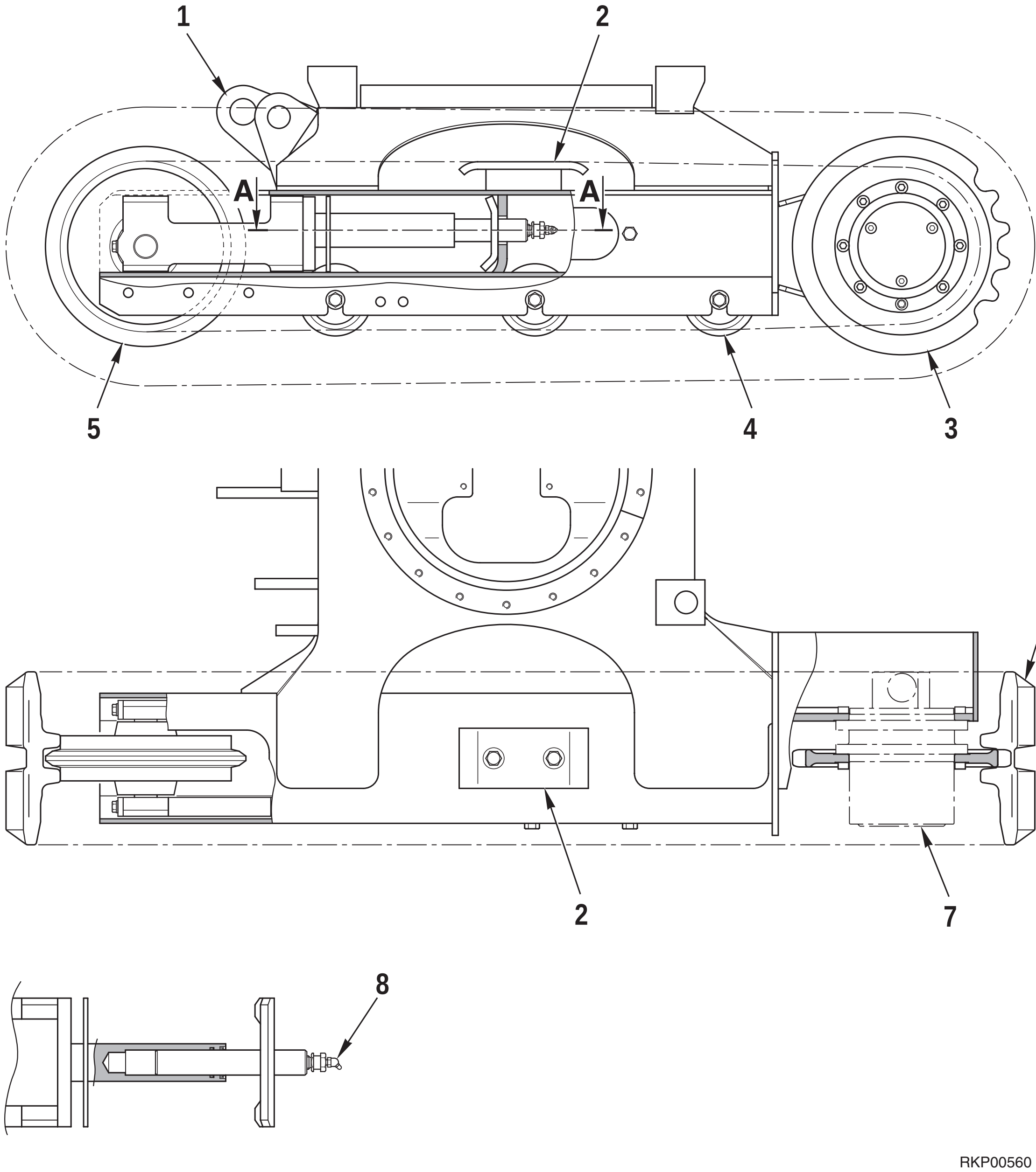
TRACK FRAME AND RECOIL SPRING

For steel shoe



1. Track frame
2. Upper idler
3. Sprocket
4. Lower idler
5. Shoe
6. Guard
7. Final drive
8. Track shoe idler
9. Recoil spring
10. Grease nipple

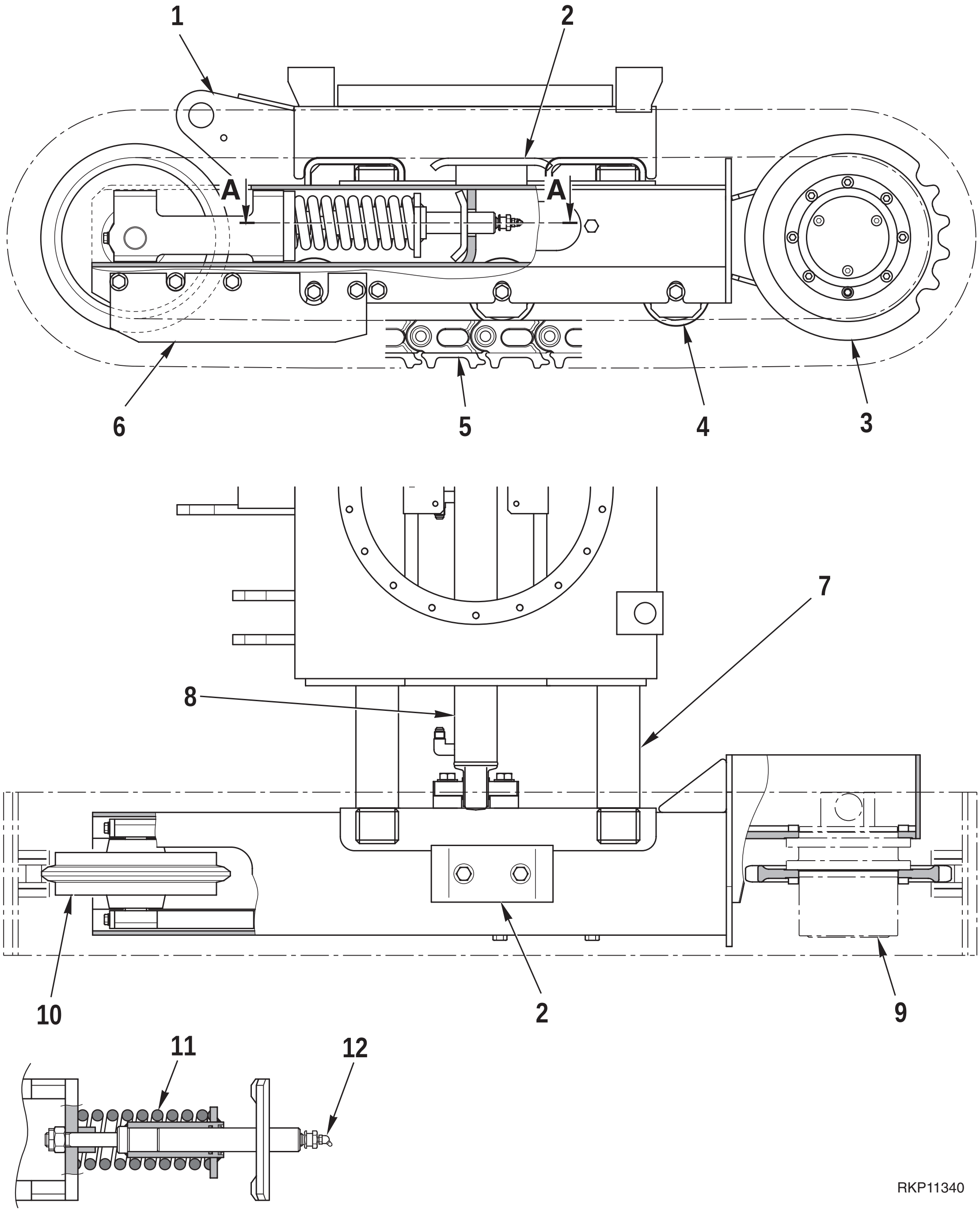
For rubber shoe



Section A - A

1. Track frame
2. Upper idler
3. Sprocket
4. Lower idler
5. Track shoe idler
6. Shoe
7. Final drive
8. Grease nipple

VARIABLE GAUGE TRACK FRAME AND RECOIL SPRING

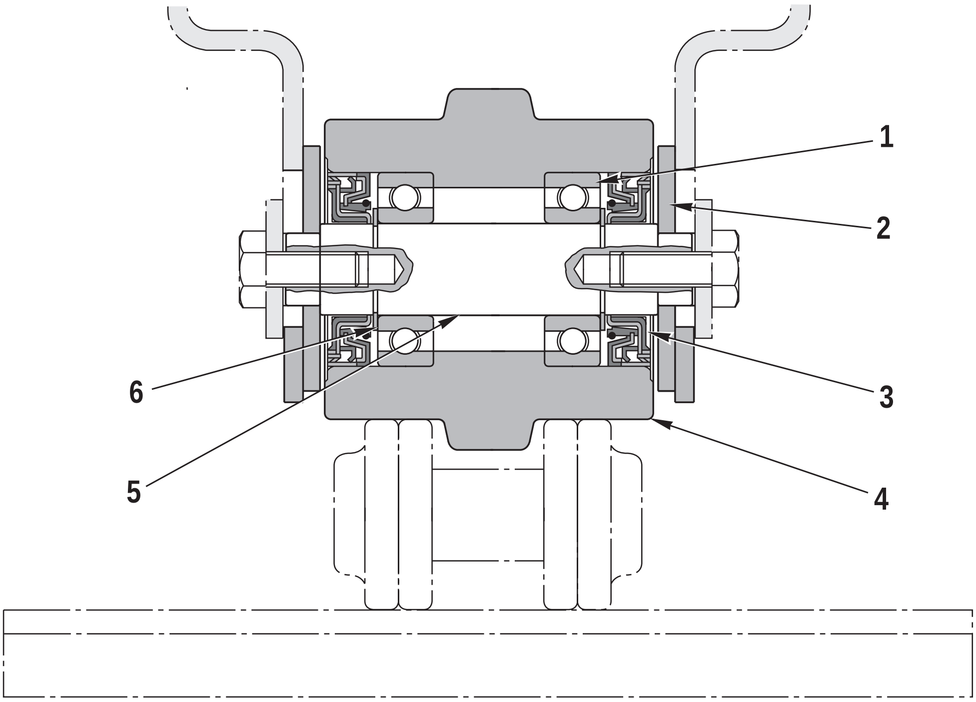


Section A - A

1. Track frame
2. Upper idler
3. Sprocket
4. Lower idler
5. Shoe
6. Guard
7. Variable gauge track
8. Variable gauge track cylinder
9. Final drive
10. Track shoe idler
11. Recoil spring
12. Grease nipple

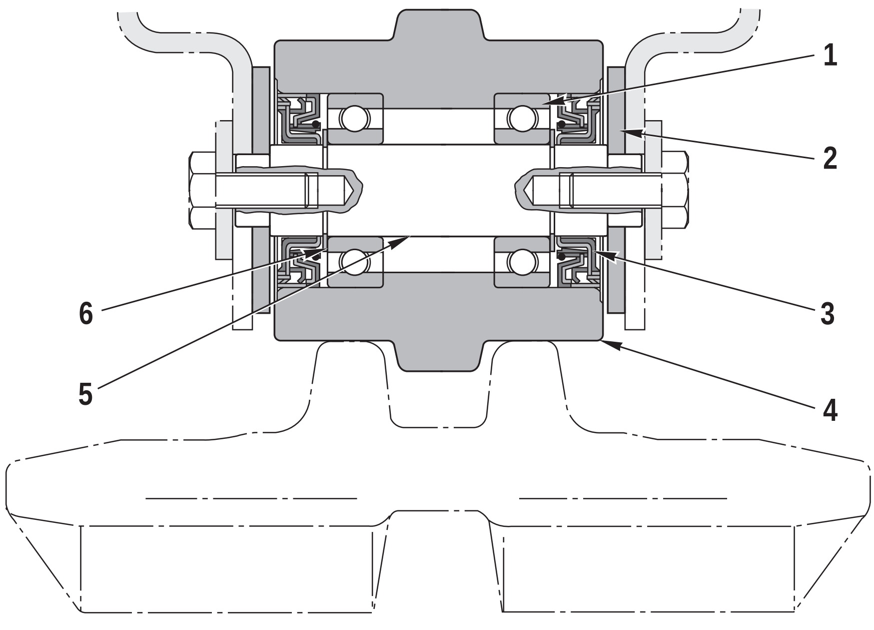
CARRIER ROLLER

For steel shoe



RKP00030

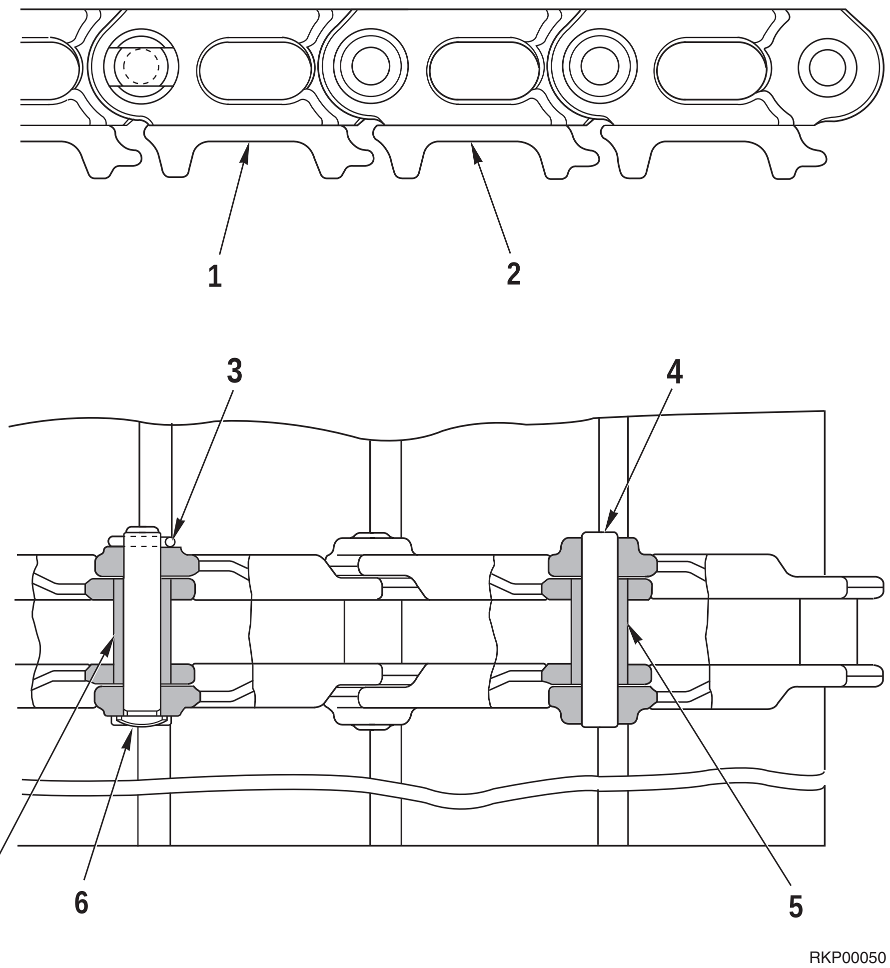
For rubber shoe



RKP00040

1. Bearing
2. Spacer
3. Seal
4. Roller
5. Shaft
6. Snap ring

STEEL SHOE



1. Link shoe
2. Shoe
3. Cotter pin
4. Pin
5. Bushing
6. Master pin
7. Master housing

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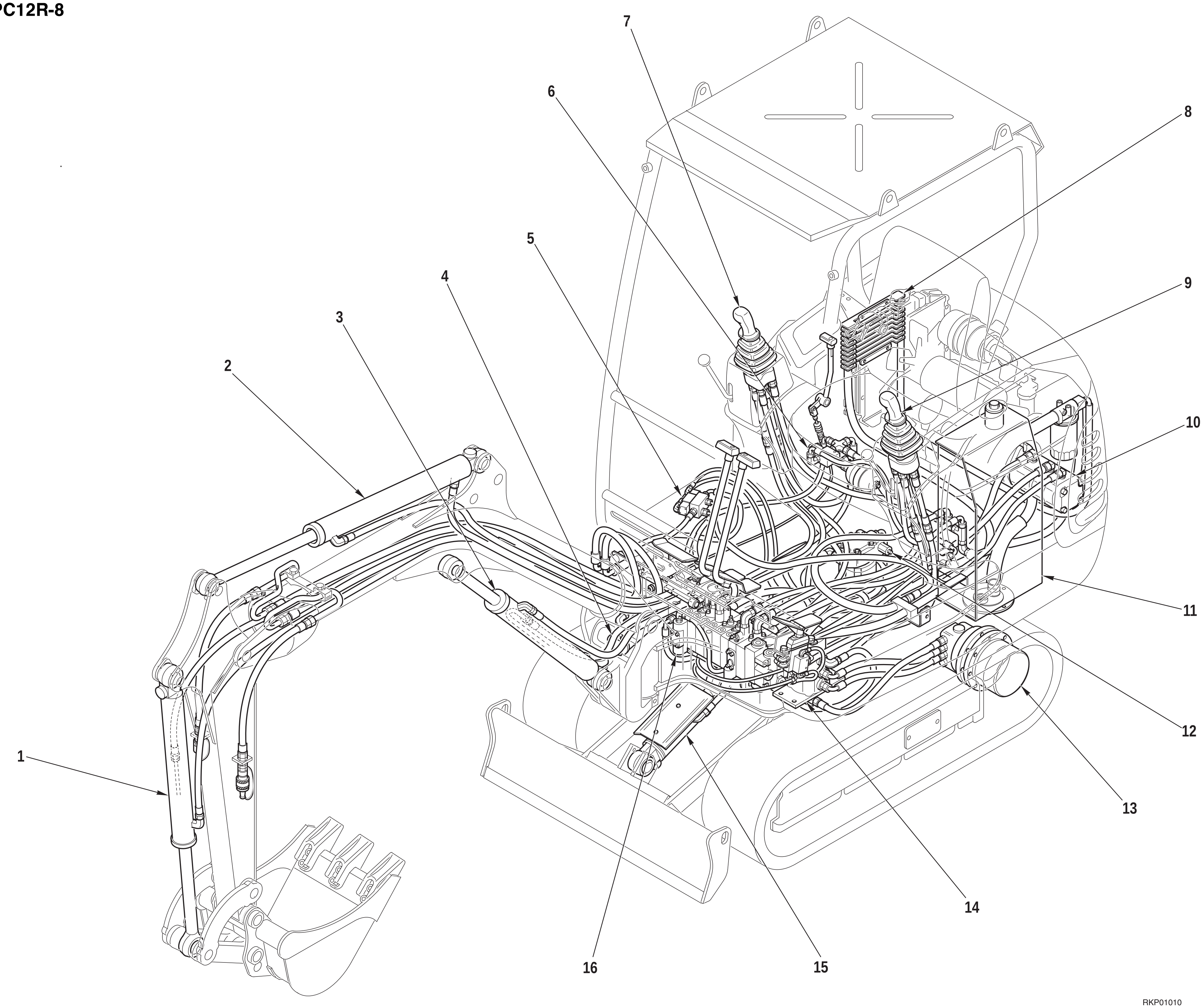
HYDRAULIC SYSTEM

PC12R-8



1. Bucket cylinder
2. Arm cylinder
3. Boom cylinder
4. Boom swing cylinder
5. Cutting shovel solenoid valve
6. Servocontrol solenoid valve
7. R.H. PPC valve
8. Oil cooler
9. L.H. PPC valve
10. Hydraulic pump
11. Hydraulic tank
12. Swing motor
13. Final drive
14. Swivel joint
15. Blade cylinder
16. Control valve

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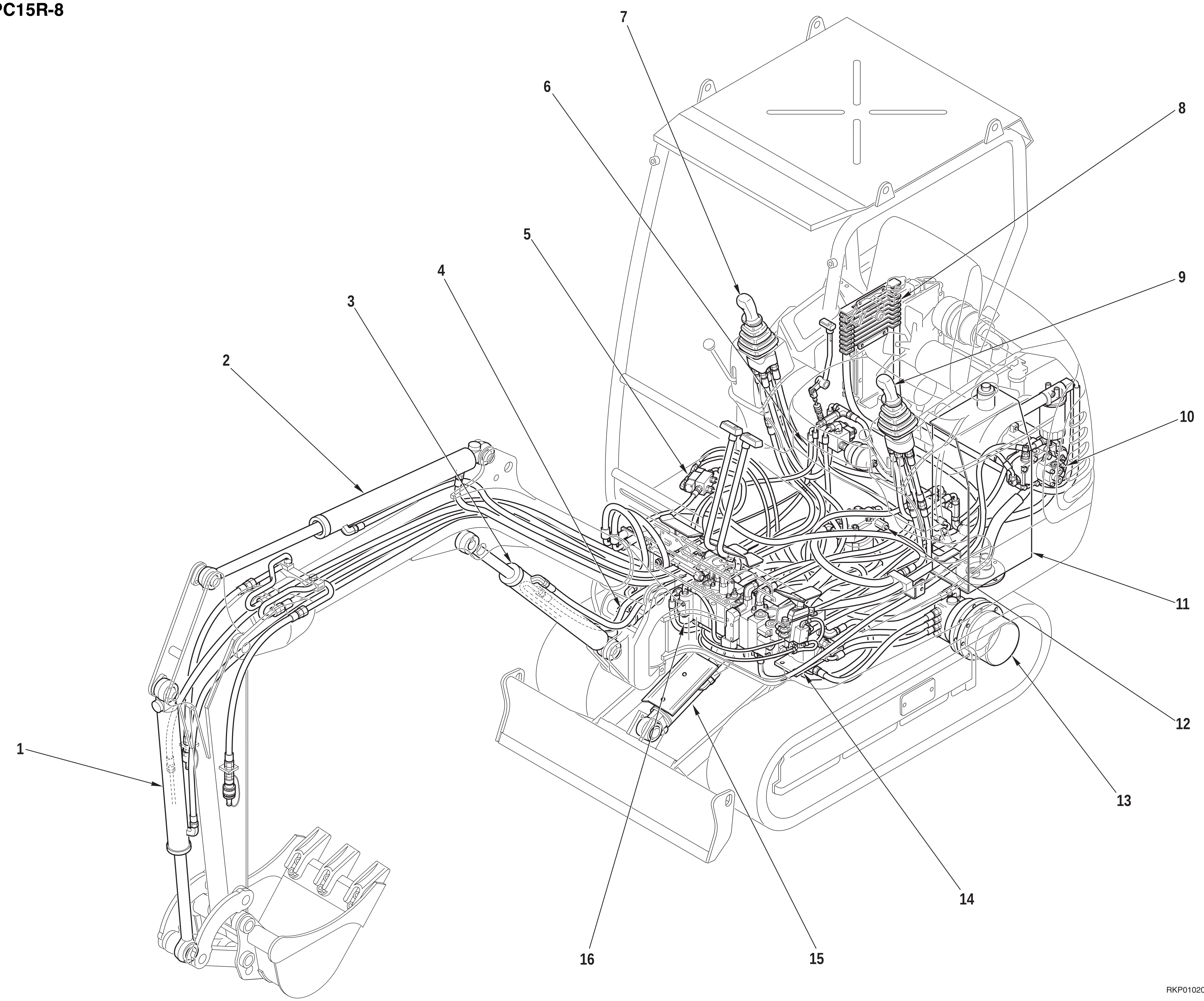
HYDRAULIC SYSTEM

PC15R-8



1. Bucket cylinder
2. Arm cylinder
3. Boom cylinder
4. Boom swing cylinder
5. Cutting shovel solenoid valve
6. Servocontrol solenoid valve
7. R.H. PPC valve
8. Oil cooler
9. L.H. PPC valve
10. Hydraulic pump
11. Hydraulic tank
12. Swing motor
13. Final drive
14. Swivel joint
15. Blade cylinder
16. Control valve

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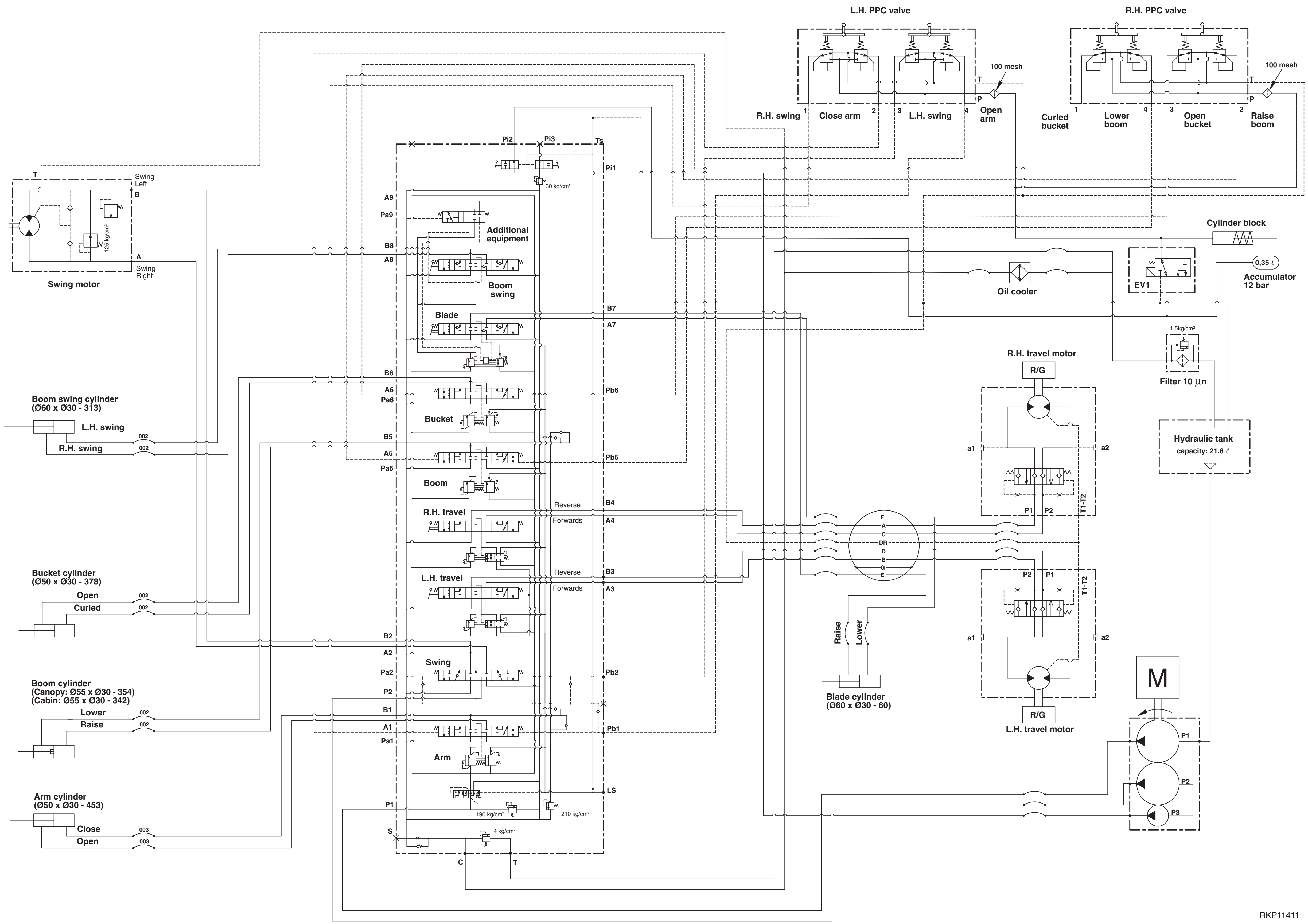
HYDRAULIC CIRCUIT DIAGRAM

PC12R-8



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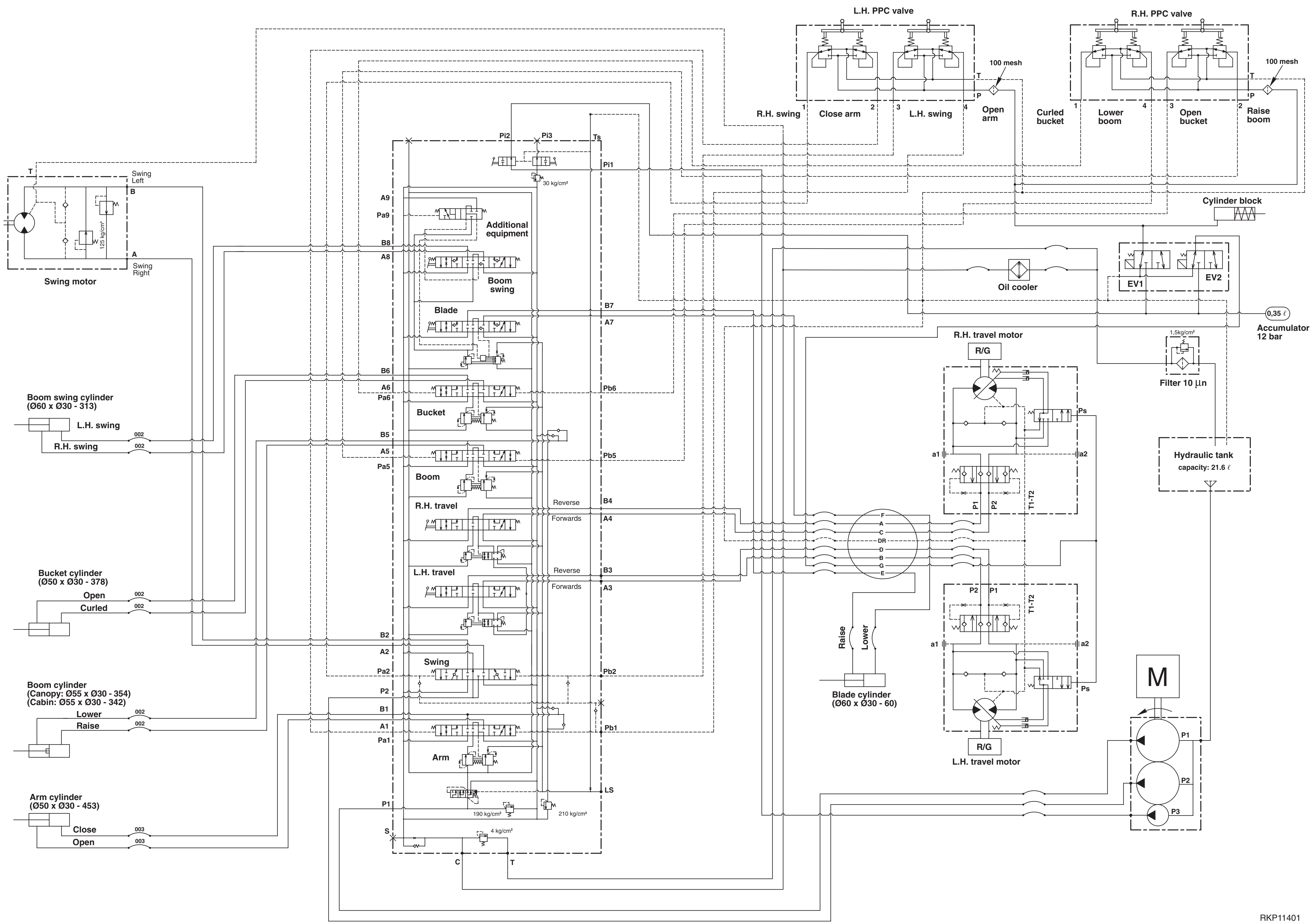
HYDRAULIC CIRCUIT DIAGRAM

PC12R-8 MISTRAL (with travel increment)



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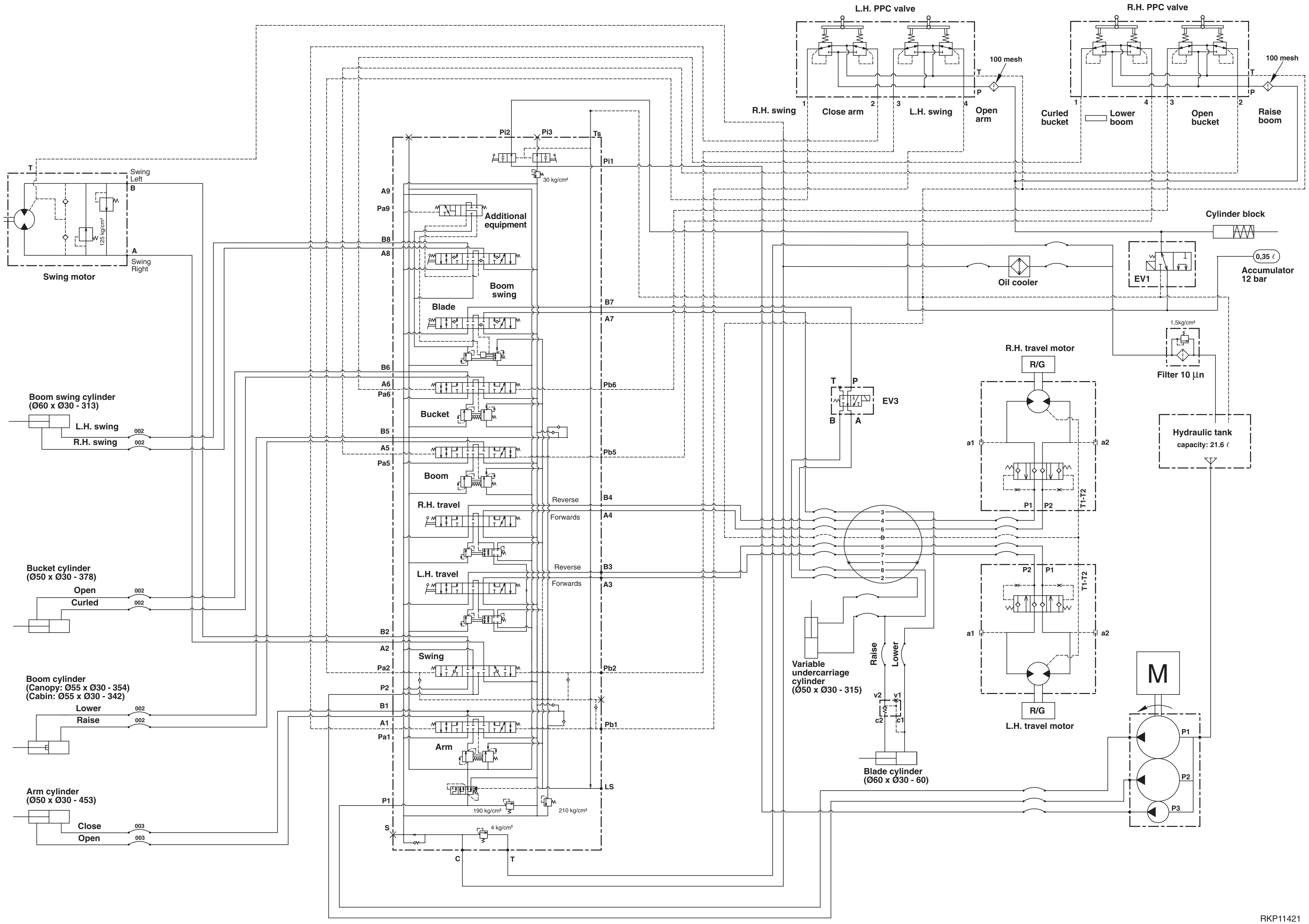
PC12R-8 HS (with variable gauge undercarriage)



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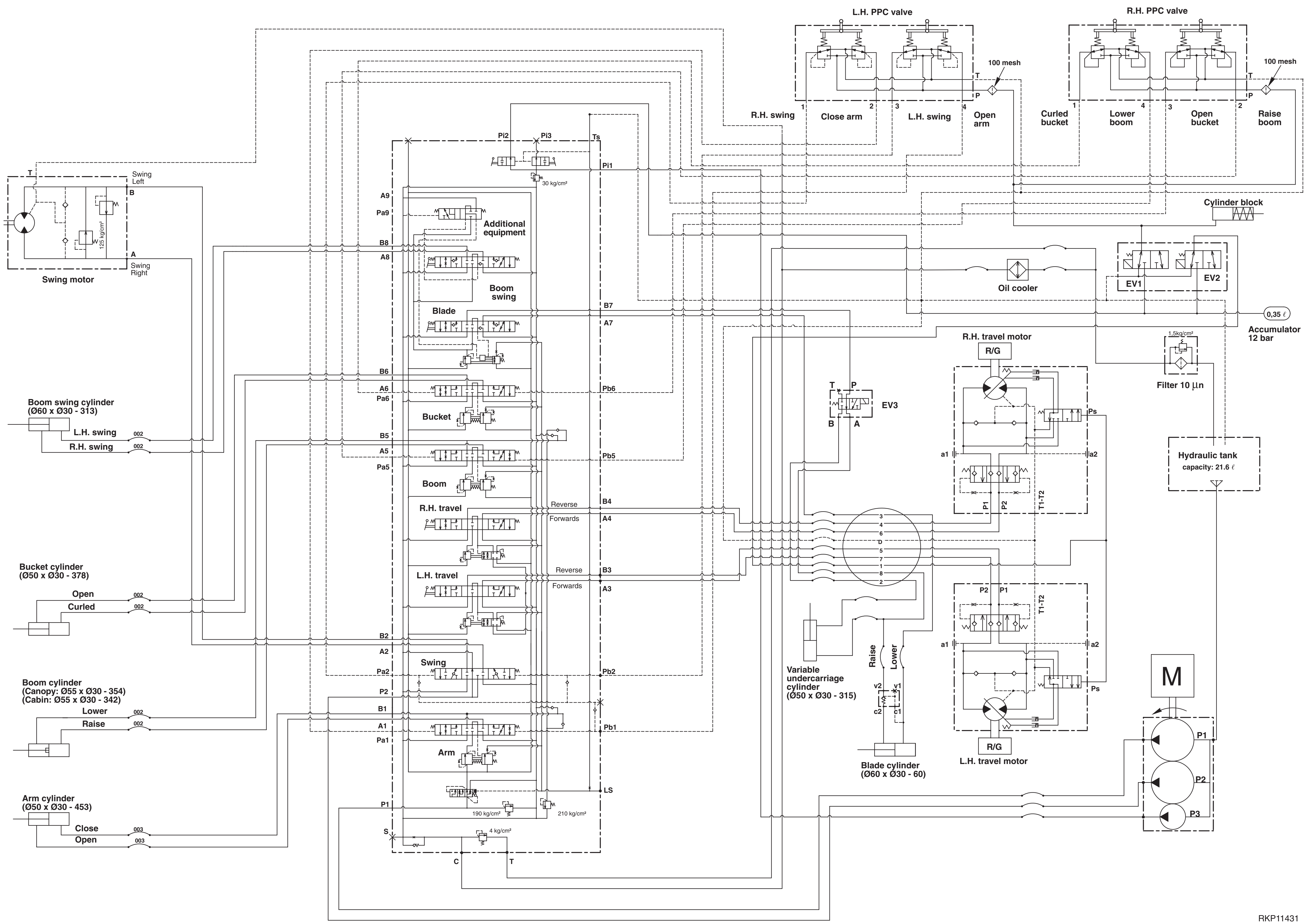
HYDRAULIC CIRCUIT DIAGRAM

PC12R-8 MISTRAL HS (with variable gauge undercarriage and travel increment)



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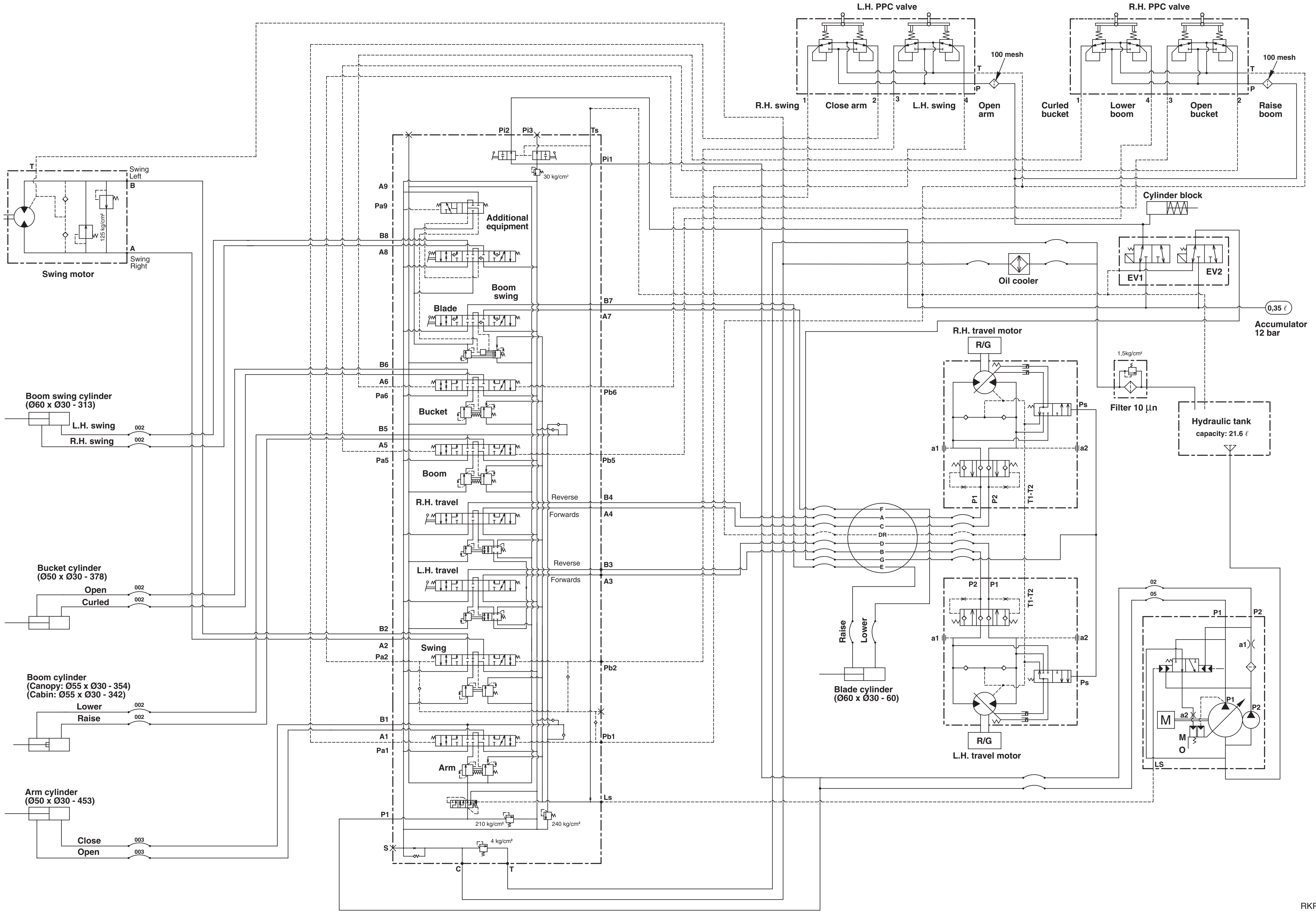
HYDRAULIC CIRCUIT DIAGRAM

PC15R-8



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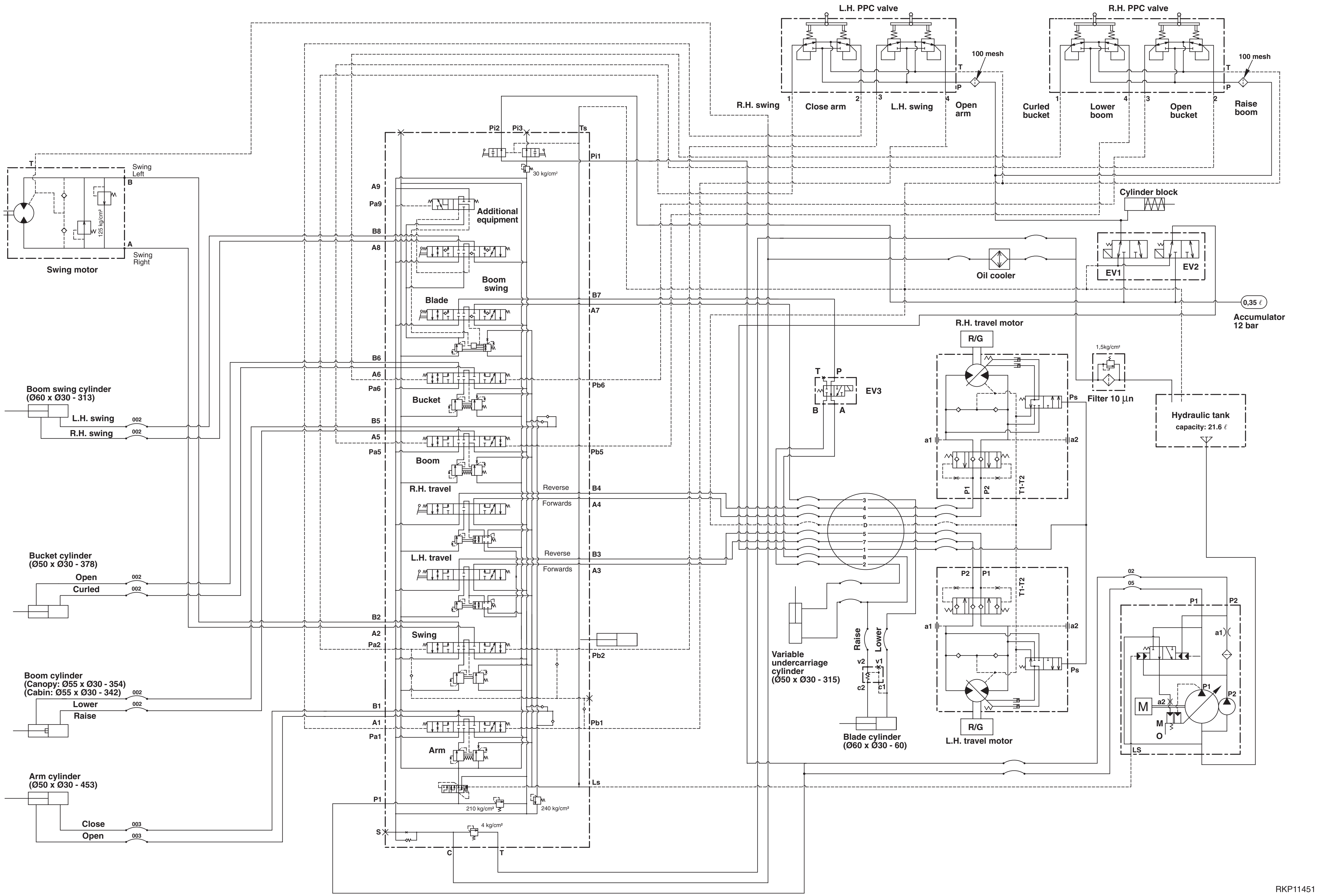
HYDRAULIC CIRCUIT DIAGRAM

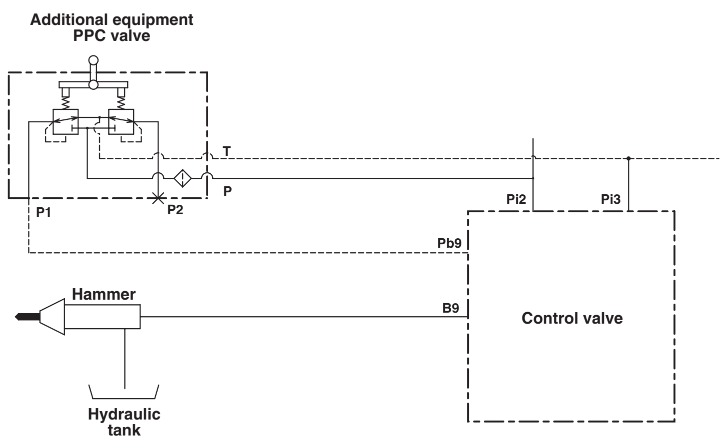
PC15R-8 HS (with variable gauge undercarriage)



HYDRAULIC CIRCUIT DIAGRAM

Equipment line

Standard



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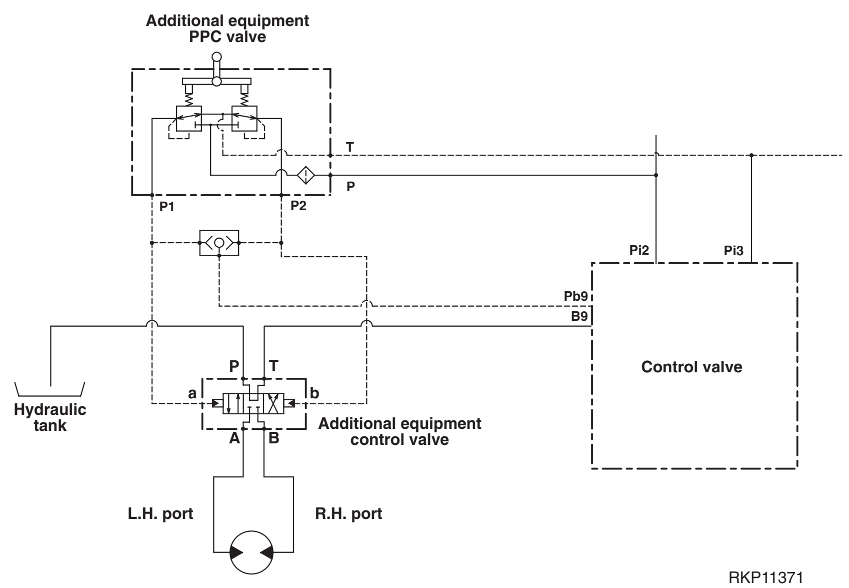
Optional



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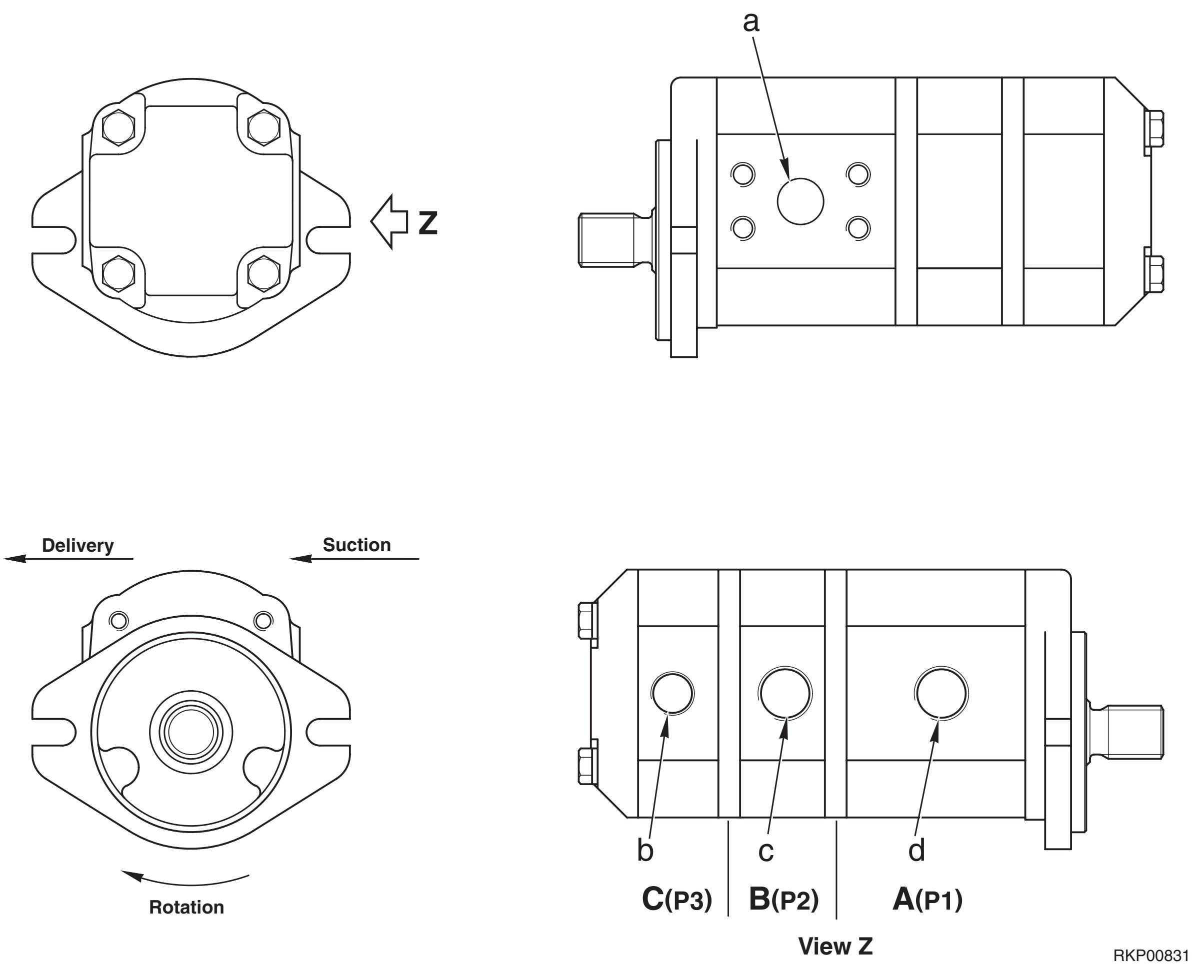
HYDRAULIC PUMP

PC12R-8



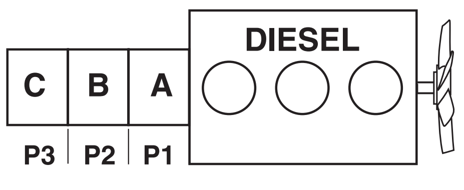
a -	S Port	- From hydraulic tank
b -	P3 Port	- To control valve (Pi1 Port)
c -	P2 Port	- To control valve (P2 Port)
d -	P1 Port	- To control valve (P Port)

SPECIFICATIONS

Type: 1Px110/1Px0.45/1Px0.30

Theorical displacement: 11 + 4.5 + 3.0 cc/rev

Nominal delivery: 25 + 10.3 + 6.8 at 2450 rpm



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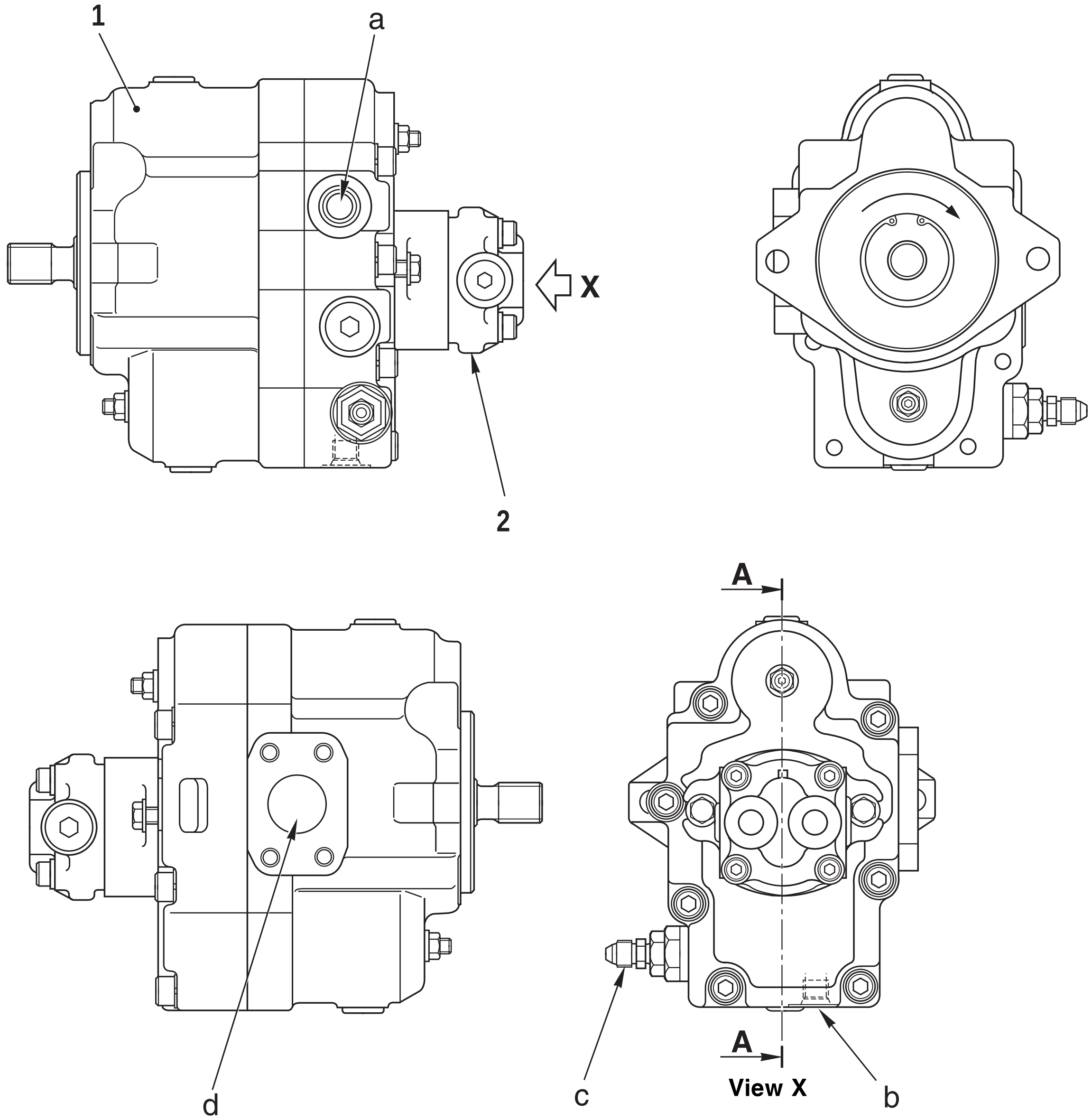
PC15R-8



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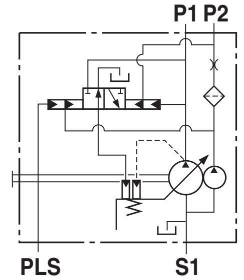


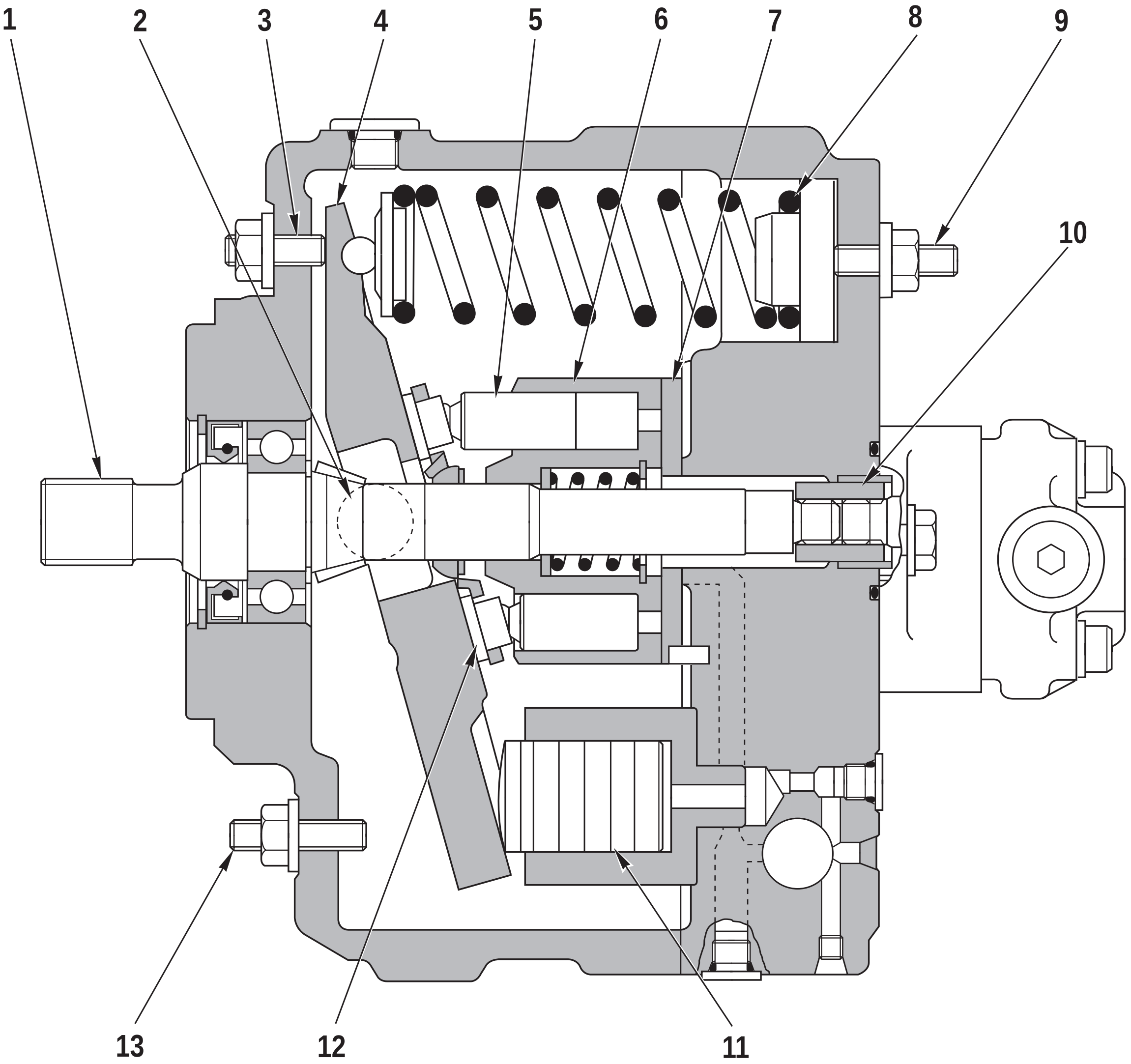
RKP00320

a - P1 Port - To control valve (P Port)
b - P2 Port - To control valve (Pi1 Port)
c - PLS Port - From control valve (LS Port)
d - S1 Port - From hydraulic tank

1. Main pump
2. Gear pump

SPECIFICATIONS

Type:	PVK - OB - 16
Displacement:	16 cc + 2.75 cc
Normal pressure:	
- Main pump:	205.8 bar (210 kg/cm^2)
- Gear pump:	29 bar (30 kg/cm^2)

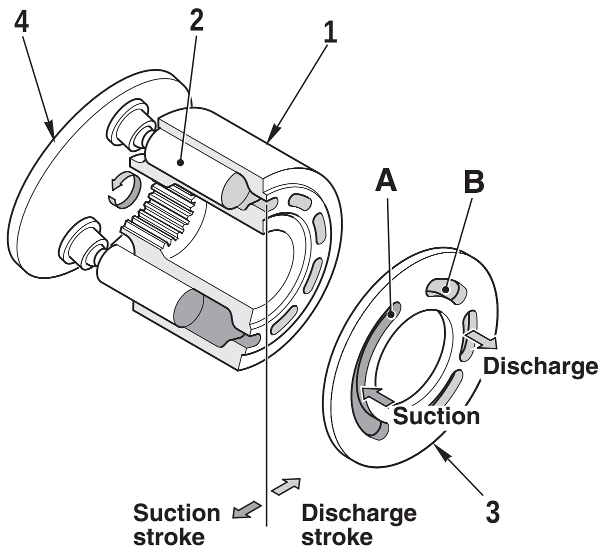


Section A - A

1. Input shaft
2. Rocker pin
3. Adjustment screw
4. Swash plate
5. Piston
6. Cylinder block
7. Valve plate
8. Spring
9. Adjustment screw
10. Joint
11. Control piston
12. Sliding shoe
13. Adjustment screw

1. Operation

- This pump has the functions of load response control and constant horsepower control.
  There are nine pistons (2) assembled inside cylinder block (1), and the face is in contact with valve plate (3).
  Suction port **A** and discharge port **B** are provided in valve plate (3).
  In this structure, swash plate (4) is secured to the body at a certain angle, and pistons (2) rotate along swash plate (4).
- By rotating shaft (5), cylinder block (1) rotates, and pistons (2) assembled inside cylinder block (1) move in a reciprocal motion following swash plate (4). This movement performs the suction and discharge action of the pump.
- Each of the nine pistons (2) performs one suction and discharge stroke for each rotation of cylinder block (1), so the rotation of shaft (5) provides continuous suction and discharge.
  The volume of the stroke of piston (2) depends on the angle of swash plate (4), so by changing the angle of swash plate (4) it is possible to change the amount of the discharge flow.



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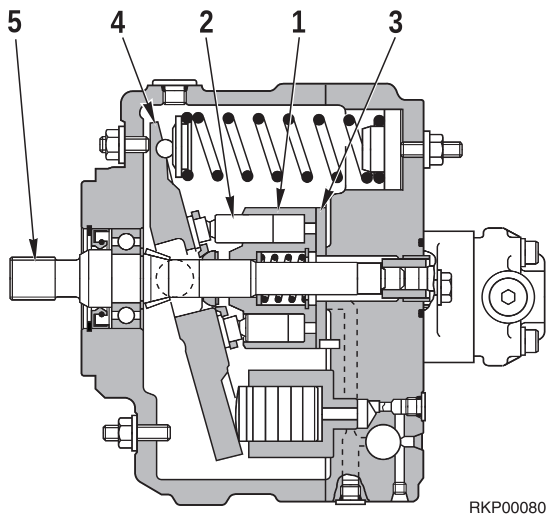
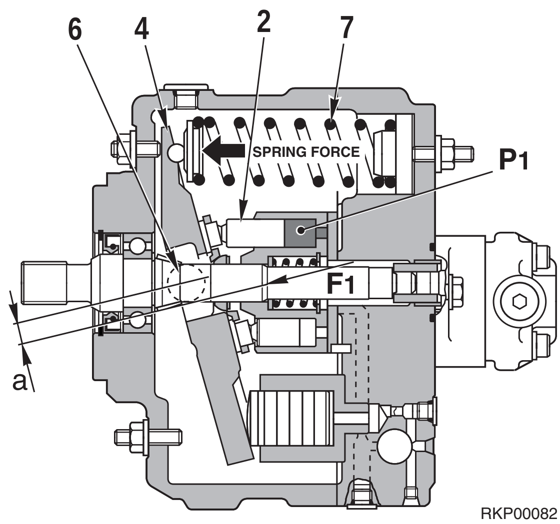


RKP00080

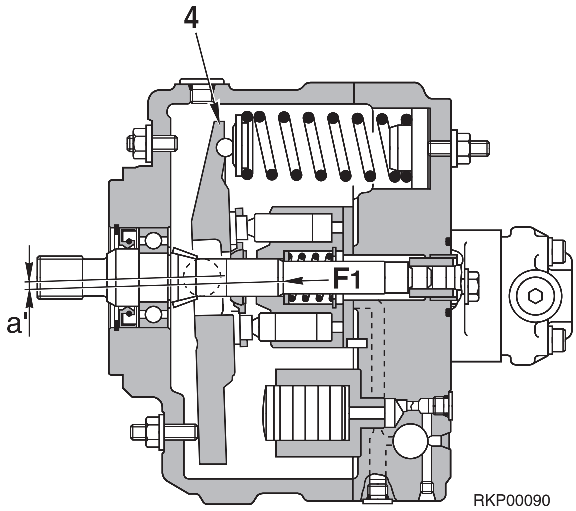
2. Constant horsepower control

- Rocker pin (6) is assembled to swash plate (4), and it is installed to the body to make it possible to change the swash plate angle. In addition, swash plate (4) is equipped with spring (7) and cylinder block piston (2), which acts in the opposite way to spring (7), and the discharge pressure of **P1** acts on piston (2).
- When the discharge pressure **P1** is lower than the set value of spring (7), the angle of swash plate (4) is held at the maximum position by spring (7).
  When the discharge pressure becomes greater than the set value of spring (7), the angle of swash plate (4) is made smaller by total piston force **F1** x **a** and is held at the position where the discharge pressure is balanced with the force of the spring.



RKP00082

- If the discharge pressure rises further, the angle of swash plate (4) becomes smaller. When this happens, the length of the arm applying total piston force **F1** is reduced from **a** to **a'**, so a larger force **F1** is needed for the angle of swash plate (4).



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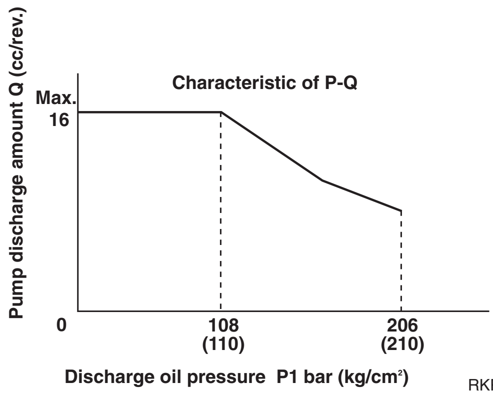
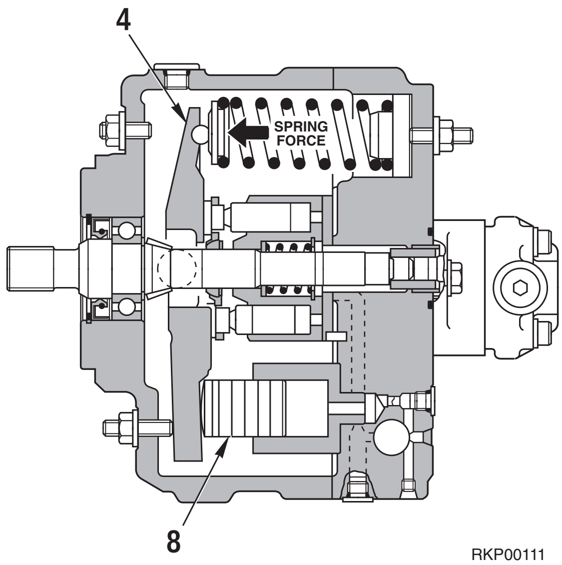
- Is this way, curve **P - Q** becomes a curve (constant horsepower control) which gives effective use of the engine horsepower.



RKP00101

3. Load response control

- When carrying out load response control, the signal pressure from the **LS** valve is transmitted to control piston (8), and control piston (8) pushes swash plate (4). The angle of swash plate (4) changes to a point where this force is balanced with the total force of the spring and piston, so the discharge amount changes.
- Constant horsepower control is carried out with priority over load response control, so the discharge amount changes in the range below the flow at constant horsepower control.



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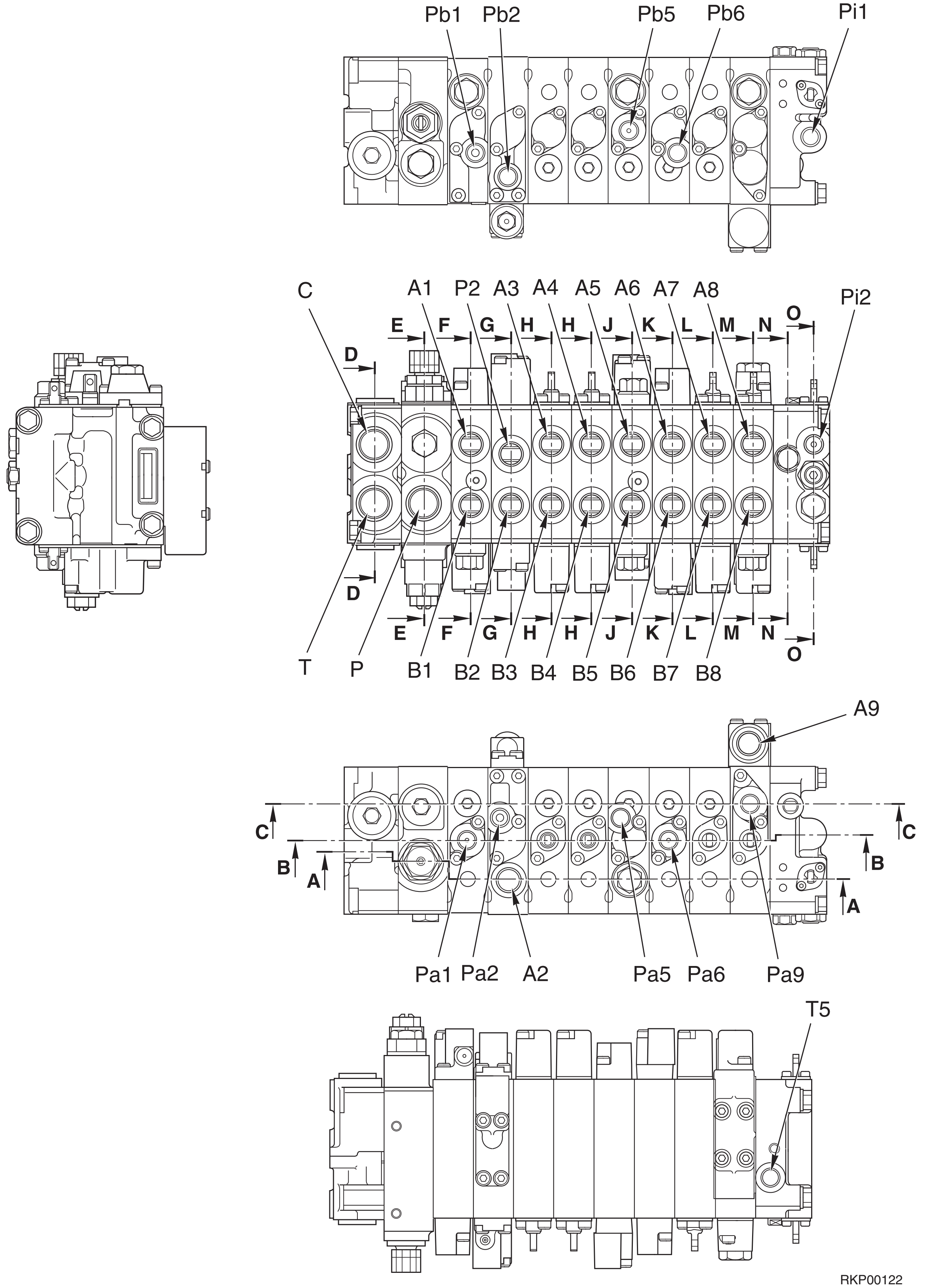
CONTROL VALVE

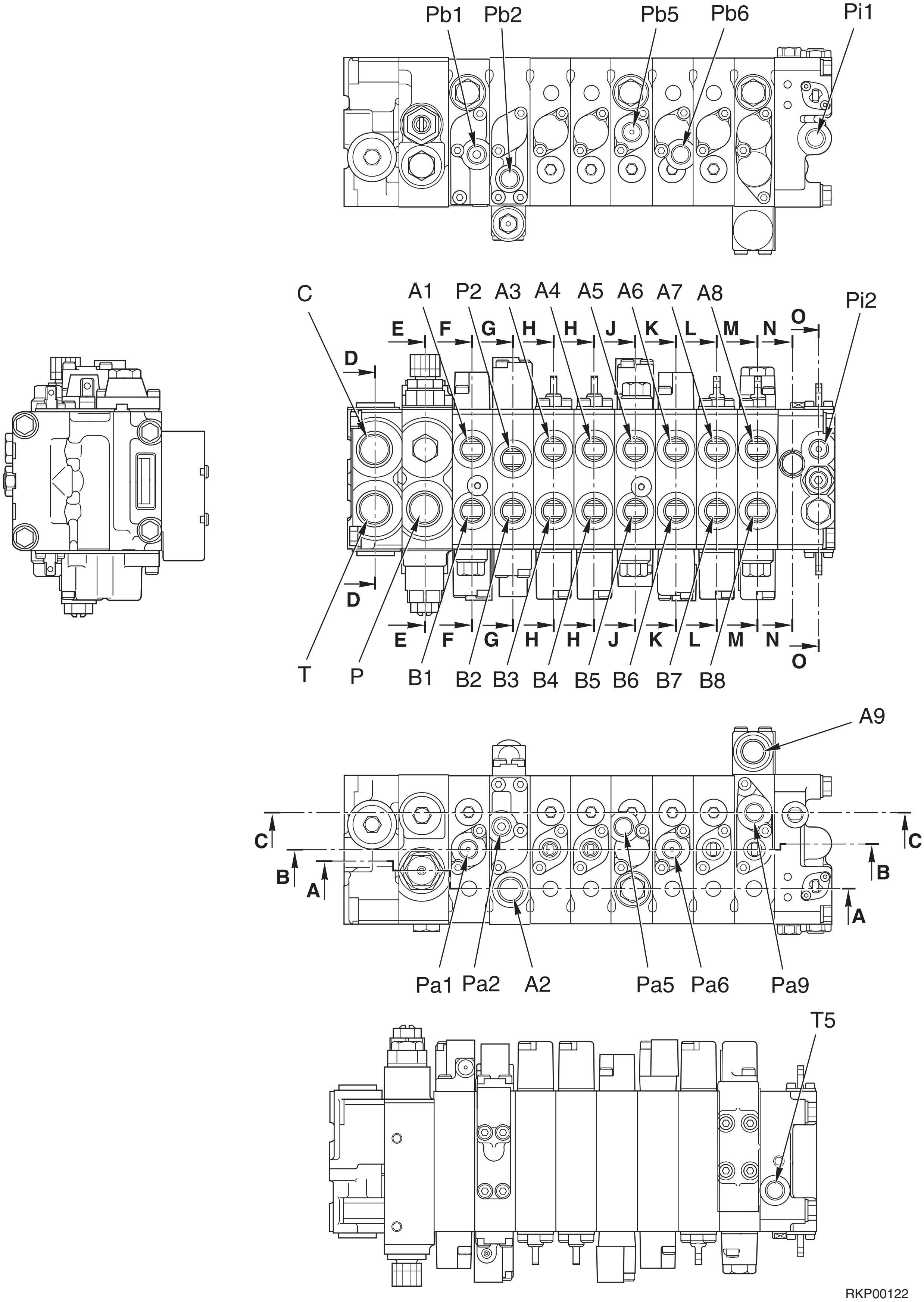
PC12R-8
PC12R-8 MISTRAL (with travel increment)



A1 Port	-	To arm cylinder (Head side)
A2 Port	-	To swing motor (A Port)
A3 Port	-	To swivel joint (D Port)
A4 Port	-	To swivel joint (C Port)
A5 Port	-	To boom cylinder (Bottom side)
A6 Port	-	To bucket cylinder (Bottom side)
A7 Port	-	To swivel joint (F Port)
A8 Port	-	To boom swing cylinder (Head side)
A9 Port	-	To attachment
B1 Port	-	To arm cylinder (Bottom side)
B2 Port	-	To swing motor (B Port)
B3 Port	-	To swivel joint (B Port)
B4 Port	-	To swivel joint (A Port)
B5 Port	-	To boom cylinder (Head side)
B6 Port	-	To bucket cylinder (Head side)
B7 Port	-	To swivel joint (E Port)
B8 Port	-	To boom swing cylinder (Bottom side)
C Port	-	To oil cooler
P Port	-	From hydraulic pump (P Port)
Pa1 Port	-	From L.H. PPC valve (4 Port)
Pa2 Port	-	From L.H. PPC valve (1 Port)
Pa5 Port	-	From R.H. PPC valve (2 Port)
Pa6 Port	-	From R.H. PPC valve (1 Port)
Pa9 Port	-	From attachment PPC valve
Pb1 Port	-	From L.H. PPC valve (2 Port)
Pb2 Port	-	From L.H. PPC valve (3 Port)
Pb5 Port	-	From R.H. PPC valve (4 Port)
Pb6 Port	-	From R.H. PPC valve (3 Port)
Pi1 Port	-	From hydraulic pump (P3 Port)
Pi2 Port	-	To ST1 solenoid valve (P Port)
P2 Port	-	From hydraulic pump (P2 Port)
T Port	-	To hydraulic tank
TS Port	-	To hydraulic tank

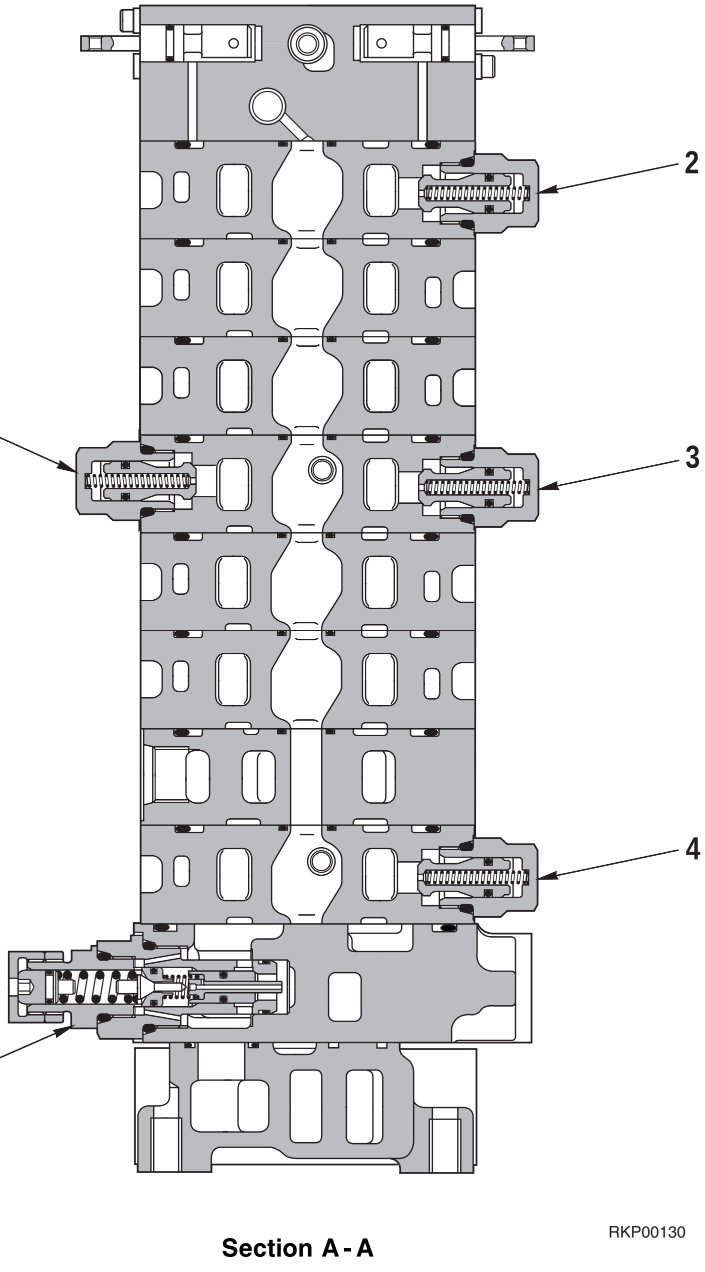
CONTROL VALVE

PC12R-8 HS (with variable gauge undercarriage)
PC12R-8 MISTRAL HS (with variable gauge undercarriage and travel increment)



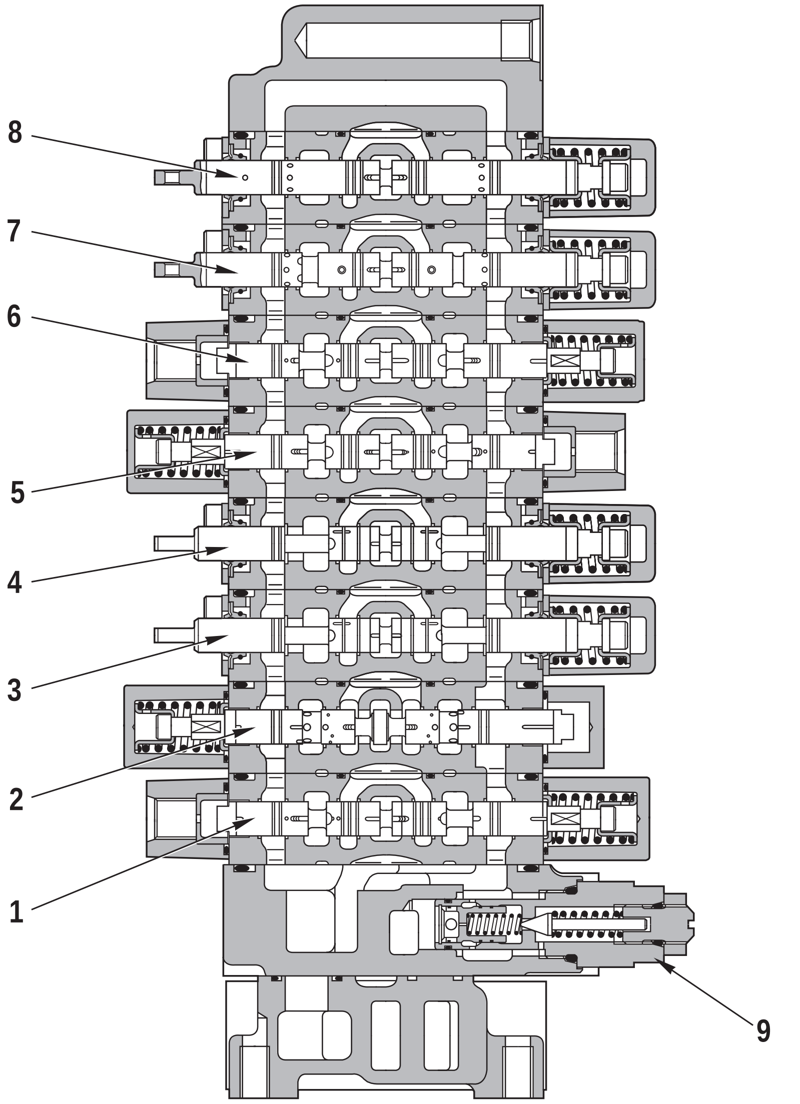
RKP00122

A1 Port	-	To arm cylinder (Head side)
A2 Port	-	To swing motor (A Port)
A3 Port	-	To swivel joint (5 Port)
A4 Port	-	To swivel joint (6 Port)
A5 Port	-	To boom cylinder (Bottom side)
A6 Port	-	To bucket cylinder (Bottom side)
A7 Port	-	To swivel joint (3 Port)
A8 Port	-	To boom swing cylinder (Head side)
A9 Port	-	To attachment
B1 Port	-	To arm cylinder (Bottom side)
B2 Port	-	To swing motor (B Port)
B3 Port	-	To swivel joint (7 Port)
B4 Port	-	To swivel joint (4 Port)
B5 Port	-	To boom cylinder (Head side)
B6 Port	-	To bucket cylinder (Head side)
B7 Port	-	To EV3 solenoid valve (P Port)
B8 Port	-	To boom swing cylinder (Bottom side)
C Port	-	To oil cooler
P Port	-	From hydraulic pump (P Port)
Pa1 Port	-	From L.H. PPC valve (4 Port)
Pa2 Port	-	From L.H. PPC valve (1 Port)
Pa5 Port	-	From R.H. PPC valve (2 Port)
Pa6 Port	-	From R.H. PPC valve (1 Port)
Pa9 Port	-	From attachment PPC valve
Pb1 Port	-	From L.H. PPC valve (2 Port)
Pb2 Port	-	From L.H. PPC valve (3 Port)
Pb5 Port	-	From R.H. PPC valve (4 Port)
Pb6 Port	-	From R.H. PPC valve (3 Port)
Pi1 Port	-	From hydraulic pump (P3 Port)
Pi2 Port	-	To ST1 solenoid valve (P Port)
P2 Port	-	From hydraulic pump (P2 Port)
T Port	-	To hydraulic tank
TS Port	-	To hydraulic tank



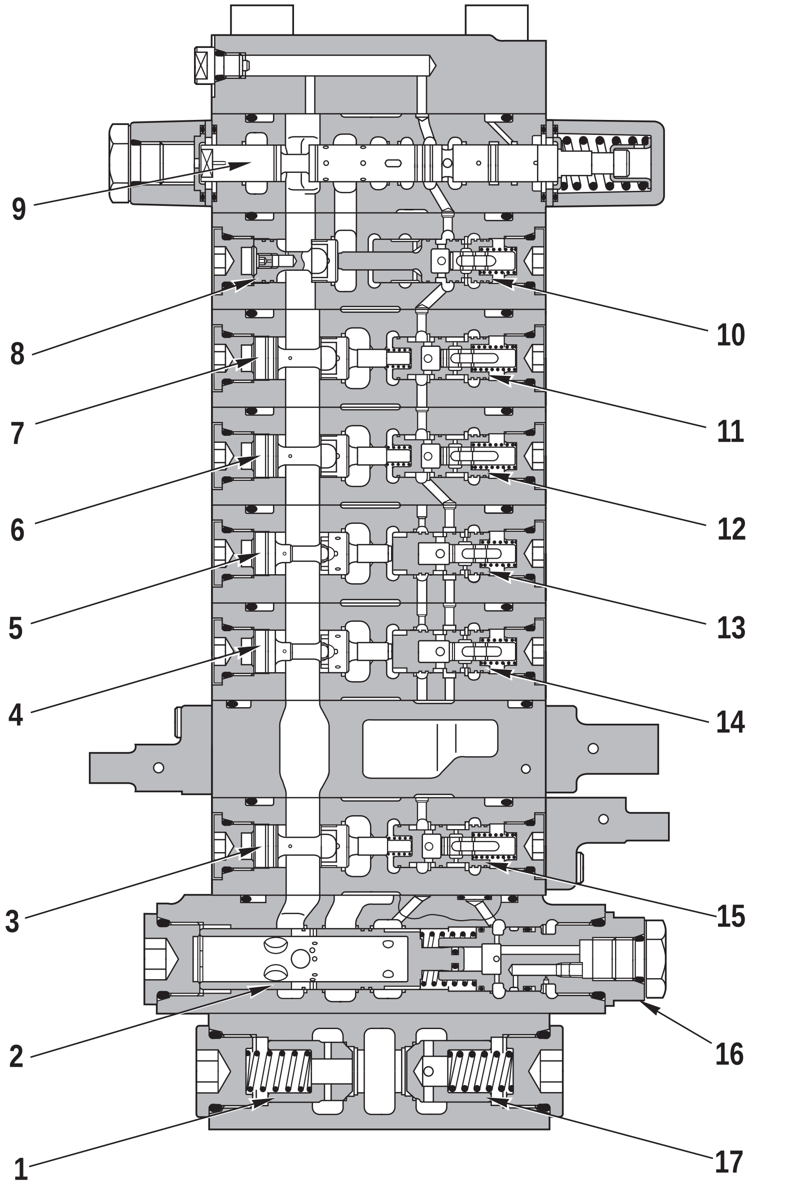
Section A - A

1. Suction valve (Boom lower)
2. Suction valve (Boom L.H. swing)
3. Suction valve (Boom raise)
4. Suction valve (Arm close)
5. Safety valve



Section B - B

1. Spool (Arm)
2. Spool (Swing)
3. Spool (L.H. travel)
4. Spool (R.H. travel)
5. Spool (Boom)
6. Spool (Bucket)
7. Spool (Blade)
8. Spool (Boom swing)
9. Main relief valve



Section C - C

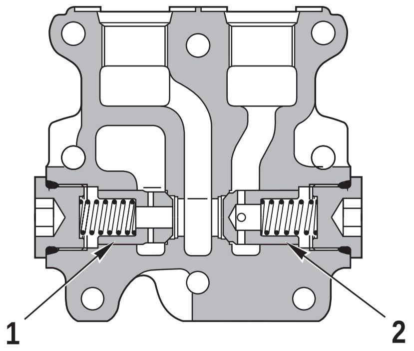
1. Check valve
2. Unload valve

FLOW COMPENSATION VALVE

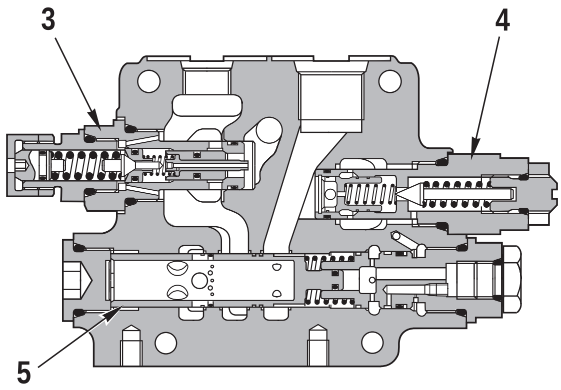
3. Arm
4. L.H. travel
5. R.H. travel
6. Boom
7. Bucket
8. Blade
9. Spool (Hammer)

REDUCING PRESSURE COMPENSATION VALVE

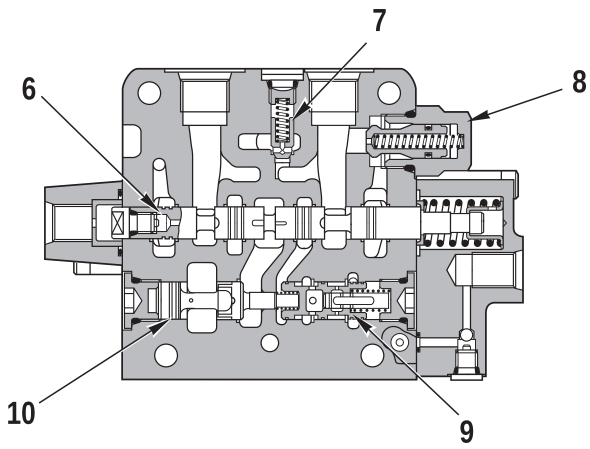
10. Blade
11. Bucket
12. Boom
13. L.H. travel
14. R.H. travel
15. Arm
16. LS by-pass plug
17. Cooler check valve



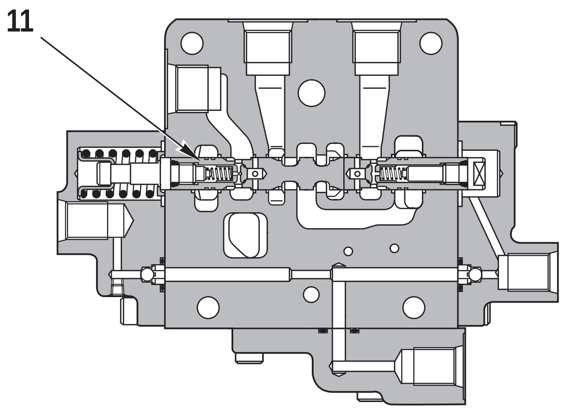
Section D - D



Section E - E



Section F - F



RKP00160

Section G - G

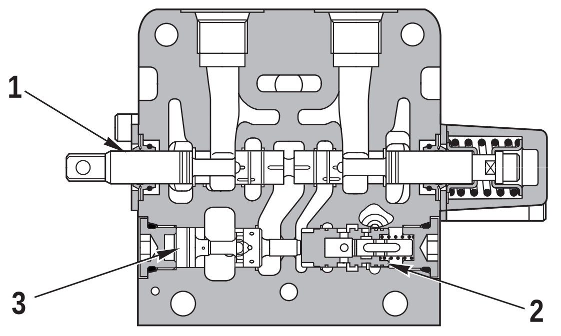
1. Check valve
2. Cooler check valve
3. Safety valve
4. Main relief valve
5. Unload valve

ARM VALVE

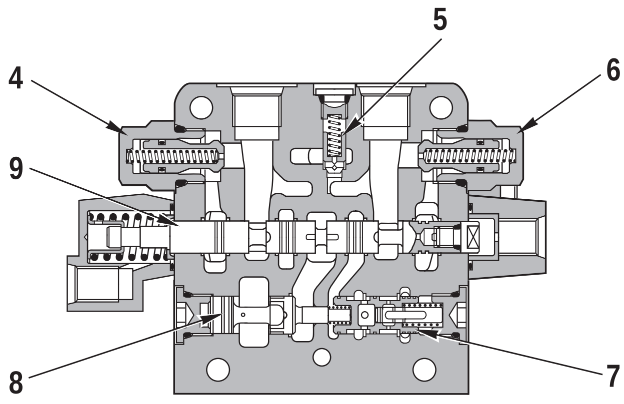
6. Spool
7. Check valve
8. Suction valve
9. Reducing pressure compensation valve
10. Flow compensation valve

SWING VALVE

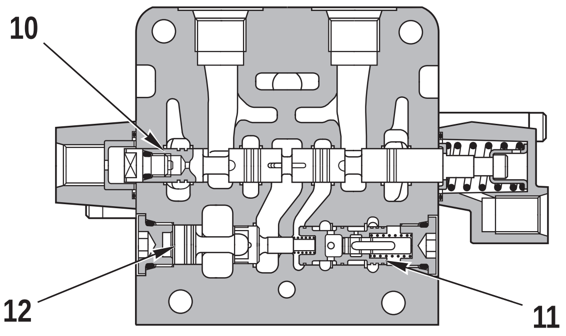
11. Spool



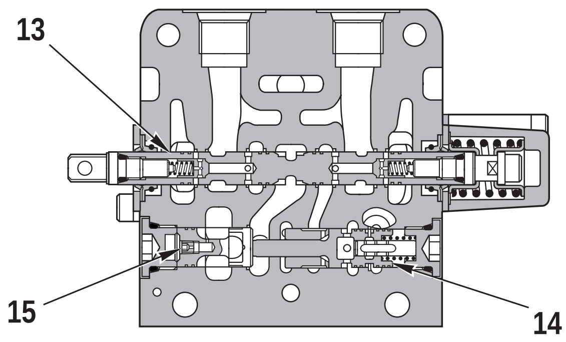
Section H - H



Section J - J



Section K - K



Section L - L

RKP00170

TRAVEL VALVE
1. Spool
2. Reducing pressure compensation valve
3. Flow compensation valve

BOOM VALVE

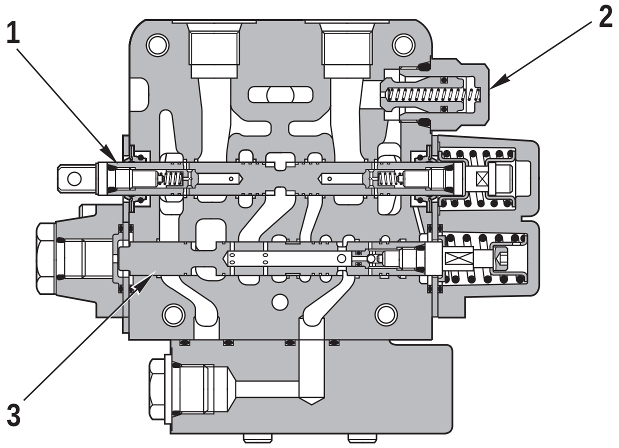
4. Suction valve
5. Check valve
6. Suction valve
7. Reducing pressure compensation valve
8. Flow compensation valve
9. Spool

BUCKET VALVE

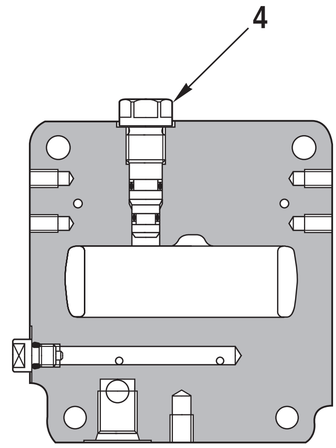
10. Spool
11. Reducing pressure compensation valve
12. Flow compensation valve

BLADE VALVE

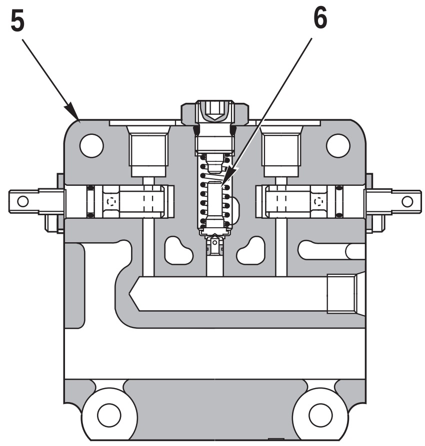
13. Spool
14. Reducing pressure compensation valve
15. Flow compensation valve



Section M - M



Section N - N



Section O - O

RKP00180

BOOM SWING AND HAMMER VALVE

1. Spool (Boom swing)
2. Suction valve
3. Spool (Hammer)
4. Plug
5. Cover
6. Reducing valve (Servocontrol)

CLSS

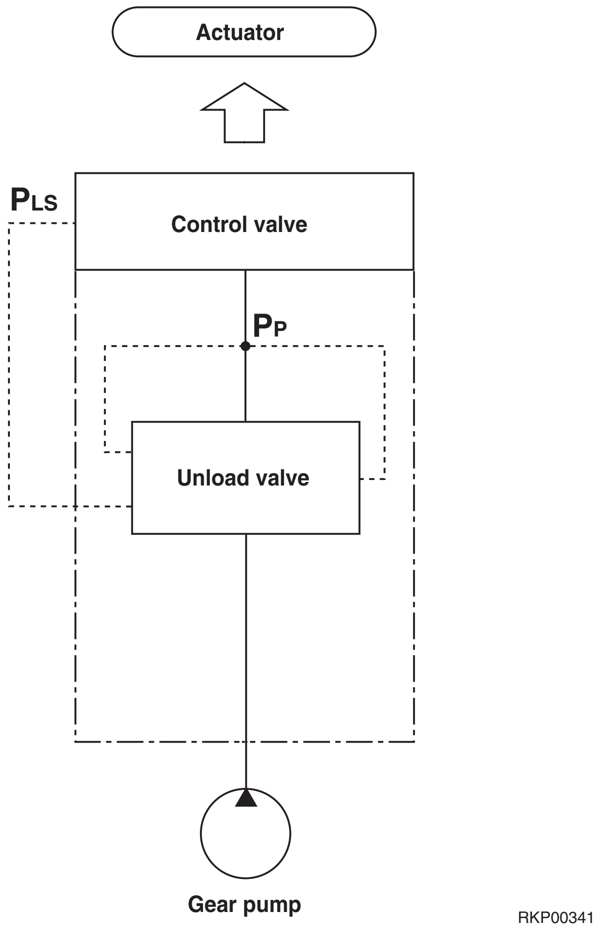
1. OUTLINE

FEATURES

The term "**CLSS**" stands for the "Closed Center Load Sensing System" which has the following features.
a) Fine-controllability not affected by loads.
b) Controllability enabling digging even in the control mode.
c) Complex operability ensured by flow distribution determined according to the opening areas of spools during complex operation.

STRUCTURE

The **CLSS** consists of a gear pump, control valve and actuators.

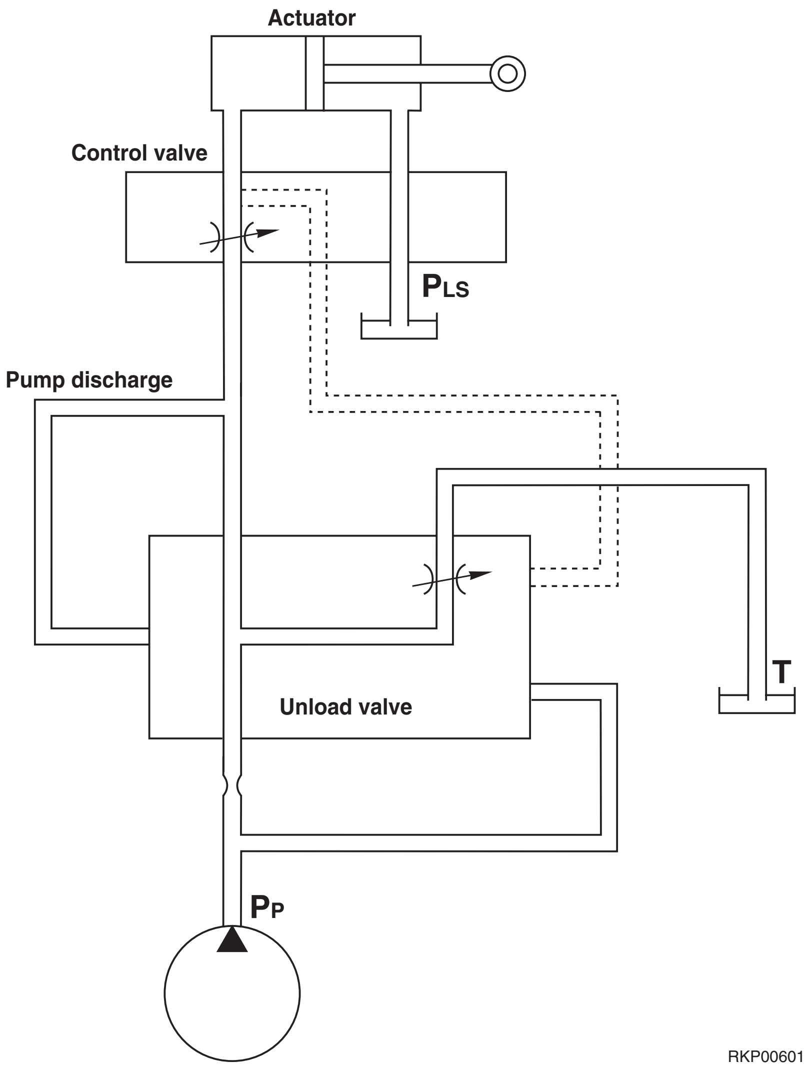


2. BASIC PRINCIPLE

1) Flow control of unload valve

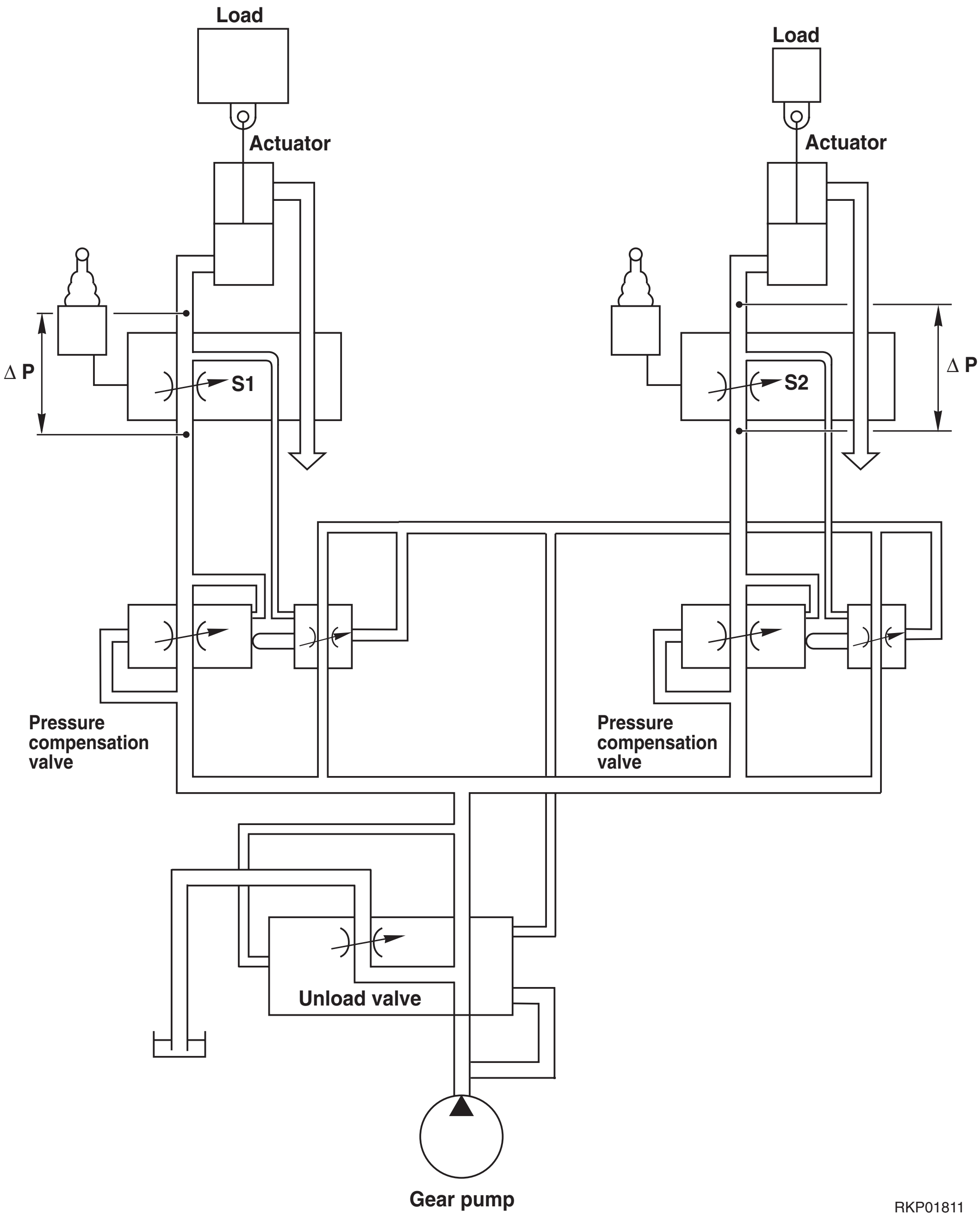
- The unload valve maintains **LS** differential pressure **ΔPLS** which is differential pressure between the pump discharge pressure **PP** and the **LS** pressure **PLS** at the outlet port of control valve (actuator load pressure) at a constant level. (**LS** differential pressure **ΔPLS** = Pump discharge pressure **PP** – **LS** pressure **PLS**).
- If the **LS** differential pressure **ΔPLS** becomes lower than the setting pressure, the Unload valve reduces drain flow to the circuit, and if it becomes higher, the Unload valve increases drain flow.

★ For the details of this action, refer to the descriptions of Unload valve.



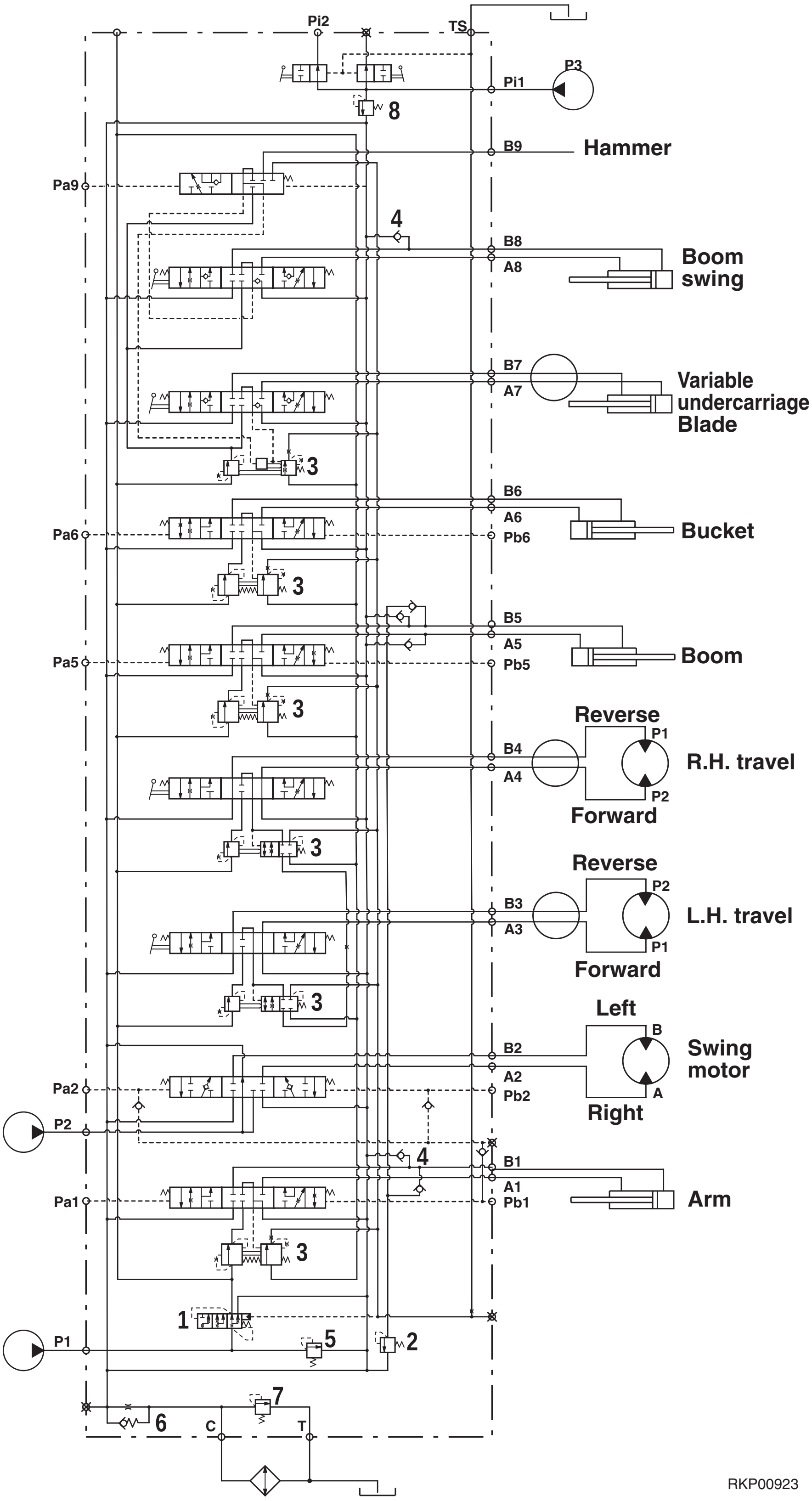
2) Pressure compensation control

- Valves (pressure compensation valves) are installed at the inlet port side of the spools of the control valves to balance the loads.
  When the actuators are complex-operated, the pressure differences **ΔP** at the upstream (inlet) and downstream (outlet) are made equal by these valves.
  In this way, the flow from the pump are distributed in proportion to the opening areas **S1** and **S2** of each valve.



3. Funzionamento per ogni circuito e valvola

SCHEMA IDRAULICO E NOME DELLE VALVOLE



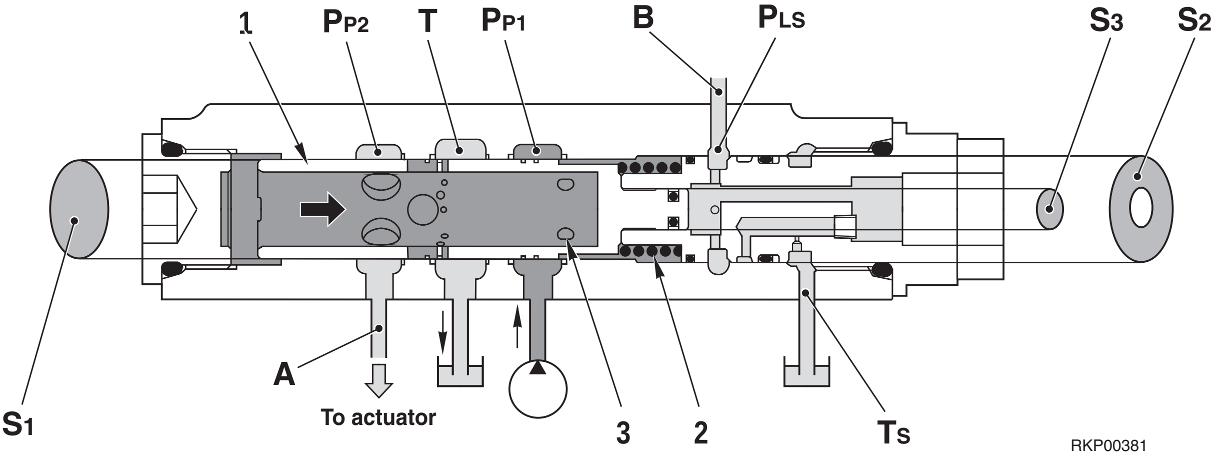
1. Unload valve:
   (LS pressure + 19.6 $^{0}_{+9.8}$ bar
   (LS + 20 $^{0}_{+10}$ kg/cm^2)
2. Safety valve:
   186 bar (190 kg/cm^2)
3. Pressure compensation valve
4. Suction valve
5. Main relief valve:
   206 bar (210 kg/cm^2)
6. Back pressure check valve: 4.5 bar (4.5 kg/cm^2)
7. Cooler by-pass valve:
   4 bar (4 kg/cm^2)
8. Pilot relief valve:
   29.5 bar (30 kg/cm^2)

1. Unload valve

FUNCTION

1) In the case of fixed pump system, the Unload valve has functions included variable pump and **LS** valve of variable pump system.

- When the control valve is at HOLD, pump discharge amount Q is released to the tank circuit.
- When the control valve is operated, the flow from pump is sent to the actuator circuit in proportion to the opening areas of valve spool.
- The **LS** differential pressure **ΔP_{LS}** is become variable according to engine speed. (Engine speed sensing function).



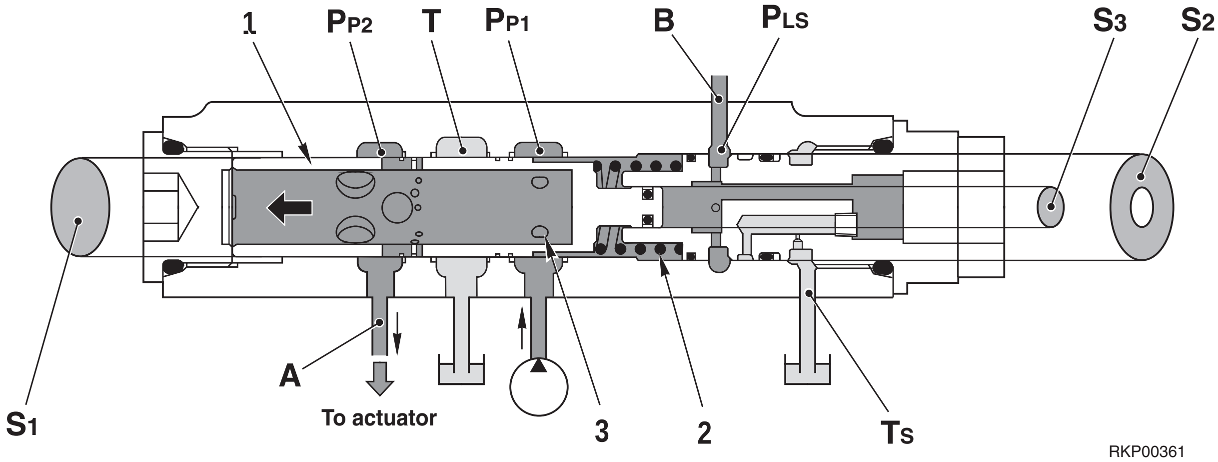
OPERATION

When control valve is at HOLD

- At the left end of spool (1), pump pressure **P_{P1}** is acting on area **S1**, and at the right end of spool (1), pump pressure **P_{P2}** and spring force of spring (2) is acting on area **S2**, and **LS** pressure **P_{LS}** is acting on area **S3**.
- The reason of difference between pump pressure **P_{P1}** and **P_{P2}** comes from pressure loss **P_P**, when the pump discharge amount passes through the orifice (3) of spool (1). (**$P_{P1} = P_{P2} + \Delta P_P$**).
- When the control valve is at HOLD, **LS** pressure **P_{LS}** is not generated, so the pump pressure **P_{P1}**, **P_{P2}**, and spring force of spring (2) is acting on spool (1).
- As pump discharge pressure **P_{P1}** rises and reaches the **P_{P2} x S1 = P_{P1} x S2** + spring force of spring (2), spool (1) is moved to the right. Pump circuit **P_{P1}**, **P_{P2}** are then connected to tank circuit **T** through the drill hole.
- In this way, the differential pressure (**LS** differential pressure) between pump discharge pressure **P_{P1}** and **LS** pressure **P_{LS}** is set to $19.6^{\,0}_{+9.8}$ bar ($20^{\,0}_{+10}$ kg/cm^2).

P_P = Pump circuit
P_{LS} = Load Sensing circuit
T-TS = Tank circuit
A = To control valve spool
B = To **LS** valve

2) When control valve is operated, pump discharge pressure **P_{P1}** is set to **LS** pressure **P_{LS}** + $19{,}6^{\,0}_{+9{,}8}$ bar ($20^{\,0}_{+10}$ kg/cm^2).

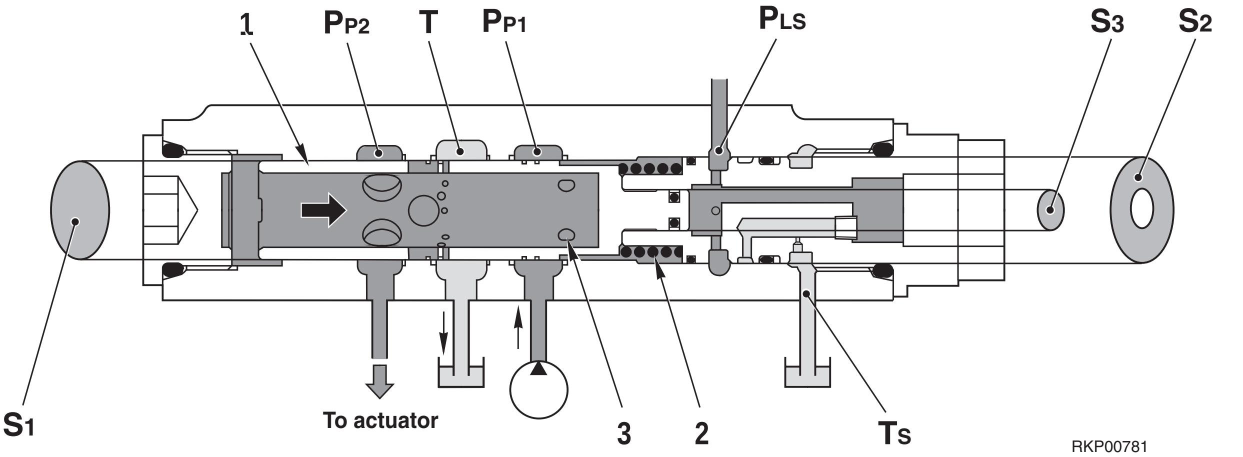


OPERATION
Control valve operated

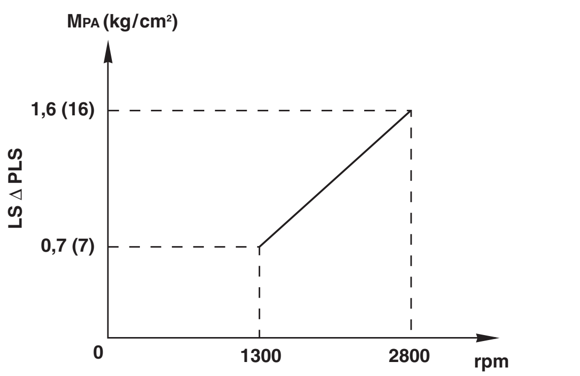
- When the control valve is operated, **LS** pressure **P_{LS}** is generated and acts on area **S3** at the right end of spool (1).
- When the differential pressure between pump discharge pressure **P_{P1}** and **LS** pressure **P_{LS}** raises and reaches $19{,}6^{\,0}_{+9{,}8}$ bar ($20^{\,0}_{+10}$ kg/cm^2), spool (1) is moved to the left, and the oil flowing to tank circuit when control valve is at HOLD flows to actuator circuit.
- The operation is same when fine control is carried out on the control valve.
- When the pump discharge amount become smaller than actuator requirement amount (Pump discharge amount < Actuator requirement amount) with operating actuators at same time, spool (1) is moved to the left more till full stroke. As a result, pump circuit **P_{P1}**, **P_{P2}** and tank circuit **T** are shut off, and all the pump discharge amount Q flows to the actuator circuit.

3) Engine speed sensing function

- All the pump discharge amount Q flows through the orifice (3) of spool (1). On the fixed pump system, the relation between engine speed and pump discharge amount Q is in proportion. Therefore when engine speed is high, pump discharge amount is much, and little pump discharge amount flows at engine speed low.
- For this reason, oil flow through the orifice (3) of spool (1) is different when engine speed is high and low. At that time, the pressure loss **ΔP_P** is varied.



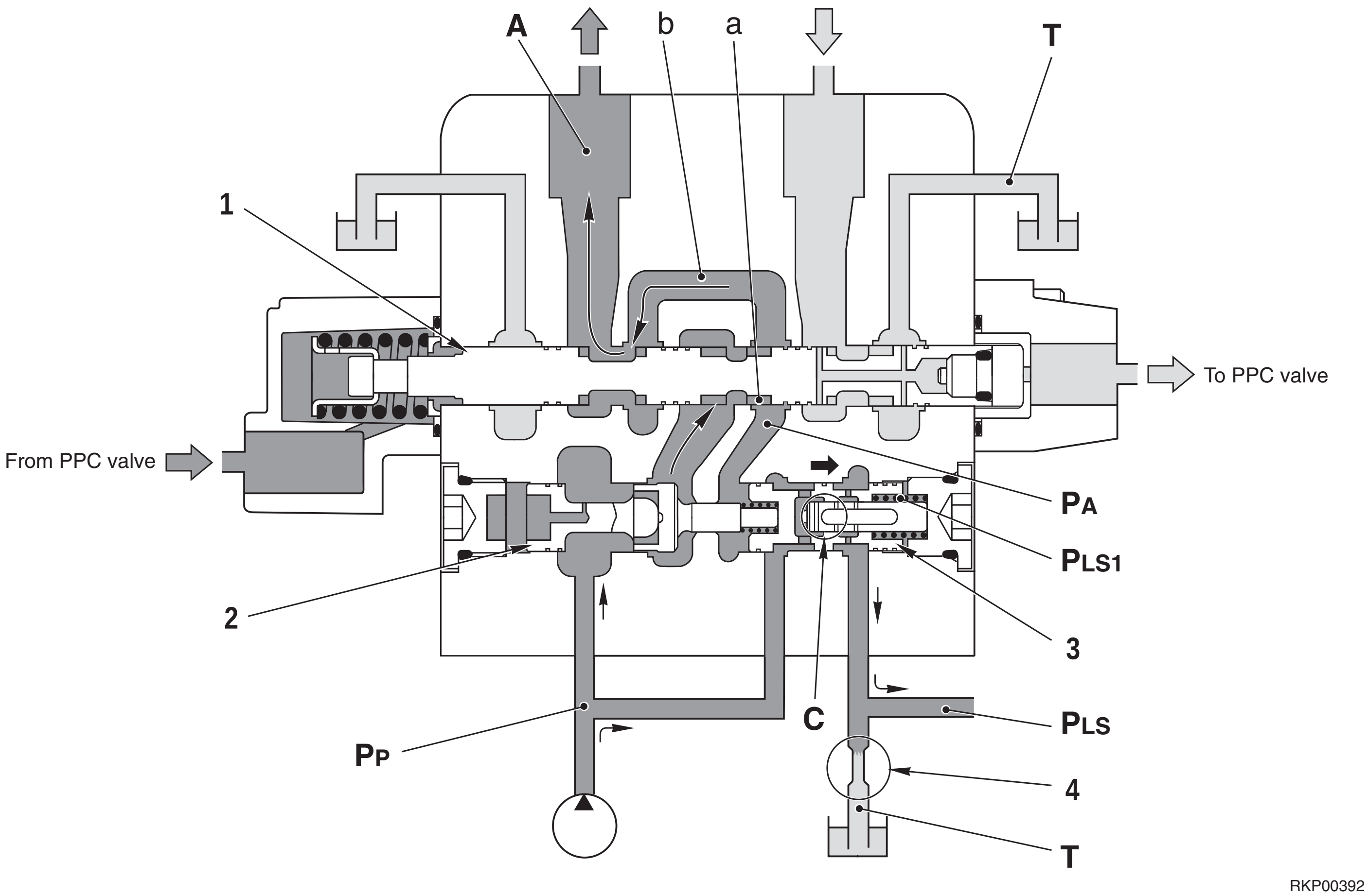
- The balance of unload valve is:
  $(P_{P2} \times S1) = (P_{P1} \times S2) + (P_{LS} \times S3)$ + spring force of spring (2).
  Developing above formula, **LS** differential pressure $\Delta P_{LS} = P_{P1} - P_{LS}$ is expressed:
  $P_{P1} - P_{LS} = \Delta P_{LS} \times S1/S3$ + spring force of spring.
  Therefore **LS** differential pressure **ΔP_{LS}** is varied according to **P_{LS}**. In other words, when engine speed varies, **LS** differential pressure also varies.
- **LS** differential pressure **ΔP_{LS}** varies as figure shown.



2. Introduction of LS pressure

FUNCTION

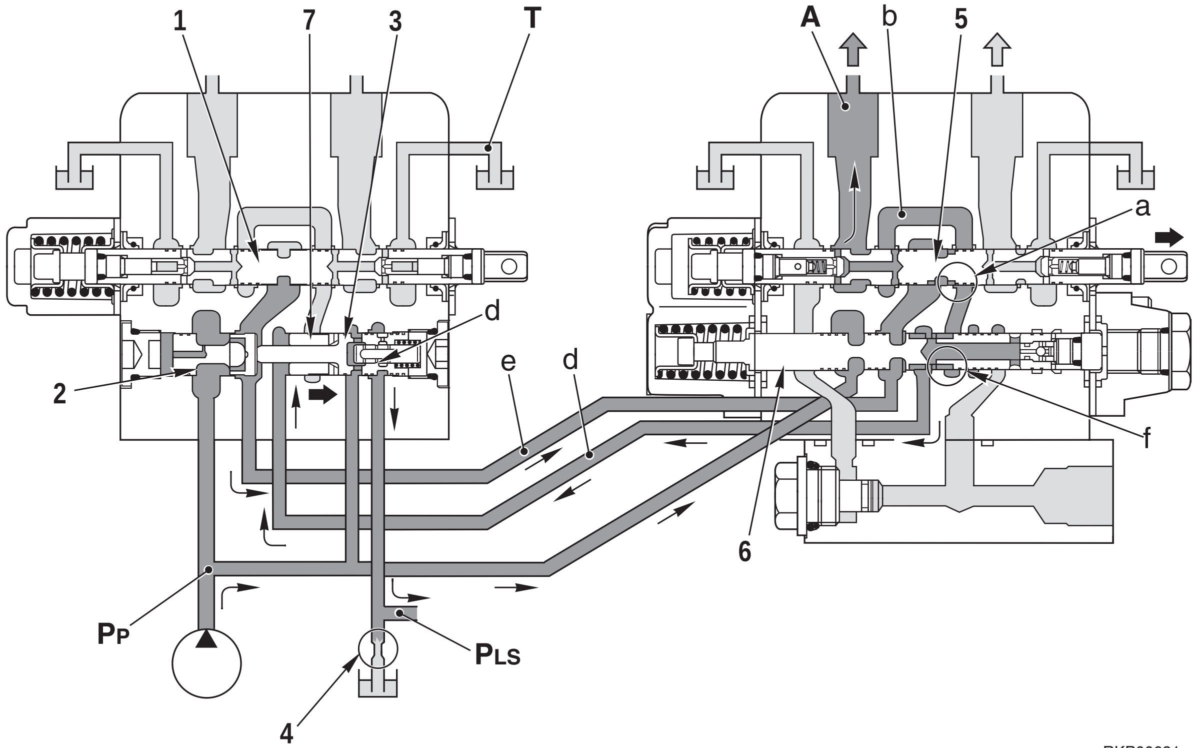
- The **LS** pressure is the actuator load pressure at the outlet port end of the control valve.
- It actually reduces pump pressure **P_P** at reducing valve (3) of the pressure compensation valve to the same pressure as actuation circuit pressure **A**, and sends it to the **LS** circuit **P_{LS}**.
- With the boom swing and blade valves, pump pressure **P_P** is reduced to the same pressure as actuator circuit pressure **A** by one reducing valve (3) used for both systems, and the pressure is sent to the **LS** circuit **P_{LS}**.
- With the hammer valve, actuator circuit pressure **A** is taken directly to the **LS** circuit **P_{LS}**.



OPERATION

1) Boom, arm, bucket, travel valve

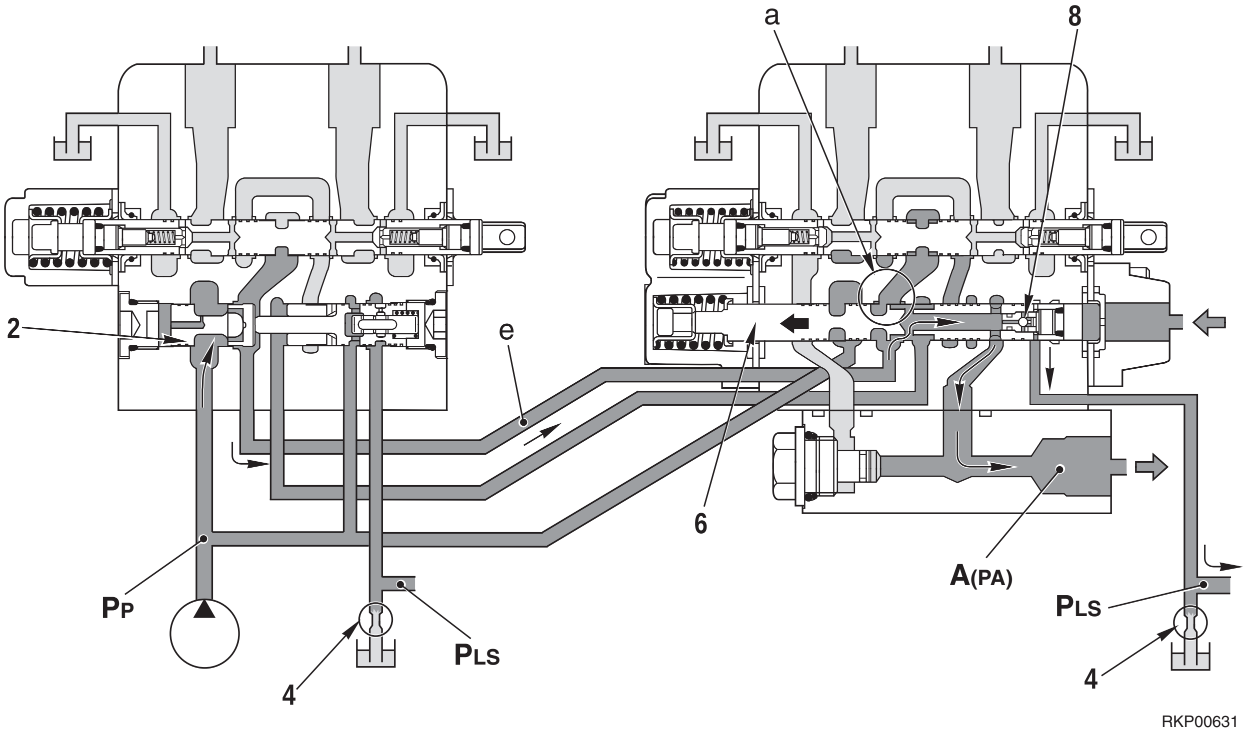
- When spool (1) is operated, pump pressure **P_P** flows from flow control valve (2) an notch **a** in spool (1) through bridge passage **b** to actuator circuit **A**.
- At the same time, reducing valve (3) also moves to the right, so pump pressure **P_P** has its pressure reduced by the pressure loss at notch **C**. It is introduced to **LS** circuit **P_{LS}**, and then goes to spring chamber **P_{LS1}**.
- When this happens, **LS** circuit **P_{LS}** is connected to tank circuit **T** from **LS** bypass plug (4) (see the section on the **LS** bypass plug).
- Actuator circuit pressure **P_A** (= **A**) acts on the left end of reducing valve (3); the reduced pump pressure **P_P** acts on the other end.
- As a result, reducing valve (3) is balanced at a position where actuator circuit pressure **P_A** and the pressure of spring chamber **P_{LS1}** are the same. Pump pressure **P_P** reduced at notch **C** becomes actuator circuit pressure **A** and is taken to **LS** circuit **P_{LS}**.



2) Boom swing, blade valve

- When boom swing spool (1) is operated, pump pressure **PP** is reduced by reducing valve (3) (in the same way as in item 1), and is sent to the **LS** circuit **PLS**.
- When blade spool (5) is operated, pump pressure **PP** flows from flow control valve (2), passage **e**, and notch **a** in blade spool (5) through bridge passage **b** to actuator circuit **A**.
- At the same time, the actuator circuit pressure passes through notch **f** in hammer spool (6), then goes through passage **d**, and acts o the left end of piston (7). Piston (7) and reducing valve (3) then move to the right.
- As a result, pump pressure **PP** is reduced at notch **d**, becomes the actuator circuit pressure, and is sent to **LS** circuit **PLS**.

★ The boom swing and blade valves are different from the boom, arm, bucket, and travel valves: they share one pressure compensation valve and bring in the **LS** pressure.



3) Hammer valve

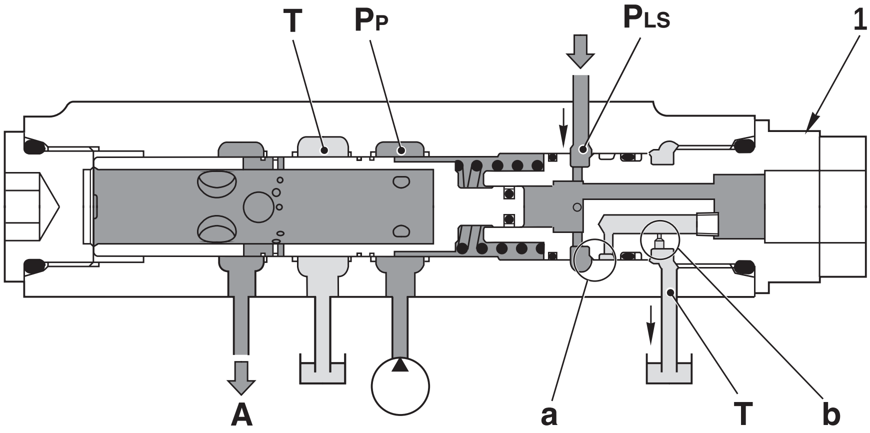
- When hammer spool (6) is operated, pump pressure **P_P** flows through flow control valve (2), passage **e**, and notch **a** in hammer spool (6) to actuator circuit **A**.
- At the same time, actuator circuit pressure **P_A** passes through check valve (8) and is interconnected with the **LS** circuit **P_{LS}**.

★ The hammer circuit is different from the other circuits: actuator circuit pressure **P_A** goes directly to **LS** circuit **P_{LS}**.

3. LS bypass plug

FUNCTION

- It releases the residual pressure of **LS** pressure **PLS**.
- It makes the speed of the rise in pressure of **LS** pressure **PLS** more gentle. In addition, with this discarded throttled flow, it creates a pressure loss in the throttled flow of the spool and increases the stability by lowering the effective **LS** differential pressure.



OPERATION

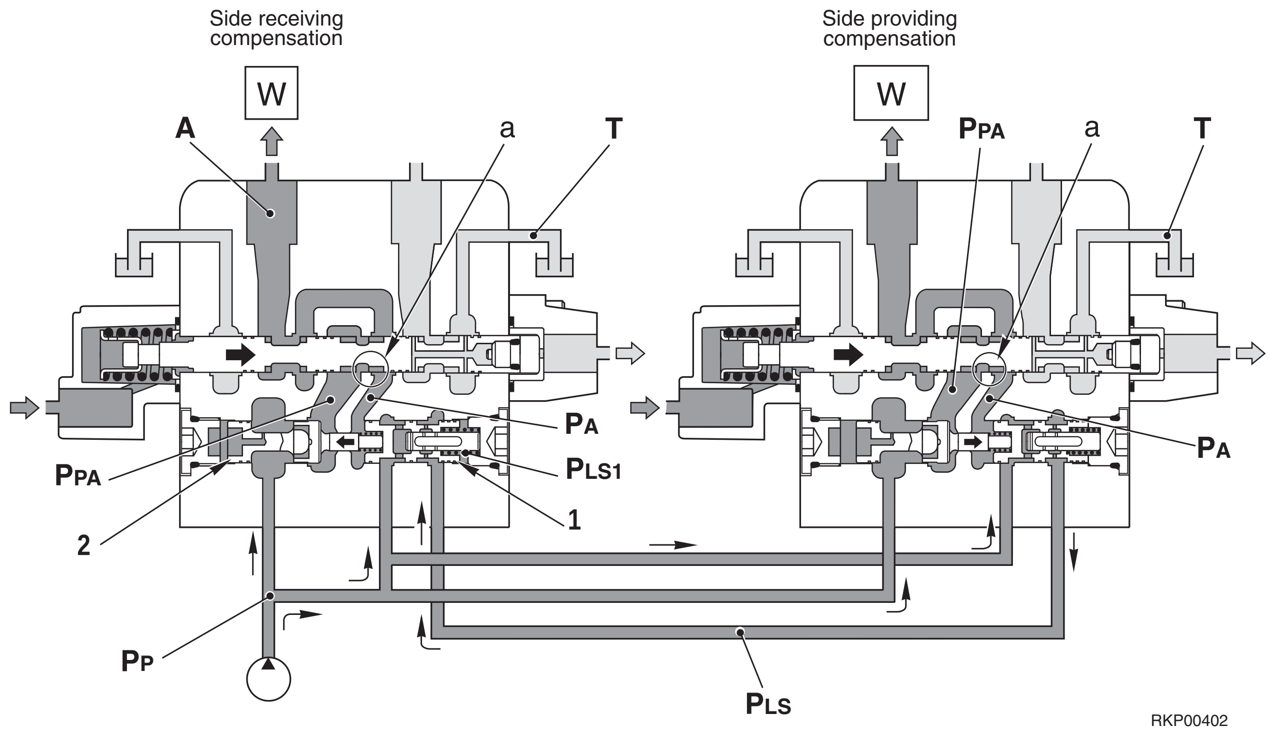
- The pressurized oil for **LS** circuit **PLS** passes from clearance filter **a** (formed by the clearance **LS** bypass plug (1) and the valve body) through orifice **b** and flows to the tank circuit **T**.

PP = Pump circuit
PLS = LS circuit
T = Tank circuit
A = To control valve spool

4. Pressure compensation valve

FUNCTION

- During compound operations, if the load pressure becomes lower than the other actuator and the oil flow tries to increase, compensation is received. (When this happens, the other actuator being used for compound operation (right side) is at a higher load than the actuator on this side (left side)).



OPERATION

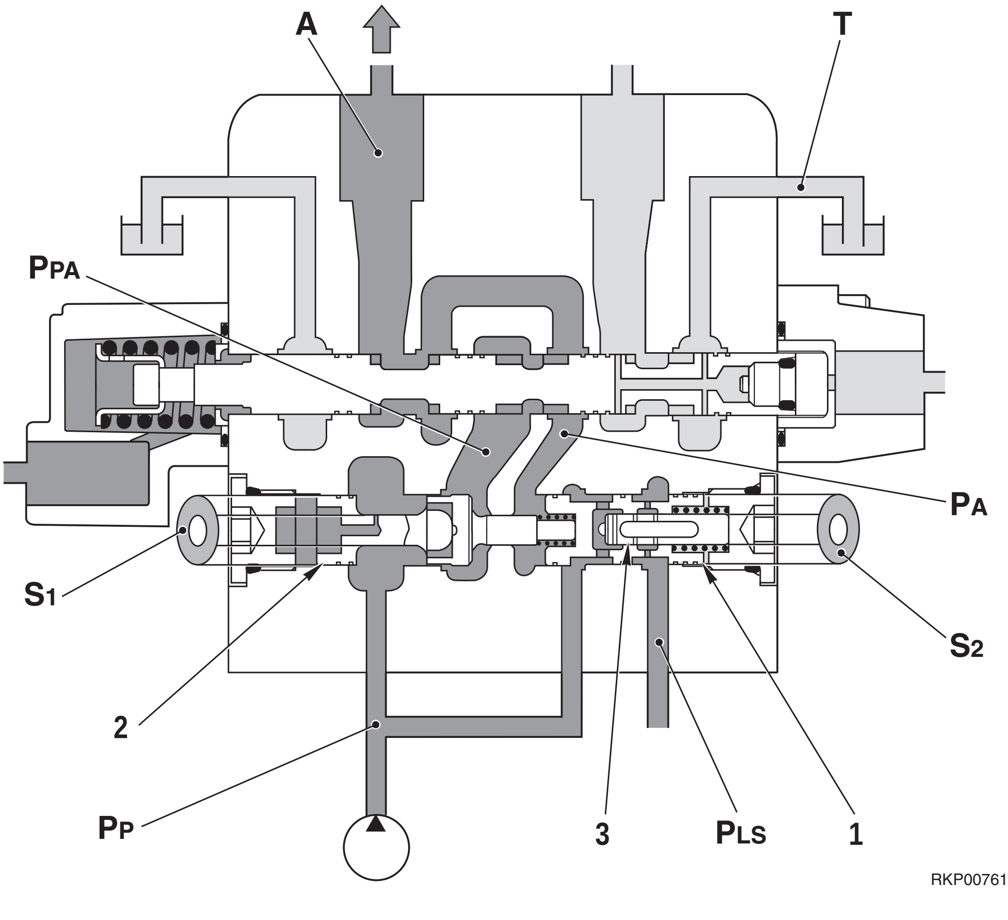
- If the load pressure of the other actuator (right side) becomes higher during compound operations, the oil flow in actuator circuit **A** on this side (left side) tries to increase.
- If this happens, the **LS** pressure **PLS** of the other actuator acts on spring chamber **PLS1**, and reducing valve (1) and flow control valve (2) are pushed to the left (←).
- Flow control valve (2) throttles the area of opening between pump circuit **PP** and spool upstream **PPA** and pressure loss is generated between **PP** and **PPA**.
- Flow control valve (2) and reducing valve (1) are balanced in position where the difference in pressure between **PLS** and **PA** acting on both ends of reducing valve (1) and the pressure loss between **PP** and **PPA** on both sides of flow control valve (2) are the same.
- In this way, the pressure difference between upstream pressure **PPA** and downstream pressure **PA** of both spools used during compound operations is the same, so the pump flow is divided in proportion to the area of opening of notch **a** of each spool.

5. **Area ratio of pressure compensation valve**

FUNCTION

- The pressure compensation valve determines the compensation characteristics by carrying out fine adjustment of the area ratio (**S1**/**S2**) between area **S2** of reducing valve (1) and area **S1** of flow control valve (2) to match the characteristics of each actuator.

S1 = Area of flow control valve (2) – area of piston (3).
S2 = Area of reducing valve (1) – area of piston (3).



Area ratio (S1:S2) and compensation characteristics

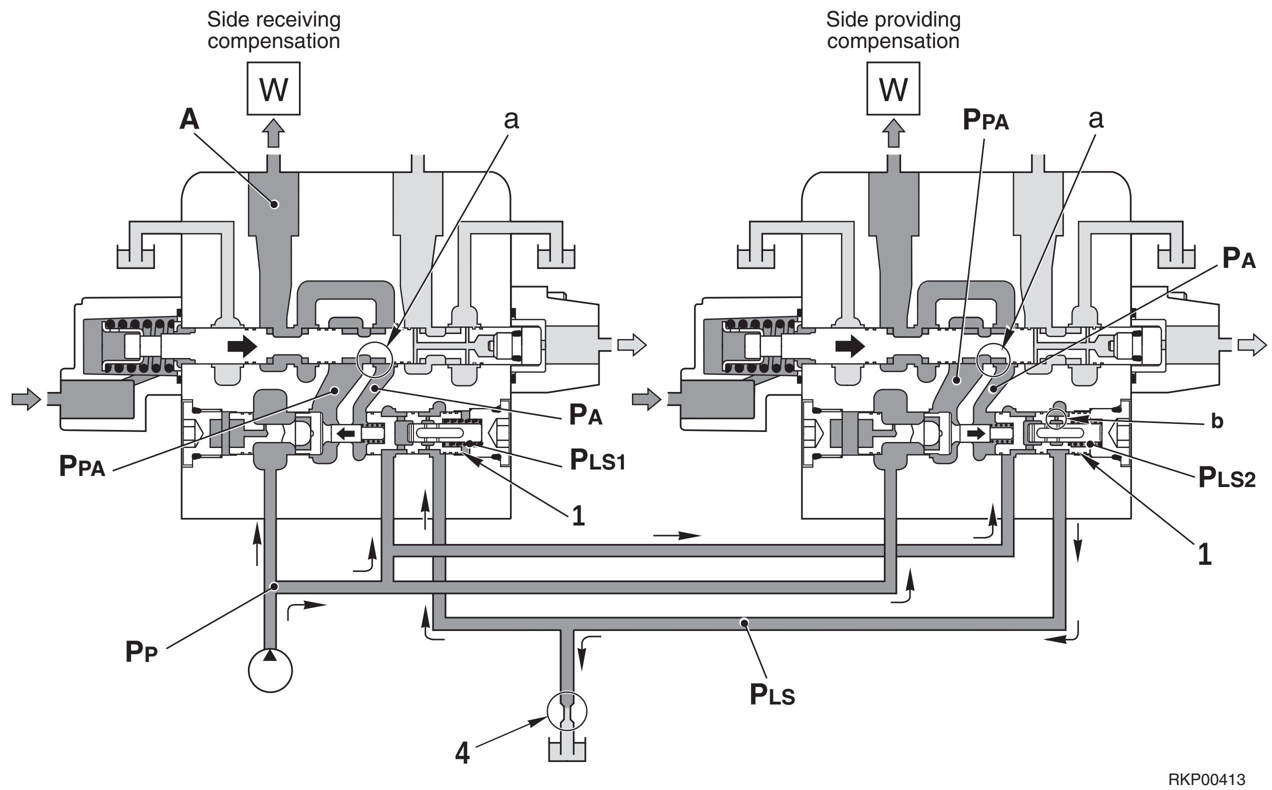
- When ratio is 1.00 :
  [Pump pressure P_P – spool notch upstream pressure P_{PA}]≒[LS circuit pressure P_{LS} – actuator circuit pressure P_A (= **A**)] and oil flow is divided in proportion to area of opening of spool.
- When ratio is more than 1.00 : $P_P - P_{PA} > P_{LS} - P_A$ (= **A**) and oil flow to side receiving compensation is divided in a proportion less than area of opening of spool.
- When ratio is less than 1.00 : $P_P - P_{PA} < P_{LS} - P_A$ (= **A**) and oil flow to side receiving compensation is divided in a proportion more than area of opening of spool.

Ratio of area **S1** and **S2**			
Valve	Ratio	Valve	Ratio
Arm	0.98	Boom swing	0.98
Travel	1.00	Blade	0.98
Boom	0.95	Hammer	1.00
Bucket	1.00	Swing	0.95

6. Throttling LS introduction of pressure compensation valve

FUNCTION

- If the other actuator is relieved during compound operations, **LS** introduction throttle **b** of reducing valve (1) divides the flow and sends more oil to the side receiving compensation.



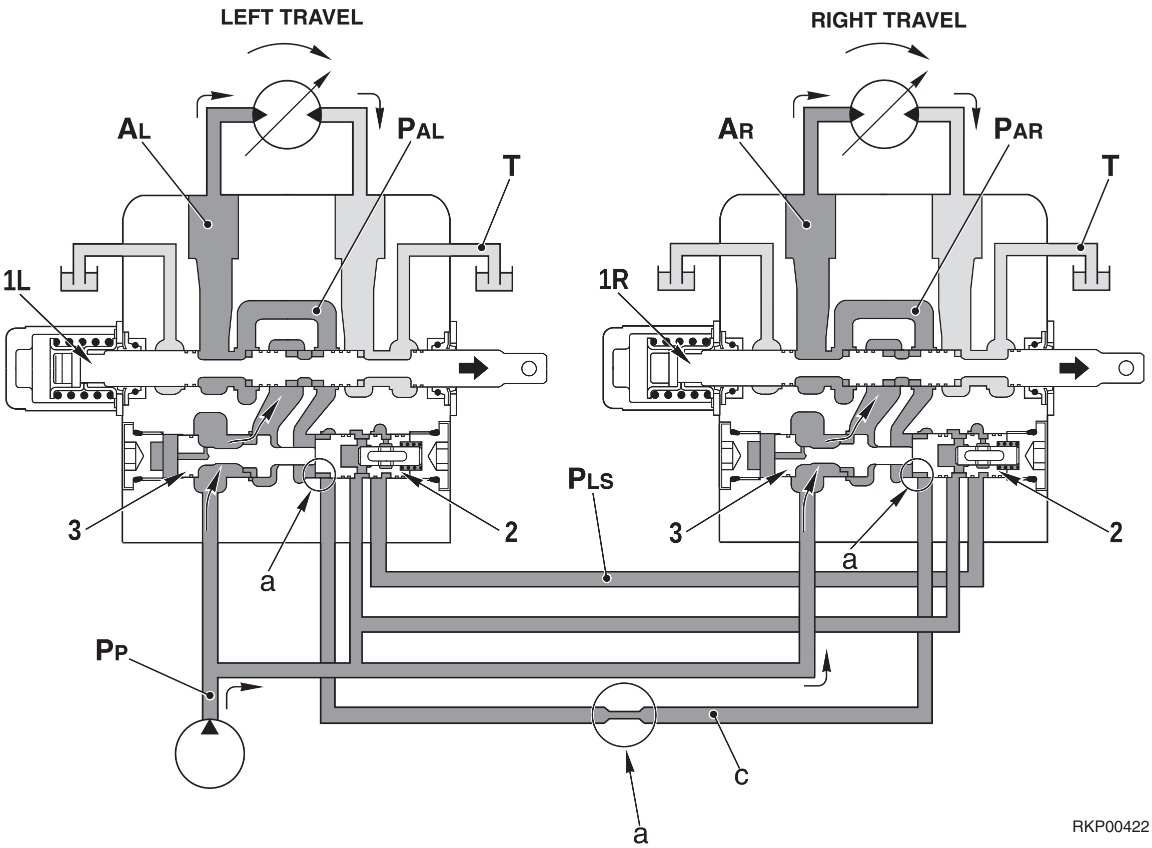
OPERATION

- If the other actuator (right side) is relieved during compound operations, each circuit pressure (**P_{PA}** and **P_A**) of the other actuator becomes the same as the pump circuit pressure (**P_P** = relief pressure).
- In this case, spring chamber **P_{LS2}** of the other actuator (right side) becomes the same as pump circuit pressure **P_P** because of the balance of reducing valve (1).
- **P_{LS2}** passes through **LS** introduction throttle **b** of reducing valve (1) and becomes **P_{LS}**. **P_{LS}** is connected to the tank circuit from **LS** bypass plug (4), so pressure loss is generated at **LS** introduction throttle **b** (the condition becomes **P_{LS}** < **P_{LS2}**).
- As a result, even if the other actuator is relieved, a pressure differential is created between **P_P** and **P_{LS}**, so more oil flows to actuator circuit **A** on this side (left side).

7. L.H., R.H. travel junction circuit

FUNCTION

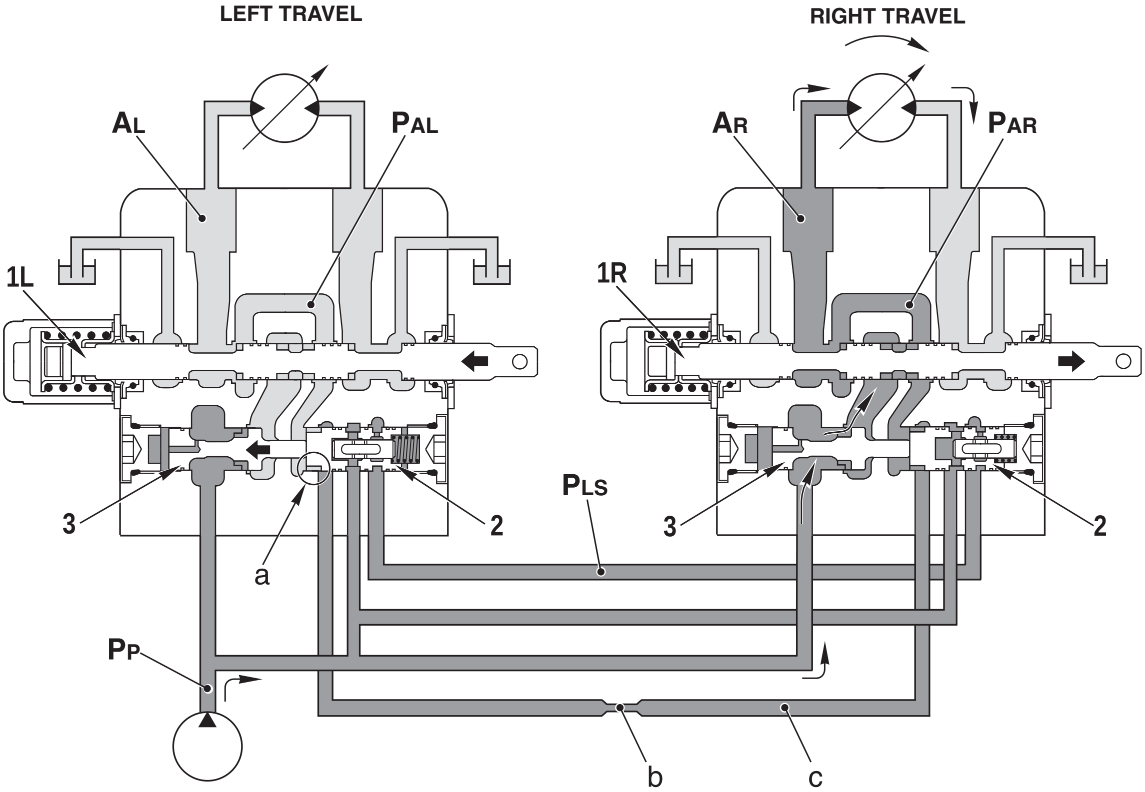
- To compensate for any difference in the oil flow in the left and right travel circuits when travelling in a straight line, the junction circuit opens when the left and right travel spools are operated.
  In this way, the flow of oil to the left and right travel motors is almost the same when travelling in a straight line, so there is no travel deviation.
- When steering the machine, the difference in the load pressure returns the reducing valve of the travel on the inside of the turn and the opening of the notch in the travel junction valve spool becomes smaller, so the machine can be steered.



OPERATION

When travelling in a straight line

- When left and right travel spools (1) are operated, the pump discharge flows from pump circuit **PP** and circuits **PAL** and **PAR** to actuator circuits **AL** and **AR**.
- When travelling in a straight line, to make actuator circuits **PAL** and **PAR** equal, left and right reducing valves (2) are pushed to the right by the same amount, and notch **a** and the travel junction circuit are opened.
- In this way, the left and right travel actuator circuits are interconnected by the travel junction circuit **c**, so if any difference occurs in the flow of oil to the left and right travel motors, the compensation is carried out to prevent any deviation in travel.



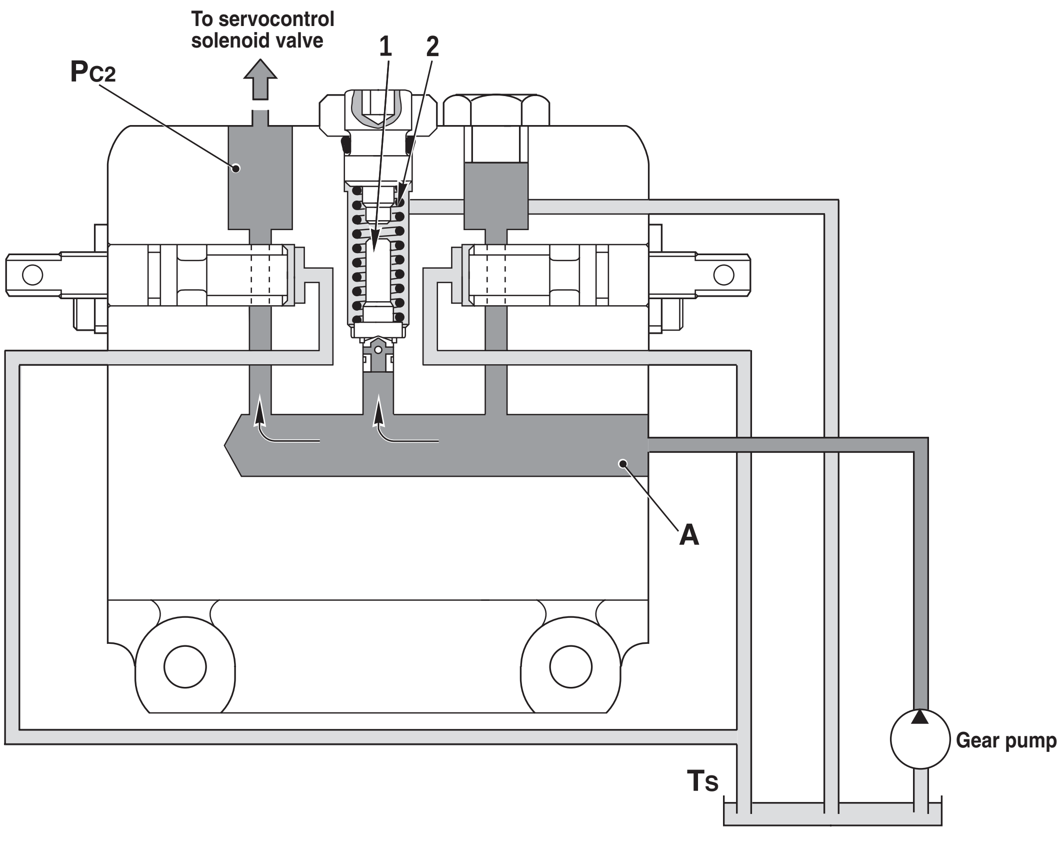
Steering when travelling

- When travelling in a straight line, if left travel spool (**1L**) is returned to the neutral position and the steering is operated, a difference (**AR** > **AL**) is generated in the load pressure of left and right travel actuator circuits **PAL** and **PAR**, and **LS** pressure **PLS** becomes the same pressure as **AR** (the side with the high load pressure).
- As a result, flow control valve (3) on the left travel side is pushed to the left by **LS** circuit **PLS**. Because of this, the opening of the left notch **a** is made smaller, so it becomes possible to operate the steering when travelling.
- Damper **b** is provided in the circuit to dampen any excessive characteristics in the opening or closing of the travel junction circuit if the spool is operated suddenly.

8. Servocontrol reducing valve

FUNCTION

- This valve set servocontrol pressure to 29.5 bar (30 kg/cm^2).



RKP00641

OPERATION

- The discharge pressure from the gear pump entering chamber **A** acts on the bottom of valve (1).
  The gear pump discharge pressure is set to 29.5 bar (30 kg/cm^2).

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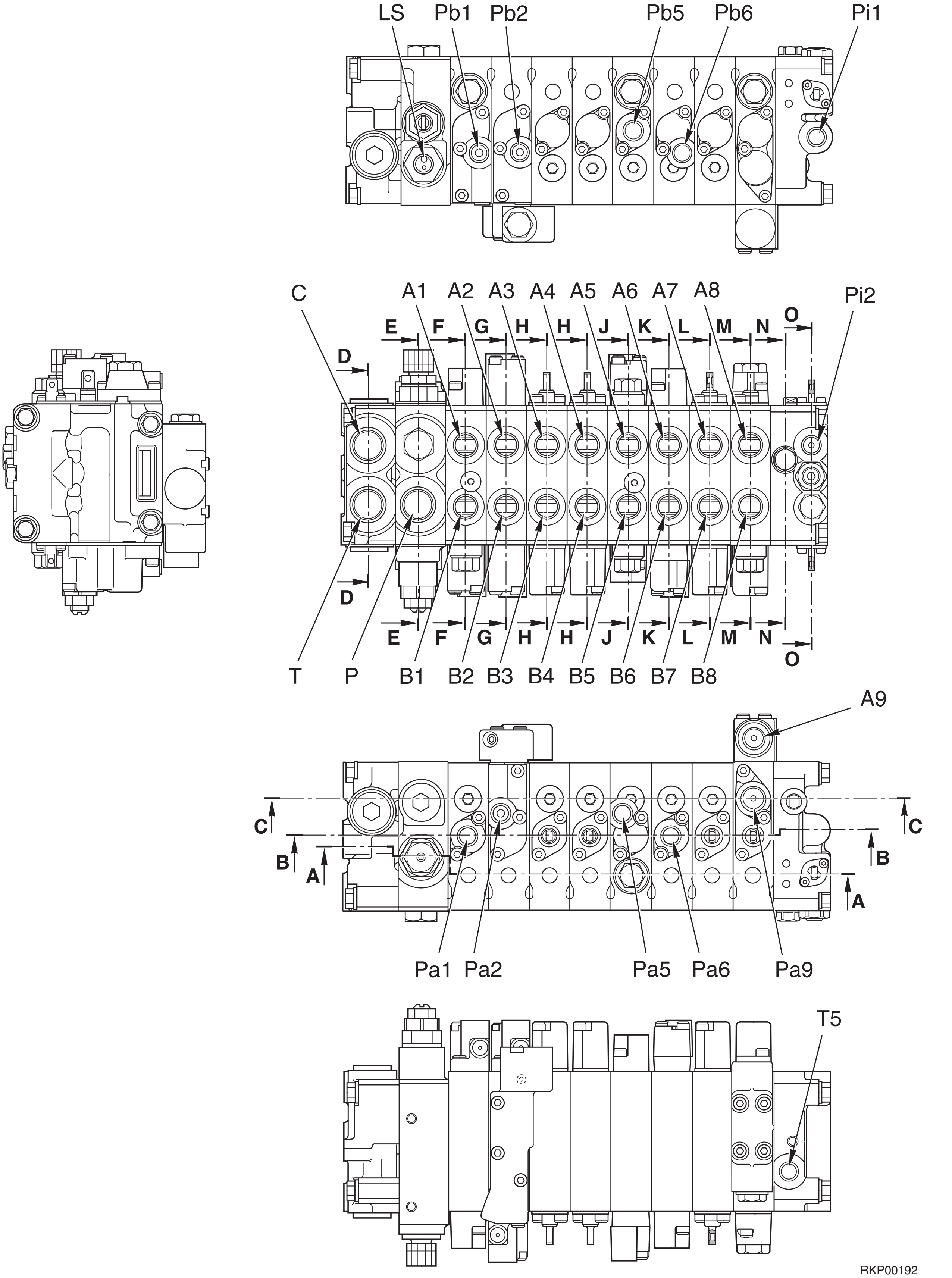
CONTROL VALVE

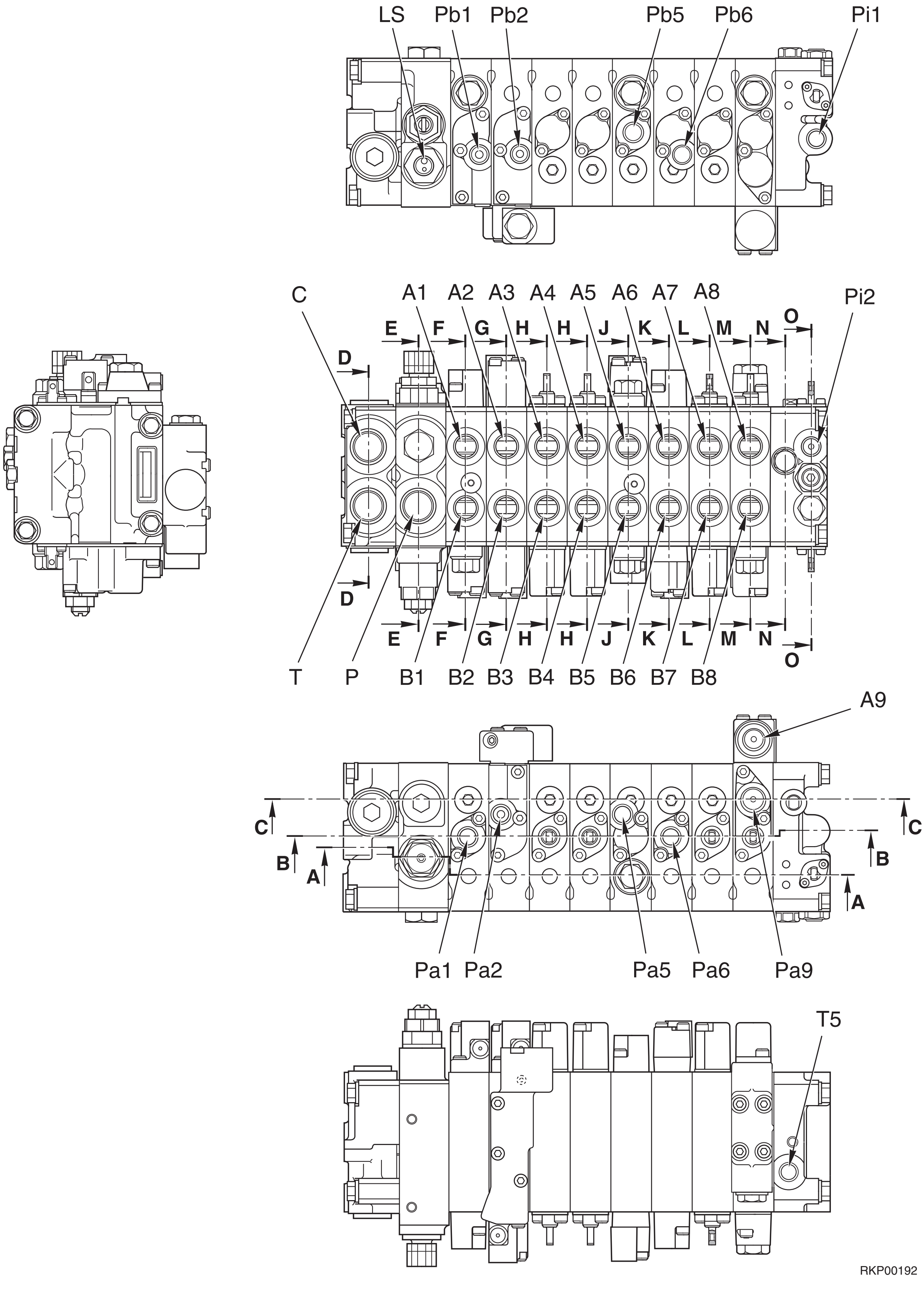
PC15R-8



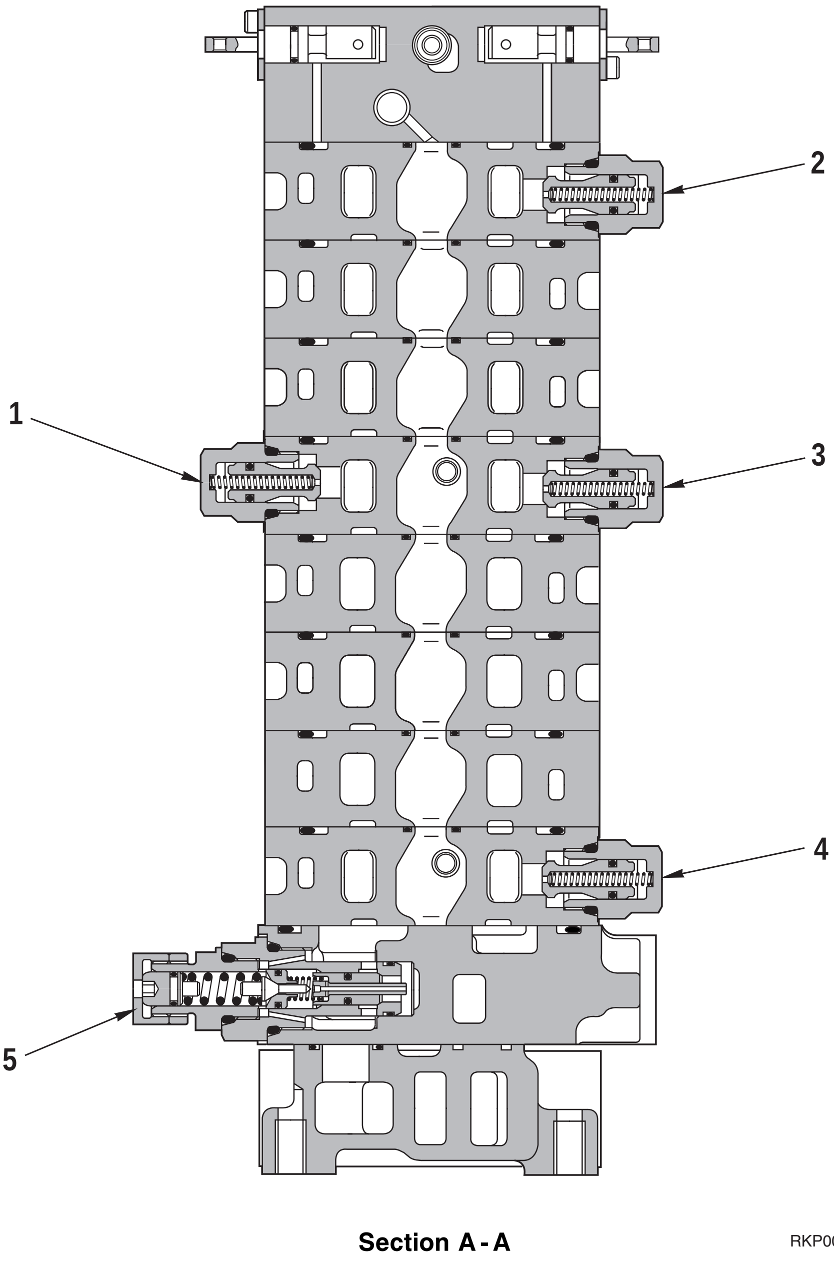
RKP00192

A1 Port	-	To arm cylinder (Head side)
A2 Port	-	To swing motor (A Port)
A3 Port	-	To swivel joint (D Port)
A4 Port	-	To swivel joint (C Port)
A5 Port	-	To boom cylinder (Bottom side)
A6 Port	-	To bucket cylinder (Bottom side)
A7 Port	-	To swivel joint (F Port)
A8 Port	-	To boom swing cylinder (Head side)
A9 Port	-	To attachment
B1 Port	-	To arm cylinder (Bottom side)
B2 Port	-	To swing motor (B Port)
B3 Port	-	To swivel joint (B Port)
B4 Port	-	To swivel joint (A Port)
B5 Port	-	To boom cylinder (Head side)
B6 Port	-	To bucket cylinder (Head side)
B7 Port	-	To swivel joint (E Port)
B8 Port	-	To boom swing cylinder (Bottom side)
C Port	-	To oil cooler
LS Port	-	To hydraulic pump (PLS Port)
P Port	-	From hydraulic pump (P1 Port)
Pa1 Port	-	From L.H. PPC valve (4 Port)
Pa2 Port	-	From L.H. PPC valve (1 Port)
Pa5 Port	-	From R.H. PPC valve (2 Port)
Pa6 Port	-	From R.H. PPC valve (1 Port)
Pa9 Port	-	From attachment PPC valve
Pb1 Port	-	From L.H. PPC valve (2 Port)
Pb2 Port	-	From L.H. PPC valve (3 Port)
Pb5 Port	-	From R.H. PPC valve (4 Port)
Pb6 Port	-	From R.H. PPC valve (3 Port)
Pi1 Port	-	From hydraulic pump (P2 Port)
Pi2 Port	-	To ST1 solenoid valve (P Port)
T Port	-	To hydraulic tank
TS Port	-	To hydraulic tank

PC15R-8 HS (with variable gauge undercarriage)



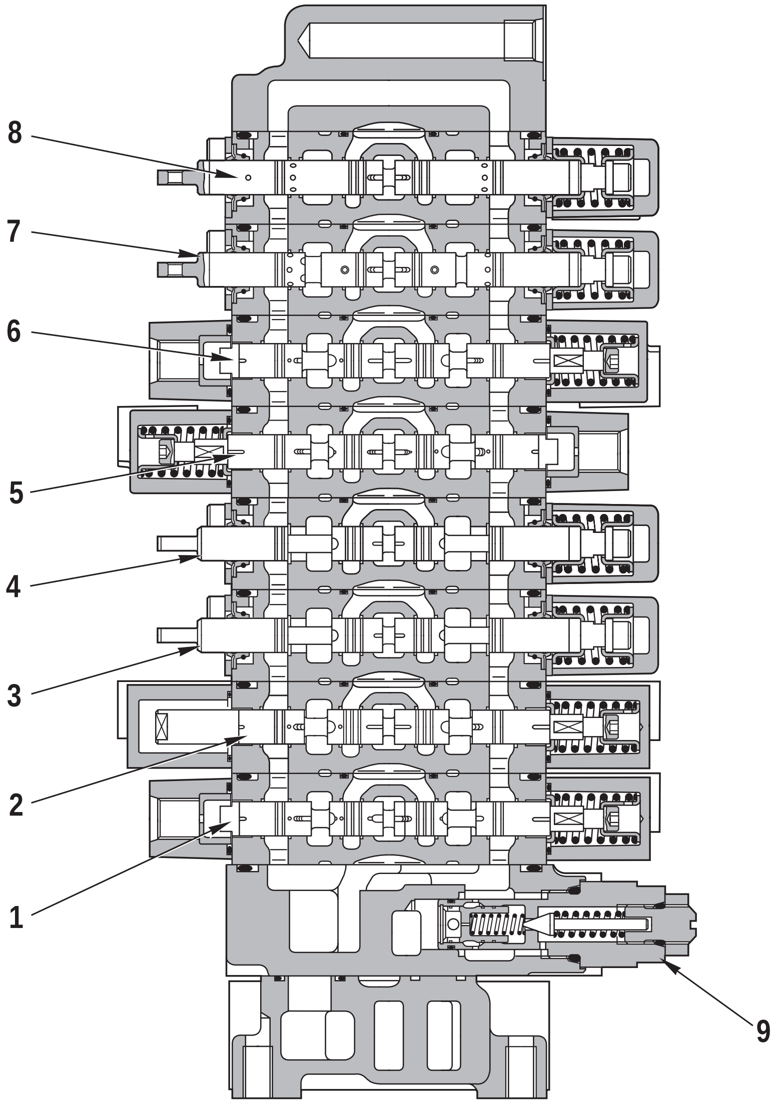
A1 Port	-	To arm cylinder (Head side)
A2 Port	-	To swing motor (A Port)
A3 Port	-	To swivel joint (5 Port)
A4 Port	-	To swivel joint (6 Port)
A5 Port	-	To boom cylinder (Bottom side)
A6 Port	-	To bucket cylinder (Bottom side)
A7 Port	-	To swivel joint (3 Port)
A8 Port	-	To boom swing cylinder (Head side)
A9 Port	-	To attachment
B1 Port	-	To arm cylinder (Bottom side)
B2 Port	-	To swing motor (B Port)
B3 Port	-	To swivel joint (7 Port)
B4 Port	-	To swivel joint (4 Port)
B5 Port	-	To boom cylinder (Head side)
B6 Port	-	To bucket cylinder (Head side)
B7 Port	-	To EV3 solenoid valve (P Port)
B8 Port	-	To boom swing cylinder (Bottom side)
C Port	-	To oil cooler
LS Port	-	To hydraulic pump (PLS Port)
P Port	-	From hydraulic pump (P1 Port)
Pa1 Port	-	From L.H. PPC valve (4 Port)
Pa2 Port	-	From L.H. PPC valve (1 Port)
Pa5 Port	-	From R.H. PPC valve (2 Port)
Pa6 Port	-	From R.H. PPC valve (1 Port)
Pa9 Port	-	From attachment PPC valve
Pb1 Port	-	From L.H. PPC valve (2 Port)
Pb2 Port	-	From L.H. PPC valve (3 Port)
Pb5 Port	-	From R.H. PPC valve (4 Port)
Pb6 Port	-	From R.H. PPC valve (3 Port)
Pi1 Port	-	From hydraulic pump (P2 Port)
Pi2 Port	-	To ST1 solenoid valve (P Port)
T Port	-	To hydraulic tank
TS Port	-	To hydraulic tank



Section A - A

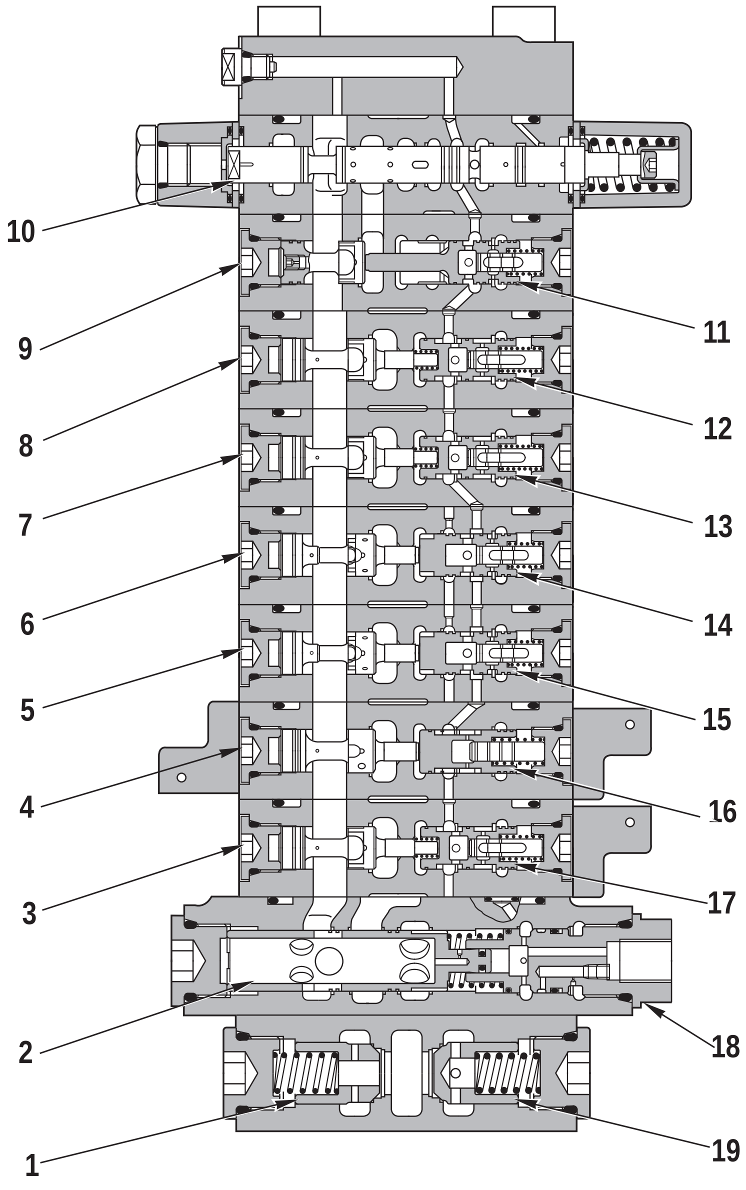
RKP00200

1. Suction valve (Boom lower)
2. Suction valve (Boom L.H. swing)
3. Suction valve (Boom raise)
4. Suction valve (Arm close)
5. Safety valve



Section B - B

1. Spool (Arm)
2. Spool (Swing)
3. Spool (L.H. travel)
4. Spool (R.H. travel)
5. Spool (Boom)
6. Spool (Bucket)
7. Spool (Blade)
8. Spool (Boom swing)
9. Main relief valve



Section C-C

1. Check valve
2. Unload valve

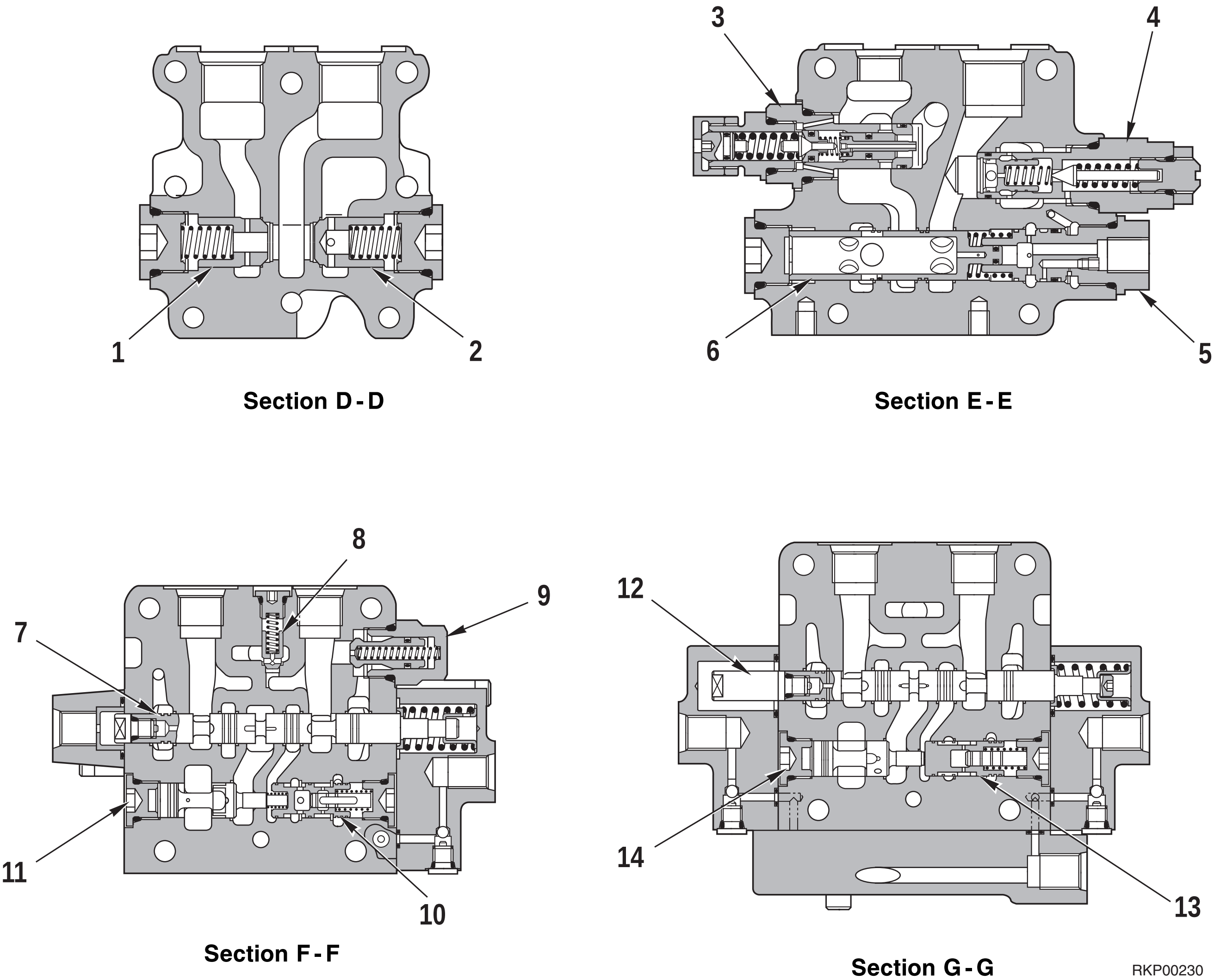
FLOW COMPENSATION VALVE

3. Arm
4. Swing
5. L.H. travel
6. R.H. travel
7. Boom
8. Bucket
9. Blade
10. Spool (Hammer)

REDUCING PRESSURE COMPENSATION VALVE

11. Blade
12. Bucket
13. Boom
14. R.H. travel
15. L.H. travel
16. Swing
17. Arm

18. LS by-pass plug
19. Cooler check valve



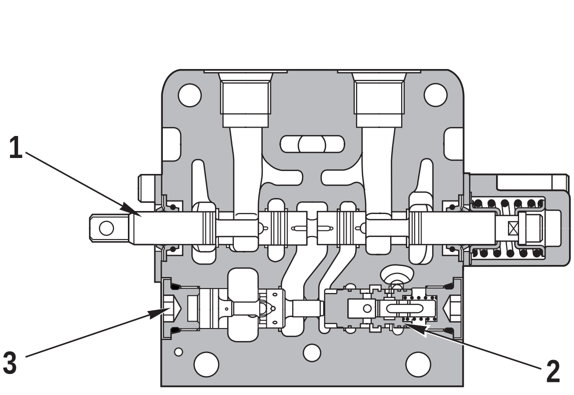
1. Check valve
2. Cooler check valve
3. Safety valve
4. Main relief valve
5. LS by-pass plug
6. Unload valve

ARM VALVE

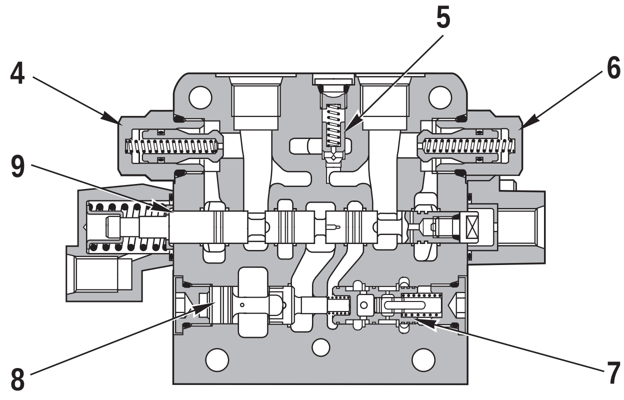
7. Spool
8. Check valve
9. Suction valve
10. Reducing pressure compensation valve
11. Flow compensation valve

SWING VALVE

12. Spool
13. Reducing pressure compensation valve
14. Flow compensation valve



Section H - H



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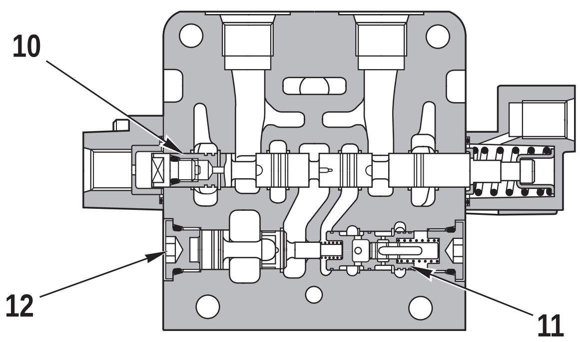
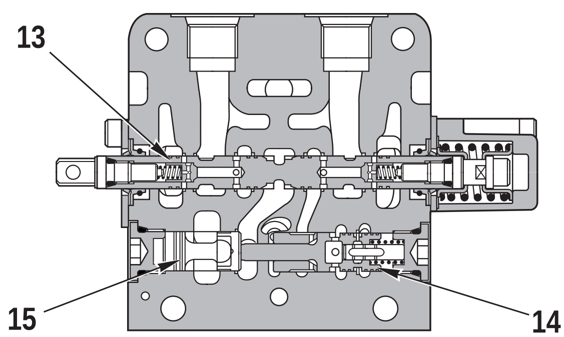


Section K - K



Section L - L

RKP00240

TRAVEL VALVE

1. Spool
2. Reducing pressure compensation valve
3. Flow compensation valve

BOOM VALVE

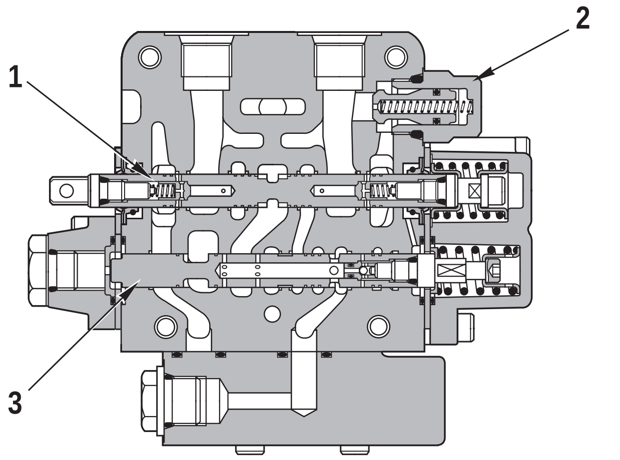
4. Suction valve
5. Check valve
6. Suction valve
7. Reducing pressure compensation valve
8. Flow compensation valve
9. Spool

BUCKET VALVE

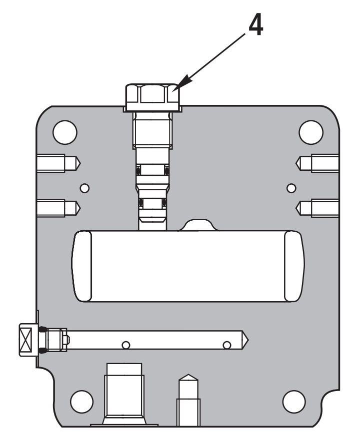
10. Spool
11. Reducing pressure compensation valve
12. Flow compensation valve

BLADE VALVE

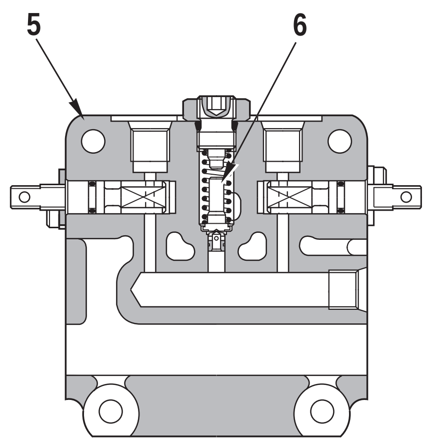
13. Spool
14. Reducing pressure compensation valve
15. Flow compensation valve



Section M - M



Section N - N



Section O - O

RKP00250

BOOM SWING AND HAMMER VALVE

1. Spool (Boom swing)
2. Suction valve
3. Spool (Hammer)
4. Plug
5. Cover
6. Reducing valve (Servocontrol)

CLSS

1. OUTLINE

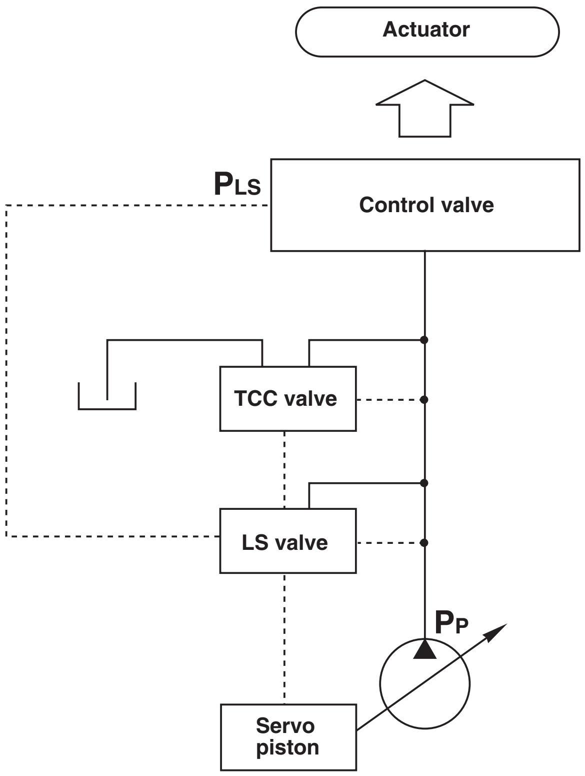
FEATURES

The term "**CLSS**" stand for the "Closed Center Load Sensing System" which has the following features.

a) Fine-controllability not affected by loads.
b) Controllability enabling digging even in the fine control mode.
c) Complex operability ensured by flow distribution determined according to the opening areas of spools during complex operation.
d) Energy-saving feature using variable pump control.

STRUCTURE

- The CLSS consists of a variable displacement single piston pump, control valve and actuators.
- The pump body consists of the main pump, **TCC** valve and **LS** valve.



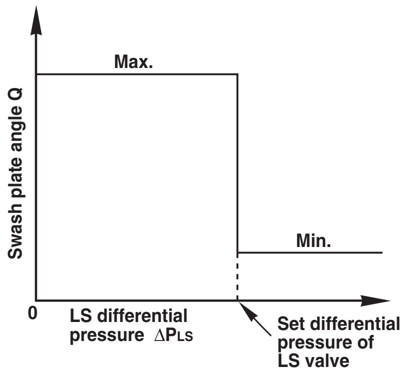
RKP00661

2. BASIC PRINCIPLE

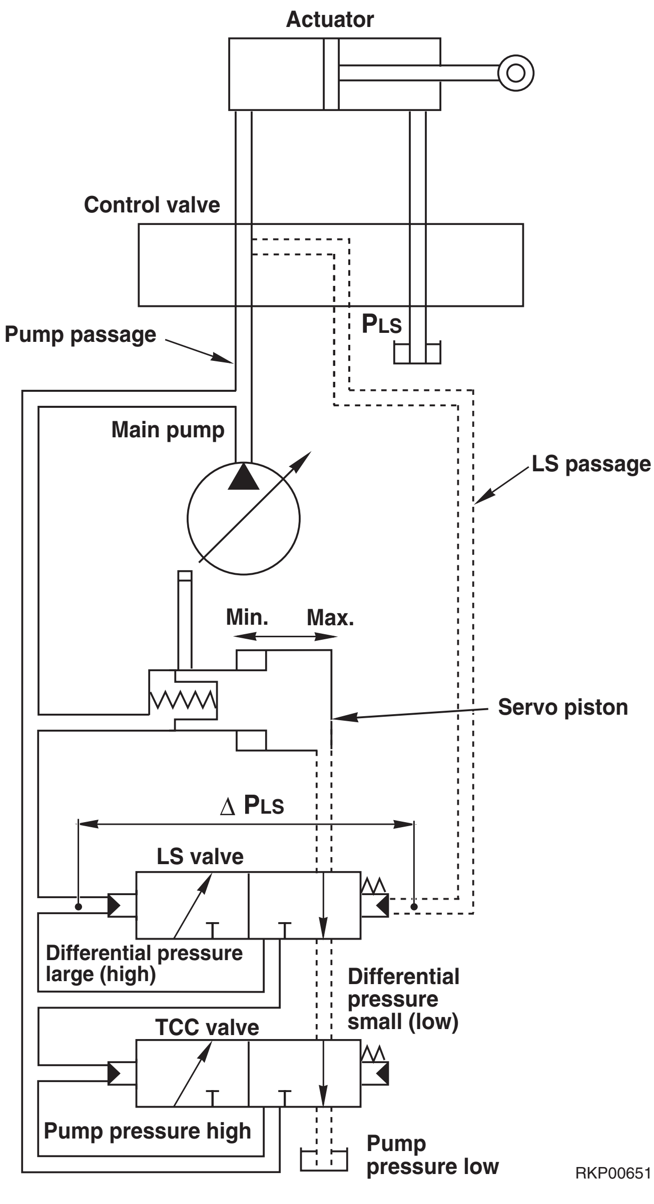
1) Control of pump swash plate angle

- The pump swash plate angle (pump discharge amount) is so controlled that the **LS** differential pressure **ΔPLS**, which is the difference between the pump discharge pressure **PP** and the **LS** pressure **PLS** at the outlet port of the control valve (actuator load pressure), is maintained at a constant level.
  (**LS** differential pressure **ΔPLS** = Pump discharge pressure **PP** – pressure **PLS**).
- If the **LS** differential pressure **ΔPLS** becomes lower than the setting pressure of the **LS** valve, the pump swash plate angle becomes larger, and if it becomes higher, the pump swash plate angle becomes smaller.

★ For the details of this action, refer to the descriptions of «HYDRAULIC PUMP».



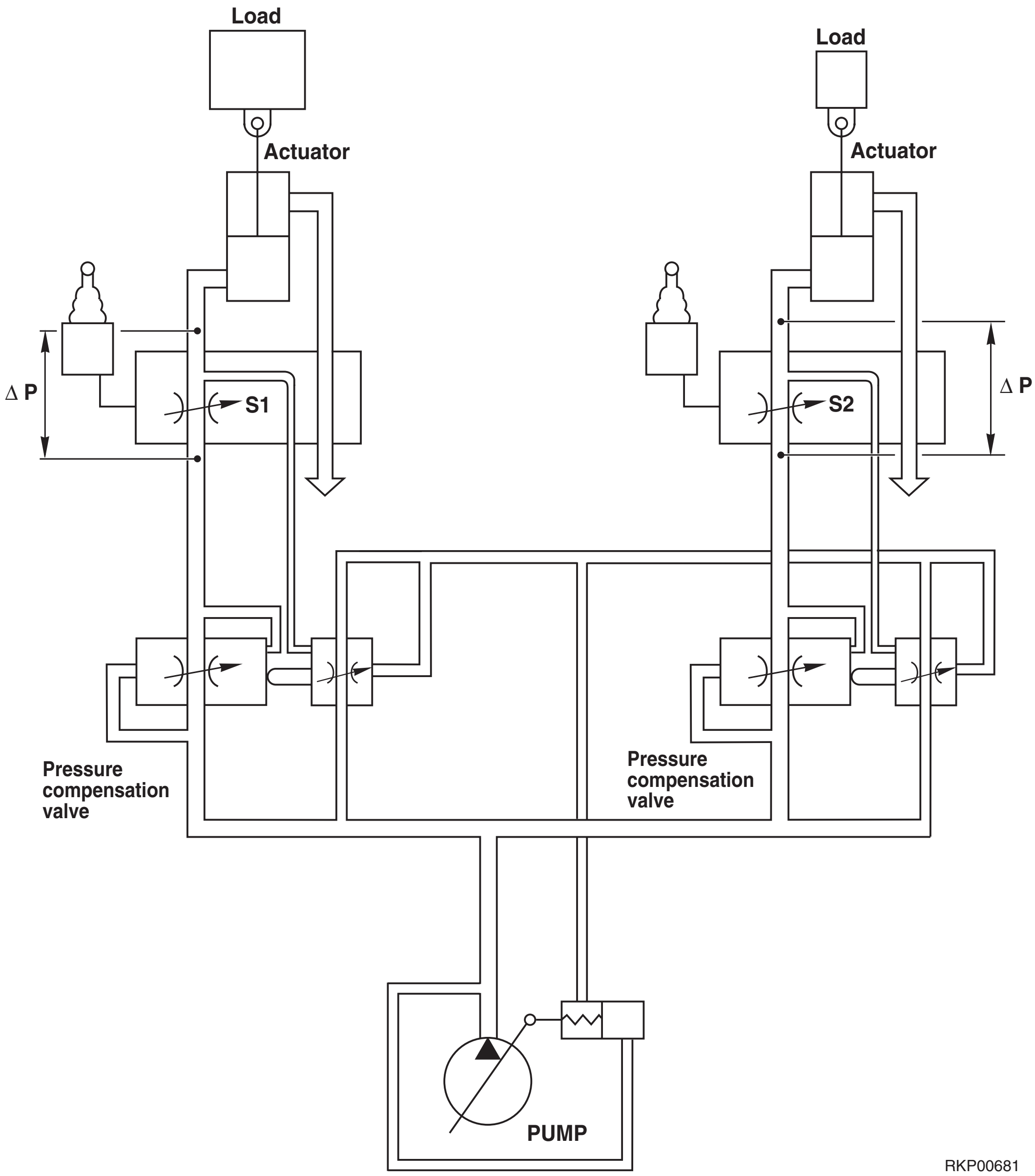
RKP00711



RKP00651

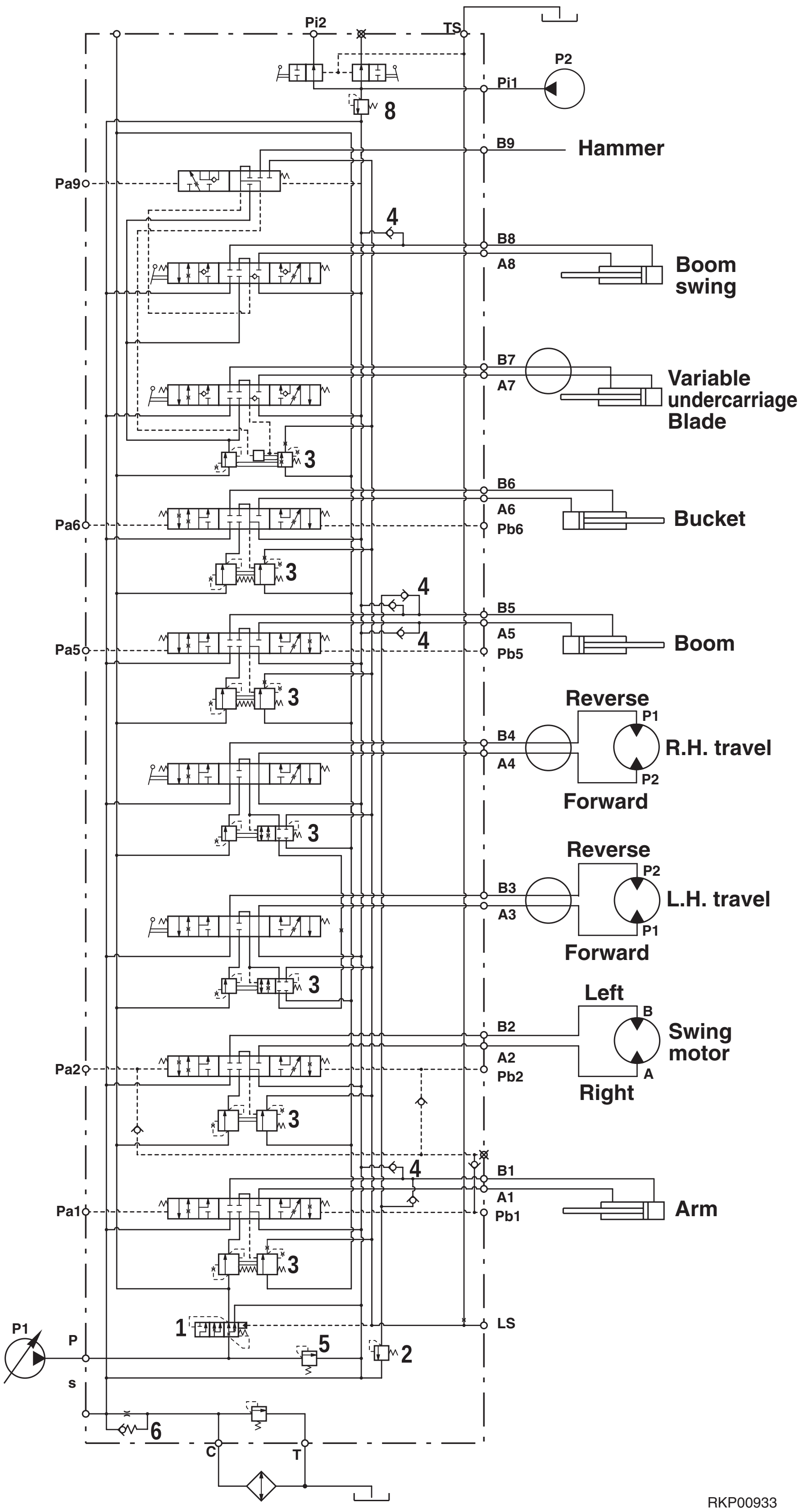
2) Pressure compensation control

- Valves (pressure compensation valves) are installed at the inlet port side of the spools of the control valves to balance the loads.
  When the actuators are complex-operated, the pressure differences **ΔP** at the upstream (inlet) and downstream (outlet) are made equal by these valves.
  In this way, the flow from the pump are distributed in proportion to the opening areas **S1** and **S2** of each valve.



3. Funzionamento per ogni circuito e valvola

SCHEMA IDRAULICO E NOME DELLE VALVOLE



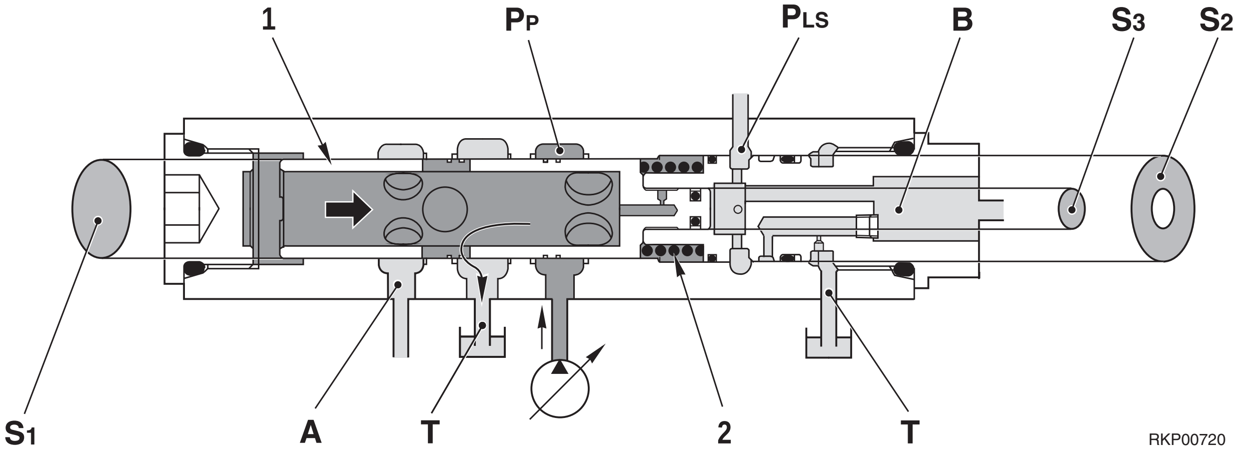
RKP00933

1. Unload valve $LS + 19.6^{\,0}_{+9.8}$ bar ($LS + 20^{\,0}_{+10}$ kg/cm^2)
2. Safety valve: 206 bar (210 kg/cm^2)
3. Pressure compensation valve
4. Suction valve
5. Main relief valve: 235 bar (240 kg/cm^2)
6. Back pressure check valve (cracking pressure): 4.5 bar (4.5 kg/cm^2)
7. Cooler by-pass valve (cracking pressure): 4 bar (4 kg/cm^2)
8. Pilot relief valve: 29.5 bar (30 kg/cm^2)

1. Unload valve

FUNCTION

1) When the control valve is at HOLD, pump discharge amount **Q** discharged by the minimum swash plate angle is released to the tank circuit. When this happens, pump discharge pressure **P_P** is set to $19.6^{0}_{+9.8}$ bar (20^{0}_{+10} kg/cm^2) by spring (2) inside the valve.
(**LS** pressure **P_{LS}** = 0 bar (0 kg/cm^2)



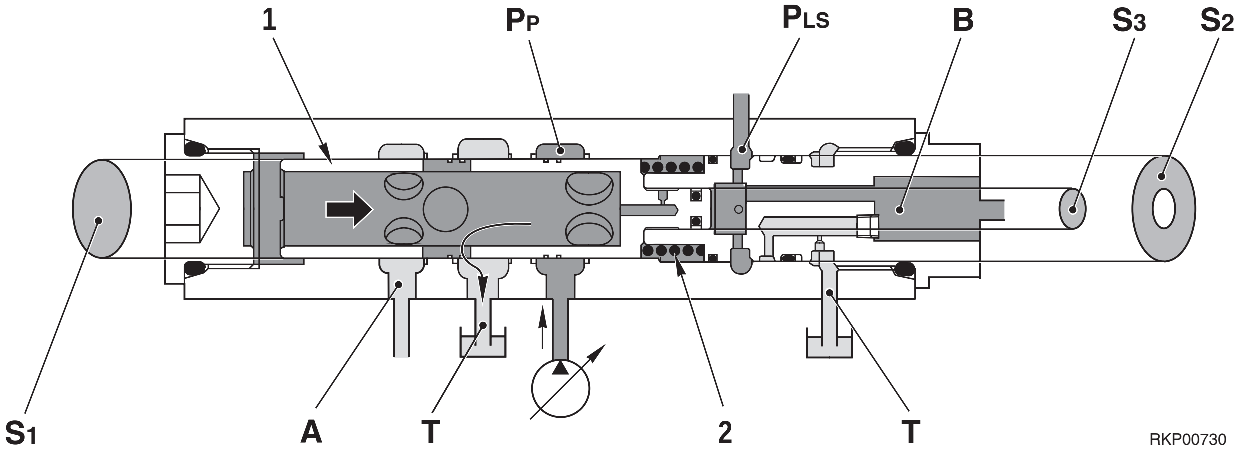
OPERATION

When control valve is at HOLD

- At the left end of spool (1), pump pressure **P_P** is acting on area **S1**, and at the right end of spool (1), pump pressure **P_P** is acting on area **S2**, and **LS** pressure **P_{LS}** is acting on area **S3**.
- When the control valve is at HOLD, **LS** pressure **P_{LS}** is not generated, so only pump discharge **P_P** has any effect, and **P_P** is set by the load of spring (2).
- As pump discharge pressure **P_P** rises and reaches the **P_P** x **S1** = **P_P** x **S2** + spring force of spring (2), spool (1) is moved to the right.
  Pump circuit **P_P** is then connected to tank circuit **T** through the drill hole.
- In this way, pump discharge pressure **P_P** is set to $19.6^{0}_{+9.8}$ bar (20^{0}_{+10} kg/cm^2).

P_P = Pump circuit
P_{LS} = LS circuit
T = Tank circuit
A = To valves
B = To pump **LS** valve

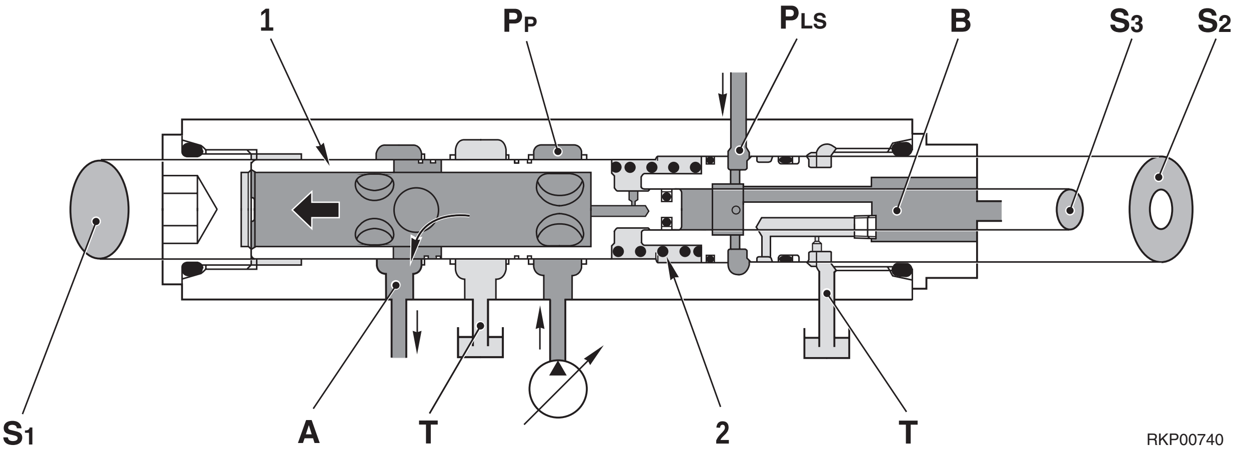
2) During fine control of the control valve, when the demand flow for the actuator is within the amount discharged by the minimum swash plate angle of the pump, pump discharge pressure **P_P** is set to **LS** pressure **P_{LS}** $+ 19.6^{\,0}_{+9.8}$ bar ($20^{\,0}_{+10}$ kg/cm^2).
When the difference in pressure between pump discharge pressure **P_P** and **LS** pressure **P_{LS}** reaches the load of spring (2) ($19.6^{\,0}_{+9.8}$ bar ($20^{\,0}_{+10}$ kg/cm^2)) the unload valve opens, so **LS** differential pressure **ΔP_{LS}** becomes $19.6^{\,0}_{+9.8}$ bar ($20^{\,0}_{+10}$ kg/cm^2).



OPERATION
During fine control of control valve

- When fine control is carried out on the control valve, **LS** pressure **P_{LS}** is generated and acts on area **S3** at the right and of spool (1).
When this happens, the area of the opening of the control valve spool is small, so there is a big difference between **LS** pressure **P_{LS}** and pump discharge pressure **P_P**.
- When the difference in pressure between pump discharge pressure **P_P** and **LS** pressure **P_{LS}** reaches the load of spring (2), spool (1) moves to the right, and pump circuit **P_P** and tank circuit **T** are connected.
- In other words, pump discharge pressure **P_P** is set to a pressure equal to the force of spring (2) ($19.6^{\,0}_{+9.8}$ bar ($20^{\,0}_{+10}$ kg/cm^2)) + **LS** pressure **P_{LS}**, and **LS** differential pressure **ΔP_{LS}** becomes $19.6^{\,0}_{+9.8}$ bar ($20^{\,0}_{+10}$ kg/cm^2).

3) When the control valve is being operated and the demand flow for the actuator becomes greater than the pump discharge from the minimum swash plate angle, the flow of the oil out, to tank circuit **T** is shut off, and all of pump discharge amount **Q** flows to the actuator circuit.



OPERATION

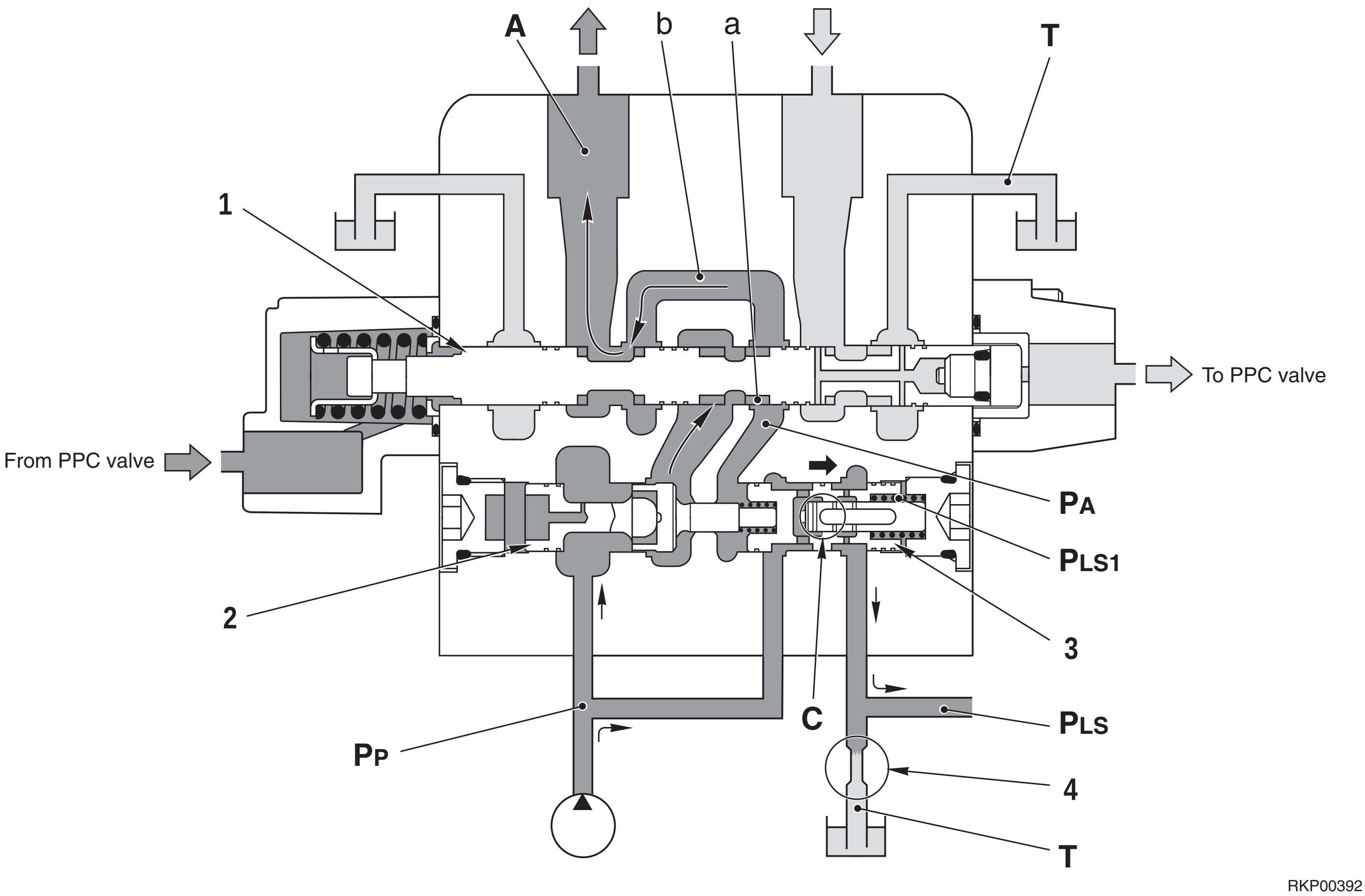
Control valve operated

- When the control valve is operated to a larger stroke, **LS** pressure $\mathbf{P_{LS}}$ is generated and acts on area **S3** at the right end of spool (1).
  When this happens, the area of the opening of the control valve spool is large, so the difference between **LS** pressure $\mathbf{P_{LS}}$ and pump discharge pressure $\mathbf{P_P}$ is small.
- For this reason, the difference in pressure between pump discharge pressure $\mathbf{P_P}$ and **LS** pressure $\mathbf{P_{LS}}$ does not reach the load of spring (2) ($19.6^{0}_{+9.8}$ bar (20^{0}_{+10} kg/cm^2)), so spool (1) is pushed to the left by spring (2).
- As a result, pump circuit $\mathbf{P_P}$ and tank circuit **T** are shut off, and all the pump discharge amount **Q** flows to the actuator circuit.

2. Introduction of LS pressure

FUNCTION

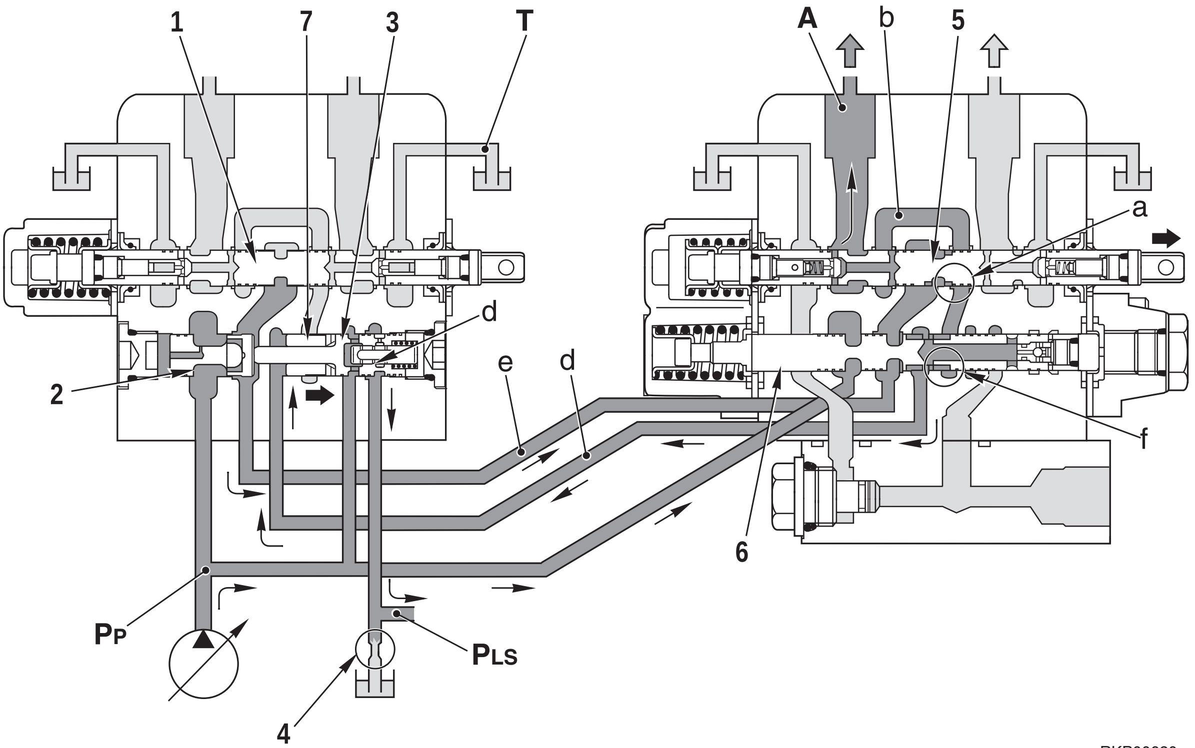
- The **LS** pressure is the actuator load pressure at the outlet port end of the control valve.
- It actually reduces pump pressure **PP** at reducing valve (3) of the pressure compensation valve to the same pressure as actuation circuit pressure **A**, and sends it to the **LS** circuit **PLS**.
- With the boom swing and blade valves, pump pressure **PP** is reduced to the same pressure as actuator circuit pressure **A** by one reducing valve (3) used for both systems, and the pressure is sent to the **LS** circuit **PLS**.
- Whit the hammer valve, actuator circuit pressure **A** is taken directly to the **LS** circuit **PLS**.



OPERATION

1) Boom, arm, bucket, travel valve

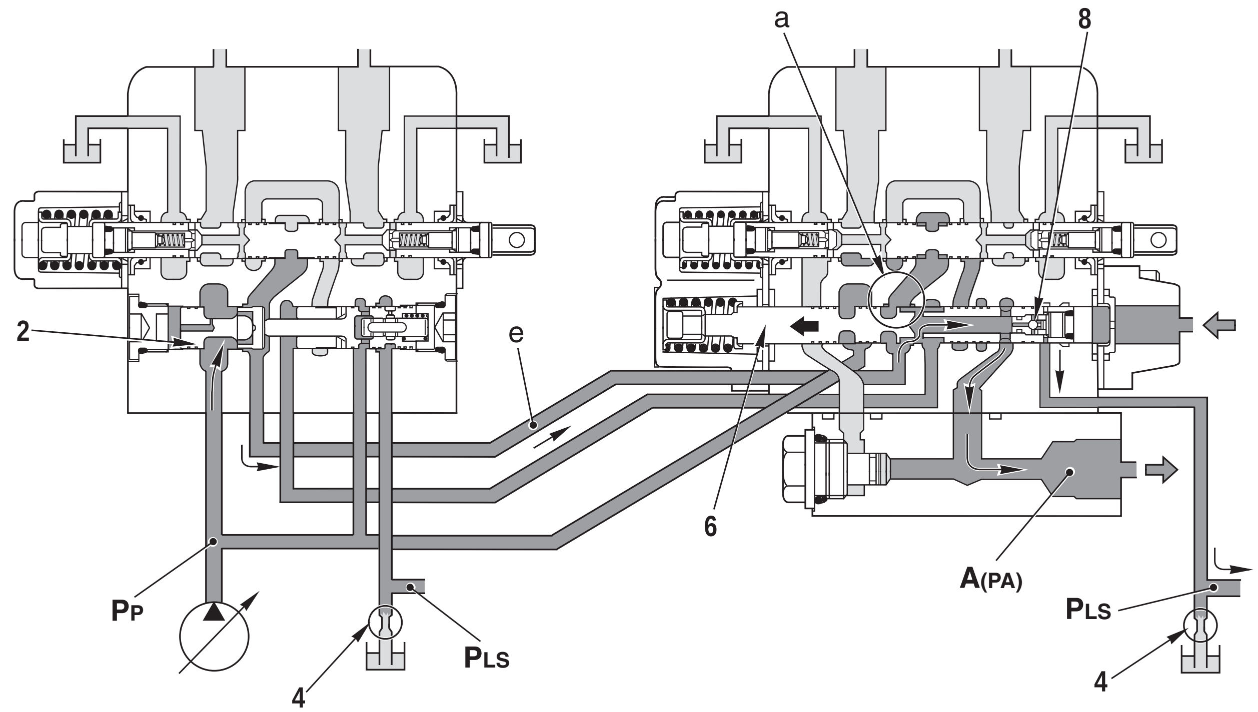
- When spool (1) is operated, pump pressure **PP** flows from control valve (2) and notch **a** in spool (1) through bridge passage **b** to actuator circuit **A**.
- At the same time, reducing valve (3) also moves to the right, so pump pressure **PP** has its pressure reduced by the pressure loss at notch **C**. It is introduced to **LS** circuit **PLS**, and then goes to spring chamber **PLS1**.
- When this happens, **LS** circuit **PLS** is connected to tank circuit **T** from **LS** by-pass plug (4) (see the section on the **LS** by-pass plug).
- Actuator circuit pressure **PA** (= **A**) acts on the left end of reducing valve (3); the reduced pump pressure **PP** acts on the other end.
- As a result, reducing valve (3) is balanced at a position where actuator circuit pressure **PA** and the pressure of spring chamber **PLS1** are the same. Pump pressure **PP** reduced at notch **C** becomes actuator circuit pressure **A** and is taken to **LS** circuit **PLS**.



2) Boom swing, blade valve

- When boom swing spool (1) is operated, pump pressure **PP** is reduced by reducing valve (3) (in the same way as in item 1), and is sent to the **LS** circuit **PLS**.
- When the blade spool (5) is operated, pump pressure **PP** flows from flow control valve (2), passage **e**, and notch **a** in blade spool (5) through bridge passage **b** to actuator circuit **A**.
- At the same time, the actuator circuit pressure passes through notch **f** in hammer spool (6), then goes through passage **d**, and acts on the left end of piston (7). Piston (7) and reducing valve (3) then move to the right.
- As a result, pump pressure **PP** is reduced at notch **d**, becomes the actuator circuit pressure, and is sent to **LS** circuit **PLS**.

★ The boom swing and blade valves are different from the boom, arm, bucket, and travel valves: they share one pressure compensation valve and bring in the **LS** pressure.



3) Hammer valve

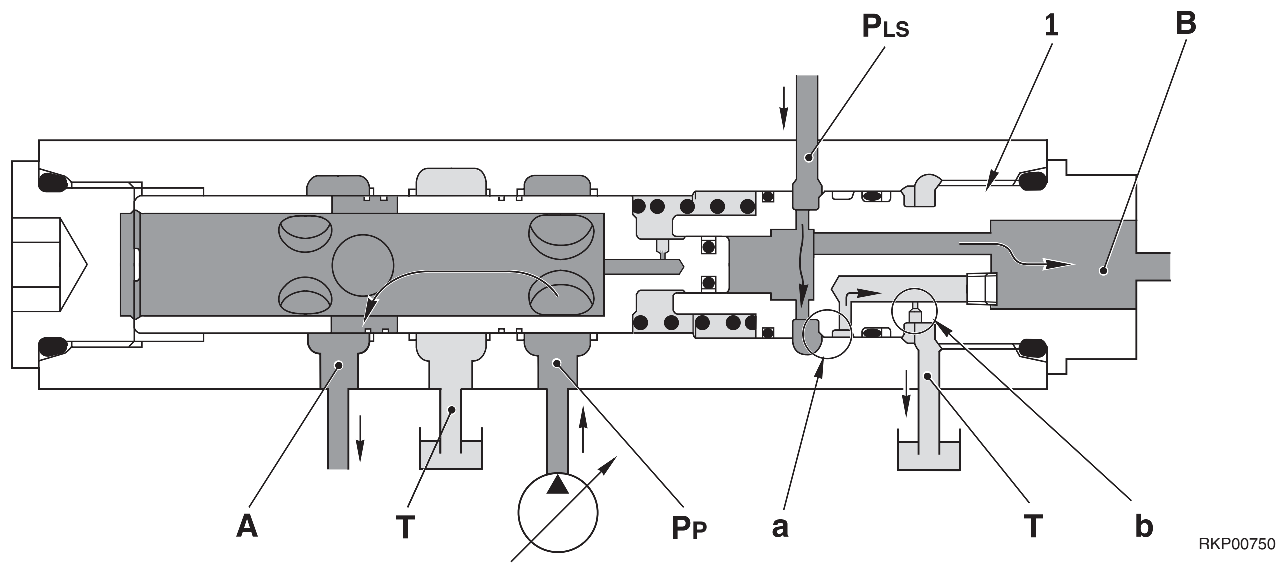
- When breaker spool (6) is operated, pump pressure **PP** flows through flow control valve (2), passage **e**, and notch **a** in hammer spool (6) to actuator circuit **A**.
- At the same time, actuator circuit pressure **PA** passes through check valve (8) and is interconnected with the **LS** circuit **PLS**.

★ The hammer circuit is different from the other circuits: actuator circuit pressure **PA** goes directly to **LS** circuit **PLS**.

3. LS by-pass plug

FUNCTION

- It releases the residual pressure of **LS** pressure **P_{LS}**.
- It makes the speed of the rise in pressure of **LS** pressure **P_{LS}** more gentle. In addition, with this discharge throttled flow, it creates a pressure loss in the throttled flow of the spool or shuttle valve, and increases the stability by lowering the effective **LS** differential pressure.



OPERATION

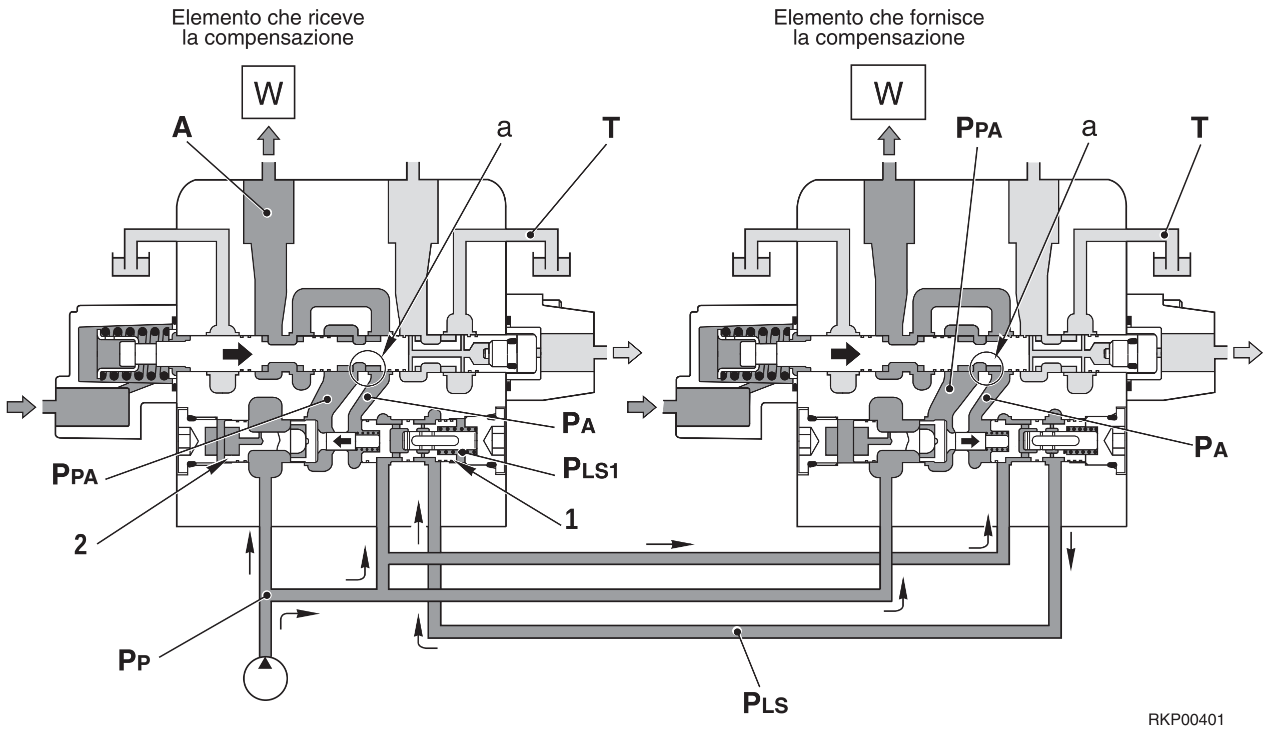
- The pressurized oil for **LS** circuit **PLS** passes from clearance filter **a** (formed by the clearance between **LS** by-pass plug (1) and the valve body) through orifice **b** and flows to the tank circuit **T**.

PP = Pump circuit
PLS = LS circuit
T = Tank circuit
A = To valves
B = To pump **LS** valve

4. **Pressure compensation valve**

FUNCTION

- During compound operations, if the load pressure becomes lower than the other actuator and the oil flow tries to increase, compensation is received. (When this happens, the other actuator being used for compound operation (right side) is at a higher load than the actuator on this side (left side)).



OPERATION

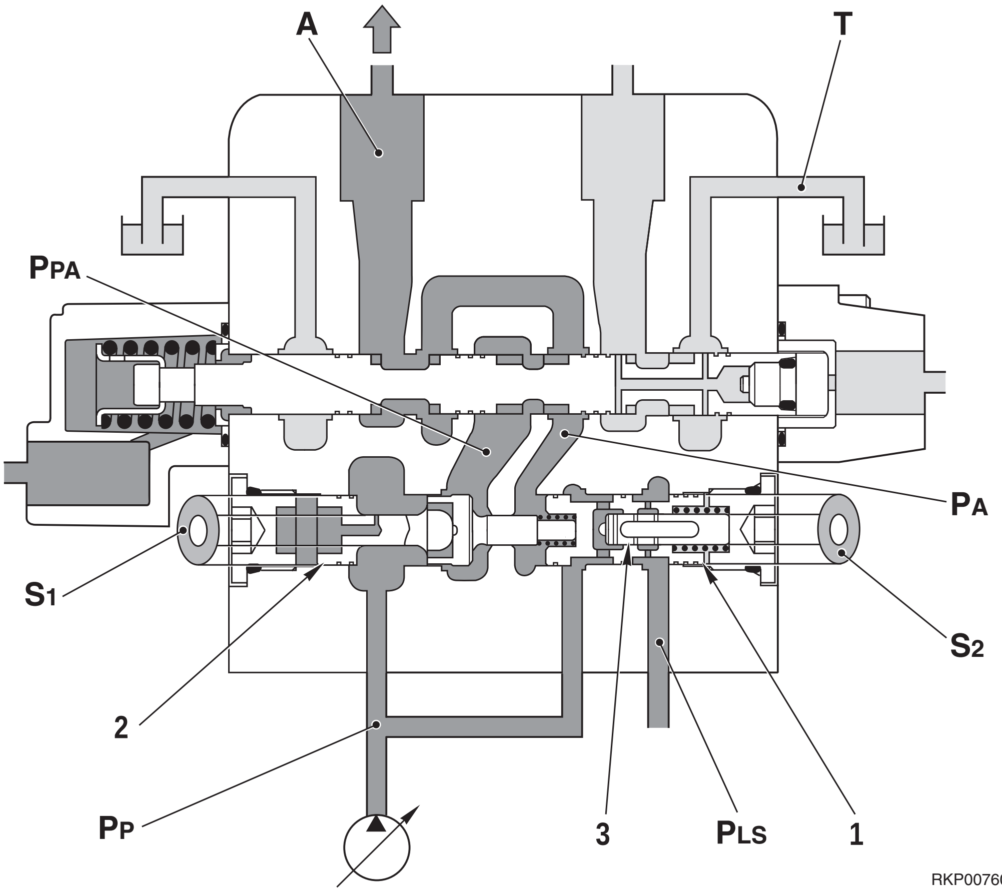
- If the load pressure of the other actuator (right side) becomes higher during compound operations, the oil flow in actuator circuit **A** on this side (left side) tries to increase.
- If this happens, the **LS** pressure **PLS** of the other actuator acts on spring chamber **PLS1**, and reducing valve (1) and flow control valve (2) are pushed to the left (←).
- Flow control valve (2) throttles the area of opening between pump circuit **PP** and spool upstream **PPA**, and pressure loss is generated between **PP** and **PPA**.
- Flow control valve (2) and reducing valve (1) are balanced in position where the difference in pressure between **PLS** and **PA** acting on both ends of reducing valve (1) and the pressure loss between **PP** and **PPA** on both sides of flow control valve (2) are the same.
- In this way, the pressure difference between upstream pressure **PPA** and downstream pressure **PA** of both spools used during compound operations is the same, so the pump flow is divided in proportion to the area of opening of notch **a** of each spool.

5. Area ratio of pressure compensation valve

FUNCTION

- The pressure compensation valve determines the compensation characteristics by carrying out fine adjustment of the area ratio (**S2**/**S1**) between area **S2** of reducing valve (1) and area **S1** of flow control valve (2) to match the characteristics of each actuator.

S1 = Area of flow control valve (2) – Area of piston (3).
S2 = Area of reducing valve (1) – Area piston (3).



RKP00760

Area ratio (S1:S2) and compensation characteristics

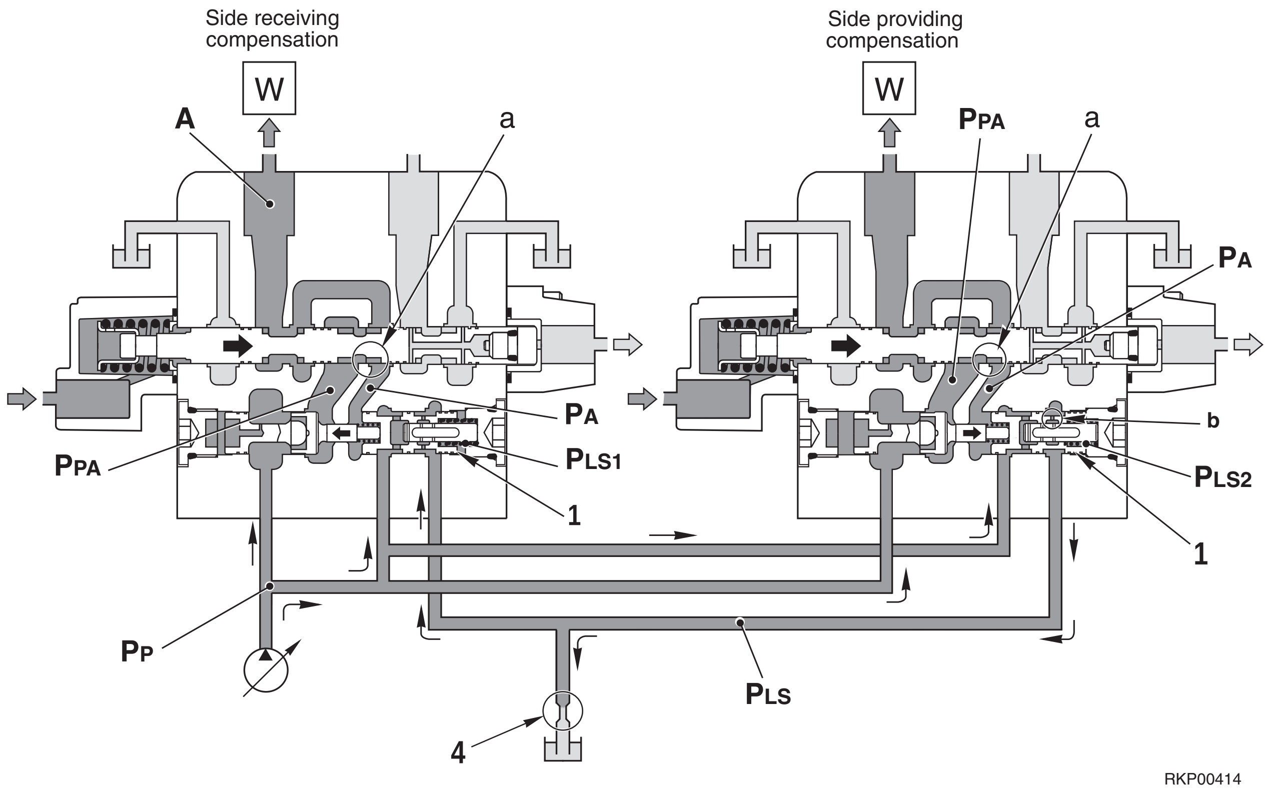
- When ration is 1.00 :
  [Pump pressure **P_P** – spool notch upstream pressure **P_{PA}**]$\fallingdotseq$[**LS** circuit pressure **P_{LS}** – actuator circuit pressure **P_A** (= **A**)] and oil flow is divided in proportion to area of opening of spool.
- When ratio is more than 1.00 : $P_P - P_{PA} > P_{LS} - P_A$ (= **A**) and oil flow to side receiving compensation is divided in a proportion less than area of opening of spool.
- When ratio is less than 1.00 : $P_P - P_{PA} < P_{LS} - P_A$ (= **A**) and oil flow to side receiving compensation is divided in a proportion more than area of opening of spool.

Ratio of area **S1** and **S2**			
Valve	Ratio	Valve	Ratio
Arm	0.98	Boom swing	0.98
Travel	1.00	Blade	0.98
Boom	0.95	Hammer	1.00
Bucket	1.00	Swing	0.95

6. Throttling LS introduction of pressure compensation valve

FUNCTION

- In the other actuator is relieved during compound operations, **LS** introduction throttle **b** of reducing valve (1) divides the flow and sends more oil to the side receiving compensation.



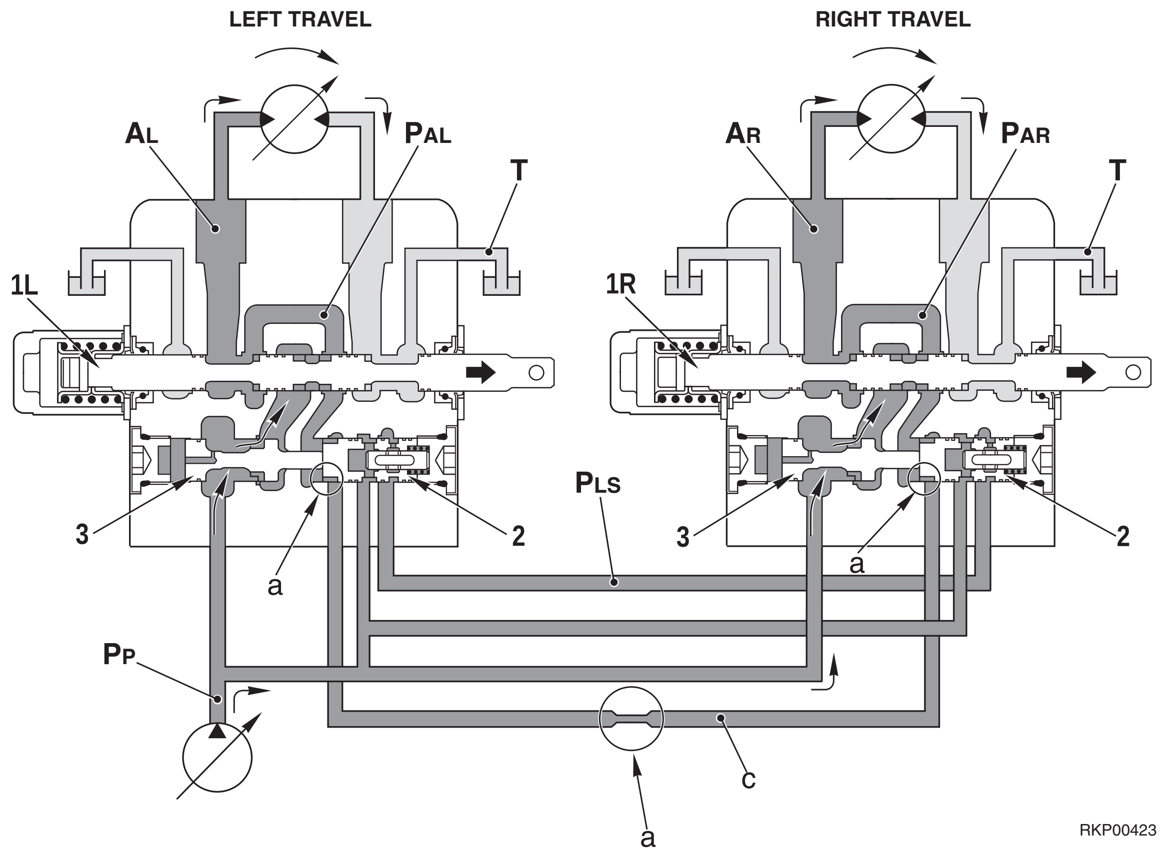
OPERATION

- If the other actuator (right side) is relieved during compound operations, each circuit pressure (**P_{PA}**, **P_A**) of the other actuator becomes the same as the pump circuit pressure (**P_P** = relief pressure).
- In this case, spring chamber **P_{LS2}** of the other actuator (right side) becomes the same as pump circuit pressure **P_P** because of the balance of reducing valve (1).
- **P_{LS2}** passes through **LS** introduction throttle **b** of reducing valve (1) and becomes **P_{LS}**. **P_{LS}** is connected to the tank circuit from **LS** by-pass plug (4), so pressure loss is generated at **LS** introduction throttle **b** (the condition becomes **P_{LS}** $<$ **P_{LS2}**).
- As a result, even if the other actuator is relieved, a pressure differential is created between **P_P** and **P_{LS}**, so more oil flows to actuator circuit **A** on this side (left side).

7. L.H., R.H. travel junction circuit

FUNCTION

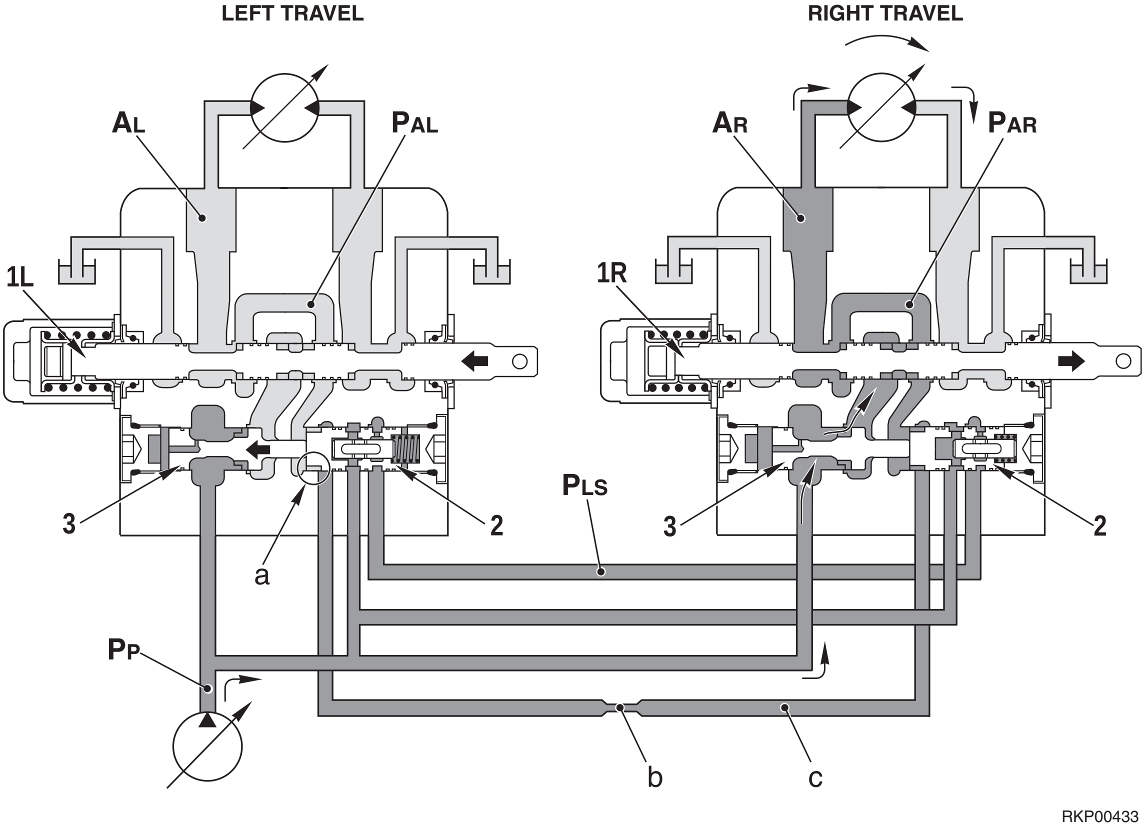
- To compensate for any difference in the oil flow in the left and right travel circuits when travelling in a straight line, the junction circuit opens when the left and right travel spools are operated.
  In this way, the flow of oil to the left and right travel motors is almost the same when travelling in a straight line, so there is no travel deviation.
- When steering the machine, the difference in the load pressure returns the reducing valve of the travel on the inside of the turn and the opening of the notch in the travel junction valve spool becomes smaller, so the machine can be steered.



OPERATION

When travelling in a straight lint

- When left and right travel spools (1) are operated, the pump discharge flows from pump circuit **PP** and circuits **PAL** and **PAR** to actuator circuits **AL** and **AR**.
- When travelling in a straight line, to make actuator circuits **PAL** and **PAR** equal, left and right reducing valves (2) are pushed to the right by the same amount, and notch **a** and the travel junction circuit are opened.
- In this way, the left and right travel actuator circuits are interconnected by the travel junction circuits, so if any difference occurs in the flow of oil to the left and right travel motors, the compensation is carried out to prevent any deviation in travel.



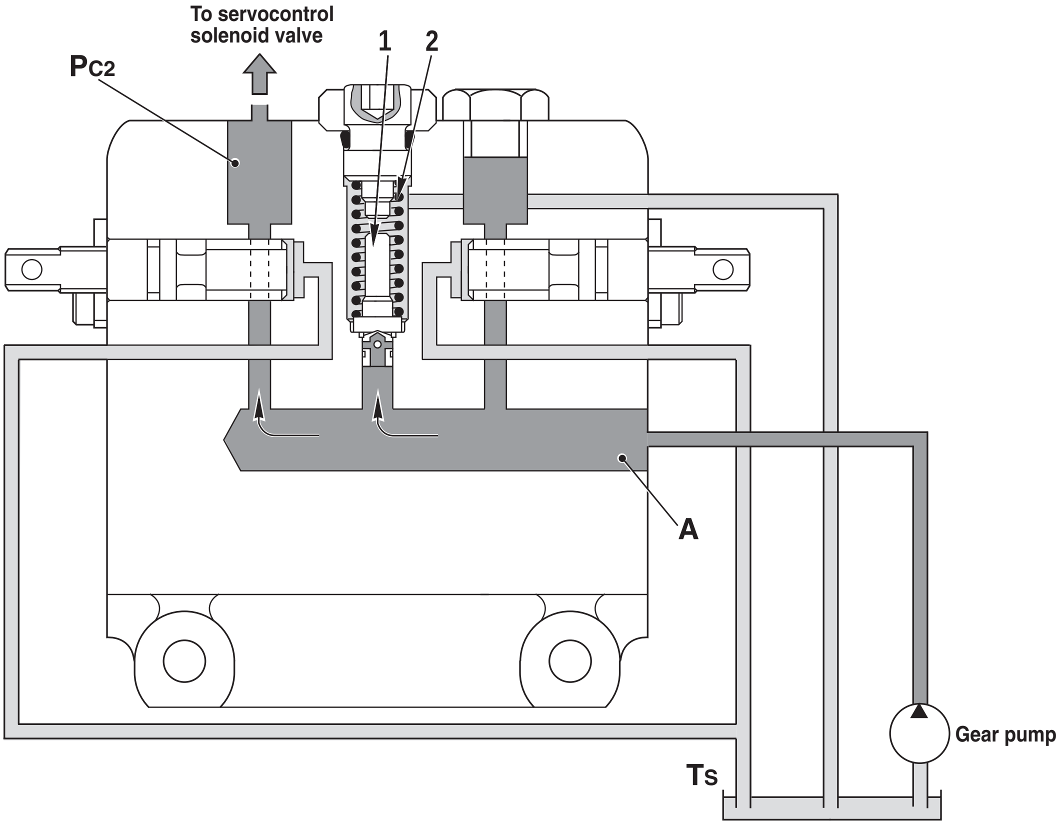
Steering when travelling

- When travelling in a straight line, if left travel spool (**1L**) is returned to the neutral position and the steering is operated, a difference (**AR** > **AL**) is generated in the load pressure of left and right travel actuator circuits **PAL** and **PAR**, and **LS** pressure **PLS** becomes the same pressure as **AR** (the side with the high load pressure).
- As a result, flow control valve (3) on the left travel side is pushed on the left by **LS** circuit **PLS**. Because of this, the opening of the left notch **a** is made smaller, so it becomes possible to operate the steering when travelling.
- Damper **b** is provided in the circuit to dampen any excessive characteristics in the opening or closing of the travel junction circuit if the spool is operated suddenly.

8. Servocontrol reducing valve

FUNCTION

- This valve set servocontrol pressure to 29.5 bar (30 kg/cm^2).



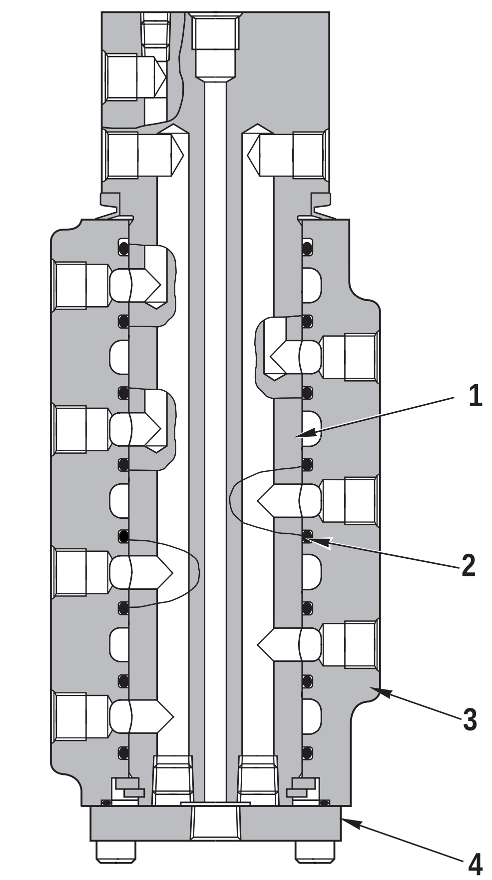
RKP00641

OPERATION

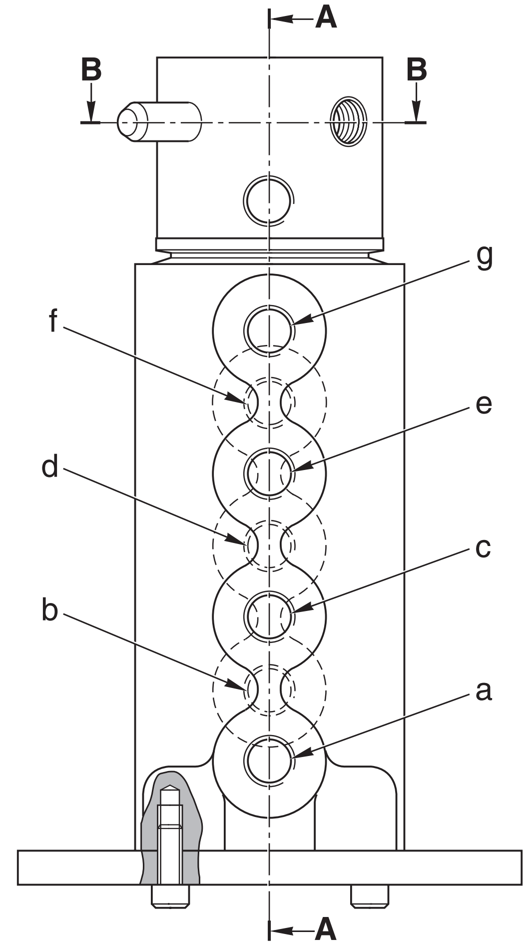
- The discharge pressure from the gear pump entering chamber **A** acts on the bottom of valve (1).
  The gear pump discharge pressure is set to 29.5 bar (30 kg/cm^2).

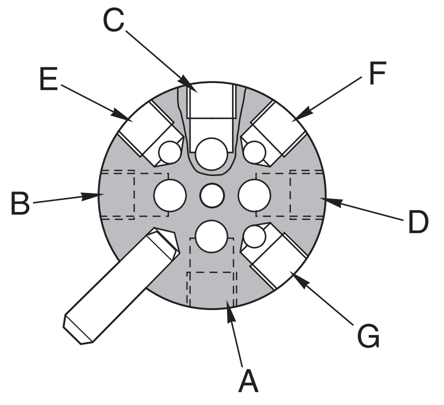
SWIVEL JOINT

PC12R-8

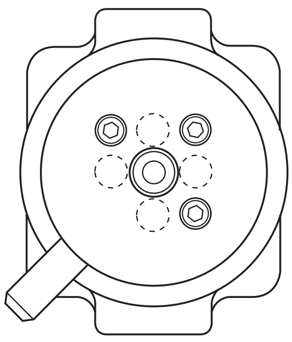


Section A - A





Section B - B

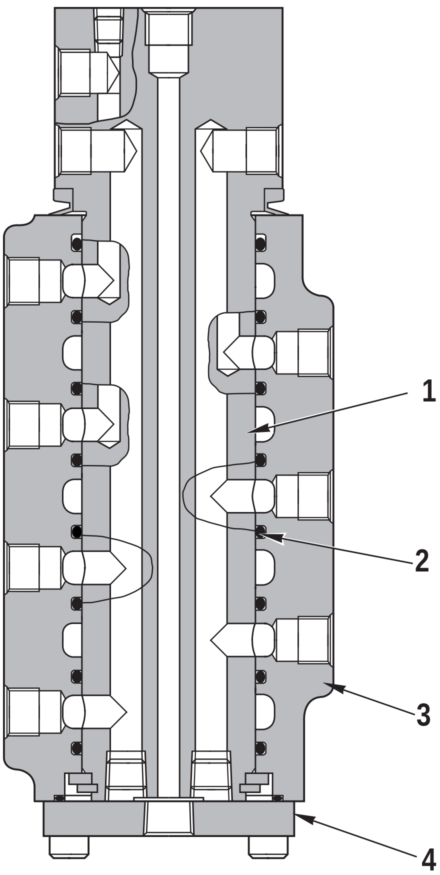


RKP00261

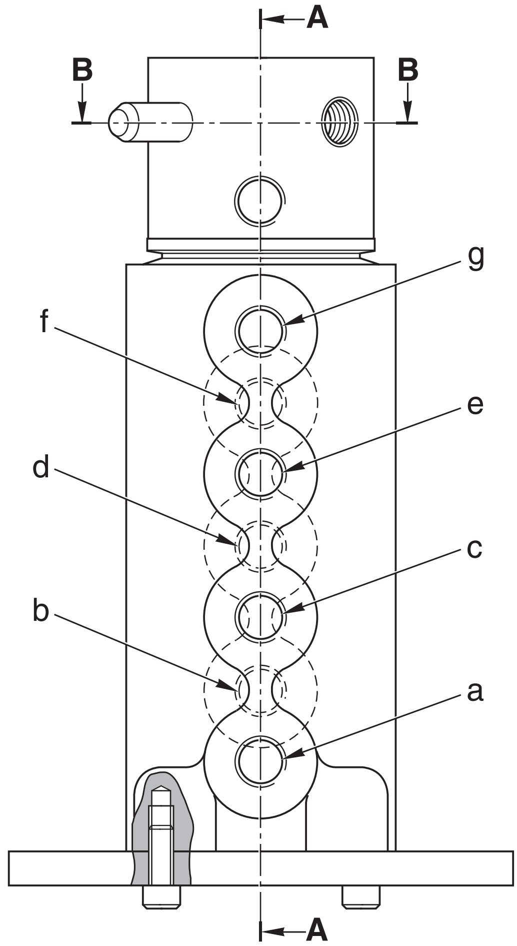
1. Shaft
2. Seal
3. Body
4. Cover

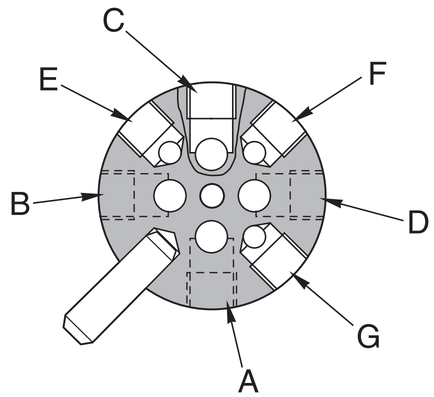
a Port - To R.H. travel motor (P1 Port)
b Port - To L.H. travel motor (P2 Port)
c Port - To R.H. travel motor (P2 Port)
d Port - To L.H. travel motor (P1 Port)
e Port - To blade cylinder (Head side)
f Port - To blade cylinder (Boom side)
g Port - Not used
A Port - From control valve (B4 Port)
B Port - From control valve (B3 Port)
C Port - From control valve (A4 Port)
D Port - From control valve (A3 Port)
E Port - From control valve (A7 Port)
F Port - From control valve (B7 Port)
G Port - Not used

PC12R-8 MISTRAL (with travel increment)
PC15R-8

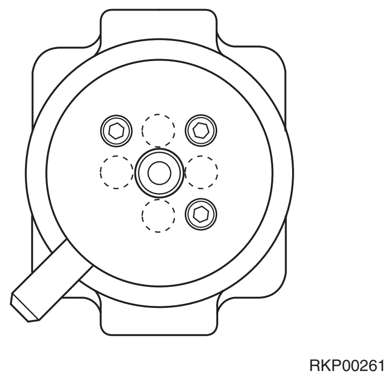


Section A - A





Section B - B

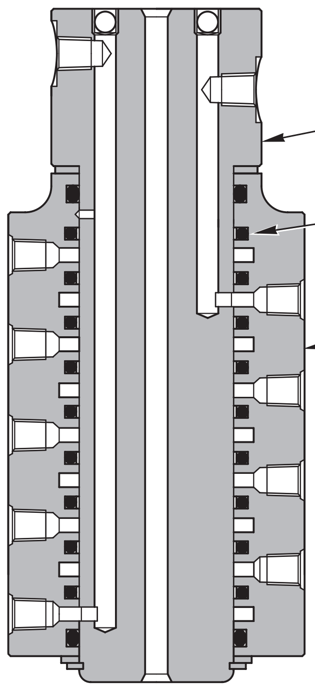


RKP00261

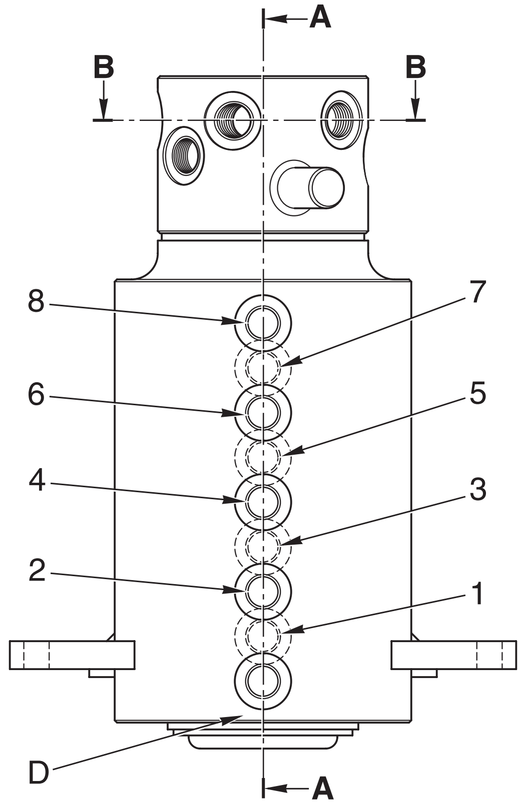
1. Shaft
2. Seal
3. Body
4. Cover

a Port	- To R.H. travel motor (P1 Port)
b Port	- To L.H. travel motor (P2 Port)
c Port	- To R.H. travel motor (P2 Port)
d Port	- To L.H. travel motor (P1 Port)
e Port	- To blade cylinder (Head side)
f Port	- To blade cylinder (Bottom side)
g Port	- To travel motor (PS Port)
A Port	- From control valve (B4 Port)
B Port	- From control valve (B3 Port)
C Port	- From control valve (A4 Port)
D Port	- From control valve (A3 Port)
E Port	- From control valve (A7 Port)
F Port	- From control valve (B7 Port)
G Port	- From EV2 solenoid valve (B Port)

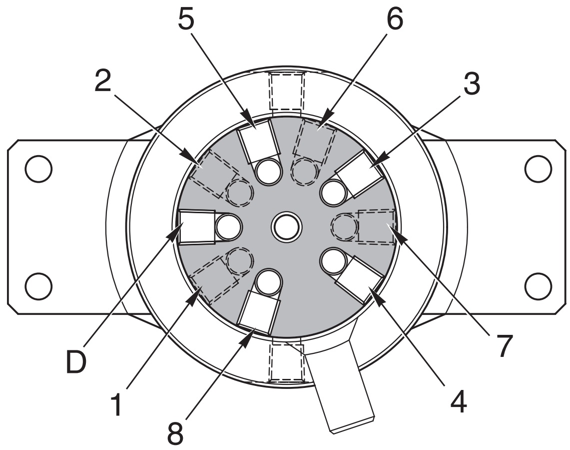
PC12R-8 HS (with variable gauge undercarriage)
PC12R-8 MISTRAL HS (with travel increment and variable gauge undercarriage)
PC15R-8 HS (with variable gauge undercarriage)



Section A - A



RKP11330



Section B - B

1. Shaft
2. Seal
3. Body

Upper side

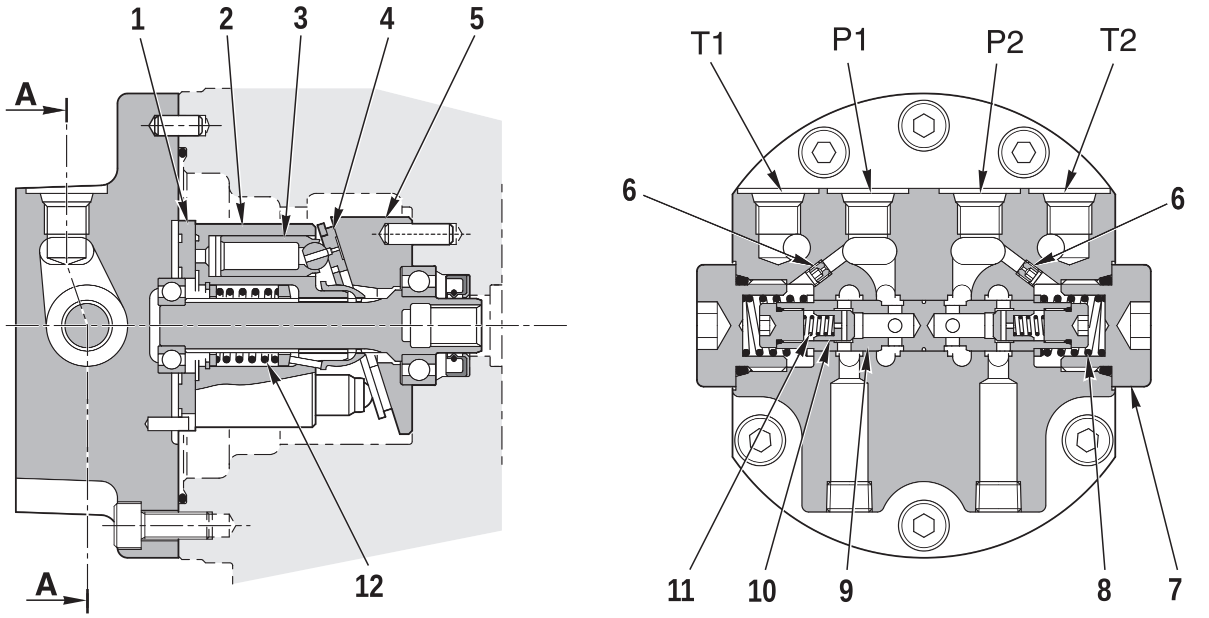
1 Port - For PC12R-8 HS: Not used
For PC12R-8 MISTRAL HS and
For PC15R-8 HS:
From EV2 solenoid valve (B Port)
2 Port - From EV3 solenoid valve (B Port)
3 Port - From control valve (A7 Port)
4 Port - From control valve (B4 Port)
5 Port - From control valve (A3 Port)
6 Port - From control valve (A4 Port)
7 Port - From control valve (B3 Port)
8 Port - From EV3 solenoid valve (A Port)
D Port - To hydraulic tank

Lower side

1 Port - For PC12R-8 HS: Not used
For PC12R-8 MISTRAL HS and
For PC15R-8 HS:
to travel motors (PS port)
2 Port - To variable gauge undercarriage cylinder (Head side)
3 Port - To blade cyinder (Bottom side)
4 Port - To R.H. travel motor (P1 port)
5 Port - To L.H. travel motor (P1 port)
6 Port - To R.H. travel motor (P2 port)
7 Port - To L.H. travel motor (P2 port)
8 Port - To safety valve blade cylinder (V2 port) and to variable gauge undercarriage cylinder (Bottom side)
D Port - From travel motors (T port)

TRAVEL MOTOR

PC12R-8



Section A - A

1. Valve plate
2. Cylinder
3. Piston
4. Shoe
5. Swash plate
6. Orifice
7. Plug
8. Spool return spring
9. Counterbalance valve spool
10. Check valve
11. Check valve spring
12. Center spring

R.H. motor

T1 Port	- Not used
P1 Port	- To swivel joint (a Port)
P2 Port	- To swivel joint (c Port)
T2 Port	- To swivel joint (h Port)

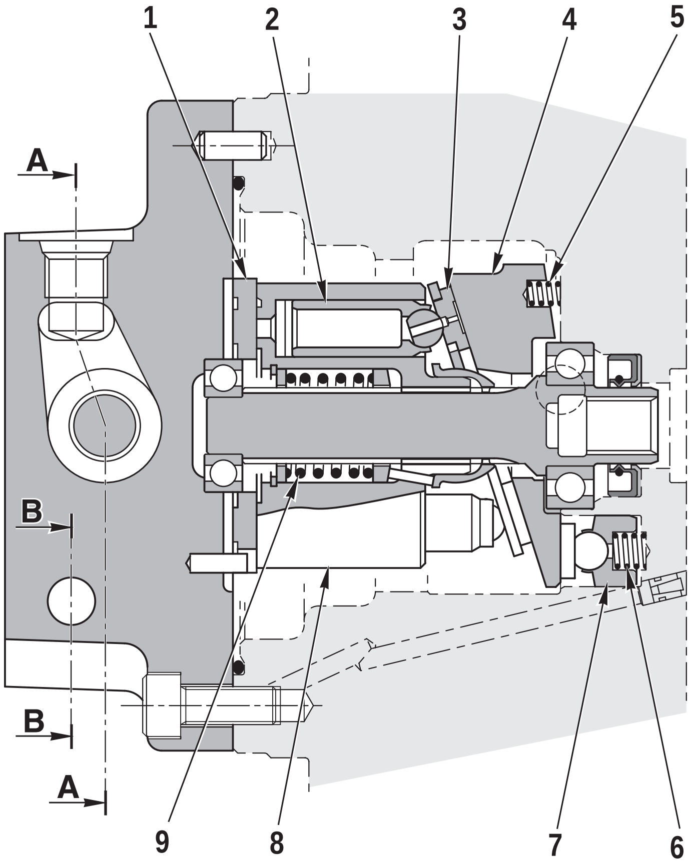
L.H. motor

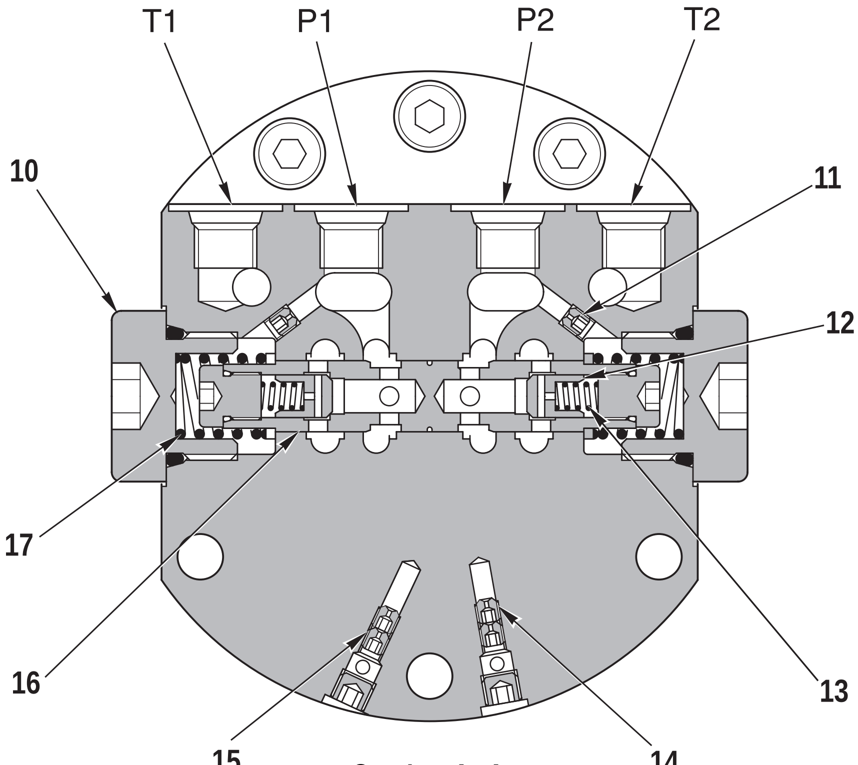
T1 Port	- To swivel joint (h Port)
P1 Port	- To swivel joint (d Port)
P2 Port	- To swivel joint (b Port)
T2 Port	- Not used

SPECIFICATIONS

Nominal pressure:	186 bar (190 kg/cm^2)
Displacement:	12.46 cm^3/rev
Swing speed:	1040 rpm

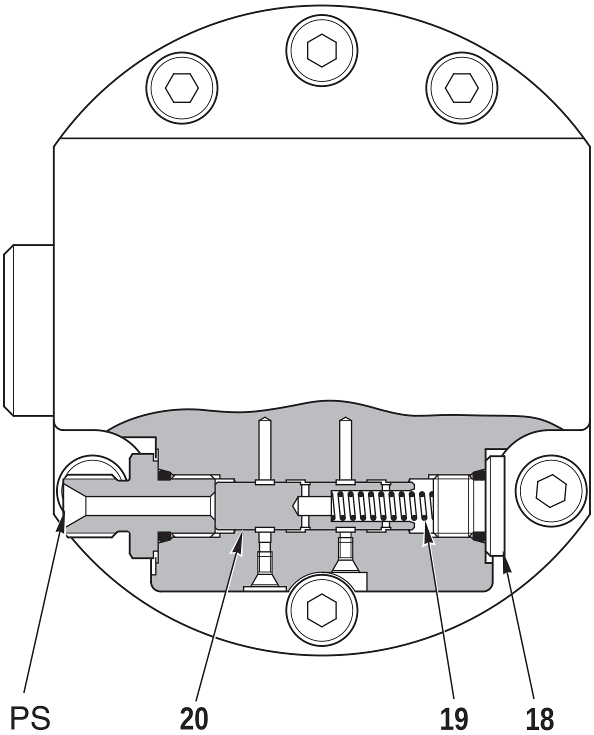
PC12R-8 (with travel increment)
PC15R-8



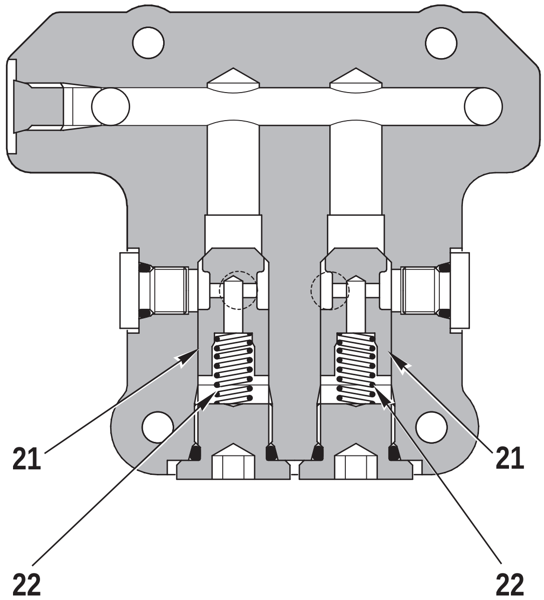


Section A - A

RKP00872



Section B - B



Section C - C

RKP00882

1. Valve plate
2. Piston
3. Shoe
4. Swash plate
5. Spring
6. Piston spring
7. Piston
8. Cylinder
9. Center spring
10. Plug
11. Orifice
12. Check valve
13. Check valve spring
14. Orifice
15. Orifice
16. Counterbalance valve spring
17. Spool return spring
18. Plug
19. Spool return spring (travel increment)
20. Counterbalance valve spring (travel increment)
21. Check valve
22. Check valve spring

R.H. motor

T1 Port	- Not used
P1 Port	- From swivel joint (a Port)
P2 Port	- From swivel joint (c Port)
T2 Port	- From swivel joint (h Port)
PS Port	- From swivel joint (g Port)

L.H. motor

T1 Port	- From swivel joint (h Port)
P1 Port	- From swivel joint (d Port)
P2 Port	- From swivel joint (b Port)
T2 Port	- Not used
PS Port	- From swivel joint (g Port)

SPECIFICATIONS

Nominal pressure: 206 bar (210 kg/cm^2)

Displacement:

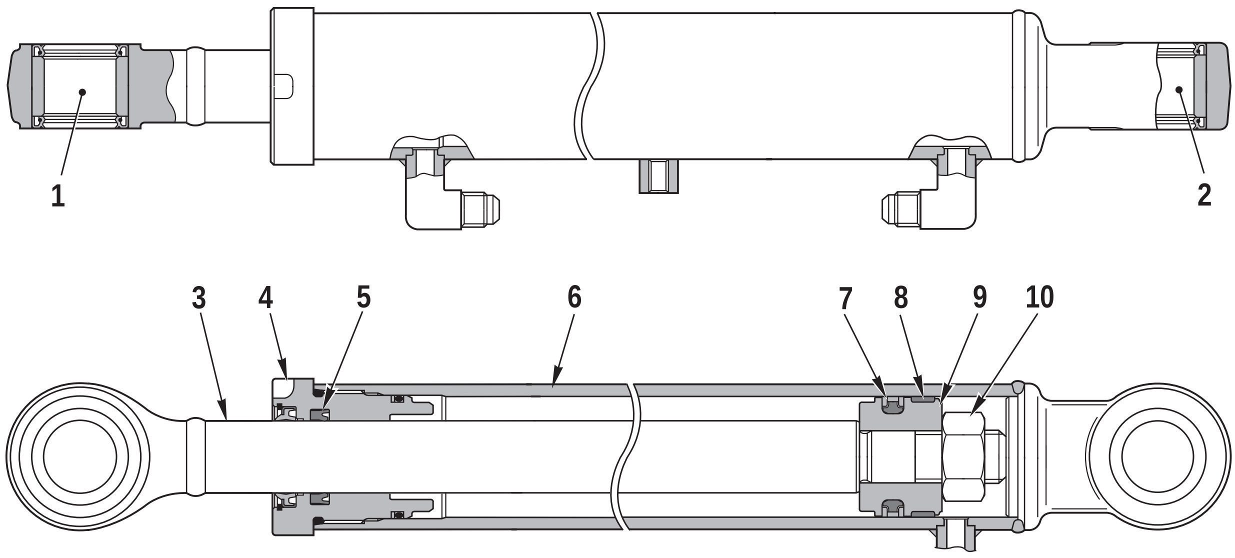
- High speed: 6.27 cm^3/rev.
- Low speed: 12.46 cm^3/rev.

Swing speed:

- High speed: 2756 rpm
- Low speed :1387 rpm

CYLINDERS

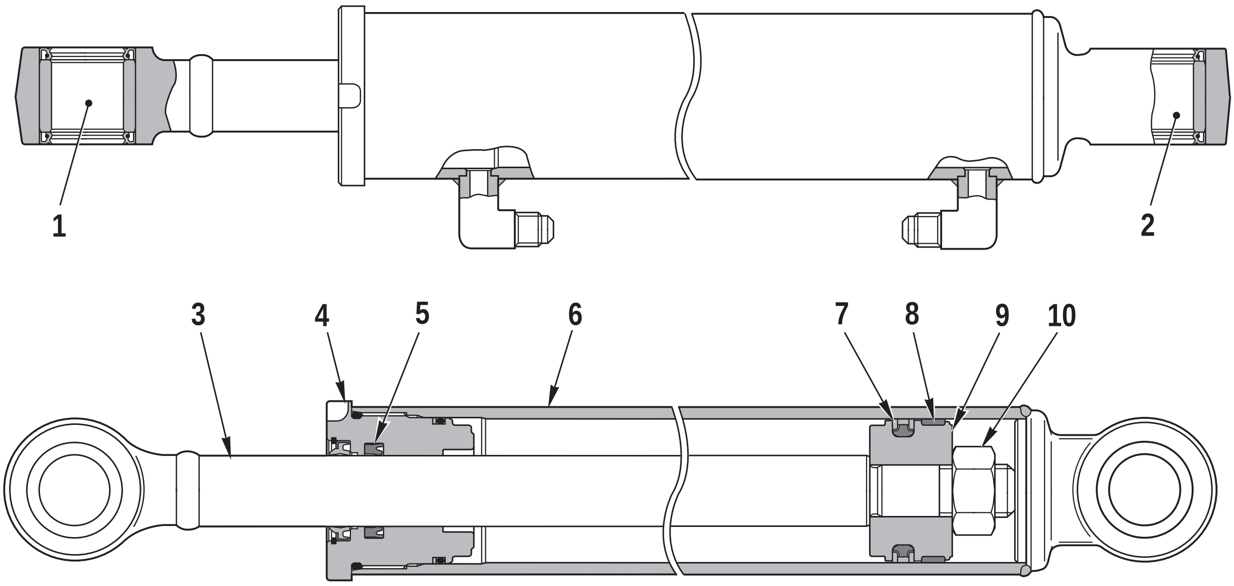
BOOM



RKP00290

1. Head side bushing
2. Bottom side bushing
3. Piston rod
4. Head
5. Washer
6. Cylinder
7. Ring
8. Spacer
9. Piston ring
10. Wear ring
11. Piston
12. Nut

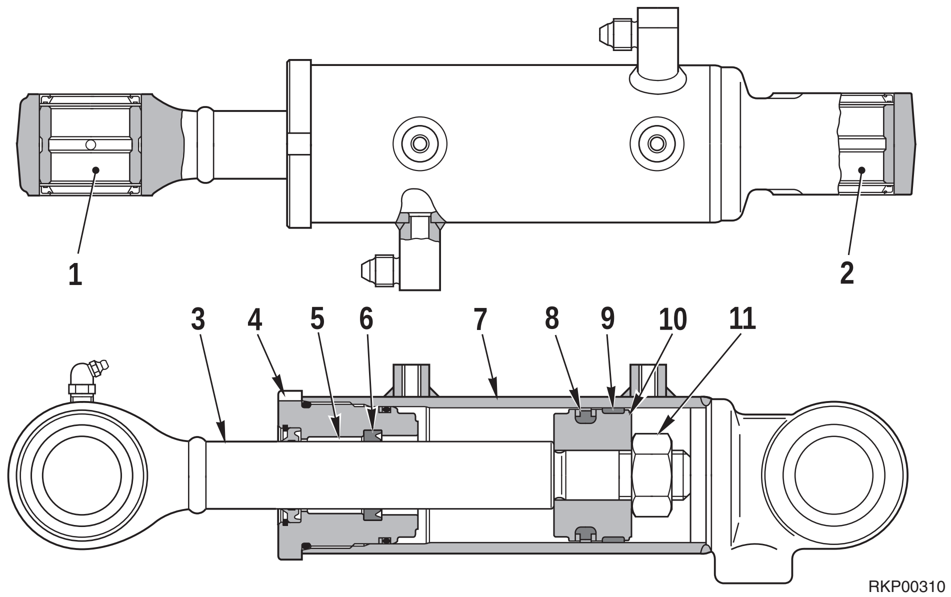
ARM



RKP00300

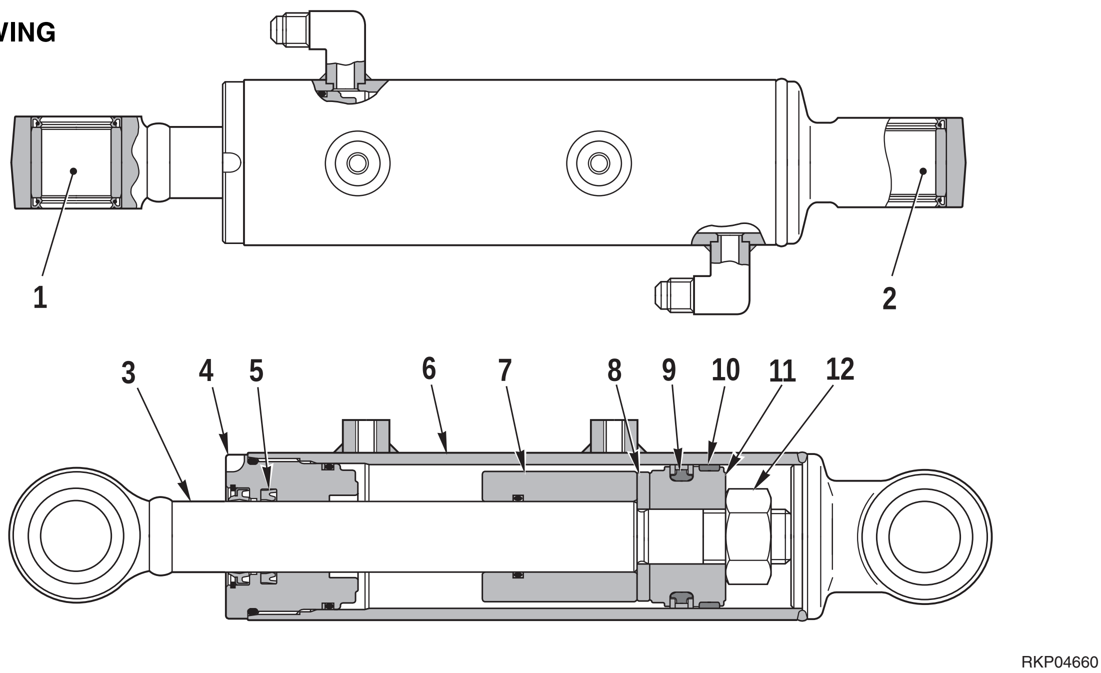
1. Head side bushing
2. Bottom side bushing
3. Piston rod
4. Head
5. Washer
6. Cylinder
7. Piston ring
8. Wear ring
9. Piston
10. Nut

BUCKET



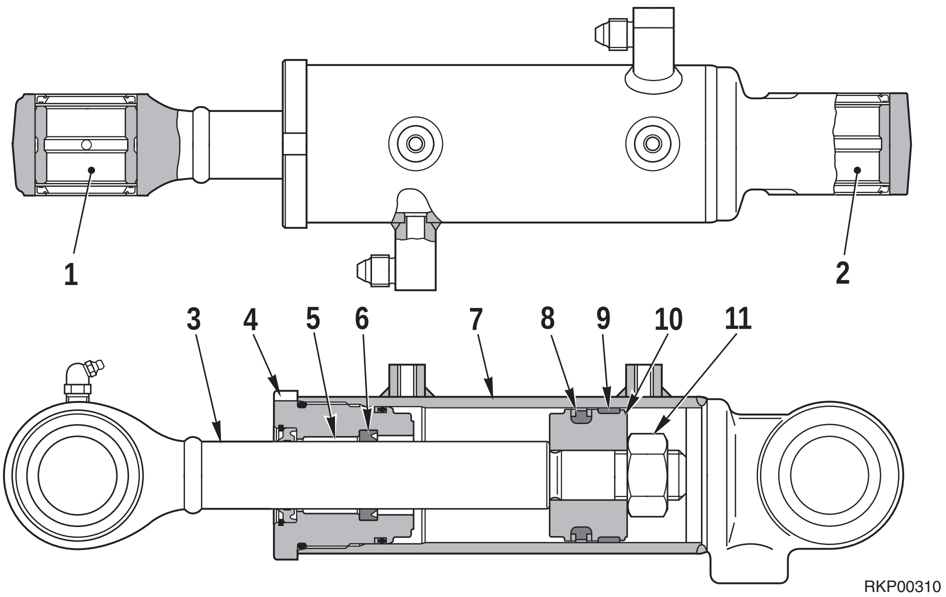
1. Head side bushing
2. Bottom side bushing
3. Piston rod
4. Head
5. Washer
6. Cylinder
7. Piston ring
8. Wear ring
9. Piston
10. Nut

BOOM SWING



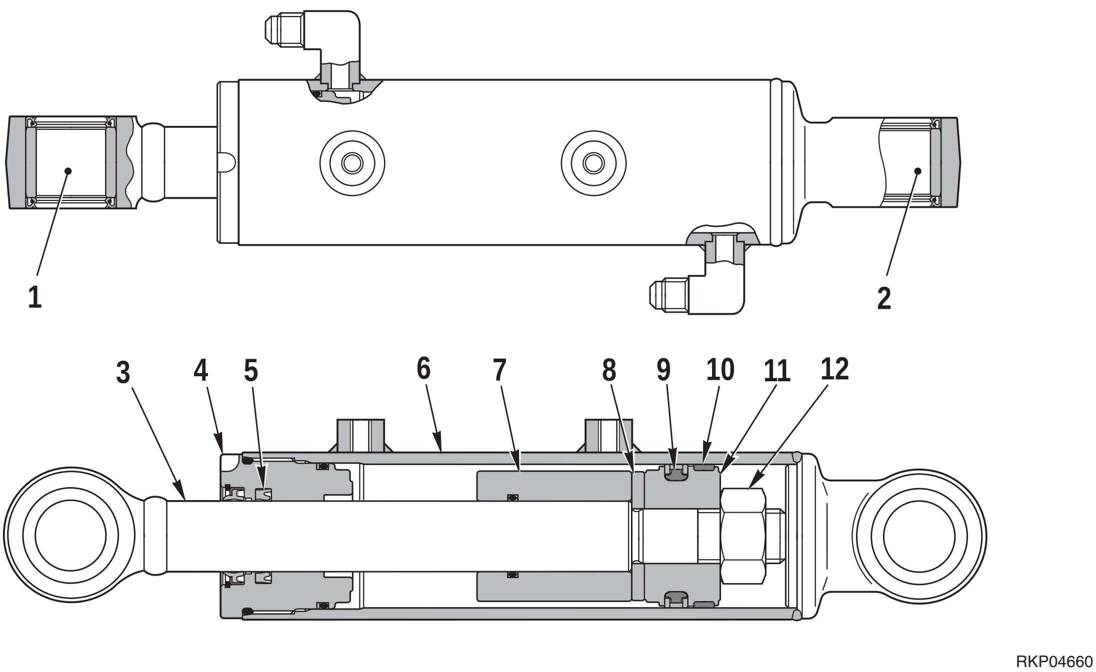
1. Head side bushing
2. Bottom side bushing
3. Piston rod
4. Head
5. Washer
6. Cylinder
7. Piston ring
8. Wear ring
9. Piston
10. Nut

BLADE (PC12R-8)



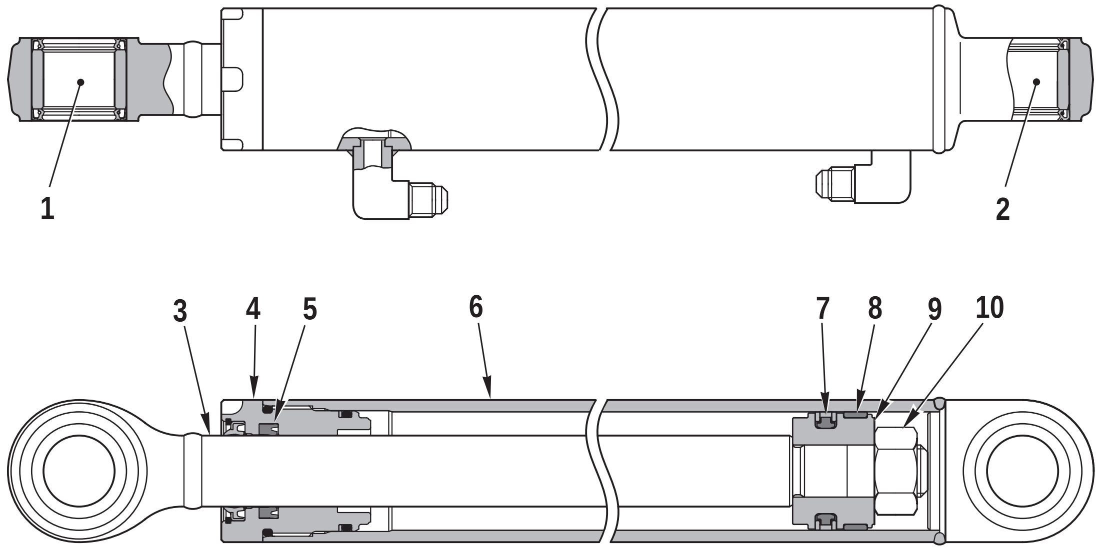
1. Head side bushing
2. Bottom side bushing
3. Piston rod
4. Head
5. Wear ring
6. Washer
7. Cylinder
8. Piston ring
9. Wear ring
10. Piston
11. Nut

BLADE (PC15R)



1. Head side bushing
2. Bottom side bushing
3. Piston rod
4. Head
5. Washer
6. Cylinder
7. Spacer
8. Spacer
9. Piston ring
10. Wear ring
11. Piston
12. Nut

VARIABLE GAUGE UNDERCARRIAGE



1. Head side bushing
2. Bottom side bushing
3. Piston rod
4. Head
5. Washer
6. Cylinder
7. Piston ring
8. Wear ring
9. Piston
10. Nut

PC12R-8

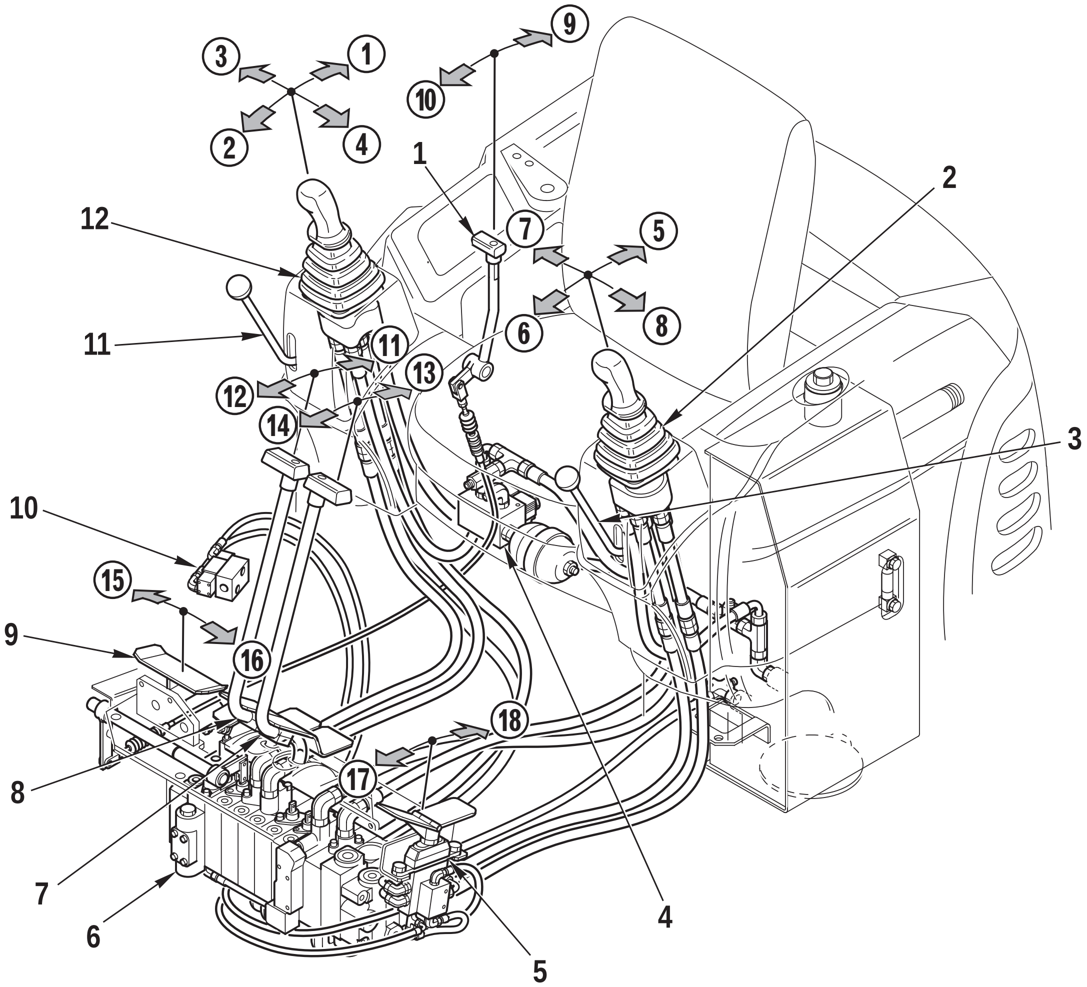
Cylinder	Boom		Arm	Bucket	Boon swing	Blade	Variable gauge undercarriage
	with canopy	with cabin					
Piston rod diameter	30	30	30	30	30	30	30
Cylinder inside diameter	55	55	50	50	60	60	50
Piston stroke	354	342	453	378	313	60	315
Max. cylinder length	987	975	1165	1027	910	393	850
Min. cylinder length	633	633	712	649	597	333	535
Piston nut width across flat	30	30	32	32	32	32	32

PC15R-8

Cylinder	Boom		Arm	Bucket	Boon swing	Blade	Variable gauge undercarriage
	with canopy	with cabin					
Piston rod diameter	35	35	35	30	30	35	30
Cylinder inside diameter	60	60	55	50	60	70	50
Piston stroke	355	345	447	378	313	60	315
Max. cylinder length	985	975	1153	1027	910	470	850
Min. cylinder length	630	630	706	649	597	410	535
Piston nut width across flat	32	32	32	32	32	41	32

VALVE CONTROL

(★ The figure represent PC15R-8)



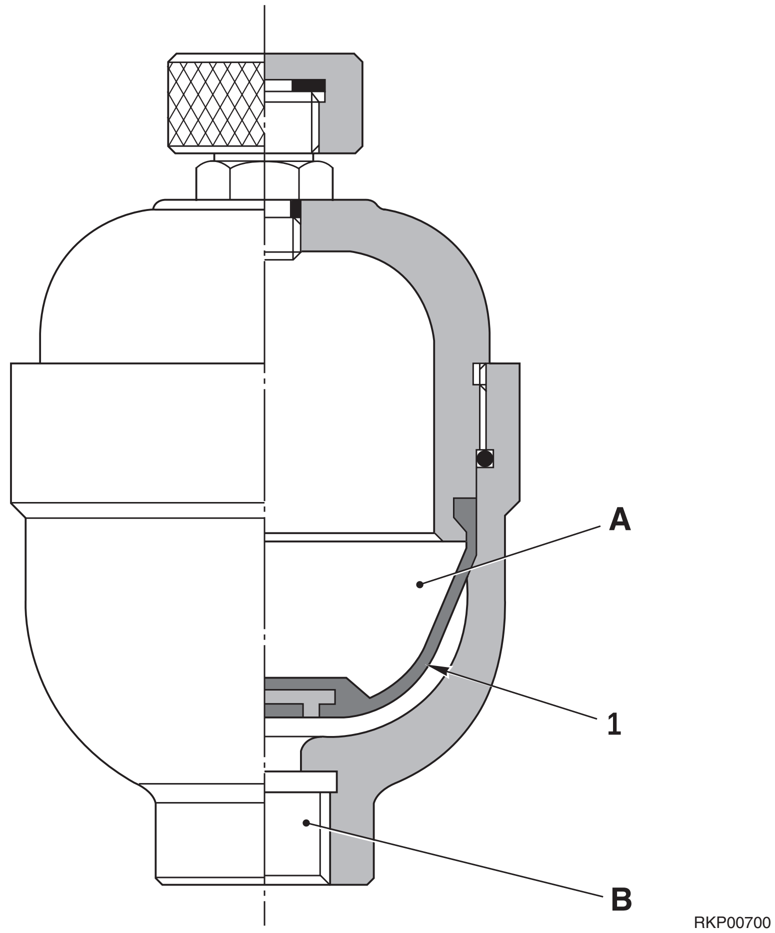
RKP01050

Position of control levers

1 Raise boom
2 Lower boom
3 Open bucket
4 Curl bucket
5 Close arm
6 Open arm
7 Swing revolving frame to the right
8 Swing revolving frame to the left
9 Raise blade
10 Lower blade
11 R.H. track shoe backwards
12 R.H. track shoe forwards
13 L.H. track shoe backwards
14 L.H. track shoe forwards
15 Swing boom to the right
16 Swing boom to the left
17 Supplementary equipment
18 Supplementary equipment

1. Blade control lever
2. L.H. PPC valve
3. L.H. safety lock lever
4. Servocontrol feed unit
5. Work equipment control pedal
6. Control valve
7. L.H. track shoe control lever
8. R.H. track shoe control lever
9. Boom swing control pedal
10. Cutting shovel control valve
11. R.H. safety lock lever (canopy model only)
12. R.H. PPC valve

ACCUMULATOR



TECHNICAL DATA

Servocontrol feed unit

Nominal volume:	0.35 ℓ
Pre-loading:	12^{0}_{+1} bar
Working pressure:	35 – 45 bar

FUNCTION

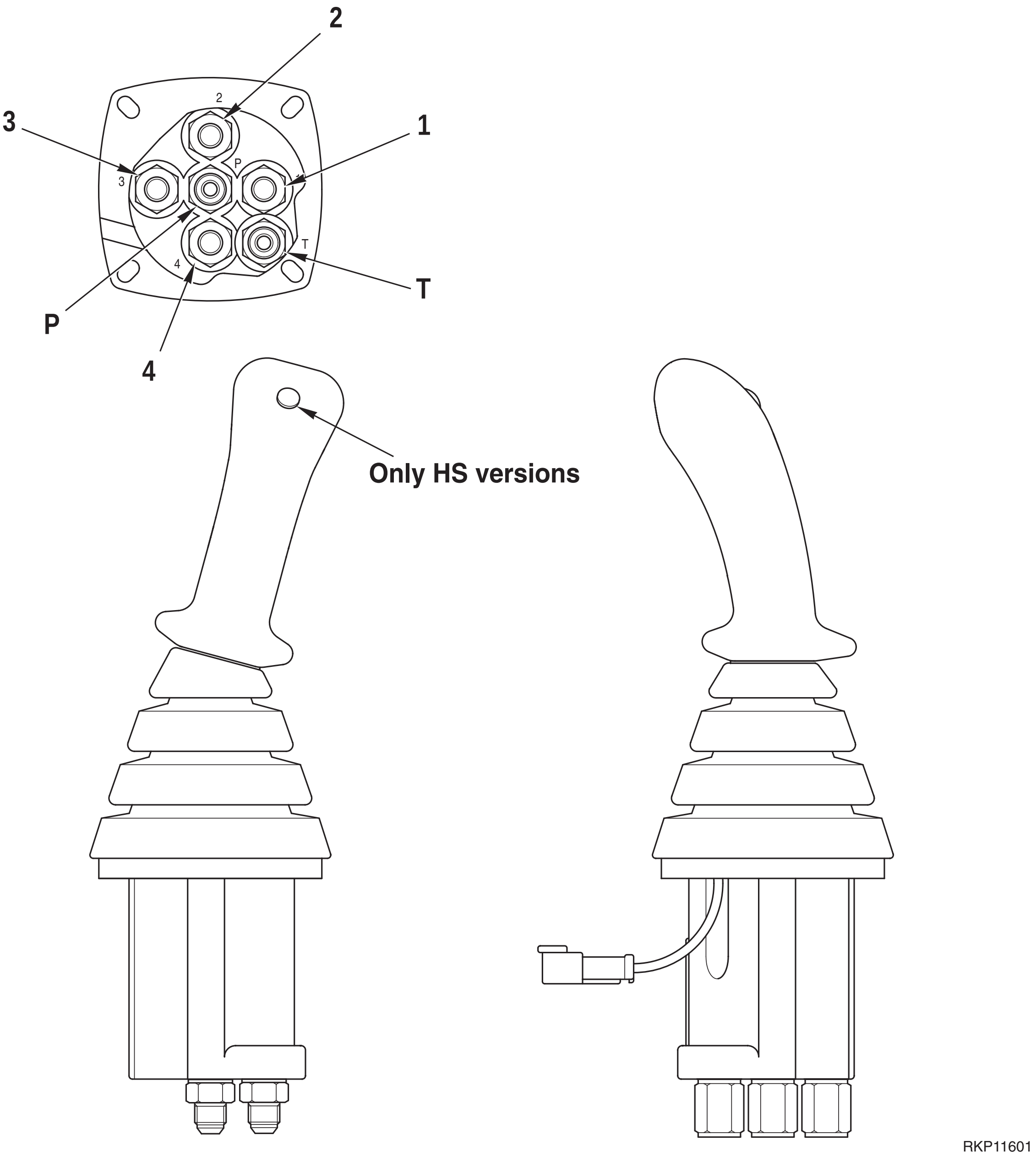
- An elastic rubber bag (1) containing nitrogen is fitted inside the accumulator to maintain oil pressure in the circuit to which the accumulator is connected.

OPERATION

- When the engine is running the chamber **A** of the rubber bag (1) (containing nitrogen) is compressed by oil under pressure coming from line **B**.
- If the oil under in line **B** falls below the maximum calibration pressure (even after intensive use), the rubber bag (1) will expand due to pressure from the nitrogen it.

PPC VALVE

Left

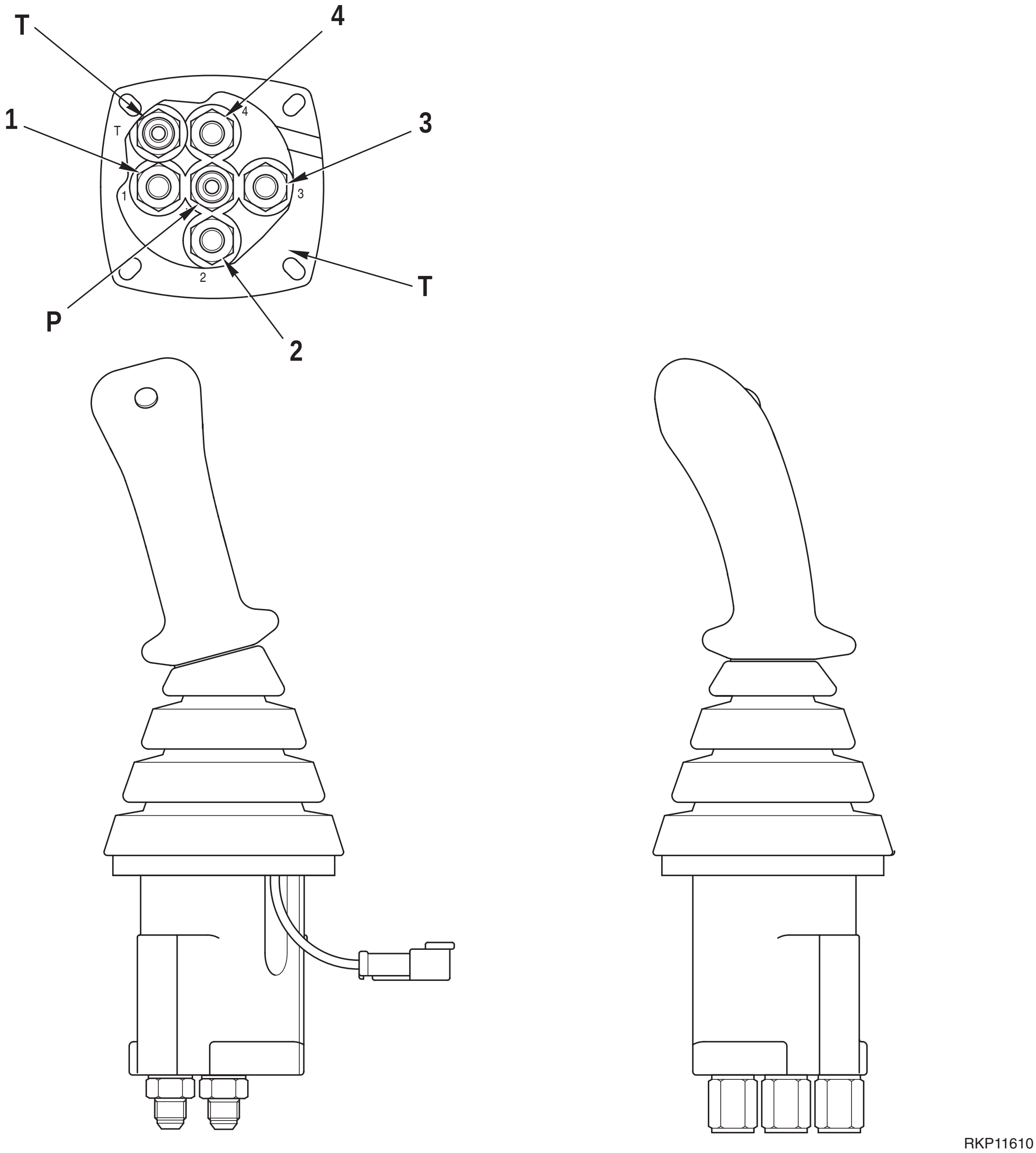


4 Port	- To control valve (Pa1 Port)	
3 Port	- To control valve (Pb2 Port)	
2 Port	- To control valve (Pb1 Port)	
P Port	- From EV1 solenoid valve (A Port)	
1 Port	- To control valve (Pa2 Port)	
T Port	- To hydraulic tank	

FUNCTION

1 Port: R.H. swing
2 Port: Close arm
3 Port: L.H. swing
4 Port: Open arm

Right



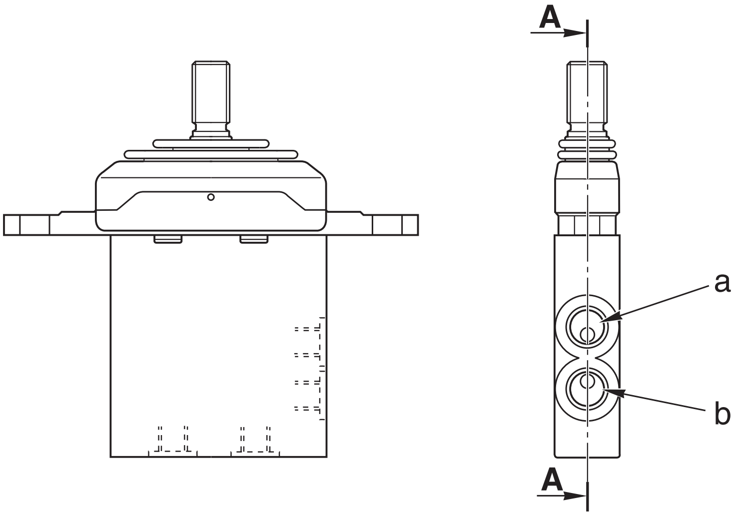
P Port	- From EV1 solenoid valve (A Port)
1 Port	- To control valve (Pa6 Port)
T Port	- To hydraulic tank
4 Port	- To control valve (Pa5 Port)
3 Port	- To control valve (Pb6 Port)
2 Port	- To control valve (Pb5 Port)

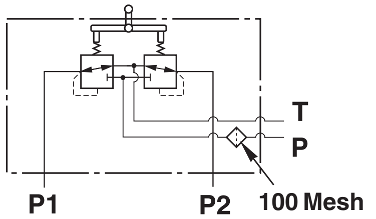
FUNCTION

1 Port: Curl bucket
2 Port: Lower boom
3 Port: Open bucket
4 Port: Raise boom

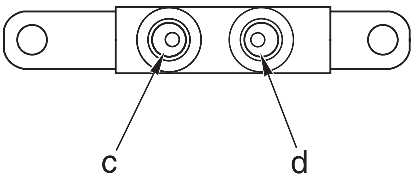
PPC VALVE

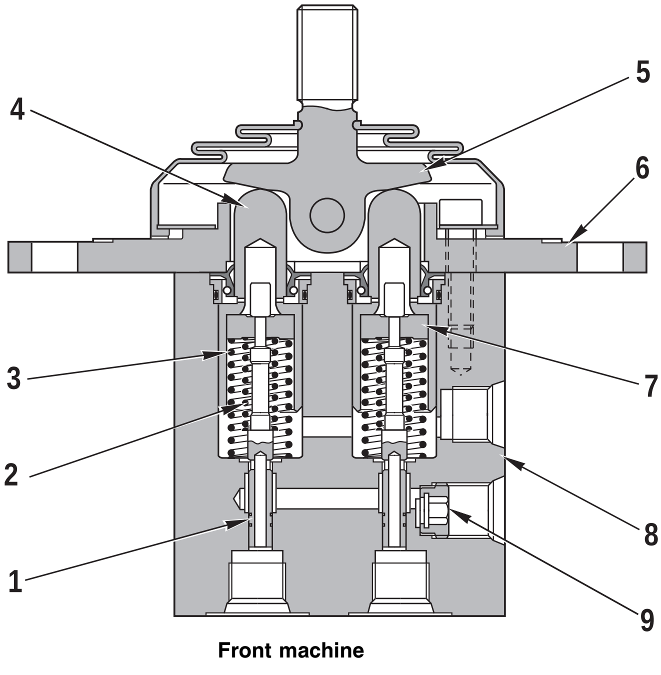
(hammer, cutting shovel)





RKP00950





RKP00960

a. T Port - To hydraulic tank
b. P Port - From control valve (Pi2 Port)
c. P1 Port - **Hammer control:** Not used

Cutting shovel control: see hydraulic circuit
d. P2 Port - **Hammer control:**
To control valve (Pa9 Port)
Cutting shovel control:
see hydraulic circuit

1. Spool
2. Adjusting spring (internal)
3. Return spring (external)
4. Plunger
5. Lever
6. Cover
7. Retainer
8. Body
9. Filter (100 mesh)

FUNCTION

1. At neutral

Ports **A** and **B** of the control valve and ports **P1** and **P2** of the PPC valve are connected to drain chamber **D** through fine control hole **f** in spool (1). (Fig. 1)

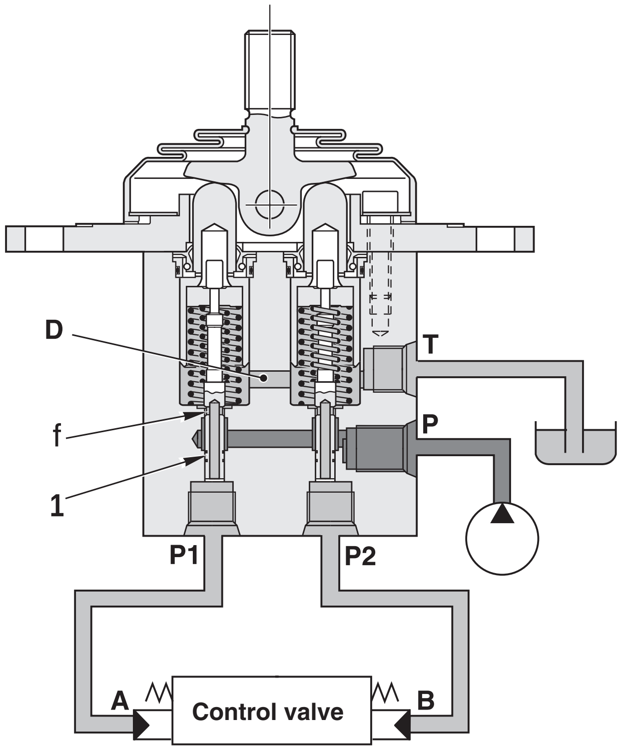


Fig. 1

2. During fine control (NEUTRAL → fine control)

When piston (4) starts to be pushed by lever (5), retainer (7) is pushed; spool (1) is also pushed by metering spring (2), and moves down.

When this happens, fine control hole **f** is shut off from drain chamber **D**, and at almost the same time, it is connected to pump pressure chamber **PP**, so pilot pressure oil from the control pump passes through fine control hole **f** and goes from port **P1** to port **A**.

When the pressure at port **P1** becomes higher, spool (1) is pushed back and fine control hole **f** is shut off from pump pressure chamber **PP**.

At almost the same time, it is connected to drain chamber **D** to release the pressure at port **P1**.

When this happens, spool (1) moves up or down so that the force of metering spring (2) is balanced with the pressure at port **P1**. The relationship in the position of spool (1) and body (8) (fine control hole **f** is at a point midway between drain hole **D** and pump pressure chamber **PP**) does not change until retainer (7) contacts spool (1).

Therefore, metering spring (2) is compressed proportionally to the amount of movement of the control lever, so the pressure at port **P1** also rises in proportion to the travel of the control lever. In this way, the control valve spool moves to a position where the pressure in chamber **A** (the same as pressure at port **P1**) and the force of the control valve spool return spring are balanced. (Fig. 2)

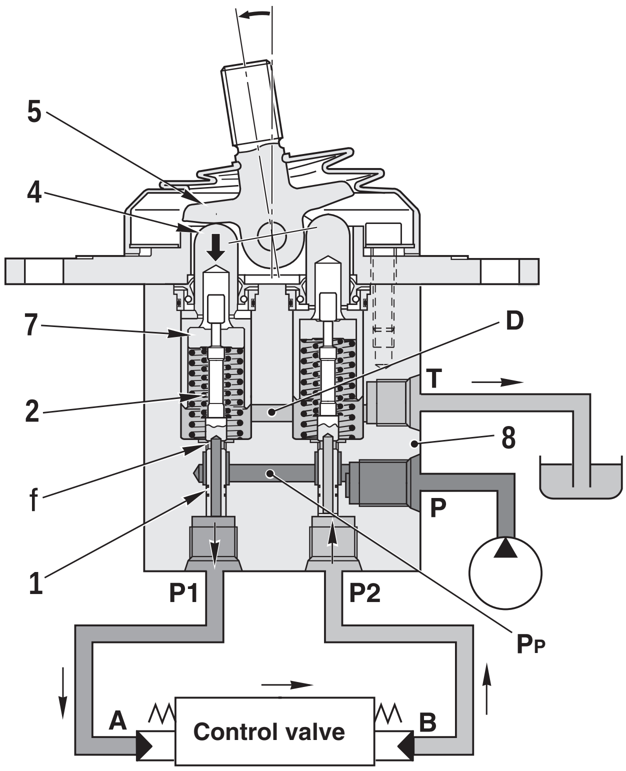


Fig. 2

3. **During fine control (when the lever is returned)**

When lever (5) starts to be returned, spool (1) is pushed up by the force of centering spring (3) and the pressure at port **P1**.
When this happens, fine control hole **f** is connected to drain chamber **D** and the pressure oil at port **P1** is released.

If the pressure at port **P1** drops too far, spool (1) is pushed down by metering spring (2), and fine control hole **f** is shut off from drain chamber **D**. At almost the same time, it is connected to pump pressure chamber **PP**, and the pump pressure is supplied until the pressure at port **P1** recovers to a pressure that corresponds to the lever position.

When the spool of the control valve returns, oil in drain chamber **D** flows in from fine control hole **f'** in the valve on the side that is not working.
The oil passes through port **P2** and enters chamber **B** to fill the chamber with oil. (Fig. 3)

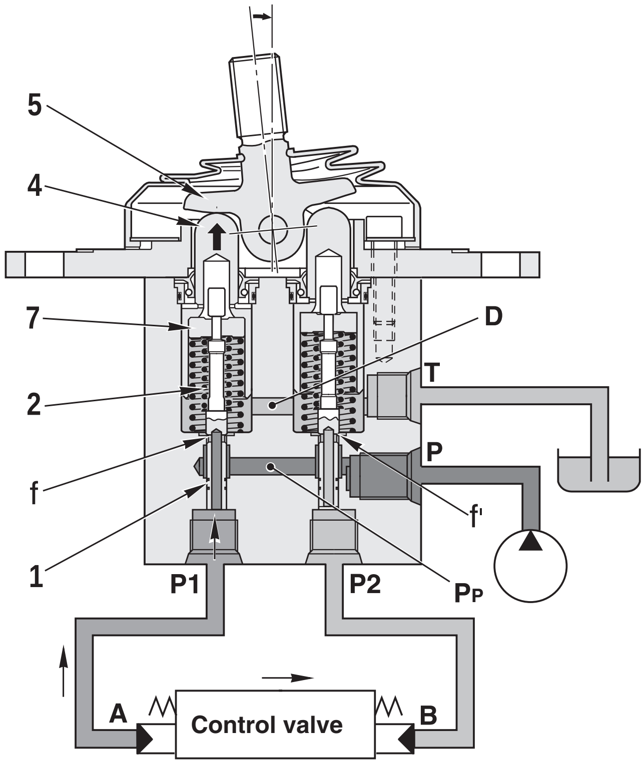


Fig. 3

4. **At full stroke**

When lever (5) pushes down piston (4), and retainer (7) pushes down spool (1), fine control hole **f** is shut off from drain chamber **D**, and is connected with pump pressure chamber **PP**. Therefore, the pilot pressure from the control pump passes through fine control hole **f** and flows to chamber **A** from port **P1**, and pushes the control valve spool.
The oil returning from chamber **B** passes from port **P2** through fine control hole **f'** and flows to drain chamber **D**. (Fig. 4)

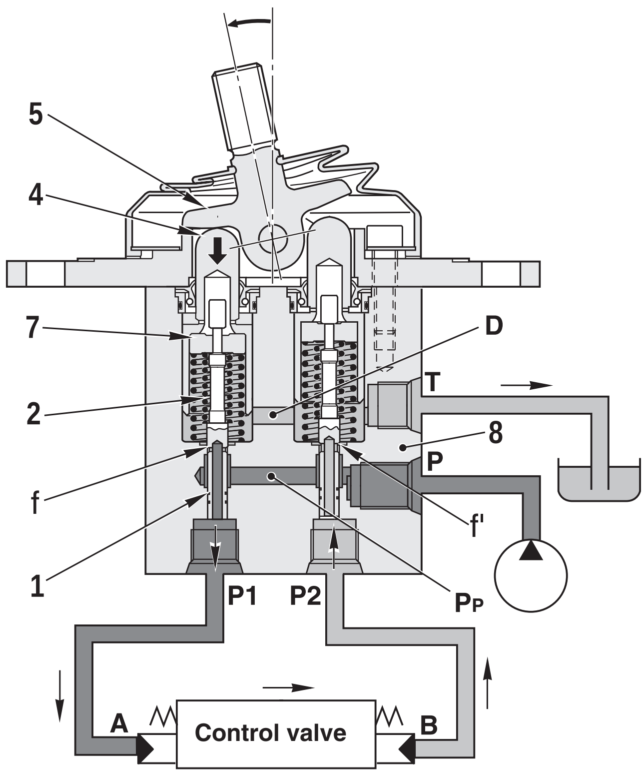
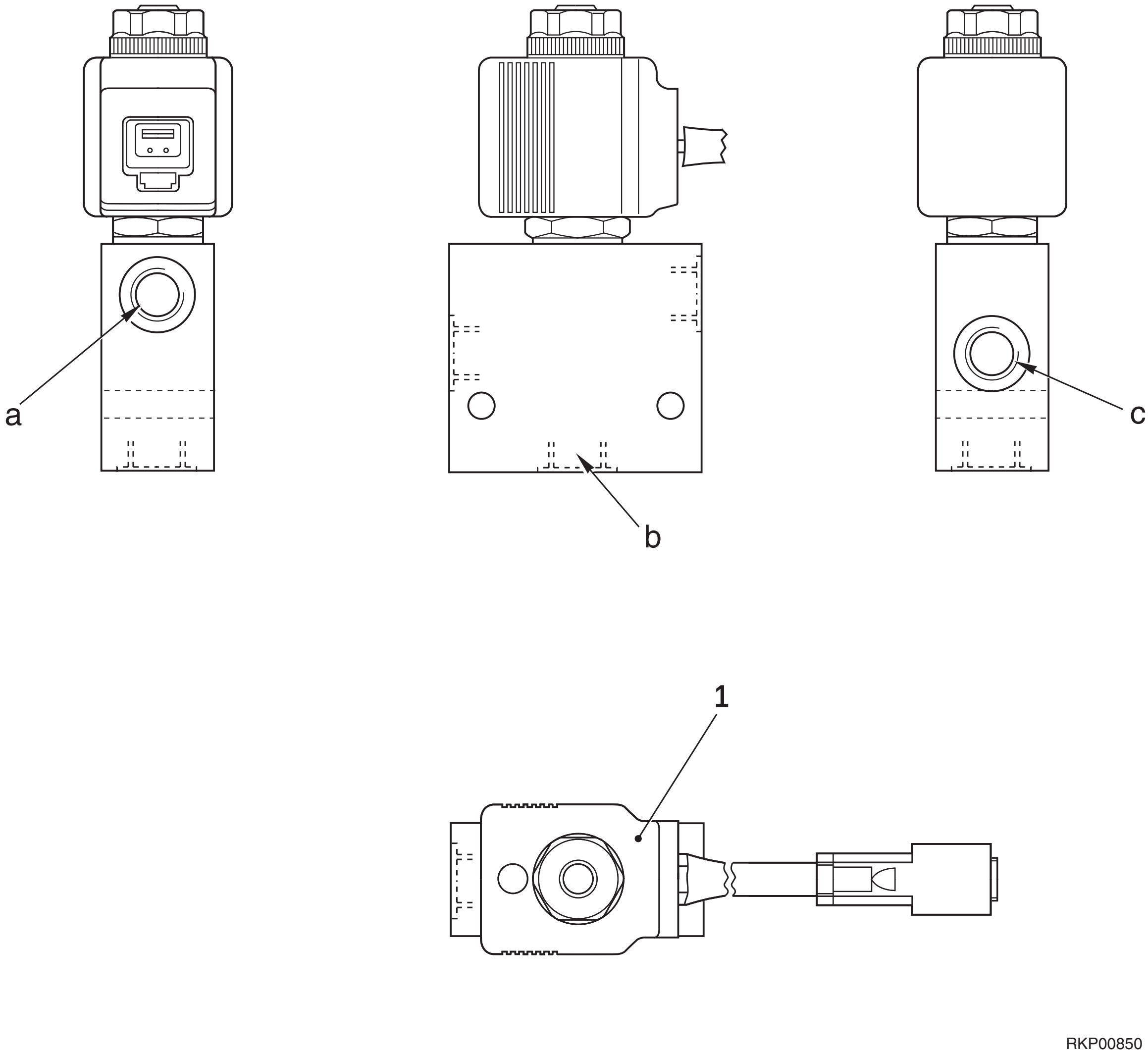


Fig. 4

SOLENOID VALVE

SERVOCONTROL
PC12R-8
PC12R-8 HS

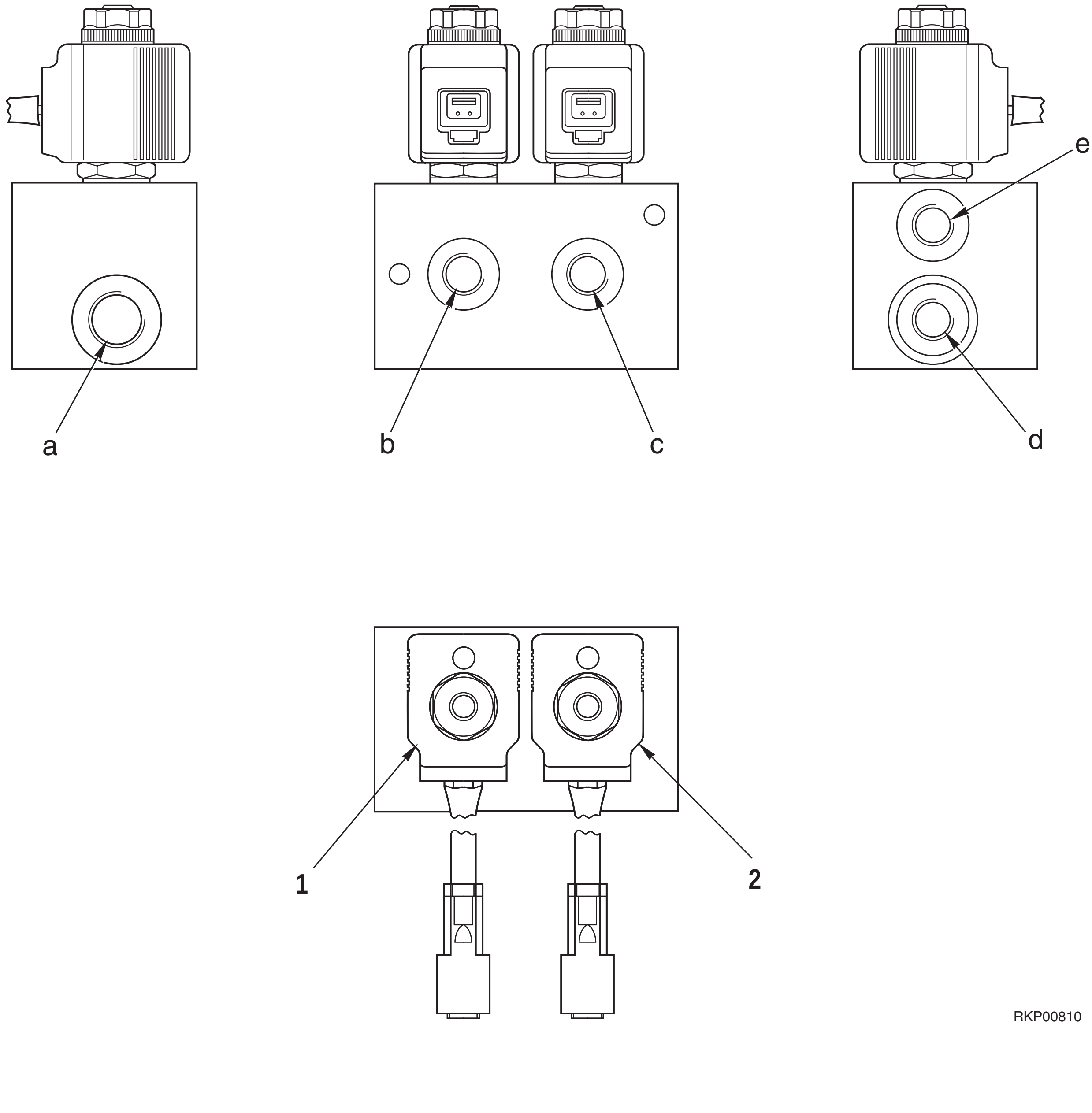


a. T Port - To hydraulic tank
b. P Port - From control valve (Pi2 Port)
c. A Port - To PPC valves (P Port)

1. EV1 Servocontrol

SERVOCONTROL
PC12R-8 MISTRAL - PC12R-8 MISTRAL HS
PC15R-8 - PC15R-8 HS

✻ UP TO SERIAL NUMBER:
PC12R-8 - N. F31768
PC15R-8 - N° F22588

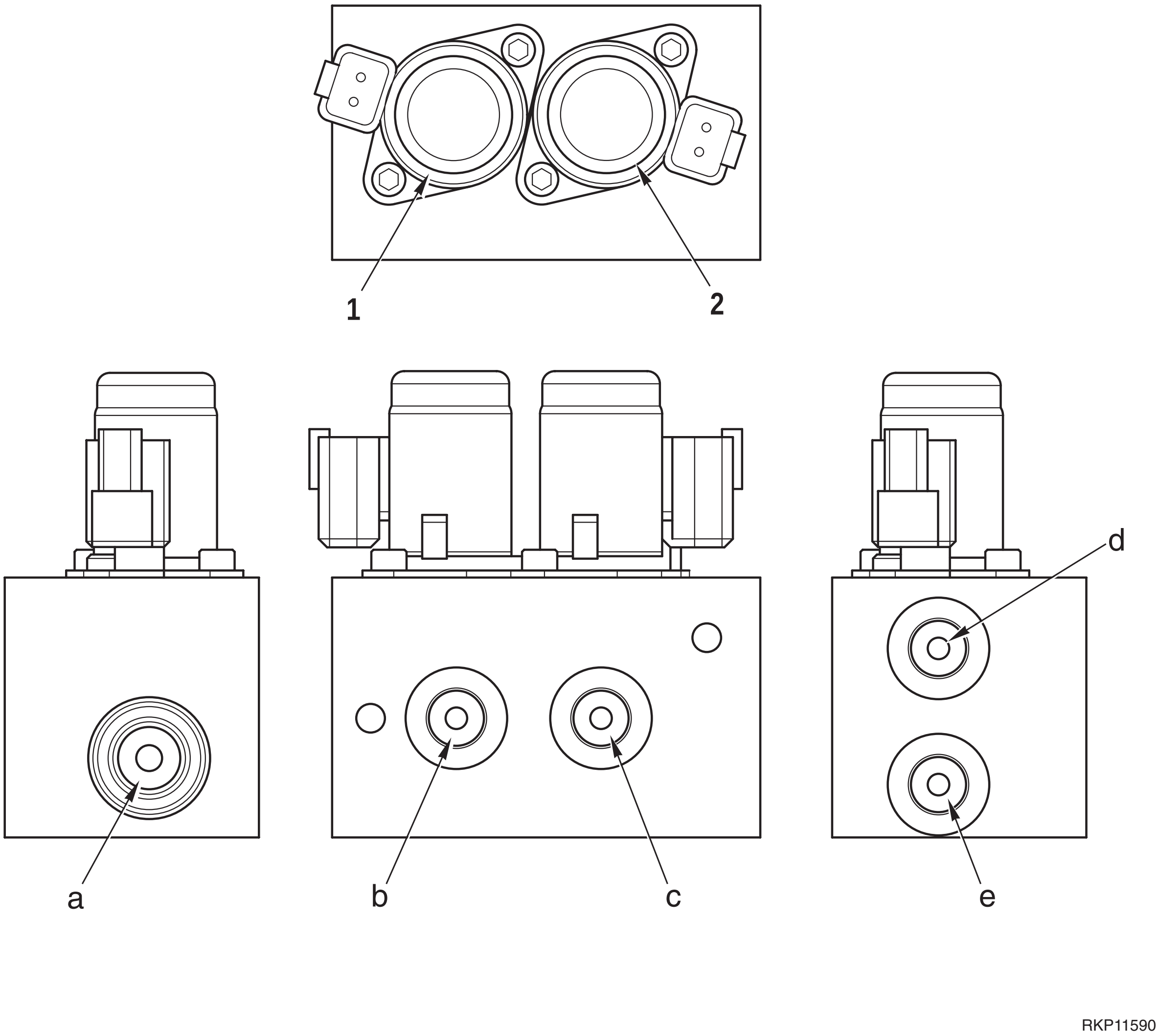


a. S Port - To accumulator
b. A Port - To PPC valves (P Port)
c. B Port - To swivel joint (G Port)
d. P Port - From control valve (Pi2 Port)
e. T Port - To hydraulic tank

1. EV1 Servocontrol
2. EV2 Travel increment

SERVOCONTROL
PC12R-8 MISTRAL - PC12R-8 MISTRAL HS
PC15R-8 - PC15R-8 HS

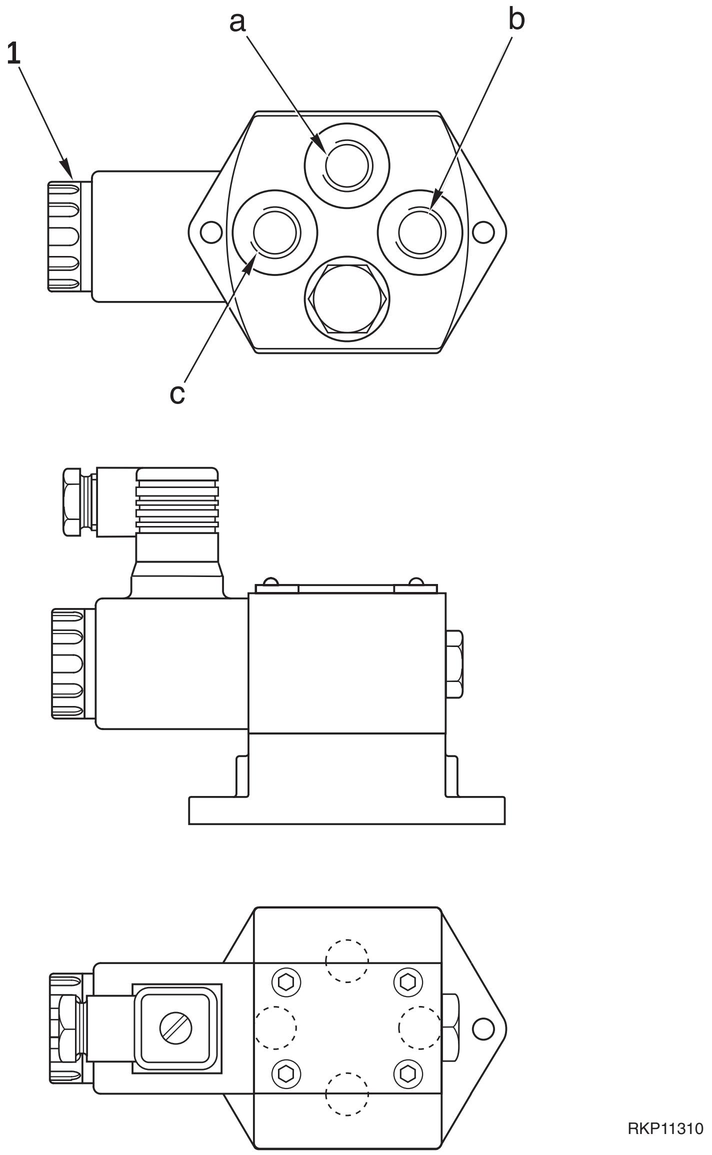
✻ **FROM SERIAL NUMBER:**
PC12R-8 - N. F31769
PC15R-8 - N° F225889



a. S Port - To accumulator
b. A Port - To PPC valves (P Port)
c. B Port - To swivel joint (G Port)
d. P Port - From control valve (Pi2 Port)
e. T Port - To hydraulic tank

1. EV1 Servocontrol
2. EV2 Travel increment

VARIABLE GAUGE UNDERCARRIAGE SERVOCONTROL
(FOR VERSION HS)

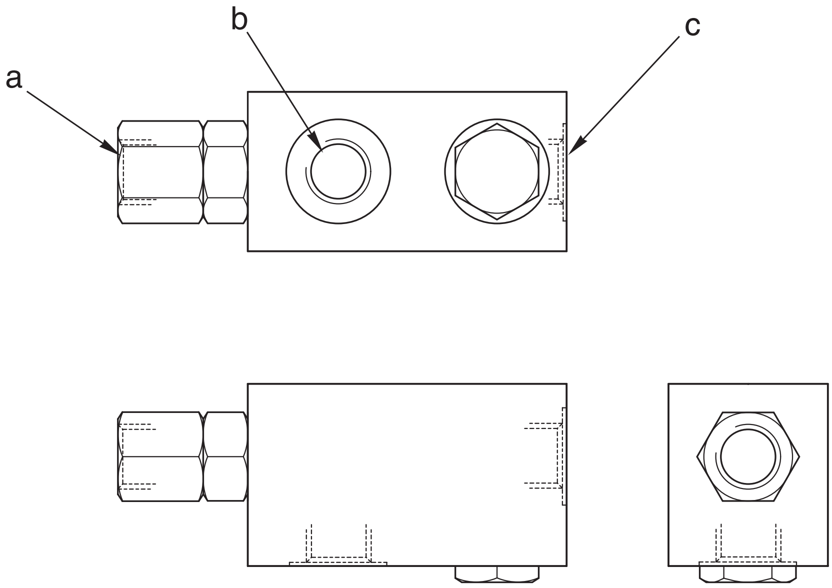


a. P Port - Dal distributore (B7 Port)
b. B Port - To swivel joint (2 Port)
c. A Port - To swivel joint (8 Port)

1. EV3 solenoid valve
   (optional equipment L.H. side)

SAFETY VALVE

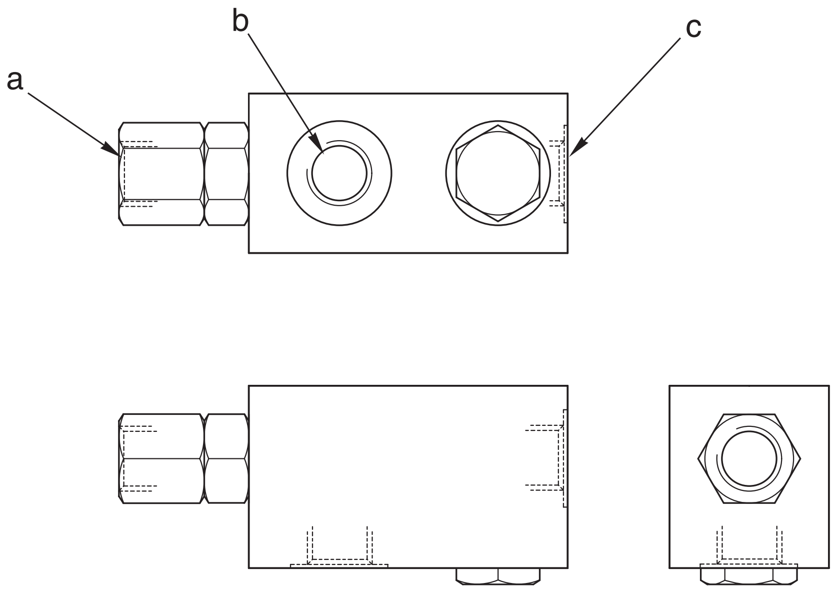
BLADE (with variable gauge undercarriage)



RKP11320

a. C2 Port - To blade cylinder (Bottom side)
b. V2 Port - From swivel joint (3 Port)
c. C1 Port - From swivel joint (8 Port)

CUTTING SHOVEL CONTROL VALVE



RKP11320

a. T Port - From control valve (A9 Port)
b. P Port - To hydraulic tank
c. A Port - To attachment (Left side)
d. B Port - To attachment (Right side)
e. a Port - From PPC valve (Hammer) (P2 Port)
f. b Port - From PPC valve (Hammer) (P1 Port)

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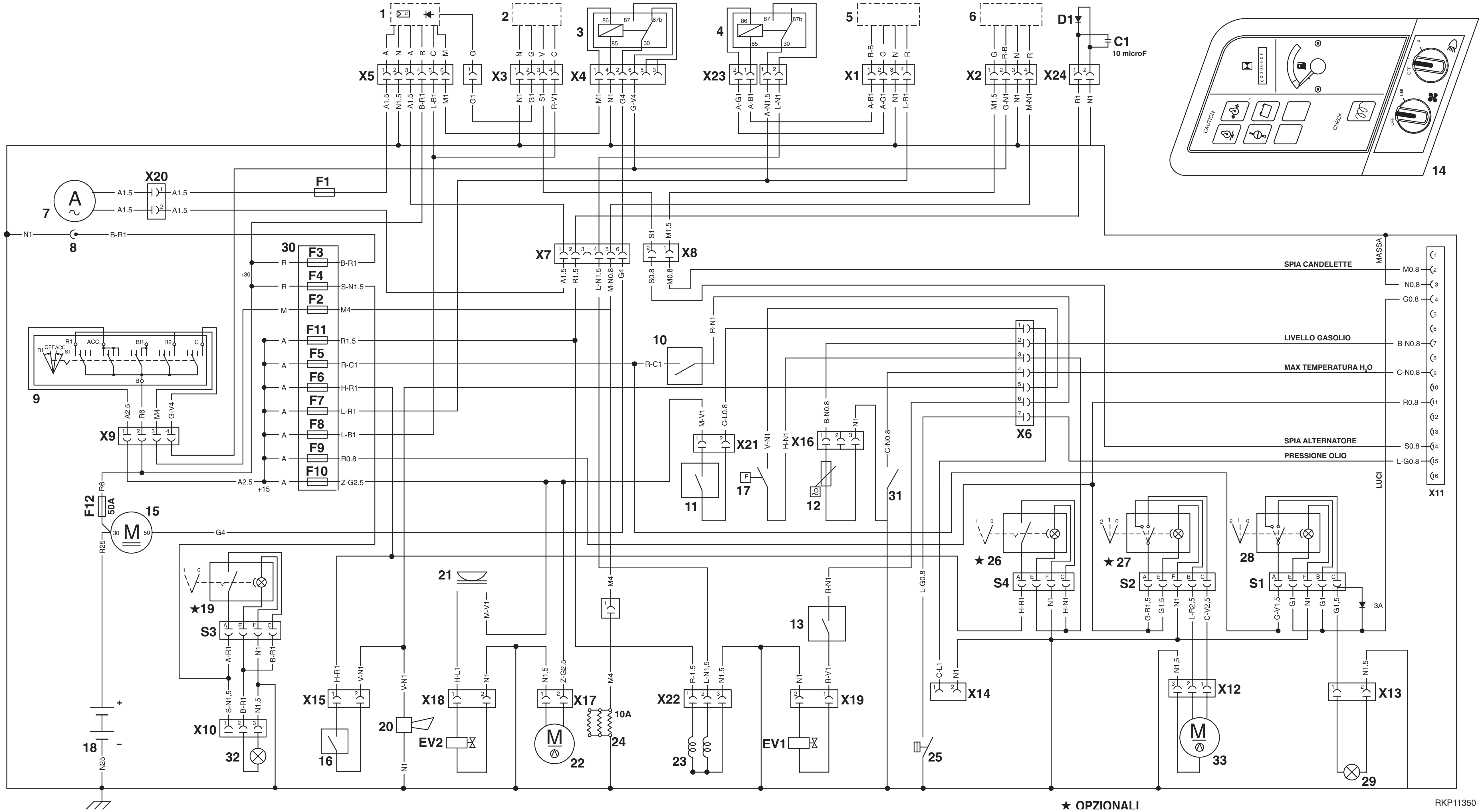
ELECTRICAL CIRCUIT DIAGRAM



COMPONENTS

1 - Rectfier - Voltage regulator
2 - Battery warning light relay
3 - Starter relay
4 - Stop motor relay
5 - Timer 1" stop motor solenoid
6 - Timer 15" preheather warning light
7 - Alternator (20A)
8 - Electric socket
9 - Starter switch
10 - R.H. Servocontrol push-button
11 - Optional push-button (L.H. PPC valve)
12 - Fuel level
13 - L.H. Servocontrol push-button
14 - Warning lights - Instrument - check box
15 - Starting motor
16 - Horn push-button
17 - Safety pressure switch (TBG)
18 - Battery (12V 45Ah 210A)
19 - Rotating beam switch (optional)
20 - Horn
21 - Travel increment pedal
22 - Fuel pump
23 - Stop motor (instantaneous current 30A - constant current 0.8A)
24 - Preheater (10A)
25 - Engine oil pressure switch
26 - TBG switch (optional)
27 - Fan heating switch (optional)
28 - Working beam and dashboard switch
29 - Working beam
30 - Fuses box
31 - Coolant temperature sensor
32 - Rotating beam
33 - Fan heating
EV1 - Servocontrol solenoid valve
EV2 - Travel increment solenoid valve
D1 - Hold solenoid diode
S1 - Working beam and dashboard switch
S2 - Fan heating switch (optional)
S3 - Rotating beam switch (optional)
S4 - TBG switch (optional)

CONNECTORS

X1 - 4 ways connector stop motor timer, solenoid
X2 - 4 ways connector preheater timer
X3 - 4 ways connector battery warning light relay
X4 - 6 ways connector starter relay
X5 - 6 ways connector voltage regulator relay
X6 - 6 ways connector motor line
X7 - 7 ways connector motor line
X8 - 2 ways connector check box line
X9 - 4 ways connector starter switch line
X10 - 3 ways connector cabin line
X11 - 6 ways connector instrument and warning light line
X12 - 3 ways connector heater line
X13 - 2 ways connector working beam line
X14 - 2 ways connector optional solenoid valve line
X15 - 2 ways connector horn line
X16 - 3 ways connector fuel indicator level line
X17 - 2 ways connector fuel pump line
X18 - 2 ways connector travel increment solenoid valve line
X19 - 2 ways connector servocontrol solenoid valve line
X20 - 2 ways connector alternator line
X21 - 2 ways connector optional push-button line
X22 - 3 ways connector stop motor line
X23 - Connector stop motor relay
X24 - Connector preheater

FUSES

F1 - Alternator
F2 - Preheater
F3 - Electrical socket
F4 - Rotating beam + cabin
F5 - Servocontrol + working beam
F6 - Horn + TBG
F7 - Stop motor relay
F8 - Compound alternator
F9 - Instrument
F10 - Fuel pump + travel increment push-button
F11 - Stop motor solenoid
F12 - General fuse

GROUP 20

20 TESTING AND ADJUSTMENTS

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⚠ When carrying out controls, adjustments or analyses for troubleshooting, park the machine on firm, level ground. Apply all the machine safety devices and use blocks to prevent any machine movement.

⚠ When more than one person is engaged in the work, use the prescribed notices that indicate that the machine is undergoing maintenance. Do not allow any unauthorised persons to remain in the vicinity.

⚠ When checking the level of the cooling liquid, wait until this liquid has cooled. If the radiator cap is removed while the liquid is still hot and under pressure, it may cause severe burns.

⚠ Take great care not to get entangled in moving parts (fan, alternator belt or any of the rotating elements).

NORMAL OR STANDARD TECHNICAL DATA

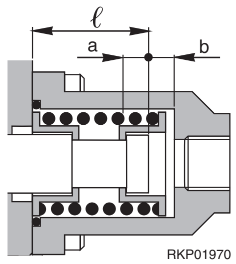
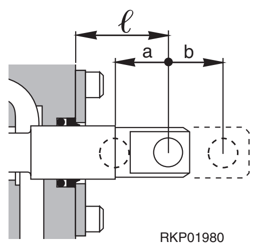
● FOR THE ENGINE

Machine model			PC12R-8	
Engine			3D68E-N3FA	
Check item	Test Condition	Unit	Standard value	Permissible value
Engine speed	High idling Low idling Rated speed	rpm rpm rpm	2620±25 1390±25 2450	— — —
Exhaust gas colour	At sudden acceleration At high idling speed	Bosch index	4.0 0.5	Max. 7.5 Max. 0.9
Valve clearance	Intake valve (20°C) Exhaust valve (20°C)	mm mm	0.20 0.20	— —
Compression pressure (SAE30 oil)	Oil temperature 40-60°C (Engine speed)	kg/cm^2 rpm	33±1 (250)	26±1 (250)
Blow-by pressure (SAE30 oil)	Water temperature in operating range At high idling speed	mm H_2O		
Engine oil pressure	(Water temperature in operating range) At high idling speed (SAE30) At low idling speed (SAE30) At low idling speed (SAE10)	 kg/cm^2 kg/cm^2 kg/cm^2		
Engine oil temperature	Whole speed range	°C	Max. 120°	Max. 120°
Fuel injection timing	Before top dead center (BTDC)	degrees	14±1	—
Fan-belt tension	Deflection when pressed with finger force of approx. 6 Kg	mm	10 – 15	—

● FOR THE ENGINE

PC15R-8					
3D68E-N3FB					
Standard value	Permissible value				
2780±25 1390±25 2600	— — —				
3.5 0.4	Max. 7.0 Max. 0.7				
0.20 0.20	— —				
33±1 (250)	26±1 (250)				
Max. 120°	Max. 120°				
14±1	—				
10–15	—				

- **FOR THE MACHINE**

Machine model				PC12R-8					
Classification	Check item	Test Condition	Unit	Standard value			Permissible value		
Engine	Engine speed with one pump at max. pressure	• Hydraulic oil temperature: 45 – 55°C • Cooling circuit: in correct range • Engine oil pressure: in correct range • Bucket circuit: max. pressure ★ Measure when pressure has stabilised	rpm						
Control valve	Boom control	 RKP01970	mm	ℓ	a	b	ℓ	a	b
Control valve	Arm control Bucket control Swing control Work equipment control		mm	30	6	6	30	6	6
Control valve	Blade control Boom swing control Travel control	 RKP01980	mm	20	6	6	20	6	6
Stroke of levers and pedals	Boom control lever	• At centre of lever knob • Reading at end of travel • Equipment on the ground • Engine stopped • Tip of pedal Neutral → Raise / Lower	mm	75			65 – 85		
Stroke of levers and pedals	Arm control lever	Neutral → Open / Curled	mm	75			65 – 85		
Stroke of levers and pedals	Bucket control lever	Neutral → Open / Curled	mm	75			65 – 85		
Stroke of levers and pedals	Swing control lever	Neutral → Swing RH / Swing LH	mm	75			65 – 85		
Stroke of levers and pedals	Blade control lever	Neutral → Raise / Lower	mm	60			50 – 70		
Stroke of levers and pedals	Boom swing pedal	Neutral → Swing RH / Swing LH	mm	20			17 – 23		
Stroke of levers and pedals	Travel control lever	Neutral → Forward / Backward	mm	85			70 – 100		
Stroke of levers and pedals	Accelerator lever	Min. — Max.	mm	60			50 – 70		
Stroke of levers and pedals	Play of control lever	Work equipment, swing	mm	Max. 5			Max. 8		
Stroke of levers and pedals	Play of control lever	Travel	mm	Max. 10			Max. 15		

- **FOR THE MACHINE**

PC15R-8																	
Standard value			Permissible value														
ℓ	a	b	ℓ	a	b												
30	6	6	30	6	6												
20	6	6	20	6	6												
75			65 – 85														
75			65 – 85														
75			65 – 85														
75			65 – 85														
60			50 – 70														
20			17 – 23														
85			70 – 100														
60			50 – 70														
Max. 5			Max. 8														
Max. 10			Max. 15														

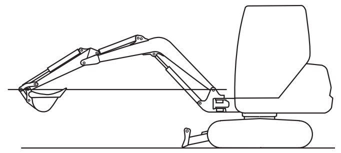
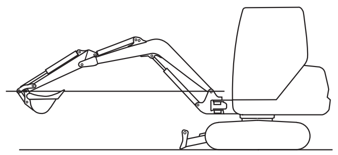
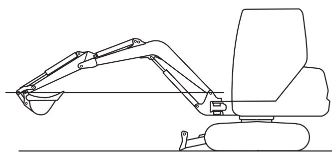
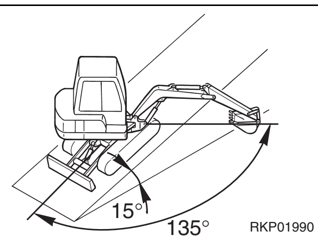
- **FOR THE MACHINE**

Machine model					PC12R-8	
Classification	Check item	Test Condition		Unit	Standard value	Permissible value
Operating force for control of levers and pedals	Boom lever	• Engine speed: high idling • Hydraulic oil temperature: 45 – 55°C • Instrument coupling at centre of control lever knob • Instrument coupling on outside edge (for pedal control) • Reading at end of travel		kg	2.0	1.7 – 2.3
	Arm lever				2.0	1.7 – 2.3
	Bucket lever				2.0	1.7 – 2.3
	Swing lever				2.0	1.7 – 2.3
	Boom swing pedal				6.5	5.5 – 7.5
	Blade lever				3.0	2.5 – 3.5
	Travel control lever				2.0	1.7 – 2.3
	Travel accelerator lever		Min. → Max.		7.0	6 – 8
			Max. → Min.		6.0	5 – 7
Hydraulic pressure	Unload pressure	• Engine speed: high idling • Hydraulic oil temperature: 45 – 55°C • Check one circuit at a time • All levers at HOLD • Relieve pump outlet pressure	P1	kg/cm^2	20	20 – 30
			P2			
			P3		29	26 – 35
	Boom	• Engine speed: high idling • Hydraulic oil temperature: 45 – 55°C • Check one circuit at a time • Relieve pump outlet pressure		kg/cm^2	190	190 – 200
	Arm				190	190 – 200
	Bucket				190	190 – 200
	Swing				125	125 – 135
	Boom swing				190	190 – 200
	Blade/Variable gauge undercarriage				190	190 – 200
	Travel				190	190 – 200
	Servocontrols				29	26 – 35
	LS differential pressure		All levers at HOLD		–	–
			Travel rotating freely, travel lever at half-way position		–	–

- **FOR THE MACHINE**

PC15R-8					
Valore Normale	Valore Ammesso				
2.0	1.7 – 2.3				
2.0	1.7 – 2.3				
2.0	1.7 – 2.3				
2.0	1.7 – 2.3				
6.5	5.5 – 7.5				
3.0	2.5 – 3.5				
2.0	1.7 – 2.3				
7.0	6 – 8				
6.0	5 – 7				
20	20 – 30				
29	26 – 35				
210	210 – 220				
210	210 – 220				
210	210 – 220				
125					
210	210 – 220				
210	210 – 220				
210	210 – 220				
29	26 – 35				
20	20 – 30				
–	–				

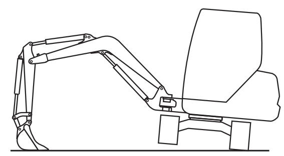
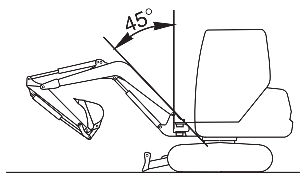
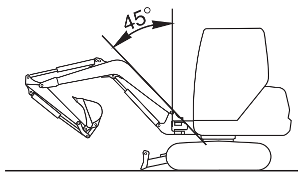
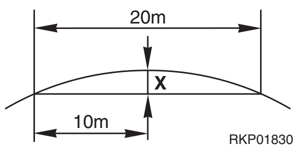
● FOR THE MACHINE

Machine model					PC12R-8	
Classifi-cation	Check item	Test Condition		Unit	Standard value	Permissible value
Swing	Braking angle	Work equipment at max. reach  RKP01840 ● No load in bucket ● Engine speed: high idling ● Hydraulic oil temperature: 45 – 55°C ● Make centering marks on the outer swing circle rings. Rotate the revolving frame 360° and lock in position. Measure the difference between the marks after stopping.		mm (Degree)	68 (17°)	Max. 80 (Max. 20°)
Swing	Time taken to start swing	Work equipment at max. reach  RKP01840 ● No load in bucket ● Engine speed: high idling ● Hydraulic oil temperature: 45 – 55°C ● Measure the time taken for swings to start from positions at 90° and 180°.	90°	sec	2	1.8 – 2.2
			180°		3.8	3.4 – 4.2
Swing	Time taken for to swing	Work equipment at max. reach  RKP01840 ● No load in bucket ● Engine speed: high idling ● Hydraulic oil temperature: 45 – 55°C ● Make one turn to settle machine ● Measure the time taken to make 5 full swings.		sec	34.0	Max. 38.0
Swing	Hydraulic drift of swing	 ● Load in bucket PC12R: 63 kg PC15R: 72 kg ● Engine switched off ● Hydraulic oil temperature: 45 – 55°C ● Park the machine on a 15° slope and position the boom at 135° with respect to the ground surface. ● On the outer swing circle, mark the position between revolving frame and track frame. After 15 minutes measure the drift.		mm (Degree)	300 (75°)	Max. 360 (Max. 90°)

- **FOR THE MACHINE**

PC15R-8					
Standard value	Permissible value				
72 (18°)	Max. 84 (Max. 21°)				
1.8	1.6 – 2.0				
3.1	2.8 – 3.9				
32.0	Max. 36.0				
300 (75°)	Max. 360 (Max. 90°)				

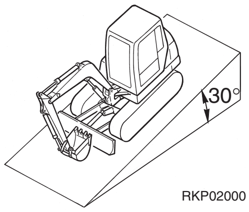
● FOR THE MACHINE

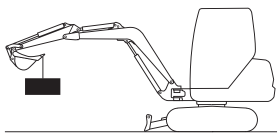
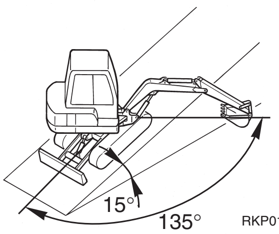
Machine model					PC12R-8	
Classifi-cation	Check item	Test Condition		Unit	Standard value	Permissible value
Swing	Internal leakage from swing motor	● Engine speed: high idling ● Hydraulic oil temperature: 45 – 55°C ● Swing lock: engaged ● Measure the leakage ● Pressurize circuit.		cm^3/ min	600	Max. 1000
Travel	Travel motor swing speed (1) (no-load)	Measuring posture  ● Engine speed: high idling ● Hydraulic oil temperature: 45 – 55°C ● Rest the bucket on the ground, raise one track-shoe, rotate one turn, then measure time taken for next.	Low speed	sec	29.5	29.5±3
			High speed		—	—
	Travel speed (2)	Measuring posture  ● Engine speed: high idling ● Hydraulic oil temperature: 45 – 55°C ● On flat ground ● Travel for at least 10 metres and then check on the time needed to cover 20 metres ● ( ): for rubber shoe.	Low speed	sec	36.0	36±4
			High speed		—	—
	Travel deviation	 ● Engine speed: high idling ● Hydraulic oil temperature: 45 – 55°C ● Travel 20 metres on flat ground and measure the deviation. ★ The surface must be firm and horizontal.  ★ Measure dimension «X»		mm	Max. 500	Max. 550

● FOR THE MACHINE

PC15R-8					
Standard value	Permissible value				
600	Max. 1000				
28.0	28±3				
14.0	14±2				
34.0	34±4				
17.0	17±2				
Max. 500	Max. 550				

• FOR THE MACHINE

<table>
<tr><td colspan="5">Machine model</td><td colspan="2">PC12R-8</td></tr>
<tr><td>Classification</td><td>Check item</td><td colspan="2">Test Condition</td><td>Unit</td><td>Standard value</td><td>Permissible value</td></tr>
<tr><td rowspan="2">Travel</td><td>Hydraulic drift of travel motors</td><td colspan="2">Measuring posture


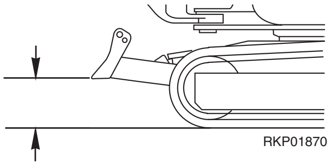
RKP02000
• Engine stopped.
• Hydraulic oil temperature: 45 – 55°C.
• Machine parked on sloping ground.
• Measure the drift after 5 minutes</td><td>mm</td><td>Max. 200</td><td>Max. 240</td></tr>
<tr><td>Leakage of travel motor</td><td colspan="2">• Engine speed: high idling
• Hydraulic oil temperature: 45 – 55°C
• Lock shoe</td><td>cm^3/min</td><td>Max. 75</td><td>Max. 90</td></tr>
<tr><td rowspan="9">Hydraulic drift of working equipment</td><td rowspan="2">Total work equipment (Downward movement of tips of bucket teeth)</td><td rowspan="7">Measuring posture

RKP01860
• Bucket: rated load:
PC12R: 63 kg
PC15R: 72 kg
• In this position, measure extension or retraction of each cylinder, and any leakages occurring when a load is applied to the tips of the bucket teeth.
• Horizontal and level ground
• Levers: neutral
• Engine: switched off
• Oil temperature: 45 – 55°C.
• Take measurements as soon as the engine stops.
• Measure the variations every 5 minutes and check the total variation after 15 mins.</td><td>Short arm</td><td rowspan="7">mm</td><td>Max. 300</td><td>Max. 340</td></tr>
<tr><td>Long arm</td><td>Max. 300</td><td>Max. 350</td></tr>
<tr><td rowspan="2">Boom cylinder (Retraction)</td><td>Short arm</td><td>Max. 20</td><td>Max. 30</td></tr>
<tr><td>Long arm</td><td>Max. 20</td><td>Max. 33</td></tr>
<tr><td rowspan="2">Arm cylinder (Extension)</td><td>Short arm</td><td>Max. 20</td><td>Max. 30</td></tr>
<tr><td>Long arm</td><td>Max. 20</td><td>Max. 33</td></tr>
<tr><td>Bucket cylinder (Retraction)</td><td></td><td>Max. 15</td><td>Max. 20</td></tr>
<tr><td rowspan="2">Boom swing</td><td rowspan="2">

RKP01990
• Bucket: rated load:
PC12R: 63 kg
PC15R: 72 kg
• Engine: switched off
• Oil temperature: 45 – 55°C
• In the same position as above, stop the machine on a 15° slope and position the revolving frame at 135°. Measure the extension and retraction of the cylinder after 15 minutes.</td><td>Short arm</td><td rowspan="2">mm</td><td>Max. 15</td><td>Max. 20</td></tr>
<tr><td>Long arm</td><td>Max. 15</td><td>Max. 22</td></tr>
</table>

• FOR THE MACHINE

PC15R-8					
Standard value	Permissible value				
Max. 200	Max. 240				
Max. 75	Max. 90				
Max. 300	Max. 340				
Max. 300	Max. 350				
Max. 20	Max. 30				
Max. 20	Max. 33				
Max. 20	Max. 30				
Max. 20	Max. 33				
Max. 15	Max. 20				
Max. 15	Max. 20				
Max. 15	Max. 22				

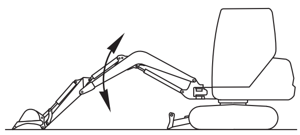
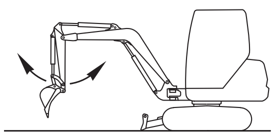
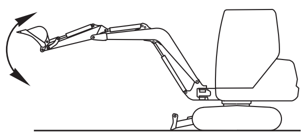
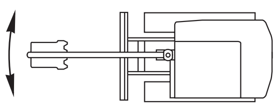
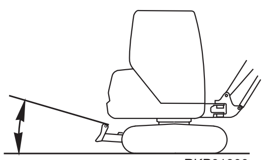
● FOR THE MACHINE

Machine model				PC12R-8	
Classifi-cation	Check item	Test Condition	Unit	Standard value	Permissible value
Hydraulic drift of working equipment	Blade (measure the downward movement of the edge of the blade)	 RKP01870 ● Engine stopped ● Hydraulic oil temperature: 45 – 55°C ● Raise the blade to its maximum height and measure the height of the edge from the ground. Measure the downward after 15 mins.	mm	Max. 20	Max. 30
Internal cylinder leakage	Boom	● Engine speed: high idling ● Hydraulic oil temperature: 45 – 55°C ● Check leakages: on the cylinder on the side opposite to the one under pressure. ★ Check one cylinder at a time	cm^3/min	2	Max. 5
	Arm			2	Max. 5
	Bucket			2	Max. 5

- **FOR THE MACHINE**

PC15R-8					
Standard value	Permissible value				
Max. 20	Max. 30				
2	Max. 5				
2	Max. 5				
2	Max. 5				

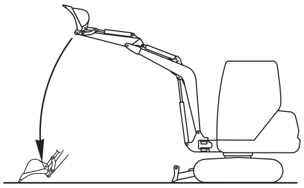
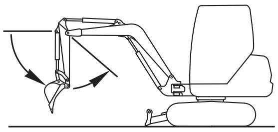
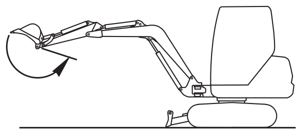
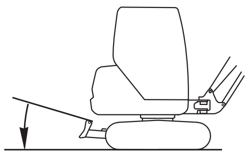
● FOR THE MACHINE

Machine model						PC12R-8	
Classification		Check item	Test Condition		Unit	Standard value	Permissible value
Work equipment	Speed	Boom Bucket teeth on the ground ↕ Cylinder fully extended	● Measuring posture  RKP01820 ● Engine speed: high idling ● Hydraulic oil temperature: 45 – 55°C	Raise	sec.	Canopy 2.0 Cabin	Canopy 1.6 – 2.4 Cabin ......
				Lower		Canopy 2.0 Cabin	Canopy 1.6 – 2.4 Cabin ......
		Arm Cylinder fully retracted ↕ Cylinder fully extended	● Measuring posture  RKP01880 ● Engine speed: high idling ● Hydraulic oil temperature: 45 – 55°C	Closed		2.5	2.0 – 3.0
				Inout		2.5	2.0 – 3.0
		Bucket Cylinder fully retracted ↕ Cylinder fully extended	● Measuring posture  RKP01890 ● Engine speed: high idling ● Hydraulic oil temperature: 45 – 55°C	Dump		2.6	2.0 – 3.2
				Curled		2.6	2.0 – 3.2
		Boom swing Cylinder fully retracted ↕ Cylinder fully extended	● Measuring posture  RKP01960 ● Engine speed: high idling ● Hydraulic oil temperature: 45 – 55°C	L.H.		4.9	3.9 – 5.9
				R.H.		5.1	4.1 – 6.1
		Blade Blade on the ground ↕ Blade raised to max. height	● Measuring posture  RKP01900 ● Engine speed: high idling ● Hydraulic oil temperature: 45 – 55°C	Raise		0.8	0.6 – 1.0
				Lower		0.9	0.7 – 1.1

- **FOR THE MACHINE**

PC15R-8					
Standard value	Permissible value				
Canopy 2.0 Cabin	Canopy 1.6 – 2.4 Cabin				
Canopy 2.0 Cabin	Canopy 1.6 – 2.4 Cabin				
2.5	2.0 – 3.0				
2.5	2.0 – 3.0				
2.6	1.8 – 2.6				
2.0	1.6 – 2.4				
6.2	5.2 – 7.2				
5.8	4.8 – 6.8				
0.9	0.7 – 1.1				
1.1	0.8 – 1.4				

• FOR THE MACHINE

Machine model					PC12R-8	
Classification	Check item		Test Condition	Unit	Standard value	Permissible value
Work equipment	Time lags	Boom	Measuring posture  RKP01910 • Engine speed: low idling • Hydraulic oil temperature: 45 – 55°C • With the work equipment fully extended, lower the boom and measure the time taken to raise the machine from when the bucket reaches the ground.	sec.	Max. 2	Max. 2
		Arm	Measuring posture  RKP01920 • Engine speed: low idling • Hydraulic oil temperature: 45 – 55°C • Bring the boom into a horizontal position. Retract the arm cylinder completely and then extend it. Measure the time elapsing from when the arm stops at dead centre until it starts to move again.		Max. 2	Max. 2
		Bucket	Measuring posture  RKP01930 • Engine speed: low idling • Hydraulic oil temperature: 45 – 55°C • Bring the boom into a horizontal position. Retract the bucket cylinder completely, then extend it. Measure the time elapsing from when the bucket stops at dead centre until it starts to move again.		Max. 2	Max. 2
		Blade	Measuring posture  RKP01940 • Engine speed: low idling • Hydraulic oil temperature: 45 – 55°C • Raise the blade to its max. height, then lower it. Measure the time that it takes to raise the machine after the blade touches the ground		Max. 1	Max. 1

- **FOR THE MACHINE**

PC15R-8					
Standard value	Permissible value				
Max. 2	Max. 2				
Max. 2	Max. 2				
Max. 2	Max. 2				
Max. 1	Max. 1				

● FOR THE MACHINE

Machine model				PC12R-8	
Classifi-cation	Check item	Test Condition	Unit	Standard value	Permissible value
Pumps	Gear pump P1	Theoretical flow	cm^3/rev	11	
		Motor speed	rpm	2450	
		Test pressure	kg/cm^2	190^{0}_{+5}	
		Nominal capacity	ℓ/min	25	
	Gear pump P2	Theoretical flow	cm^3/rev	4.5	
		Motor speed	rpm	2450	
		Test pressure	kg/cm^2	125^{0}_{+5}	
		Nominal capacity	ℓ/min	10.3	
	Gear pump P3	Theoretical flow	cm^3/rev	3	
		Motor speed	rpm	2450	
		Test pressure	kg/cm^2	30^{0}_{+5}	
		Nominal capacity	ℓ/min	6.8	

- **FOR THE MACHINE**

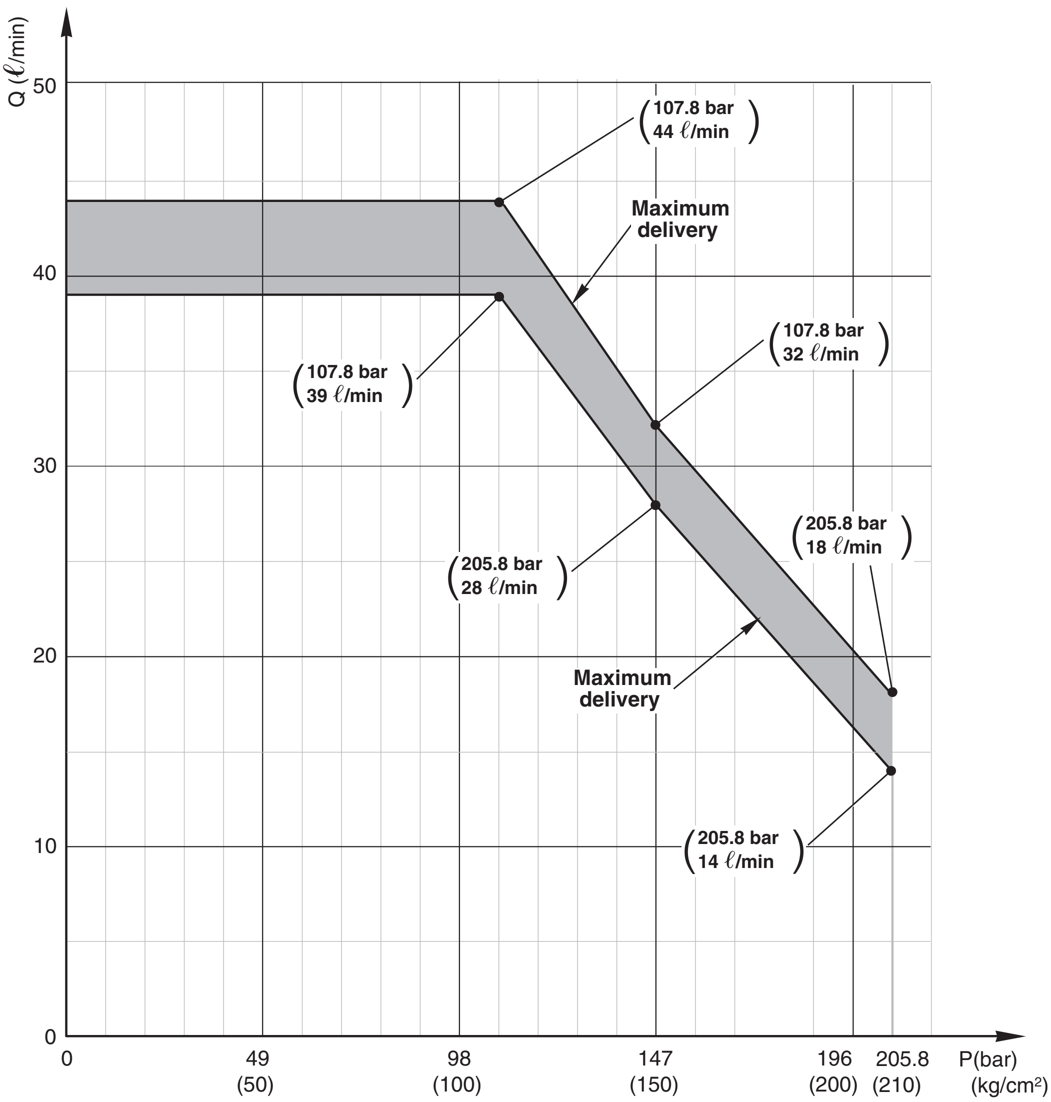
PC15R-8					
Standard value	Permissible value				
—	—				
—	—				
—	—				
—	—				
2.75					
2600					
30^{0}_{+5}					
6.6					
—	—				
—	—				
—	—				
—	—				

Machine model	PC15R-8

Classification

- Delivery piston pump P1
- Pump speed: 2600 rpm
- Hydraulic oil temperature: 45 – 55°C

Pump characteristics



★ When measuring deliveries with the pumps mounted on the machine, it is difficult to use the accelerator to count the precise number of revs needed for this test.
Make delivery measurements with the engine running at a speed close to the test speed and then make a proportional calculation.

Example: MEASUREMENT

- Engine speed: 2525 rpm
- Delivery: 31 ℓ/min

PROPORTIONAL DELIVERY AT 2600 rpm
(31x2600)/2525 = 31.9 ℓ/min

SPECIAL TOOLS

Measurement check points	Symbol		Code	Name	Q.ty	Remarks
Valve clearance	A	1	Commercially available	Feeler gauge	1	—
Compression pressure	B	1	ATR800090	Compression gauge	1	0-70 kg/cm^2
		2	ATR800130	Adapter	1	—
Engine speed	C	1	ATR800070	Multi-scale tachometer	1	20 - 4000 rpm
		2	ATR800060	Stroboscopic tachometer	1	6 - 30000 rpm
Water and oil temperature	D	1	Commercially available	Digital temperature gauge	1	– 50 - 1200 °C
Hydraulic pressure	E	1	ATR800170	Compression gauge	1	Scale 60 bar
		2	ATR800140	Compression gauge	1	Scale 400 bar
		3	ATR800010	Compression gauge	1	Scale 600 bar
		4	ATR800200	Servocontrol kit (Differential pressure)	1	—
		5	3F3055600	Elbow	1	P2 Pressure
	F	1	ATR800120	Flowmeter	1	—
		2		Tube union kit	1	
Track shoe tension	G	1	823001135	Grease nipple	1	Included in the machine tool kit

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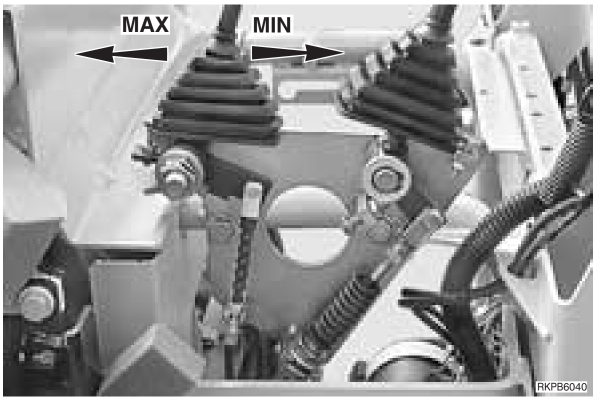
CHECKING THE ENGINE SPEED

⚠ When checking the engine rpm , always be very careful not to touch parts that reach high temperatures and not to get entangled in rotating elements.

★ Check the engine speed after the following conditions have been reached:
- Temperature of engine cooling water: 68 – 80 °C.
- Temperature of hydraulic oil: 45 – 55 °C.

1 - Mount and connect the tachometer **C1**.
   ★ If the stroboscopic tachometer **C2** is used, make a distinct mark on the engine pulley to facilitate the reading.

2 - Start the engine and check:
- Low idling without load (accelerator lever in "minimum" position).
- High idling without load (accelerator lever in "maximum" position).
  ★ Low idling: PC12R – PC15R: $1350^{\,0}_{+50}$ rpm
  ★ High idling: PC12R: 2600±50 rpm
  PC15R: 2775±50 rpm



★ If the minimum and maximum speeds do not fall within permissible limits when the engine is without load, check the position locks of the accelerator lever, and the sheathing of the accelerator well, before carrying out any tests under load. (See «ADJUSTMENT OF THE ACCELERATOR LEVER»).
- Engine rpm with the pumps under load.

★ Max. speed with pump P1 under load:
PC12R: 2550±50 rpm
PC15R: 2625±50 rpm

★ Max. speed with pumps P1 and P2 under load:
PC12R: 2400±50 rpm

★ If engine efficiency does not fall within permissible limits, have the engine checked by an authorised workshop.

ADJUSTMENT OF VALVE CLEARANCE

- Adjust the clearance between valve and rockers to the following values:

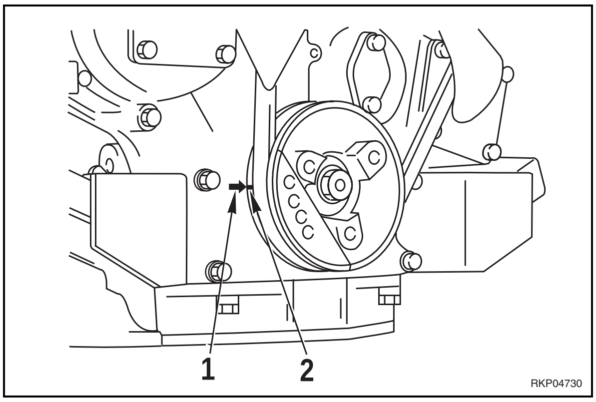
Unit: mm

With engine cold	Suction valves	Exhaust valves
	0.20	0.20

1 - Remove the valve cover.

2 - Rotate the drive shaft in the normal direction of rotation, until the No. 1 cylinder is in the top dead centre in a compression stroke corresponding to the alignment between the reference mark on the casing (1) and the mark (2) on the pulley.

★ If the cylinder is in a compression stroke, the valves do not move when the drive shaft is rotated slightly.
If the valves do move, rotate the drive shaft by one turn and realign the reference marks (1) and (2).

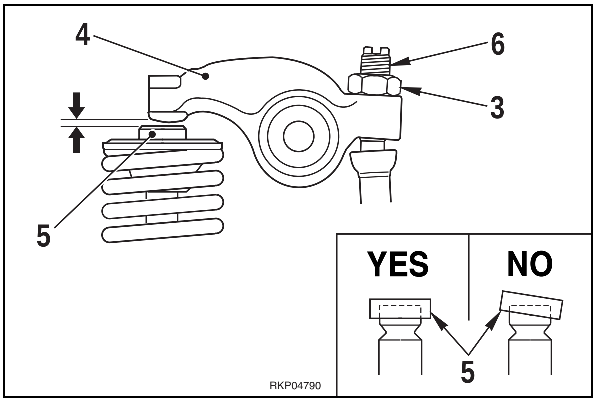


3 - Loosen the lock nut (3) and unscrew the adjustment screw (6) by approximately 1 turn.

★ Check that the valve cap (5) is lying flat on the valve stem and that there is no lop-sided wear.

1 - If the valve caps (5) are damaged, replace them with new ones.

2 - Make sure that the valve caps fit perfectly and are lying flat on the valve stem.



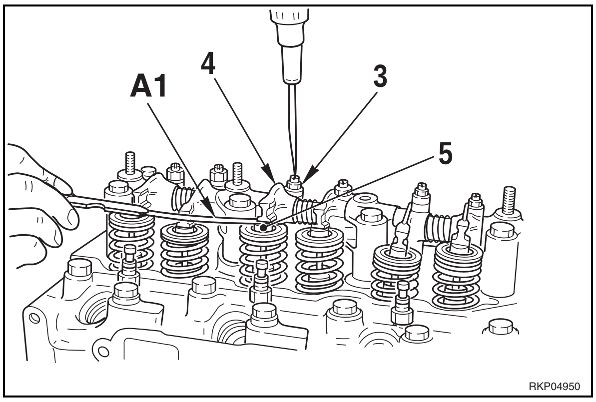
4 - Insert the feeler gauge **A1** between the rocker (4) and the valve cap (5).
Rotate the adjusting screw (6) until it rubs against the feeler gauge **A1**.
Secure this position with the nut (3).

Nm Lock nut: 25.5±2.5 Nm

★ After locking the nut (3), check the valve clearance again.

5 - After adjusting the No. 1 cylinder, rotate the drive shaft 240° each time and adjust the valve clearance of the other cylinders according to the ignition sequence.

★ Ignition sequence: 1 - 3 - 2.

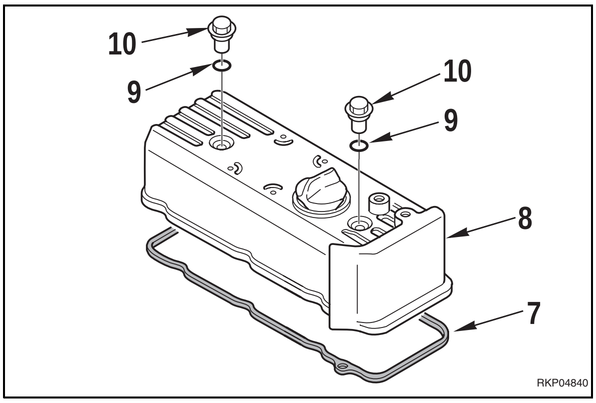


- **Assembly of the valve cover**

1 - Check the condition of the gasket (7) of the valve cover (8), and the O-rings (9). Thoroughly clean the contact surface on the cylinder heads.

2 - Replace the valve cover (8) and mount the O-rings (9) and the lock nuts (10).

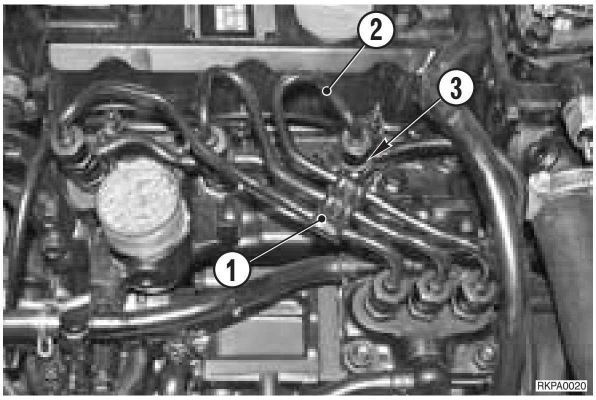
Nm Lock nuts for cover: 25±3 Nm



MEASUREMENT OF THE COMPRESSION PRESSURE

- While measuring the compression, take care not to get entangled in the cooling fan, the alternator belt, or in other rotating parts.
- Check all cylinders.

★ Test conditions:
- Engine: at working temperature.
- Hydraulic oil: 55 – 60 °C.
- Battery: fully charged.
- Valve clearance: adjusted (See «ADJUSTMENT OF VALVE CLEARANCE»).
- Air filter functioning properly.



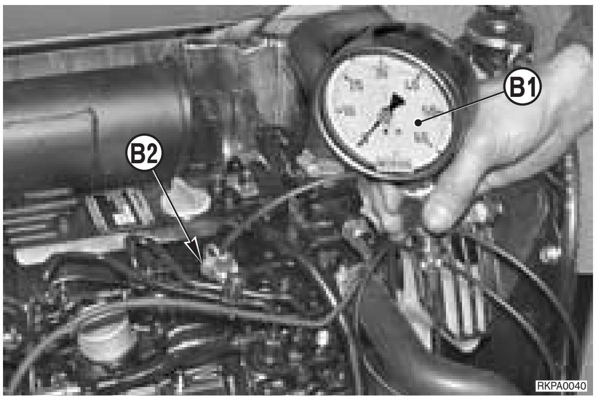
1 - Remove the clamp (1) and disconnect the high-pressure tube (2).

2 - Remove the nozzle holder (3) of the cylinder to be checked.

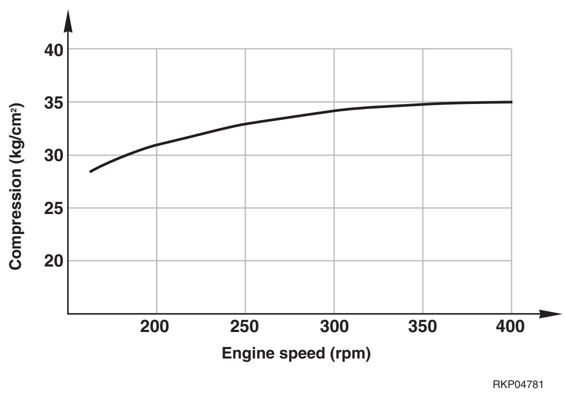
3 - Disconnect the connector (4) of the engine-stopping solenoid.

4 - Turn the engine over a few times, using the starting motor.

5 - Mount the adapter **B2** and connect the test pressure gauge **B1**.
  ★ Check that the seal is mounted in the adapter, and that it is undamaged.



6 - Turn the engine using the starting motor and read the compression value.
  ★ Read the compression value when the pressure gauge has stabilised.
  ★ While reading the compression, also check the engine rpm using the stroboscopic tachometer **C2**. If the speed does not correspond with the control value, check it against the diagram.
  ★ Compression value:
  Normal: 33±1 kg/cm^2 at 250 rpm
  Minimum permissible: 26±1 kg/cm^2 at 250 rpm
  ★ Maximum difference between the cylinders: 2 – 3 kg/cm^2



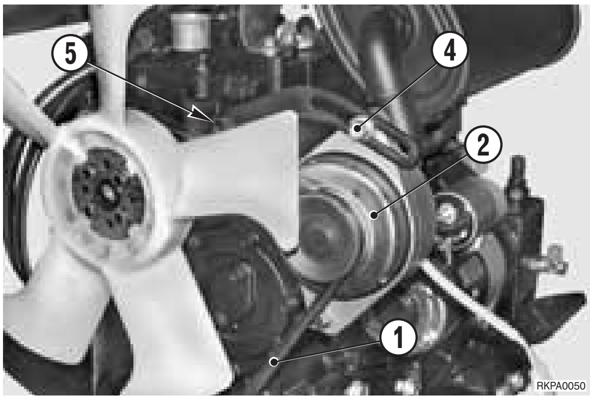
7 - After the reading, re-assemble the nozzle holder (3), and reconnect the high- pressure tube (2) and the connector (4).
  Nm Nut that secures the nozzle: 55 – 59.5 Nm
  Nm High-pressure coupling: 33 – 38.5 Nm

CONTROL AND ADJUSTMENT OF THE TENSION OF THE FAN BELT

1. Checking the tension

1 - Depress the belt (1) at the centre of the section between the alternator (2) and the pulley (3) that drives the water pump. Check the flexion.
At a pressure of 10 kg (98 N) the flexion should be 10 – 15 mm. If this value is not found, adjust the belt tension.

★ With a new belt the flexion should be 7 – 9 mm.



2. Adjusting the belt tension

1 - Loosen the screws (4) that secure the alternator (2) and the screw (5) that secures the belt-tightening stop.

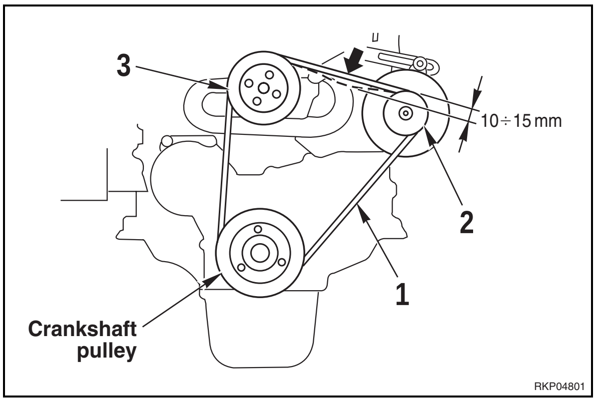
2 - Rotate the alternator (2) to give the belt (1) the correct tension and tighten the screws (4) and (5).

3 - Check the belt (1) tension.

★ If the belt has been replaced with a new one, check the tension again after about 20 hours of operation.

Nm Screws fastening the alternator to the timing system cover: 45 – 54 Nm

Nm Screws locking the support: 25 – 32 Nm



CONTROL AND ADJUSTMENT OF THE INJECTION TIMING

★ Check the injection timing of the No.1 cylinder by means of the No.1 union of the injection pump.

★ The cylinders are numbered 1-2-3 counting from the flywheel side.

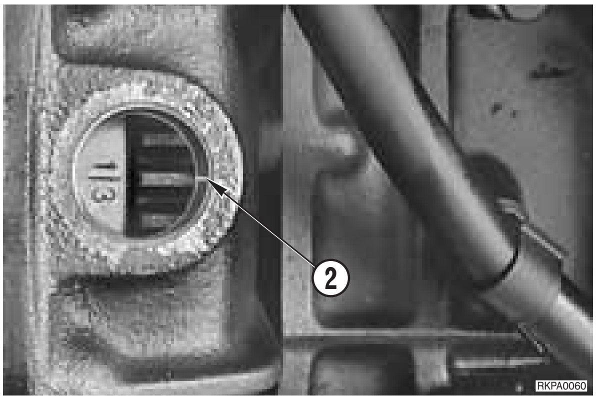
★ The spark advance notches of 0°-10°-15°-20°; are also marked on the flywheel. In order to read the intermediate values, sub-divide the sections between the two marks into equal lengths.

1 - Remove the cap (1) of the flywheel casing.

2 - Pass a screwdriver between the teeth and rotate the flywheel in a counter-clockwise direction (as seen from the flywheel side) until the 1/3 notch of the flywheel is aligned with the notch (2) marked inside the hole in the casing.

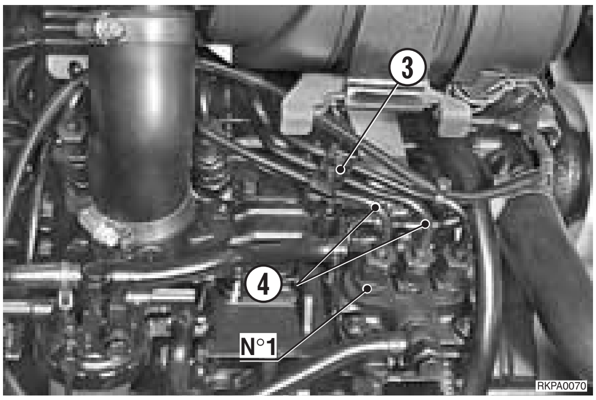
★ In this position, the piston of the No. 1 cylinder is at the top dead centre (B.T.D.C.). Check that the cylinder is in a compression stroke, i.e. that both valves are closed.

★ Once the B.T.D.C. has been ascertained, rotate the drive shaft in a clockwise direction (seen from the flywheel side) for about 25 teeth.



3 - Take off the clamp (3) and disconnect all the fuel delivery tubes (4) from the injection pump.

4 - Rotate the flywheel slowly in a counter-clockwise direction (seen from the flywheel side), checking carefully the level of the fuel in the No. 1 union of the injection pump. Stop the rotation when the fuel level starts to rise.



5 - Check the position of the notches at 15° and 10° that appear in the hole in the casing and, in function of the position, establish the true fuel injection timing.

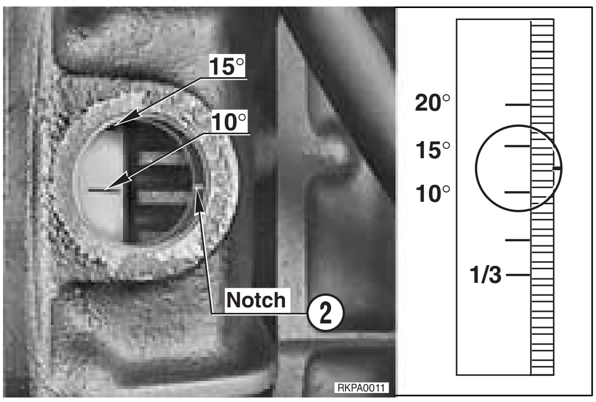
★ In order to determine the degrees of intermediate fuel injection timing, sub-divide the space between 10° and 15°.

★ Normal fuel injection timing: 14±1°

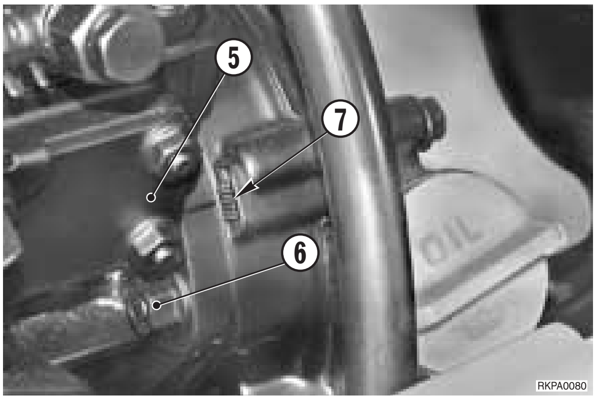
⚠ There are two ways of restoring the fuel injection timing:

a) By varying the angular position of the fuel injection pump.

b) By varying the thickness of the shim provided underneath the pump group.



1. Method "A" (Pump separated)

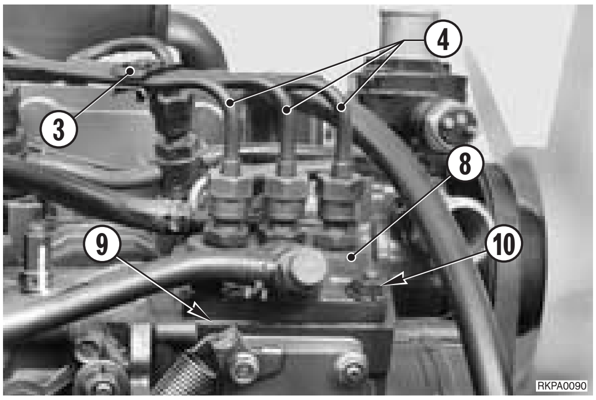


6 - Rotate the injection pump (5) towards the outside or towards the motor, after having loosened the pump (6) retaining nuts.
- To DELAY the injection, rotate the pump (5) towards the outside.
- To BRING FORWARD the injection rotate the pump (6) towards the cylinder block.
- ★ Check the extent of the movement on the scale (7).

7 - Lock the nuts (6) that fasten the pump to its block.

Pump fastening nuts: 25 – 35 Nm

2. Method "B" (Pump in its block)



8 - Remove the injection pump (8) and change the shim (9) provided underneath the pump.
- To DELAY the injection, increase the shim thickness.
- To BRING FORWARD the injection, decrease the shim thickness.

9 - Secure the pump (8) with the nuts (10).

Nuts: 50 – 60 Nm

★ After adjustment of the fuel injection timing:

10 - Connect the fuel delivery tubes (4) to the pump and replace the clamp (3).

Delivery tube couplings: 33 – 38.5 Nm

11 - Bleed any air from the fuel circuit.

CONTROL AND ADJUSTMENT OF THE ACCELERATOR STROKE

★ Test conditions:
- Engine: Switched off, but at working temperature.
- Working equipment: resting on the ground

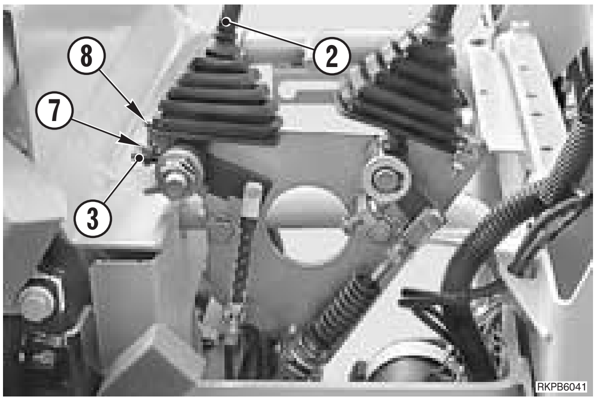
1 - Remove the top hood (1).

2 - Push the accelerator lever (2) to the end of its stroke in "minimum" position, until it rests on the screw (3).

3 - Check that the lever (4) on the cover of the injection pump governor touches the "minimum" adjustment screw.

4 - Eliminate the clearances between the sheathing (5) and the belt-stretcher (6).
  ★ Check carefully that the positions of the two levers remain fixed.

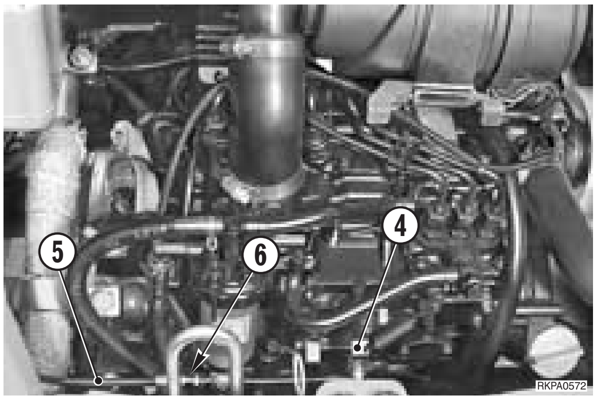
5 - Loosen the nut (7) and loosen the screw (8) by several turns.



6 - Start the engine and accelerate up to high idling speed, using the tachometer **C1** or **C2** to check.
  ★ If using the stroboscopic tachometer **C2**, make a distinct mark on the engine pulley to facilitate reading.
  ★ Max. speed: PC12R: 2600±50 rpm
  PC15R: 2775±50 rpm

7 - Keeping the high idling position, tighten the screw (8) until it rests against the lever (2). Secure the position of the screw with the nut (7).

8 - Make a final check of the MIN and MAX. engine speeds.



ADJUSTMENT OF THE STROKE OF THE BLADE COMMAND LEVER

★ Test conditions:
- Engine: switched off.
- Working equipment: resting on the ground.

The adjustment, carried out on the power train, is aimed at restoring the position of the command lever, keeping the neutral position of the valve block spool.

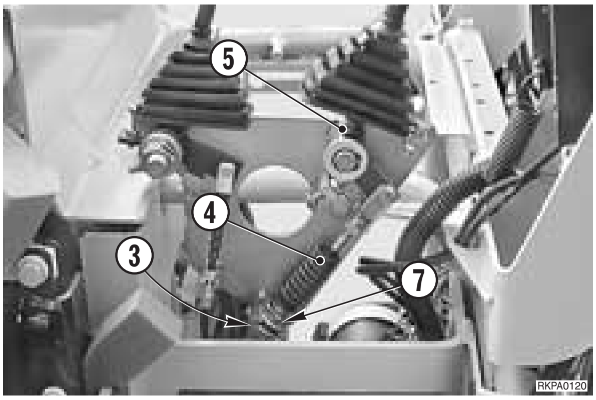
The procedure is as follows:

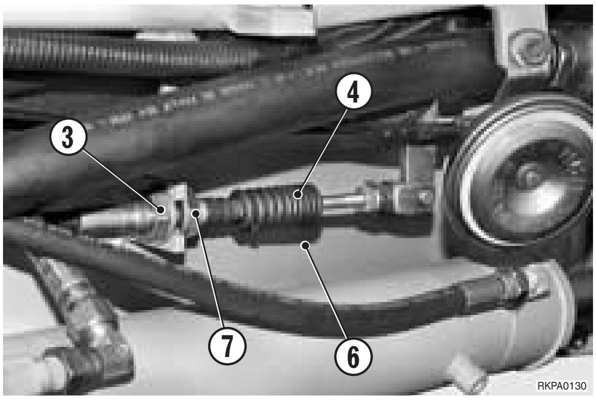
1 - Remove the top hood (1) and the right-hand side-hood (2).

2 - Loosen the inside nuts (3) that secure the sheathing (4) both on the side of the command lever (5) and on the upper chassis (6).

3 - Loosen an outside nut (7) and tighten the other until the lever (5) is centered with the outside nuts (7) behind the supports.

4 - Secure the position with the inside nuts (3).





5 - Loosen the nuts (8) and unscrew the lock-screws (9).

6 - Execute a full stroke in one of the two directions with the lever (5).

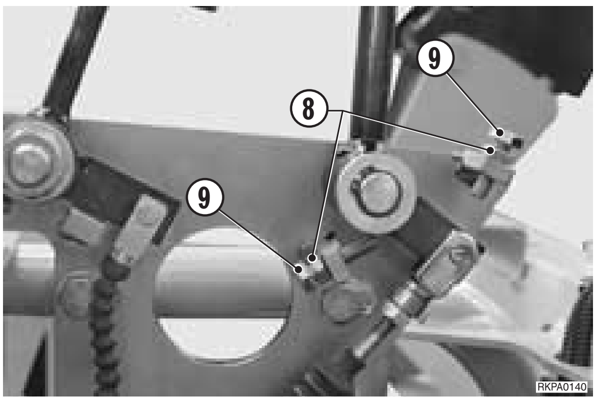
★ Make sure that the valve block spool executes the full stroke.

7 - Tighten the lock-screw (9) until it rests on the lever and then turn it for another half turn. Secure the position with the nut (8).

8 - Repeat this lever adjustment (5) for the other direction.

⚠ Before starting the engine to check the adjustment, make sure that the valve block spool returns to its neutral position each time the lever (5) is released.

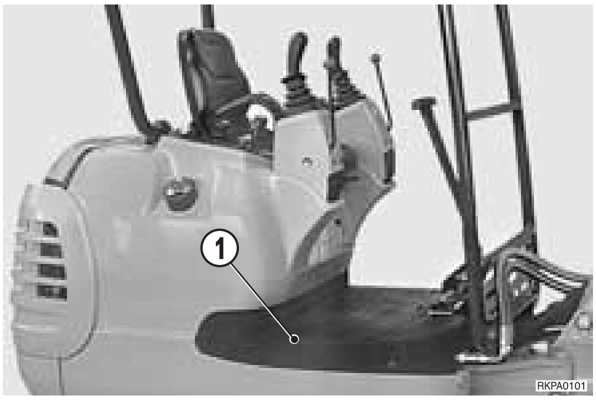
9 - Replace the engine hoods (1) and (2).



CONTROL AND ADJUSTMENT OF THE STROKE OF THE TRAVEL LEVER

★ Test conditions:
- Engine: switched off.
- Working equipment: resting on the ground.

1 - **Only for machines with a canopy.**
Remove the rubber mat (1) to gain access to the lever stroke lock-screws.



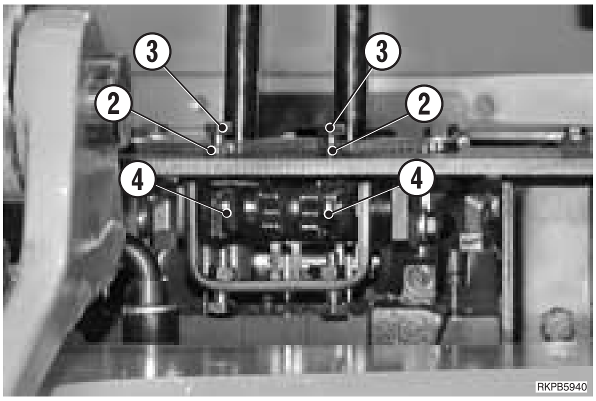
2 - Loosen the nuts (2) and unscrew the lock-screws (3) by a few turns.

3 - Push one lever (4) to the end of its stroke in one direction. Maintaining this position, tighten the corresponding lock-screw (3) until it touches the lever. Turn the screw (3) by another half turn.

4 - Keeping the position of the lever (4), tighten the nut (2).

5 - Repeat the same operations for the other direction and for the other lever.

⚠ Before starting the engine, check that the levers and the valve block spools return to their neutral position.



CENTERING ADJUSTMENT OF THE BOOM SWING COMMAND PEDAL

★ Test conditions:
- Engine: switched off
- Working equipment: resting on the ground.

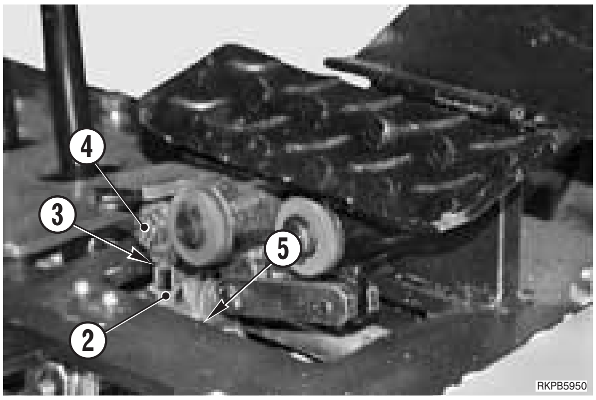
1 - Raise the rubber mat (1) on the right-hand side of the machine.

2 - Loosen the nut (2) on the joint (3) for a few turns.

3 - Remove the screw (4).

4 - Tighten or unscrew the joint (3) in the fork (5) connected to the control valve until the horizontal position of the pedal has been restored.

5 - Mount the screw (4) and secure the position of the joint (3) with the nut (2).



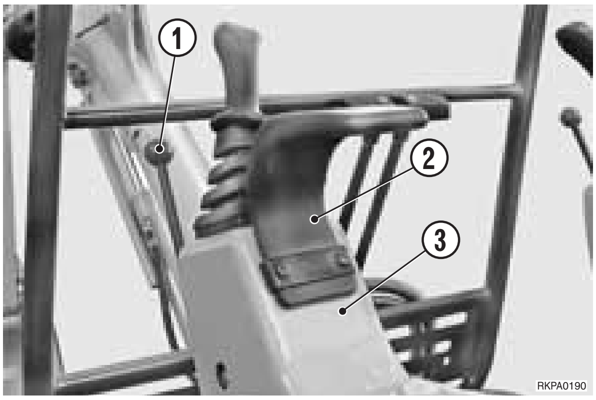
ADJUSTMENT OF THE RUBBER PAD AND SAFETY MICROSWITCH FOR SERVO-CONTROL ENGAGEMENT

Adjustment of rubber pad

★ Test conditions:
- Engine: switched off.
- Working equipment: resting on the ground.

1 - Remove the grip (1) from the servo-control engagement lever, take off the arm-rest (2), and remove the protective cover (3).

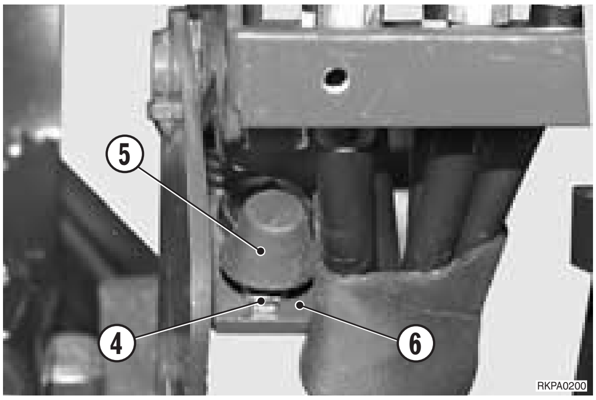
2 - Loosen the nut (4) that secures the rubber pad (5) and screw the pad into the lower plate (6) for a few turns.

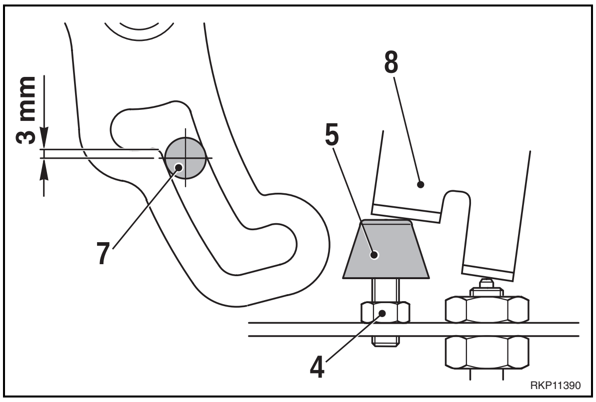


3 - Lower the servo-control engagement lever until the pitch point of the roller (7) is approximately 3 mm from the starting point of the cut-off slot.

4 - Keep this position and bring the rubber pad into contact with the console (8).

5 - Release the servo-control engagement lever and secure the rubber pad (5) with the nut (4).





Adjustment of the microswitch

1 - Disconnect the connectors (9).

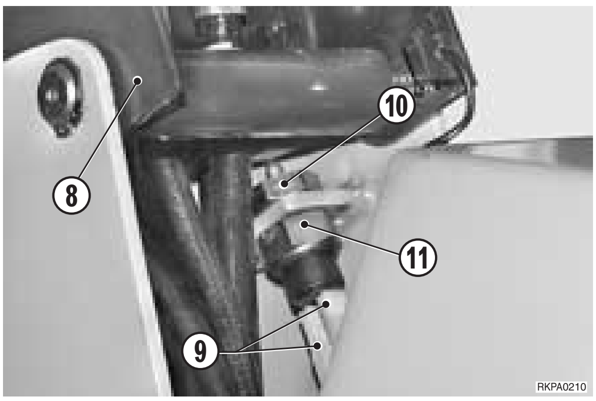
2 - Loosen the nut (10) and unscrew the microswitch (11) by a few turns.

3 - Lower the console (8) into its working position.

4 - Tighten the microswitch (11) until it depresses the push-button by 3±0.5 mm.

5 - Put the console (8) into its 'safe' position and lock the nut (10).

6 - Connect the connectors (9) and replace the protective cover (3), the arm-rest (2) and the lever grip (1).



CONTROL AND ADJUSTMENT OF THE TRACK-SHOE TENSION

1. Test

★ Test conditions:

- Solid, flat ground.
- Working equipment: resting on the ground.

1 - **Only for machines with rubber track-shoes**
Move the machine backwards and forwards until the track-shoe joint is uppermost and halfway between the sprocket wheel and the track-shoe stretcher wheel.

2 - Rotate the revolving frame 90° towards the side of the track-shoe to be checked.

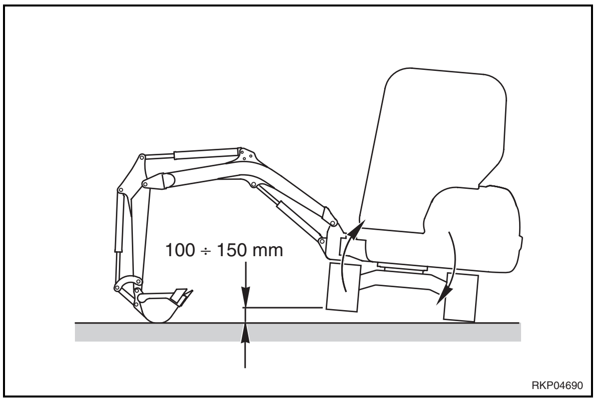
3 - Close the bucket, bring the arm perpendicular to the ground and rest the bucket on the ground.

4 - Force the boom downwards until the track-shoe to be checked is completely raised.

5 - Measure the distance "**A**" between the track-shoe race and the lower central rollers.

★ Standard measurements

Model	RUBBER TRACK-SHOE	STEEL TRACK-SHOE
PC12R	A = 10 – 15 mm	A = 10 – 20 mm
PC15R	A = 10 – 15 mm	A = 10 – 20 mm



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2. Adjustment

If the track-shoe tensions do not fall within permissible limits, adjust them as follows:

★ On completion of the adjustment and before engaging the greasing pump **G1**, thoroughly clean the grease nipple and surrounding area.

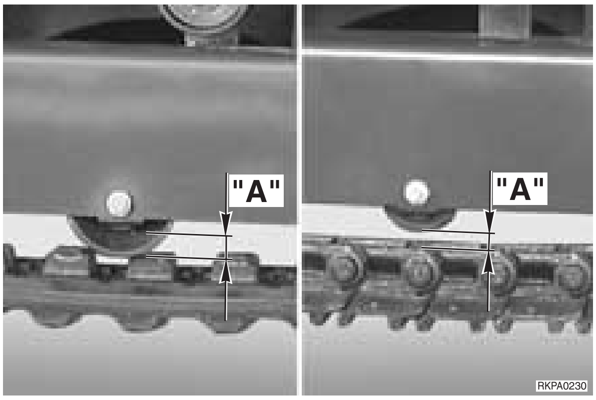
1 - If the tension is too low.
Inject grease through the grease nipple (1) using the grease pump **G1**.

★ If difficulties are found when injecting the grease, move the machine slowly backwards and forwards over a short distance.

2 - If the tension is too high.
Slowly loosen the union (2) in order to let grease out of the valve.

⚠ The grease in the stretcher cylinder is under pressure and could seriously injure the operator. For this reason the valve should not be loosened for more than one turn.

★ If the grease does not come out easily, move the machine slowly backwards and forwards over a short distance.



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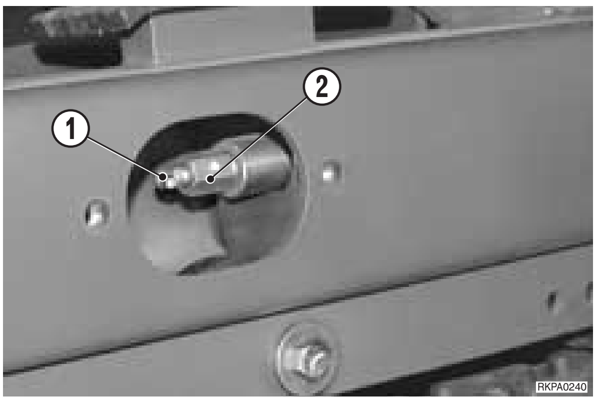

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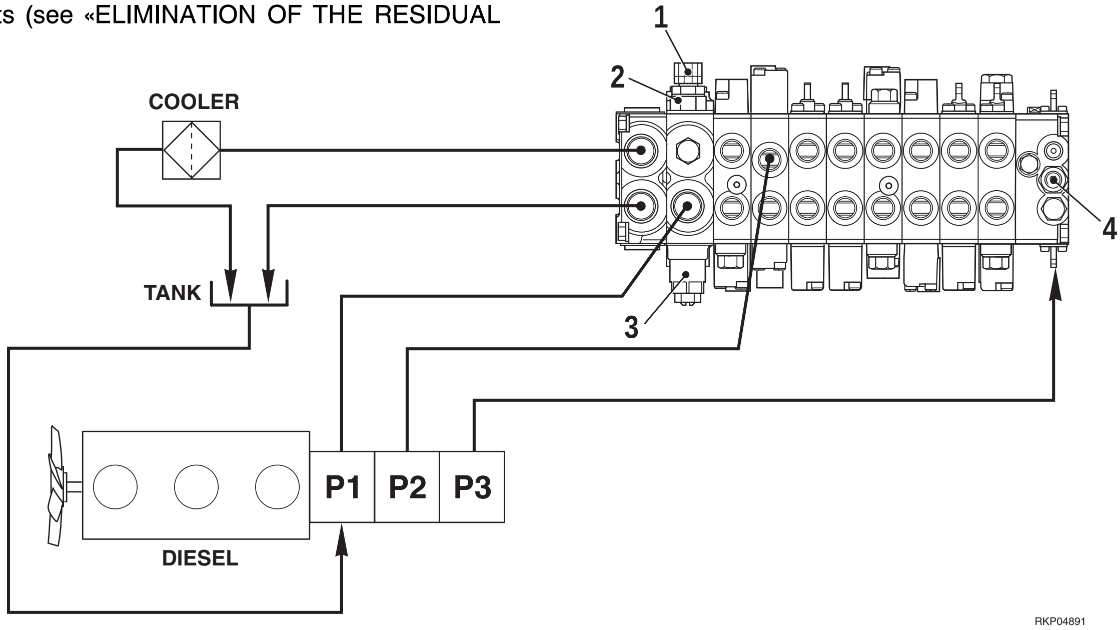
CONTROL AND REGULATION OF PRESSURE IN THE HYDRAULIC CIRCUITS (PC12R)

★ Test conditions:
- Engine: at working temperature.
- MIN and MAX. engine speeds: within permissible limits
- Hydraulic oil: 45 – 55 °C.

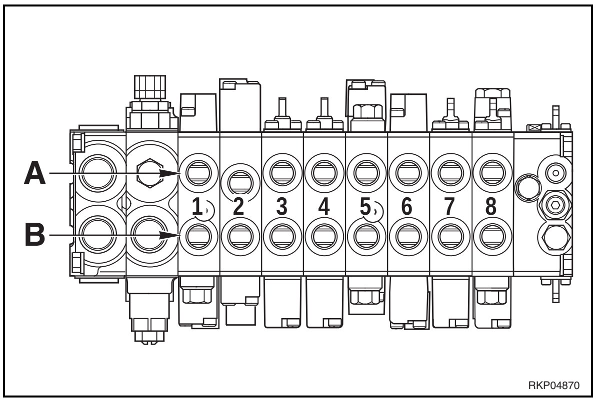
Before removing the plugs in order to measure the pressures, release the residual pressures in the circuits (see «ELIMINATION OF THE RESIDUAL PRESSURES IN THE CIRCUITS AND IN THE TANK») and put the safety-engagement levers into their locked positions.

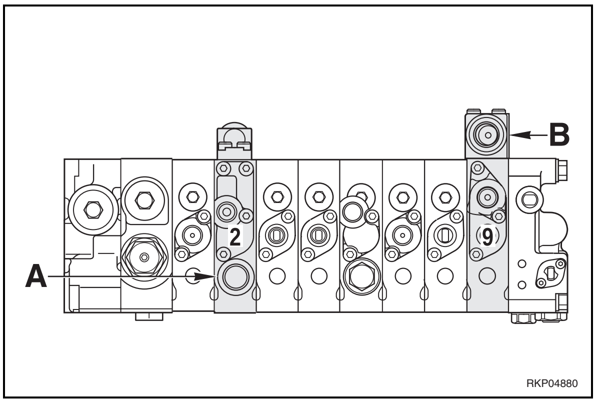
After having connected the pressure gauges, pressurise the tank. For details, see «PRESSURISATION OF THE TANK».



- The control valve consists of the spools that command:

Command	Ports
Arm (Open - Close)	A1 - B1
Swing (Right - Left)	A2 - B2
Engine travel to the left (Backwards and Forwards)	A3 - B3
Engine travel to the right (Backwards and Forwards)	A4 - B4
Boom (Raise - Lower)	A5 - B5
Bucket (Curl - Dump)	A6 - B6
Blade (Lower - Raise)	A7 - B7
Boom swing (Right - Left)	A8 - B8
Hammer (Throw)	B9





1. Control of operating pressure (unloading valve)

1 - Remove the plug (1) of pump P1 and mount a pressure adapter.

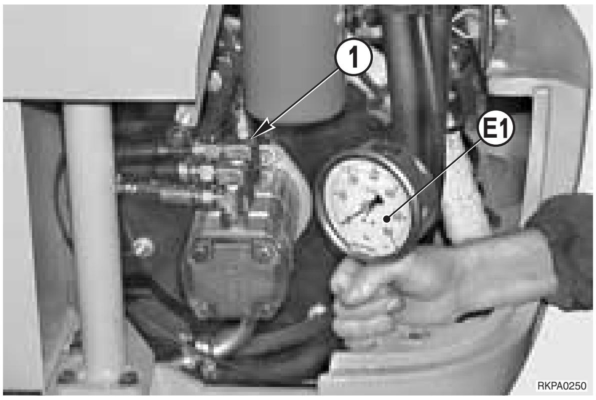
2 - Connect a pressure gauge **E1** (60 bar).

3 - Start the engine and bring it up to high idling with all levers in neutral position.

4 - Check the pressure.

★ Normal pressure:
$20^{\,0}_{+10}$ kg/cm^2 ($19.6^{\,0}_{+9.8}$ bar)

⚠ The unloading valve cannot be re-adjusted. If the pressure differs from the normal value the valve must be substituted.



2. Control the operating pressures of the working equipment and machine travel

1 - Remove the plug (1) of pump P1 and mount a pressure adapter.

2 - Connect a pressure gauge **E2** (400 bar) or **E3** (600 bar).

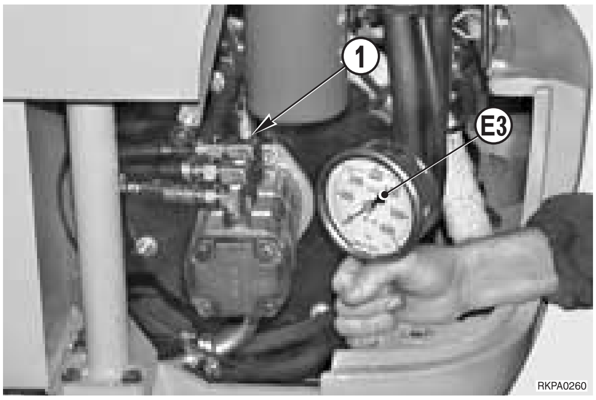
3 - Start the engine and bring it up to high idling.

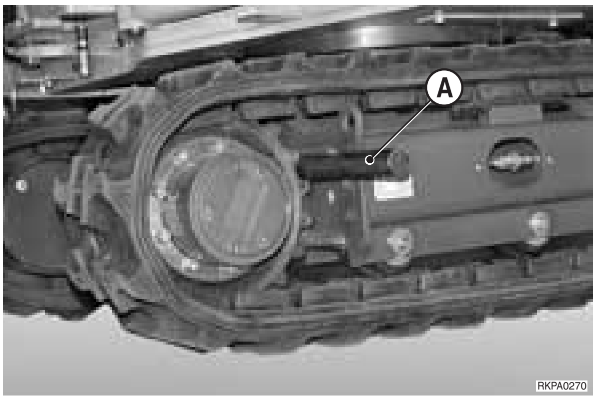
4 - Check the pressure for each movement with the command lever at the end of its stroke and with the pressure stabilised.

⚠ To check the pressure of the working equipment, push the piston to the end of its stroke.

⚠ To check the machine travel pressure, insert a block "**A**" between the chassis and the sprocket wheel.

★ Normal pressure:
$190^{\,0}_{+10}$ kg/cm^2 ($186^{\,0}_{+10}$ bar)





3. Control of the swing pressure

1 - Remove the plug (2) of pump P2 and mount a pressure adapter.

2 - Connect a pressure gauge **E2** (400 bar) or **E3** (600 bar).

3 - Start the engine and insert the swing lock.

4 - Bring the engine up to high idling, execute a swing, and push the command lever to the end of its stroke.

5 - Check the pressure once it has stabilised.

★ Normal pressure:
$125^{\,0}_{+10}$ kg/cm^2 ($123^{\,0}_{+10}$ bar)

Valve adjustment

★ The unloading valve cannot be re-adjusted, only substituted.

1. Adjustment of the main relief valve

If the pressures measured for the working equipment and machine travel do not fall within normal values, adjust the main relief valve (1) as follows:

1 - Remove the lower casing (2).

2 - Loosen the lock nut (3) and rotate the adjusting screw (4).

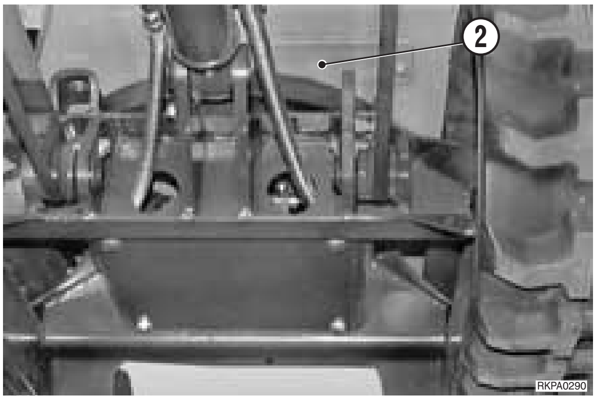
- To INCREASE pressure, turn in a CLOCKWISE direction.
- To DECREASE pressure, turn in a COUNTER-CLOCKWISE direction.

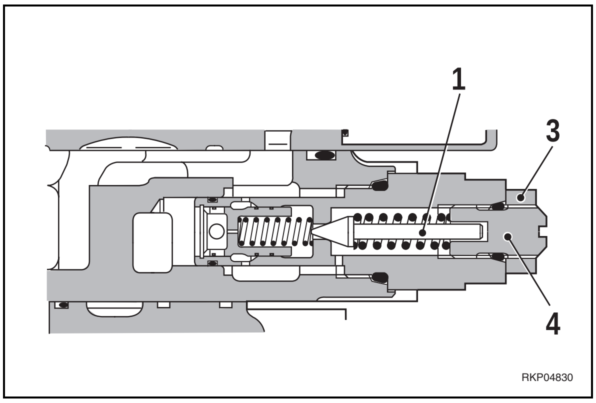
★ Each turn of the adjusting screw (4) varies the pressure by about 125 bar (128 kg/cm^2).

3 - Lock the nut (3).

Nm Nut: 59±10 Nm

★ After adjustment, check the adjustment of the main relief valve with the same procedures as used for the measurements.





2. Adjustment of the safety valve of the swing motor

If the pressures measured for the swings, to the right and to the left, do not come within the normal values, adjust the safety valve (1) of the swing motor as follows:

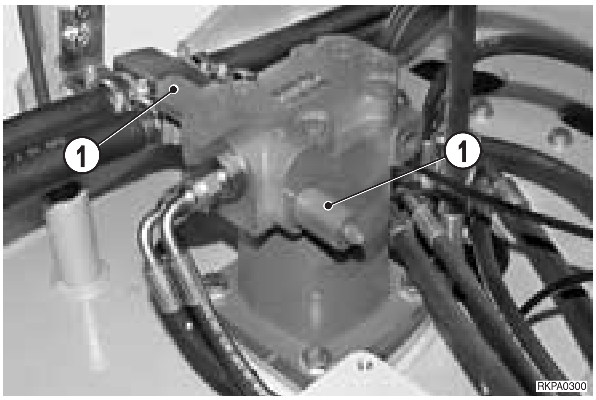
1 - Remove the cap nut (2).

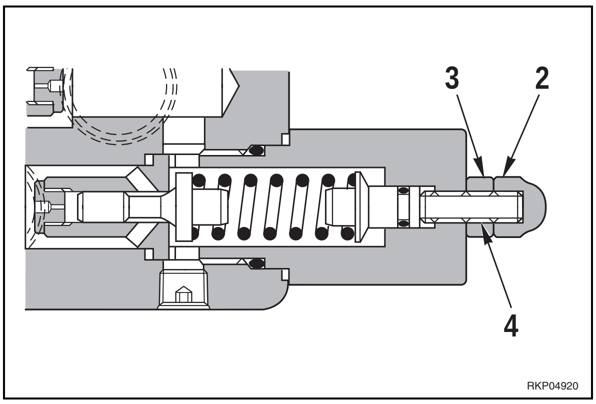
2 - Loosen the lock nut (3) and turn the adjusting screw (4).

- To INCREASE pressure, turn in the CLOCKWISE direction.
- To DECREASE pressure, turn in the COUNTER-CLOCKWISE direction.

3 - Lock the nut (3) and replace the cap nut (2).

★ After the adjustments, check the setting of the safety valves following the same procedure used for the measurements.



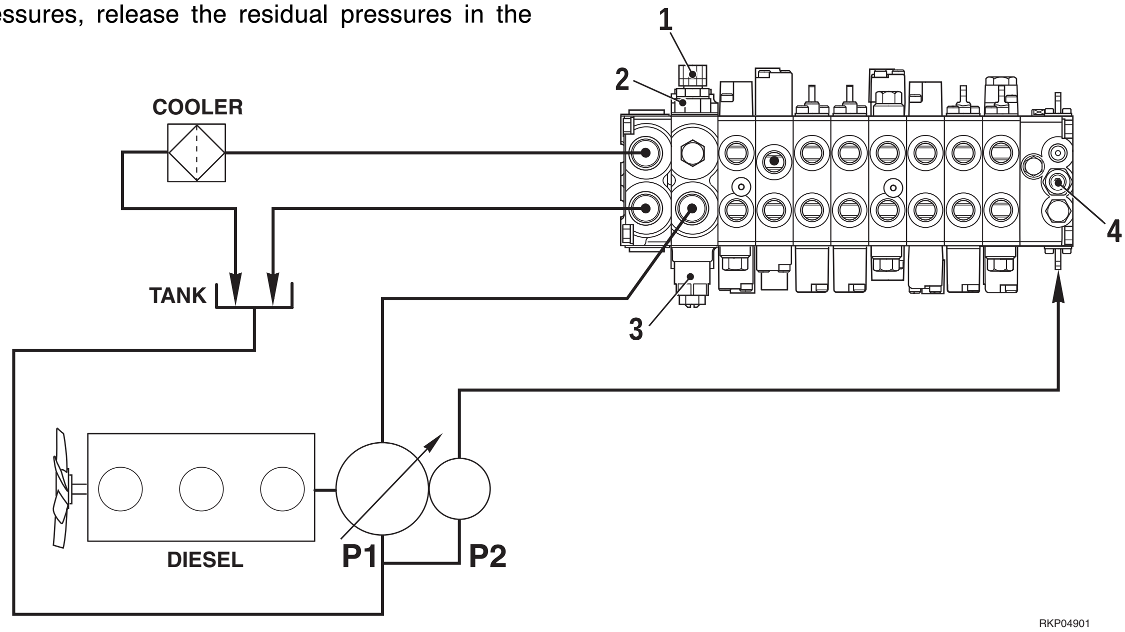


CONTROL AND REGULATION OF THE PRESSURES IN THE HYDRAULIC CIRCUITS (PC15R)

★ Test conditions:
- Engine: at working temperature.
- MIN and MAX. engine speeds: within permissible limits.
- Hydraulic oil: 45 – 55 °C.

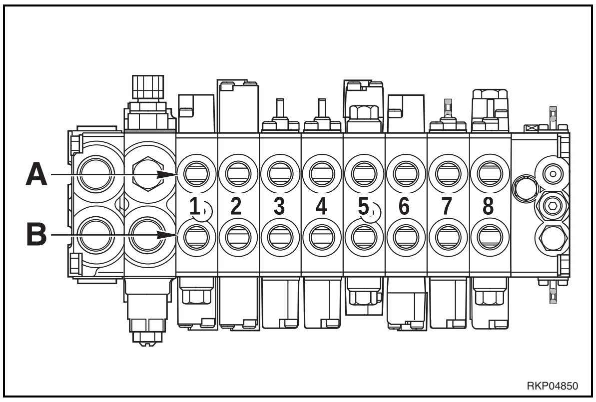
Before removing the plugs in order to measure the pressures, release the residual pressures in the circuits (see «ELIMINATION OF THE RESIDUAL PRESSURES IN THE CIRCUITS AND IN THE TANK») and place the safety engagement levers into their locked positions.

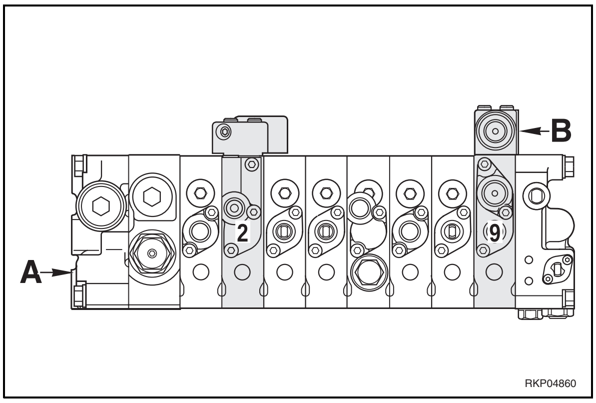
After having connected the pressure gauges, pressurise the tank. For details, see «PRESSURISATION OF THE TANK».



- The control valve consists of the spools that command:

Command	Ports
Arm (Open - Close)	A1 - B1
Swing (Right - Left)	A2 - B2
Engine travel to the left (Backwards and Forwards)	A3 - B3
Engine travel to the right (Backwards and Forwards)	A4 - B4
Boom (Raise - Lower)	A5 - B5
Bucket (Curl - Dump)	A6 - B6
Blade (Lower - Raise)	A7 - B7
Boom swing (Right - Left)	A8 - B8
Hammer (Throw)	B9





1. Control of operating pressure (unloading valve)

1 - Remove the plug (1) of pump P1 and mount a pressure adapter.

2 - Connect a pressure gauge **E1** (60 bar).

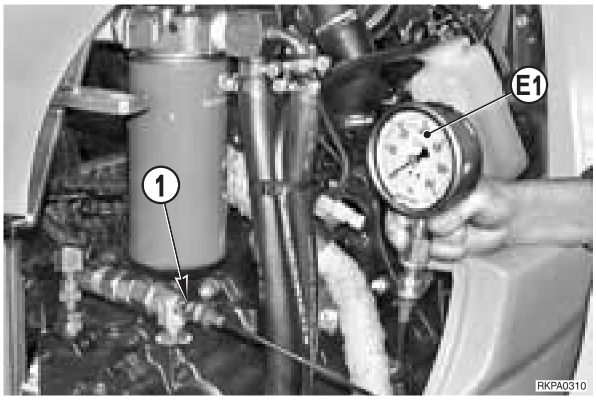
3 - Start the engine and bring it up to high idling with all levers in neutral position.

4 - Check the pressure.

★ Normal pressure:

$20 \overset{0}{+} 10$ kg/cm^2 ($19.6 \overset{0}{+} 9.8$ bar)

⚠ The unloading valve cannot be re-adjusted. If the pressure differs from the normal value the valve must be substituted.



2. Control the operating pressures of the working equipment, machine travel, and swing

1 - Remove the plug (1) of pump P1 and mount a pressure adapter.

2 - Connect a pressure gauge **E2** (400 bar) or **E3** (600 bar).

3 - Start the engine and bring it up to high idling.

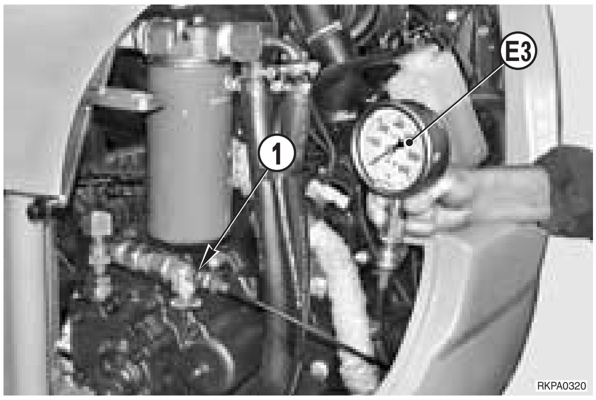
4 - Check the pressure for each movement with the command lever at the end of its stroke and with the pressure stabilised.

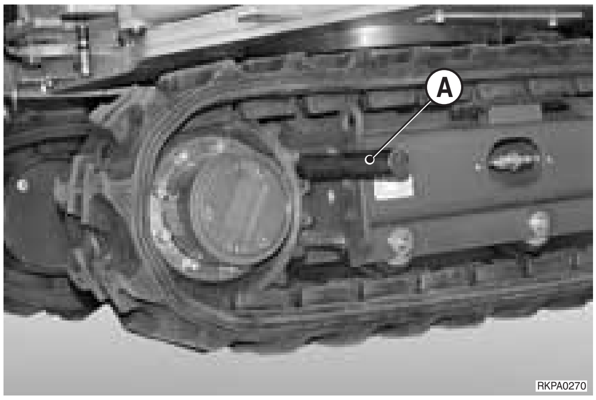
⚠ To check the pressure of the working equipment, push the piston to the end of its stroke.

⚠ To check the pressure of machine travel, insert a block "**A**" between the chassis and the sprocket wheel.

⚠ To check the pressures of the swing, insert the swing lock.

★ Normal pressures:
Working equipment and travel:
$210 \overset{0}{+} 10$ kg/cm^2 ($206 \overset{0}{+} 10$ bar)
Swing: $125 \overset{0}{+} 10$ kg/cm^2 ($123 \overset{0}{+} 10$ bar)





Valve adjustment

★ The unloading valve cannot be re-adjusted, only substituted.

1. Adjustment of the main relief valve

If the pressures measured for the working equipment and machine travel do not fall within normal values, adjust the main relief valve (1) as follows:

1 - Remove the lower casing (2).

2 - Loosen the lock nut (3) and rotate the adjusting screw (4).

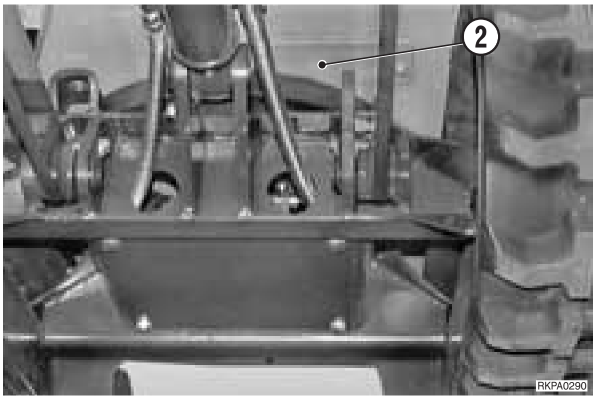
- To INCREASE pressure, turn in a CLOCKWISE direction.
- To DECREASE pressure, turn in a COUNTER-CLOCKWISE direction.

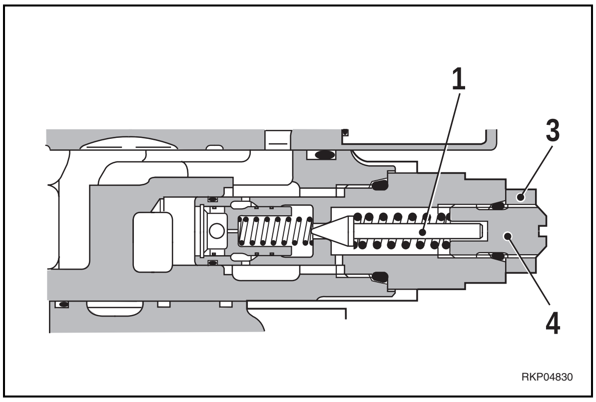
★ Each turn of the adjusting screw (4) varies the pressure by about 125 bar (128 kg/cm^2).

3 - Lock the nut (3).

Nm Nut: 59±10 Nm

★ After adjustment, check the adjustment of the main relief valve with the same procedures as used for the measurements.





2. Adjustment of the safety valve of the swing motor

If the pressures measured for the swings to the right and to the left do not come within the normal values, adjust the safety valve (1) of the swing motor as follows:

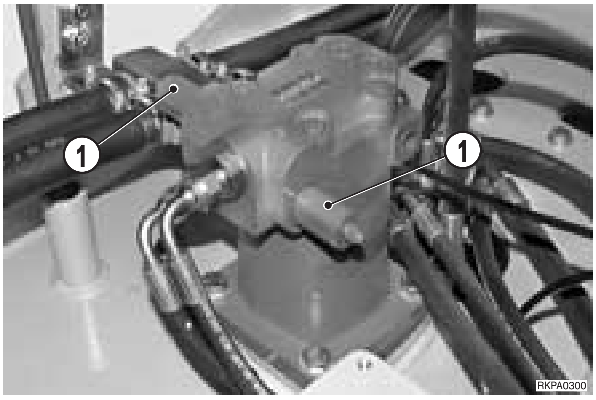
1 - Remove the cap nut (2).

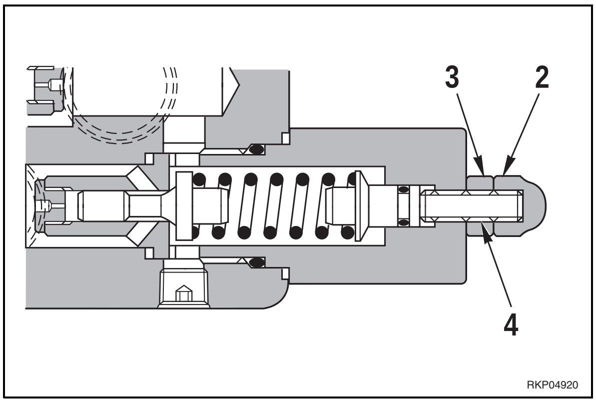
2 - Loosen the lock nut (3) and turn the adjusting screw (4).

- To INCREASE pressure, turn in a CLOCKWISE direction.
- To DECREASE pressure, turn in a COUNTER-CLOCKWISE direction.

3 - Lock the nut (3) and replace the cap nut (2).

★ After the adjustments, check the setting of the safety valves following the same procedure used for the measurements.





CONTROL AND REGULATION OF THE LS DIFFERENTIAL PRESSURE AND ADJUSTMENT OF THE LS VALVE

Test

1. Test method with differential pressure gauge E3

1 - Remove the plugs (1) and (2) and mount two pressure adapters.

2 - Connect the differential pressure gauge **E4**.

★ Connect the high-pressure side to the adapter (3) and the low-pressure side to the adapter (4).

3 - Start the engine and use the working equipment to raise one track-shoe.

4 - Bring the engine up to high idling and check the LS differential pressure according to the test conditions in Table 1.

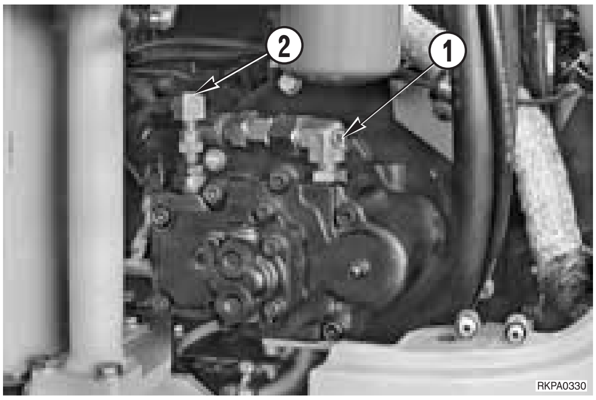


Table 1

Position of the travel lever	LS differential pressure in kg/cm^2	NOTES
Neutral	$20^{\,0}_{+10}$	The LS differential pressure is equal to the pressure given by the unloading valve
Half the stroke (Swing without load)		

2. Test method with pressure gauges E2 or E3

★ The maximum differential pressure is 20 kg/cm^2 (roughly 20 bar). For a precise check use the same pressure gauge together with a decimal scale.

1 - Remove the plugs (1) and (2) and mount two pressure adapters.

2 - Connect pressure gauge **E2** or **E3** to the pressure adapter (3).

3 - Start the engine and use the working equipment to raise one track-shoe.

4 - Bring the engine up to high idling and measure the delivery pressure of pump (**P**P) in the conditions shown in Table 1. Make a note of the values read.

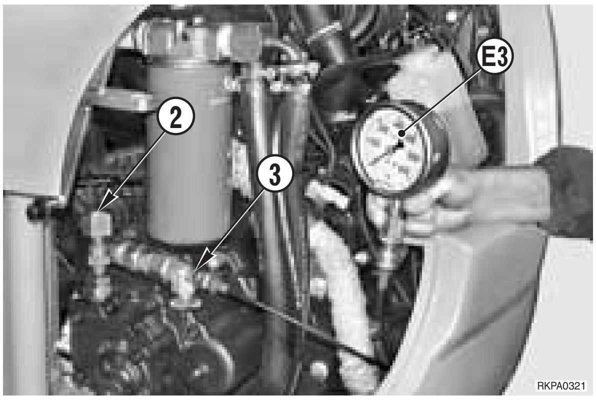
★ Check the instrument by reading it from the front and making sure that the reading is correct.

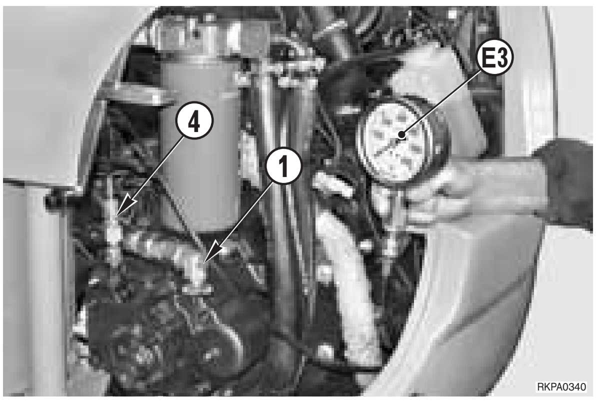
5 - Disconnect the pressure gauge **E2** or **E3** from the pump delivery and connect it to the pressure adapter (4).

6 - Measure the **LS** pressure in the same conditions indicated at point 4. Make a note of the value read.

7 - Subtract the **LS** pressure from the delivery pressure of the pump (**P**P) in order to obtain the differential pressure value **ΔP**LS (**P**P – **LS** = **ΔP**LS)

★ **ΔP**LS normal = $20^{\,0}_{+10}$ kg/cm^2 ($19.6^{\,0}_{+9.8}$ bar)





LS valve adjustment

If the **ΔP$_{LS}$** value is not the one indicated, adjust the **LS** valve (3) as follows:

1 - Disconnect the tube (4).

2 - Loosen the lock nut (5) and turn the adjusting screw (6).

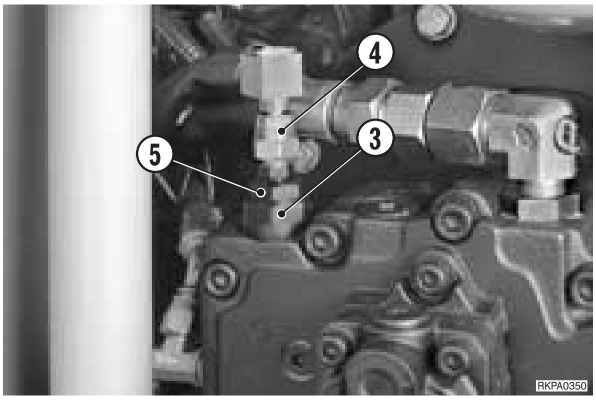
- To INCREASE pressure, turn in a CLOCKWISE direction.
- To DECREASE pressure, turn in a COUNTER-CLOCKWISE direction.

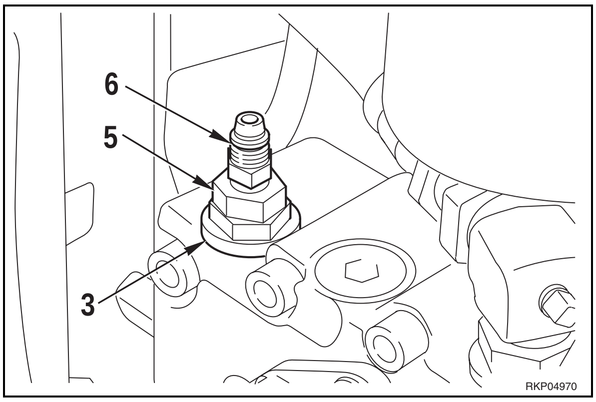
★ Each turn of the adjusting screw (6) varies the pressure by about 13 bar (13 kg/cm^2).

3 - Lock the nut (5).

Nm Nut: 31±3.5 Nm

★ After the adjustment, check the setting of the **LS** valve (3) following the procedure used for the test.





REGULATION OF THE PC VALVE

★ If the engine speed decreases when an increase in pressure or delivery is requested, or when the speed of the working equipment is low, even though the engine speed, the delivery pressure and the LS differential pressure are all normal, the PC valve (1) should be regulated as follows:

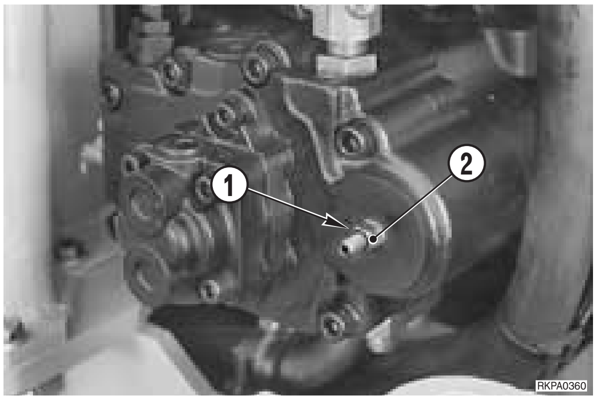
1 - Loosen the check-nut (2).

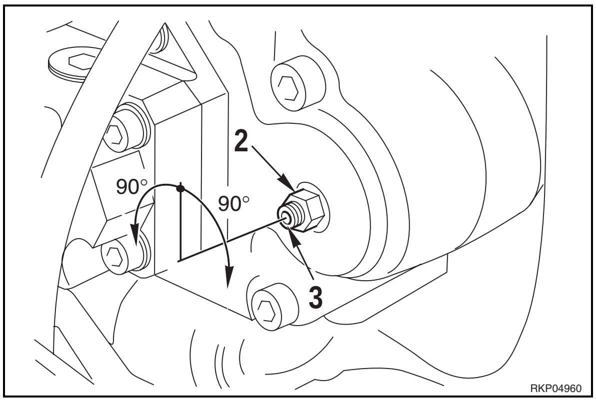
2 - Turn the adjustment screw (3).

- If the working equipment speed is low, turn the screw (3) in a CLOCKWISE direction to INCREASE the torque absorption of the pump.
- If the engine rpm suffer an abnormal drop, turn the screw (3) in a COUNTER-CLOCKWISE direction to DECREASE the torque absorption.

★ Turn the adjusting screw (3) within an adjustment range of 90° either to the right or to the left.

3 - After adjustment, tighten the check-nut (2).





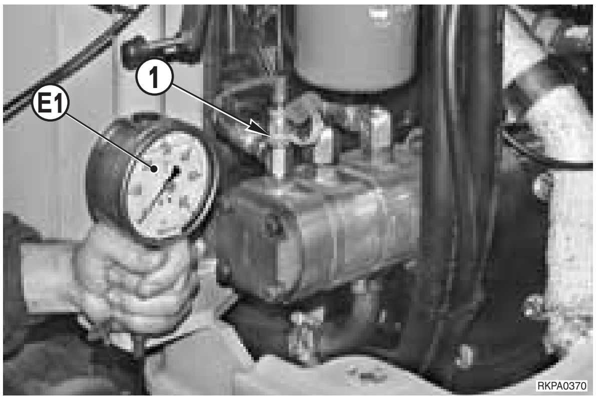
CONTROL AND REGULATION OF THE SERVO-CONTROL POWER SUPPLY (PC12R)

★ Test conditions:

- Engine: at working temperature.
- Hydraulic oil temperature: 45 – 55 °C.

Before removing the cap to measure the pressure, release the residual pressures from the circuits (See «ELIMINATION OF RESIDUAL PRESSURES OF THE CIRCUIT AND THE TANK») and put the safety device engagement levers into their locked position.

After connecting the pressure gauge, pressurise the tank. For details see «PRESSURISATION OF THE TANK».



1. Checking the pressure of the servo-controls

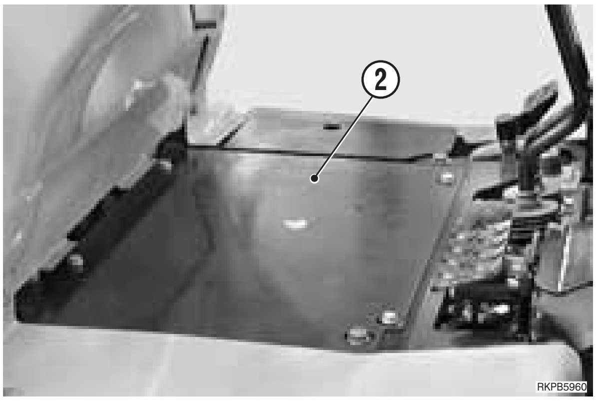
1 - Remove the cap (1) of pump P3 and mount a pressure adapter.

2 - Connect the pressure gauge **E1** (60 bar).

3 - Start the engine and bring it up to high idling with all levers in neutral position.

4 - Check the pressure.

★ Normal pressure: 29^{+6}_{-3} bar (30^{+6}_{-3} kg/cm²)



2. Regulating the servo-control valve

If the pressure value does not fall within the tolerances, regulate the valve (3) as follows:

1 - Take up the flooring (2).

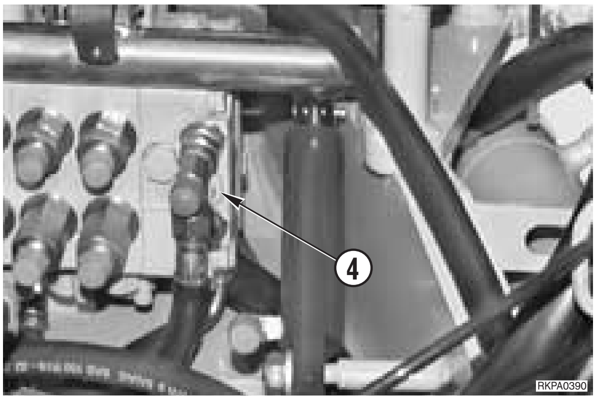
2 - Loosen the lock nut (4) and turn the adjusting screw (5).

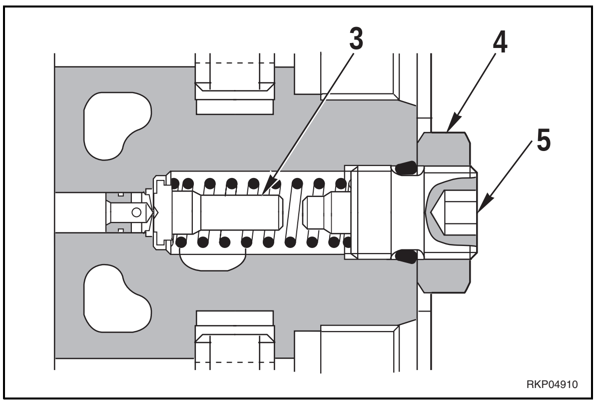
- To INCREASE pressure, rotate in a CLOCKWISE direction.
- To DECREASE pressure, rotate in a COUNTER-CLOCKWISE direction.

★ Each turn of the screw (5) varies the pressure by 56 kg/cm² (55 bar).

3 - Lock the nut (4).

Nut: 22±2.5 Nm



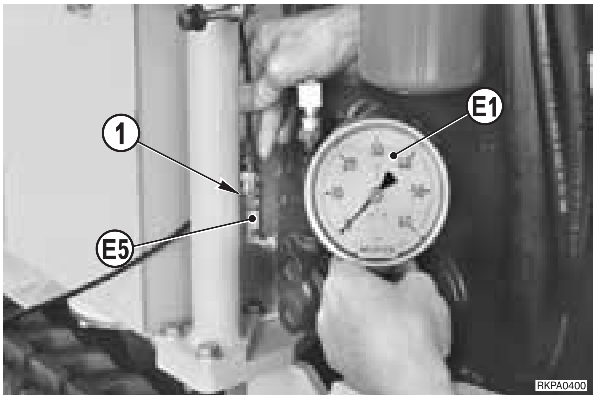


CONTROL AND REGULATION OF THE SERVO-CONTROL POWER SUPPLY (PC15R)

★ Test conditions:
- Engine: at working temperature.
- Hydraulic oil temperature: 45 – 55 °C.

Before removing the cap to measure the pressure, release the residual pressures from the circuits (See «ELIMINATION OF RESIDUAL PRESSURES OF THE CIRCUIT AND THE TANK») and put the safety device engagement levers into their locked position.

After connecting the pressure gauge, pressurise the tank. For details see «PRESSURISATION OF THE TANK».



1. Checking the pressure of the servo-controls

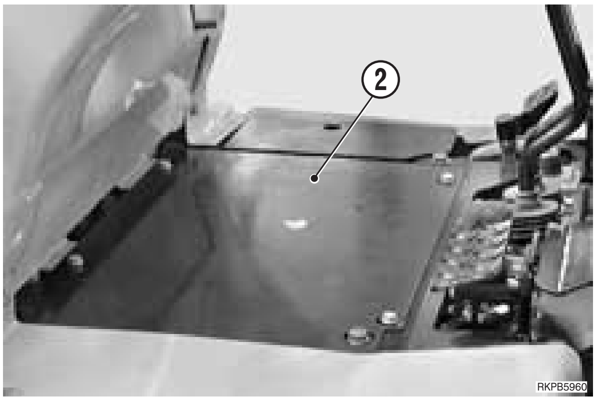
1 - Remove the cap (1) of pump P2 and mount elbow **E5** and a pressure adapter.

2 - Connect the pressure gauge **E1** (60 bar).

3 - Start the engine and bring it up to high idling with all leers in neutral position.

4 - Check the pressure.

★ Normal pressure: 29^{+6}_{-3} bar (30^{+6}_{-3} kg/cm²)



2. Regulating the servo-control valve

If the pressure value does not fall within the tolerances, regulate the valve (3) as follows:

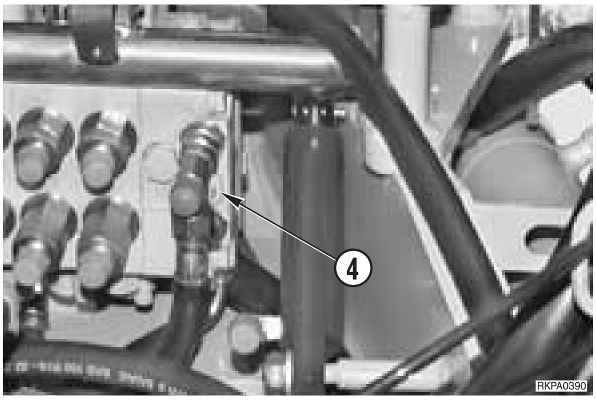
1 - Take up the flooring (2).

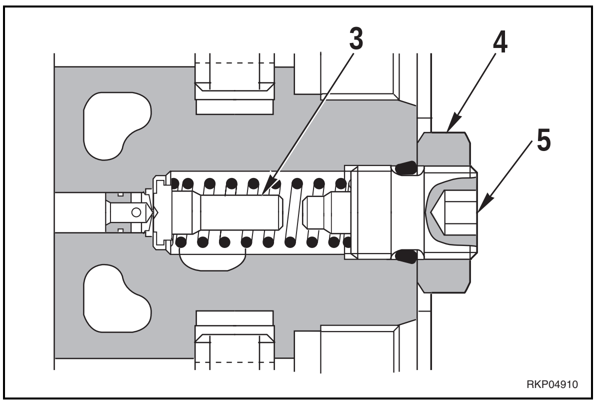
2 - Loosen the lock nut (4) and turn the adjusting screw (5).
- To INCREASE pressure, rotate in a CLOCKWISE direction.
- To DECREASE pressure, rotate in a COUNTER-CLOCKWISE direction.

★ Each turn of the screw (5) varies the pressure by 56 kg/cm² (55 bar).

3 - Lock the nut (4).

Nm Nut: 22±2.5 Nm





ELIMINATION OF RESIDUAL PRESSURES - PRESSURISATION OF THE TANK

1. Elimination of pressures from the hydraulic circuits.

1 - Rest the working equipment on the ground and stop the engine.

2 - Turn the ignition key to the position «**I**» and move the command lever in all directions to release all pressure in the main hydraulic circuits and the servo-controls .

3 - Return the ignition key to the position «**O**» (OFF) and remove it.

4 - Put the safety device lever into its «LOCKED» position.

2. Elimination of pressure in the tank

⚠ The hydraulic oil tank is of the sealed and pressurised type.
When tubes are to be removed or disconnected for controls or repairs, or when caps are removed, tank pressure must be eliminated using the following method:

1 - Rest the working equipment on the ground and stop the engine.

2 - Slowly loosen the oil-refuelling cap in order to release residual pressure.

3. Pressurising the tank

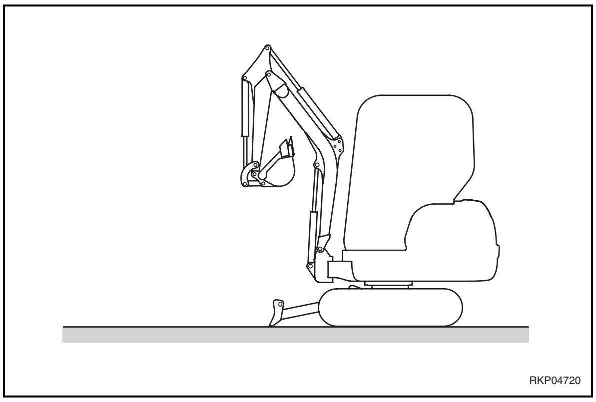
★ This operation should be performed every time the oil-refuelling cap is moved for removal of the tubes or other hydraulic equipment.

1 - Start the engine and position the machine as in the figure.

2 - Stop the engine, loosen the tank cap (1) and then close it again.

★ This operation lets air into the tank when the level of the remaining oil is at minimum.

3 - Start the engine and lower the working equipment to the ground.



BLEEDING AIR FROM THE HYDRAULIC CIRCUITS

Sequence of operations or procedures for bleeding the air

	Procedures for bleeding air						
	1	2	3	4	5	6	7
	Bleeding air from pumps ★2	Starting engine	Bleeding air from cylinders	Bleeding air from swing motor	Bleeding air from travel motor	Pressurising tank	Starting tasks
• Substitution of hydraulic oil • Cleaning tank filter	○	→ ○	→ ○	→ ○ ★1	→ ○ ★1	→ ○	→ ○
• Substitution filter		○				→ ○	→ ○
• Repair - substitution pump • Removal of suction tube	○	→ ○	→ ○			→ ○	→ ○
• Substitution - repair control valve		○	→ ○			→ ○	→ ○
• Repair-Substitution cylinders • Removal of cylinders tube		○	→ ○			→ ○	→ ○
• Repair - substitution swing motor • Removal of tubes from swing motor		○		→ ○		→ ○	→ ○
• Repair - substitution travel motor - joint • Removal of tubes from travel motor - joint		○			→ ○	→ ○	→ ○

★1: Only bleed air from the swing and travel motors if the engine oil (casing) is to be drained.
★2: Only for PC15R

1. Bleeding air from the pump (PC15R)

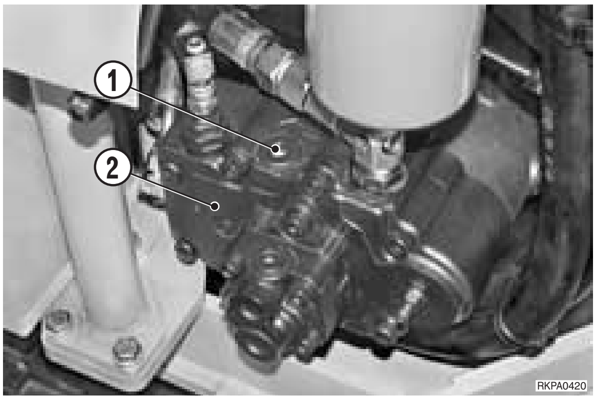
1 - Loosen and remove the cap (1) from the pump body (2).

2 - Pour hydraulic oil through the hole until the entire casing is full.

3 - Replace the cap (1).

Nm Cap: 63.7±4.9 Nm

★ After filling the casing, start the engine and allow it to run at low idling for about 10 minutes before proceding to bleed the air from the circuits.



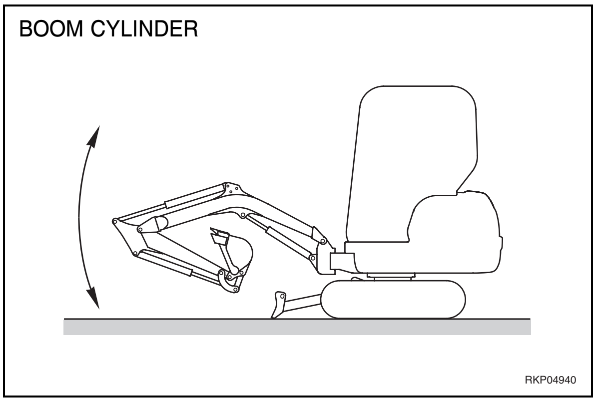
2. Bleeding air from the cylinders

1 - Start the engine and let it run at low idling for about 5 minutes.

2 - Lower and raise the boom 4-5 times.
  ★ Lower and raise the piston of the boom up to about 100 mm of the end of its stroke.
  Every care must be taken to avoid pressurising the circuits.

3 - Bring the engine up to high idling and repeat the operations described in point 2. Return the engine to low idling and pout the piston through its entire stroke until it reaches max. pressure in both directions.

4 - Repeat the operation (starting from point 2) for the arm, bucket, arm swing, and blade cylinders.

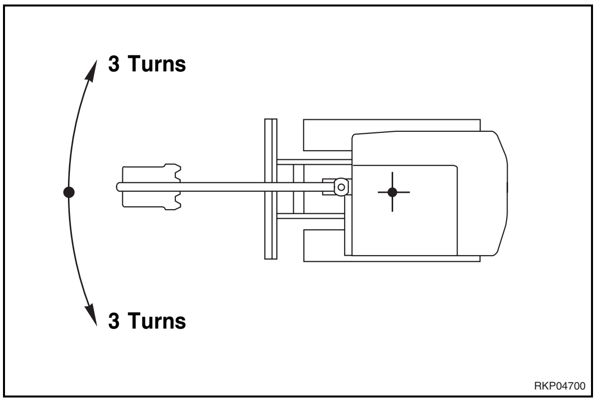


3. Bleeding air from the swing motor

⚠ Make sure that the swing-locking pin is not engaged.

1 - With the engine at low idling, rotate the revolving frame three turns towards the left.

2 - Repeat the same manoeuvre, rotating the revolving frame to the right.

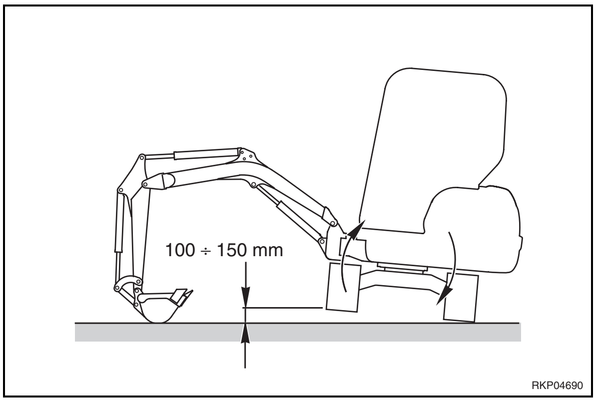


4. Bleeding air from the travel motors

1 - With the engine at low idling, use the working equipment to raise the left-hand track-shoe from the ground.

2 - Let the track-shoe turn for about 30 seconds.

3 - Repeat points 1 and 2 for the right-hand track-shoe.
  ★ For a PC12R with a travel increment and for the PC15R, also engage the travel increment for about 10 seconds.



5. Bleeding air from any optional equipment

  ★ This method must be used for all the optional working equipment, unless otherwise indicated.

1 - Each time an item of optional working equipment is installed, operate the equipment repeatedly, with the engine at low idling, until all air has been completely eliminated.

CONTROL OF HYDRAULIC DRIFTS - ANALYSIS OF THE CAUSES OF A DRIFT

★ Test conditions:
- Machine: in the conditions indicated in the NORMAL TECHNICAL DATA.
- Engine: at working temperature.
- Hydraulic oil: 45 – 55 °C.

1. Test

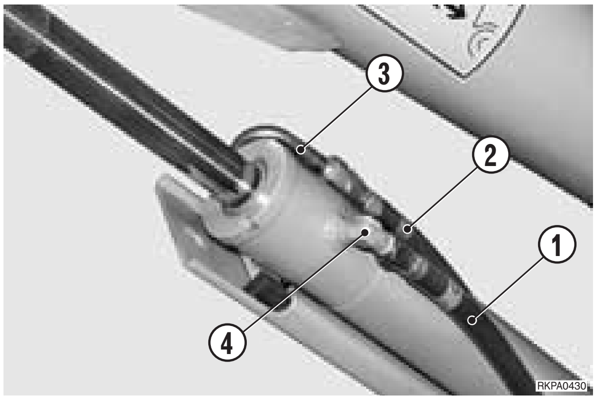
To check on the extent of the hydraulic drifts of individual components and the total hydraulic drift, position the machine and follow the procedures indicated in the «NORMAL TECHNICAL DATA».

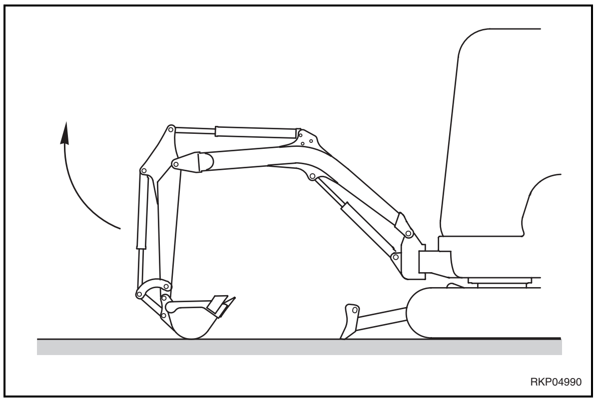
2. Analysis of the causes of hydraulic drifts

Before disconnecting the tubes, release hydraulic pressures in the circuits (see «ELIMINATION OF THE RESIDUAL PRESSURES»).

1. Boom test

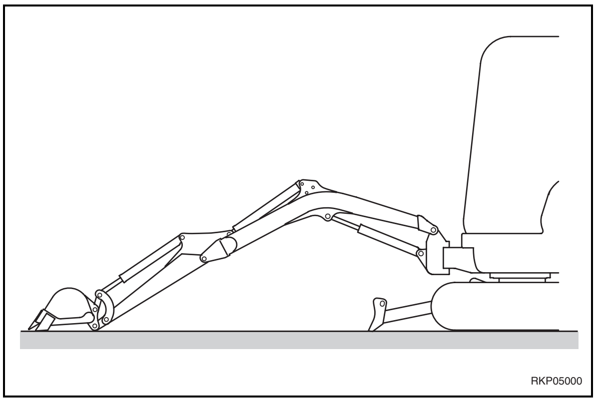
1 - Position the machine with the arm vertical and with the back of the bucket resting on the ground.
2 - Stop the engine and release the residual hydraulic pressures.
3 - Disconnect the hoses (1) and (2) that supply the cylinder on the head side and on the base side.
4 - Plug the two hoses to prevent entry of impurities.
5 - Plug the rigid tube (3) that supplies the cylinder on the base side.
6 - In order to catch any oil leakages, attach a tube to the fitting (4) that supplies the head side of the cylinder.
7 - Start the engine and extend the arm completely.
8 - Stop the engine and check the position of the boom for 15 minutes.
   - If the boom moves downwards the drift is due to the cylinder gaskets.
   - If the boom does not move, the drift is due to the control valve.



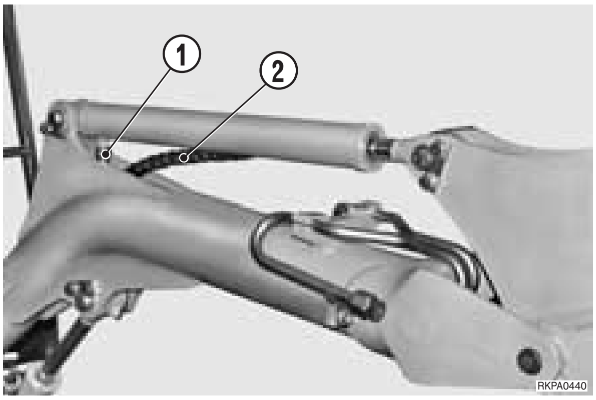


2. Arm test

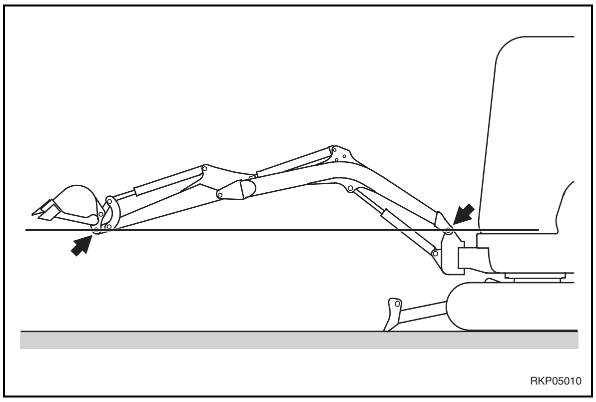
1 - Position the machine with the arm completely extended and with the bucket teeth on the ground.
2 - Stop the engine and release the residual hydraulic pressures.



3 - Disconnect the hoses (1) and (2) from the arm cylinder and plug them to prevent the entry of impurities.
4 - Plug the hole of the arm cylinder on the head side and attach a provisional tube on the base side to catch any oil leakages.

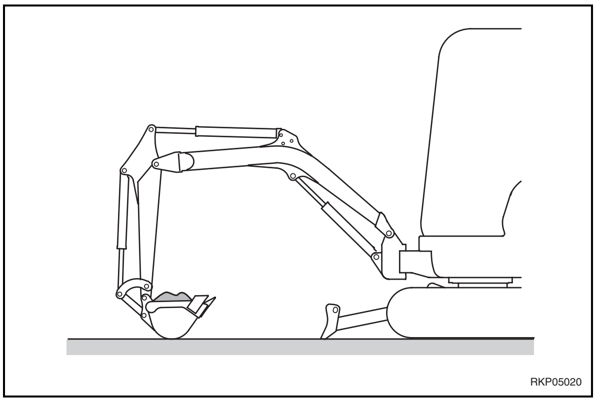


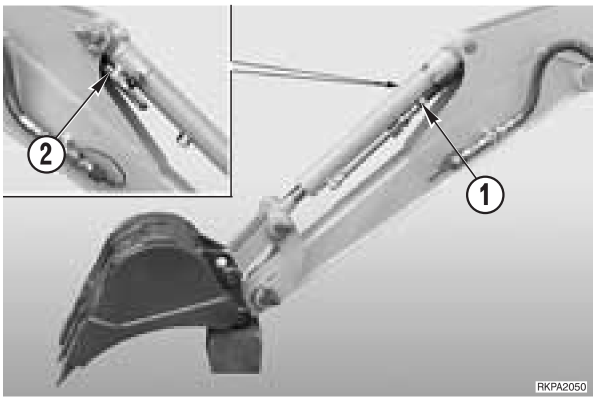
5 - Start the engine and raise the boom.
6 - Stop the engine and check the position of the arm for 15 minutes.
   - If the arm moves downwards the drift is due to the cylinder gaskets.
   - If the arm does not move, the drift is due to the control valve.



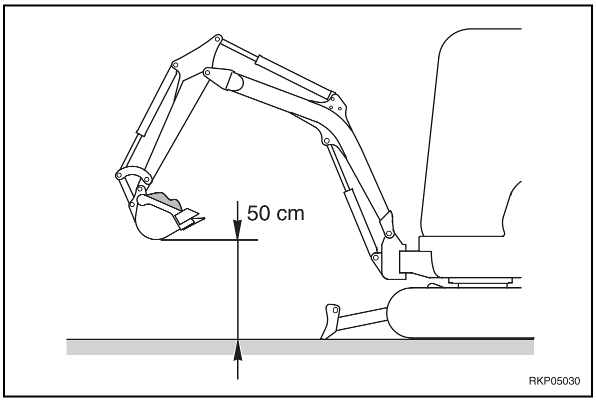
3. Bucket test

1 - Position the machine with the arm vertical and the bucket resting on the ground in a horizontal position. Put a weight in the bucket, or fill it with earth.
2 - Stop the engine and release the residual hydraulic pressures.
3 - Disconnect the bucket cylinder hoses (1) and (2) and plug them to prevent the entry of impurities.
4 - Plug the hole of the bucket cylinder on the base side and attach a provisional tube on the head side to catch any oil leakages.



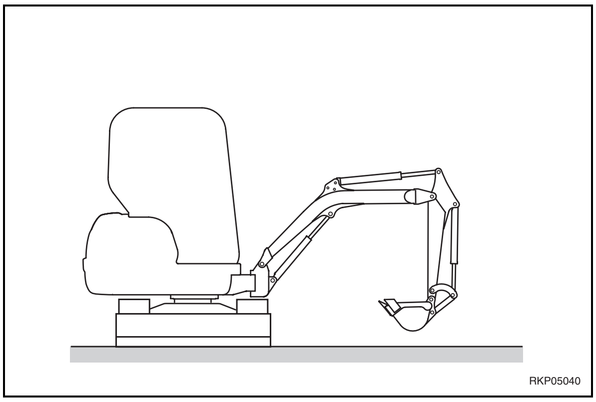


5 - Start the engine and raise the boom.
6 - Stop the engine and check the position of the bucket for 15 minutes.
- If the bucket makes an opening movement the drift is due to the cylinder gaskets.
- If the bucket does not move, the drift is due to the control valve.

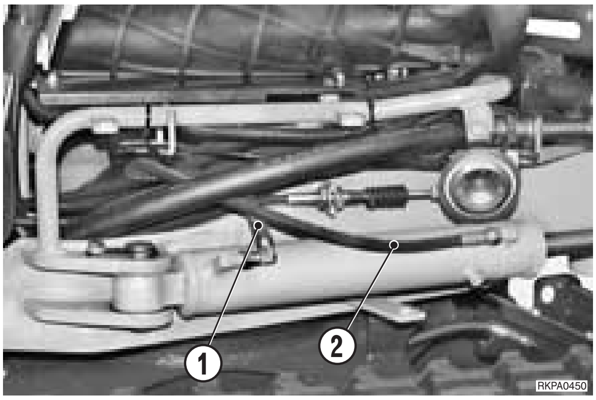


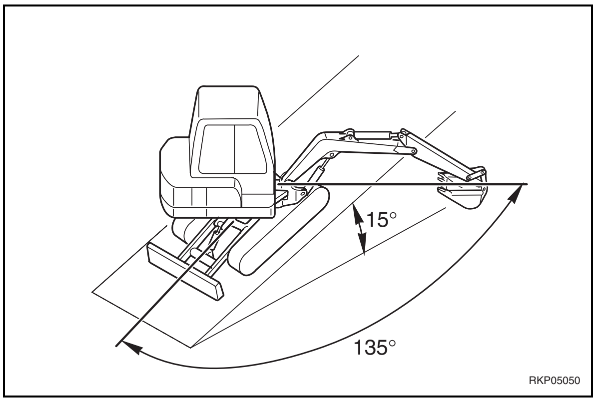
4. Boom swing test

1 - Position the machine with the boom, arm and bucket raised and with the revolving frame turned 135° to the left.
2 - Stop the engine and release the residual hydraulic pressures.



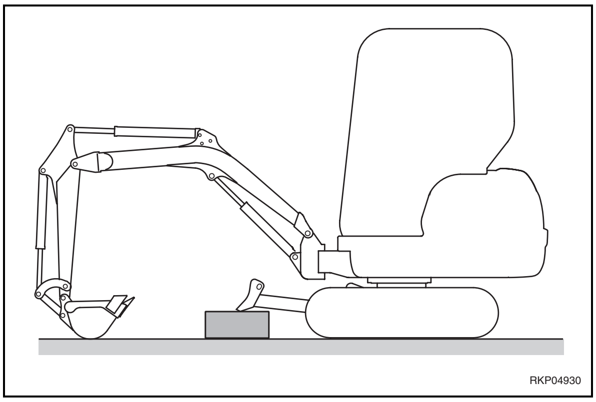
3 - Disconnect the boom swing cylinder hoses (1) and (2) and plug them.
4 - Plug the hole of the boom swing cylinder on the base side and attach a provisional tube on the head side to catch any oil leakages.
5 - Start the engine and move the machine to a 15° slope.
6 - Stop the engine and check the position of the boom for 15 minutes.
   - If the boom makes a rotating movement the drift is due to the cylinder gaskets.
   - If the boom does not move, the drift is due to the control valve.





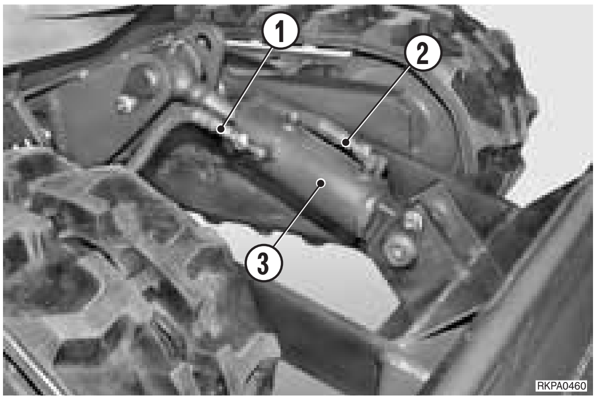
5. Blade test

1 - Position the machine with the arm resting vertically on the ground and with the bucket resting on its back.
2 - Raise the blade completely and support it on a centrally-positioned block.
3 - Stop the engine and release the residual hydraulic pressures.



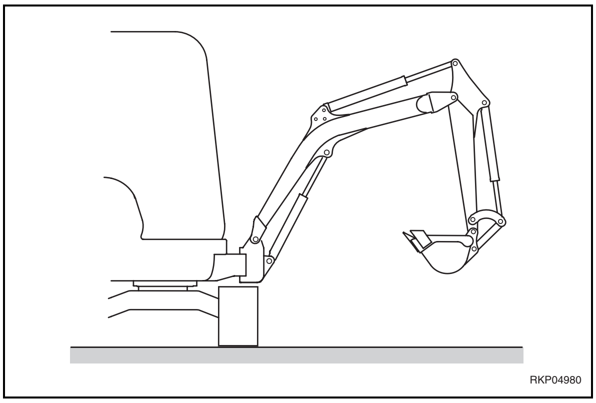
4 - Disconnect the hoses (1) and (2) of the blade cylinder (3) and plug them.
5 - Plug the hole of the blade cylinder on the head side and attach a provisional tube on the base side to catch any oil leakages.
6 - Start the engine and force the boom down to raise the machine in order to remove the block on which the blade is resting.
7 - Lower the blade and stop the engine.
8 - Check the position of the blade for 15 minutes.
- If the blade moves downwards the drift is due to the cylinder.
- If the blade does not move downwards, the drift is due to the safety valve.

★ In order to check whether the drift is due to the swivel joint, see: «CHECKING LEAKAGES INSIDE THE SWIVEL JOINT».

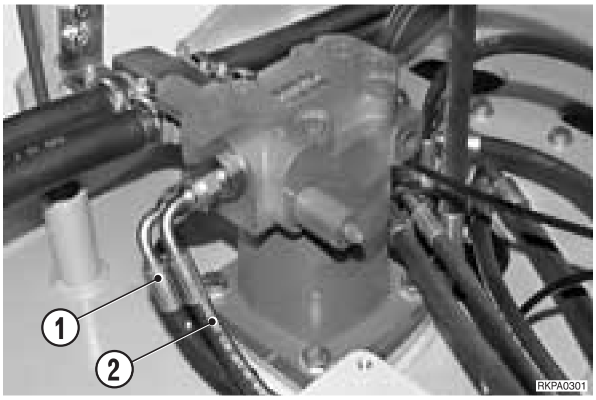


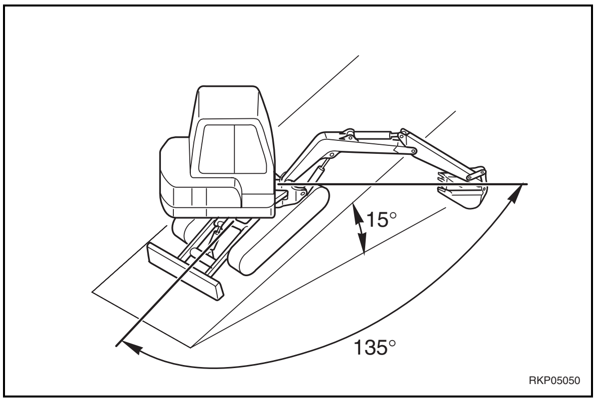
6. Swing motor test

1 - Position the machine with boom, arm and bucket raised as in the figure and with the revolving frame turned 135° to the left.
2 - Stop the engine and release the residual hydraulic pressures.



3 - Disconnect the hoses (1) and (2) from the motor and plug them to prevent entry of impurities. Attach provisional tubes to the motor to catch any oil leakages.
4 - Start the engine, move the machine to a 15º slope, and stop the engine.
5 - Mark the position between revolving frame and lower track-frame on the swing circle and for 15 minutes check whether or not the revolving frame rotates.
   - If the revolving frame rotates the drift is due to either the safety valve or the control valve.
   - ★ To establish the cause of the drift, install a new safety valve.





CHECKING FOR ANY LEAKAGES INSIDE THE WORKING EQUIPMENT CYLINDERS

★ Test conditions:
- Engine: at working temperature.
- Hydraulic oil: 45 – 55 °C.

1 - Fully extend the rod of the cylinder to be checked and stop the engine.

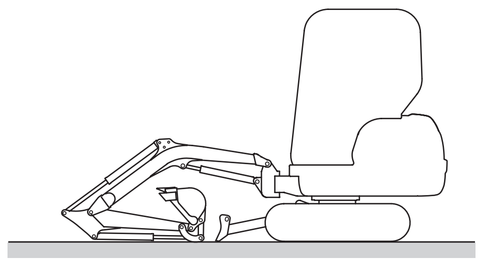
2 - Disconnect the tube (1) from the head side of the cylinder and bind it to the structure.

⚠ Take great care not to disconnect the tube on the base side of the cylinder.

3 - Start the engine, bring it up to high idling and bring the base side of the cylinder up to maximum pressure.

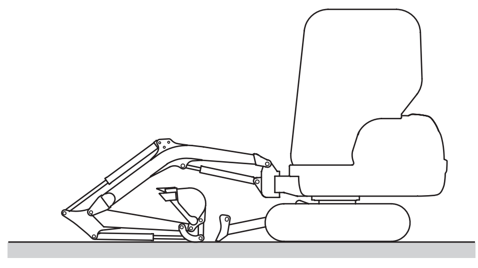
4 - After 30 seconds, wait for a full minute to collect any leakages from the free tube.

POSITION FOR THE BOOM TEST



RKP04710

POSITION FOR THE ARM AND BUCKET TEST



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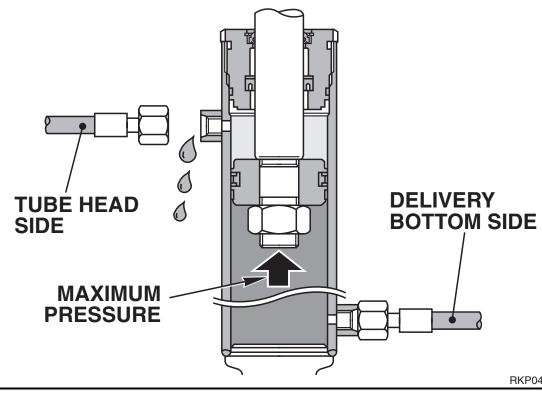


RKP04751

CHECKING FOR ANY LEAKAGES INSIDE THE SWING MOTOR

★ Test conditions:
- Engine: at working temperature.
- Hydraulic oil: 45 – 55°C.
- Turret: locked in place with the swing-locking pin.

1 - Disconnect the drainage tube (1) of the motor (2) and plug it.

2 - Attach a provisional tube to catch the drainage oil.

3 - Start the motor and bring it up to maximum swing.

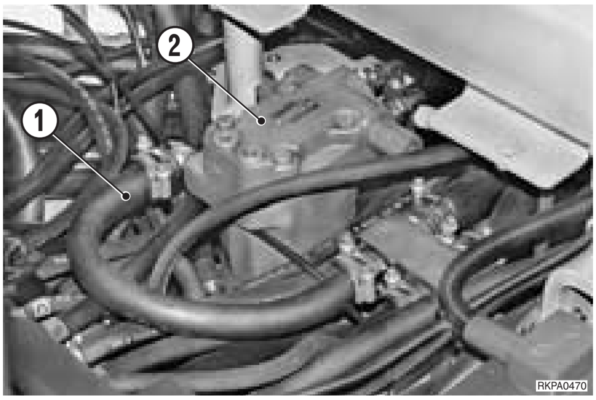
4 - Make sure that the turret is locked in place and push the swing command lever to the end of its stroke.

5 - Hold it in this position for 15 seconds and then measure the leakage for the next full minute.

6 - Bring the motor back to low speed and repeat the reading for the other direction of swing.

7 - Check that the average between the two readings falls within normal values (See «TECHNICAL DATA»).

8 - Re-assemble the hydraulic drainage circuit.



METHODS FOR TESTING FOR LEAKAGES INSIDE THE SWIVEL JOINT

★ Test conditions:
- Engine: at working temperature.
- Hydraulic oil: 45 – 55°C.

1. Functionality test

1 - When a lower actuator (blade, travel motor, travel increment) is found to be defective, one of the possible causes of failure is the swivel joint.

2 - In order to ascertain the cause of the defect it is sufficient to by-pass the joint by connecting (using a length of additional tubing) the input and output tubes of the joint of the line to be checked.
If this corrects the defect, it is certainly due to the swivel joint.
If the defect persists, it can be ascribed to other causes, but definitely not to the swivel joint.

2. Looking for a defective seal

⚠ These controls are to be carried out only on those lines subjected to working pressures. The drainage line is therefore not included in these tests.

The test method consists of pressurising the line to be checked and measuring any leakages from the adjacent lines according to the following tables:

PC12R-8

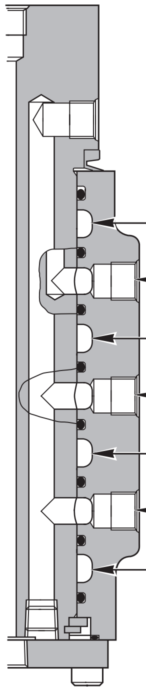


TABLE A

Symbol	Line to be controlled (under pressure)	Adjacent line (possible leakages)	Sym.
A	Travel motor to the right - Reverse	Travel motor to the left - Reverse	B
		External leak (visible)	—
B	Travel motor to the left - Reverse	Travel motor to the right - Forward	C
		Travel motor to the right - Reverse	A
C	Travel motor to the right - Forward	Travel motor to the left - Forward	D
		Travel motor to the left - Reverse	B
D	Travel motor to the left - Forward	Blade cylinder, head side - Rise	E
		Travel motor to the right - Forward	C
E	Blade cylinder, head side - Rise	Blade cylinder base side - Descent	F
		Travel motor to the left - Forward	D
F	Blade cylinder base side - Descent	Descent Passage not used ✻	G
		Blade cylinder, head side - Rise	E

⚠ The symbols correspond to the symbols stamped onto the input and output ports of the swivel joint.

✻ Remove the cap for the test. After the test, replace the cap.

PC12R-8 HS

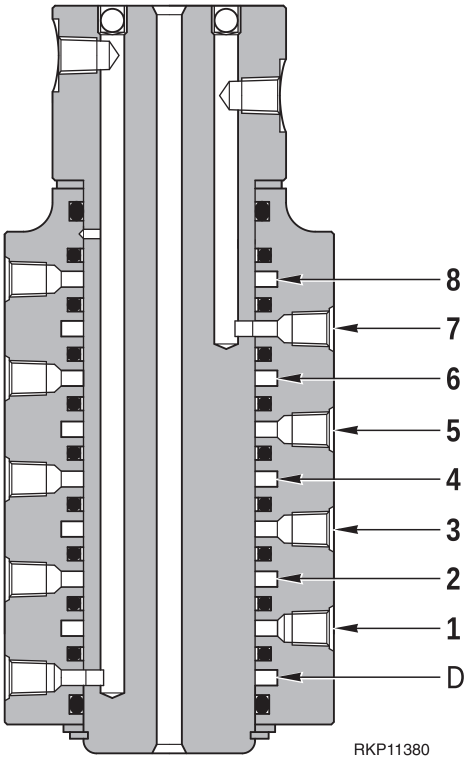


TABLE B

Symbol	Line to be controlled (under pressure)	Adjacent line (possible leakages)	Sym.
8	Blade cylinder, head side - Rise	Travel motor to the left - Reverse	**D**
	Variable gauge undercarriage Bottom side - Open	Draining	**7**
7	Travel motor to the left - Reverse	Blade cylinder, head side - Rise	**8**
		Travel motor to the right - Forward	**6**
6	Travel motor to the right - Forward	Travel motor to the left - Reverse	**7**
		Travel motor to the left - Forward	**5**
5	Travel motor to the left - Forward	Travel motor to the right - Forward	**6**
		Travel motor to the right - Reverse	**4**
4	Travel motor to the right - Reverse	Travel motor to the left - Forward	**5**
		Blade cylinder base side - Descent	**3**
3	Blade cylinder base side - Descent	Travel motor to the right - Reverse	**4**
		Variable gauge undercarriage head side - Close	**2**
2	Variable gauge undercarriage Head side - Close	Blade cylinder base side - Descent	**3**
		Not used ✻	**1**

⚠ The symbols correspond to the symbols stamped onto the input and output ports of the swivel joint.

✻ Remove the cap for the test. After the test, replace the cap.

PC12R-8 MISTRAL HS

PC15R-8 HS

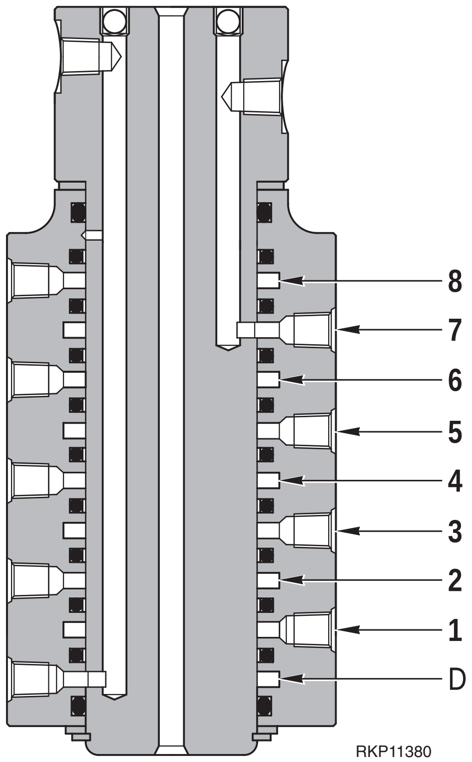


TABLE C

Symbol	Line to be controlled (under pressure)	Adjacent line (possible leakages)	Sym.
8	Blade cylinder, head side - Rise	Draining	**D**
	Variable gauge undercarriage Bottom side - Open	Travel motor to the left - Reverse	**7**
7	Travel motor to the left - Reverse	Blade cylinder, head side - Rise	**8**
		Travel motor to the right - Forward	**6**
6	Travel motor to the right - Forward	Travel motor to the left - Reverse	**7**
		Travel motor to the left - Forward	**5**
5	Travel motor to the left - Forward	Travel motor to the right - Forward	**6**
		Travel motor to the right - Reverse	**4**
4	Travel motor to the right - Reverse	Travel motor to the left - Forward	**5**
		Blade cylinder base side - Descent	**3**
3	Blade cylinder base side - Descent	Travel motor to the right - Reverse	**4**
		Variable gauge undercarriage head side - Close	**2**
2	Variable gauge undercarriage Head side - Close	Blade cylinder base side - Descent	**3**
		Travel increment	**1**
1	Travel increment	Variable gauge undercarriage Head side - Close	**2**
		Draining	**D**

⚠ The symbols correspond to the symbols stamped onto the input and output ports of the swivel joint.

✻ Remove the cap for the test. After the test, replace the cap.

PC12R-8 MISTRAL
PC15R-8

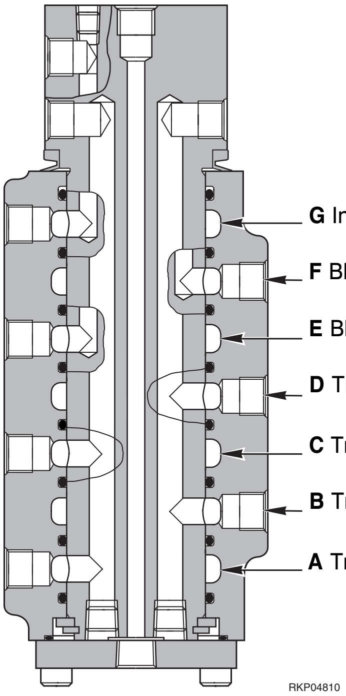


TABLE D

Symbol	Line to be controlled (under pressure)	Adjacent line (possible leakages)	Sym.
A	Travel motor to the right - Reverse	Travel motor to the left - Reverse	**B**
		External leak (visible)	**—**
B	Travel motor to the left - Reverse	Travel motor to the right - Forward	**C**
		Travel motor to the right - Reverse	**A**
C	Travel motor to the right - Forward	Travel motor to the left - Forward	**D**
		Travel motor to the left - Reverse	**B**
D	Travel motor to the left - Forward	Blade cylinder, head side - Rise	**E**
		Travel motor to the right - Forward	**C**
E	Blade cylinder, head side - Rise	Blade cylinder, bottom side - Descent	**F**
		Travel motor to the left - Forward	**D**
F	Blade cylinder, bottom side - Descent	Travel increment	**G**
		Blade cylinder, head side - Rise	**E**
G	Travel increment	External leak (visible)	**—**
		Blade cylinder, bottom side - Descent	**F**

⚠ The symbols correspond to the symbols stamped onto the input and output ports of the swivel joint.

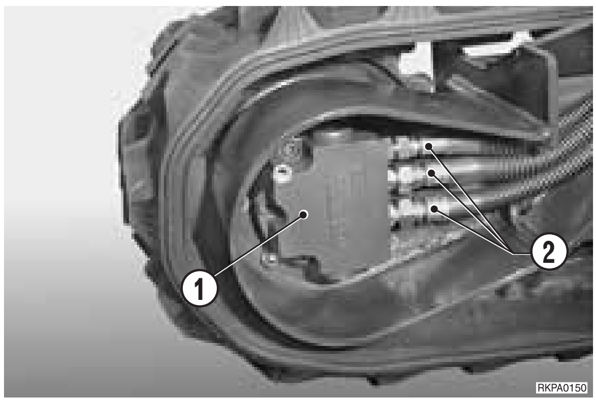
3. Preparation for the testing:

- **Travel motor**
- **Travel increment**

1 - Release all residual hydraulic pressures. (See «ELIMINATION OF THE RESIDUAL PRESSURES FROM THE CIRCUITS»).

2 - Disconnect from the travel motor (1) the tube (2) corresponding to the line to be checked and seal it. Also plug the motor to prevent entry of impurities.

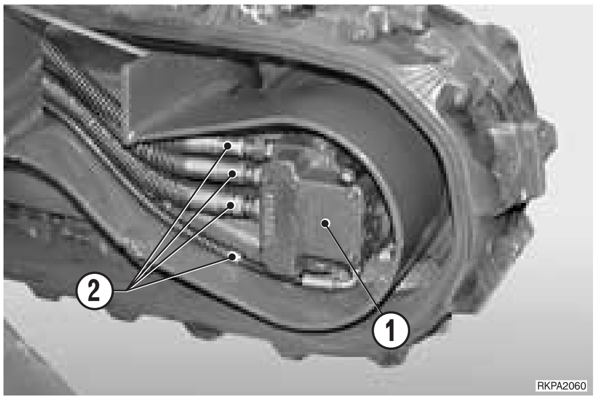
PC12R-8



3 - Disconnect from the relative actuators the tubes that correspond to the lines adjacent to the one being checked. Plug the disconnected tubes to prevent entry of impurities.
   ★ To identify the lines adjacent to the line being checked, please refer to Tables **A** and **B**.

4 - Wait a few minutes to give the oil in the tubes time to drain out.

PC12R-8 (with travel increment) - PC15R-8



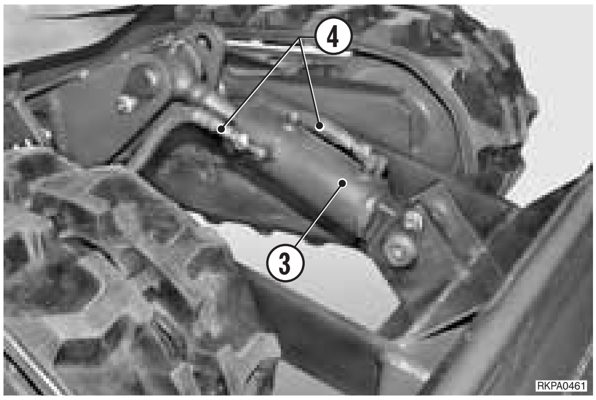
4. Preparation for testing the blade

1 - Release all residual hydraulic pressures. (See «ELIMINATION OF THE RESIDUAL PRESSURES FROM THE CIRCUITS»).

2 - Disconnect from the blade cylinder (3) the tube (4) corresponding to the line to be checked and seal it. Also plug the holes in the actuators to prevent entry of impurities.

3 - Disconnect from the relative actuators the tubes that correspond to the lines adjacent to the one being checked. Plug the disconnected tubes to prevent entry of impurities.
   ★ To identify the lines adjacent to the line being tested, please refer to Tables **A** and **B**.

4 - Wait a few minutes to give the oil in the tubes time to drain out.

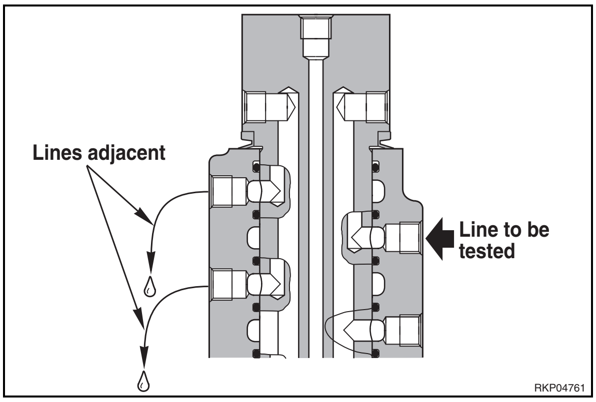


5. Checking the leaktightness

1 - Start the motor and bring it up to the testing speed for each group of components.

2 - Pressurise the line to be tested.

3 - After 30 seconds, then for the next full minute check to see if there are any leakages.
   ★ If oil leaks out of one of the two tubes of the actuators (adjacent lines), it means that there is a leakage of the intermediate gasket between the high pressure line and the adjacent line.



GROUP 30

30 REMOVAL AND INSTALLATION

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HOW TO READ THE MANUAL

1. Removal and Installation of the groups

(1) The procedures and information needed to carry out the work of removing or Installing units or groups are given in the removal procedure. The sequence of operations is not repeated in the installation procedure.

(2) Information needed for installation is marked with the symbol ※1. The same symbol is repeated at the end of each removal procedure for the same item, to indicate to which installation item it refers.

(Example)

REMOVAL GROUP : ○○○ : .... Title of operation

:.. Safety precautions to be followed when carrying out the operation.

1 - Remove XXXX (1):............................... Step in removal procedure.

★ :... Technique or important point to remember when removing XXXX (1)

2 - △△△ (2): .... ※1 This sign means that information is given for the installation procedure

3 - Remove □□□□ (3):

.... ℓ: .... Recovery of oil or water, and the quantity to be recovered.

INSTALLATION GROUP ○○○ :..................... Title of operation.

- To install, reverse removal procedure.

  ※1 : .... Technique to be used for installation.

  ★ : .... Technique or important point to remember when removing △△△ (2).

- Addition of water or oil: .... Step in removal procedure.

  ★ : .... Point to remember when adding water or oil.

2. To the precautions to be taken during the removal or installation of the groups, must be added the specific «PRECAUTIONS TO BE TAKEN DURING THE OPERATIONS».
Always make sure that these precautions are taken.

3. List of special tools.

(1) For details of the descriptions, codes and quantities of each tool (**A1**; **A2** etc.) mentioned in the operational procedures, see the list «SPECIAL TOOLS» supplied in this section.

4. List of the tightening torques and weights, and the quantities oil, liquids or grease needed to fill tanks and containers

(1) In the operating procedures, you will find the symbols Nm, kg, , . In the following order, these represent the values of «TIGHTENING TORQUES», «WEIGHT OF PARTS OR GROUPS», «QUANTITIES OF OIL OR LIQUIDS TO BE INTRODUCED», «SCREW LOCKING MATERIAL, SEALANTS AND LUBRICATION», «LUBRICATING GREASE».

NOTE
If no symbol is indicated, the values to be used are those given in the introductory sections of this manual.

PRECAUTIONS TO BE TAKEN WHILE WORKING

★ When dismantling or installing a part, always take the following general precautions.

1. **Precautions for removal operations**
   - If not otherwise indicated, lower the work equipment until it rests on the ground.
   - If the coolant liquid contains an anti-freeze substance, follow the instructions given for drainage.
   - After having removed flanges and tubes, insert plugs to prevent impurities from entering.
   - Before removing a cylinder, fully retract the piston and tie it with wire.
   - Use a sufficiently large container to collect the oil.
   - Before removing a part from the machine, check the alignment reference marks which show the correct installation position. If necessary add further marks to avoid incorrect installation.
   - While dismantling the connectors, always grasp them firmly to avoid undue strain on the wiring.
   - If necessary, attach markers to the wires and tubes to avoid muddling them up during installation.
   - Check the number and height of the adjustments to a given clearance and store them in a safe place.
   - When raising the machine or some parts of it, use adequate equipment for the weight of the part concerned.
   - When using screws or eyebolts to remove items of the machinery, screw them alternately, and as deeply as they will go.
   - Before removing a piece, clean the surrounding area and, after removal, cover the area to prevent dirt or dust from gaining entrance.
2. **Precautions to be taken during installation**
   - Tighten nuts and screws with the specified tightening torques.
   - Install the flexible hoses, taking care not to entangle or twist them.
   - Bend the cotter pins and stops in such a way as to secure them.
   - When coating the threads with adhesives, clean the piece to remove oil and grease, then apply just enough adhesive to cover the threading in a uniform manner.
   - When applying a liquid sealant, clean the surface involved, remove residual oil and grease, check that there are no dents or dirt, then apply the liquid sealant in a uniform manner.
   - Clean all the parts, remove dirt, rust, burrs, or dents.
   - Apply a film of engine oil over all the moving parts.
   - Apply a film of anti-friction grease (ASL800040) over all surfaces assembled with pressure, to avoid sticking.
   - After having mounted the snap-rings, check that they are firmly positioned in their seatings.
   - When installing electrical system jacks, remove any oil, dust or water that may have penetrated into them, then connect them firmly.
   - If using eyebolts, check that they are not distorted, screw them in fully, and then align the eye with the hoisting hook.
   - Mount the flanges in a uniform manner, and tighten the screws in criss-cross sequence, to avoid excessive pull on one side only.
3. **Precautions to be taken on completion of removal and installation operations.**
   - If the coolant liquid has been drained away, close the drainage plug and add new liquid up to normal level. Start the engine to circulate the liquid throughout the cooling system and then top up the level once more.
   - When the hydraulic equipment has been dismantled, add engine oil to the indicated level. Start up the engine to circulate the oil in the hydraulic circuits, and then top up to the indicated level.
   - If hoses or hydraulic equipment, such as hydraulic cylinders, pumps, motors, solenoid valves and valves, are removed for repairs or substitution, bleed air from the hydraulic circuits after having re-assembled the machine.
     ★ For details, see «20. TESTING AND ADJUSTMENTS».
   - After having re-assembled cylinder joints or cylinders, or work equipment articulations, lubricate thoroughly.

SPECIAL TOOLS

Nature of work	Symbol		Code	Description	Q.ty	Notes
Removal - installation of steel track shoe	A	1	ATR200460	Equipment	1	For master pin
Disassembly - assembly recoil spring	B	1	ATR200720	Equipment	1	Removal - installation recoil spring
Disassembly - assembly cylinders	C	1	ATR200620	Equipment for disassembly - assembly cylinders	1	All cylinders
		2	ATR800190	Dynamometric wrench with multiplier	1	Max. 400 kg (400 dNm)
		3	ATR200730	Pliers for mounting gaskets	1	All cylinders
		4	ATR200740	Plunger Øi 30	2	Mounting bushings on cylinders and piston rod
			ATR200750	Plunger Øi 35	2	
		5		Wrench for cylinder Ø 65	1	Removal - installation of head
				Wrench for cylinder Ø 70	1	
				Wrench for cylinder Ø 75	1	
				Wrench for cylinder Ø 80	1	
		6		6-point socket wrench (30)	1	Removal - installation of piston
				6-point socket wrench (32)	1	
				6-point socket wrench (36)	1	
			ATR200870	6-point socket wrench (41)	1	
		7		Plunger for piston rod Ø 30	1	Mounting ring on the head
				Plunger for piston rod Ø 35	1	
		8		Plunger for cylinder Ø 50	1	Mounting piston gasket
				Plunger for cylinder Ø 55	1	
				Plunger for cylinder Ø 60	1	
				Plunger for cylinder Ø 70	1	
		9		Gauge for cylinder Ø 50	1	Gauging piston gasket
				Gauge for cylinder Ø 55	1	
			ATR200990	Gauge for cylinder Ø 60	1	
			ATR201000	Gauge for cylinder Ø 70	1	
		10		Bushing for piston rod Ø 30	1	Mounting head
			ATR201150	Bushing for piston rod Ø 35	1	

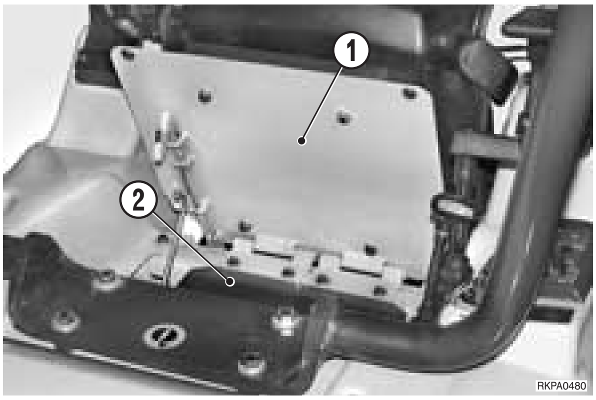
SPECIAL TOOLS

Nature of work	Symbol		Code	Description	Q.ty	Notes
Disassembly - assembly cylinders	C	11		Bushing for piston Ø 50	1	Assembling piston - cylinder
				Bushing for piston Ø 55	1	
			ATR201190	Bushing for piston Ø 60	1	
			ATR201200	Bushing for piston Ø 70	1	
Disassembly - assembly final drive	D	1		Plunger	1	Mounting planetary gear
		2		Tool	1	Mounting front seal
		3		Spacer	1	Mounting motor-gears
		4		Pad	1	Removal and mounting bearings

REMOVAL OF THE STARTER MOTOR

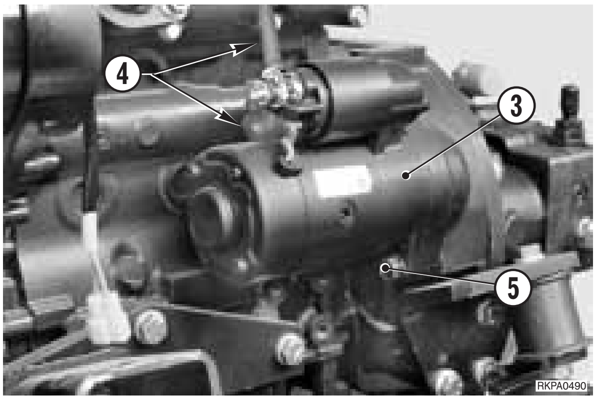
⚠ Disconnect the negative terminal cable (-) from the battery.

1 - Tip up the seat (1) and take out the toolbox (2).



2 - Disconnect the electric wiring (4) from the starter motor (3).

3 - Take out the screws (5) and remove the starter motor. ※1



INSTALLATION OF THE STARTER MOTOR

- To install, reverse the removal procedure.

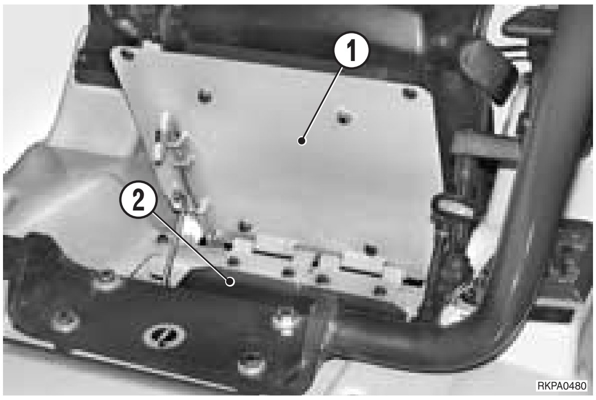
※1

Screw: 45 – 52 Nm

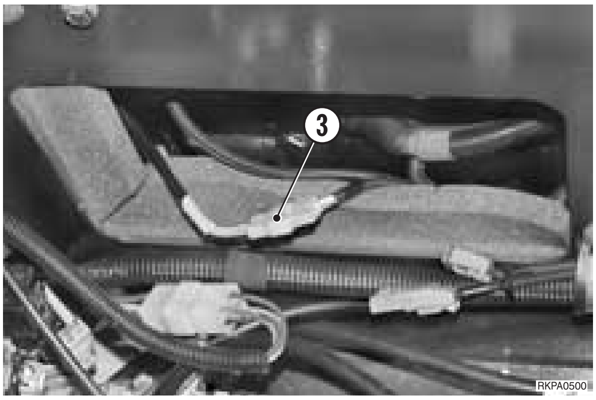
REMOVAL OF THE ALTERNATOR

⚠ Disconnect the negative terminal cable (-) from the battery.

1 - Tip up the seat (1) and take out the toolbox (2).

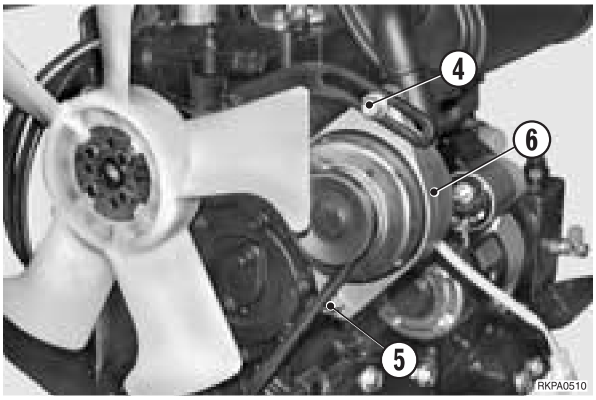


2 - Disconnect the connector (3).



3 - Loosen and take out the screws (4) and (5). ※1

4 - Remove the alternator (6). ※2



INSTALLATION OF THE ALTERNATOR

- To install, reverse the removal procedure.

※1

Nm Screws (4): 23 – 29 Nm

Nm Screws (5): 45 – 52 Nm

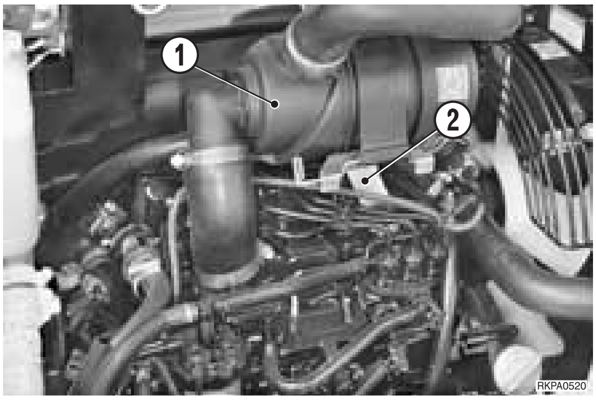
※2

★ Adjust the tension of the fan belt. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

REMOVAL OF THE PUMP GROUP

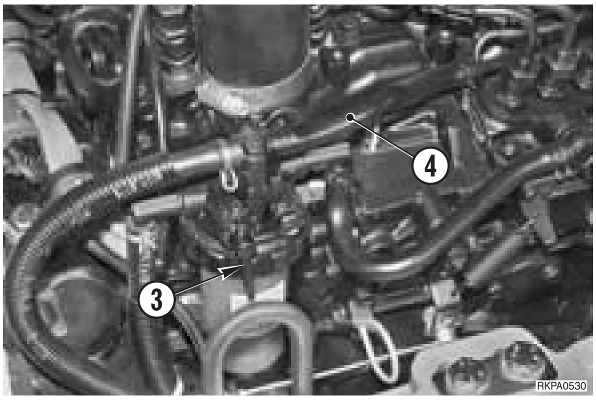
⚠ Disconnect the negative terminal cable (-) from the battery.

1 - Remove the suction filter group (1) and the supporting bracket (2).



2 - Close the filter cock (3).

3 - Remove the fuel return tubes (4) from the injection nozzles.

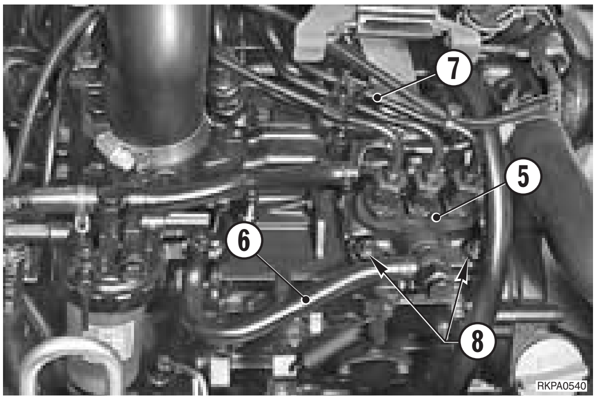


4 - Disconnect the fuel supply tube (6) from the pump group (5).

5 - Remove the high-pressure tubes (7). ※1

6 - Loosen and remove the nuts (8) and remove the pumping group (5). ※2

★ Take care not to damage the shim underneath the pump group.



INSTALLATION OF THE PUMPING GROUP

- To install, reverse the removal procedure.

※1

Nm High-pressure tube unions: 29 – 34 Nm

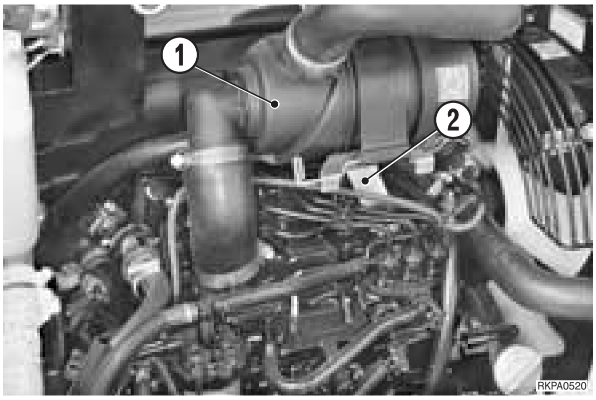
※2

Nm Nuts: 44 – 53 Nm

★ Check the fuel injection timing. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

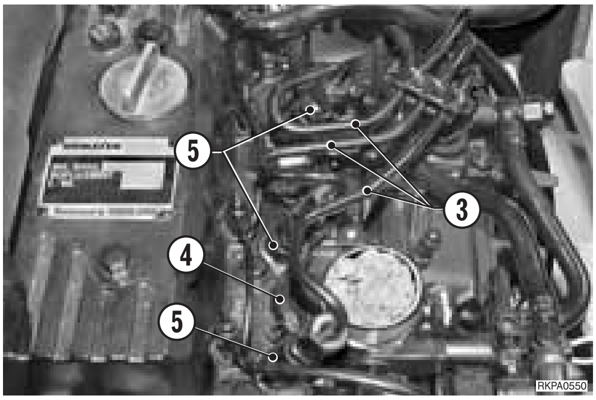
REMOVAL OF THE INJECTION NOZZLES

1 - Remove the suction filter (1) and the supporting bracket (2).



2 - Remove the high-pressure pipes (3) and the fuel return tubes (4). ※1

3 - Remove the complete injection nozzles (5). ※2



INSTALLATION OF THE INJECTION NOZZLES

- To install, reverse the removal procedure.

※1

Nm High-pressure pipe unions: 29 – 34 Nm

※2

Nm Injection nozzles: 50 – 53 Nm

REMOVAL OF THE CYLINDER HEAD

⚠ Disconnect the negative terminal cable (-) from the battery.

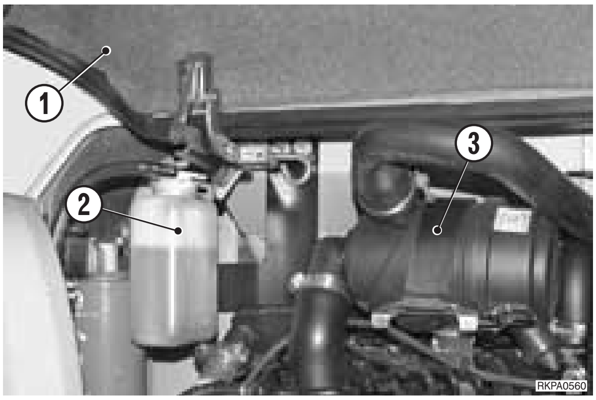
★ Drain the engine coolant.

Coolant: Approx. 3.2 ℓ

※1

1 - Remove the engine hood (1), the expansion chamber (2) and the relative supporting bracket.

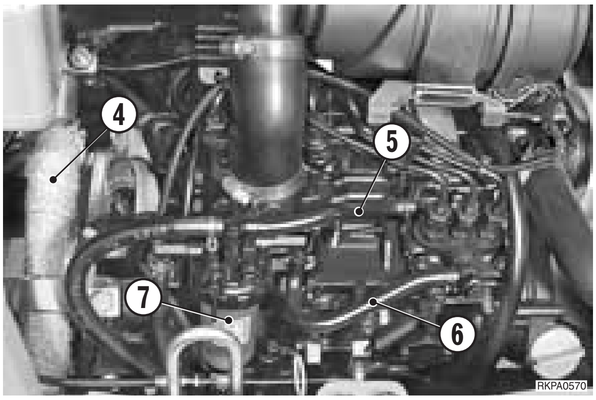
2 - Remove the complete air filter (3) together with its support.



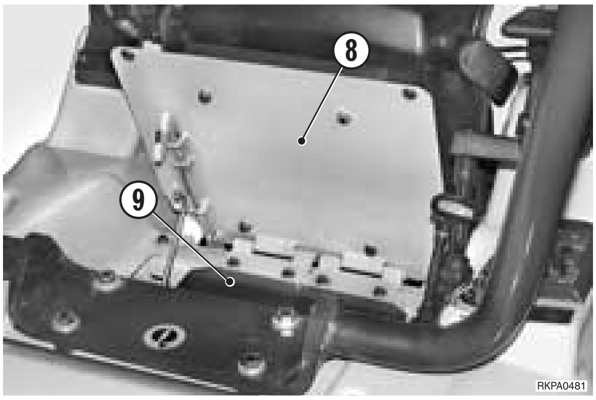
3 - Remove the tail-pipe (4).

4 - Remove the injection pump supply tube (5) and the fuel return tube (6) from the injection nozzles.

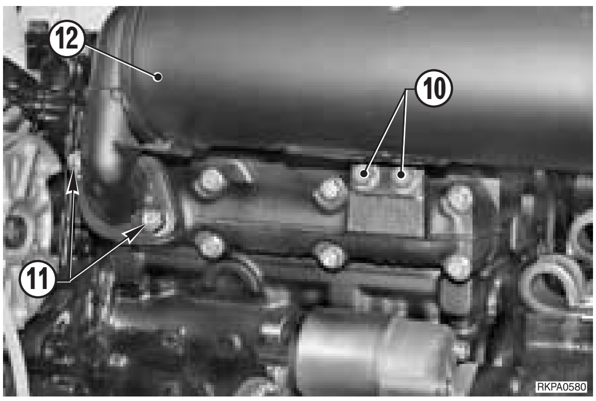
5 - Remove the fuel filter (7) without disconnecting the tank supply and return tubes. Put it to one side.



6 - Tip up the seat (8) and take out the toolbox (9).

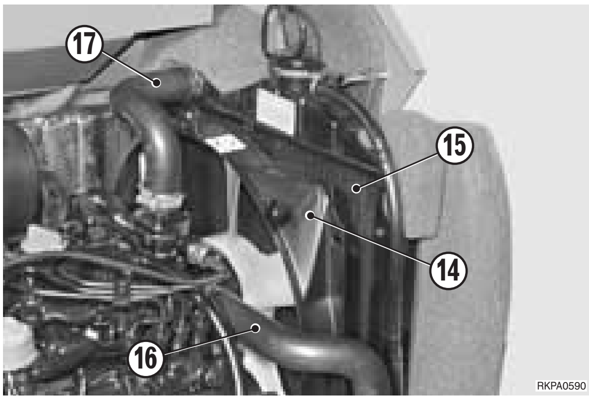


7 - Take out the screws (10), the nuts (11), and remove the muffler (12). ※2



8 - Remove the fan cover (13) and disconnect the fan-cooling conveyor (14) from the radiator (15).

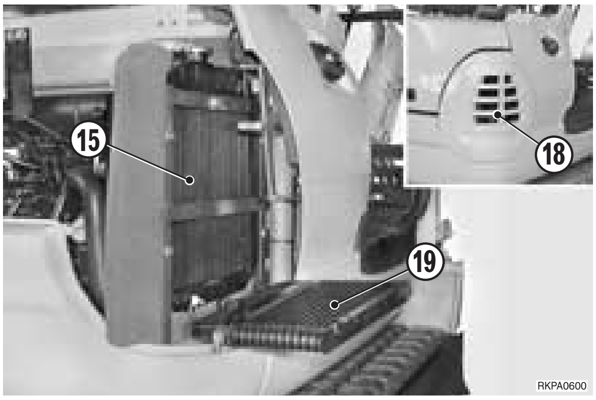
9 - Disconnect the engine coolant tubes (16) and (17) from the pump.



10 - Remove the right-hand rear panel (18). ※3

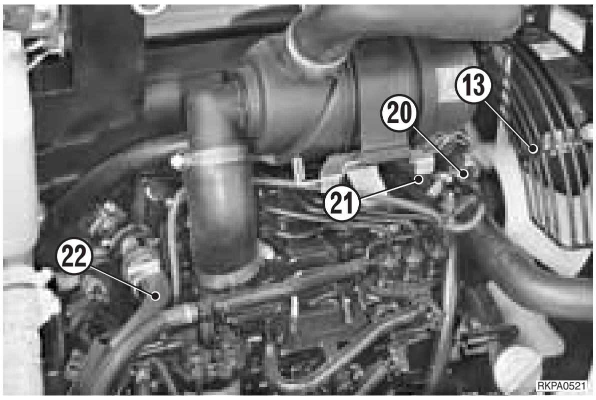
11 - Remove the oil-cooler (19) and put it to one side.

12 - Remove the radiator (15).



13 - Disconnect the coolant thermostat (20).

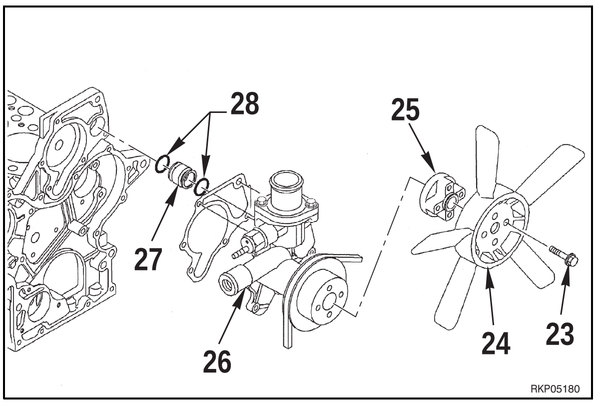
★ **Only for machines with cab heating:**
disconnect the heating pipe (21) from the pump and disconnect the return tube (22).



14 - Take out the screws (23) and remove the cooling fan (24) and the spacer (25). Take out the fan-cooling conveyor (14).

15 - Loosen the alternator drive belt and disengage the pulley of the water pump. ※4

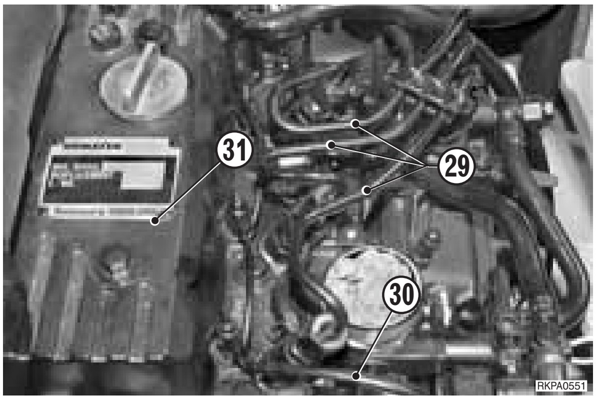
16 - Remove the water pump (26) complete with joint (27) and washer (28). ※5



17 - Remove the high-pressure pipes (29). ※6

18 - Disconnect the glow plug supply cable (30).

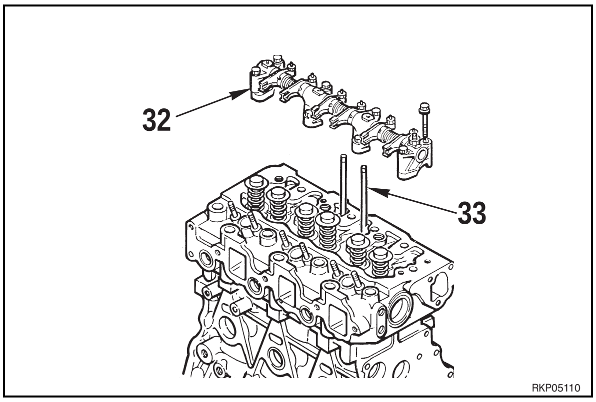
19 - Remove the valve tappet cover (31).



20 - Remove the rocker-arm shaft (32).

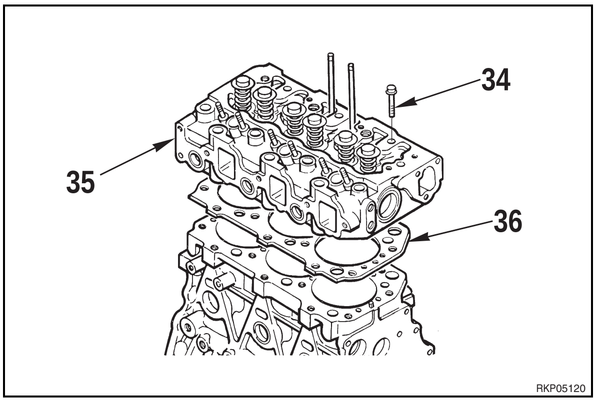
★ Loosen the lock nuts and unscrew the valve tappets by 2-3 turns. ※7

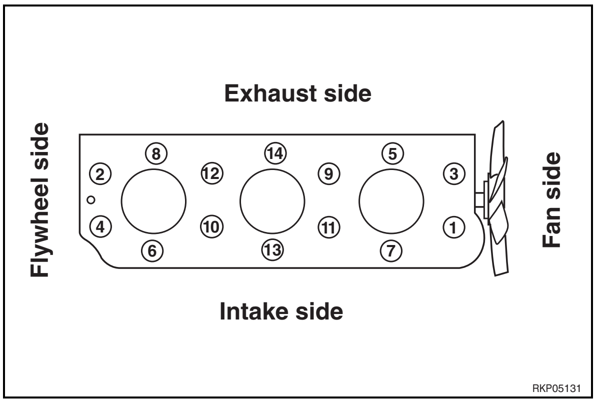
21 - Take out the rocker-arm control rods (33).



22 - Take out the screws (34) in the sequence indicated and remove the cylinder head (35). ※8

★ The cylinder head gasket (36) must be substituted every time it is dismantled.





INSTALLATION OF THE CYLINDER HEAD

- To install, reverse the removal procedure.

※1

1 - Fill up the cooling circuit.

Coolant: approx. 3.2 ℓ

2 - Start the engine to circulate the liquid through all circuits. Stop the engine and check the level.

★ **Only for machines with cab heating**
Make sure that the heating cock is open.

※2

Muffler screws and nuts: 23 – 29 Nm

※3

Rear guard screws: 108±11 Nm

※4

★ Adjust belt tension. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

※5

★ Check the gaskets:

Screws M6: 9.8 – 11.7 Nm

Screws M8: 23 – 28 Nm

※6

High-pressure pipe unions: 29 – 34 Nm

※7

★ Check that the valve tappets are firmly engaged in the rods.

★ Start tightening the rocker-arm shaft from the centre outwards.

Rocker-arm shaft screws: 23 – 28 Nm

★ Adjust valve clearance. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

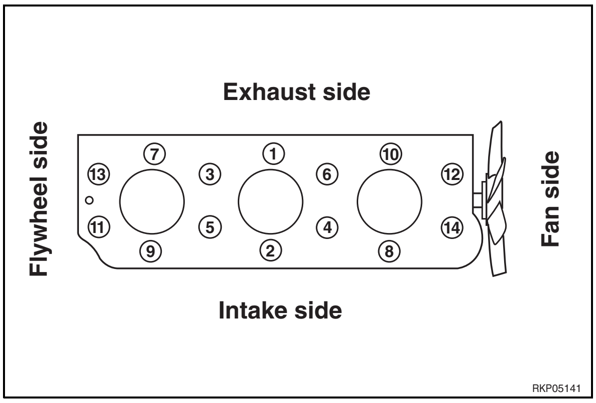
※8

★ Raise the cylinder head, keeping it horizontal, and place it on the gasket without shifting anything.

★ Lubricate the screw-threadings with engine oil.

★ Tighten the screws in the sequence indicated. (See figure).

Cylinder head screws: 37.2 – 41 Nm



REMOVAL OF THE OIL COOLER

Completely lower the working equipment until it is resting on the ground and stop the engine.

Release all residual pressures from the circuits and the tank. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

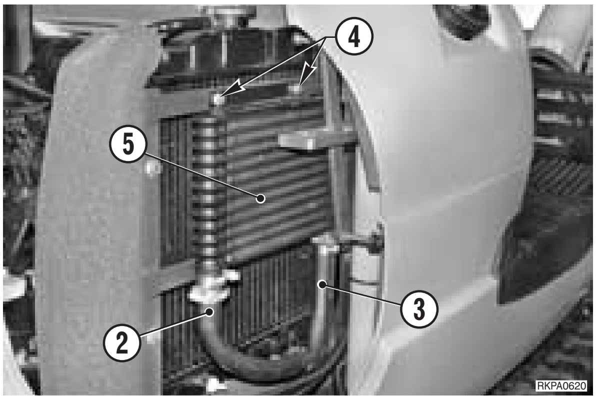
1 - Remove the right-hand rear grill (1). ※1

2 - Slowly loosen the clamps on tubes (2) and (3) in order to drain the oil from the oil cooler and drainage tubing.

Oil-cooler oil: approx. 0.3 ℓ ※2

3 - Disconnect the tubes (2) and (3) and plug them to prevent entry of any impurities.

4 - Take out the screws (4) and remove the oil-cooler (5).



INSTALLATION OF THE OIL COOLER

- To install, reverse the removal procedure.

※1

Rear grill screws: 108±11 Nm

※2

★ Fill the hydraulic oil tank with oil up to its maximum level.

Hydraulic oil required: approx. 0.3 ℓ

1 - Start the engine to fill the oil cooler and check that there are no leaks.

2 - Stop the engine, check the level and, if necessary, top it up.

REMOVAL OF THE RADIATOR

Completely lower the working equipment until it is resting on the ground and stop the engine.

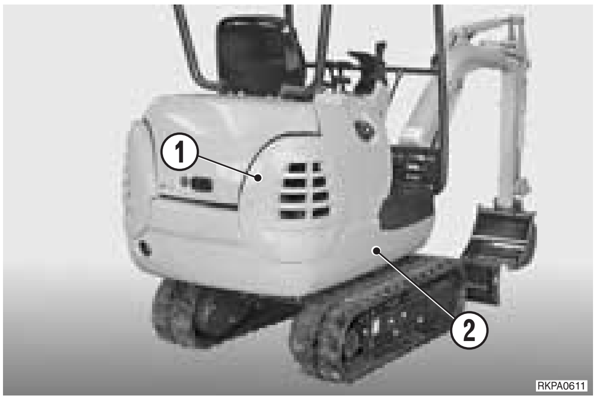
Release all residual pressures from the circuits and the tank. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

1 - Remove the right-hand rear grill (1).

2 - Remove the lower right-hand panel (2).

3 - Drain the Coolant.

Coolant: approx. 3.2 ℓ



4 - Remove the air filter and disconnect the tubes (3) and (4) from the radiator.

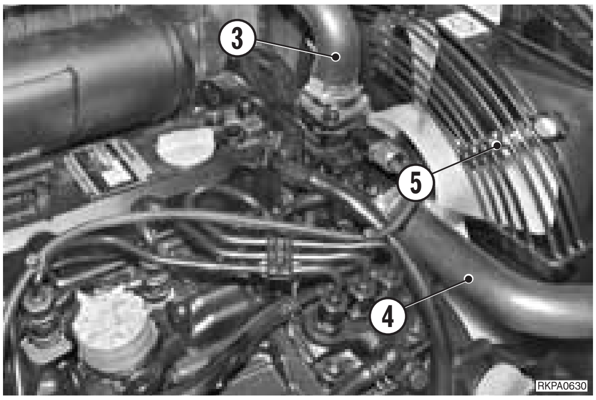
5 - Take off the fan guard (5).

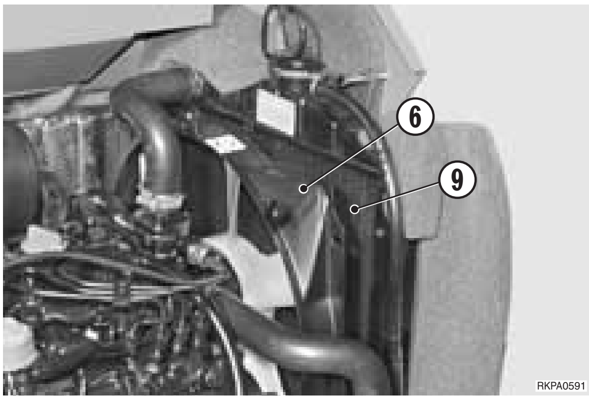
6 - Disconnect the fan-cooling conveyor (6).

7 - Remove the oil cooler (7) without disconnecting the tubes and put it to one side.

8 - Take out the radiator screws (8).

9 - Remove the radiator (9).





INSTALLATION OF THE RADIATOR

- To install, reverse the removal procedure.

※1

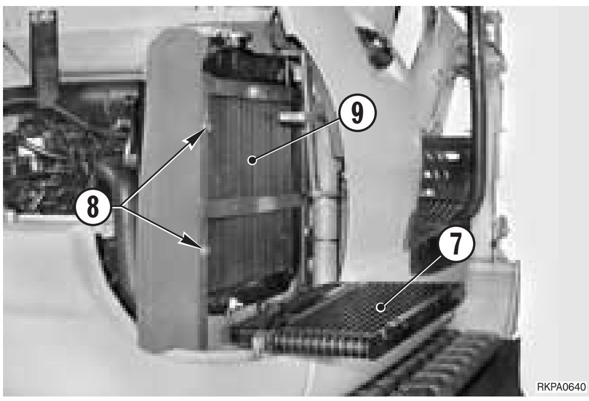
★ Fill up the cooling circuit.

Coolant: approx. 3.2 ℓ

★ Add hydraulic oil to the tank. (See «INSTALLATION OF THE OIL-COOLER»).

1 - Start the engine to circulate the Coolant throughout the system and to fill the oil-cooler with oil.

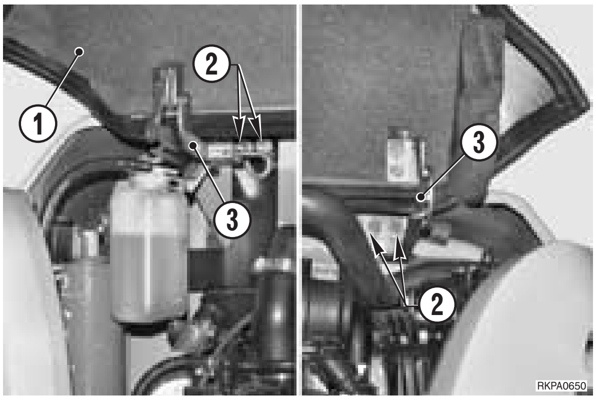
2 - Stop the engine, check the levels and, if necessary, top them up.



REMOVAL OF THE ENGINE HOOD

⚠ Completely lower the working equipment until it is resting on the ground and stop the engine.

1 - Block the engine hood (1) in its raised position, take out the screws (2) that fasten the hinge (3) to the frame and remove the hood. ※1

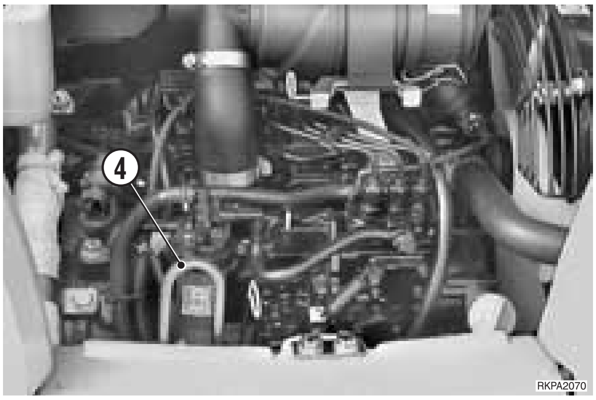


INSTALLATION OF THE ENGINE HOOD

- To install, reverse the removal procedure.

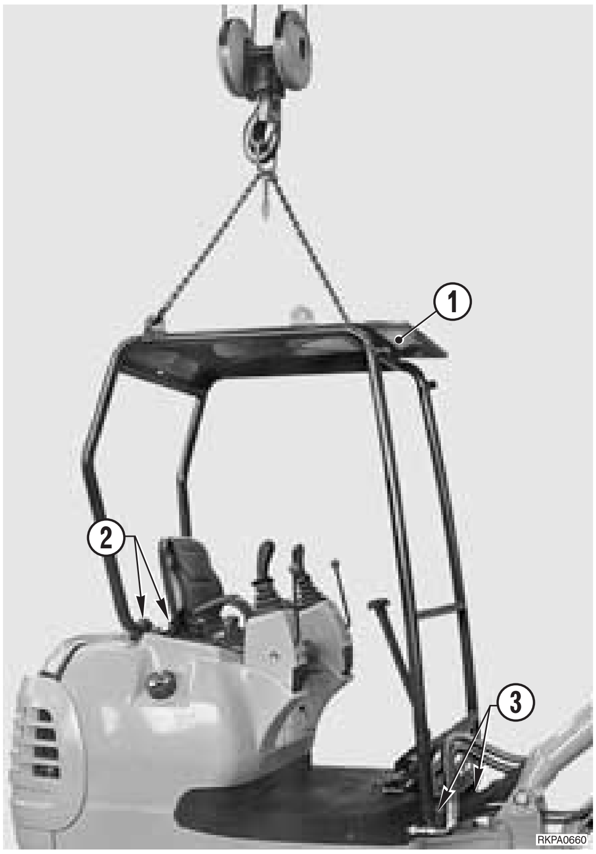
※1

★ Check the alignment of the outside edges, the centering and the adjustment of the closing mechanism (4).



REMOVAL OF CAB AND CANOPY

⚠ Completely lower the working equipment until it is resting on the ground and stop the engine and take out the ignition key.



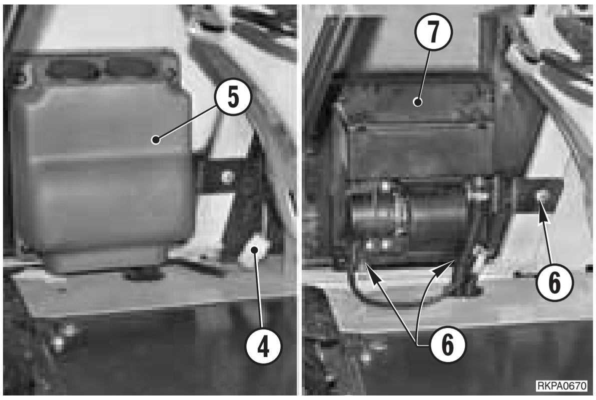
1. Removal of the canopy

1 - Attach the canopy (1) to some hoisting tackle.

2 - Loosen and remove the screws (2) and (3). ※1

3 - Remove the canopy.

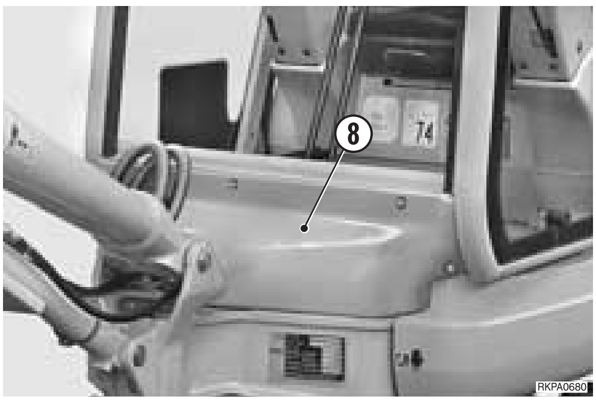
2. Removal of the cab



1 - Disconnect the connector (4).

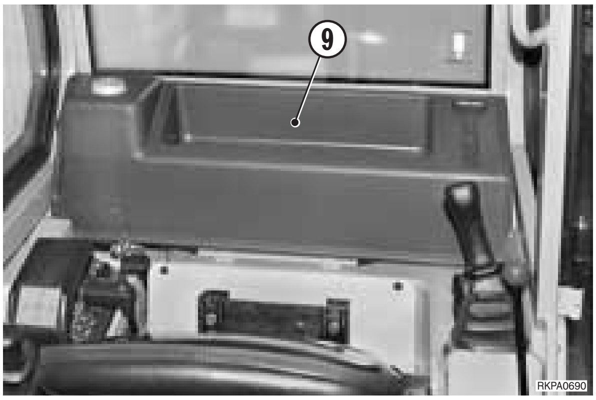
2 - Remove the cover (5).

3 - Take out the screws (6) and remove the heater (7), putting it to one side.



4 - Remove the front cover (8).

5 - Remove the rear shelf (9).



6 - Attach the cab (10) to some hoisting tackle.

7 - Loosen and remove the front and rear screws (11) and nuts (12). ※2

8 - Remove the cab (10).

INSTALLATION OF CANOPY AND CAB

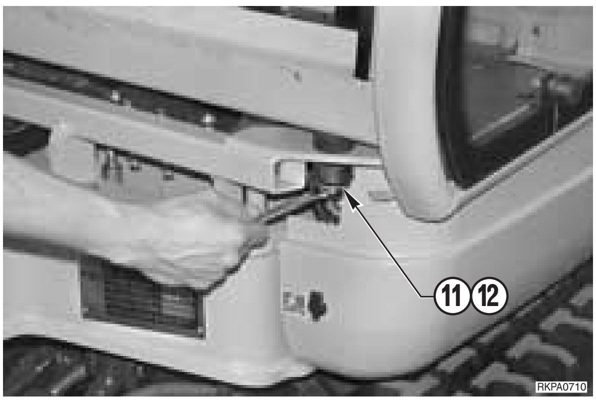
- To install, reverse the removal procedure.

※1

Nm Canopy screws: 108±11 Nm

※2

Nm Cab screws: 108±11 Nm



REMOVAL OF THE HEATING FAN

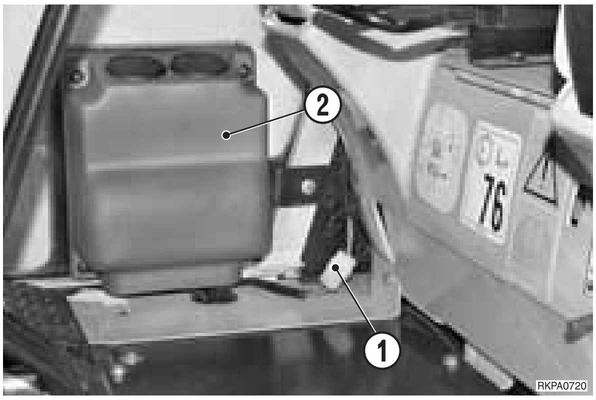
⚠ Completely lower the working equipment until it is resting on the ground and stop the engine and take out the ignition key.

★ Drain the engine coolant.

Coolant: approx. 3.2 ℓ

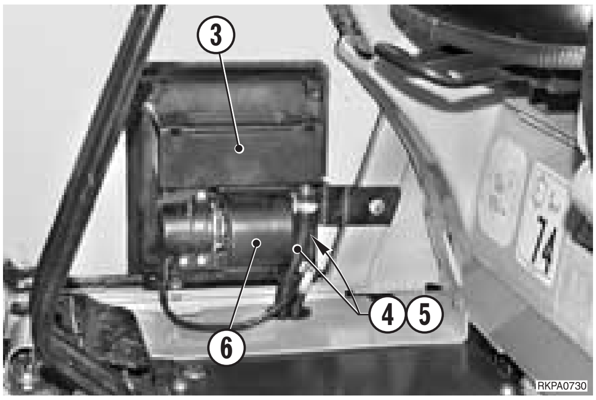
1 - Disconnect the connector (1).

2 - Remove the cover (2).



3 - Loosen the clamps and disconnect the heating pipes (4) and (5) from the radiator (3).

4 - Remove the fan group (6).



INSTALLATION OF THE HEATER FAN

- To install, reverse the removal procedure.

※1

★ Check that the lower diffuser engages in its union.

1 - Make sure that the heating cock is fully open.

2 - Fill up the coolant circuit.

Coolant: approx. 3.2 ℓ

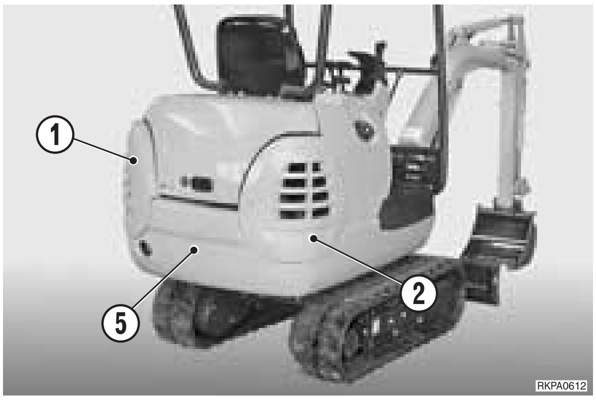
3 - Start the engine to circulate the coolant.

4 - Stop the engine and top up the level.

REMOVAL OF THE REAR COUNTERWEIGHT

⚠ Completely lower the working equipment until it is resting on the ground and stop the engine.

1 - Remove the rear side grills (1) and (2). ※1
2 - Remove the hood fastener (3).
3 - Loosen the counterweight screws (4) to eliminate the tightening torque. ※2
4 - Attach the counterweight (5) to some hoisting tackle, remove the screws, and pull out the counterweight (5).



INSTALLATION OF THE REAR COUNTERWEIGHT

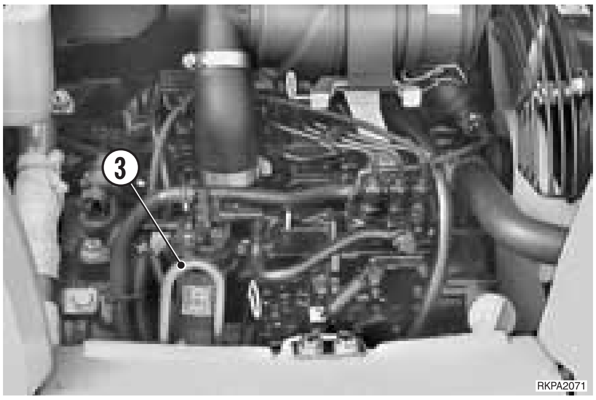
- To install, reverse the removal procedure.

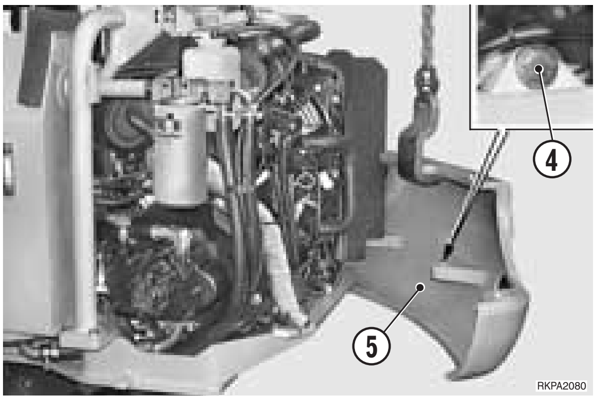
※1

Grill screws: 108±11 Nm

※2

Counterweight screws: Loctite 262
Counterweight screws: 268±29 Nm



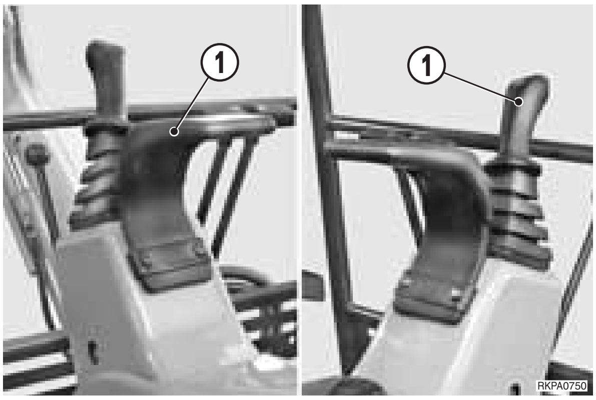


REMOVAL OF THE TOP COVER AND SIDE PANELS

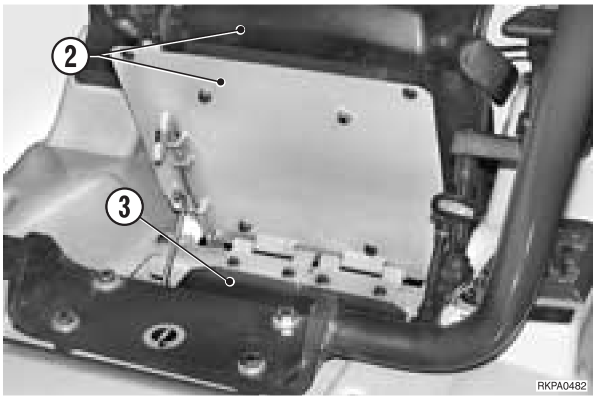
⚠ Completely lower the working equipment until it is resting on the ground, stop the engine and take out the ignition key.

1. Top cover

1 - Remove the arm-rests (1).



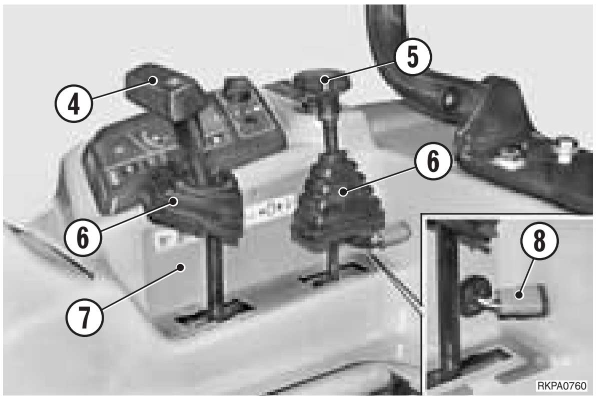
2 - Remove the seat (2) complete with its support and the toolbox (3).



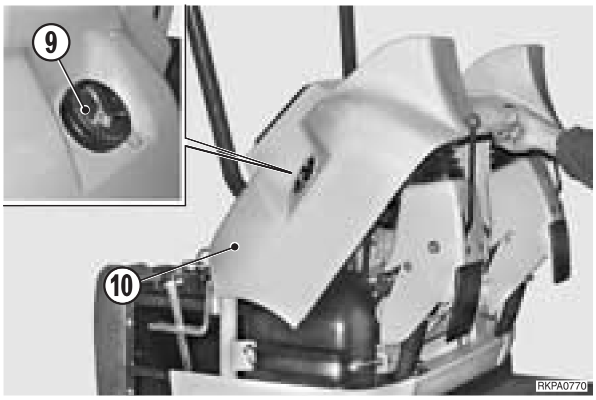
3 - Remove the knobs (4) and (5) from the accelerator and blade levers. Pull off the rubber sleeves (6).

4 - Remove the accelerator and blade command guard (7).

5 - Remove the core-hitch and push the connector (8) inside the casing.

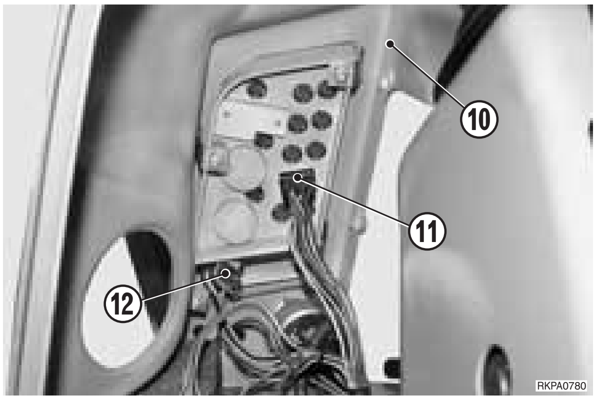


6 - Remove the cap (9) of the diesel fuel tank.



7 - Take out the screws and partially raise the casing (10), disconnect the ignition key and dashboard illumination connectors (11) and (12).

8 - Lift off the casing (10) by raising it from the front.

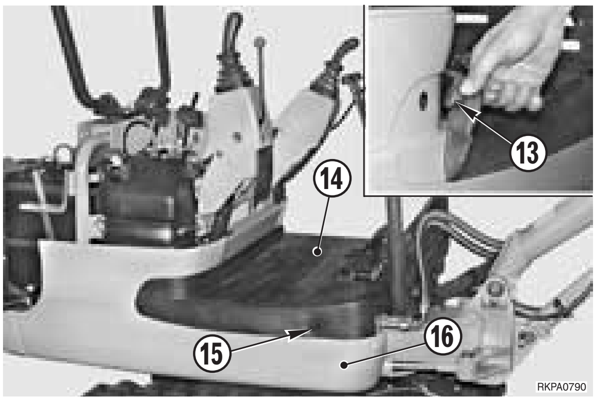


2. Side panels

1 - **Only for the version with canopy**
Disengage the hooks (13) of the floor-mat (14).

2 - Remove the front buttons (15) and take up the mat.

3 - **For all versions**
Take out the screws and remove the side panels (16).



INSTALLATION OF THE TOP COVER AND SIDE PANELS

- To install, reverse the removal procedure.

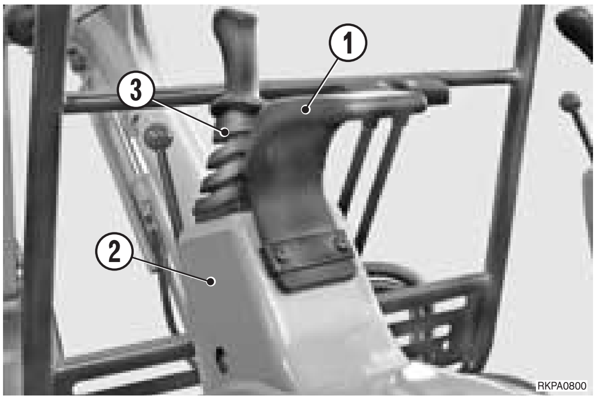
REMOVAL OF THE HYDRAULIC OIL TANK

⚠ Completely lower the working equipment until it is resting on the ground and stop the engine.

⚠ Release all residual pressures from the circuits and the tank. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

★ Drain out the hydraulic oil.

Hydraulic oil: approx. 22 ℓ



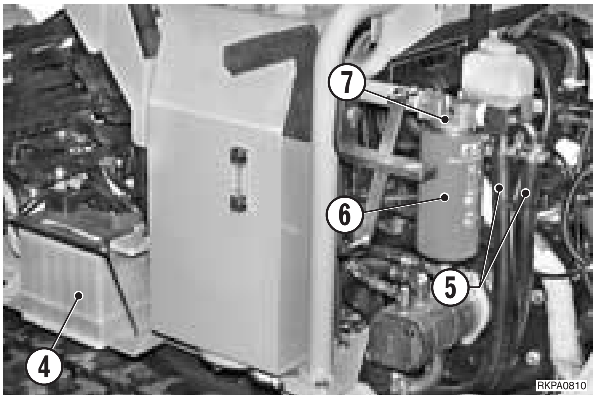
1 - Lift off the top cover and the left-hand side panel. (For details, see «REMOVAL OF THE TOP COVER AND THE SIDE PANELS»).

2 - Remove the arm-rest (1) and the casing (2) of the left-hand PPC valve (3).

3 - Remove the battery (4). ※1

⚠ Disconnect first the negative terminal (–) and then the positive terminal (+).

4 - Disconnect the drainage tubes (5) and remove the filter (6). Also remove the filter head (7). ※2

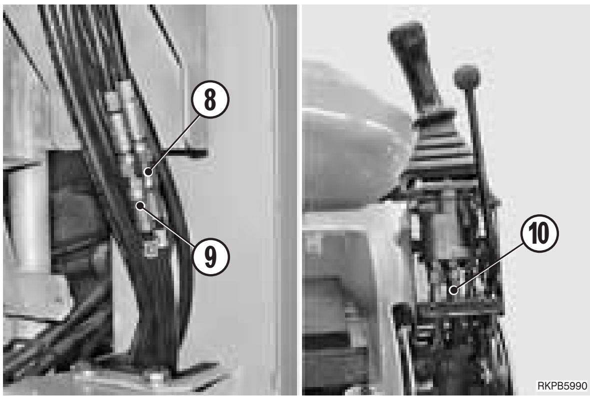


5 - Disconnect the servo-controls tubes (L blue) (8) and (C green) (9).

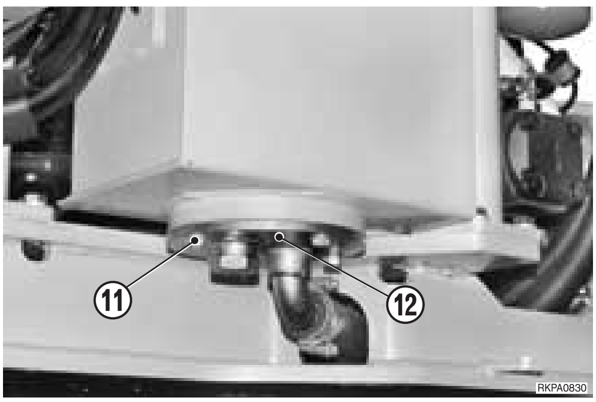
★ Plug the tubes to prevent entry of impurities.

6 - Disconnect the other tubes (10) from the left-hand PPC valve and draw them off the tank support.

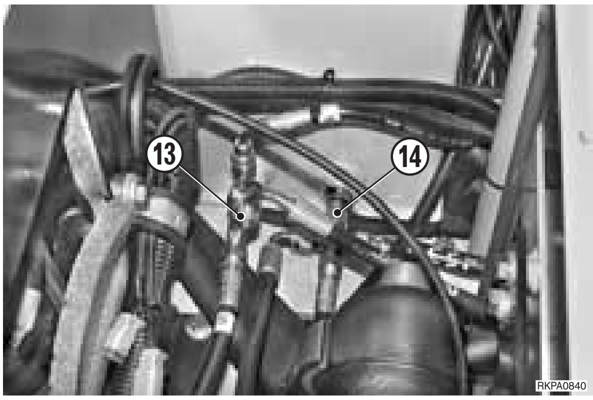
★ Plug the tubes to prevent entry of impurities. ※3



7 - Take out the screws (11) and remove the suction flange (12). ※4

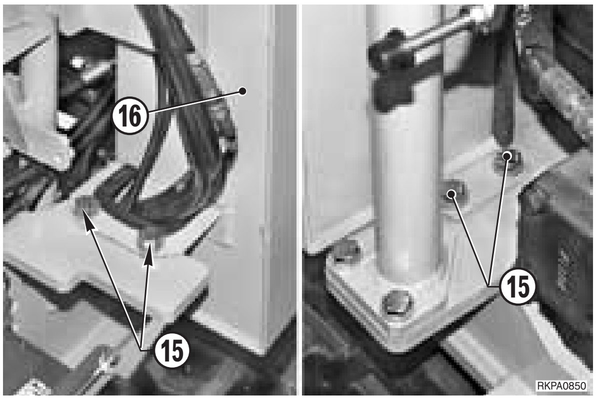


8 - Tip up the seat and remove the toolbox. Disconnect the drainage tubes (13) and (14) from the tank.



9 - Take out the screws (15) and remove the tank (16).

kg Tank: 16 kg



INSTALLATION OF THE HYDRAULIC OIL TANK

- To install, reverse the removal procedure.

※1

★ Connect first the positive terminal (+).and then the negative terminal (–)

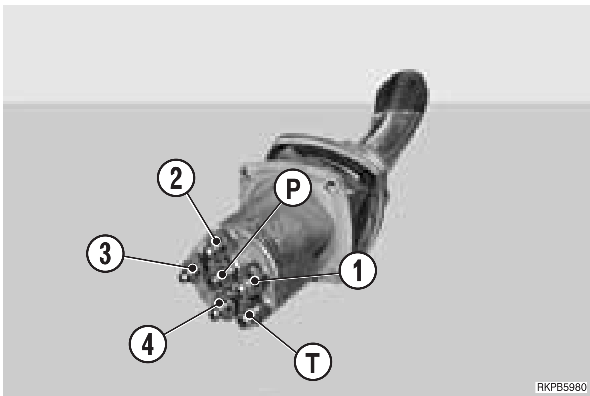
※2

★ Make sure that the threading of the filter head is leak-tight.

※3

★ Carefully check the connection on the PPC valve.

Position					
P	**T**	**1**	**2**	**3**	**4**
White S	White M	Green R	Green C	Blue L	Green A



※4

★ Carefully check the condition of the O-ring seal.

1 - Fill up the hydraulic oil to its maximum level.

Hydraulic oil: approx. 22 ℓ

2 - Start the engine at low idling to circulate the oil throughout the system.

3 - Pressurise the tank and bleed air from all circuits. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

REMOVAL OF THE FUEL TANK

⚠ Completely lower the working equipment until it is resting on the ground and stop the engine.

★ Drain the fuel.

Fuel: max. 20 ℓ

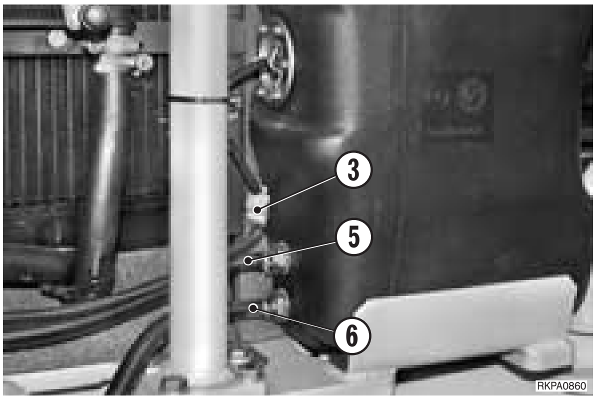
1 - Remove the engine hood (1) and the right-hand side panel (2). (For details, see «REMOVAL OF THE TOP COVER AND THE SIDE PANELS»).

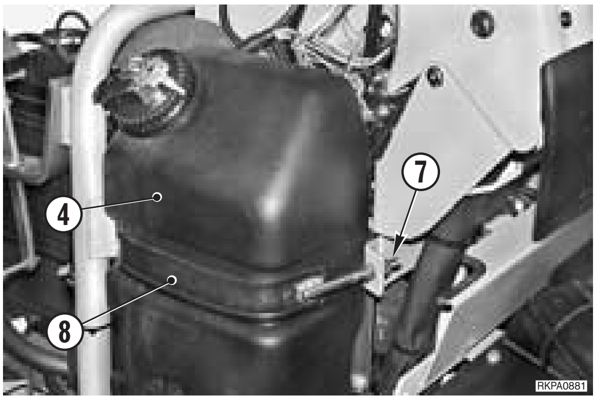
2 - Disconnect the connector (3) of the level indicator.

3 - Disconnect the suction line (5) and the fuel return tube (6) from the tank and plug them.

★ Mark the tubes to avoid exchanging them during re-installation.

5 - Loosen and remove the nut (7) of the retaining band (8). Remove the band and the tank (4).





INSTALLATION OF THE FUEL TANK

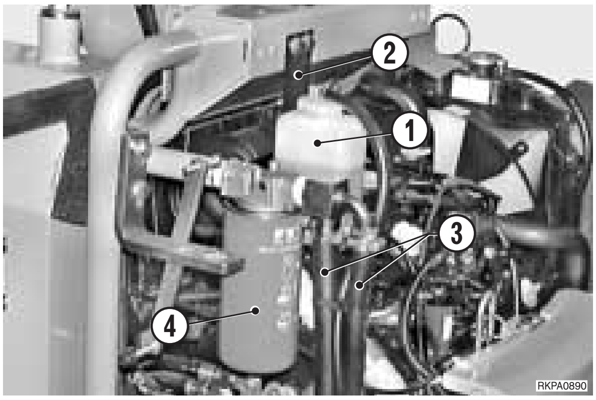
- To install, reverse the removal procedure.

1 - Fill up the tank.

Fuel: max. 20 ℓ

2 - Bleed the air from the fuel pipes and start the engine.

REMOVAL OF THE ENGINE-PUMP GROUP



Completely lower the working equipment until it is resting on the ground and stop the engine.

Release all residual pressures from the circuits and the tank. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

Disconnect first the negative terminal (-) from the battery.

★ Drain the hydraulic oil.

Hydraulic oil: approx. 22 ℓ

★ Drain the engine coolant.

Quantity of coolant: approx. 3.2 ℓ

1 - Remove the hood, the side counterweights, the central counterweight, and the oil-cooler - radiator group. For details, please refer to the removal of each individual component.

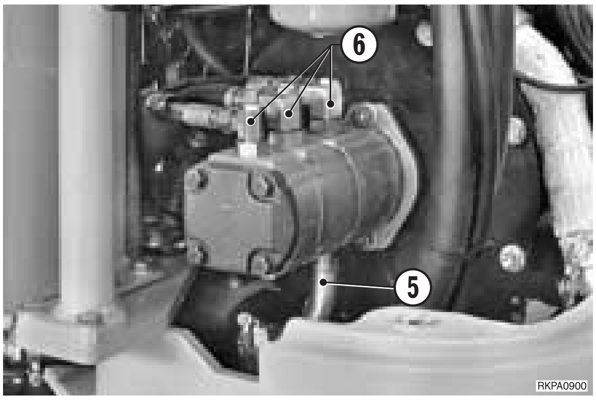
2 - Remove the expansion chamber (1) and its support (2).

3 - Disconnect the oil drainage tubes from the filter fitting and remove the oil filter (4).

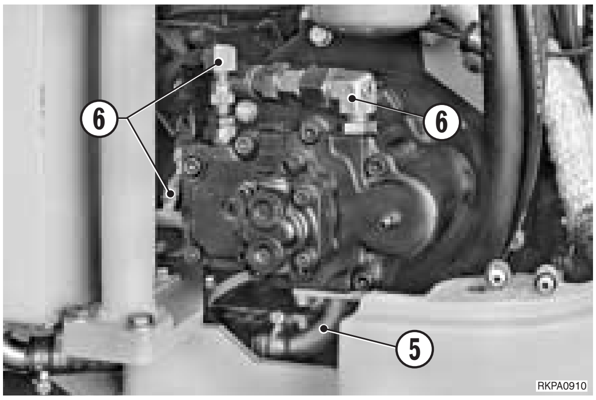
4 - Disconnect the suction (5) and delivery tubes (6) from the pumps.

★ Plug the tubes and their fittings to prevent entry of impurities.

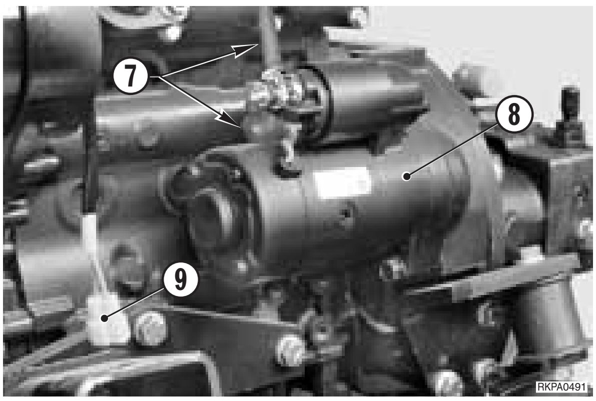
PC12R-8



PC15R-8



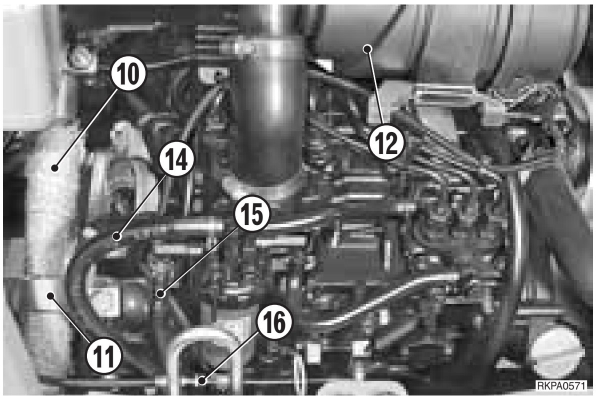
5 - Disconnect the cables (7) from the starter motor (8) and disconnect the alternator connector (9).



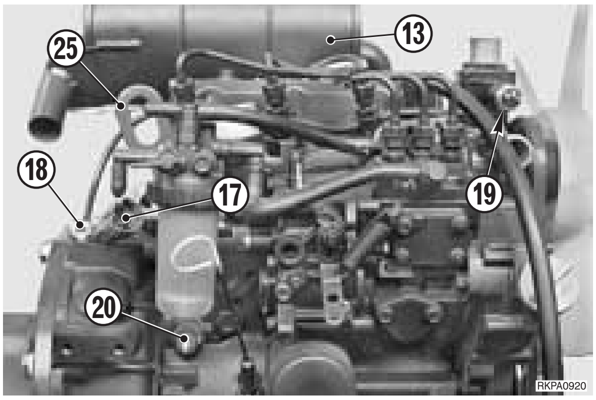
6 - Remove the tail-pipe (10), and clamps (11) screwed onto the flywheel cover, the suction filter (12) and the muffler (13). ※1

7 - Disconnect the fuel supply and return tubes (14) and (15) from the fuel filter.
  ★ Plug the tubes to prevent entry of impurities.

8 - Disconnect the accelerator cable (16) and its sleeve. ※2



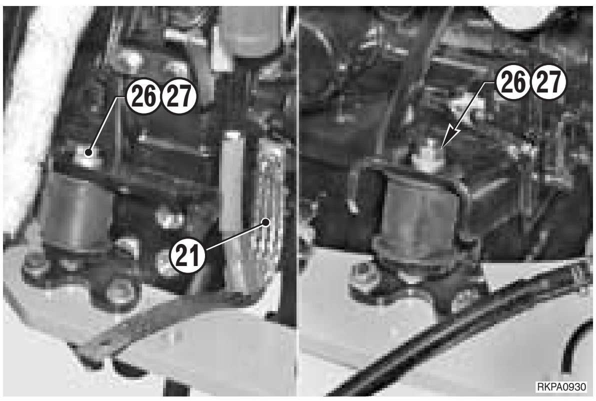
9 - Disconnect the connector (17) and the pre-heating connector (18), the temperature sensor (19) cables, the oil pressure indicator (20), and the grounding plait (21).



10 - **Only for machines with heating**
Disconnect the tubes (22) and (23). Remove the cock (24) and the engine connection tube.

11 - Attach the engine hoisting hook to some hoisting tackle and apply a slight tension to the cable.

12 - Take out the nuts (26) and the four washers (27), raise the engine slowly and lift it out. ※3
  ★ Check that the motor swings completely free while it is being raised, and that no other parts are damaged.



INSTALLATION OF THE ENGINE-PUMP GROUP

- To install, reverse the removal procedure.

※1

Muffler screws and nuts: 23 – 29 Nm

※2

★ Adjust the accelerator stroke. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

※3

Vibration-damping nuts: .... Nm

1 - Fill the tank with hydraulic oil up to the maximum level.

For the PC15R only
While filling the tank, bleed air from the pump.
(For details, see «20. CONTROLS AND ADJUSTMENTS»).

Hydraulic oil required: approx. 22 ℓ

2 - Fill the cooling circuit up to its maximum level.

Coolant: approx. 3.2 ℓ

3 - Start the engine to circulate the oil and coolant and check that there are no leaks.

4 - Stop the engine, check the levels and, if necessary, top them up.

5 - Bleed air from the hydraulic circuits and pressurise the tank. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

REMOVAL OF THE PUMP

⚠ Lower the working equipment until it is resting on the ground and stop the engine.

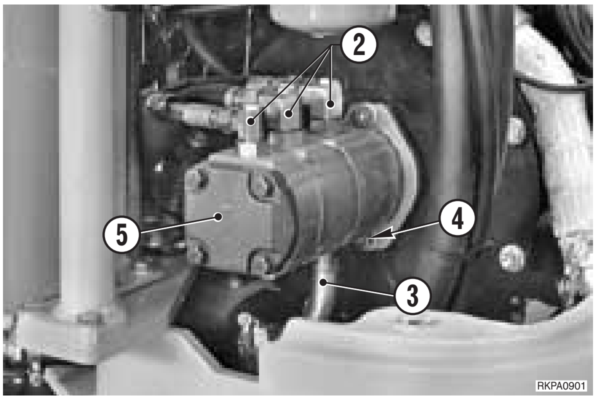
⚠ Release all residual pressures from the circuits and the tank. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

★ Drain the hydraulic oil.

Quantity of oil: approx. 22 ℓ

1 - Remove the left-hand side panel (1).

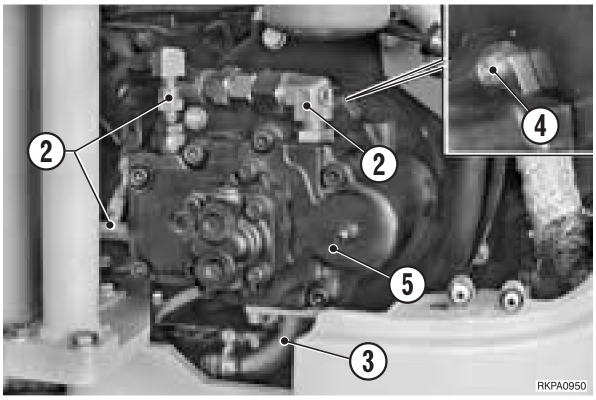
PC12R-8



2 - Disconnect the delivery tubes (2) and the suction flange (3) from the pump and plug tubes and flange to prevent entry of impurities. ※1

3 - Remove the two screws (4) and take out the pump (5). ※2

PC15R-8



INSTALLATION OF THE PUMP

- To install, reverse the removal procedure.

※1

★ Before connecting the suction flange (3), check that the seal is undamaged.

Suction flange screws: PC12R: 45±4.9 Nm
PC15R: 63±6.5 Nm

※2

Pump screws: Loctite 262

Pump screws: PC12R: 63±6.5 Nm
PC15R: 108±11 Nm

1 - Fill the tank to its maximum level.

Hydraulic oil required: approx. 22 ℓ

⚠ **Only for PC15R**
Bleed the air from the pump. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

2 - Start the engine to circulate the oil and check that there are no leaks.

3 - Stop the engine, check the oil level and, if necessary, top it up.

4 - Bleed air from the hydraulic circuits and pressurise the tank. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

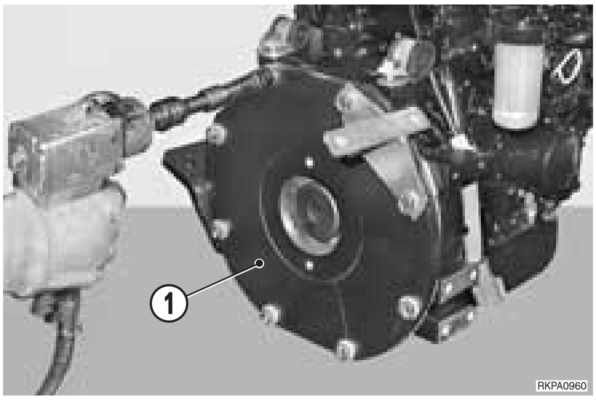
REMOVAL OF ENGINE-PUMP COUPLING

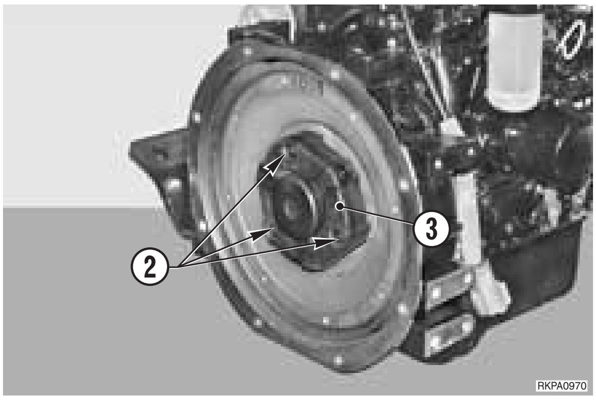
⚠ Lower the working equipment until it is resting on the ground and stop the engine.

1 - Remove the pump. (For details, see «REMOVAL OF THE PUMP»).

2 - Remove the flywheel cover (1). (8 screws). ※1

3 - Take out the screws (2) and remove the coupling (3). ※2





INSTALLATION OF THE ENGINE-PUMP COUPLING

- To install, reverse the removal procedure.

※1

Flywheel cover screws: Loctite 262

Flywheel cover screws: 55 Nm

※2

Coupling screws: Loctite 262

Coupling screws: 55 Nm

1 - Fill the tank up to its maximum level.

Hydraulic oil required: approx. 22 ℓ

⚠ **Only for the PC15R**
Bleed the air from the pump. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

2 - Start the engine to circulate the oil and check that there are no leaks.

3 - Stop the engine, check the oil level and, if necessary, top it up.

4 - Bleed the air from the hydraulic circuits and pressurise the tank. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

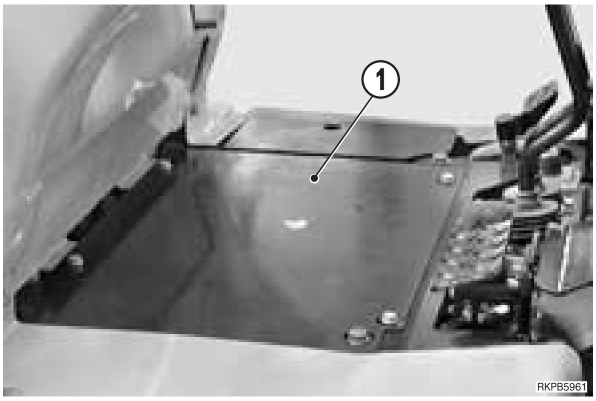
REMOVAL OF THE CONTROL VALVE

Lower the working equipment until it is resting on the ground and stop the engine.

Release all residual pressures from all circuits and from the tank. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

★ Drain the hydraulic oil.

Quantity of oil: approx. 22 ℓ



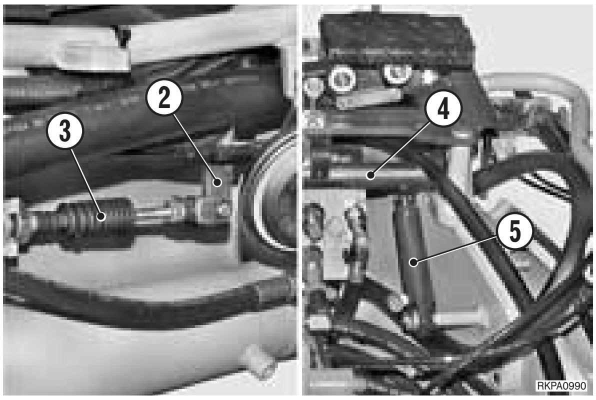
1 - Remove the canopy or the cab. (For details, see «REMOVAL OF THE CANOPY - CAB»).

2 - Remove the top cover and the side panels. (For details, see «REMOVAL OF THE TOP COVER AND SIDE PANELS»).

3 - Remove the floor mat, the flooring (1) and the lower guard.

4 - Disconnect the blade command cable (3) from the lever (2).

5 - Disconnect the piston (5) from the command block lever (4).

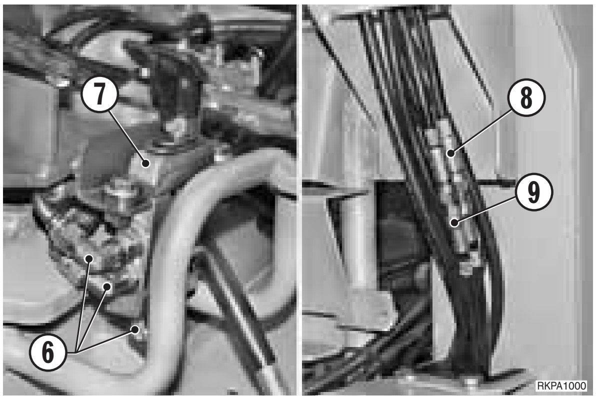


6 - Disconnect the tubes (6) from the PPC valve (7) that commands the working equipment.

★ Mark the tubes to avoid exchanging them during re-assembly.

7 - Disconnect the couplings of the tubes (8) and (9) coming from the PPC valves. Pull out the lower tubes.

★ Check that the tubes are identifiable by letters and colours. If necessary, mark them to avoid exchanging them during re-assembly.



8 - Disconnect all the tubes from the control valve (14), with the exception of:

a - the servo-control tubes disconnected in phase 7.

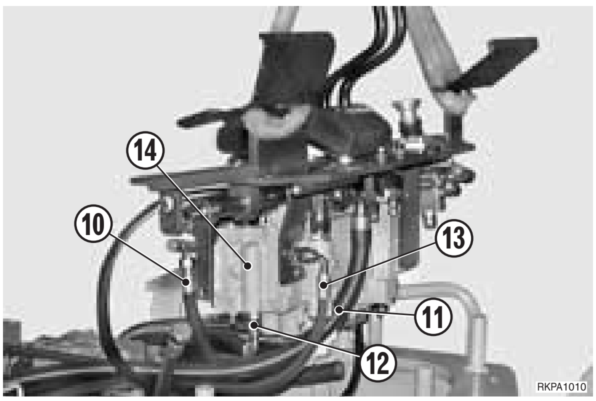
b - the delivery tube (10) for the hammer PPC.

c - the hammer command tube (11).

d - the servo-control delivery and return tubes (12) and (13).

Mark the tubes to avoid exchanging them during re-assembly.

The tubes still connected to the control valve must be disconnected from the working equipment to which they are attached.

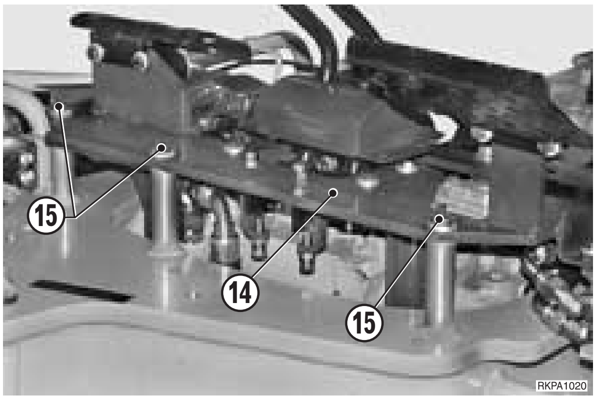


9 - Put a sling around the control valve group and connect it to some hoisting tackle.
   ★ Adjust the length of the cables to balance the group.

10 - Take out the screws (15) and remove the control valve group complete with its support.

   Control valve group: 45 kg

   Accompany the tubes that are still connected to the control valve.



INSTALLATION OF THE CONTROL VALVE

- To install, reverse the removal procedure.

While positioning the control valve group, direct and accompany the tubes still connected to it, to avoid creasing or entangling them.

1 - Fill the hydraulic oil tank up to its maximum level.

   Hydraulic oil required: approx. 22 ℓ

2 - Start the engine to circulate the oil, and check that there are no leaks.

3 - Stop the engine, check the level of the hydraulic oil and, if necessary, top it up.

4 - Bleed the air from all circuits and pressurise the tank. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

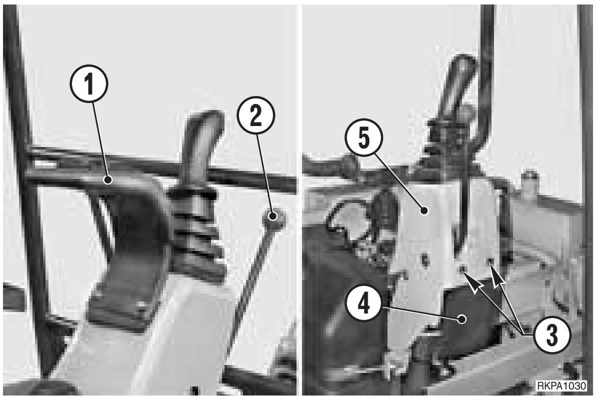
REMOVAL OF RIGHT-HAND PPC VALVE (BOOM-BUCKET)

Lower the working equipment until it is resting on the ground, stop the engine and remove the ignition key.

Release all residual pressures from all circuits and from the tank. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

1 - Take off the arm-rest (1) and the knob (2).

2 - Take out the screws (3) and remove the cover and the right-hand casing (5).

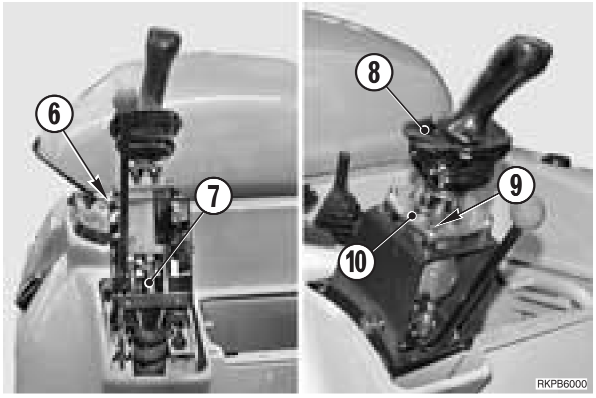


3 - Disconnect the klaxon connector (6).

4 - Disconnect the six PPC valve tubes (7) and plug them to prevent entry of impurities.

★ Check that the tubes are marked to avoid exchanging them during re-assembly. ※1

5 - Raise the rubber sleeve (8), remove the screws (9) and remove the PPC valve (10).



INSTALLATION OF THE RIGHT-HAND PPC VALVE

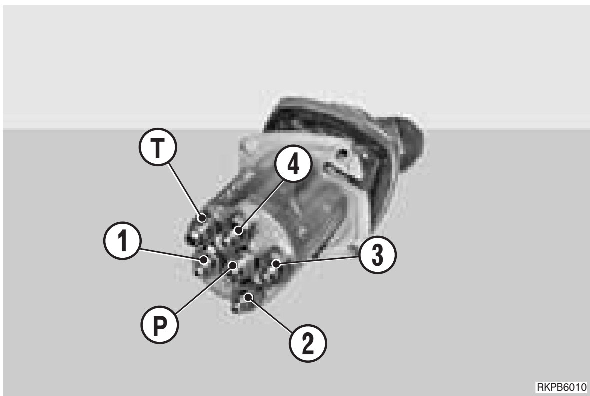
- To install, reverse the removal procedure.

※1

★ Check carefully the positions for re-connecting the tubes.

Position					
P	**T**	**1**	**2**	**3**	**4**
White M	White S	Yellow C	Red D	Yellow A	Red S

If the couplings are removed from the PPC valves, make sure that the coupling with a filter is mounted on input **P**.



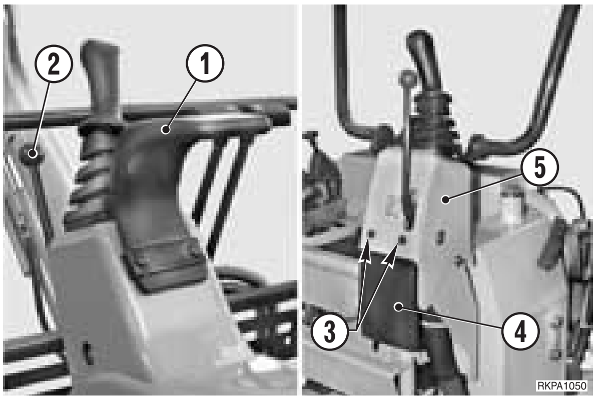
REMOVAL OF LEFT-HAND PPC VALVE (ARM-BUCKET)

Lower the working equipment until it is resting on the ground, stop the engine and remove the ignition key.

Release all residual pressures from all circuits and from the tank. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

1 - Take off the arm-rest (1) and the knob (2).

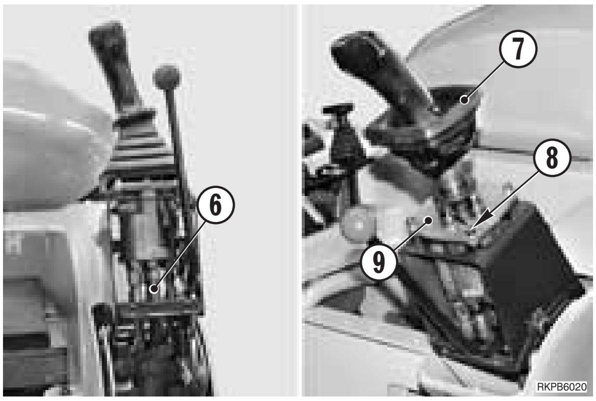
2 - Take out the screws (3) and remove the cover and the left-hand casing (5).



3 - Disconnect the six tubes (6) of the PPC valve and plug them to prevent entry of impurities.

★ Check the marks on the tubes to avoid exchanging them during re-assembly. ※1

4 - Raise the rubber sleeve (7), remove the screws (8) and remove the PPC valve (9).



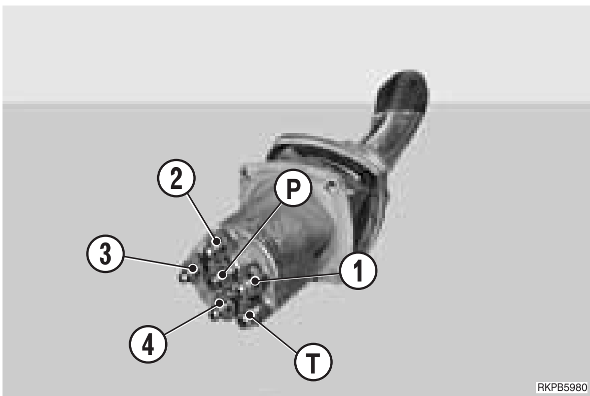
INSTALLATION OF THE RIGHT-HAND PPC VALVE

- To install, reverse the removal procedure.

※1

★ Carefully check the positions for re-connecting the tubes.

Position					
P	T	1	2	3	4
White S	White M	Blue R	Green C	Blue L	Green A



If the couplings are removed from the PPC valves, make sure that the coupling with a filter is mounted on input **P**.

REMOVAL OF THE SERVOCONTROL SOLENOID GROUP

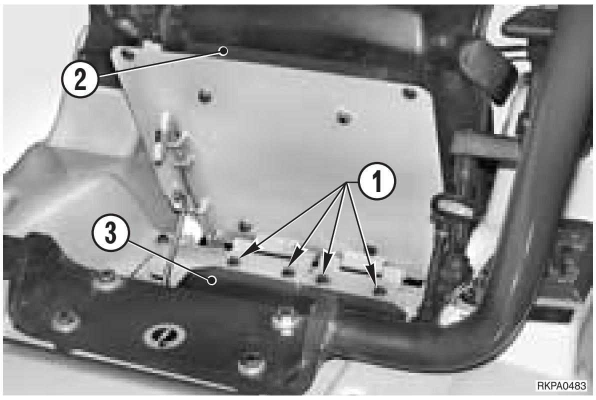
(PC12R without travel increment)

Lower the working equipment until it is resting on the ground, and stop the engine.

Release all residual pressures from all circuits and from the tank. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

1 - **Only for machines with a cab**
Take out the screws (1) and remove the entire seat (2).

2 - Remove the toolbox (3).

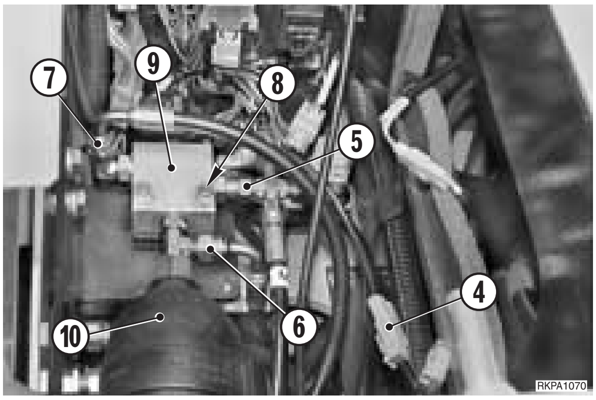


3 - Disconnect the connector (4).

4 - Disconnect the servo-control delivery tube coupling (5).

5 - Disconnect the tubes (6) and (7).
★ Plug the tubes to prevent entry of impurities.

6 - Take out the screws (8) and remove the solenoid group (9) complete with accumulator (10).



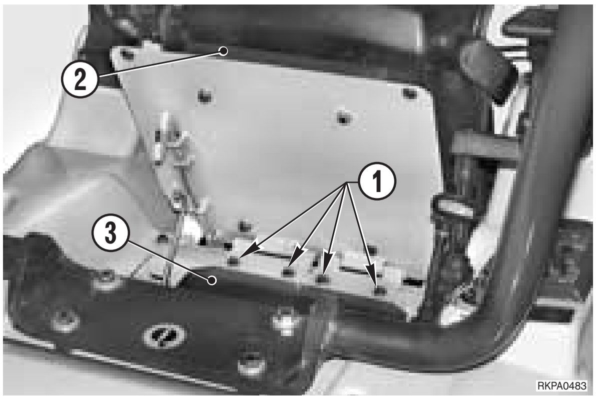
INSTALLATION OF THE SERVO-CONTROL SOLENOID GROUP

- To install, reverse the removal procedure.

REMOVAL OF THE SERVO-CONTROL SOLENOID GROUP
(PC12R with travel increment - PC15R)

Lower the working equipment until it is resting on the ground, stop the engine and remove the ignition key.

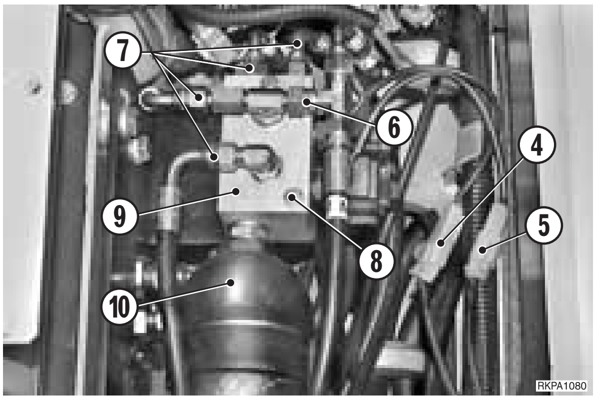
Release all residual pressures from all circuits and from the tank. (For details, see «20. CONTROLS AND ADJUSTMENTS»).



1 - **Only for machines with a cab**
Take out the screws (1) and remove the entire seat (2).

2 - Remove the toolbox (3).

PC12R-8: UP TO S/N F31768
PC15R-8: UP TO S/N F22588



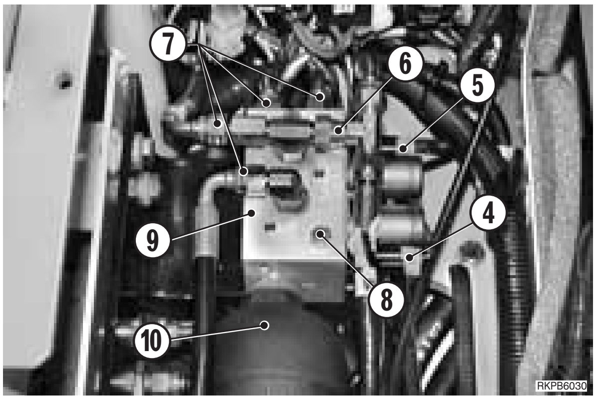
3 - Disconnect connectors (4) and (5).

4 - Disconnect the servo-control delivery tube coupling (6).

5 - Disconnect the tubes (7).
- ★ Mark the tubes to avoid exchanging them during re-assembly.
- ★ Plug the tubes to prevent entry of impurities.

6 - Take out the screws (8) and remove the solenoid group (9) complete with accumulator (10).

PC12R-8: FROM S/N F31769-
PC15R-8: FROM S/N F22589-



INSTALLATION OF THE SERVO-CONTROL SOLENOID GROUP

- To install, reverse the removal procedure.

REMOVAL OF THE SWIVEL JOINT

Lower the working equipment until it is resting on the ground, and stop the engine.

Release all residual pressures from all circuits and from the tank. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

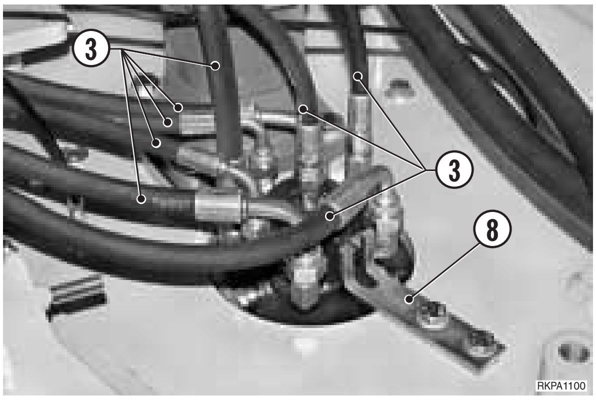
1 - Take out the floor-mat (1) and remove the cab floor (2).

2 - Disconnect the upper tubes (3) from the swivel joint (7 tubes for the PC12R and 8 tubes for the PC12R with travel increment and the PC15R).

★ Mark the tubes to avoid exchanging them during re-assembly.

If necessary, disconnect some of the tubes from the control valve, after having marked them.

★ Plug the tubes to prevent entry of impurities.



3 - Remove the protective cover (4) from the lower track-frame.

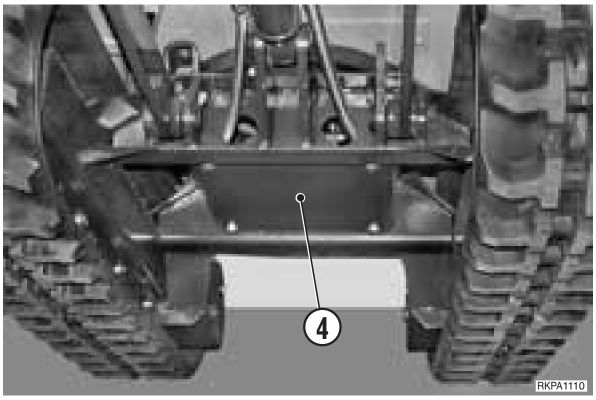
4 - Disconnect the tubes (5) from the swivel joint (6).

★ Mark the tubes to avoid exchanging them during re-assembly.

★ Plug the tubes to prevent entry of impurities.

5 - Take out the screws (7) and the washers and remove the swivel joint (6). ※1

★ Mark the position between the joint and the frame.



INSTALLATION OF THE SWIVEL JOINT

- To install, reverse the removal procedure.

★ Make sure that the swivel joint is correctly positioned and that the rotor pin is engaged properly in the bracket (8).

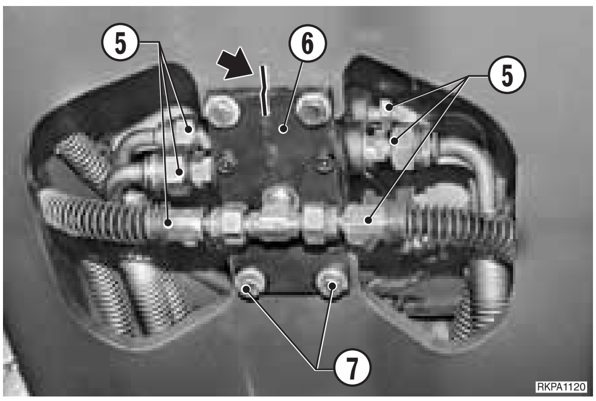
※1

Nm Bracket screws: 32.2 ±3.5 Nm

1 - Start the engine to circulate the oil, bleed air from the lower circuits and check that tubes are leaktight.

2 - Stop the engine and check the level of the tank.

3 - Pressurise the tank.

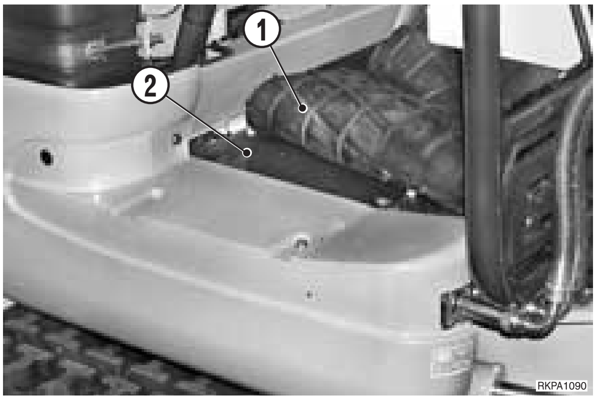


REMOVAL OF THE SWING MOTOR

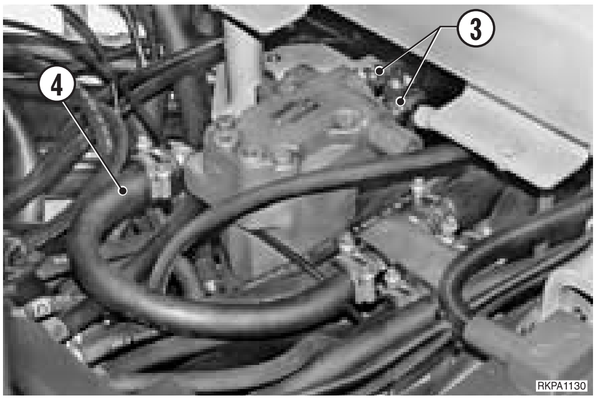
Insert the turret-locking device and lower the working equipment until it is resting on the ground. Stop the engine.

Release all residual pressures from all circuits and from the tank. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

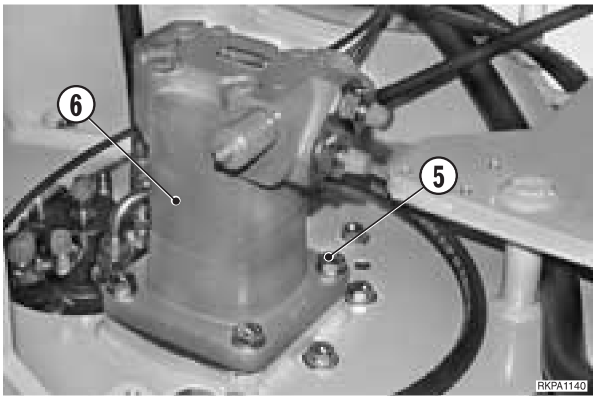
1 - Take out the floor-mat (1) and remove the cab floor (2).



2 - Disconnect the tubes (3) and the drainage tube (4). Plug them to prevent entry of impurities.



3 - Take out the four screws (5) and remove the complete swing motor (6). ※1



INSTALLATION OF THE SWING MOTOR

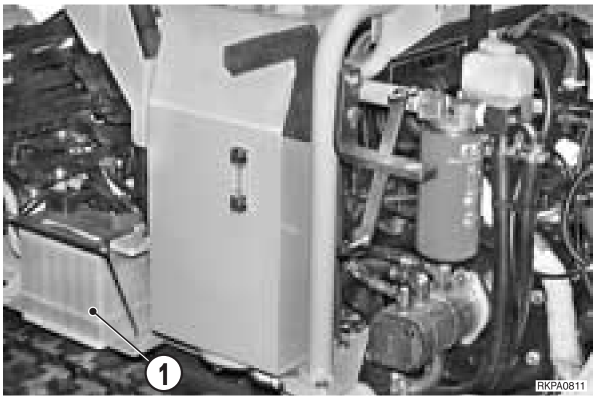
- To install, reverse the removal procedure.

※1

Nm Gearmotor screws: 108±11 Nm

1 - Start the engine, disengage the turret-locking device and perform several swings in both directions to bleed air from the system.

REMOVAL OF THE REVOLVING FRAME



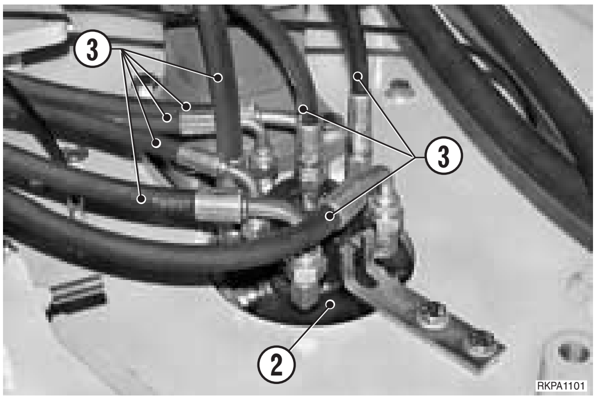
⚠ Lower the working equipment until it is resting on the ground, and stop the engine.

⚠ Release all residual pressures from all circuits and from the tank. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

1 - Remove the canopy or the cab. (For details, see «REMOVAL OF THE CANOPY AND CAB»).

2 - Remove the top casing, the side panels, and the engine hood. (For details, see the removal of the individual parts).

3 - Remove the battery (1).
  ★ First disconnect the negative terminal cable (–) and then the positive terminal cable (+).

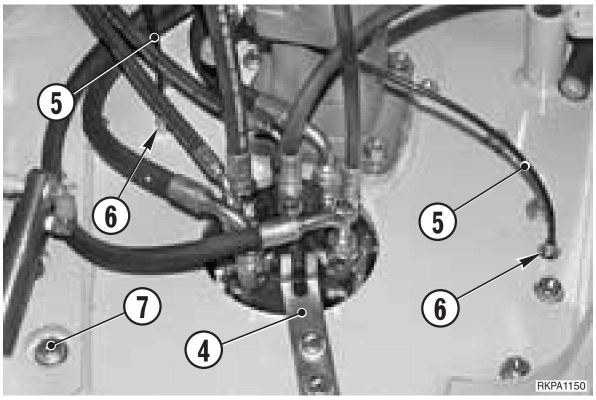


4 - Remove the rear grills and the counterweight. (For details, see «REMOVAL OF THE REAR COUNTERWEIGHT»).

5 - Drain the hydraulic oil tank.
  Quantity of oil: approx. 22 ℓ

6 - Drain the fuel tank.
  Quantity of fuel: max. 20 ℓ

7 - Remove the working equipment. (For details, see «REMOVAL OF THE WORKING EQUIPMENT»).



8 - Remove the boom-raising cylinder. (For details, see REMOVAL OF THE BOOM CYLINDER»).

9 - Disconnect the upper tubes (3) from the swivel joint (2) and plug them (7 tubes for the PC12R and 8 tubes for the PC12R with travel increment - PC15R).
  ★ Mark the tubes to avoid exchanging them during re-assembly.

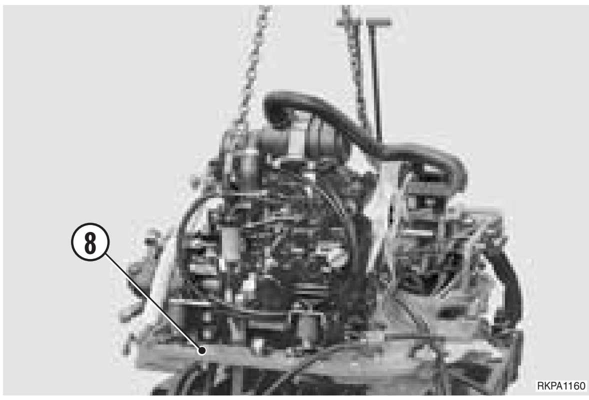
10 - Remove the bracket (4) of the joint (2).

11 - Remove the swing motor. (For details, see «REMOVAL OF THE SWING MOTOR»).

12 - Disconnect the swing circle lubrication tubes (5) and remove the couplings (6).

13 - Loosen and remove the screws (7) that secure the revolving frame.
  ★ Leave two opposite screws in position for safety.

※1



14 - Attach the evolving frame (8) to some hoisting tackle and apply a slight tension to the cables.
  ★ Adjust the length of the cables to balance the group.

15 - Loosen and remove the two turret screws (7) left in position for safety.

16 - Remove the evolving frame. ※2

Complete turret: 620 kg

INSTALLATION OF THE REVOLVING FRAME

- To install, reverse the removal procedure.

※1

Turret screws: Loctite 262

Turret screws: 66±7 Nm

1 - Refill the hydraulic tank.

Quantity of oil: approx. 22 ℓ

2 - Start the engine to circulate the oil and check for leaks.

3 - Bleed air from all hydraulic circuits. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

4 - Stop the engine, check and top up the hydraulic oil level in the tank and pressurise the tank.

※2

★ Take great care not to damage the reference pins and the swivel joint.

Swing circle lubrication: ASL800050

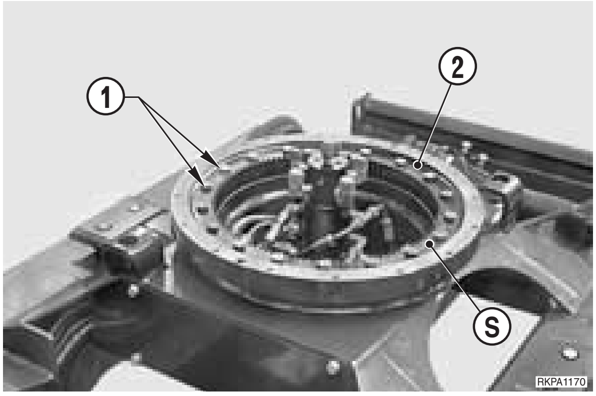
REMOVAL OF THE SWING CIRCLE

1 - Remove the evolving frame (For details, see «REMOVAL OF THE REVOLVING FRAME»).

2 - Take out the screws (1) that secure the swing circle (2). ※1

3 - Remove the swing circle (2). ※2

kg Swing circle: 20 kg



INSTALLATION OF THE SWING CIRCLE

- To install, reverse the removal procedure.

※1

★ Before attaching the swing circle, check that the area marked with an «**S**» is placed to the right of the frame.

Screws: Loctite 262

Nm Screws: 66±7 Nm

※2

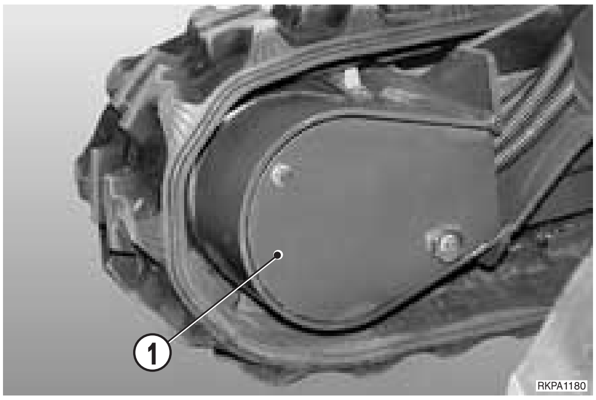
Swing circle: ASL800050

REMOVAL OF THE TRAVEL MOTOR

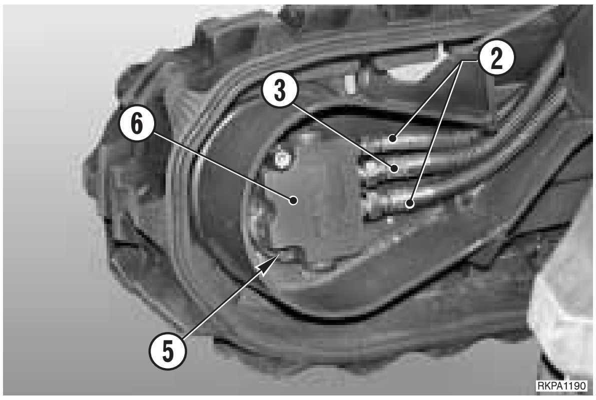
Lower the working equipment until it is resting on the ground, and stop the engine.

Release all residual pressures from all circuits and from the tank. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

1 - Remove the protective cover (1).



PC12R-8



2 - Disconnect the hydraulic oil supply tubes (2) and the drainage tube (3) from the motor and plug them to prevent entry of impurities.

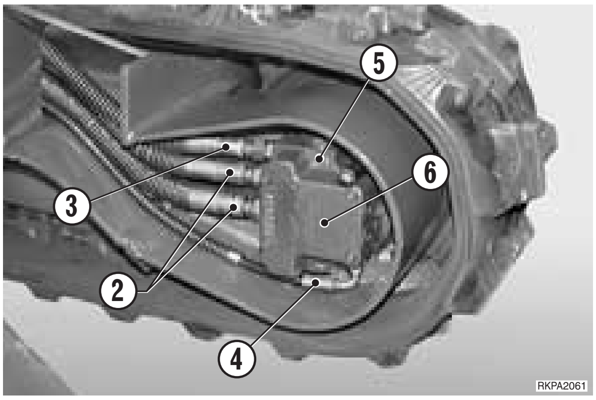
★ **For the PC12R with travel increment and the PC15R.**
Disconnect also the travel increment tube (4).

3 - Take out the screws (5) that secure the motor (6).

※ 1

4 - Remove the motor (6).

PC12R-8 with travel increment - PC15R-8



INSTALLATION OF THE TRAVEL MOTOR

- To install, reverse the removal procedure.

※ 1

Nm Motor screws: Loctite 262

Nm Motor screws: 75 Nm

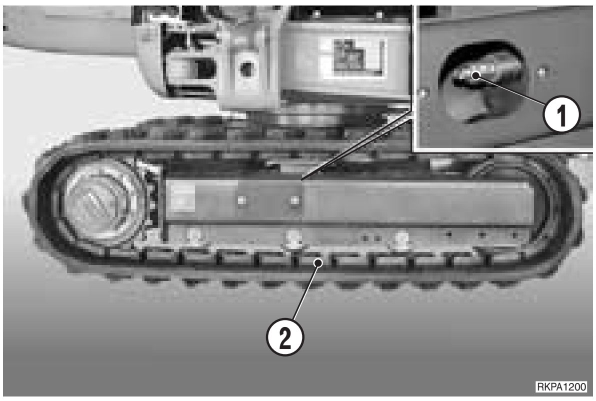
1 - Start the engine and bleed air from the travel motor. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

2 - Stop the engine and check the oil level in the tank. If necessary, top it up.

REMOVAL OF RUBBER TRACK SHOES

1 - Rotate the turret by 90° to the side of the track-shoe to be removed and rest the back of the bucket on the ground with the arm perpendicular to the ground.

2 - Slowly loosen the grease nipple (1) to let out the grease and release the tension of the track-shoe (2). ※1

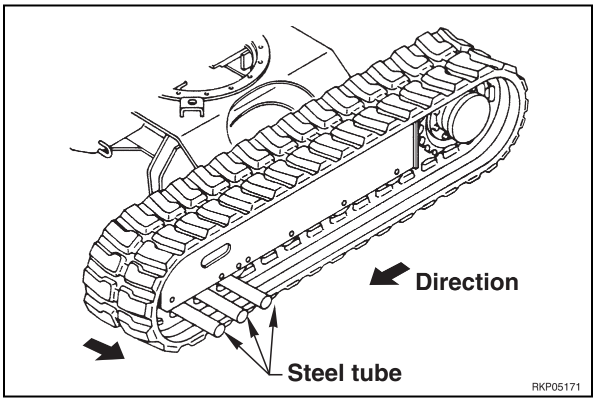


⚠ The grease contained in the idler cylinder is under pressure and could seriously injure the Operator. For this reason the valve should never be loosened by more than one turn.

★ If the grease does not run out easily, move the machine slowly backwards and forwards.

3 - Force the boom downwards to raise the machine.

4 - Insert three steel pipes into the track-shoe and then reverse the track-shoe until the first pipe is above the idler.



5 - Push the track-shoe (2) outwards and remove it.

kg Track-shoe: 45 kg

INSTALLATION OF RUBBER TRACK-SHOES

- To install, reverse the removal procedure.

※1

★ Adjust the track-shoe tension. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

REMOVAL OF TRACK-SHOES

1 - Rotate the track-shoe until the connecting pin (1) is above the horizontal axis of the idler (2).

2 - Slowly loosen the grease nipple to let out the grease and release the tension of the track-shoe.

※1

The grease contained in the idler cylinder is under pressure and could seriously injure the Operator. For this reason the valve should never be loosened by more than one turn.

★ If the grease does not run out easily, move the machine slowly backwards and forwards.

3 - Using the tool **A1**, remove the connecting pin (1).

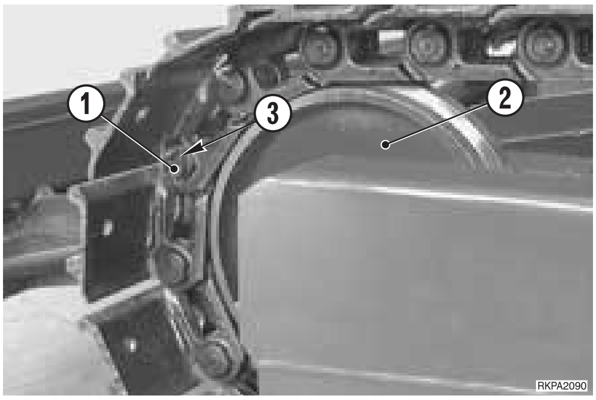
★ First remove the safety cotter-pin (3).

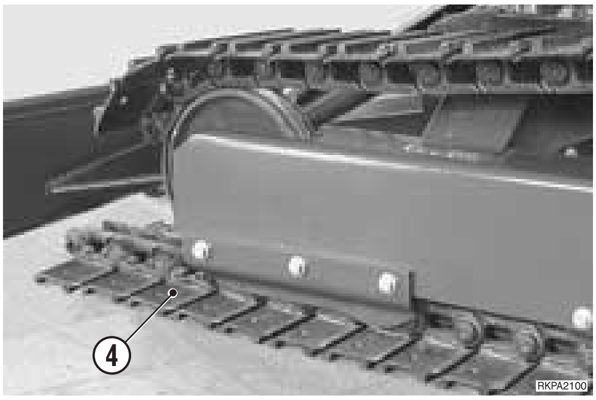
★ While dismantling the track-shoe, support the part of the track-shoe that is wound round the idler with a block placed under the shoe-ribbing. Once the track shoe (4) has been unfastened, lay it on the ground.

4 - Keeping the horizontal end-piece of the track-shoe raised, move the machine in order to remove the track-shoe (4) and lay it on the ground. ※2

5 - Push down with the boom in order to raise the lower track-frame and pull out the track-shoe (4).

kg Track-shoe: 70 kg





INSTALLATION OF TRACK-SHOES

- To install, reverse the removal procedures.

※1

★ Adjust the track-shoe tension. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

※2

1 - Rotate the turret 90° towards the side on which the track-shoe is to be installed. Push down with the boom to raise the lower track-frame.

2 - Arrange the track-shoe on the ground beneath the bottom rollers. Lower the track-frame.

3 - Attach the first articulated joint of the sprocket wheel and move the machine forwards until the articulated joint is close to the sprocket wheel.

4 - Keeping the track-shoe raised, travel in order to bring the end-piece above the idler.

5 - Install the connecting-pin using the tool **A1**.

6 - Install the safety cotter pin (3).

REMOVAL OF THE SPROCKET WHEEL

1 - Remove the track-shoe. (For details, see «REMOVAL OF TRACK-SHOES»).

2 - Rotate the turret 90° away from the side of the wheel to be removed.

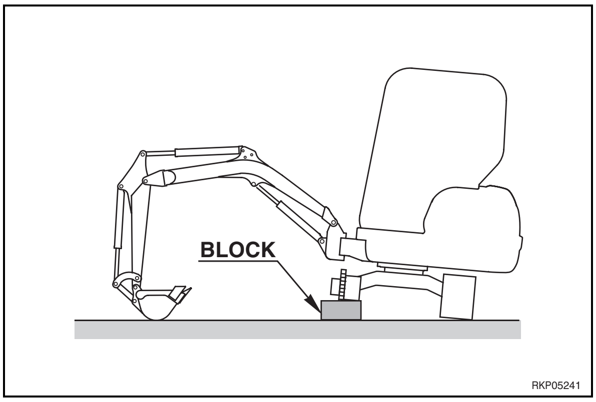
3 - Push down with the boom perpendicular to the ground and raise the lower track-frame.

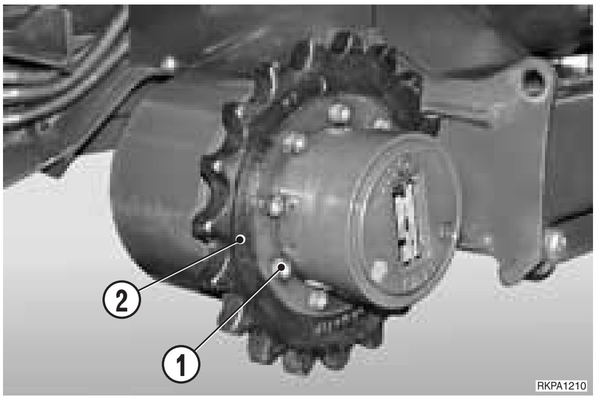
⚠ Insert safety blocks underneath the track-frame.

4 - Take out the screws (1) and their washers.

5 - Remove the sprocket wheel (2). ※1

kg Sprocket wheel: 5 kg





INSTALLATION OF THE SPROCKET WHEEL

- To install, reverse the removal procedure.

※1

Screws: Loctite 262

Nm Screws: 75 Nm

REMOVAL OF THE COMPLETE FINAL DRIVE

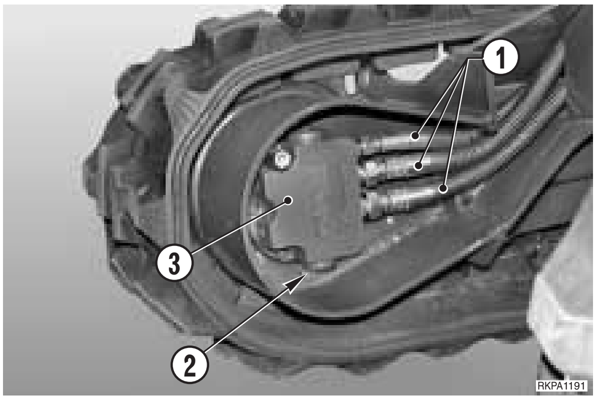
1 - Remove the sprocket wheel (For details, see «REMOVAL OF THE SPROCKET WHEEL»).

2 - Disconnect the tubes (1) from the travel motor. Plug the tubes and the motor fittings to prevent entry of impurities.
  ★ For the PC12R with travel increment and the PC15R, also remove the increment tube (4).
  ★ Mark the tubes to avoid exchanging them during re-assembly.

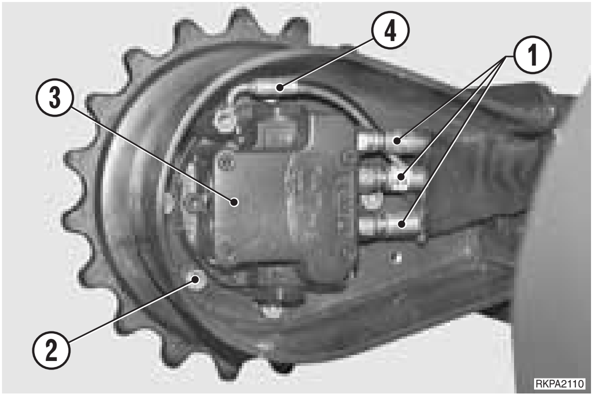
3 - Take out the screws (2). ※1

4 - Remove the final drive (3).
  kg Complete final drive: 17 kg

PC12R-8



PC12R-8 with travel increment - PC15R-8



INSTALLATION OF THE FINAL DRIVE

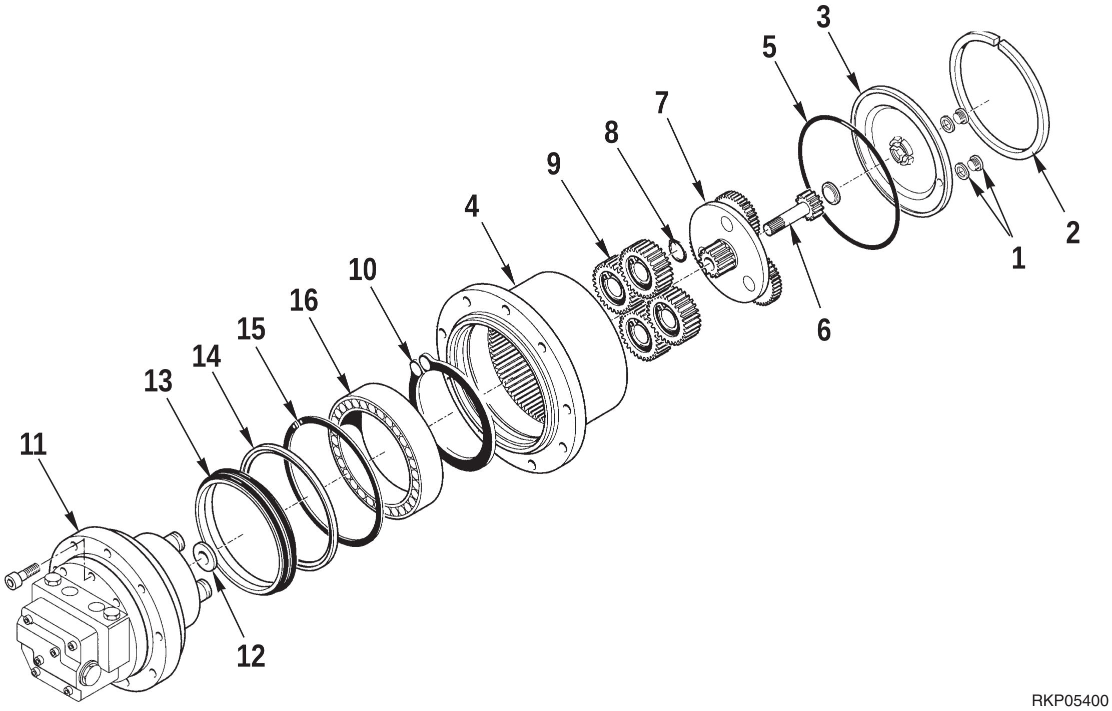
- To install, reverse the removal procedure.

※1

  Final drive screws: Loctite 262
  Nm Final drive screws: 75 Nm

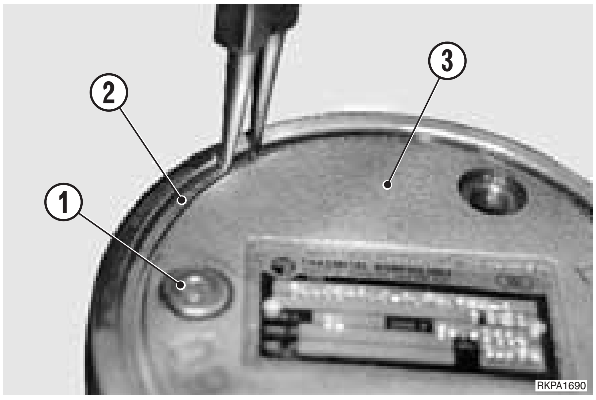
1 - Start the engine and bleed air from the travel motors. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

DISASSEMBLY OF THE FINAL DRIVE

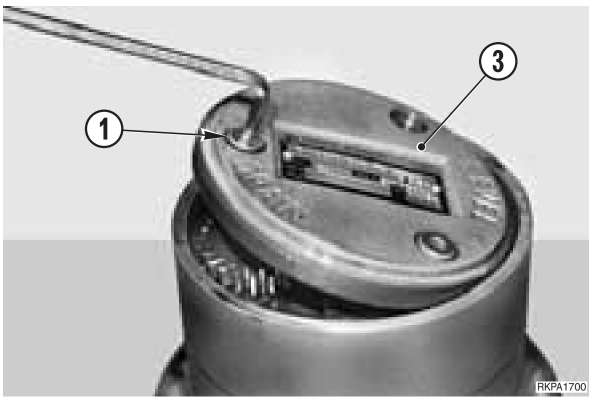


RKP05400

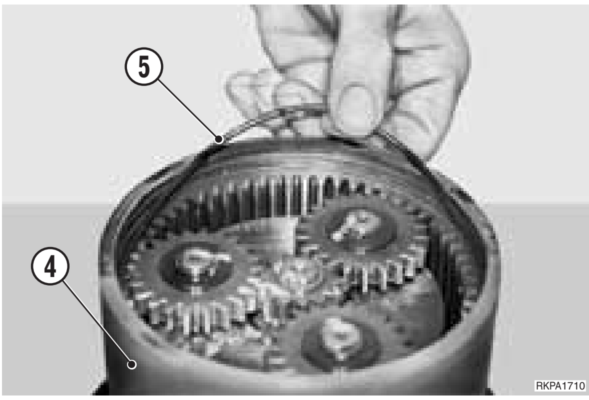
1 - After taking off the caps (1) and draining the oil from the final drive, remove the snap ring (2) and shoulder that secure the outer cover (3).



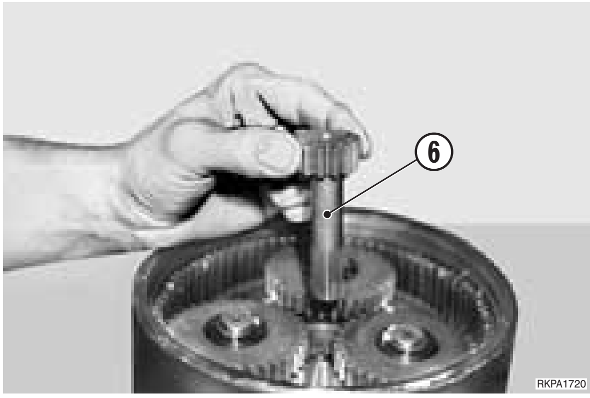
2 - Insert a socket wrench into the cavity (1) of the oil-refiller cap. Use it as a lever to pull off the outer cover (3).



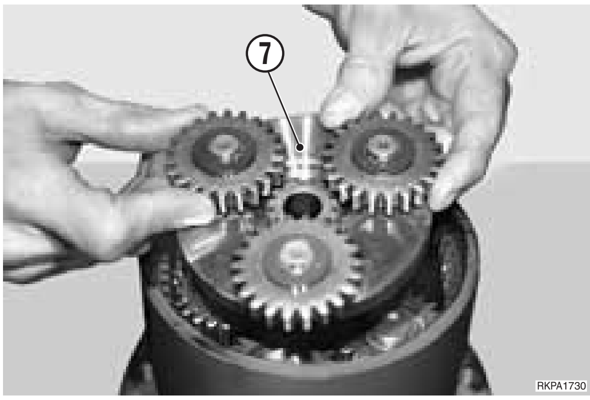
3 - Take the O-ring (5) off the housing (4).



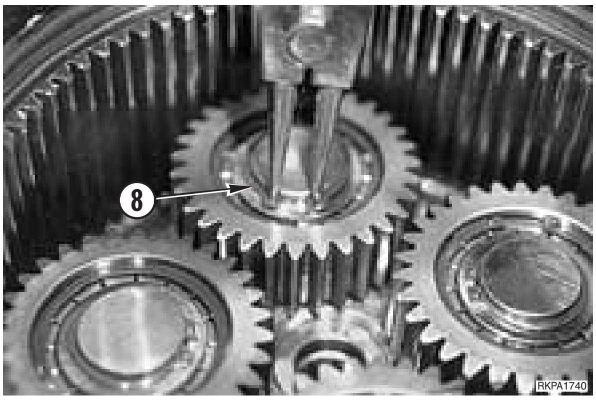
4 - Extract the no. 1 planetary gear (or sun-gear) (6).



5 - Extract the planetary carrier (7) from the no. 1 planetary gear.

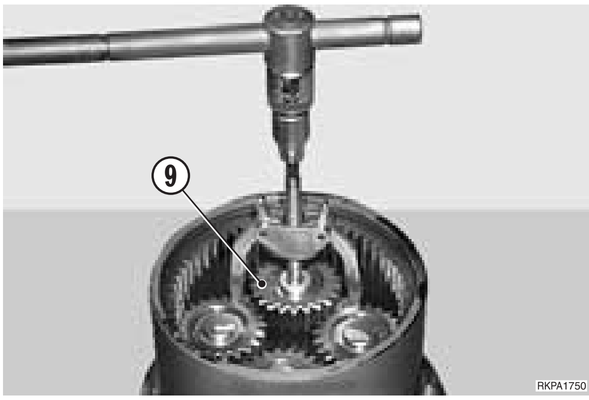


6 - Remove the four snap rings (8).

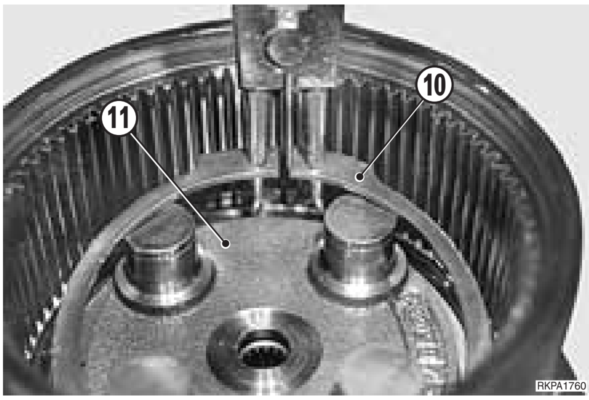


7 - Using a puller, take out the four planetary groups (9) of the no. 2 planetary gear.

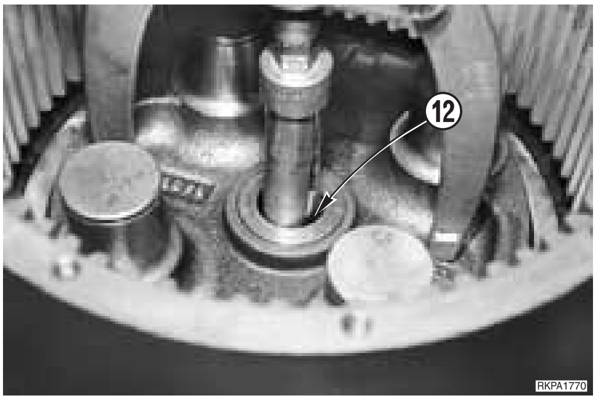
NOTE.
Note down the assembly side.



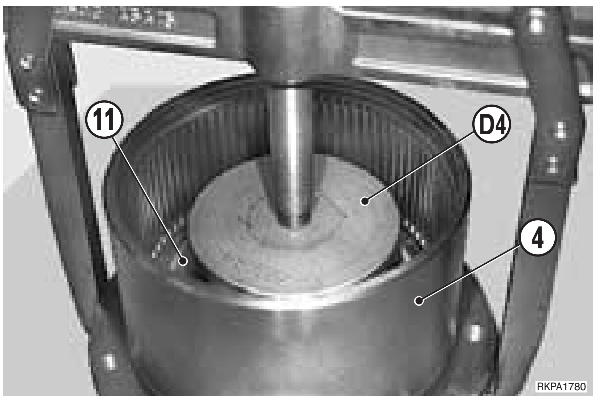
8 - Remove the snap ring (10) from the hydraulic motor seating (11).



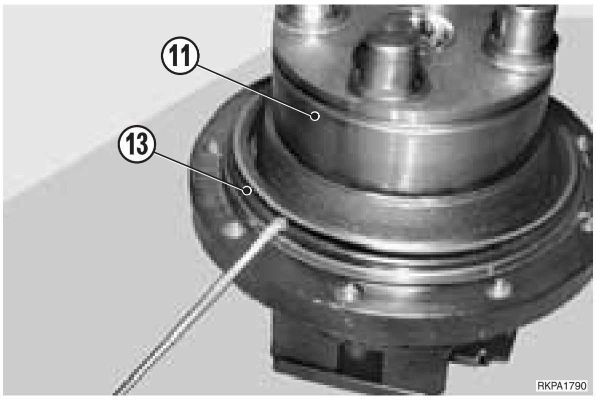
9 - Using an internal puller, remove the centering ring (12).
- ★ Only remove the centering ring (12) if the hydraulic motor is to be substituted.



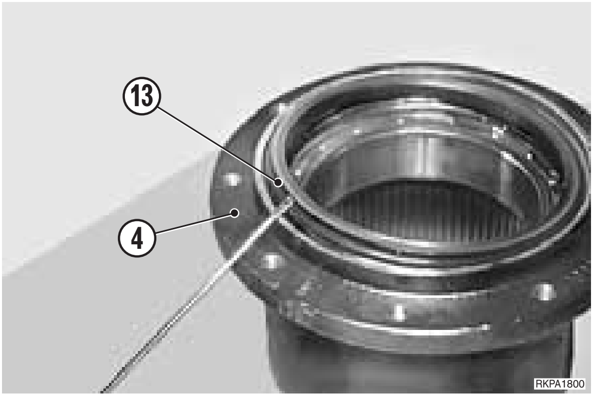
10 - Using the tool **D4** and a puller, separate the hydraulic motor (11) from its housing (4).



11 - Remove the first half-seal (13) from the hydraulic motor (11).

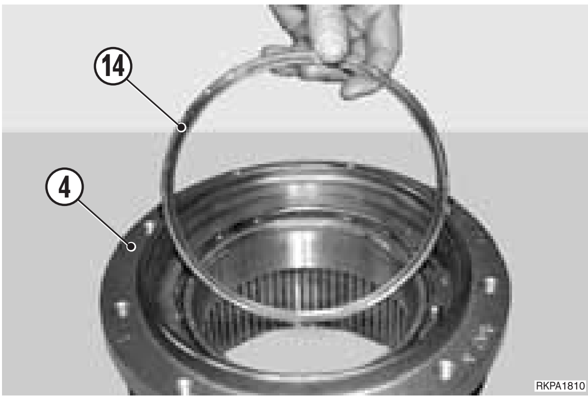


12 - Remove the second half-seal (13) from the housing (4).

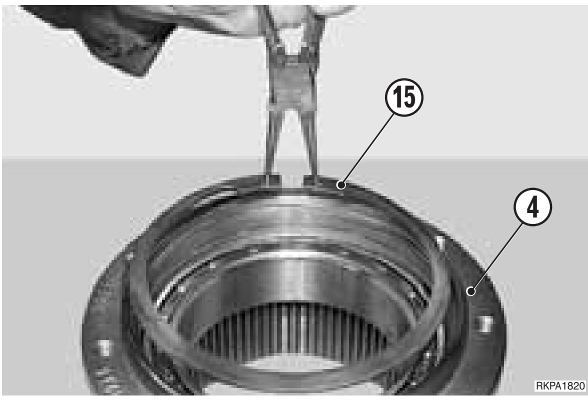


13 - Remove the spacer (14) from the housing (4).

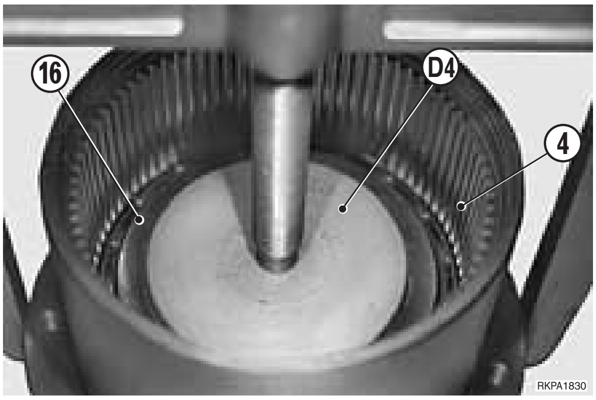
NOTE.
Note down the assembly side



14 - Remove the snap ring (15) from the housing (4).



15 - Using the tool **D4** and a puller, remove the bearing (16) from the housing (4).



NOTES CONCERNING RE-ASSEMBLY

1 - Important points

When commencing re-assembly of the final drive, there are a few fundamental rules to be observed:

a) If any gears are damaged, a new complete final drive must be fitted.

b) Always fit new O-rings on the parts to be re-assembled after having thoroughly cleaned the seatings and having spread a film of grease (ASL800050) over the seatings and the O-rings to facilitate assembly.

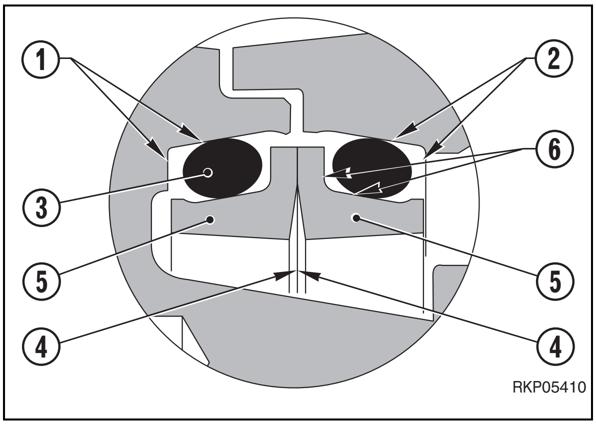
2 - Assembly method for the half-seals

To obtain perfect leaktightness, proceed with the assembly of the rings as follows:

a) Thoroughly clean casings «1» and «2», if necessary using metal brushes or solvents (The surfaces in contact with the rubber rings «3» must be perfectly clean and dry).

b) Make sure that the sealing surfaces «4» of the rings «5» are completely without scoring, dents or foreign bodies, and that the surfaces «6» of the same rings are perfectly clean and dry.

c) Remove from the lapped surfaces «4» of the rings «5» every trace of dust or fingerprints and moisten them with a light film of oil, taking care not to get oil on the remaining parts.

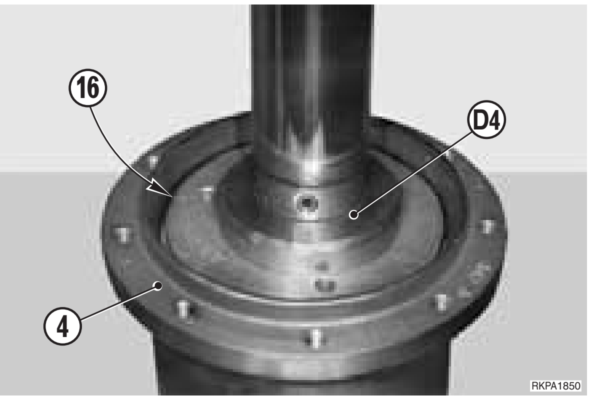


ASSEMBLY OF THE FINAL DRIVE

1 - Position the bearing (16) inside the housing (4).
★ **For PC12R-8 MISTRAL and PC15R-8**
Mount the bearing with groove "**A**" facing up.

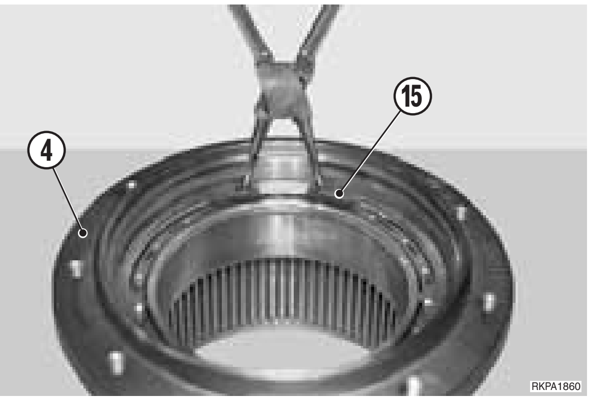
RKPA1841

2 - Using the tool **D4** and a press, push the bearing (16) home in the housing (4).



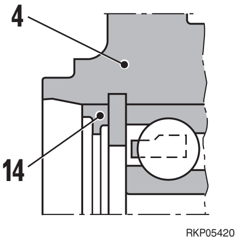
RKPA1850

3 - Mount the snap ring (15) in the housing (4).



RKPA1860

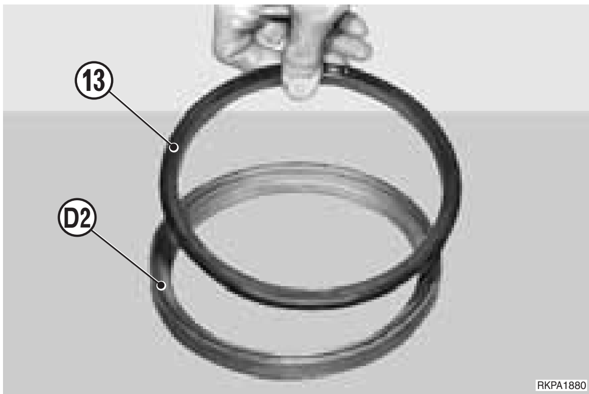
4 - Mount the spacer (14) in the housing (4).
★ Carefully check the orientation of the spacer.



RKP05420

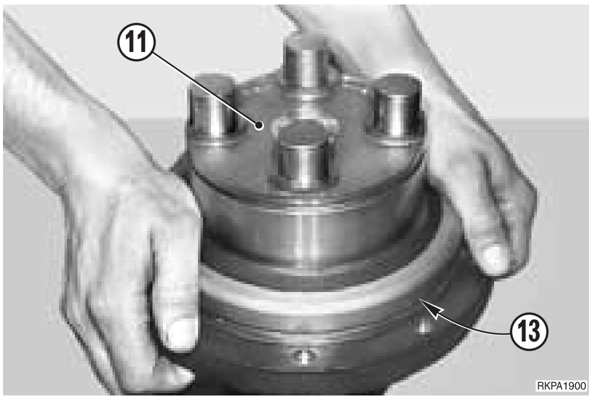
RKPA1870

5 - Mount the first half-seal (13) on the tool **D2**.



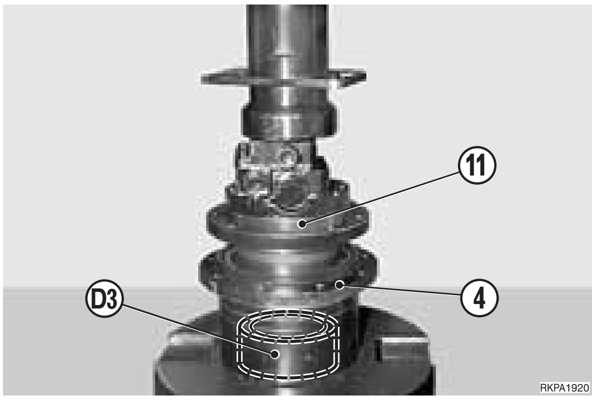
6 - Assemble the first half-seal (13) on the housing (4).

7 - Repeat the operation of point 5 for the second half-seal (13) and assemble it on the hydraulic motor (11).



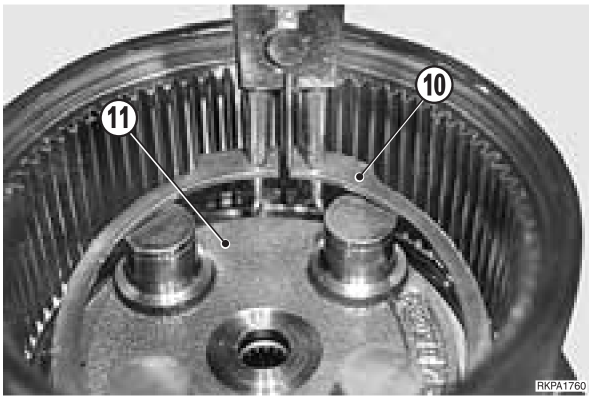
8 - Lubricate the metal surface of the seal (13) with oil.

9 - Position the housing (4) with the bearing (16) supported by the tool **D3**. Position the hydraulic motor (11) and use a press to push it into the housing (4).



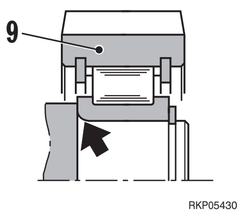
10 - Position the centering ring (12) on the hydraulic motor (11) and, using a press and a push rod, press it home.

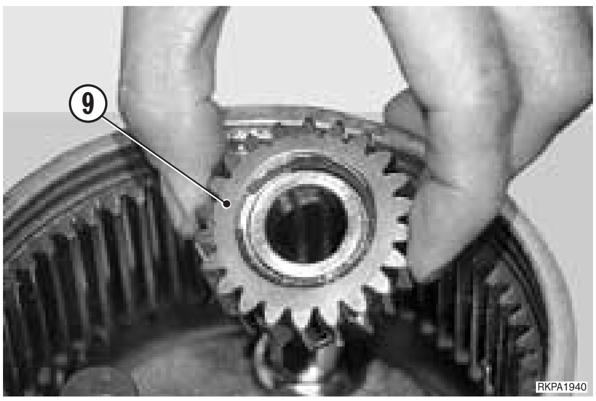
11 - Mount the snap-ring (15) in the seating of the hydraulic motor (11).



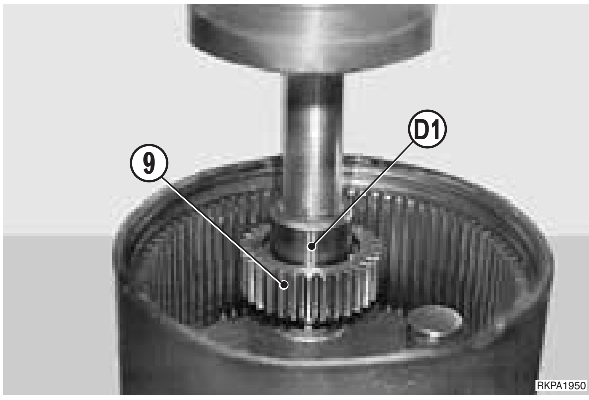
12 - Mount the no. 2 planetary gear on the pins of the hydraulic motor.

★ Keep a careful check on the direction of assembly.

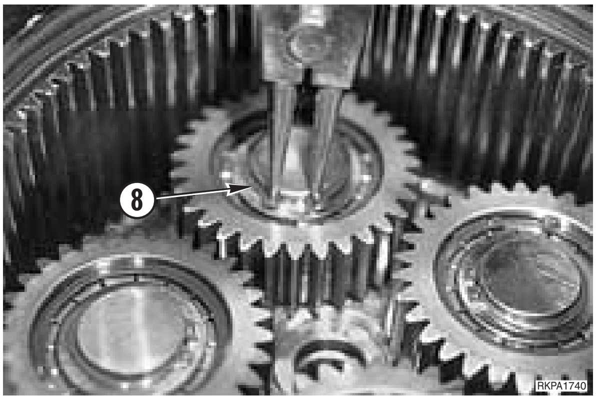




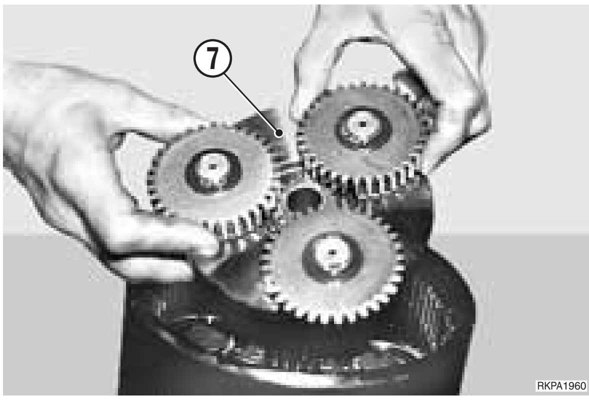
13 - Use the tool **D1** and a press to push the differential gear (9) home on the pins of the hydraulic motor.



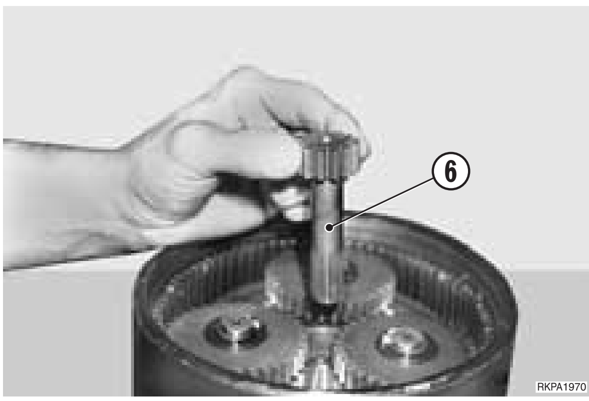
14 - Mount the snap rings (8).



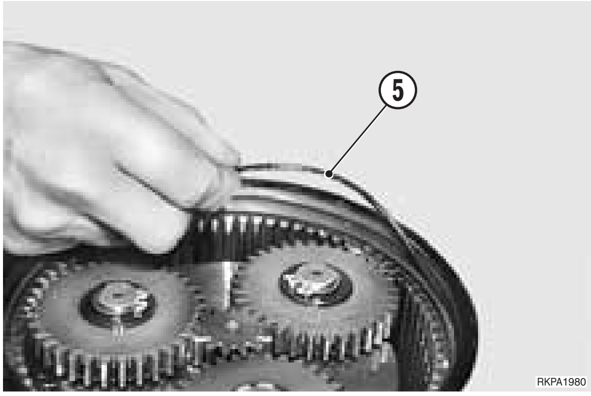
15 - Install the planetary carrier (7) of the no. 1 planetary gear.



16 - Install the no. 1 planetary gear (or sun gear) (6).

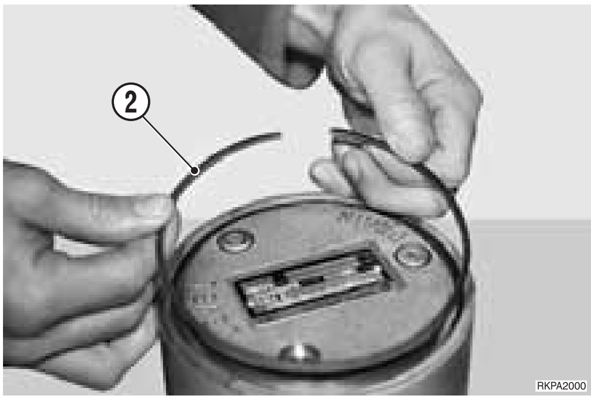


17 - Install the O-ring (5) in the housing.



18 - Position the cover (3) and press it home.

19 - Mount the snap ring (2).



20 - Fill up, mount the caps (1) complete with seals, and tighten them.

Quantity of oil: approx. 0.4 ℓ

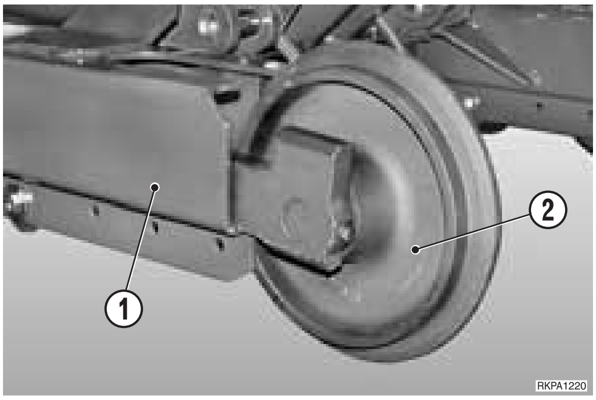
Cap: 8 – 12 Nm

REMOVAL OF IDLER AND RECOIL SPRING ASSEMBLY

Rubber track-shoes

1 - Remove the track-shoe (For details, see «REMOVAL OF RUBBER TRACK-SHOES).

2 - Pull the idler (2) and the cylinder (3) out of the lower track-frame (1).



Steel track-shoes

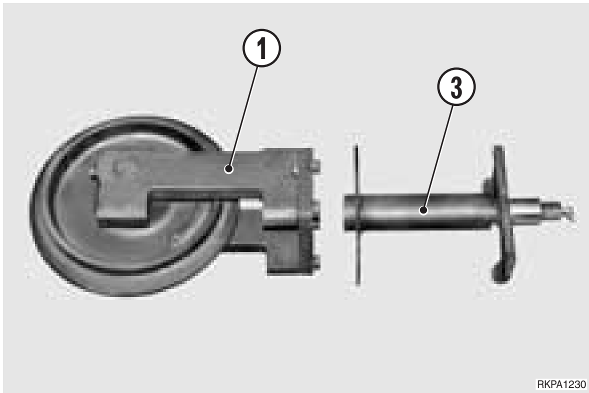
1 - Bring the connecting pin (4) of the track-shoe into the upper idler (5) position.

2 - Slowly loosen the grease nipple to let out the grease and release the tension in the track-shoe.

The grease contained in the idler cylinder is under pressure and could seriously injure the Operator. For this reason the valve should never be loosened by more than one turn.

★ If the grease does not run out easily, move the machine slowly backwards and forwards. ※1

Rest the working equipment on the ground and stop the engine.



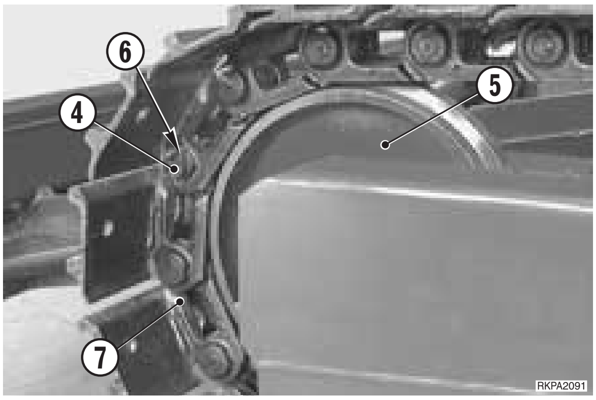
3 - Take out the connecting pin (4) using the tool **A1**.

★ First remove the safety cotter pin (6).

★ While dismantling the track-shoe (7), support the part of the track-shoe wound round the idler with a block placed beneath the shoe-ribbing. Once it is dismantled, lay the track-shoe (7) on the ground.

4 - Pull off the idler (8) and the recoil spring assembly (9).

kg Complete idler: 17 kg

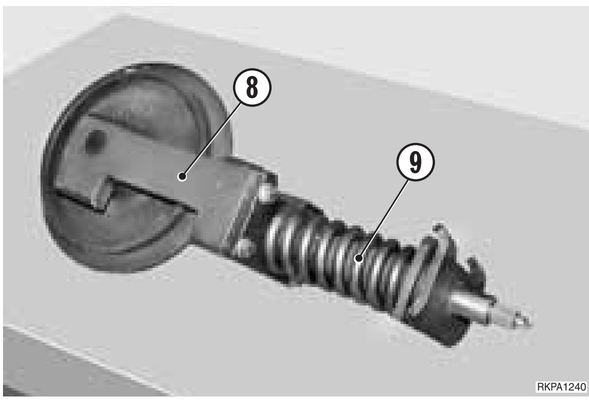


INSTALLATION

- To install, reverse the removal procedure.

※1

★ Restore tension to the track-shoe. (For details, see «20. CONTROLS AND ADJUSTMENTS).

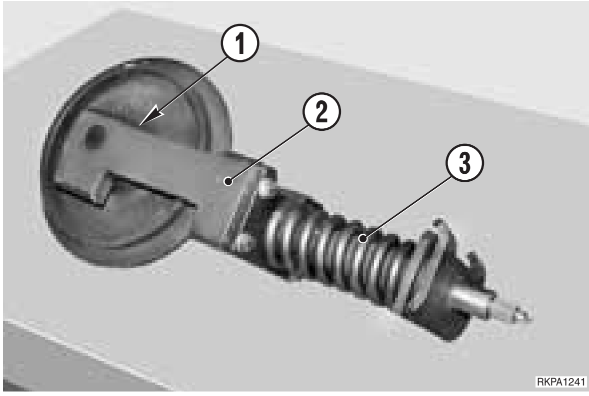


DISASSEMBLY OF THE IDLER

★ When dismantling the idlers, all seals must be substituted.

★ Remove the cap (1) and drain the oil.

Quantity of oil: approx. 20 cc.

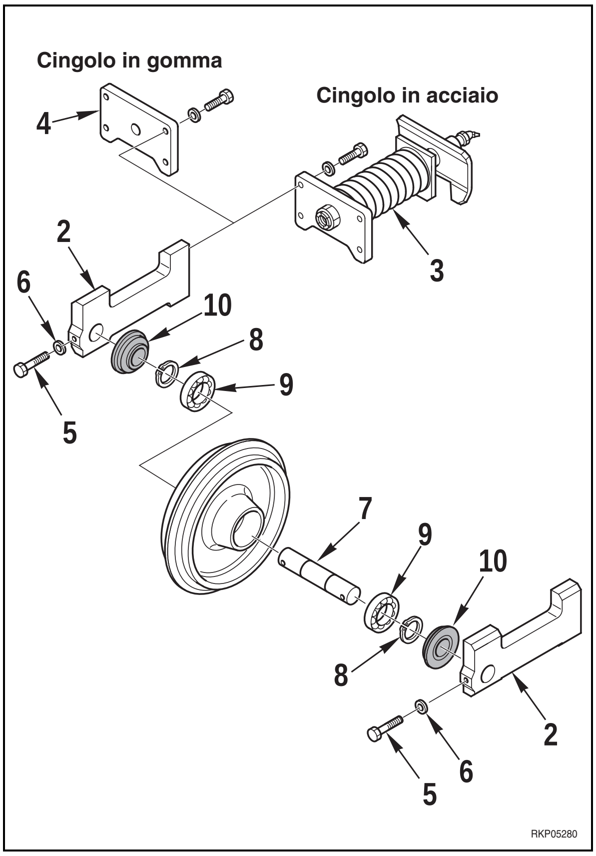


1 - **Only for steel track-shoes**
Disconnect the group (3) from the supports (2).

2 - **Only for rubber track-shoes**
Disconnect the plate (4) from the supports (2).

3 - Remove the screws (5) and their washers (6).

4 - Using a press, take out the pin (7) and remove the snap rings (8), the bearings (9) and the lateral seals (10). ※1



ASSEMBLY OF THE IDLER

- To re-assemble, reverse the dismantling procedure.

※1

★ Use a press for the final assembly.

★ Fill the inner chamber and the bearings with grease.

Grease: ASL800050

★ Quantity of grease: 36 cc.

DISASSEMBLY AND ASSEMBLY OF THE SPRING RECOIL AND THRUST CYLINDER GROUPS

1 - Spring recoil group

★ First inject grease to remove the piston.

Disassembly

1 - Place the group (1) beneath a press on which the tool **B1** is mounted.

⚠ The spring is mounted with a strong pre-loading. Make sure that the group is well-centred and that it is standing perfectly flat.

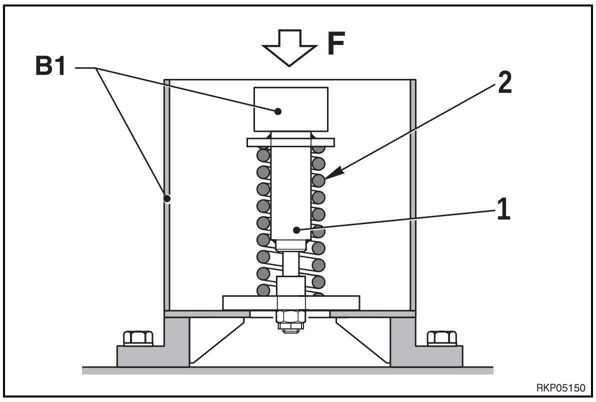
2 - Increase pressure slowly and compress the spring (2).

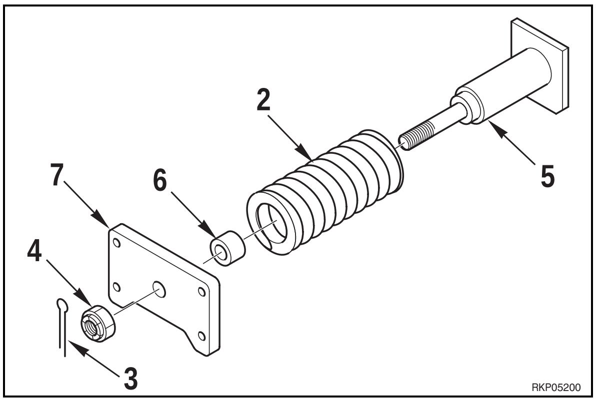
3 - Maintaining pressure, remove the cotter pin (3) and the nut (4).

4 - Slowly release pressure until the spring is completely released.

★ Length of released spring: 200 mm

5 - In sequence remove the cylinder (5), the spring (2), the spacer (6) and the support (7).





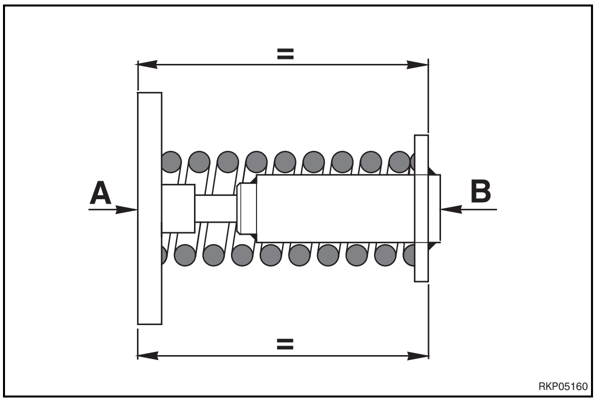
Assembly

- To re-assemble, reverse the dismantling procedure.

※ 1

★ Tighten the nut (4) up to the indicated length of the spring. (See «40. STANDARD MAINTENANCE»). Mount the cotter pin (3).

★ After assembly, check that the parallelism error between the faces A and B is less than 0.5 mm.



2 - Thrust cylinder

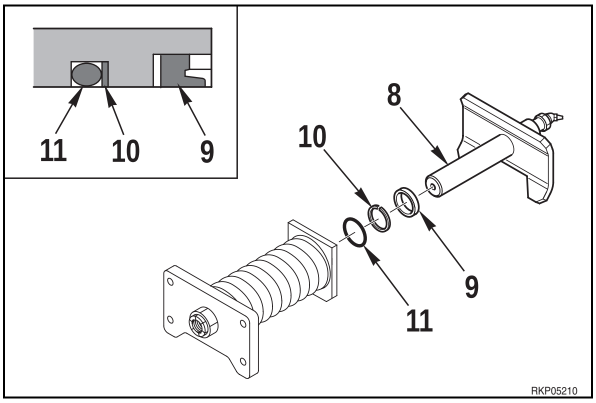
Disassembly

1 - Take the piston rod (8) out of the cylinder.

2 - Take out the guard ring (9), the anti-extrusion ring (10), and the O-ring (11).

Assembly

- To re-assemble, reverse the dismantling procedure.

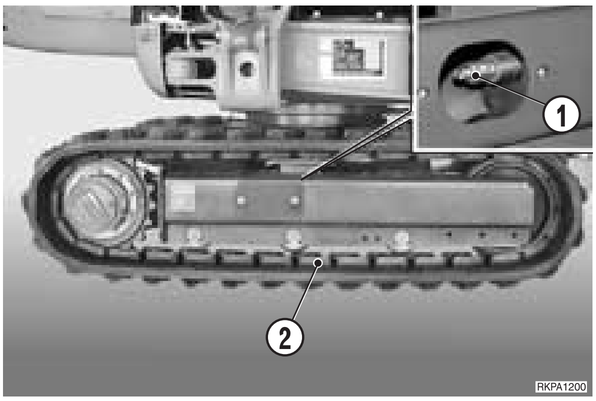


REMOVAL OF THE TRACK ROLLERS

1 - Slowly loosen the grease nipple (1) to let out the grease and release tension in the track-shoe.

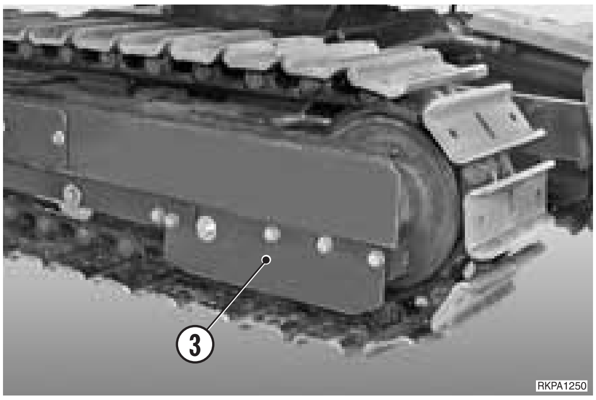
The grease contained in the cylinder is under pressure and could seriously injure the Operator. For this reason, the valve should not be loosened for more than one turn.

★ If the grease does not come out easily, move the machine slowly backwards and forwards. ※1



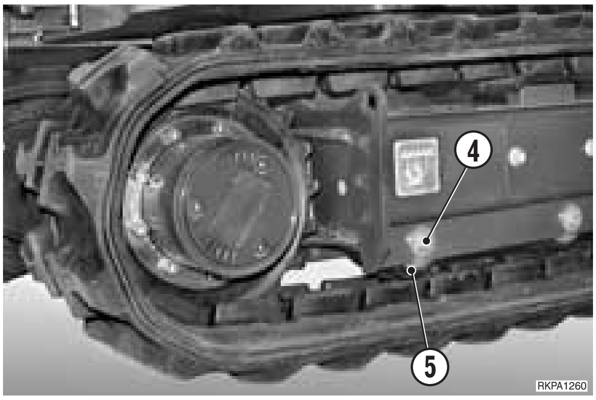
2 - Rotate the turret 90° towards the removal side and force the boom down to raise the lower track-frame (2).

3 - **Only for steel track-shoes**
Remove the guard (3).



4 - Loosen the screws (4) and remove the rollers (5).

※2



INSTALLATION OF THE TRACK ROLLERS

- To install, reverse the removal procedure.

※1

★ With the lower track-frame (2) raised, install the idler rollers (5), and slightly tighten the screws (4).

★ Slowly lower the lower track-frame (2) until the rollers (5) rest fully on the track-shoe, then finish tightening the screws (4).

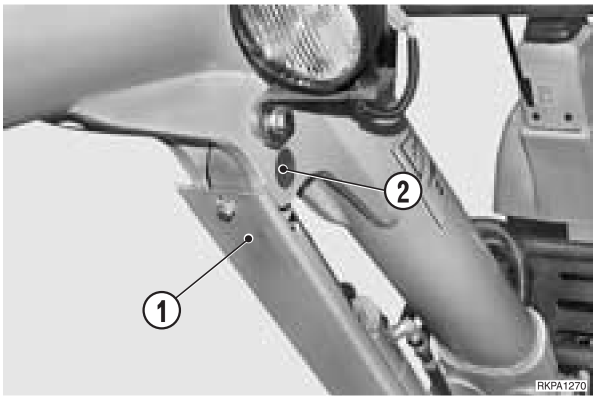
Roller screws: Loctite 262

Roller screws: 75 Nm

※2

★ Restore the track-shoe tension. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

REMOVAL OF BOOM CYLINDER



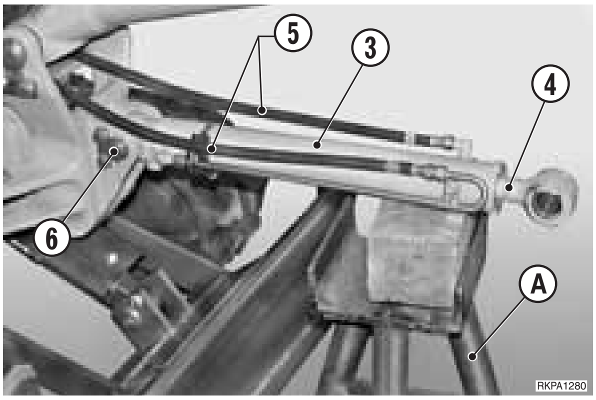
⚠ Fully extend the arm and open the bucket completely. Lower the equipment until it rests on the ground.

1 - Remove the protection (1) and the relative shoes. ※1

2 - Stop the engine, release the pressures in the cylinder by moving the right-hand PPC valve lever several times.

3 - Remove the pin (2). ※2 ※3

4 - Lower the cylinder (3) until it rests on a stand «A».
   ★ Bind the piston rod with wire to secure the fully retracted position.



5 - Start the engine to retract the piston (4). ※3

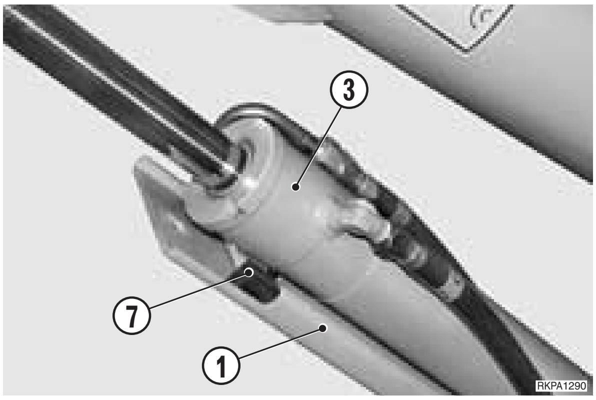
6 - Stop the engine and release the residual hydraulic pressures. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

7 - Disconnect the tubes (5) and plug them. Also plug the holes in the cylinder to prevent entry of impurities.

8 - Remove the pin (6). ※3 ※4

9 - Remove the cylinder (3).
   kg Boom cylinder:: PC12R: 10.7 kg
   PC15R: 12 kg

INSTALLATION OF THE BOOM CYLINDER



- To install, reverse the removal procedure.

※1
   ★ Check the centering and the smooth movement of the protection (1) on the shoes (7).
   Shoes and guides: ASL800050

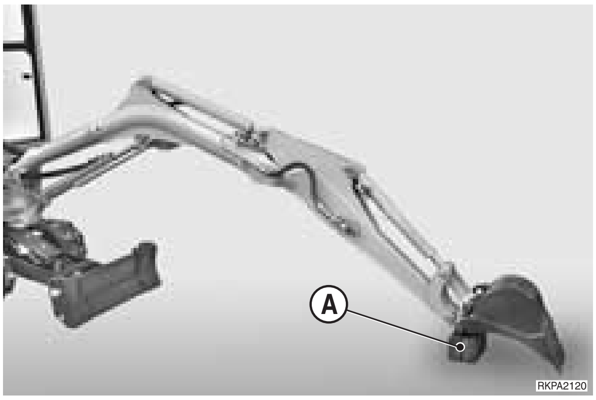
※2
   ★ Insert the shims on both sides of the piston rod.

※3
   ⚠ When aligning the positions between the hole and the pin, turn the engine over at low idling. Do not insert fingers in the holes to check alignment.

※4
   Internal bushings: ASL800050

1 - Start the engine and bleed the air from the cylinder. (For details, see «20. CONTROLS AND ADJUSTMENTS»).
   ★ After bleeding the air, check the level of oil in the tank.

REMOVAL OF THE ARM CYLINDER



⚠ Completely open the front equipment. Make the necessary movements to rest the bucket teeth on the ground with the arm supported on a block «A».

1 - Stop the engine and release the pressures from the cylinder by moving the left-hand PPC valve lever several times.

2 - Place a block «B» beneath the cylinder (1).

3 - Remove the pin (2). ※1 ※3

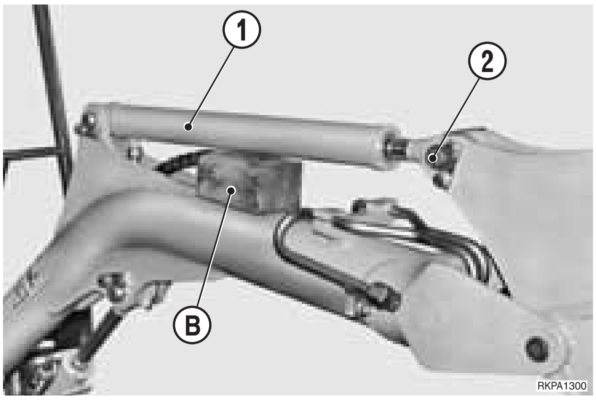
4 - Start the engine and retract the piston (3).
   ★ Bind the piston rod with wire to secure the fully retracted position of the piston.

5 - Stop the engine and release any residual hydraulic pressures. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

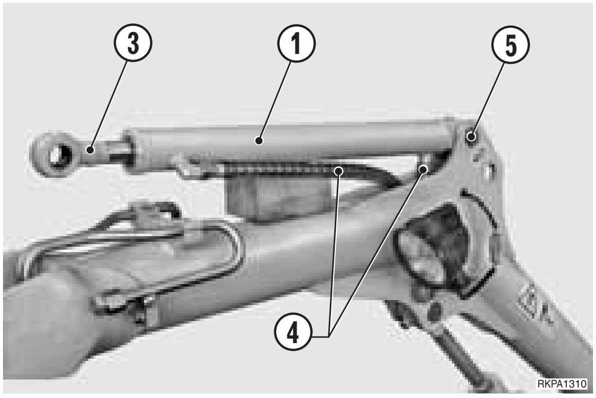
6 - Disconnect the tubes (4) and plug them. Also plug the holes in the cylinder to prevent the entry of impurities.

7 - Remove the pin (5). ※2 ※3

8 - Remove the cylinder (1).
   kg Arm cylinder: PC12R: 10 kg
   PC15R: 11 kg



INSTALLATION OF THE ARM CYLINDER



- To install, reverse the removal procedure.

※1
   ★ Insert the shims on both sides of the piston rod.

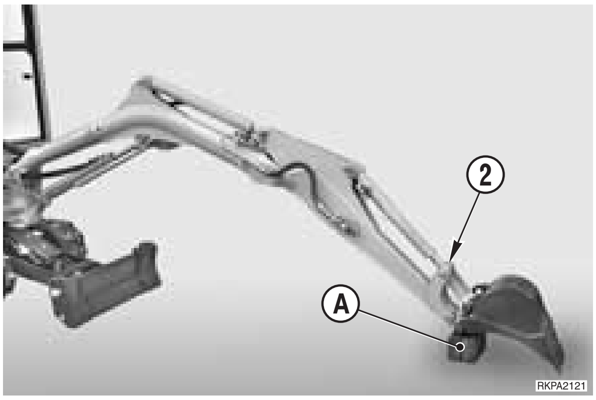
※2
   ⚠ When aligning the positions between the hole and the pin, turn the engine over at low idling. Do not insert fingers in the holes to check alignment.

※3
   Internal bushings: ASL800040

- Start the engine and bleed the air from the cylinder. (For details, see «20. CONTROLS AND ADJUSTMENTS»).
   ★ After bleeding the air, check the oil level in the tank.

REMOVAL OF THE BUCKET CYLINDER

⚠ Completely open the front equipment. Make the necessary movements to rest the bucket teeth on the ground with the arm supported on a block «A».



1 - Stop the engine and release the pressures from the cylinder (1) by moving the right-hand PPC valve lever several times.

2 - Place a block «B» beneath the cylinder (1) and remove the pin (2). ※1 ※2 ※3

3 - Start the engine and retract the piston rod (3).
   ★ Bind the piston rod with wire to secure the fully retracted position.

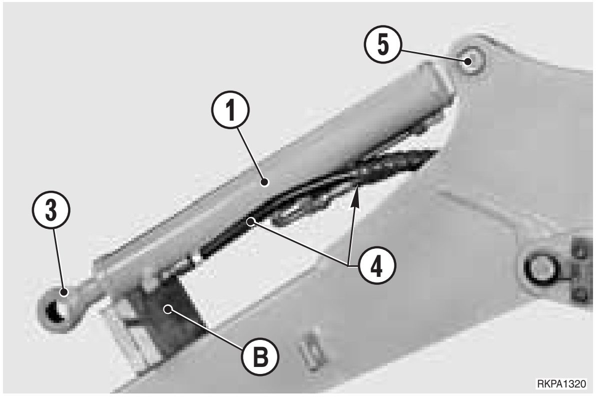
4 - Stop the engine and release any residual hydraulic pressures. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

5 - Disconnect the hoses (4) and plug them. Also plug the holes in the cylinder to prevent the entry of impurities.

6 - Put a sling round the cylinder (1).

7 - Remove the pin (5). ※2 ※3 ※4

8 - Remove the cylinder (1).
   kg Bucket cylinder: PC12R: 9 kg
   PC15R: 9 kg



INSTALLATION OF THE BUCKET CYLINDER

- To install, reverse the removal procedure.

※1
   ★ Insert the shims on both sides of the piston rod.

※2
   ⚠ When aligning the positions between the hole and the pin, do not insert fingers in the holes to check alignment.

※3
   Internal bushings: ASL800040

※4
   ★ Insert the shims on both sides of the piston rod.

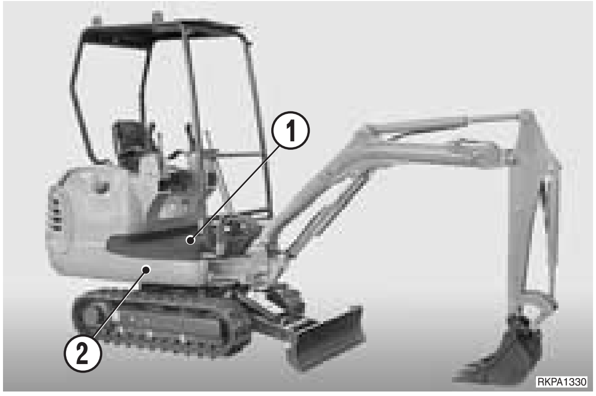
- Start the engine and bleed the air from the cylinder. (For details, see «20. CONTROLS AND ADJUSTMENTS»).
   ★ After bleeding the air, check the oil level in the tank.

REMOVAL OF THE BOOM SWING CYLINDER

⚠ Lower the working equipment to the ground with all safety devices engaged. Rest the back of the bucket on the ground with the arm in a vertical position.

1 - Stop the engine and move the command pedal several times to release residual pressures.

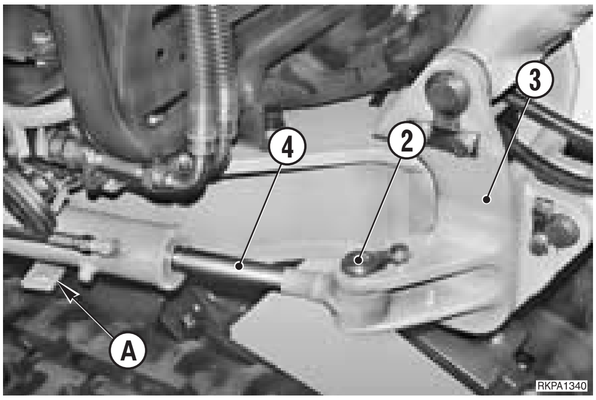
2 - Raise the floor mat (1) and remove the right-hand side panel (2).



3 - Make a note of the position of the shims of the cylinder and the piston rod.

4 - Place a supporting adjustment «A» beneath the cylinder.

5 - Remove the pin (2) and disengage the piston rod from its support (3). ※1 ※2

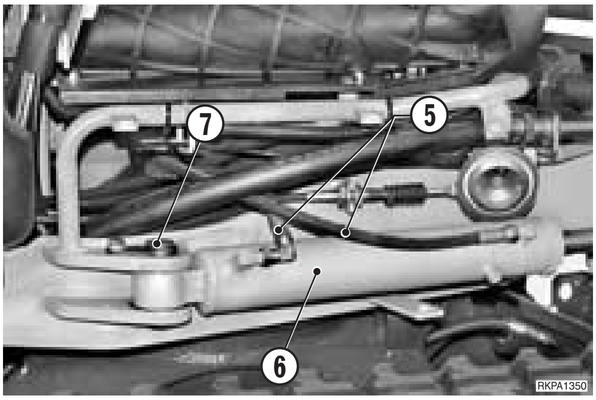


6 - Start the engine and retract the piston rod (4).
   ★ Bind the piston rod with wire to secure the fully retracted position.

7 - Stop the engine and release any residual hydraulic pressures. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

8 - Disconnect the hoses (5) and plug them. Also plug the holes in the cylinder (6) to prevent entry of impurities.

9 - Remove the pin (7) on the base side and remove the cylinder. ※2 ※3 ※4



kg Boom swing cylinder: PC12R: 10 kg
PC15R: 10 kg

INSTALLATION OF THE BOOM SWING CYLINDER

- To install, reverse the removal procedure.

※1

★ Insert the shims above the piston rod.

※2

⚠ When aligning the positions between the hole and the pin, turn the engine over at low idling. Do not insert fingers in the holes to check alignment.

※3

Internal bushings: ASL800040

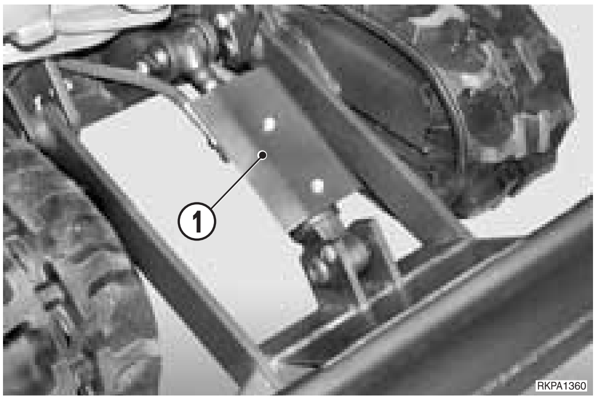
※4

★ Insert the shim.

- Start the engine and bleed the air from the cylinder. (For details, see «20. CONTROLS AND ADJUSTMENTS»).
   ★ After bleeding the air, check the oil level in the tank.

REMOVAL OF THE BLADE CYLINDER

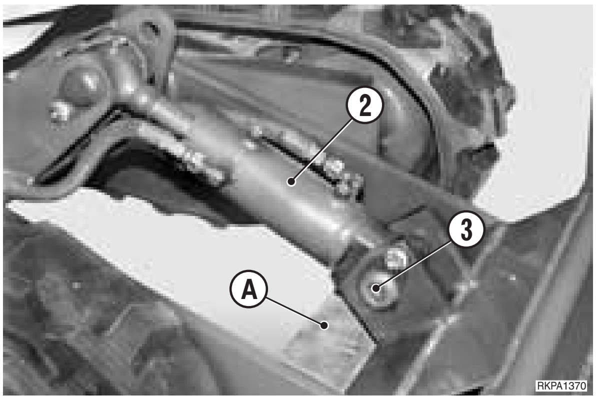
⚠ Lower the working equipment to the ground with all safety devices engaged. Rest the back of the bucket on the ground with the arm in a vertical position.



1 - Remove the protection (1).
   ★ Place a supporting block «A» beneath the cylinder.

2 - Stop the engine, release the pressures in the cylinder (2) by moving the command lever several times in both directions.

3 - Remove the pin (3). ※1 ※3



4 - Start the engine to retract the piston (4). ※2
   ★ Bind the piston rod with wire to secure the fully retracted position.

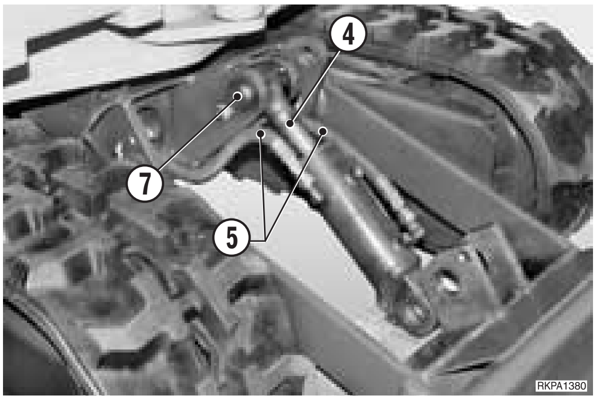
5 - Stop the engine and release the residual hydraulic pressures. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

6 - Disconnect the tubes (5) and plug them. Also plug the holes in the cylinder to prevent entry of impurities.

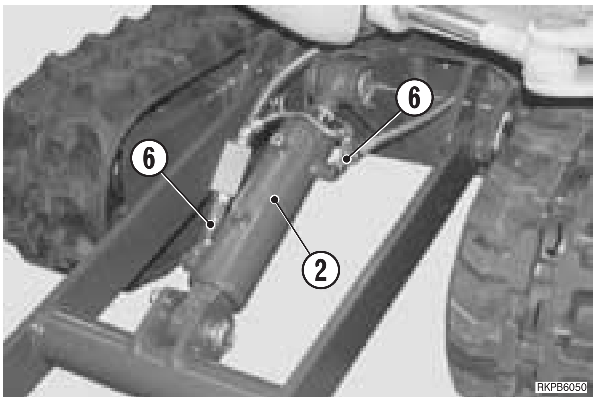
7 - Only for HS version.
   Disconect the unions (6) and plug them. Also plug the holes in the cylinder to prevent entry of impurities.

7 - Remove the pin (7). ※2 ※3

8 - Remove the cylinder (2).
   kg Blade cylinder: PC12R: 6.8 kg
   PC15R: 11 kg



HS VERSION



INSTALLATION OF THE BLADE CYLINDER

- To install, reverse the removal procedure.

※1

★ Insert the shims on both sides of the piston rod.

※2

⚠ When aligning the positions between the hole and the pin, turn the engine over at low idling. Do not insert fingers in the holes to check alignment.

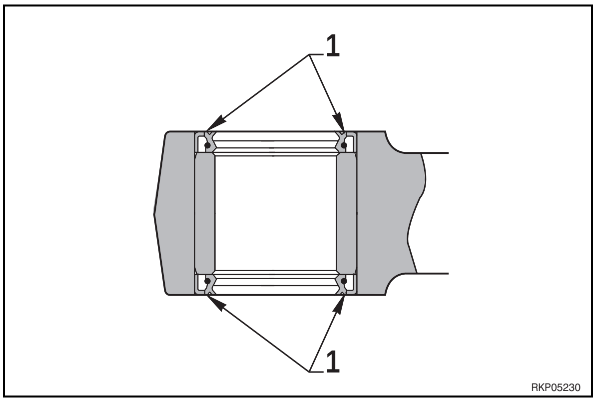
※3

Internal bushings: ASL800040

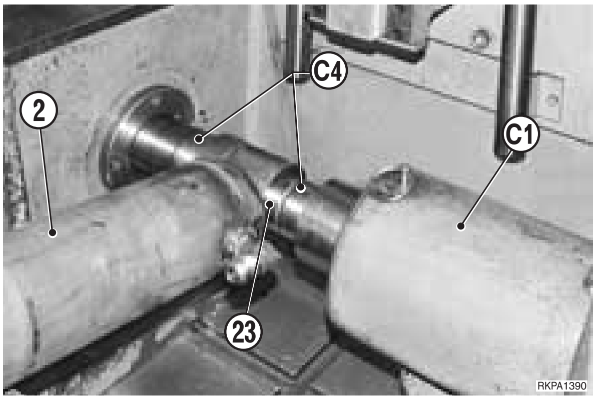
- Start the engine and bleed the air from the cylinder. (For details, see «20. CONTROLS AND ADJUSTMENTS»).
   ★ After bleeding the air, check the oil level in the tank.

DISASSEMBLY OF THE WORKING EQUIPMENT CYLINDERS

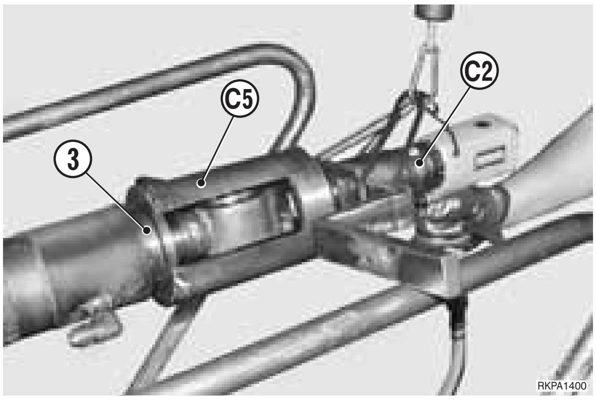
1 - Take off the guard rings (1) from both sides of the cylinder and from the piston rod.
  ★ Make sure that the tube unions are not plugged.



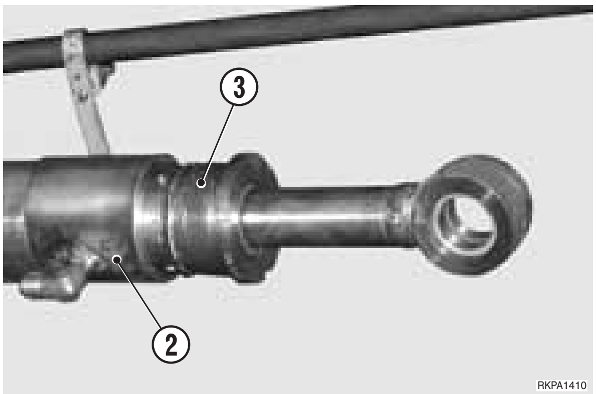
2 - Place the cylinder (2) on the apparatus **C1**. Engage the cylinder in the tools **C4**, having the same bushing diameter.



3 - Attach the special wrench **C5** (adjusted to fit the cylinder) to the head and apply the dynamometric tool **C2**.



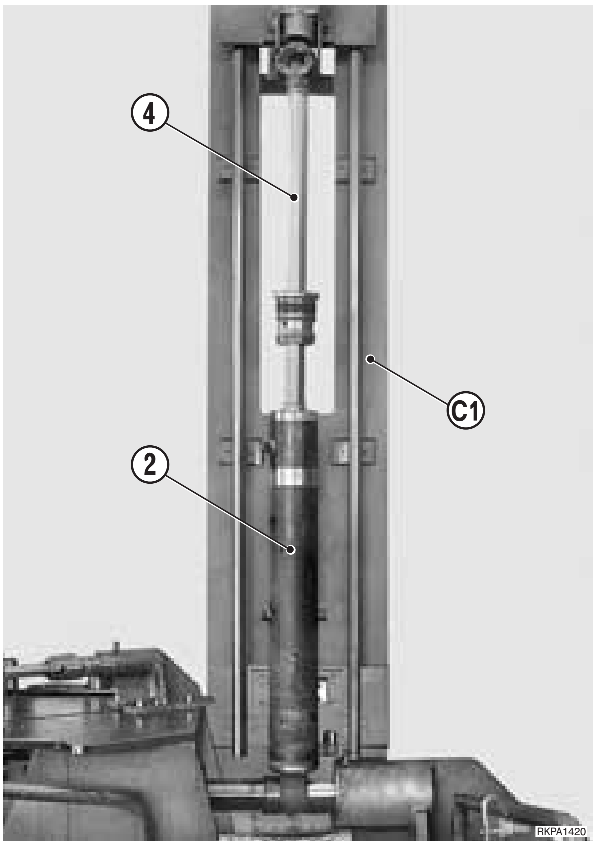
4 - Unscrew the head (3) and extract it completely from the cylinder (2).



5 - Raise the cylinder and hook the piston rod to the mobile group of the tool **C1**.

6 - Extract the piston rod group (4) from the cylinder.

7 - Remove the cylinder (2) and the piston rod group.



8 - Lock the complete piston rod (4) onto the apparatus **C1**.

9 - Attach the socket wrench **C6** to the lock nut (5) of the piston (6) and, using the dynamometric tool with a multiplier **C2**, remove the nut.

★ Socket wrench measurement:
Boom cylinder PC12R: 30 mm
PC15R: 32 mm

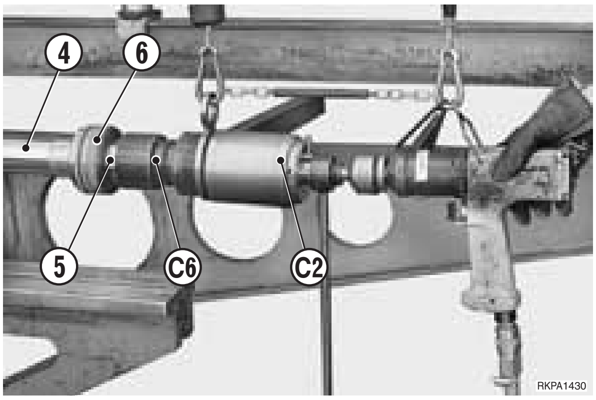
Arm cylinder PC12R: 32 mm
PC15R: 36 mm

Bucket cylinder: 32 mm

Boom swing: 32 mm

Blade cylinder PC12R: 32 mm
PC15R: 41 mm

Variable undercarriage: 32 mm



10 - Take all the groups to pieces and remove all the seals, guard rings and guide rings.

The seals, guard rings, and guide rings cannot be used again.

ASSEMBLY OF THE WORKING EQUIPMENT CYLINDERS

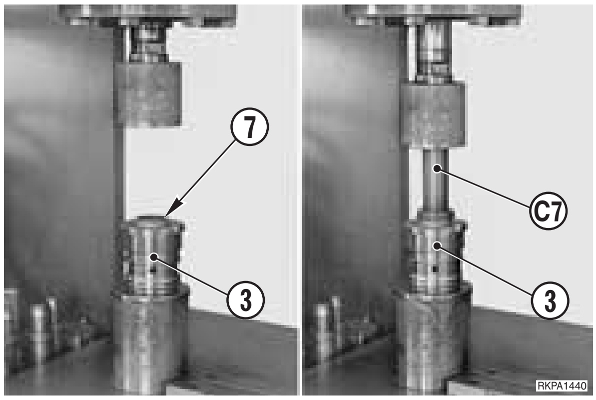
★ Take great care not to damage the seal and the sliding surfaces.

★ Prepare each individual component before commencing the final assembly.

1. Assembly of the cylinder head

1 - Position the guard ring (7) and, using a press and the push rod **C7**, press it home in the head (3).

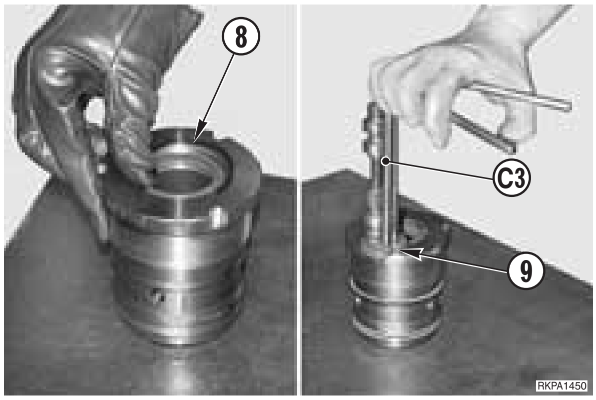
★ Check the orientation carefully.



2 - Mount the snap ring (8).

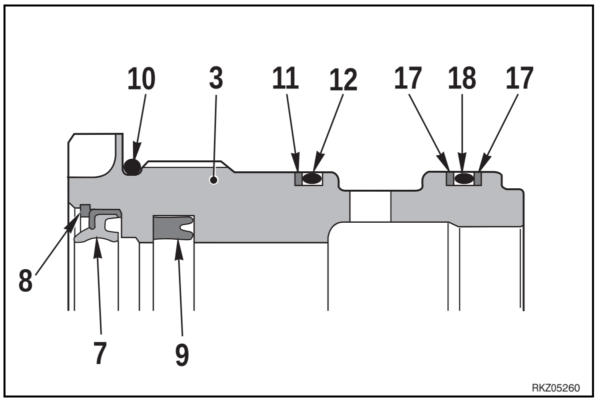
3 - Using the tool **C3**, mount the lip-seal (9).

★ Check that the lips face into the cylinder.



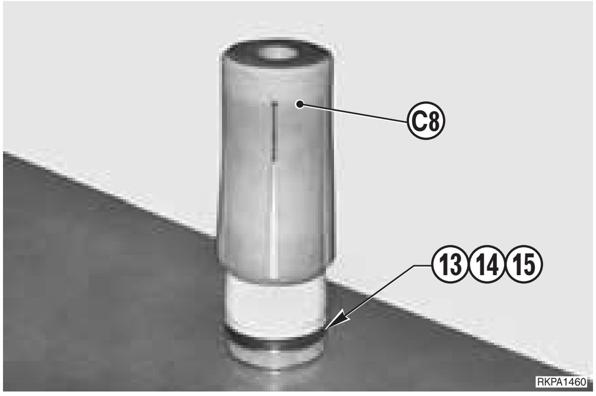
4 - Mount the O-ring (10), the anti-extrusion ring (11) and the O-ring (12) onto the cylinder head (3).

★ **Only for the boom cylinders.**
In sequence mount the anti-extrusion ring (17), the O-ring (18) and the 2nd anti-extrusion ring (17).



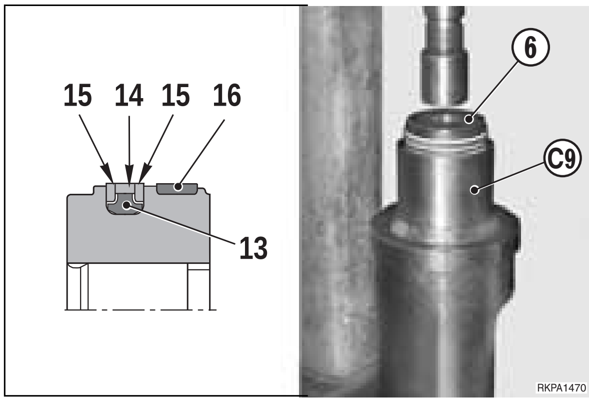
2. Piston assembly

1 - Using the tool **C8**, mount the piston seal. Mount in sequence the rubber ring (13), the outer seal (14) and the anti-extrusion rings (15).



2 - Mount the guide ring (16).

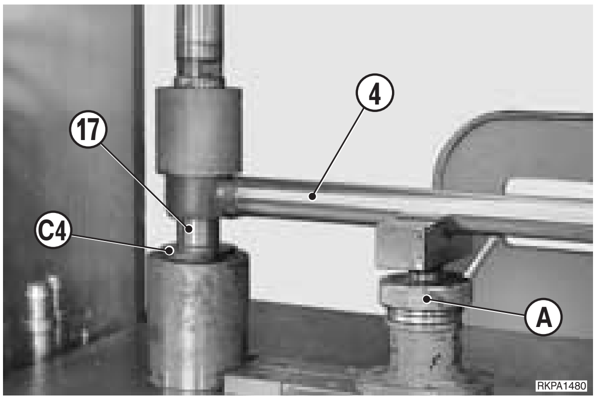
3 - Calibrate the diameter of the gasket (14) of the piston (6), mounting the group beneath the press and using the calibrating ring **C9** adapted to fit the piston diameter.



3. Piston rod group assembly

1 - Using a press and the tool **C4** adapted to the diameter, insert the bushing (17) into the piston rod (4).

2 - Insert the support «A» beneath the piston rod.

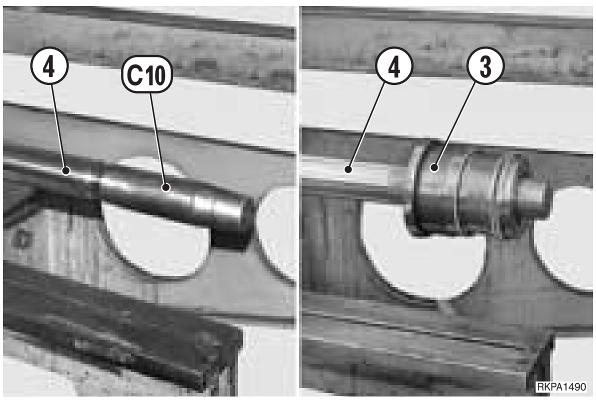


3 - Mount the pilot boss **C10** adapted to the diameter onto the extremity of the piston rod.

4 - Slide the head (3) onto the piston rod (4).

★ **For the PC15R blade cylinder:** slide the spacer (19) complete with its O-ring (20) onto the piston rod (4).

5 - Remove the pilot boss **C10** from the extremity of the piston rod.

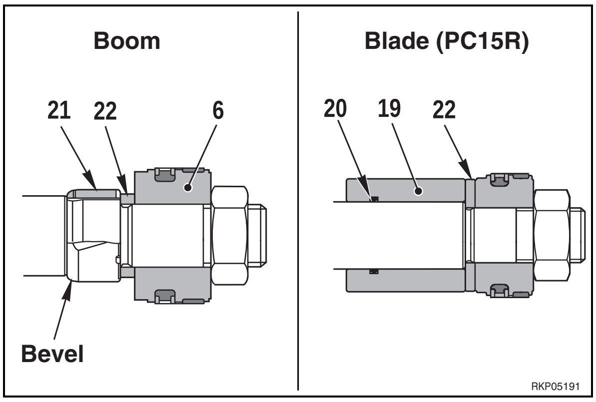


6 - **For the boom cylinders.**
Mount the brake bushing (21).

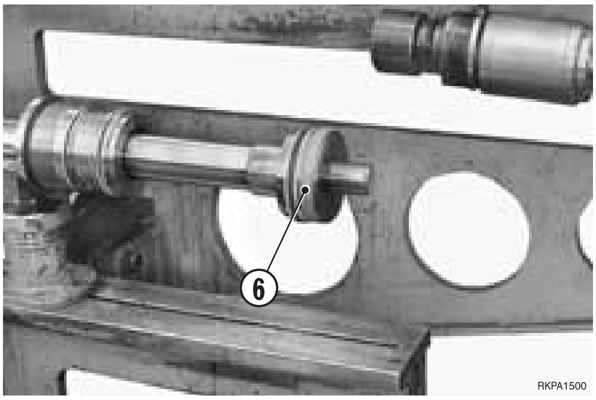
★ For the boom cylinder for the PC12R, also mount the spacer (22).

★ Carefully check the orientation of the chamfer on the brake bushing.

★ **For the PC15R blade cylinder**: mount only the spacer (22).



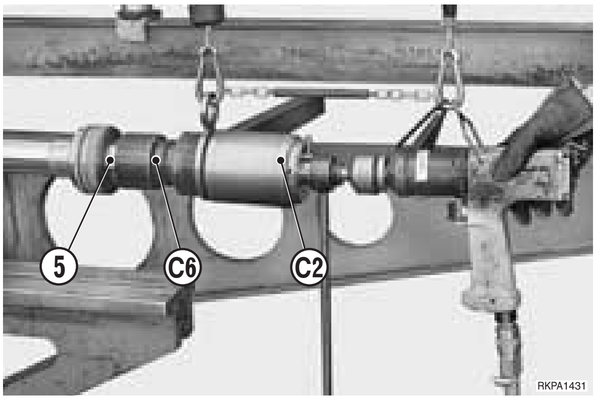
7 - Mount the complete piston (6).



8 - Mount the nut (5) that secures the piston and tighten it with the socket wrench **C6** and the dynamometric tool with a multiplier **C2.**

Nut: Loctite 262

Nut:
Boom cylinder PC12R: 392±39 Nm
PC15R: 539±54 Nm
Arm cylinder PC12R: 539±54 Nm
PC15R: 686±68 Nm
Bucket cylinder: 539±54 Nm
Boom swing cylinder: 539±54 Nm
Blade cylinder PC12R: 539±54 Nm
PC15R: 1127±112 Nm
Variable undercarriage: 539±54 Nm

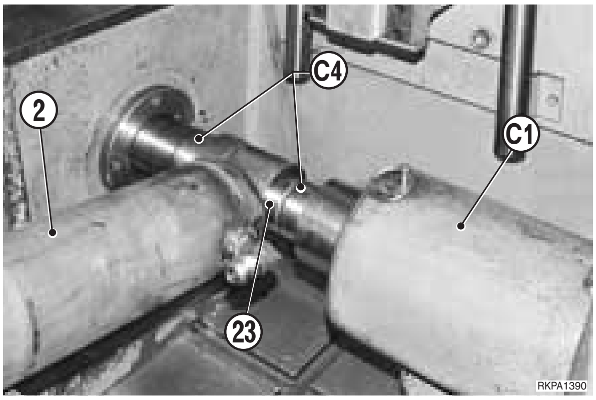


4. Cylinder assembly

1 - Mount the tools **C4** onto the apparatus **C1**.

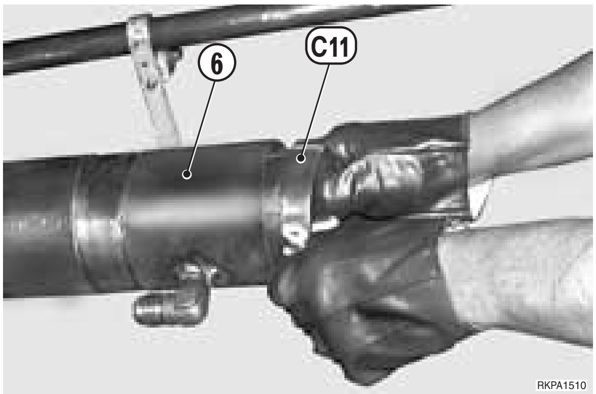
2 - Position the bushing (23) and mount it onto the cylinder (2).

★ Leave the cylinder in position, ready for the next assembly operation.



3 - Lubricate the threading and the first part of the cylinder (2).
   Cylinder: ASL800050

4 - Mount the two halves of the tool **C11**, adapted to the diameter, onto the mouthpiece of the cylinder (2).

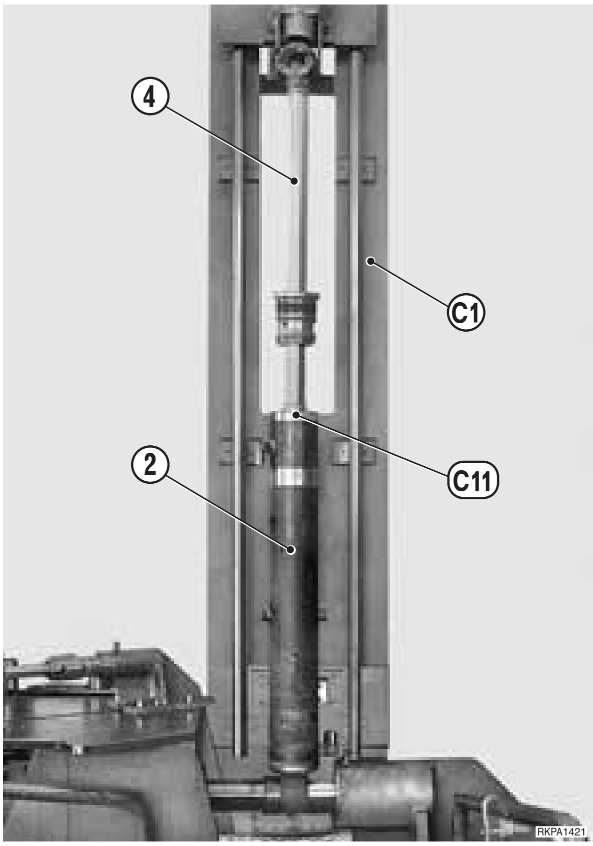


5 - Mount the piston rod group (4) onto the tool **C1** and raise the mobile part up to the end of its stroke.

6 - Put the cylinder (2) into a vertical position and guide the piston into the tool **C11**.

7 - Lower the apparatus supporting the piston rod (4) in order to insert the piston into the cylinder liner (2).

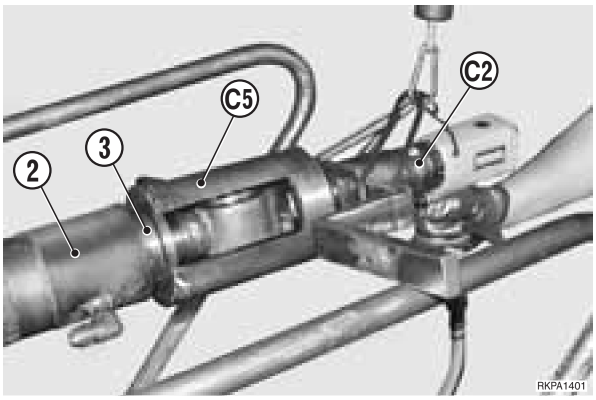
8 - Remove the tool **C11** from the cylinder and then lower the apparatus **C1** even further, until the head (3) and the piston rod approach the cylinder.



9 - Place the cylinder (2) in position for screwing in the head (3).

10 - Insert the head into the cylinder and screw it in by hand for a few turns.

11 - Attach the special wrench **C5** to the dynamometric tool **C2** and screw the head (3) fully home.
   Nm Head:
   Boom swing cylinder PC12R: 412±41 Nm
   PC15R: 441±44 Nm
   Arm cylinder PC12R: 392±39 Nm
   PC15R: 412±41 Nm
   Bucket cylinder PC12R: 392±39 Nm
   PC15R: 392±39 Nm
   Boom swing cylinder PC12R: 441±44 Nm
   PC15R: 392±39 Nm
   Blade cylinder: PC12R: 441±44 Nm
   PC15R: 540±54 Nm
   Variable undercarriage: 392±39 Nm

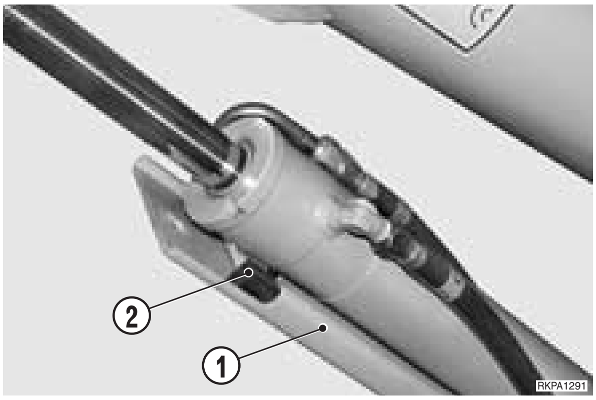


12 - Mount the guard rings (1) on both sides of the cylinder and the piston rod.

REMOVAL OF THE UPPER WORKING EQUIPMENT

⚠ Fully extend the arm and open the bucket completely. Lower the equipment until it rests on the ground.

1 - Remove the protection (1) and the relative shoes (2). ※1

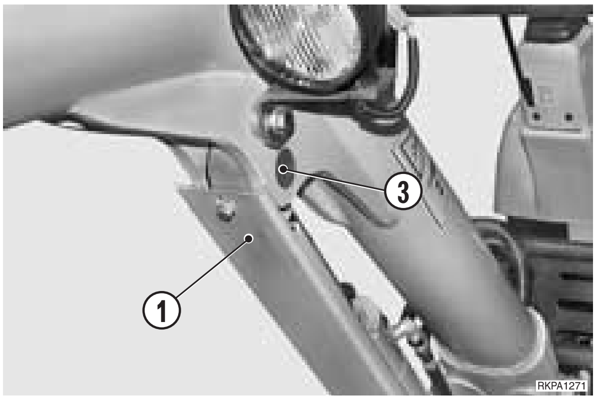


2 - Stop the engine, release the pressures in the cylinder by moving the PPC valve lever several times.

3 - Remove the pin (3). ※2

4 - Start the engine to retract the piston (4). ※3

★ Bind the piston rod with wire to secure the fully retracted position.



5 - Lower the cylinder (2) until it rests on a stand «A».

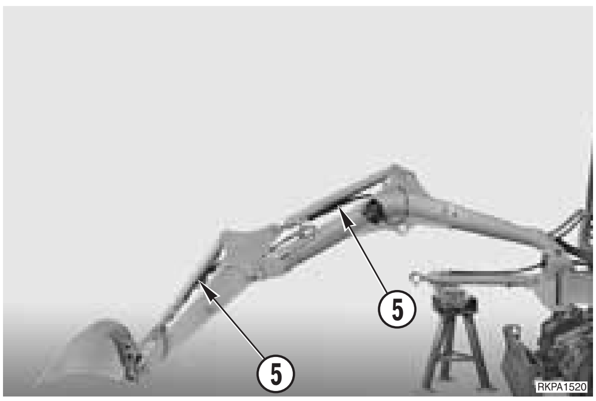
6 - Stop the engine and release the residual hydraulic pressures. (For details, see «20. CONTROLS AND ADJUSTMENTS»).

7 - Disconnect the hoses (5) and plug them. Also plug the holes in the cylinder to prevent entry of impurities.

★ Disconnect the hoses from any optional equipment. Plug the hoses and the unions to prevent entry of impurities.

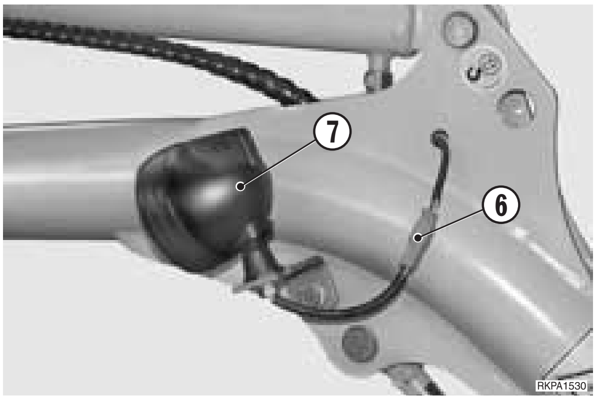
★ Mark the hoses to avoid exchanging them during re-installation.

8 - Slide the arm cylinder and bucket hoses off the boom, leaving in position the hoses of the optional equipment.



9 - Disconnect the connector (6) that supplies current to the working spotlight (7), and pull off the power supply cable to the boom.

10- Remove the working spotlight (7) complete with its bracket.



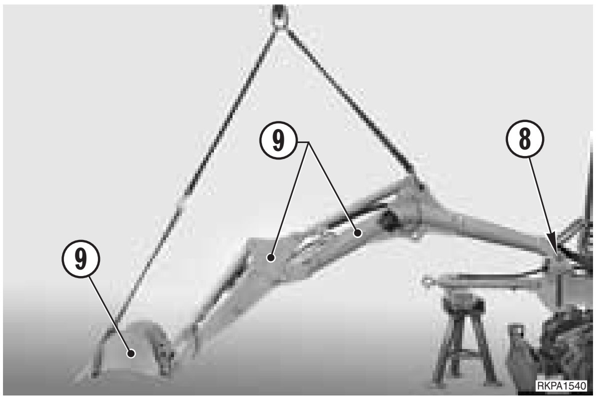
11 - Put a sling around the equipment and apply a slight tension to the cables.

★ Adjust the length of the cables to balance the load.

12 - Take away the pin (8). Remove the working equipment (9).

★ Check and make a note of the position of the shim. ※4

kg Working equipment: PC12R: 150 kg
PC15R: 160 kg



INSTALLATION OF THE UPPER WORKING EQUIPMENT

- To install, reverse the removal procedure.

※1

★ Check the centering and the smooth movement of the protection (1).

Shoes and guides: ASL800050

※2

★ Insert shims on both sides of the piston rod.

※3

When aligning the positions between the hole and the pin, turn the engine over at low idling. Do not insert fingers in the holes to check alignment.

※4

★ Insert the shim.

Internal bushings: ASL800040

Nm Pin screws: 63±6.5 Nm

- Start the engine to circulate the oil and bleed the air from the cylinder.

★ After bleeding the air, stop the engine and check the oil level in the tank.

REMOVAL OF THE BUCKET

Position the bucket on the ground on a flat surface, and resting on its back.

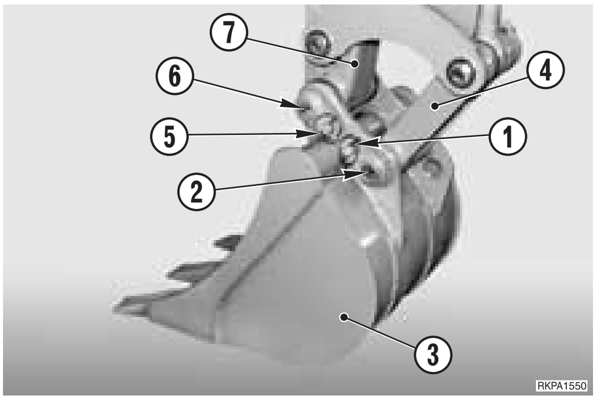
1 - Take out the safety pin (1) and remove the connecting pin (2) between the bucket (3) and the tie-rods (4).

※1 ※2 ※3

2 - Take out the safety pin (5) and remove the pin (6) that connects the bucket (3) to the arm (7).

※2 ※3 ※4

kg Bucket: PC12R: 21 kg
PC15R: 22 kg



INSTALLATION OF THE BUCKET

- To install, reverse the removal procedure.

※1

★ Insert shims on both sides of the piston rod.

※2

When aligning the positions between the hole and the pin, turn the engine over at low idling. Do not insert fingers in the holes to check alignment.

※3

Internal bushings: ASL800040

※4

★ Insert shims on both sides between the bucket (3) and the arm (7).

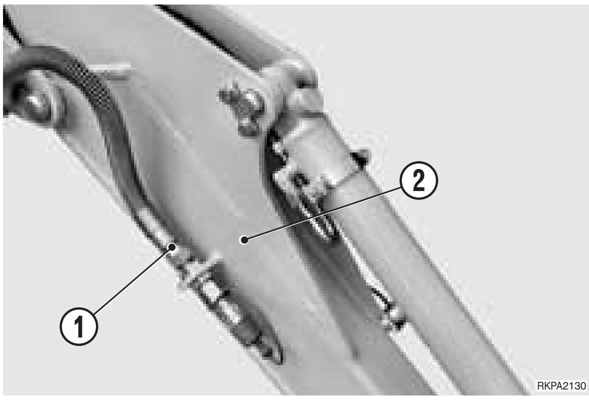
REMOVAL OF THE ARM

1 - Remove the bucket. (For details, see «REMOVAL OF THE BUCKET»).

2 - Remove the bucket cylinder. (For details, see «REMOVAL OF THE BUCKET CYLINDER»).

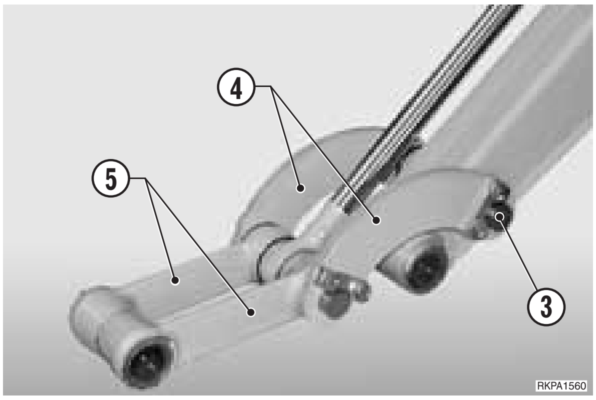
3 - If the machine is designed for the application of optional front working equipment, disengage the tubes (1) from the arm (2) brackets.

★ Plug the tubes and fittings to prevent entry of impurities.

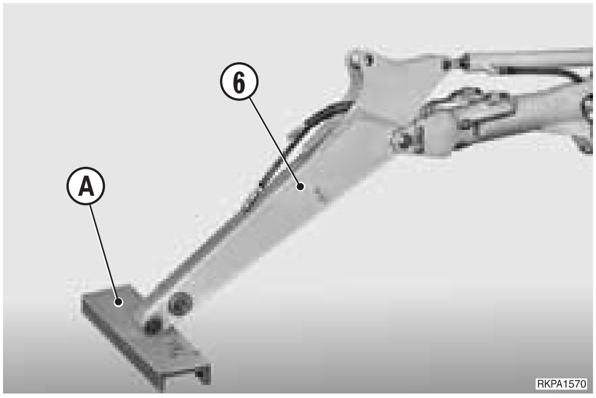


4 - Remove the pin (3) and the levers (4). ※1 ※2

★ The links (5) are removed during the removal of the bucket cylinder.



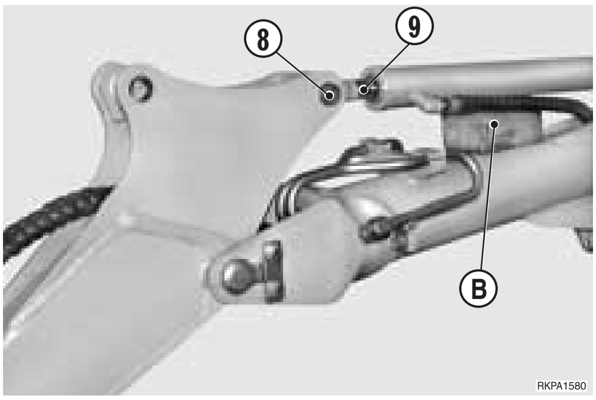
5 - Extend the arm (6) and rest it on a block «A».



6 - Stop the engine and release the residual pressures.

7 - Position a block «B» beneath the arm cylinder and remove the pin (8).

8 - Start the engine and completely retract the piston (9).



9 - Stop the engine.

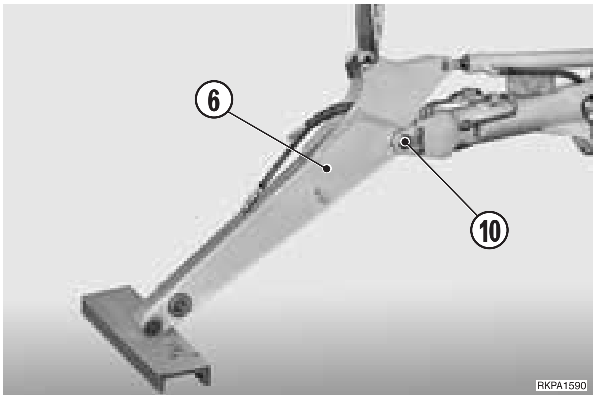
10 - Connect the arm (6) to some hoisting tackle and apply a slight tension to the cable.

11 - Take out the pin (10). ※4

12 - Remove the arm (6).

kg Arm: PC12R: 23 kg
PC15R: 25 kg

kg Arm: PC12R: 36 kg
PC15R: 38 kg



INSTALLATION OF THE ARM

- To install, reverse the removal procedure.

※1

Internal bushings: ASL800040

★ Insert the shims.

※2

When aligning the positions between the hole and the pin, do not insert fingers in the holes to check alignment.

※3

★ Insert the shims on both sides of the piston.

When aligning the positions between the hole and the pin, turn the engine over at low idling. Do not insert fingers in the holes to check alignment.

※4

Internal bushings: ASL800040

★ Insert the shims on both sides of the arm.

When aligning the positions between the hole and the pin, do not insert fingers in the holes to check alignment.

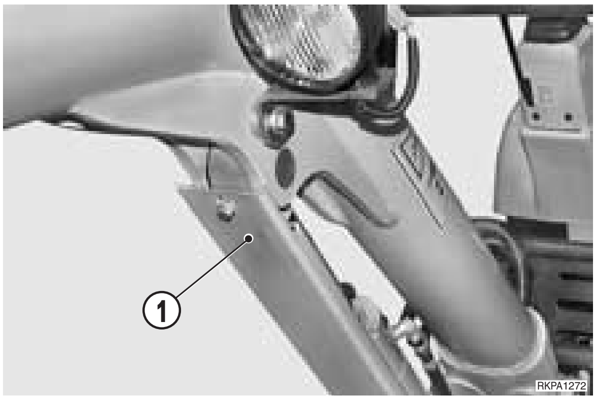
REMOVAL OF THE BOOM

⚠ Disconnect the negative terminal cable (-) from the battery.

1 - Remove the arm. (For details, see «REMOVAL OF THE ARM»).

2 - Remove the arm cylinder. (For details, see «REMOVAL OF THE ARM CYLINDER»).

3 - Remove the protection (1) and the relative sliding shoes. ※5

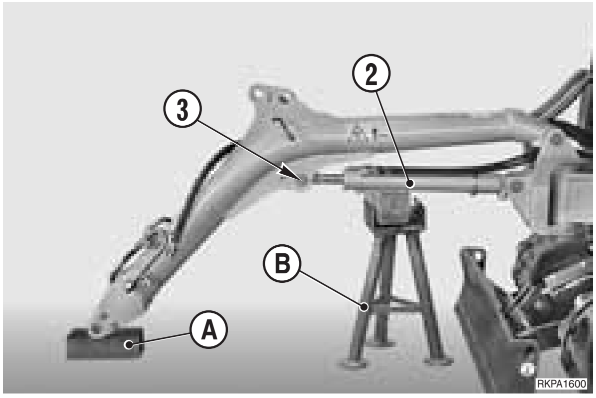


4 - Stop the engine, and rest the boom on a block «A».

5 - Stop the engine and move the PPC valve several times to release pressures in the cylinder.

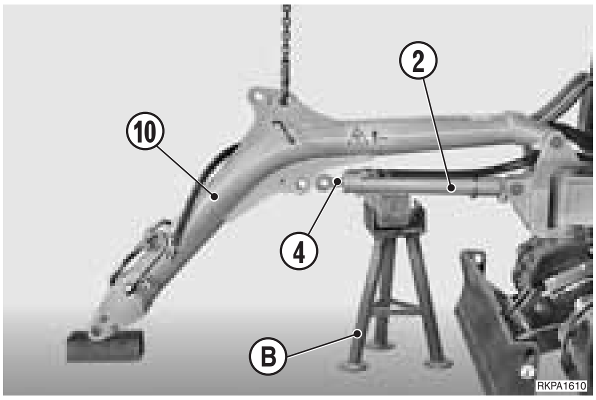
6 - Place a stand «B» beneath the cylinder (2).

7 - Remove the pin (3). ※1 ※3



8 - Start the engine to retract the piston (4). ※2

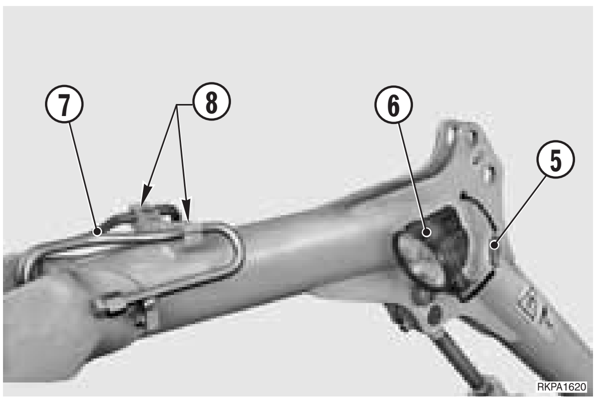
9 - Stop the engine and release the residual pressures. (For details, see «20. CONTROLS AND ADJUSTMENTS»).



10 - Disconnect the connector (5) and remove the working spotlight (6).

11 - Disconnect the rigid pipes (7) from the hoses of the optional equipment.
Plug the tubes and their fittings to prevent entry of impurities.
★ Mark the hoses to avoid exchanging them during re-installation.

12 - Remove the brackets (8) and take away the rigid pipes (7).



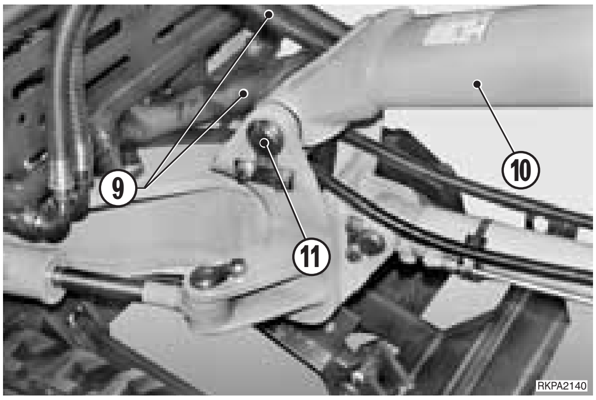
13 - Slide off the boom the tubes (9) of the arm, bucket and attachment cylinders and the cable that supplies current to the working spotlight.

14 - Connect the boom (10) to some hoisting tackle, using the hole provided and apply a slight tension to the cables.

15 - Remove the pin (11).

16 - Remove the boom (10). ※3 ※4
★ Check and make a note of the position of the shim.

kg Boom: PC12R: 48 kg
PC15R: 51 kg



INSTALLATION OF THE BOOM

- To install, reverse the removal procedure.

※1
★ Insert shims on both sides of the piston rod.

※2
When aligning the positions between the hole and the pin, turn the engine over at low idling. Do not insert fingers in the holes to check alignment.

※3
Internal bushings: ASL800040

※4
★ Insert the shim.
Nm Pin screws: 63±6.5 Nm

- Start the engine and bleed the air from the cylinder.
  ★ After bleeding the air, stop the engine and check the oil level in the tank.

※4
★ Check the centering and the smooth movement of the protection (1).
Shoes and guides: ASL800050

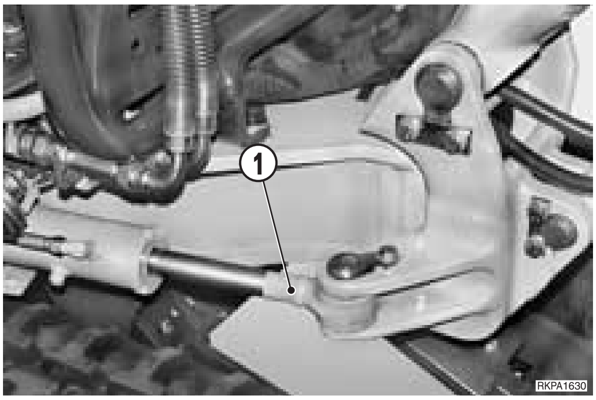
REMOVAL OF THE BOOM SWING SUPPORT

⚠ Extend the working equipment completely and rest it on the ground.

1 - Remove the front working equipment. (For details, see «REMOVAL OF THE UPPER WORKING EQUIPMENT»).

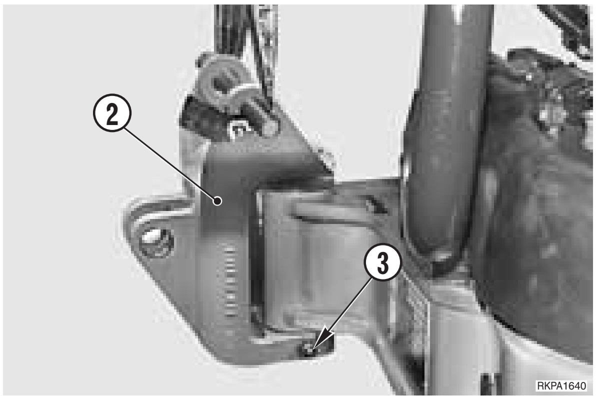
2 - Remove the boom cylinder. (For details, see «REMOVAL OF THE BOOM»).

3 - Disconnect the boom swing cylinder (1). (For details, see «REMOVAL OF THE BOOM SWING CYLINDER»).



4 - Attach the boom swing support (2) to some hoisting tackle and apply a slight tension to the cable.

5 - Take out the screw (3) and remove the swing support (2). ※1 ※2
   ★ Make a note of the position of the spacer (4) and the quantity of shims (5).
   kg Boom swing support: PC12R: 22 kg
   PC15R: 22 kg



INSTALLATION OF THE BOOM SWING SUPPORT

- To install, reverse the removal procedure.

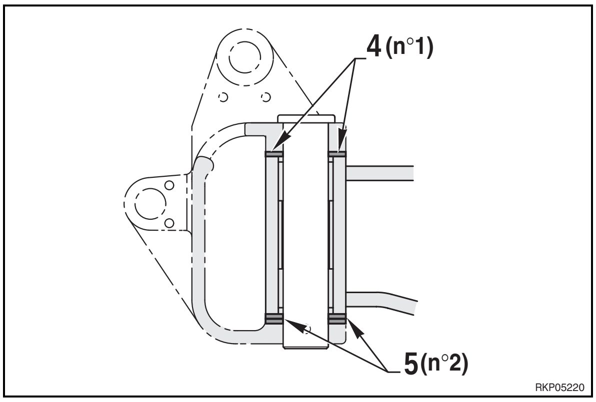
※1

Pins: ASL800040

※2

★ Insert the spacer (4) and the shims (5) between the frame and the support.

Supporting surfaces and shims: ASL800040



REMOVAL OF THE BLADE

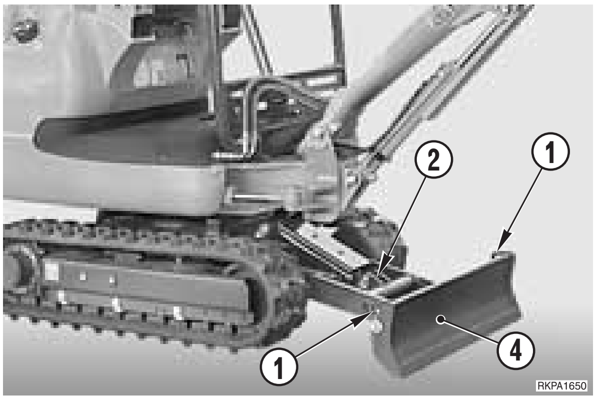
1 - Rotate the turret 90° and rest the working equipment on the ground.

2 - Disconnect the cylinder from the blade. (For details, see «REMOVAL OF THE BLADE CYLINDER»).

3 - Attach the blade to some hoisting tackle, using the lateral holes provided (1) and the cylinder attachment (2).

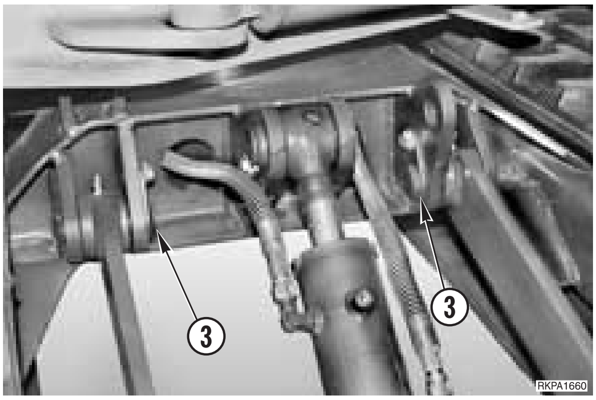
★ Adjust the length of the cables to balance the group.

4 - Take out the pin (3). ※1 ※2



5 - Remove the blade (4).

kg Blade: PC12R: 43 kg
PC15R: 54 kg



INSTALLATION OF THE BLADE

- To install, reverse the removal procedure.

※1

Internal bushings: ASL800050

※2

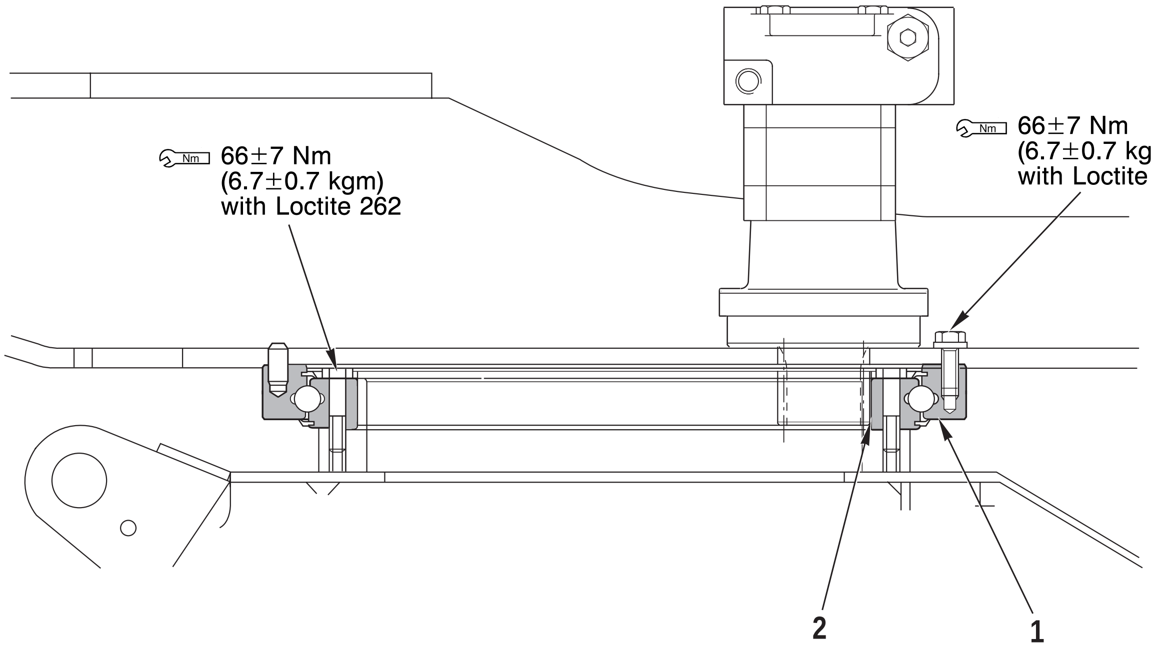
⚠ When aligning the positions between the hole and the pin, turn the engine over at low idling. Do not insert fingers in the holes to check alignment.

GROUP 40

40 STANDARD MAINTENANCE

Swing circle 2
Track frame and recoil spring 3
Variable gauge track frame and recoil spring 4
Idler 5
Final drive 6
Sprocket 7
Track roller 8
Track shoe 9
Hydraulic pump
  PC12R-8 11
  PC15R-8 12
Control valve
  PC12R-8 13
  PC15R-8 19
Swivel joint 25
Swivel joint (variable gauge undercarriage) 26
Swing motor 27
Travel motor
  PC12R-8 28
  PC12R-8 HS 28
  PC12R-8 MISTRAL 30
  PC12R-8 MISTRAL HS 30
  PC15R-8 30
  PC15R-8 HS 30
PPC valve 32
Cylinders 34
Work equipment 36

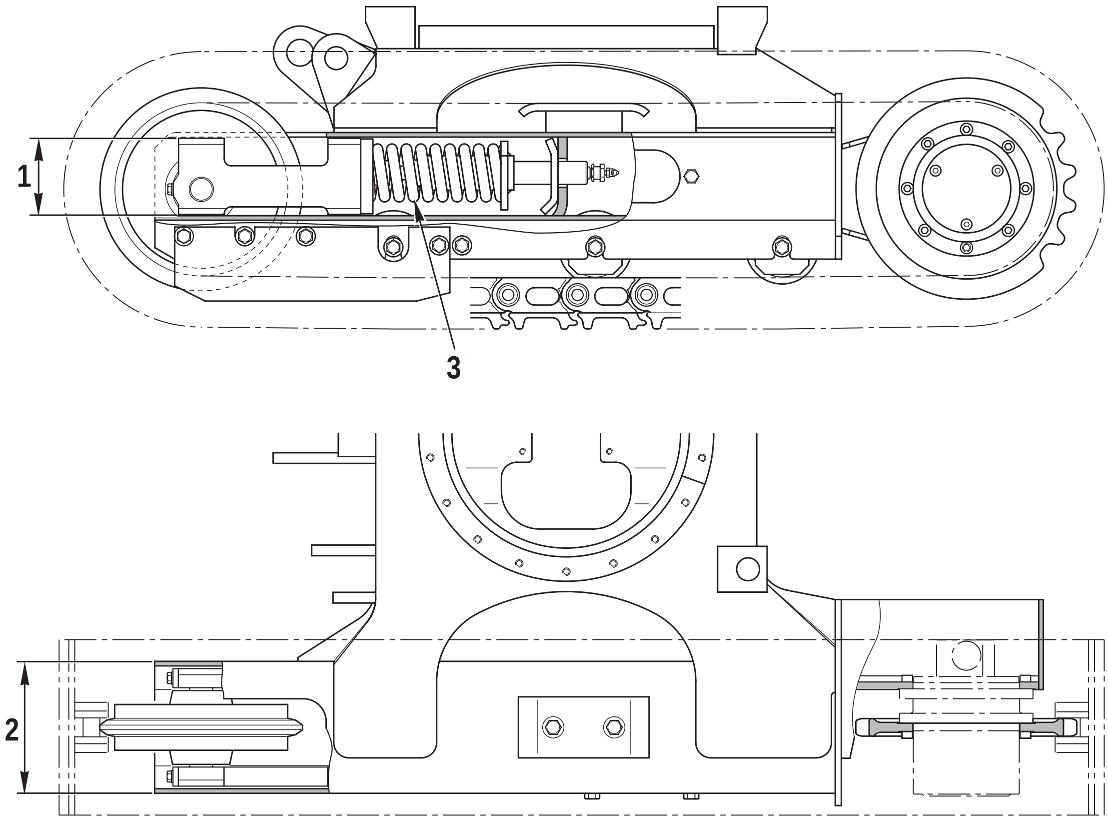
SWING CIRCLE



Unit: mm

No.	Check item	Criteria		Remedy
1	Axial bearing clearance	Standard clearance	Clearance limit	Replace
		0.3	0.8	
2	Backlash between pinion and swing circle toothing	0.1 – 0.5	1	

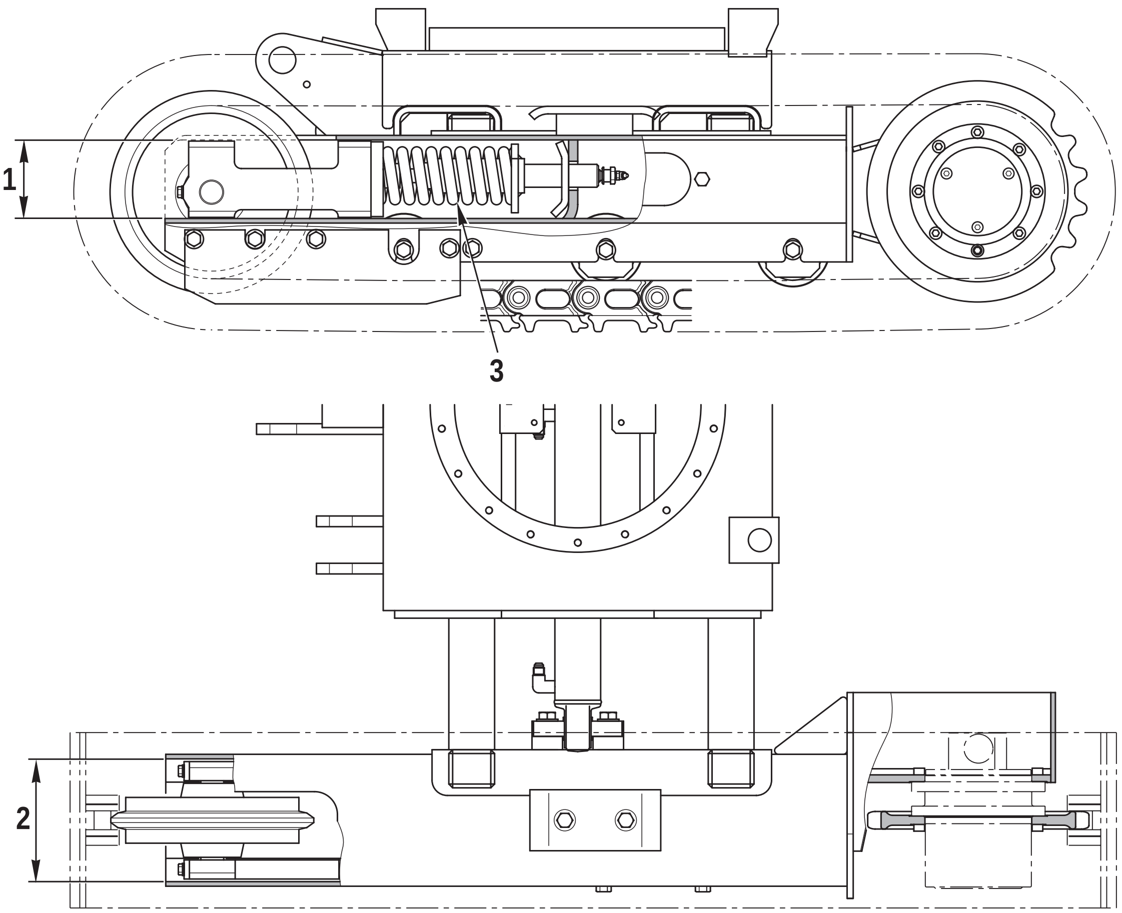
TRACK FRAME AND RECOIL SPRING



Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Vertical width of idler guide</td><td colspan="2">Item</td><td colspan="2">Standard size</td><td>Repair limit</td><td rowspan="2">Build up by welding</td></tr>
<tr><td colspan="2">Track frame</td><td colspan="2">103</td><td>106</td></tr>
<tr><td colspan="2">Idler support</td><td colspan="2">100</td><td>93</td><td>Build up by welding or replace</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Horizontal width of idler guide</td><td colspan="2">Track frame</td><td colspan="2">161</td><td>164</td><td>Build up by welding</td></tr>
<tr><td colspan="2">Idler support</td><td colspan="2">158</td><td>155</td><td>Build up by welding or replace</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Recoil spring</td><td colspan="2">Standard size</td><td colspan="3">Repair limit</td><td rowspan="3">Replace</td></tr>
<tr><td>Free length</td><td>Preloaded length</td><td>Installed load</td><td>Free length</td><td>Installed load</td></tr>
<tr><td>200</td><td>168</td><td>6865 N (700 kg)</td><td>195.6</td><td>5997 N (611.5 kg)</td></tr>
</table>

VARIABLE GAUGE TRACK FRAME AND RECOIL SPRING



RKP11341

Unit: mm

<table>
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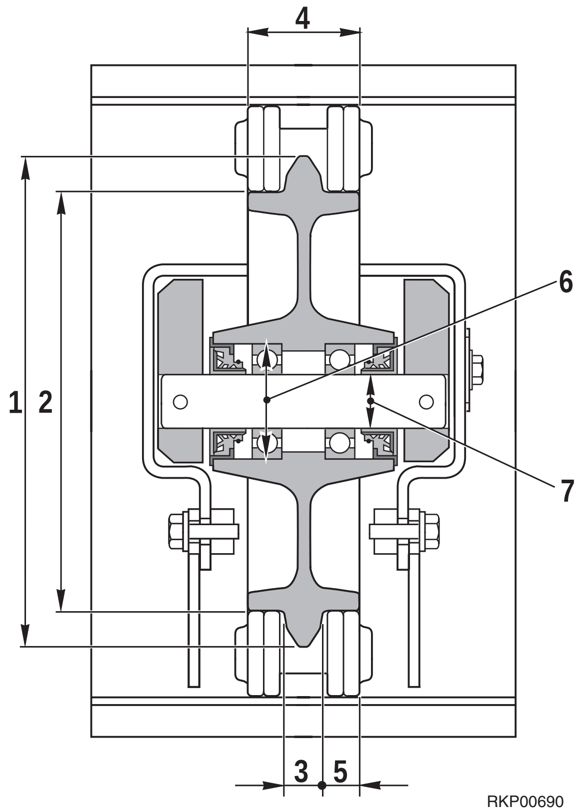
<tr><td colspan="2">Track frame</td><td colspan="2">103</td><td>106</td></tr>
<tr><td colspan="2">Idler support</td><td colspan="2">100</td><td>93</td><td>Build up by welding or replace</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Horizontal width of idler guide</td><td colspan="2">Track frame</td><td colspan="2">161</td><td>164</td><td>Build up by welding</td></tr>
<tr><td colspan="2">Idler support</td><td colspan="2">158</td><td>155</td><td>Build up by welding or replace</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Recoil spring</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="3">Replace</td></tr>
<tr><td>Free length</td><td>Preloaded length</td><td>Installed load</td><td>Free length</td><td>Installed load</td></tr>
<tr><td>200</td><td>168</td><td>6865 N
(700 kg)</td><td>195.6</td><td>5997 N
(611.5 kg)</td></tr>
</table>

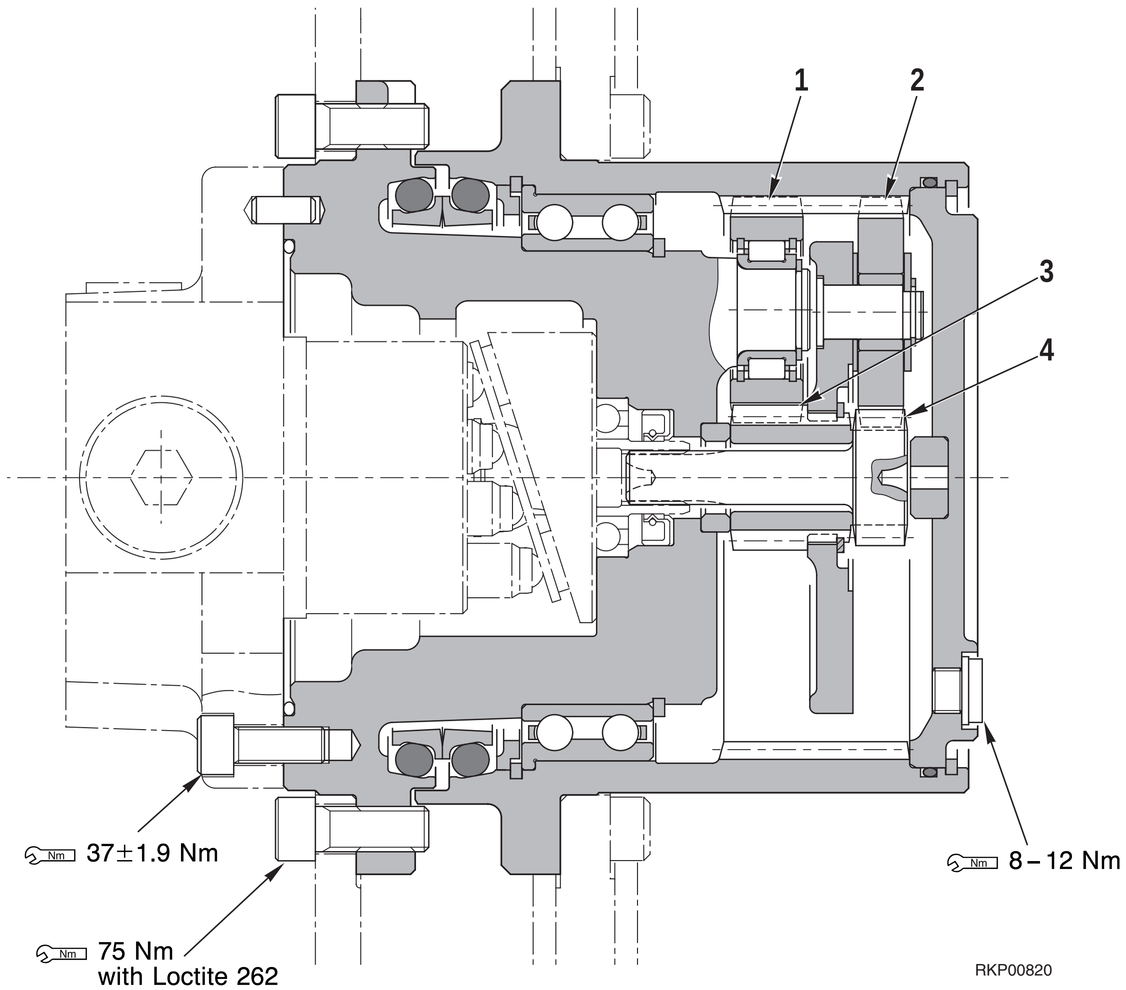
IDLER



Unit: mm

No.	Check item	Criteria					Remedy
1	Outer diameter of track shoe guide	Standard size			Repair limit		Build up by welding or replace
		266			259.5		
2	Outer diameter of tread	227			221		
3	Width of track shoe guide	23			17		
4	Total width	60			55		
5	Width of tread	18.5			21.5		
6	Clearance between bushing and idler	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		62	+0.030 0	+0.030 0	0 –0.030	1.5	
7	Clearance between shaft and support	30	0 –0.025	+0.039 0	0 –0.064	1.5	

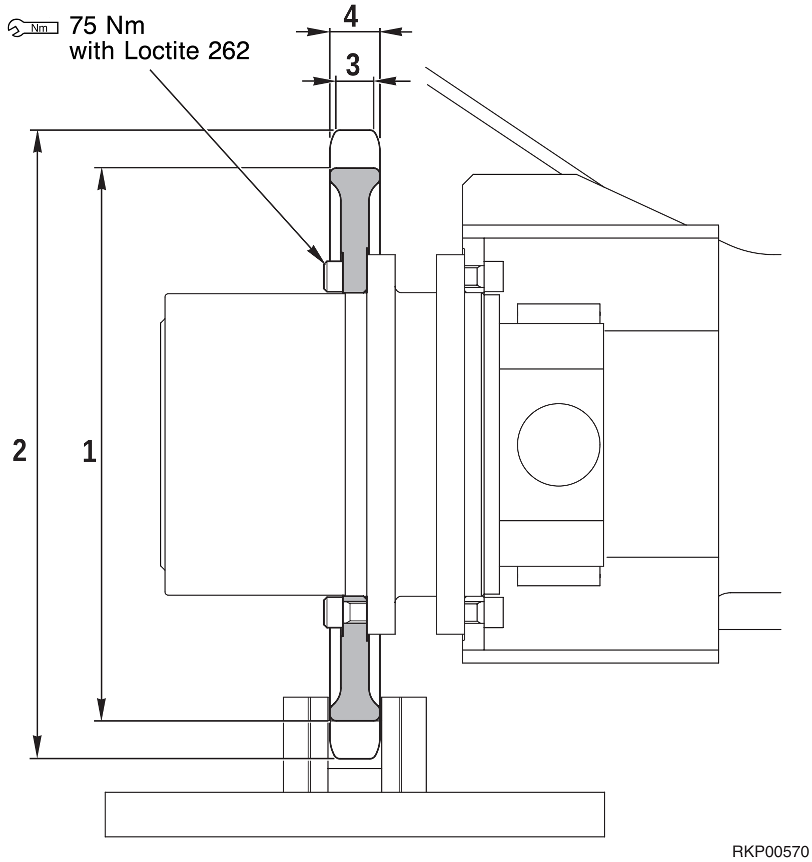
FINAL DRIVE



Unit: mm

No.	Check item	Criteria		Remedy
		Standard clearance	Clearance limit	
1	Backlash between No. 2 planetary gear and housing	0.15	0.35	Replace
2	Backlash between No. 1 planetary gear and housing	0.15	0.35	
3	Backlash between No. 2 sun gear and No. 2 planetary gear	0.10	0.30	
4	Backlash between No. 1 sun gear and No. 1 planetary gear	0.10	0.30	

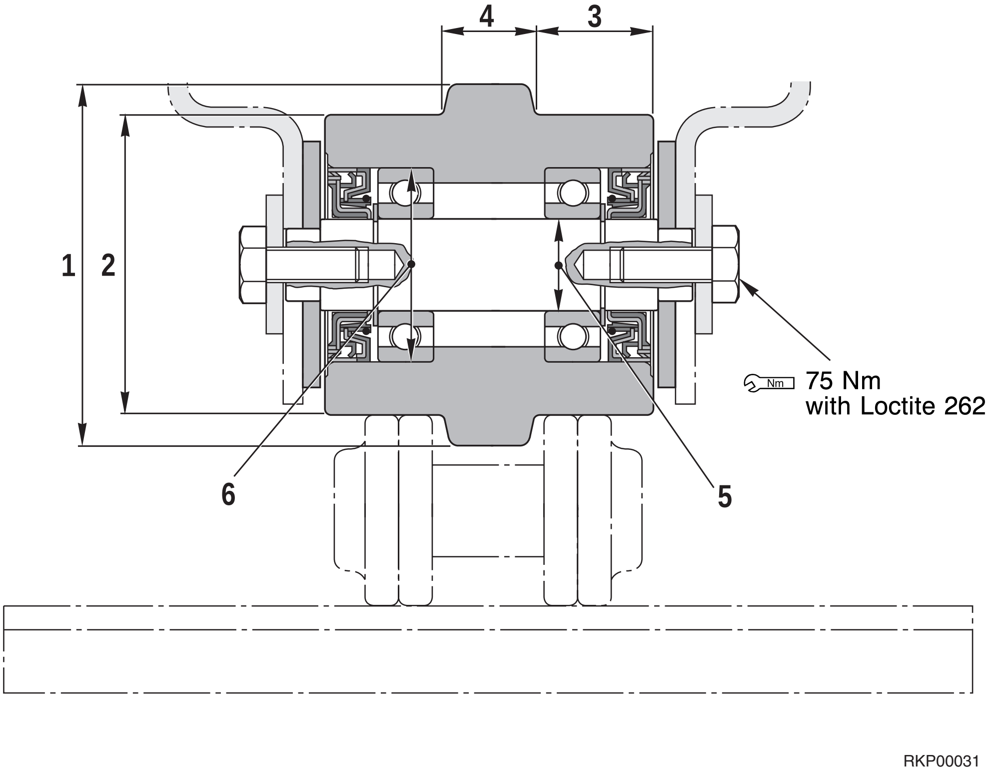
SPROCKET



Unit: mm

No.	Check item	Criteria			Remedy
1	Wear at roots of sprocket teeth	Standard size	Tolerance	Repair limit	Build up by solder or replace
		255	+1 −2	245	
2	Wear at tips of sprocket teeth	290	±1.5	278	
3	Face width at tips of sprocket teeth	17	—	12	
4	Face width at base of sprocket teeth	23	+1 −2	18	

TRACK ROLLER

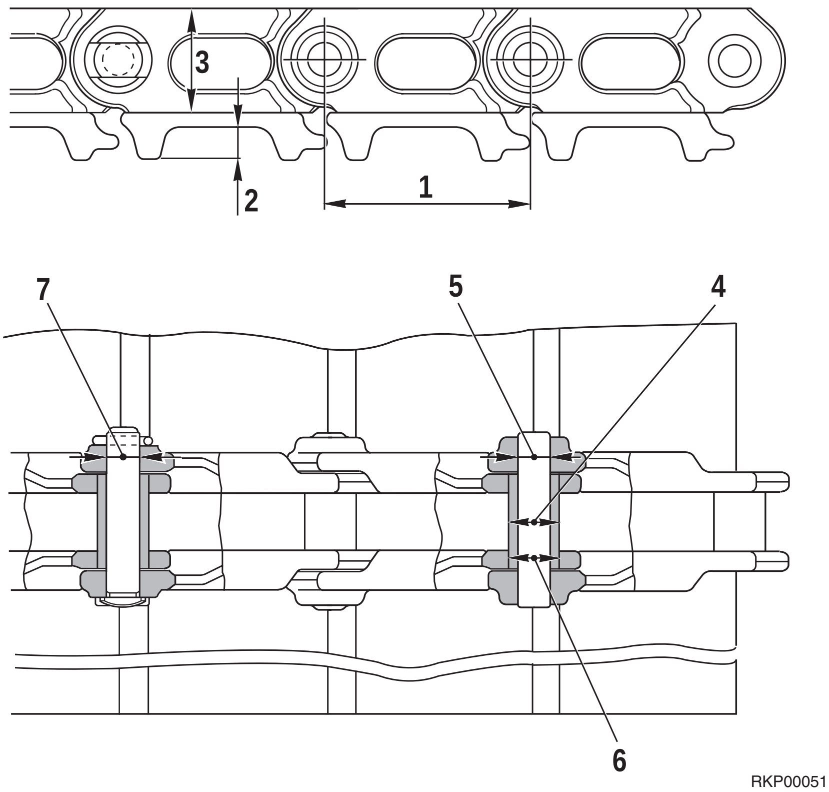


Unit: mm

No.	Check item	Criteria					Remedy
1	Outer diameter of thread	Standard size		Repair limit			Build up by solder or replace
		96		90			
2	Outer diameter of protusion	80		74			
3	Width of thread	31		34			
4	Width of protusion	26		23			
5	Clearance between shaft and bushing	Standard size	Tolerance		Standard interference	Interference limit	Replace
			Shaft	Hole			
		25	0 –0.021	–0.2 –0.4	0.179 – 0.4	—	
6	Interference between roller and bushing	35	+ 0.4 + 0.2	+ 0.039 0	0.161 – 0.4	—	

TRACK SHOE

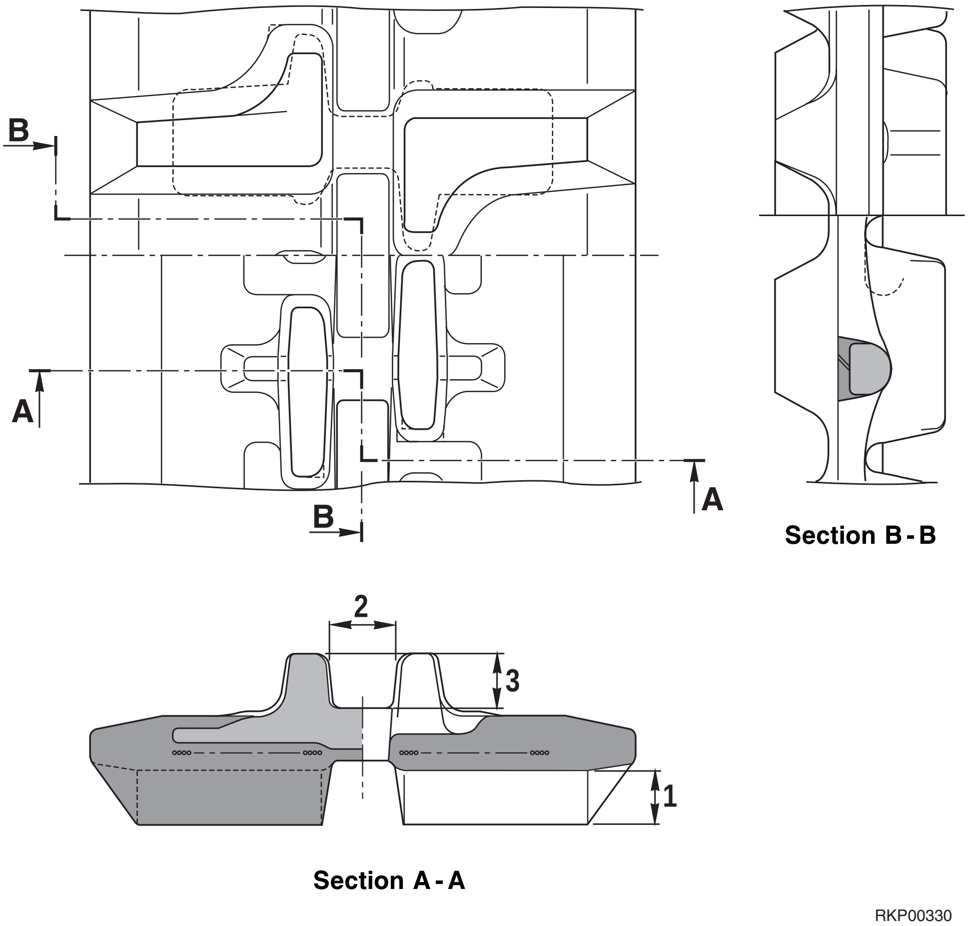
STEEL SHOE



Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Link pitch</td><td colspan="2">Standard size</td><td colspan="3">Repair limit</td><td rowspan="2">Replace pin and bushing or complete link</td></tr>
<tr><td colspan="2">90</td><td colspan="3">92</td></tr>
<tr><td>2</td><td>Grouser height</td><td colspan="2">15</td><td colspan="3">5</td><td rowspan="9">Replace</td></tr>
<tr><td>3</td><td>Link height</td><td colspan="2">46</td><td colspan="3">41</td></tr>
<tr><td>4</td><td>Outer diameter of bushing</td><td colspan="2">22</td><td colspan="3">18</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Interference between regular pin and link</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard interference</td><td rowspan="2">Interference limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>14</td><td>+0.155
+0.150</td><td>+0.050
0</td><td>0.100 –
0.104</td><td>—</td></tr>
<tr><td>6</td><td>Interference between bushing and link</td><td>22</td><td>+0.154
+0.150</td><td>+0.050
0</td><td>0.100 –
0.104</td><td>—</td></tr>
<tr><td rowspan="3">7</td><td rowspan="3">Interference between master pin and link</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>14</td><td>-0.020
-0.050</td><td>+0.050
0</td><td>0.020 –
0.100</td><td>0.8</td></tr>
</table>

RUBBER SHOE

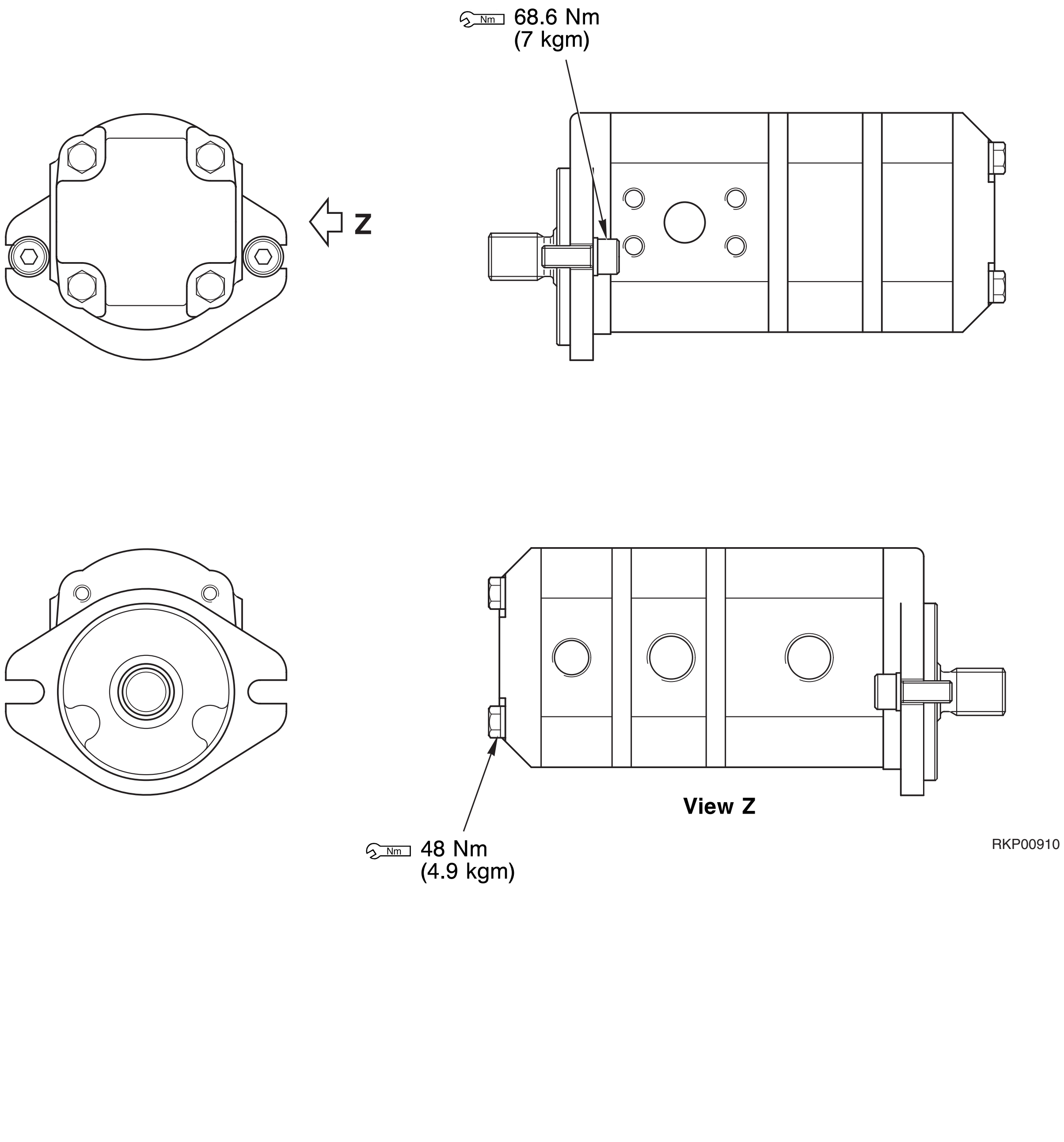


Unit: mm

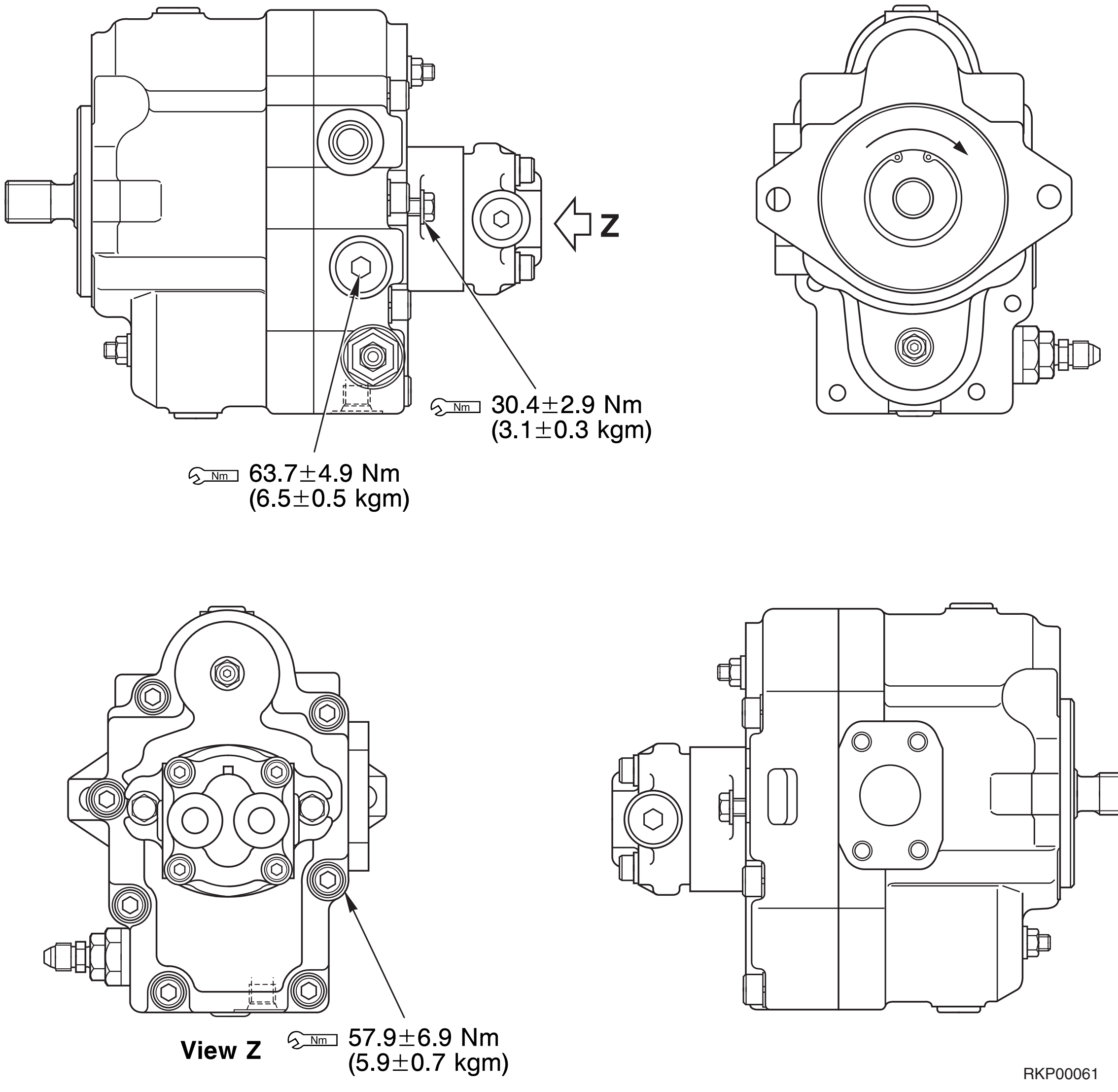
No.	Check item	Criteria			Remedy
1	Wear of lug height	Standard size		Repair limit	Replace
		23 (25)		5	
2	Widht of sprocket treads	30		33	
3	Wear of meshing portion of sprocket	Standard size	Tolerance	Repair limit	
		23	+1.5 0	27	

HYDRAULIC PUMP

PC12R-8

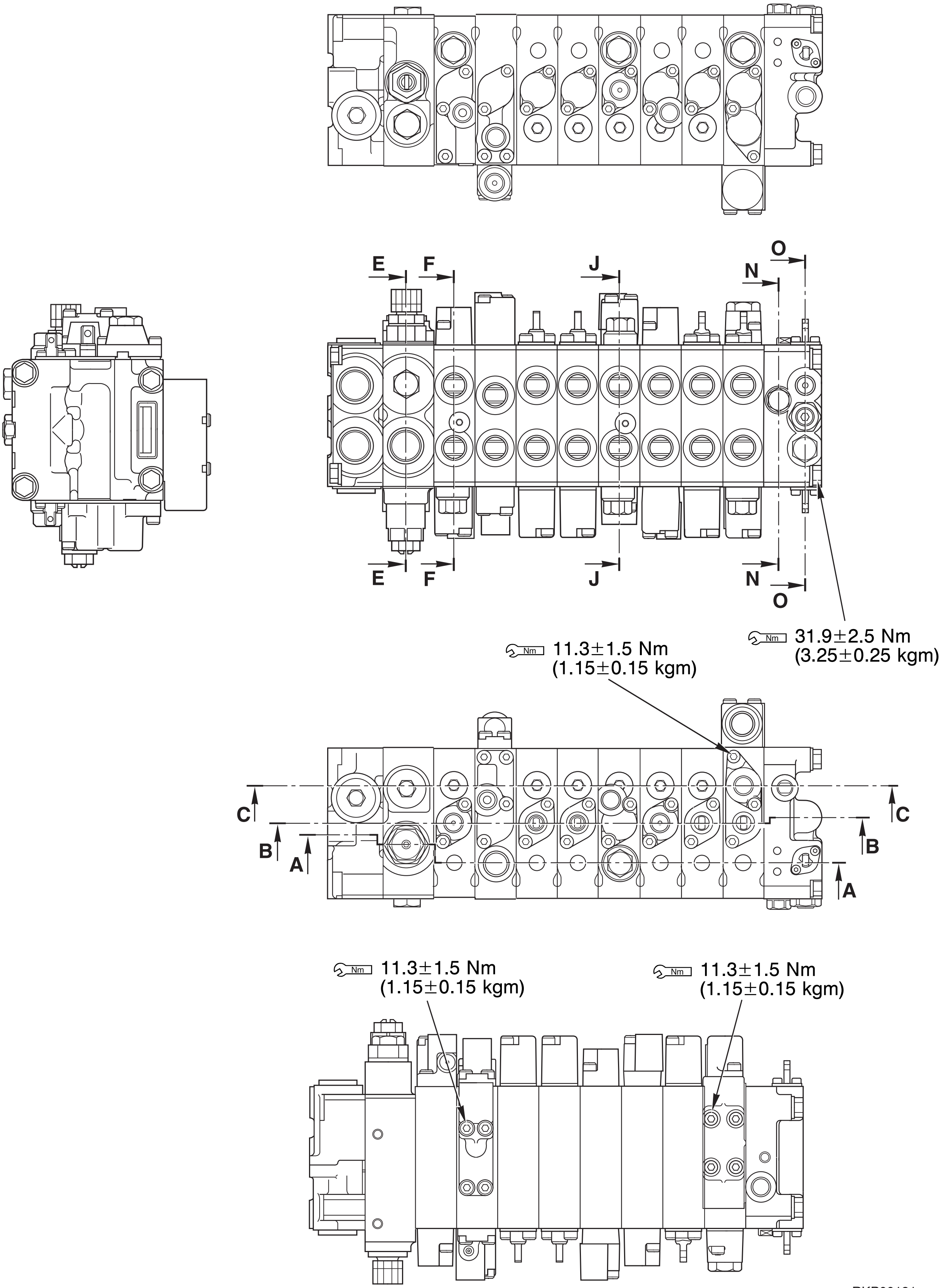


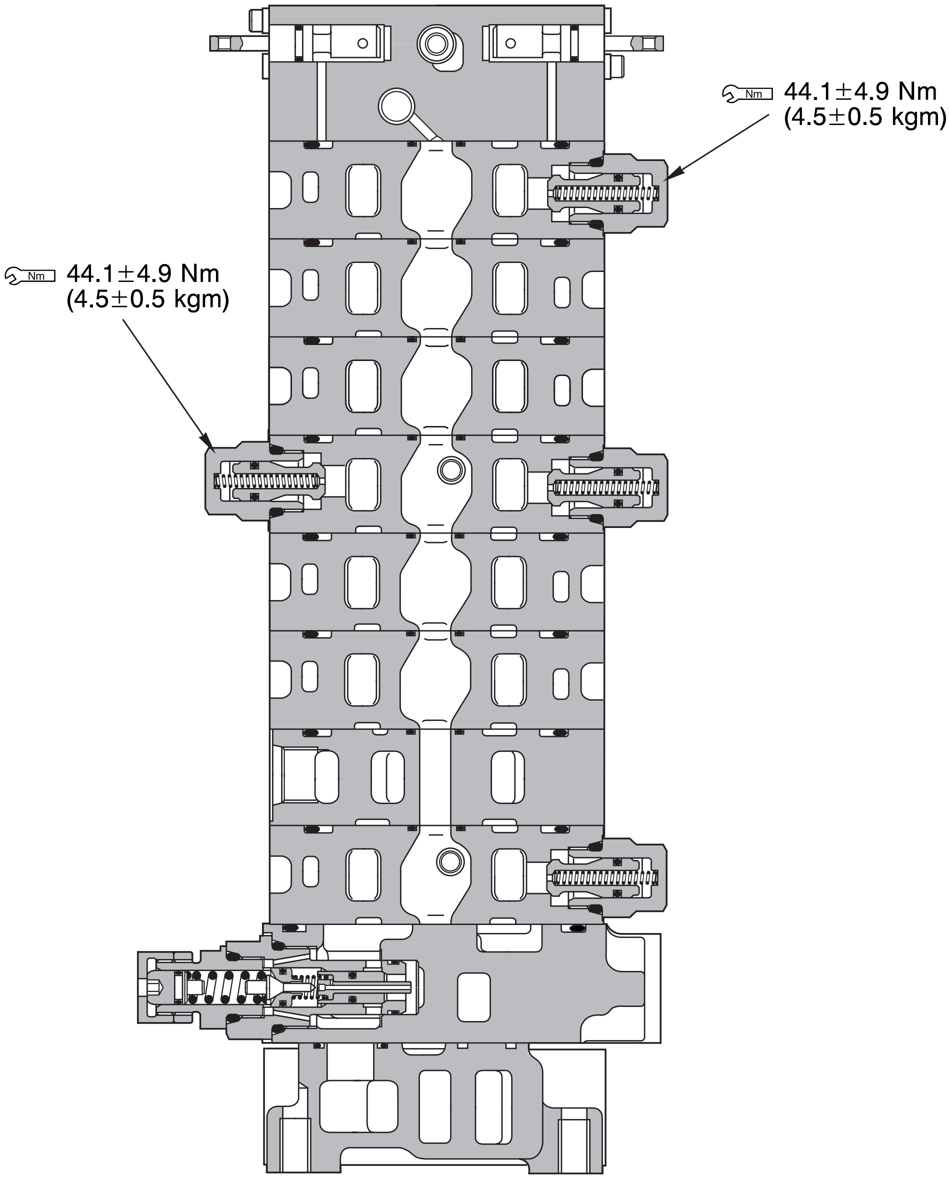
PC15R-8


Z
30.4±2.9 Nm
(3.1±0.3 kgm)
63.7±4.9 Nm
(6.5±0.5 kgm)
View Z
57.9±6.9 Nm
(5.9±0.7 kgm)
RKP00061

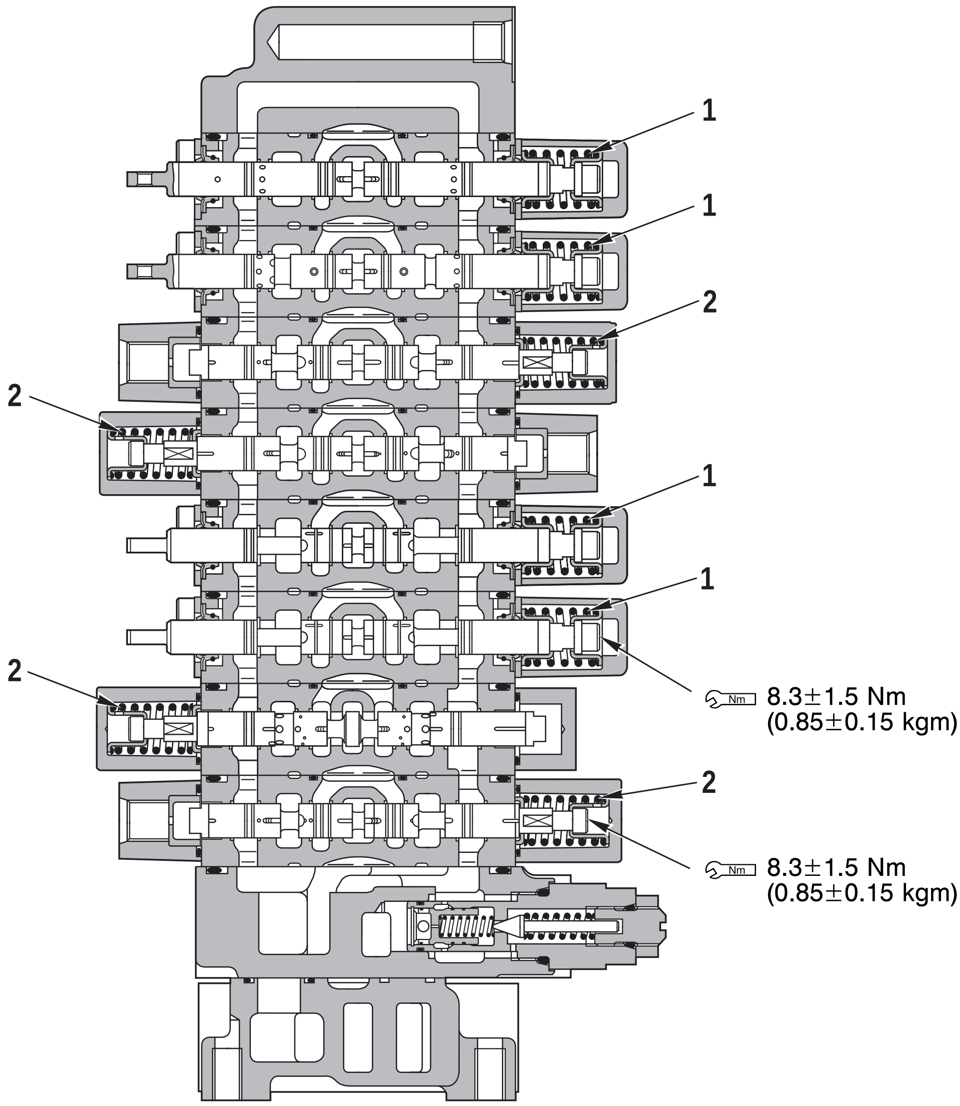
CONTROL VALVE

PC12R-8





Section A - A RKP00131

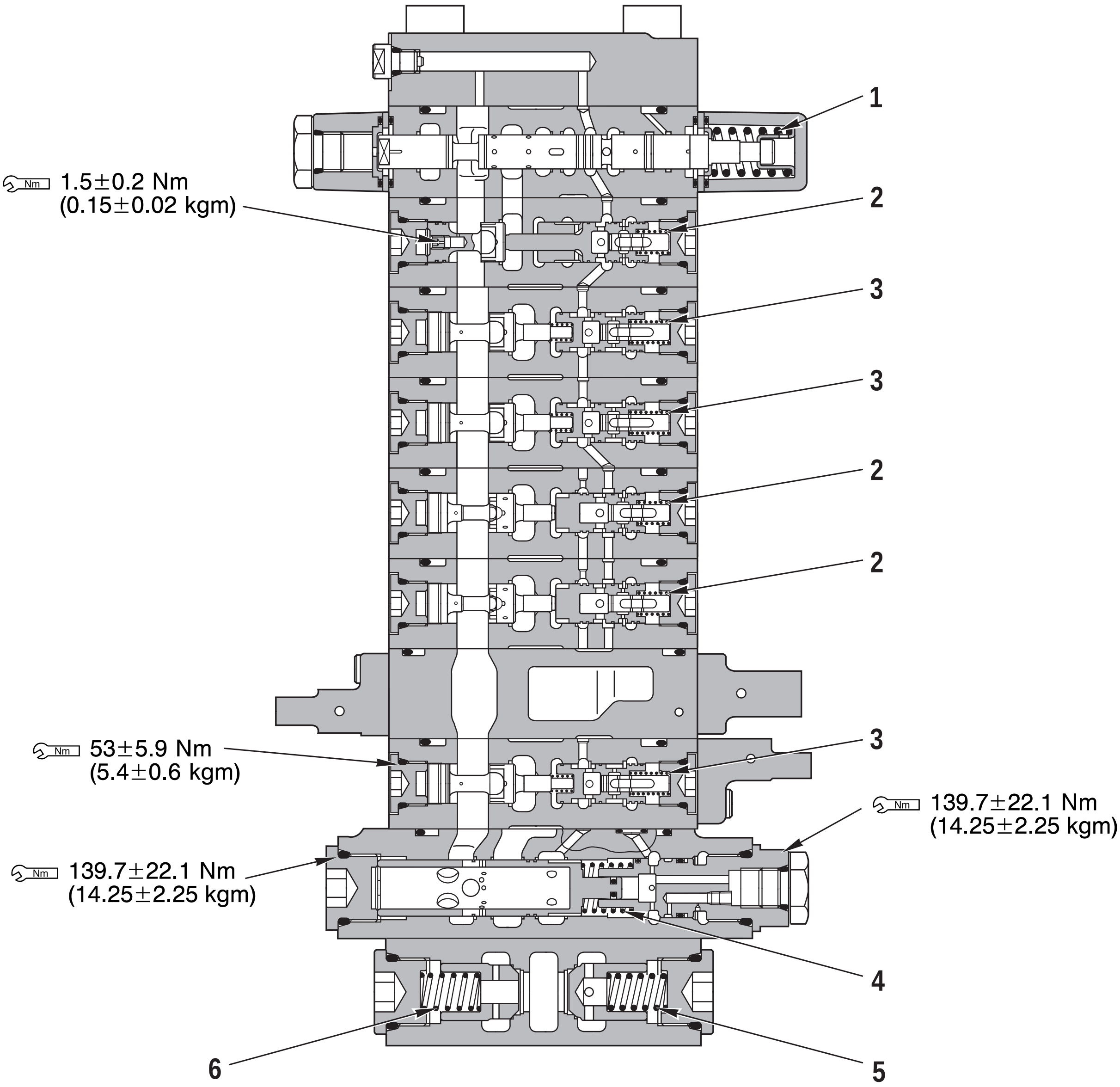


Section B - B

RKP00141

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Spool return spring (travel, blade, swing boom)	Free length x Ø.D.	Installed length	Installed load	Free length	Installed load	When damage or deformation is found, replace the spring
		46.2x20	25.4	98 N (10 kg)	—	78.4 N (8 kg)	
2	Spool return spring (arm, swing, boom, bucket)	29x17.5	28.5	22.6 N (2.3 kg)	—	18.1 N (1.84 kg)	

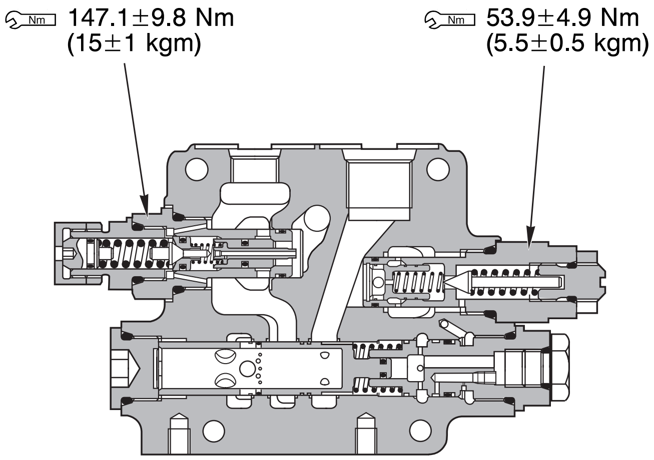


Section C-C

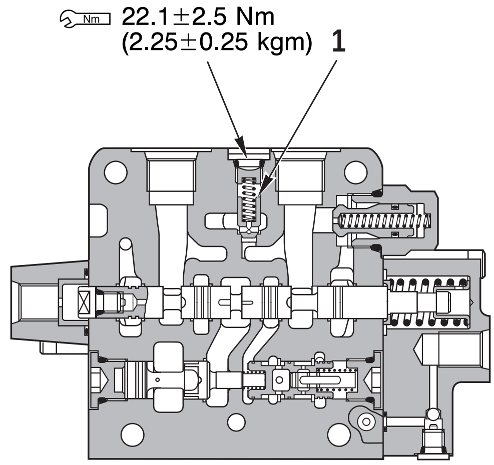
RKP00151

Unit: mm

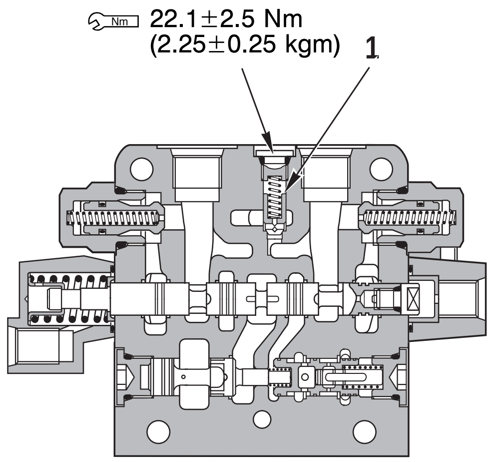
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x Ø.D.	Installed length	Installed load	Free length	Installed load	
1	Spool return spring (hammer)	29x17.5	28.5	22.6 N (2.3 kg)	—	18.1 N (1.84 kg)	When damage or deformation is found, replace the spring
2	Pressure compensation valve spring	20x8.4	12	6.86 N (0.7 kg)	—	5.49 N (0.56 kg)	
3	Pressure compensation valve spring	16.9x8.4	15	7.64 N (0.78 kg)	—	6.11 N (0.62 kg)	
4	Unload valve spring	38.5x17.7	18	28.8 N (2.94kg)	—	23.1 N (2.36 kg)	
5	Cooler check valve spring	27.2x13.2	21	78.8 N (8.04 kg)	—	63.0 N (6.43 kg)	
6	Back pressure check valve spring	29x13.3	21	15.3 N (1.56 kg)	—	12.2 N (1.25 kg)	



Section E - E



Section F - F

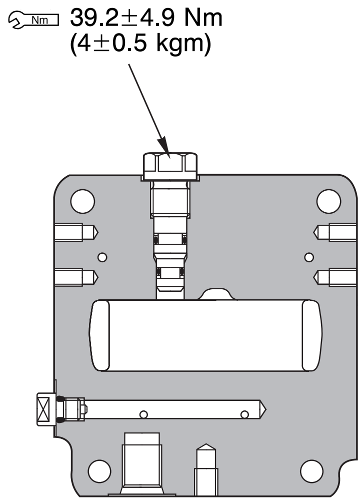


Section J - J

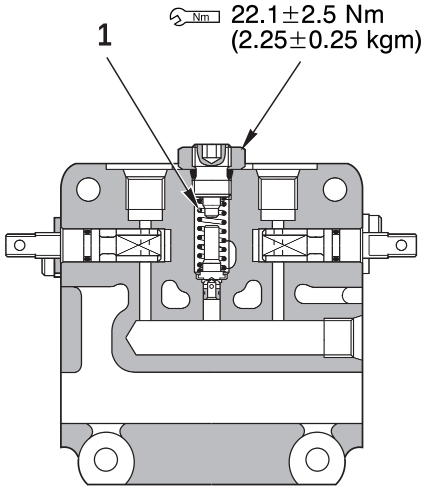
RKP00470

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Check valve spring (arm, boom)	Free length x Ø.D.	Installed length	Installed load	Free length	Installed load	When damage or deformation is found, replace the spring
		21.9x5	15.8	1.96 N (0.2 kg)	—	1.57 N (0.16 kg)	



Section N - N



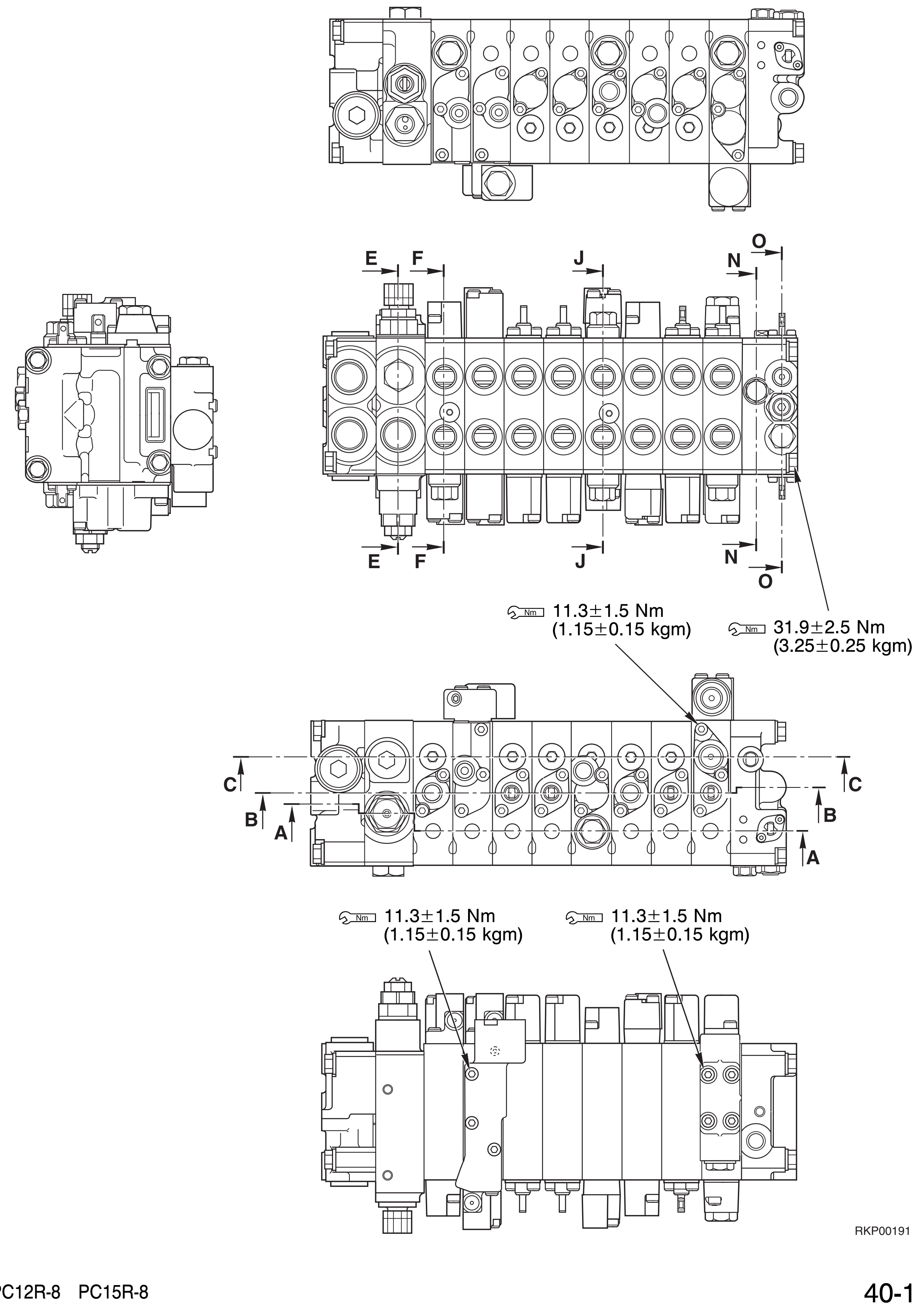
Section O - O

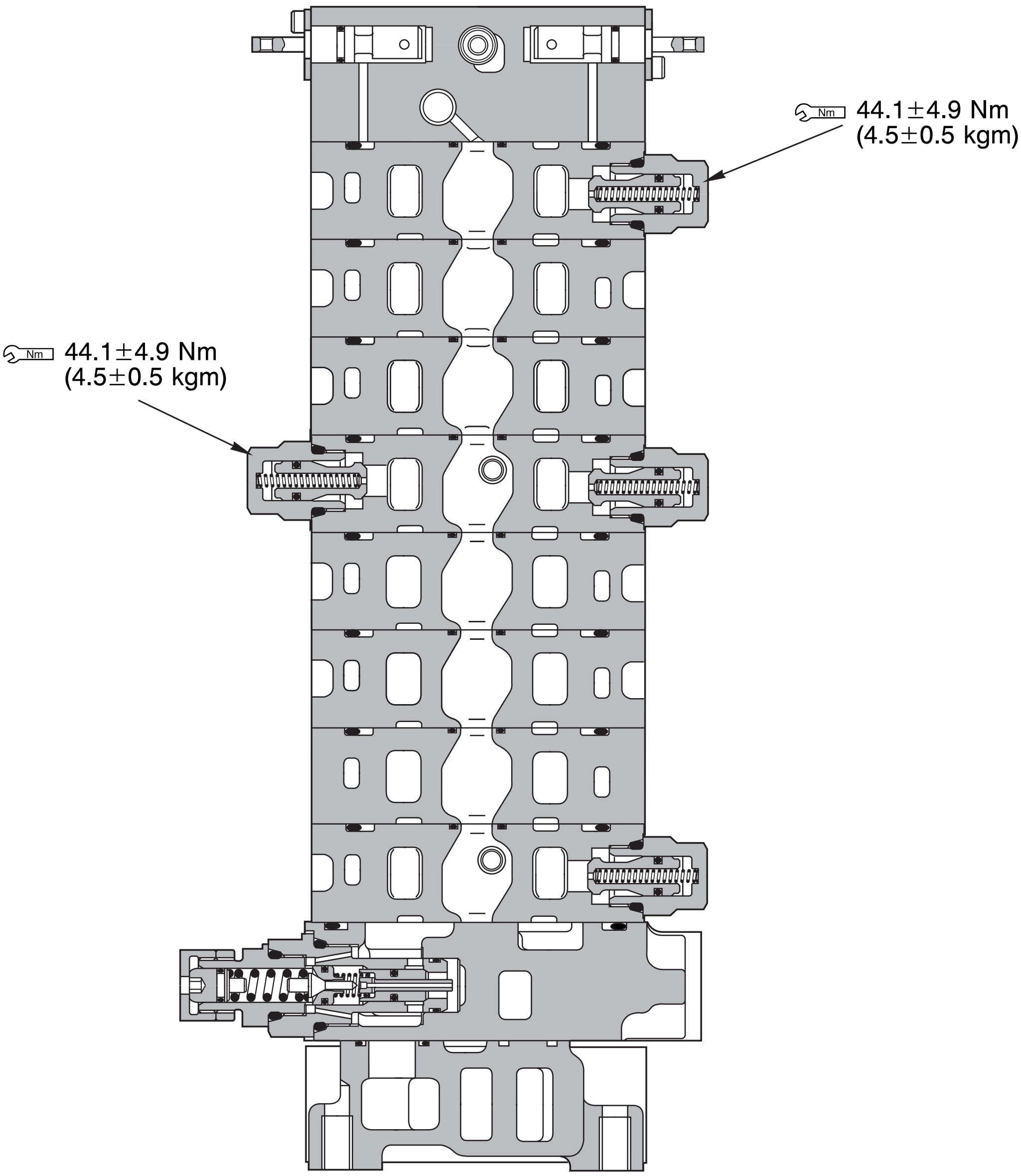
RKP00251

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x Ø.D.	Installed length	Installed load	Free length	Installed load	
1	Pilot relief valve spring	32.4x10.4	27	83.3 N (8.5 kg)	—	66.6 N (6.8 kg)	When damage or deformation is found, replace the spring

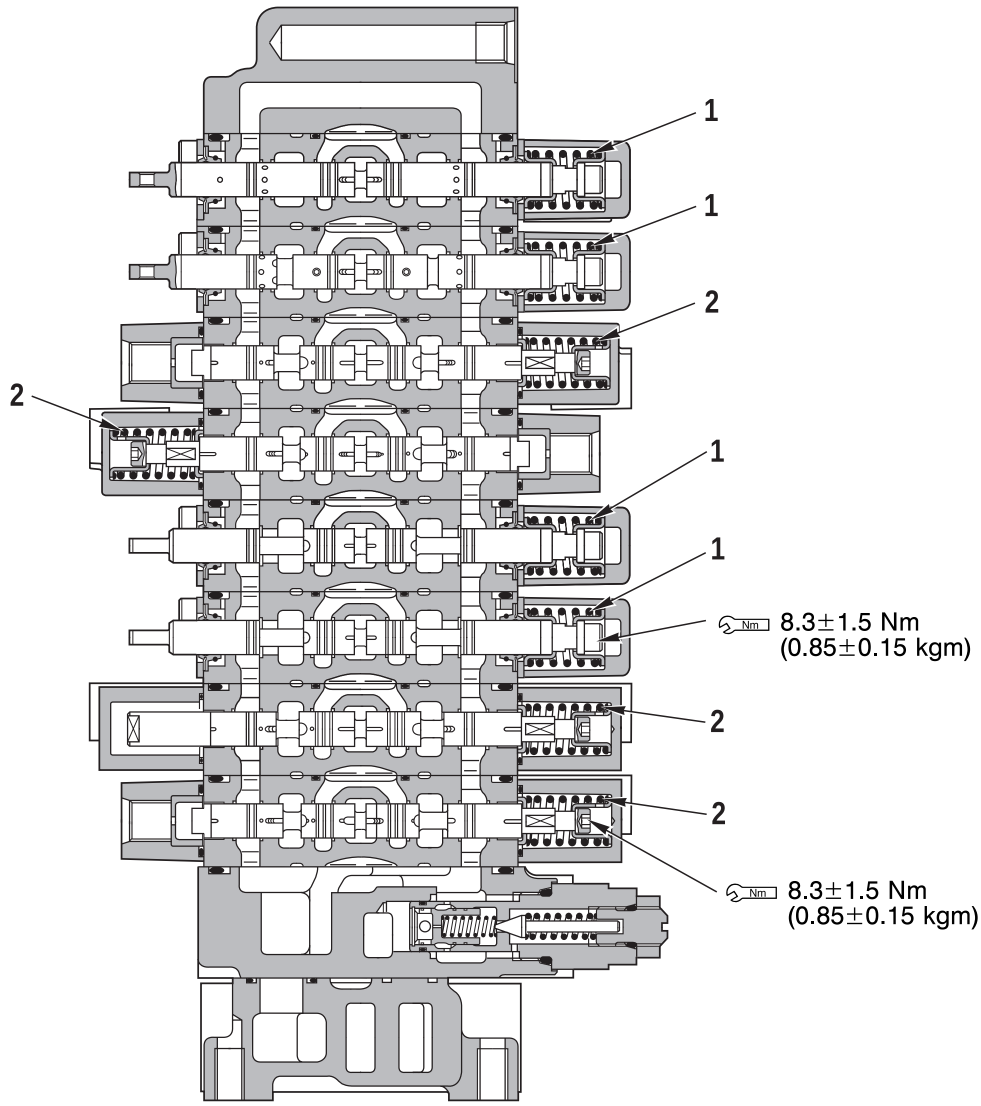
PC15R-8


E
F
J
N
O
11.3±1.5 Nm
(1.15±0.15 kgm)
31.9±2.5 Nm
(3.25±0.25 kgm)
C
B
A
11.3±1.5 Nm
(1.15±0.15 kgm)
11.3±1.5 Nm
(1.15±0.15 kgm)
RKP00191



Section A - A

RKP00201

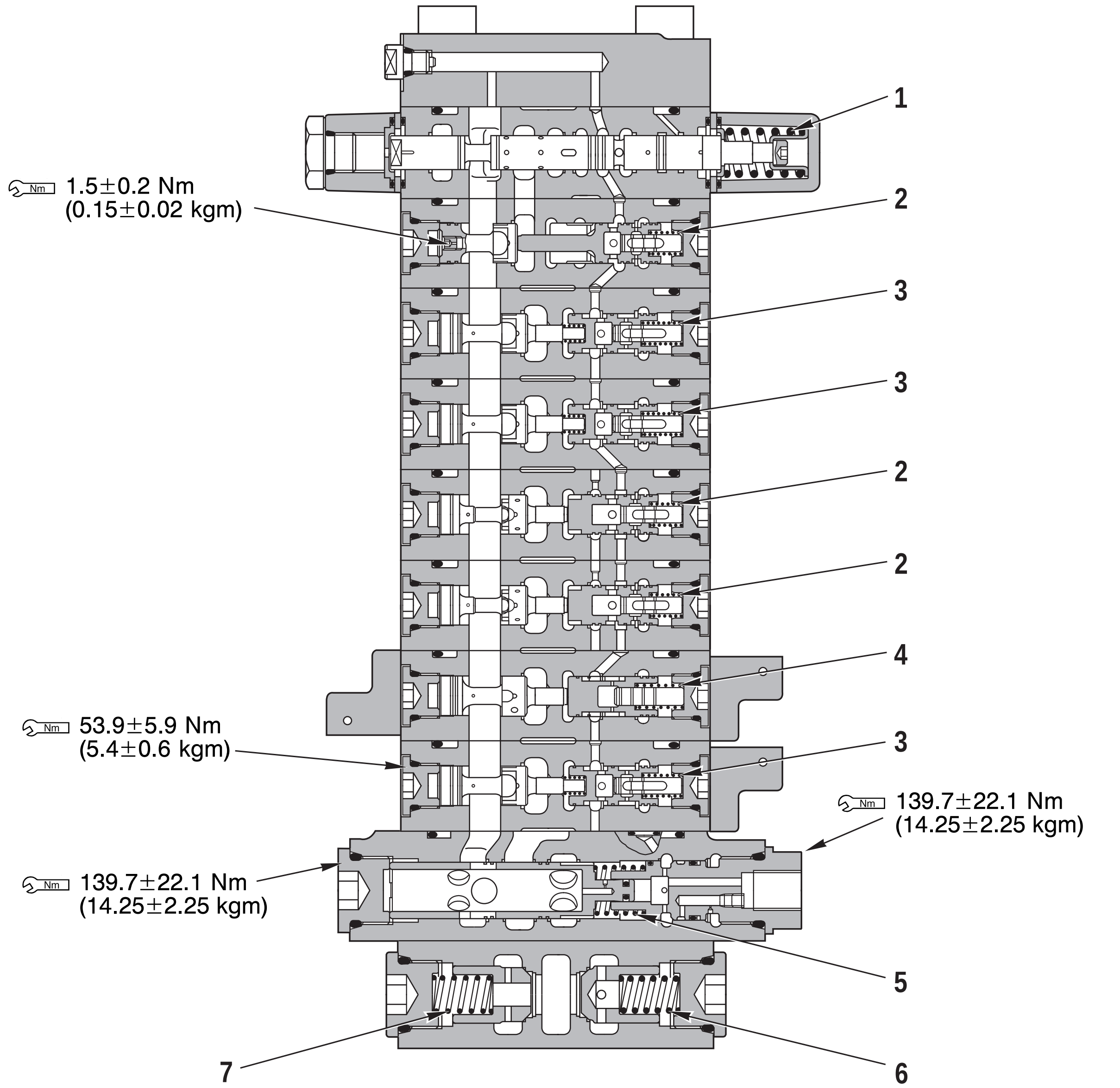


Section B - B

RKP00211

Unit: mm

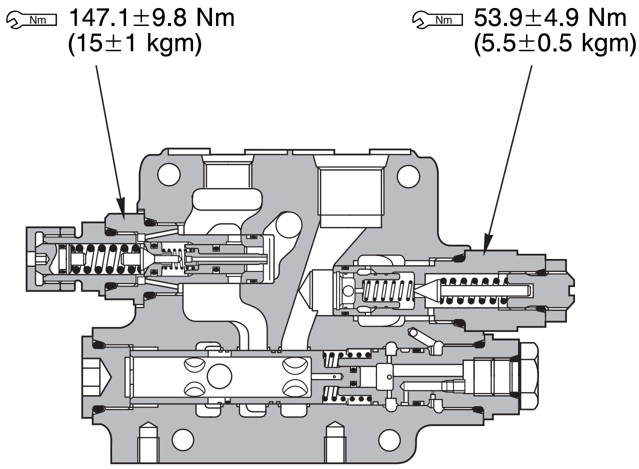
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Spool return spring (travel, blade, boom swing)	Free length x Ø.D.	Installed length	Installed load	Free length	Installed load	When damage or deformation is found, replace the spring
		46.2x20	25.4	98 N (10 kg)	—	78.4 N (8 kg)	
2	Spool return spring (arm, swing, boom, bucket)	29x17.5	28.5	22.6 N (2.3 kg)	—	18.1 N (1.84 kg)	



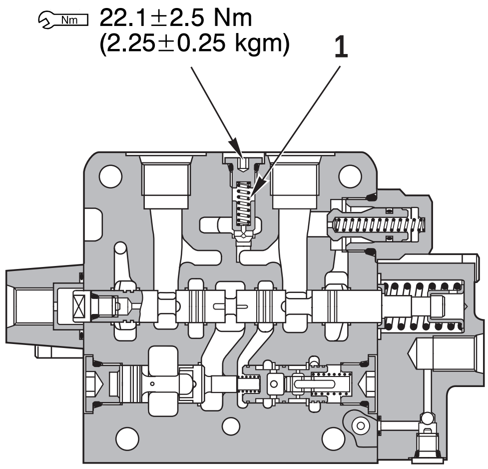
Section C - C

Unit: mm

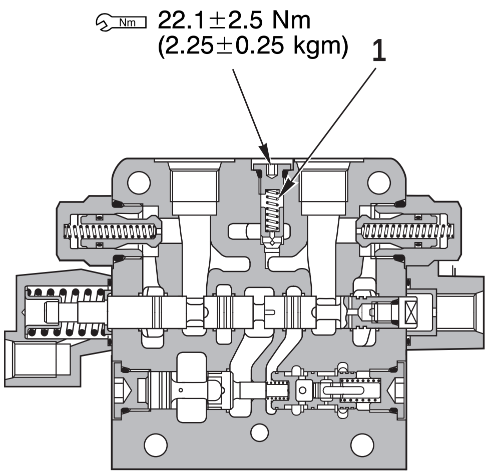
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x Ø.D.	Installed length	Installed load	Free length	Installed load	
1	Spool return spring (hammer)	29x17.5	28.5	22.6 N (2.3 kg)	—	18.1 N (1.84 kg)	When damage or deformation is found, replace the spring
2	Pressure compensation valve spring	20x8.4	12	6.86 N (0.7 kg)	—	5.49 N (0.56 kg)	
3	Pressure compensation valve spring	16.9x8.4	15	7.64 N (0.78 kg)	—	6.11 N (0.62 kg)	
4	Pressure compensation valve spring	23.61x8.4	17	30.5 N (3.11 kg)	—	24.4 N (2.49 kg)	
5	Unload valve spring	29.1x18.7	18	82.4 N (8.4 kg)	—	65.9 N (6.7 kg)	
6	Cooler check valve spring	27.2x13.2	21	78.8 N (8.04 kg)	—	63.0 N (6.43 kg)	
7	Back pressure check valve spring	29x13.3	21	15.3 N (1.56 kg)	—	12.2 N (1.25 kg)	



Section E - E



Section F - F

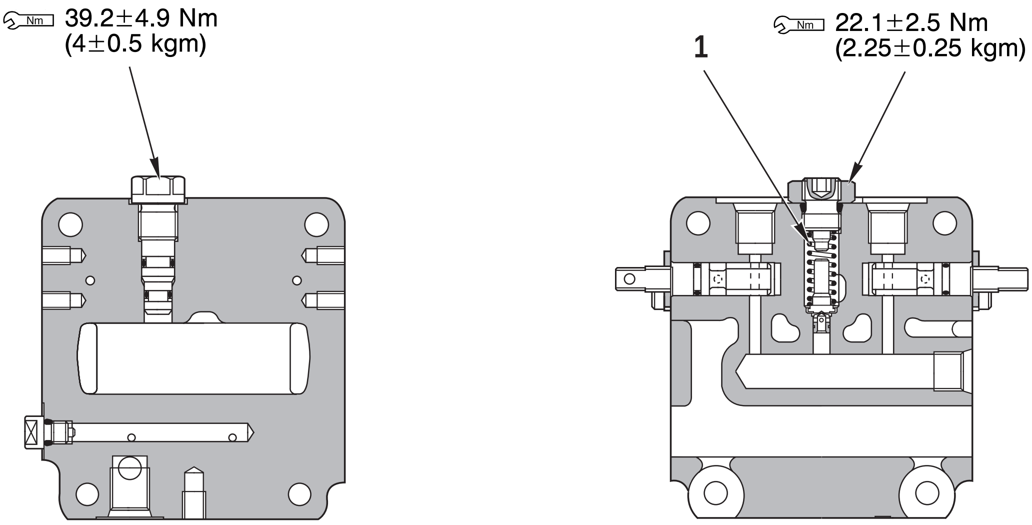


Section J - J

RKP00490

Unit: mm

No.	Check item	Criteria					Remedy
1	Check valve spring (arm, boom)	Standard size			Repair limit		When damage or deformation is found, replace the spring
		Free length x Ø.D.	Installed length	Installed load	Free length	Installed load	
		21.9x5	15.8	1.96 N (0.2 kg)	—	1.57 N (0.16 kg)	



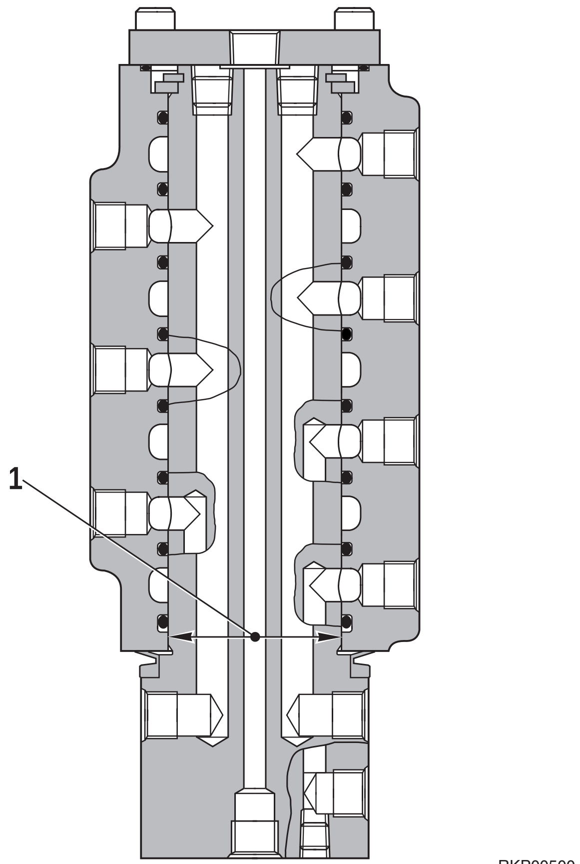
Section N - N　　**Section O - O**

RKP00480

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x Ø.D.	Installed length	Installed load	Free length	Installed load	
1	Pilot relief valve spring	32.4x10.4	27	83.3 N (8.5 kg)	—	66.6 N (6.8 kg)	When damage or deformation is found, replace the spring

SWIVEL JOINT

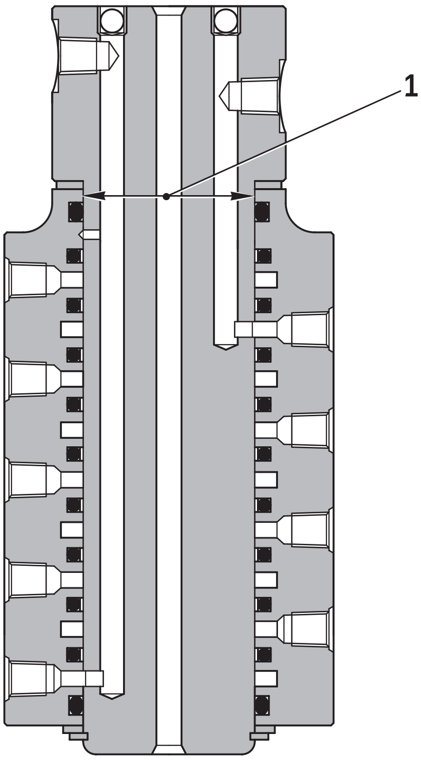


Unit: mm

No.	Check item	Criteria			Remedy
1	Clearance between rotor and shaft	Standard size	Standard clearance	Clearance limit	Replace
		45	0.055 – 0.085	0.090	

SWIVEL JOINT

For variable gauge undercarriage

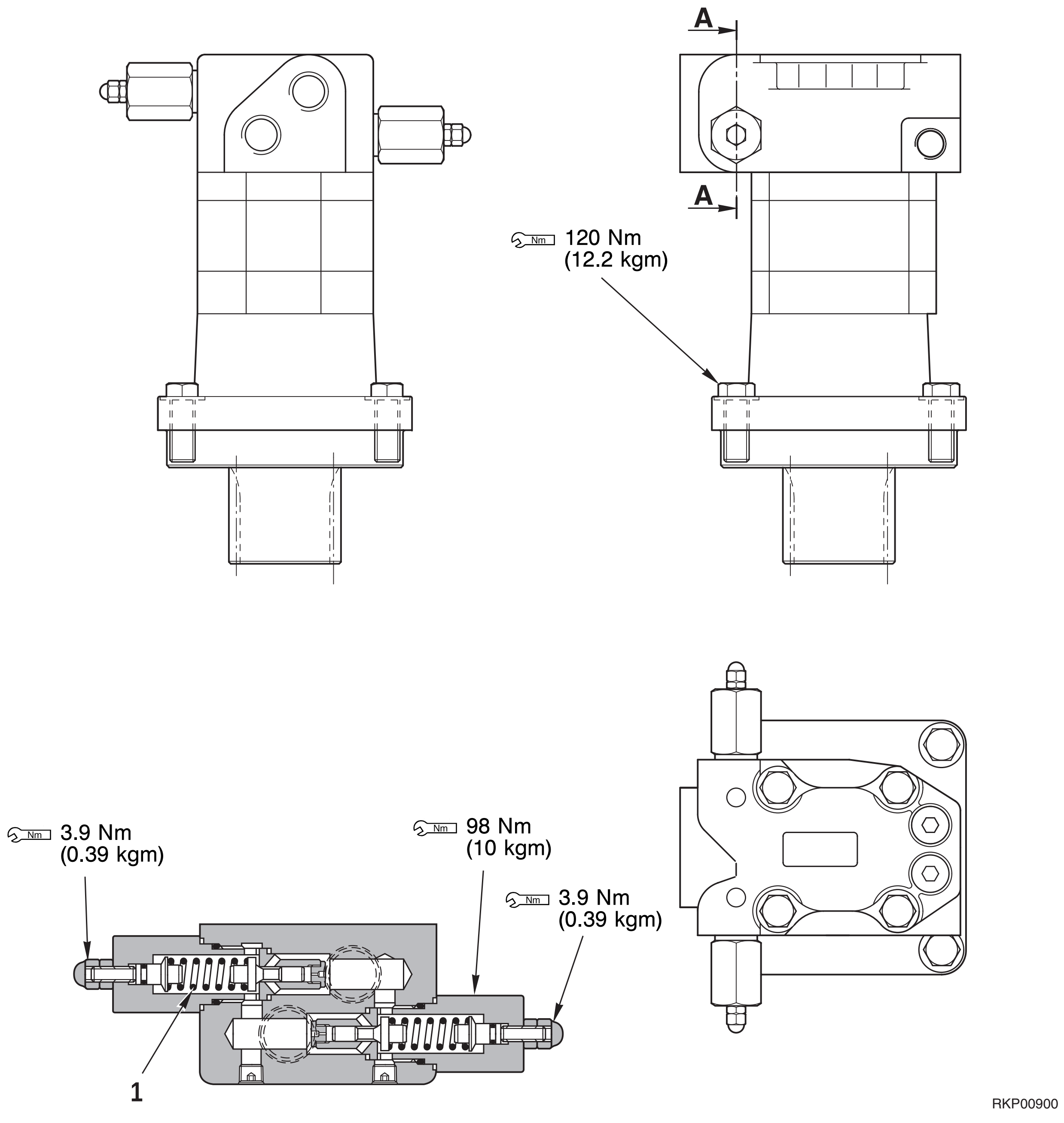


RKP11331

Unit: mm

No.	Check item	Criteria			Remedy
1	Clearance between rotor and shaft	Standard size	Standard clearance	Clearance limit	Replace
		60	–	–	

SWING MOTOR



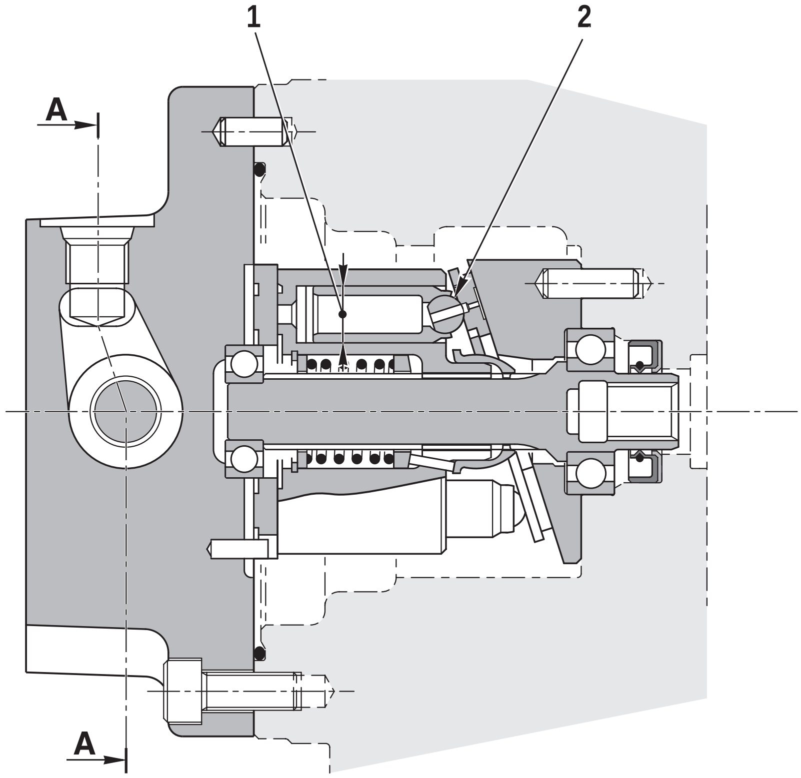
Section A - A

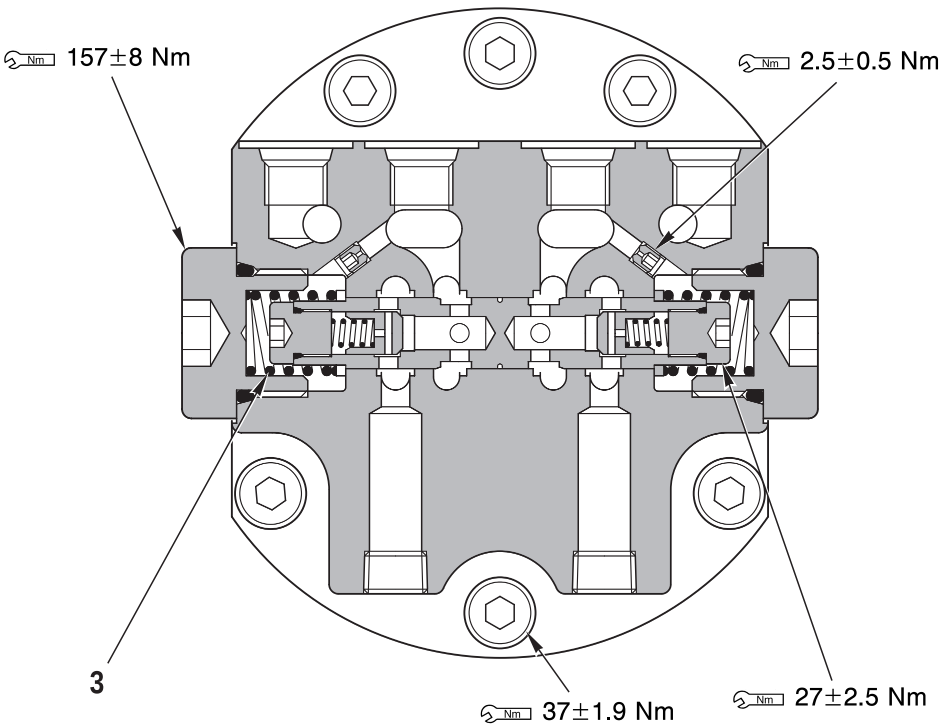
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Suction valve spring	Free length x Ø.D.	Installed length	Installed load	Free length	Installed load	When damage or deformation is found, replace the spring
		36.1x14.2	32.9	332 N	31.9	429 N	

TRAVEL MOTOR

PC12R-8





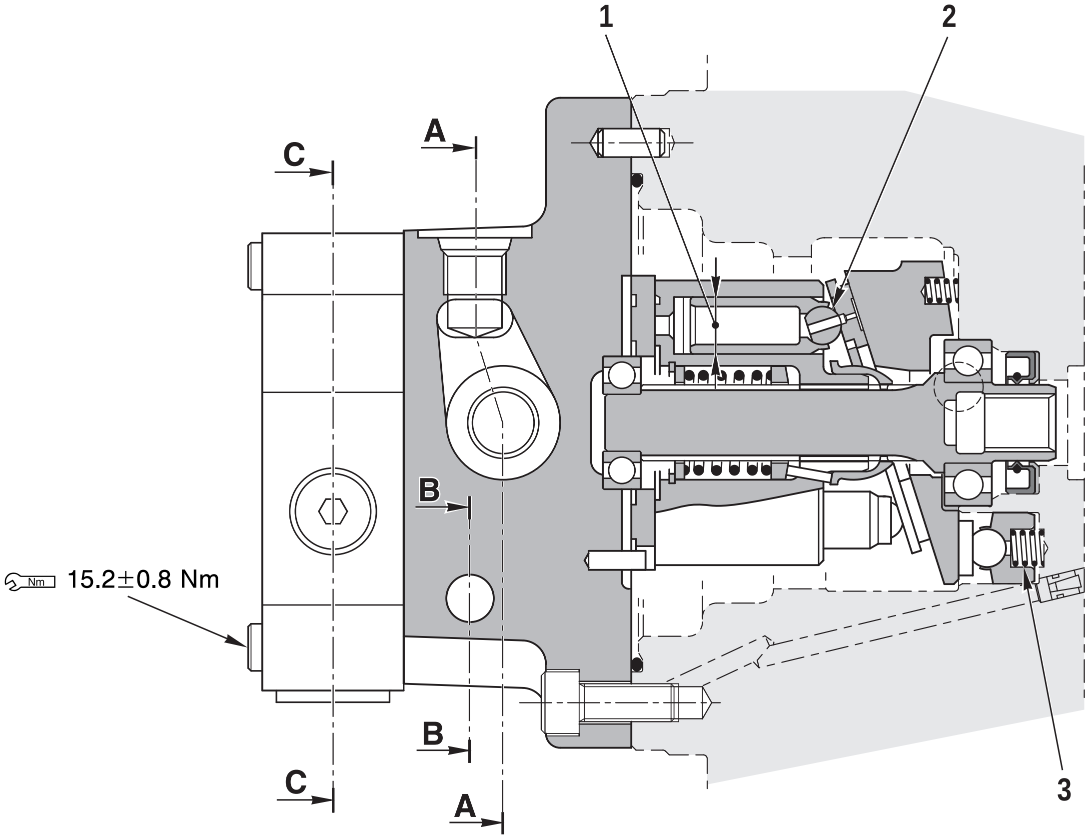
Section A - A

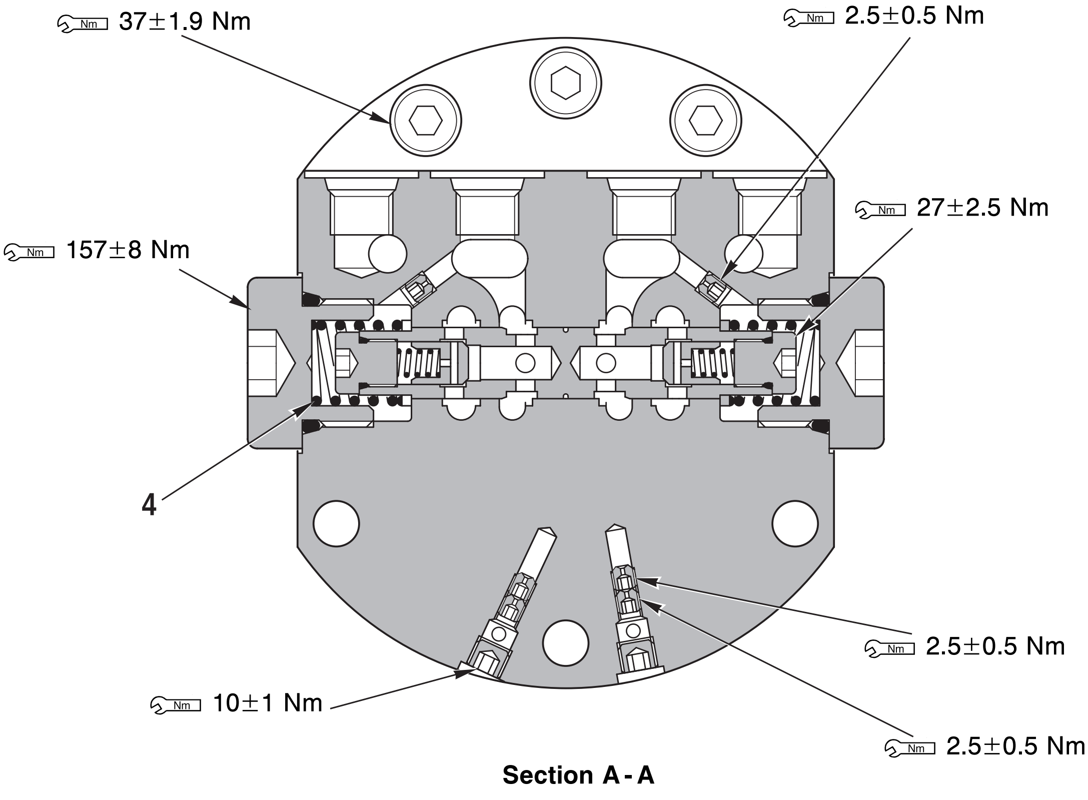
RKP00891

Unit: mm

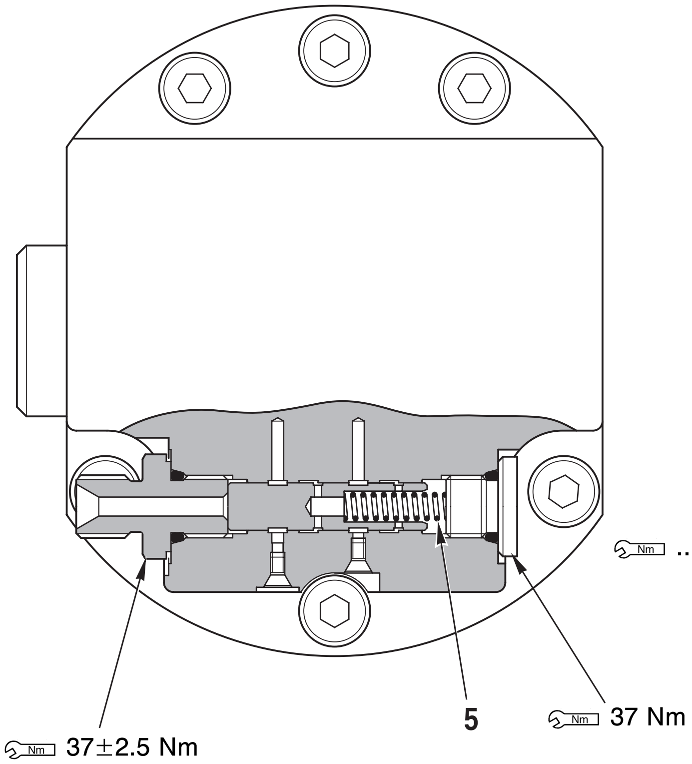
<table>
<tr><th>No.</th><th>Check item</th><th colspan="10">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Clearance between piston and cylinder</td><td colspan="5">Standard clearance</td><td colspan="5">Clearance limit</td><td rowspan="3">Replace</td></tr>
<tr><td colspan="5">0.009–0.014</td><td colspan="5">0.04</td></tr>
<tr><td>2</td><td>Clearance between shoe and piston</td><td colspan="5">0.03–0.15</td><td colspan="5">0.4</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Cylinder block spring</td><td colspan="6">Standard size</td><td colspan="4">Repair limit</td><td rowspan="3">When damage or deformation is found, replace the spring</td></tr>
<tr><td colspan="2">Free length</td><td colspan="2">Installed length</td><td colspan="2">Installed load</td><td colspan="2">Free length</td><td colspan="2">Installed load</td></tr>
<tr><td colspan="2">26</td><td colspan="2">19</td><td colspan="2">72.4N</td><td colspan="2">24.6</td><td colspan="2">58N</td></tr>
</table>

PC12R-8 MISTRAL
PC12R-8 MISTRAL HS
PC15R-8
PC15R-8 HS

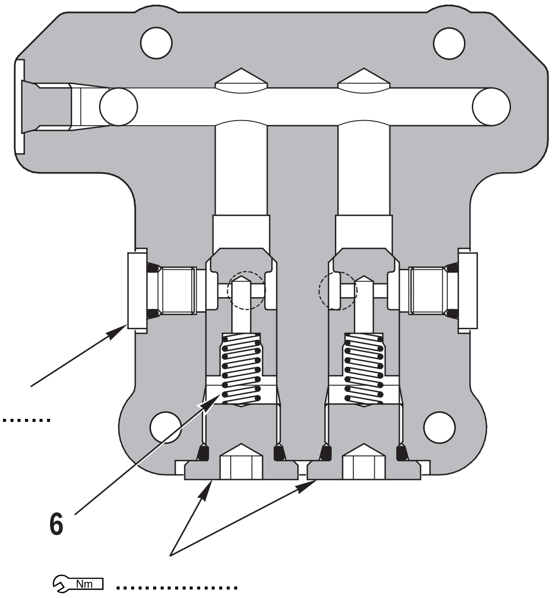




Section A - A



Section B - B



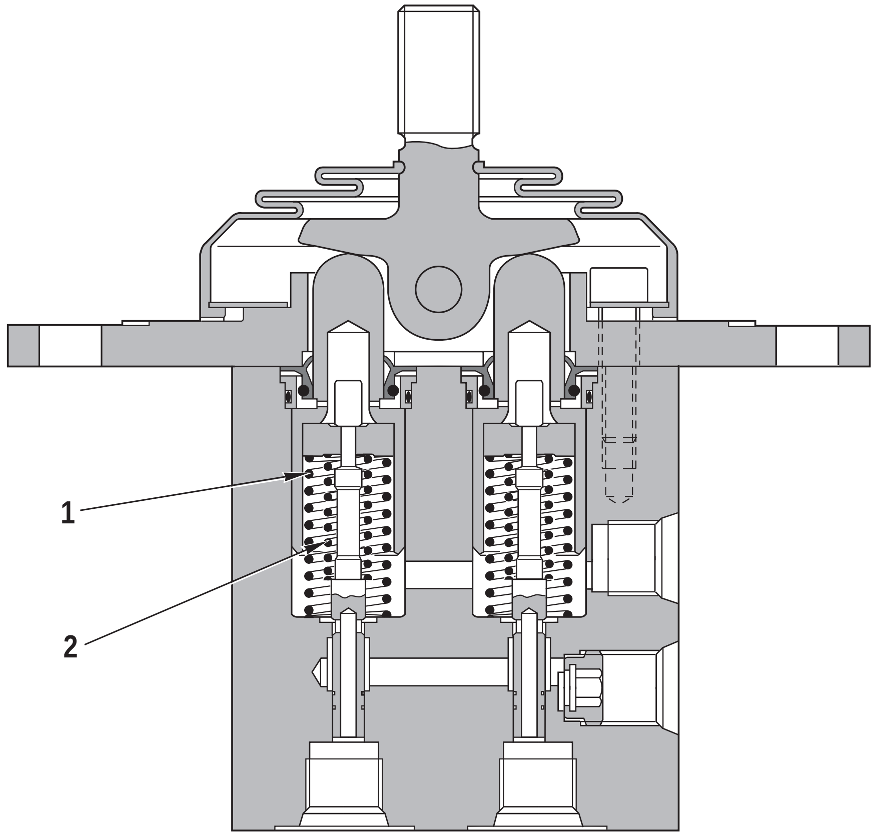
Section C - C

RKP00883

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between piston and cylinder	Standard clearance			Clearance limit		Replace
		0.009–0.014			0.04		
		0.009–0.014			0.04		
2	Clearance between shoe and piston	0.03–0.15			0.4		
3	Travel increment piston spring	Standard size			Repair limit		When damage or deformation is found, replace the spring
		Free length	Installed length	Installed load kg/cm^2	Free length	Installed load kg/cm^2	
		17.8	12.3	6.85N	16.7	5.5N	
4	Braking valve return spring	26.4	19.0	52.2N	24.9	41.8N	
5	Travel increment spool return spring	25.4	20.5	33.4N	24.4	26.7N	
6	Check valve spring						

HAMMER



RKP01710

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Centering spring	Free length x Ø.D.	Installed length	Installed load	Free length	Installed load	Replace
		33.9x15.3	28.4	124.5 N (12.7 kg)	—	100.0 N (10.2 kg)	
2	Metering spring	22.7x8.1	22.0	16.7 N (1.7 kg)	—	13.7 N (1.4 kg)	

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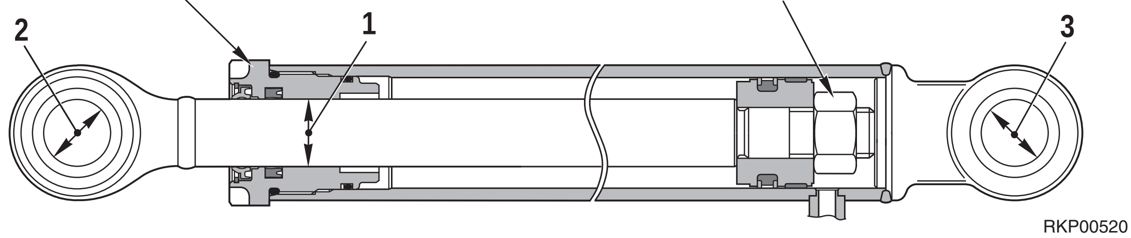
CYLINDERS

PC12R-8

Nm	Boom:	412±41.2 Nm
	Arm:	392±39.2 Nm
	Bucket:	392±39.2 Nm
	Boom swing:	441±44.1 Nm
	Blade:	441±44.1 Nm
	Variable gauge undercarriage:	392±39 Nm

Nm	Boom:	245±24.5 Nm (Wrench size: 30 mm)
	Arm:	324±32.4 Nm (Wrench size: 32 mm)
	Bucket:	324±32.4 Nm (Wrench size: 32 mm)
	Boom swing:	343±34.3 Nm (Wrench size: 32 mm)
	Blade:	324±32.4 Nm (Wrench size: 32 mm)
	Variable gauge undercarriage:	539±54 Nm (Wrench size: 32 mm)



Unit: mm

No.	Check item	Cylinder	Standard size	Tolerance: Shaft	Tolerance: Hole	Standard clearance	Repair limit	Remedy
1	Clearance between piston rod and cylinder	Boom	30	–0.020 –0.072	+0.033 0	0.020– 0.105	0.405	Replace cylinder head
		Arm	30	–0.020 –0.072	+0.033 0	0.020– 0.105	0.405	
		Bucket	30	–0.020 –0.072	+0.033 0	0.020– 0.105	0.405	
		Boom swing	30	–0.020 –0.072	+0.033 0	0.020– 0.105	0.405	
		Blade	30	–0.020 –0.072	+0.033 0	0.020– 0.105	0.405	
		Variable undercarriage	30	–0.020 –0.072	+0.033 0	0.020– 0.105	0.405	
2	Clearance between cylinder head bushing and pin	Boom	35	—	+0.134 +0.072	—	0.1	Replace bushing
		Arm	30	—	+0.099 +0.040	—	0.1	
		Bucket	30	—	+0.099 +0.040	—	0.1	
		Boom swing	30	—	+0.099 +0.040	—	0.1	
		Blade	35	—	+0.134 +0.072	—	0.1	
		Variable undercarriage	30	—	+0.099 +0.040	—	0.1	
3	Clearance between cylinder bottom bushing and pin	Boom	35	—	+0.134 +0.072	—	0.1	
		Arm	30	—	+0.099 +0.040	—	0.1	
		Bucket	30	—	+0.099 +0.040	—	0.1	
		Boom swing	30	—	+0.099 +0.040	—	0.1	
		Blade	35	—	+0.134 +0.072	—	0.1	
		Variable undercarriage	30	—	+0.099 +0.040	—	0.1	

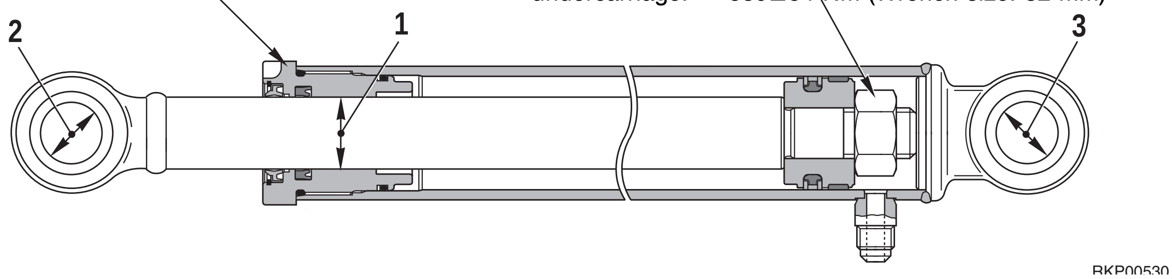
CYLINDERS

PC15R-8

Boom: 441±44.1 Nm
Arm: 412±41.2 Nm
Bucket: 392±39.2 Nm
Boom swing: 441±44.1 Nm
Blade: 539±53.9 Nm
Variable gauge undercarriage: 392±39 Nm

Loctite 262

Boom: 324±32.4 Nm (Wrench size: 32 mm)
Arm: 412±41.2 Nm (Wrench size: 32 mm)
Bucket: 324±32.4 Nm (Wrench size: 32 mm)
Boom swing: 324±32.4 Nm (Wrench size: 32 mm)
Blade: 618±61.8 Nm (Wrench size: 41 mm)
Variable gauge undercarriage: 539±54 Nm (Wrench size: 32 mm)

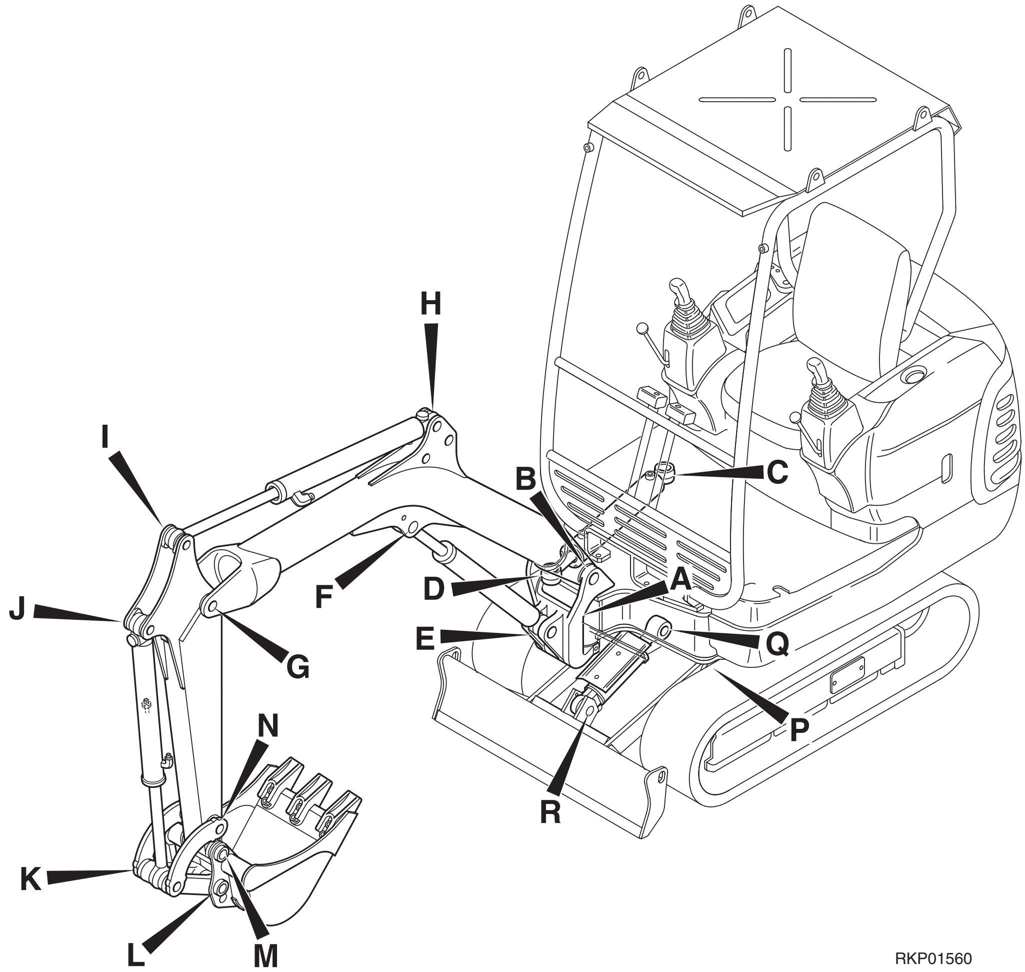


Unit: mm

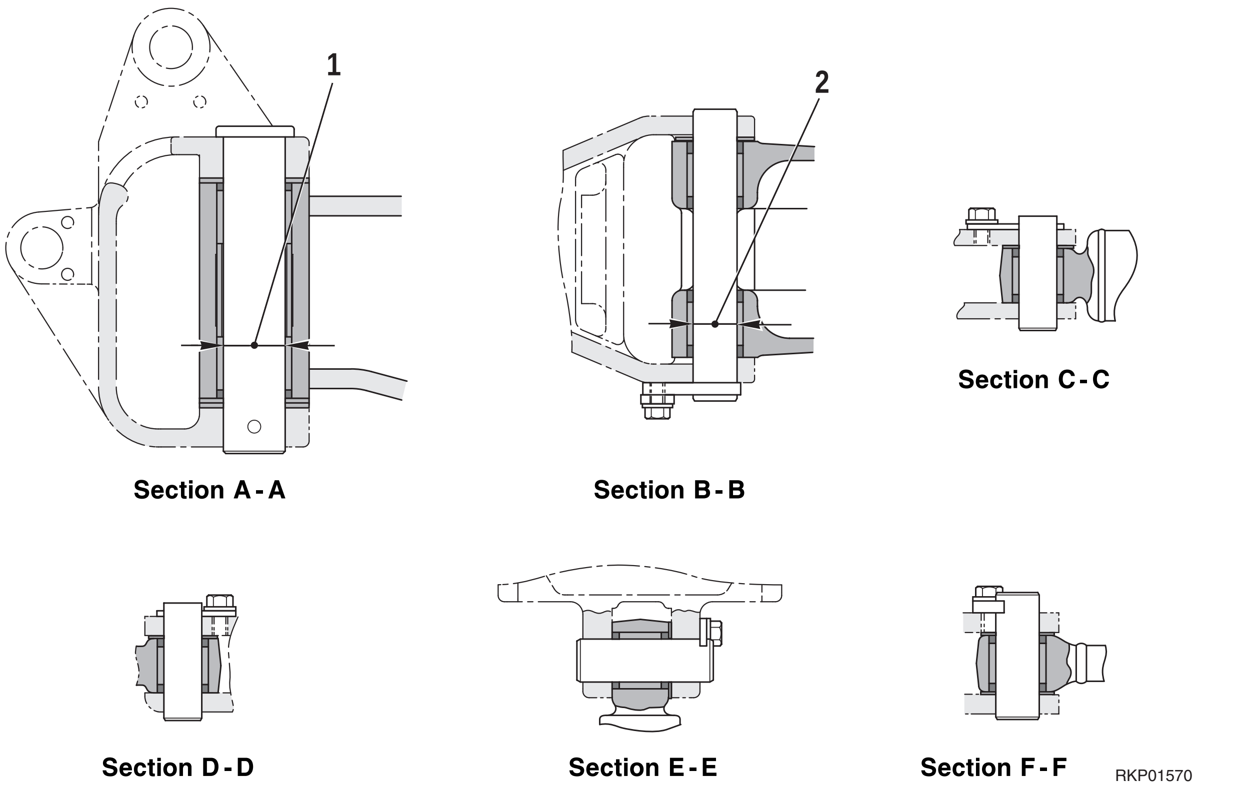
No.	Check item	Cylinder	Standard size	Tolerance: Shaft	Tolerance: Hole	Standard clearance	Repair limit	Remedy
1	Clearance between piston rod and cylinder	Boom	35	–0.025 –0.087	+0.039 0	0.025– 0.126	0.426	Replace cylinder head
		Arm	35	–0.025 –0.087	+0.039 0	0.025– 0.126	0.426	
		Bucket	30	–0.020 –0.072	+0.033 0	0.020– 0.105	0.405	
		Boom swing	30	–0.020 –0.072	+0.033 0	0.020– 0.105	0.405	
		Blade	35	–0.025 –0.087	+0.039 0	0.025– 0.126	0.426	
		Variable undercarriage	30	–0.020 –0.072	+0.033 0	0.020– 0.105	0.405	
2	Clearance between cylinder head bushing and pin	Boom	35	—	+0.134 +0.072	—	0.1	Replace bushing
		Arm	30	—	+0.099 +0.040	—	0.1	
		Bucket	30	—	+0.099 +0.040	—	0.1	
		Boom swing	30	—	+0.099 +0.040	—	0.1	
		Blade	35	—	+0.134 +0.072	—	0.1	
		Variable undercarriage	30	—	+0.099 +0.040	—	0.1	
3	Clearance between cylinder bottom bushing and pin	Boom	35	—	+0.134 +0.072	—	0.1	
		Arm	30	—	+0.099 +0.040	—	0.1	
		Bucket	30	—	+0.099 +0.040	—	0.1	
		Boom swing	30	—	+0.099 +0.040	—	0.1	
		Blade	35	—	+0.134 +0.072	—	0.1	
		Variable undercarriage	30	—	+0.099 +0.040	—	0.1	

WORK EQUIPMENT

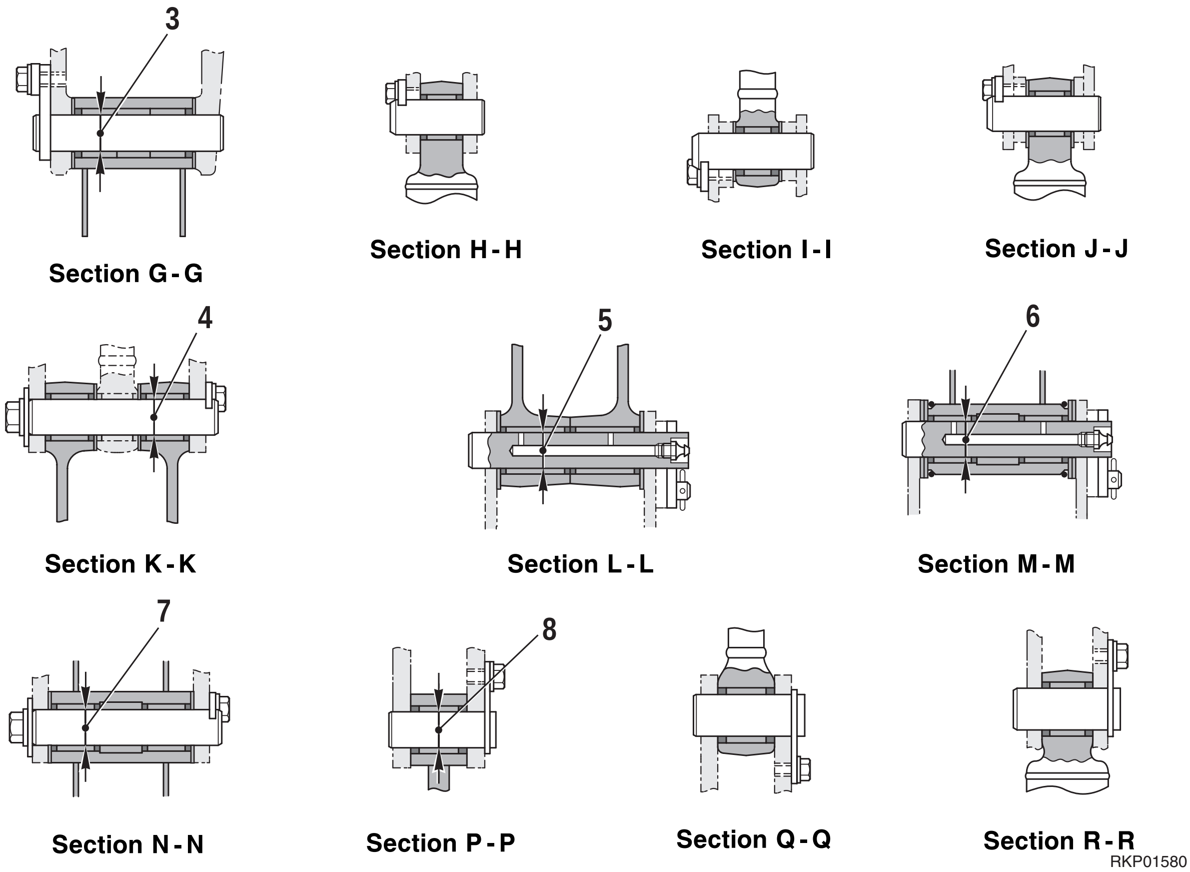
PC12R-8



RKP01560



RKP01570

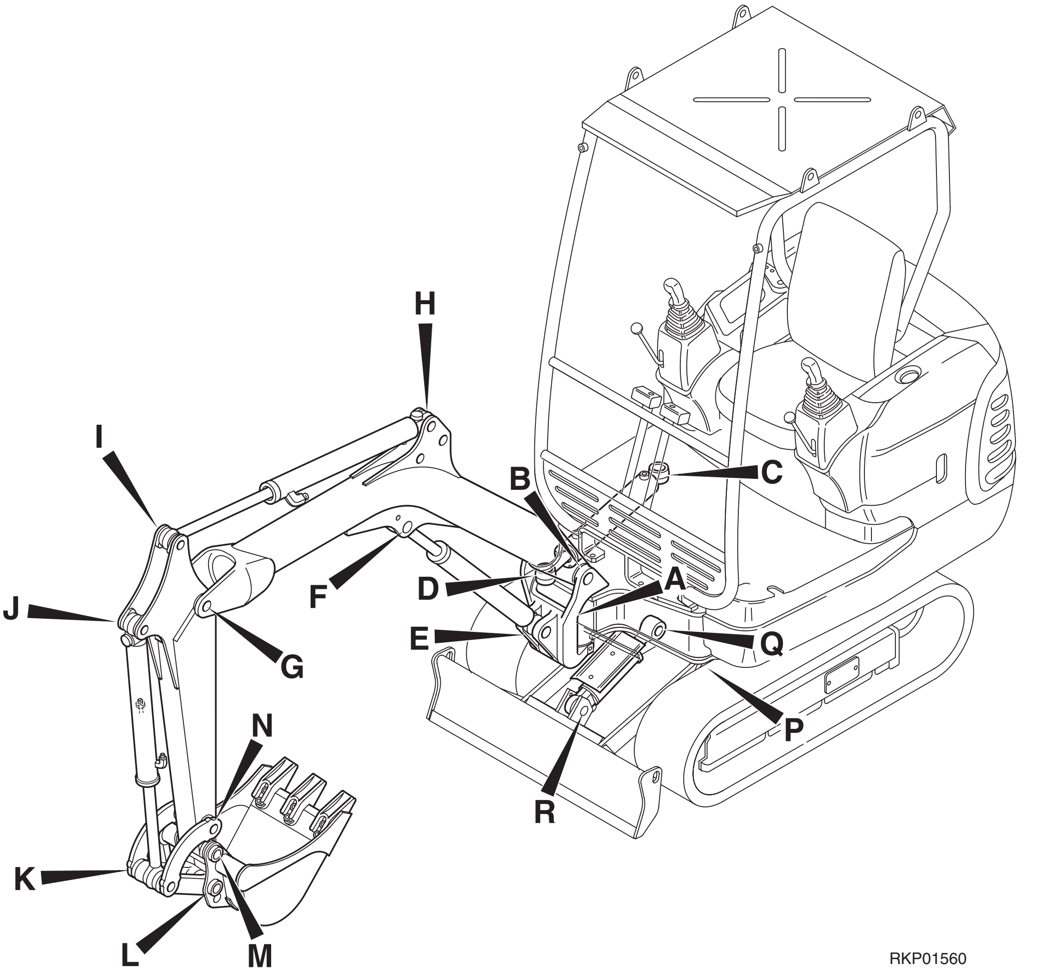


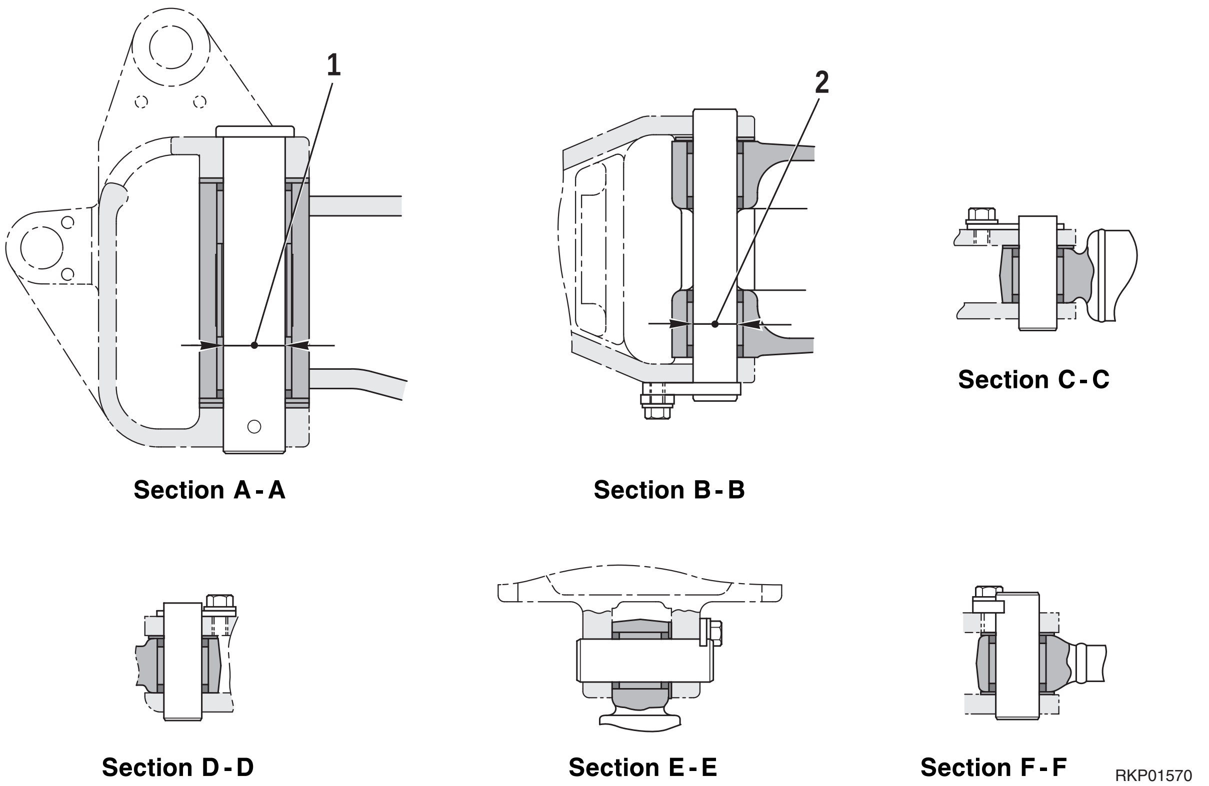
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Repair limit	
			Shaft	Hole			
1	Clearance between bushing and mounting pin of boom swing bracket and revolving frame	50	–0.010 –0.050	+ 0.230 + 0.060	0.070÷ 0.280	1.0	Replace
2	Clearance between bushing and mounting pin of boom swing bracket and boom	35	–0.010 –0.050	+ 0.134 + 0.072	0.082÷ 0.184	1.0	
3	Clearance between bushing and mounting pin of arm and boom	30	–0.010 –0.050	+ 0.134 + 0.072	0.082÷ 0.184	1.0	
4	Clearance between bushing and mounting pin of link and link	30	–0.010 –0.050	+ 0.134 + 0.072	0.082÷ 0.184	1.0	
5	Clearance between bushing and mounting pin of bucket and link	30	–0.090 –0.130	+ 0.117 + 0.080	0.170÷ 0.247	1.0	
6	Clearance between bushing and mounting pin of bucket and link	30	–0.010 –0.050	+ 0.134 + 0.072	0.082÷ 0.184	1.0	
7	Clearance between bushing and mounting pin of bucket and arm	30	–0.090 –0.130	+ 0.117 + 0.080	0.170÷ 0.247	1.0	
8	Clearance between bushing and mounting pin of track frame and blade	30	–0.090 –0.130	+ 0.135 + 0.064	0.154÷ 0.265	1.0	

WORK EQUIPMENT

PC15R-8





Section A - A

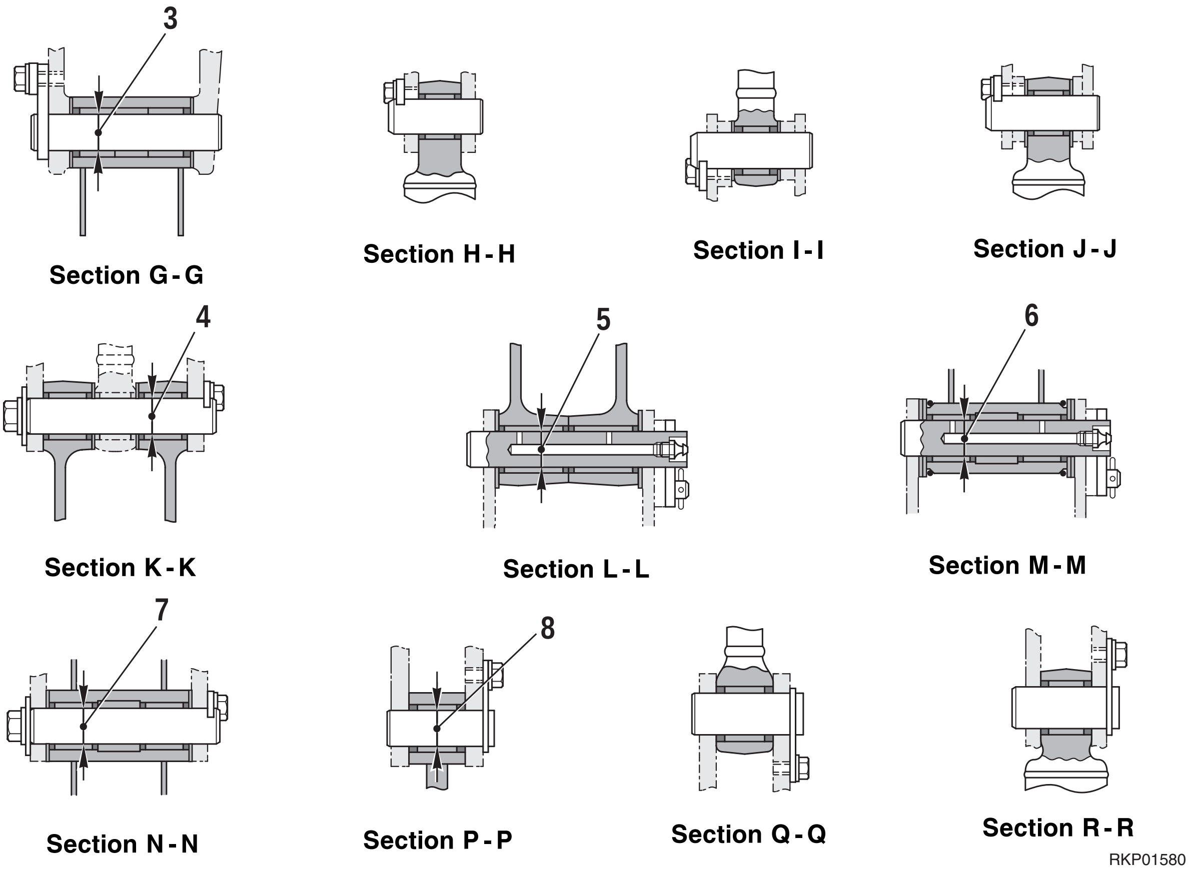
Section B - B

Section C - C

Section D - D

Section E - E

Section F - F



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Repair limit	
			Shaft	Hole			
1	Clearance between bushing and mounting pin of boom swing bracket and revolving frame	50	–0.010 –0.050	+ 0.230 + 0.060	0.070÷ 0.280	1.0	Replace
2	Clearance between bushing and mounting pin of boom swing bracket and boom	35	–0.010 –0.050	+ 0.134 + 0.072	0.082÷ 0.184	1.0	
3	Clearance between bushing and mounting pin of arm and boom	30	–0.010 –0.050	+ 0.134 + 0.072	0.082÷ 0.184	1.0	
4	Clearance between bushing and mounting pin of link and link	30	–0.010 –0.050	+ 0.134 + 0.072	0.082÷ 0.184	1.0	
5	Clearance between bushing and mounting pin of bucket and link	30	–0.090 –0.130	+ 0.117 + 0.080	0.170÷ 0.247	1.0	
6	Clearance between bushing and mounting pin of bucket and link	30	–0.010 –0.050	+ 0.134 + 0.072	0.082÷ 0.184	1.0	
7	Clearance between bushing and mounting pin of bucket and arm	30	–0.090 –0.130	+ 0.117 + 0.080	0.170÷ 0.247	1.0	
8	Clearance between bushing and mounting pin of track frame and blade	30	–0.010 –0.050	+ 0.099 + 0.062	0.073÷ 0.149	1.0	