156SHO3202

NEW FRONTIERS NEW DREAMS

SHOP MANUAL

BE220G / BE220 / BE220LC

EXCAVATOR

BHARAT EARTH MOVERS LIMITED

INDIA

CONTENTS

IMPORTANT SAFETY NOTICE

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

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

⚠ SAFETY

GENERAL PRECAUTIONS

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

1. Before carrying out any greasing or repairs, read all the precautions given on the decals decals which are fixed to the machine.
2. When carrying out any operation, always wear safety shoes and helmet. Do not wear loose work clothes, or clothes with buttons missing.
   - Always wear safety glasses when hitting Parts with a hammer.
   - Always wear safety glasses when grinding parts with a grinder, etc.
3. If welding repairs are needed, always have a trained, experienced welder carry out the work. When carrying out welding work, always wear welding gloves, apron, glasses, cap and other clothes suited for welding work.
4. When carrying out any operations 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 pats. 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 smooking. Never smoke while working.

PREPARATIONS FOR WORK

7. Before adding oil or making any repairs, park the machine on hard, level ground, and block the wheels or tracks to prevent the machine from moving.
8. Before starting work lower blade,ripper,bucket or any other work equipment to the ground. If this is not possible, insert the safety pin or use blocks to prevent the work equipment from falling.In addition,be sure to lock all the control levers and hang warning signs on them.
9. When disassembling or assembling, support the machine with blocks, blocks, jecks 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, laddera or steps when getting on or off the machine. Neverjump on or off the machine, If it is impossible o use the handrails, ladders or steps, use a stand to provide safe footing.

PRECAUTIONS DURING WORK

11. When removing the oil filler cap, drain plug or hydraulic pressure measuring plugs, loosen them slowly to prevent the oil from spurting out.

    Before disconnecting or removing components of the oil, water or air circuits, first remove the pressure completely from the circuit.

12. The water and oil in the circuits are not when the engine is stopped, so be careful not to get burned.

    Wait for the oil and water to cool before carrying out any work on the oil or water circuits.

13. Before starting work, remove the leads from the battery. Always remove the lead from 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 coorect places. Use a hoist or crane and operate slowly to prevent the component from hitting any other part. Do not work with any part still raised by the hoist or crane.

15. When removing covers which are under internal pressure or under pressure from a spring, always leave two bolts in position on opposite sides. Slowly release the pressure then slowly loosen the bolts to remove.

16. When removing components, be careful not to break or damage the wiring. Damaged wiring may cause electrical fires.

17. When removing piping, stop the fuel or oil from spilling out. If any fuel or oil drips on to the floor, wipe it up immediately, fuel or oil on the floor can cause you to slip, or can even star 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.
    Replaces any damaged parts with new parts.
    - When installing hoses and wires, be sure that they will not be damaged by contact with other parts when the machine is being operated.

20. When installing high pressure hoses, make sure that they are not twisted. Damaged tubes are dangerous, so be extremely careful when installing tubes for high pressure circuits. Also, check that connecting parts are correctly installed.

21. When assembling or installing parts, always use the specified tightening torques. When installing protective parts such as guards, or parts which vibrate violently or rotate at high speed, be particularly careful to check that they are installed correctly.

22. When aligning two holes, never insert your fingers or head. Be careful not to get your fingers caught in a nole.

23. When measuring hydraulic pressure, check that the measuring tool is correctly assembled before taking any measurements.

24. Take care when removing or installing the tracks of track-type machines.
    When removing the track, the track separates suddenly, so never let anyone stand at either end of the track.

FOREWORD

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

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

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

STUCTURE AND FUNCTION

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

TESTING AND ADJUSTING

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

Troubleshooting charts correlating "Problems" to "Causes" are also indicated 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.

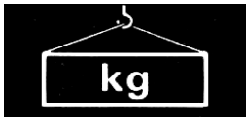
NOTE :

1. For B(S)6D105-1 engine details refer seperate engine shop manual of SE105 M 06 00 7
2. For swing machinery, final drive details refer PMP instruction manual of PMTE M001
3. For travel gear final drive details refer PMP instruction manual of PMCI M001
4. For hydraulic system details refer Rexroth instruction manual of HS-64-05-E0403-1-3

NOTICE

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

HOISTING INSTRUCTIONS



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

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

2. Wire ropes

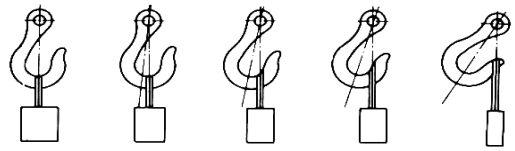
1) Use adequate ropes depending on the weight of parts to be hoisted, referring to the table below:

Wire ropes (Standard "Z" or"S" twist ropes without galvanizing)	
Rope diameter (mm)	Allowable load (tons)
10	1.0
11.2	1.4
12.5	1.6
14	2.2
16	2.8
18	3.6
20	4.4
22.4	5.6
30	10.0
40	18.0
50	28.0
60	40.0

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

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

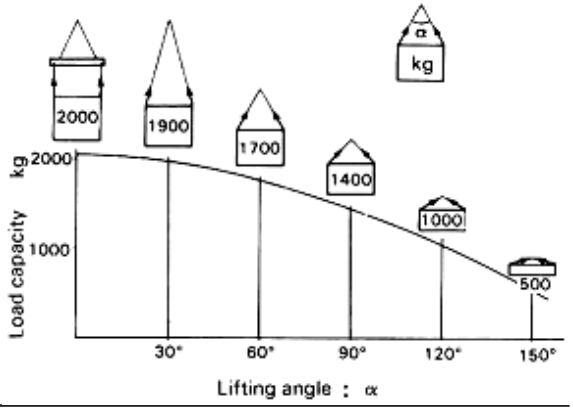
Hooks have maximum strength at the middle portion.

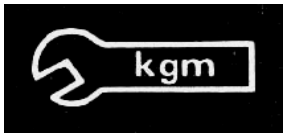


3) Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound on to the load.

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

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





STANDARD TIGHTENING TORQUE

1. STANDARD TIGHTENING TORQUE OF BOLTS AND NUTS

The following charts give the standard tightening torques of bolts and nuts. Exceptions are given in section of “Disassembly and Assembly

Thread diameter of bolt (mm)	width across flat (mm)		
		kgm	Nm
6	10	1.35±0.15	13.2±1.4
8	13	3.2±0.3	31.4±2.9
10	17	6.7±0.7	65.7±6.8
12	19	11.5±1.0	112±9.8
14	22	18.0±2.0	177±1.9
16	24	28.5±3	279±29
18	27	39±4	383±39
20	30	56±6	549±58
22	32	76±8	745±78
24	36	94.5±10	927±98
27	41	135±15	1320±140
30	46	175±20	1720±190
33	50	225±25	2210±240
36	55	280±30	2750±290
39	60	335±35	3280±340

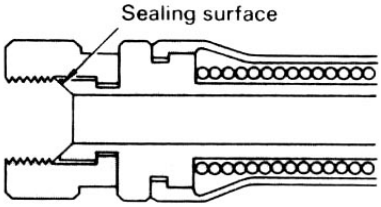
This torque table does not apply to the bolts with which nylon packings or other non-ferrous metals washers are to be used, or which require tightening to otherwise specified torque.

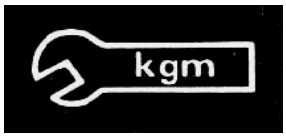
★ Nm (newton meter): 1 Nm = 0.1 kgm

2. TIGHTENING TORQUE OF SPLIT FLANGE BOLTS

Use these torques for split flange bolts.

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



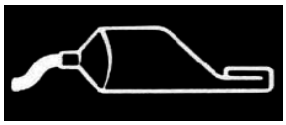


3. TIGHTENING TORQUE FOR NUTS OF FLARED

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
14	19	2.5±0.5	24.5±4.9
18	24	5±2	49±19.6
22	27	8±2	78.5±19.6
24	32	14±3	137.3±29.4
30	36	18±3	176.5±29.4
33	41	20±5	196.1±49
36	46	25±5	245.2±49
42	55	30±5	294.2±49

COATING MATERIALS

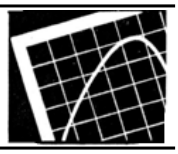


The recommended coating materials prescribed in **beml** Shop Manuals are listed below.

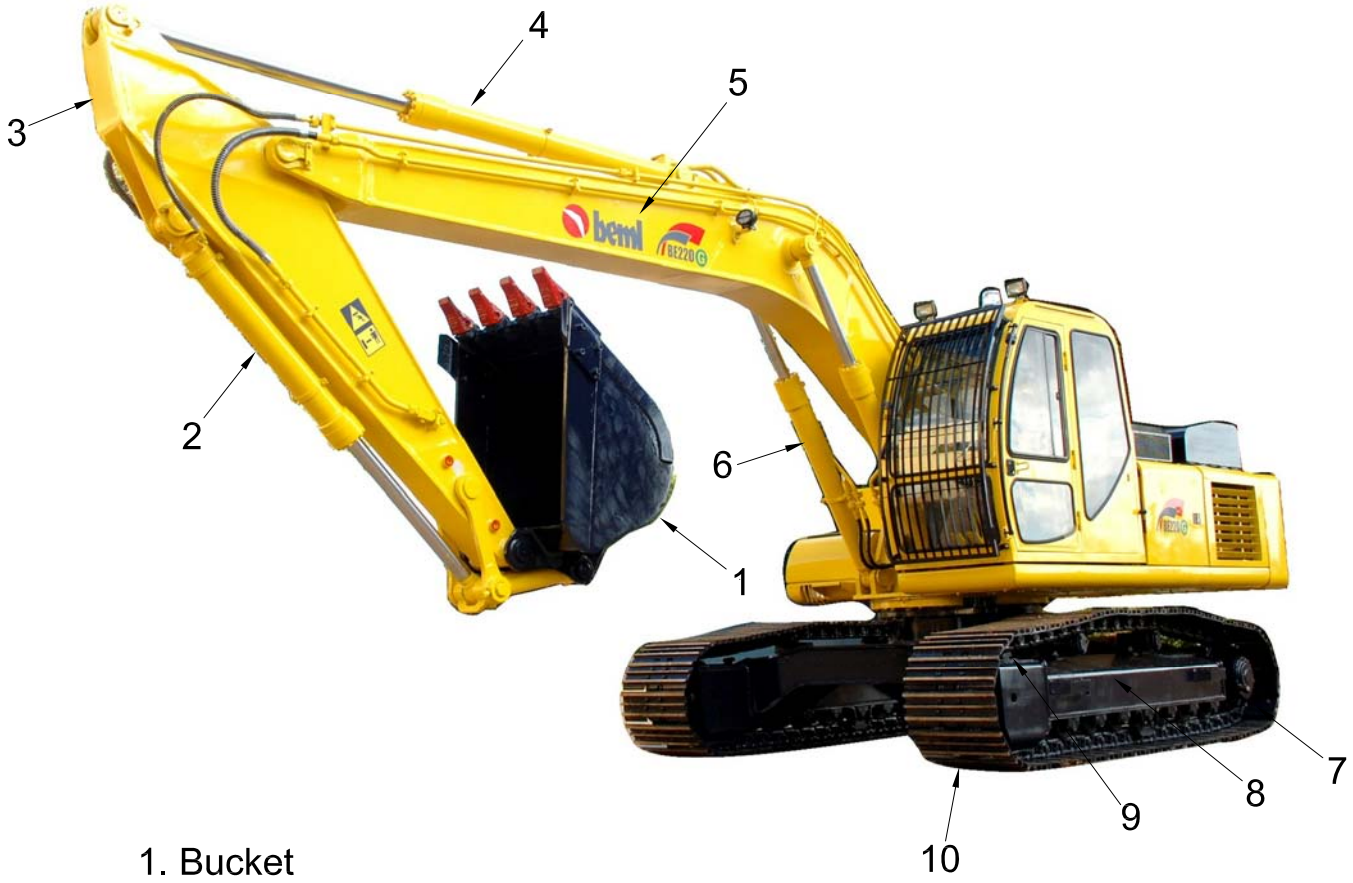
Nomenclature	BEML code	Applications
Adhesives	LT-1A	Used to apply rubber pads, rubber gaskets, and cork plugs
	LT-1B	Used to apply resin, rubber, metallic and non-metallic parts when a fast, strong seal is needed
	LT-2*	Preventing bolts, nuts and plugs from loosening and leaking oil.
	LT-3	Provides an airtight, electrically insulating seal. Used for aluminum surfaces.
	LT-4	Used to coat plugs (plate shaped, bowl shaped) and holes, and mating portion of shaft.
Sealant gasket	LG-1	Used with gaskets and packings to increase sealing effect.
	LG-3	Heat-resistant gasket for precombustion chambers and exhaust piping.
	LG-4	Used by itself on mounting surfaces on the final drive and transmission cases. (Thickness after tightening: 0.07 - 0.08 mm)
	LG-5	Used by itself to seal grease fittings, tapered screw fittings and tapered screw fittings in hydraulic circuits of less than 50 mm in diameter.
	LG-6	Silicon base type used in combination with LG-1 and LG-4.
	LG-7	Has a shorter curing time than LG-6, and is easier to peel off.
Antifriction compound (Lubricant including molybdenum disulfide)	LM-P	Applied to bearings and taper shafts to facilitate press-fittings and to prevent sticking, burning or rusting.
Grease (Lithium grease)	G2-L1 -	Applied to bearings, sliding parts and oil seals for lubrication, rust prevention and facilitation of assembling work.
Vaseline		Used for protecting battery electrode terminals from corrosion.

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

01 GENERAL



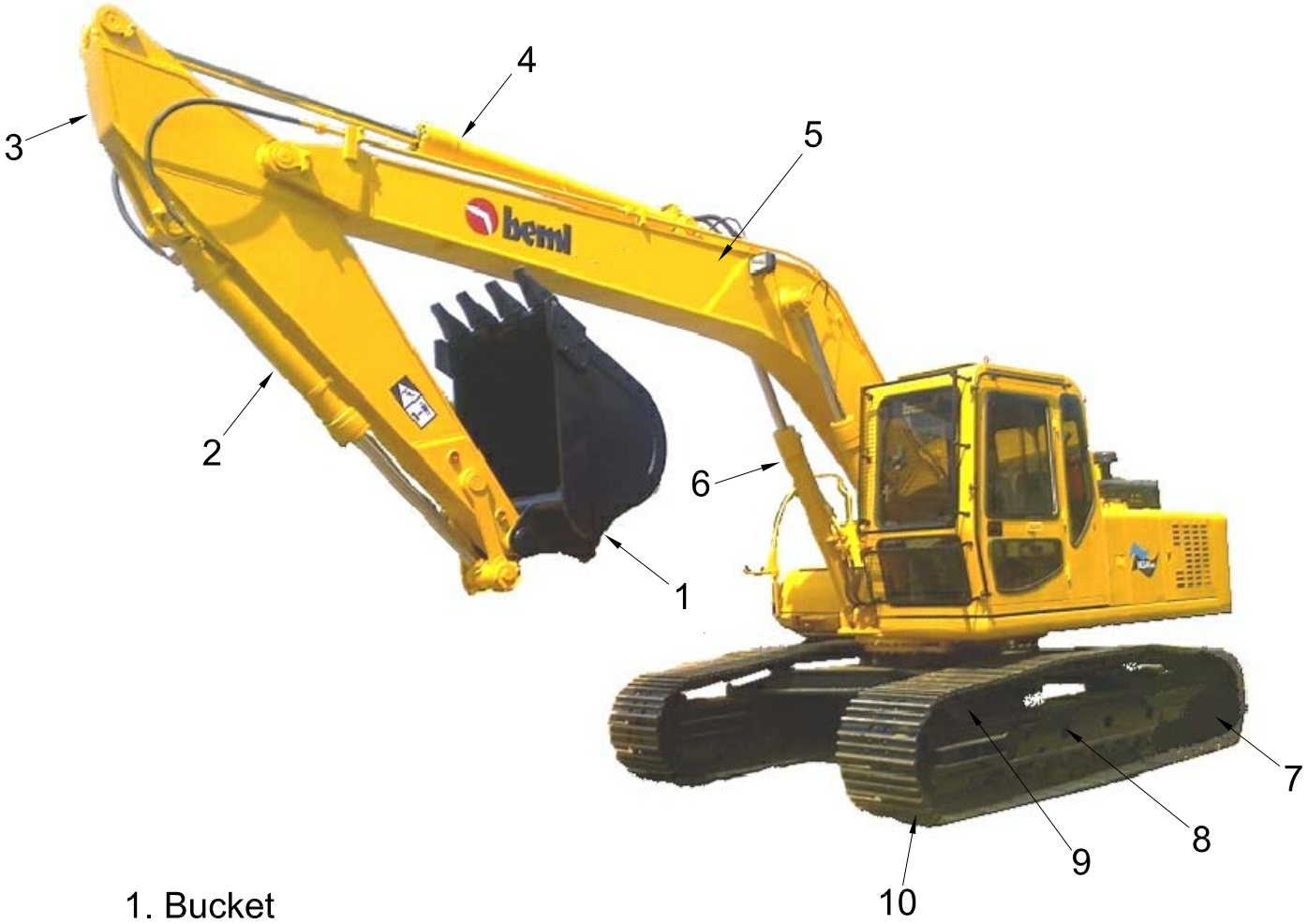
GENERAL VIEW



1. Bucket
2. Bucket cylinder
3. Arm
4. Arm cylinder
5. Boom
6. Boom cylinder
7. Sprocket
8. Track frame
9. Idler
10. Track shoe

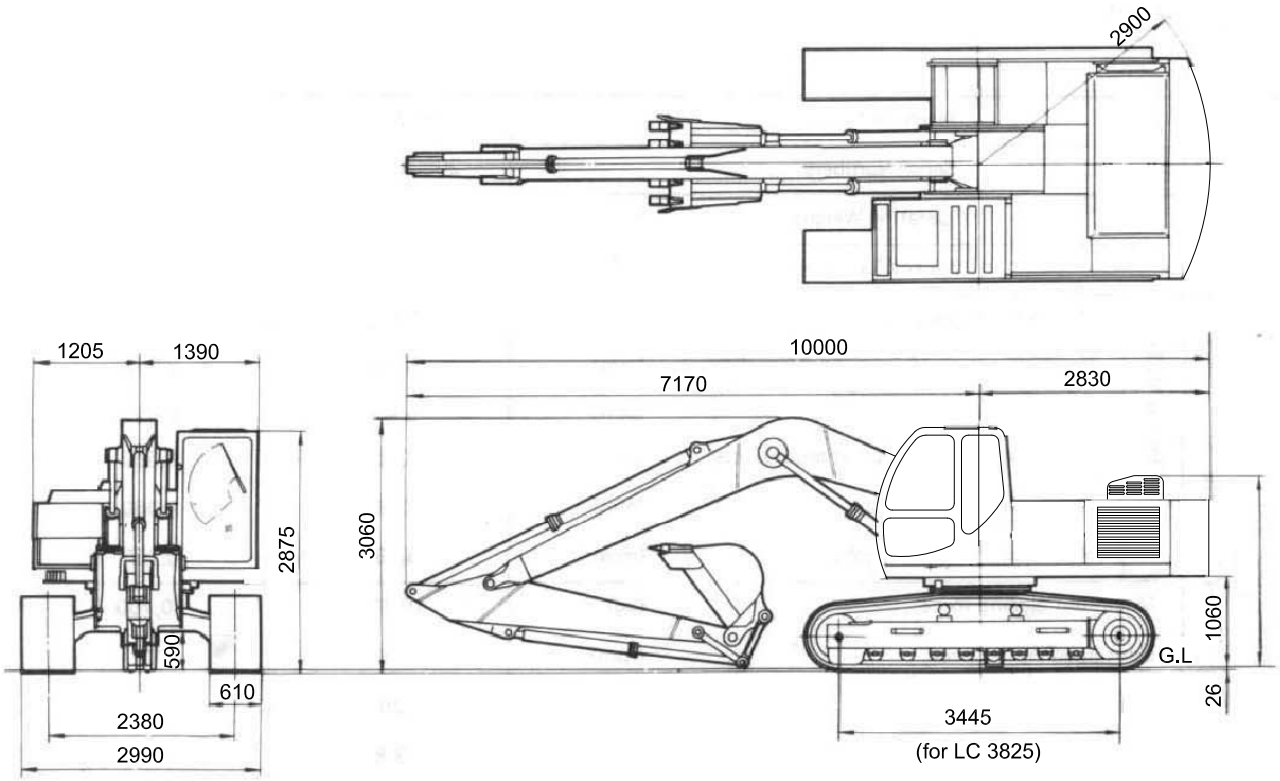
BE220 /BE220LC

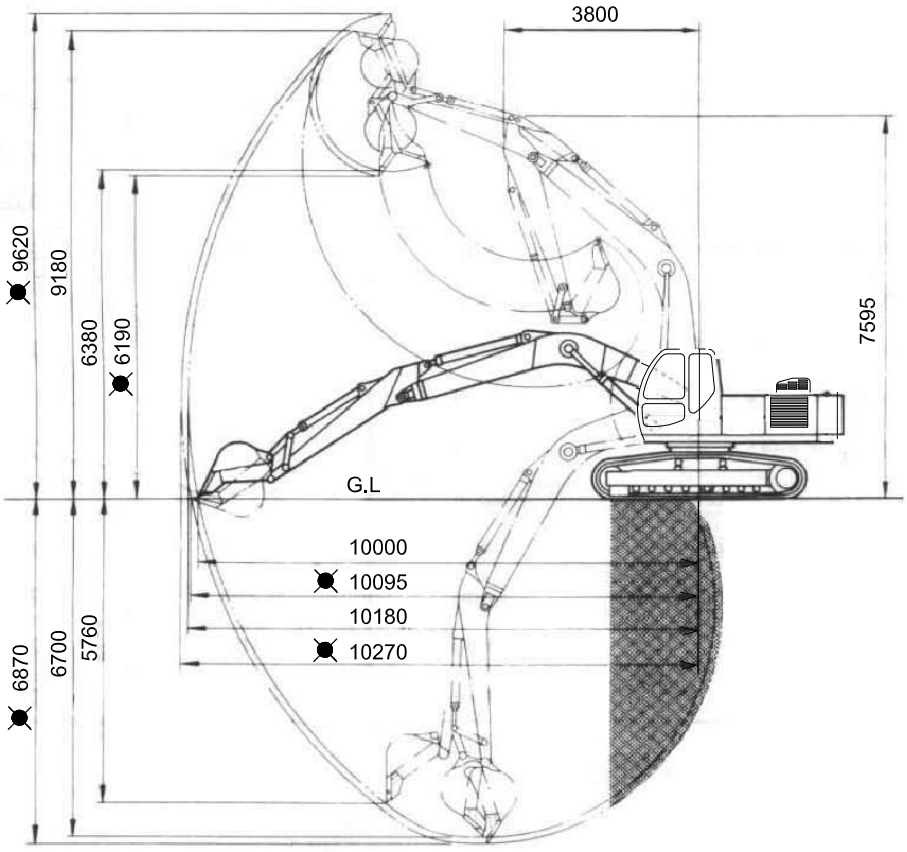
GENERAL VIEW



1. Bucket
2. Bucket cylinder
3. Arm
4. Arm cylinder
5. Boom
6. Boom cylinder
7. Sprocket
8. Track frame
9. Idler
10. Track shoe

GENERAL ASSEMBLY DRAWING



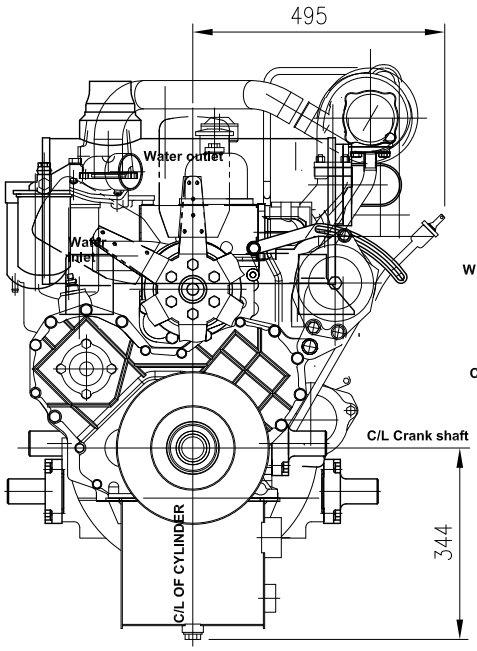


The marks ✕ indicates the dimensions for shovel operation.

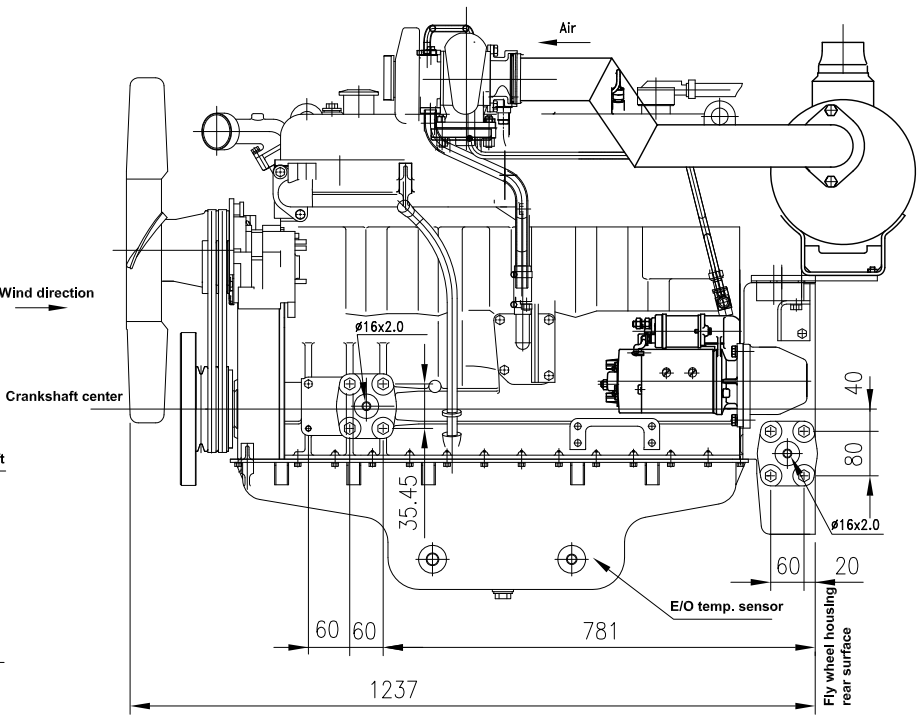
MACHINE MODEL				BE220G
SERIAL NUMBER				G16803 and up
ENGINE		Engine model		BS6D105-1
		Type		4 cycle, in-line, water cooled direct injection type diesel engine with turbo charger
		No. of cylinder - bore x stroke	(mm)	6 - 105 x 125
		Total displacement	(cc)	6,494
		Flywheel horsepower	(HP/rpm)	148 / 2,100
		Maximum torque	(kgm/rpm)	56.5 / 1,600
		High idle speed	(rpm)	2300 ± 50
		Low idle speed	(rpm)	850 ± 50
		Manimum fuel consumption ratio	(g/hpH)	155
		Starting motor		24V, 4.5 kW
		Alternator		24V, 30A
		Battery		24V (12 x 21) - 120 Ah
		Type of radiator core		Flat fin type
UNDER CARRIAGE		Carrier roller	(one side)	2
		Track roller	(one side)	8
		Track shoe		Built built-up triple growser
HYDRAULIC SYSTEM	HYDRAULIC PUMP	Type, Number		Variable displacemnt piston type x 2
				Gear type x1
		Delivery	(l per / min)	piston type : 2 x 203 (at reted engine speed)
		Set pressure	(kg / cm^2)	Gear type : 50 (at reted engine speed) Piston type : 320 Gear type : 30
	CONTROL VALVE	Type, number		7 Spool type + One optlonal spool
		Control lever operation		Pilot type, Travel control by lever with foot pedal
	HYDRAULIC MOTOR	Travel motor		Piston type
		Swing motor		Piston type
		Hydraulic cylinder		Double acting piston
		Hydraulic tank		Closed box type
		Hydraulic filter		Tank return side
		Hydraulic coller		Forced, Air cooled

ENGINE ASSEMBLY DRAWING

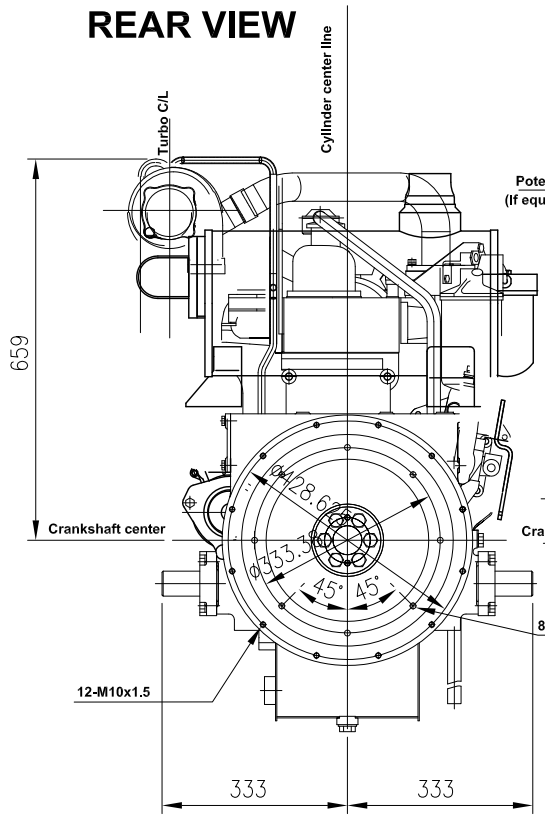
FRONT VIEW



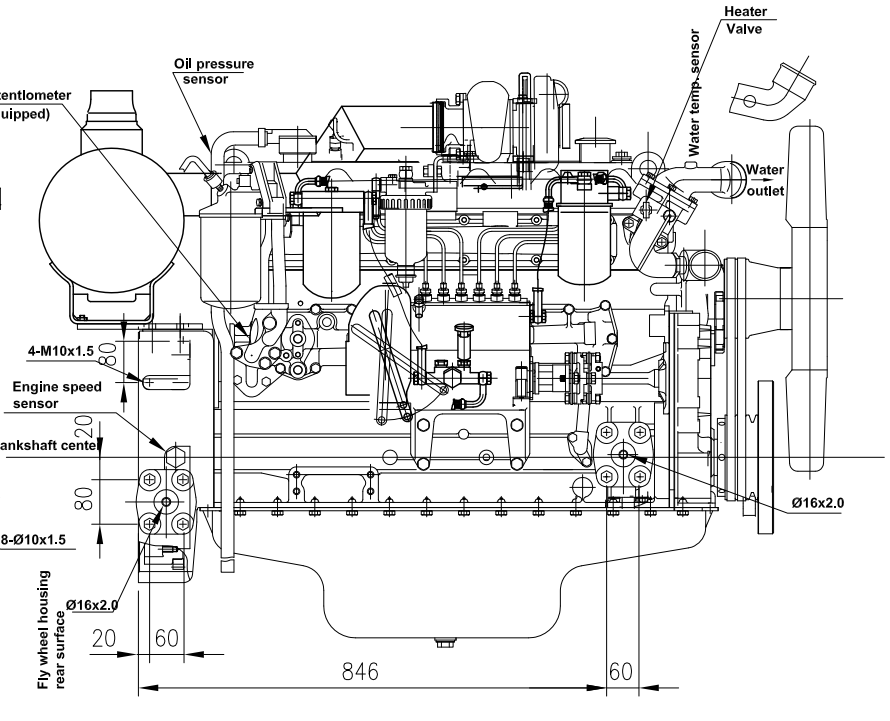
LEFT SIDE VIEW



REAR VIEW



RIGHT SIDE VIEW



BE220G / BE220, BE220LC

MACHINE MODEL	BE220G	BE220	BE220LC
Engine assembly	655	783	783
• Engine	655	655	655
• Damper	-	12	12
• Main piston pump	-	116	116
• Charging pump	-	85	85
Radiator and oil cooler assy	130	130	130
Hydraulic tank (without hydraulic oil)	196	196	196
Fuel tank (without fuel)	111	111	111
	1965	1965	1965
	395	395	395
	194	194	194
Revolving frame	1864	1853	1853
Operator's cab(including operartor's seat & heater)	395	395	395
Swing machinery	230	194	1943
Swing motor assembly	73	23	23
Travel motor assembly	-	25 x 2	25 x 2
7 - spool control valve	-	148	148
8 - spool control valve	195	-	-
Center swivel joint assembly	35	35	35
Counter Weight	3935	3935	3935
Track frame assembly	4604	4604	5100
• Track frame	3245	3245	3565
• Carrier roller assembly	22 x 4	22 x 4	22 x 4
• Track roller assembly	36 x 16	36 x 16	36 x 20
• Recoil spring assembly	135 x 2	135 x 2	135 x 2
• Idler assembly	120 x 2	120 x 2	120 x 2
• Final drive assembly	245	640	640
• Final drive assembly (with motor)	245	-	-
• Sprocket	42 x 2	42 x 2	42 x 2
• Swing circle assembly	243	243	243
Track shoe assembly	2849	2849	3146
Boom assembly	1696	1696	1696
Arm assembly	793	793	793
Bucket assembly	965	965	965

MACHINE MODEL	BE220G	BE220	BE220LC
Boom cylinder assembly	187 x 2	187 x 2	187 x 2
Arm cylinder assembly	266	266	266
Bucket cylinder assembly	167	167	167
Link (large) assembly	79	79	79
Link (small) assembly	23 x 2	23 x 2	23 x 2
Boom pin	43 + 10 x 2 + 30 + 10 + 32	43 + 10 x 2 + 30 + 10 + 32	43 + 10 x 2 + 30 + 10 + 32
Arm pin	10 x 2	10 x 2	10 x 2
Bucket pin	20 x 2	20 x 2	20 x 2
Link pin	18 x 2	18 x 2	18 x 2

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

BE220 / BE220LC

PROPER SELECTION OF FUEL, COOLANTS AND LUBRICANTS

RESERVOIR	KIND OF FLUID	BEML STD.	VISCOSITY GRADE	CAPACITY (LITERS)	
ENGINE OIL PAN	ENGINE OIL	C6002-30	CF_4 15W40	25	17.5
SWING MACHINERY CASE		C6002-03	SAE 30 CD	5	4.5
SWING BRAKE				5	4.5
FINAL DRIVE CASE				4	3.4
TRAVEL BRAKE				4	3.4
HYDRAULIC SYSTEM		C6002-03	SAE 30 CD	250	150
FUEL TANK	DIESEL	C6002-01	HSD	280	-
COOLING SYSTEM	WATER	-	-	35	26.5
GREASE	NLGI – 2 (MOLEX)	C6003-02	MOLEX GREASE	-	-

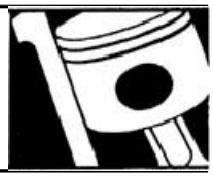
BE220G

PROPER SELECTION OF FUEL, COOLANTS AND LUBRICANTS

RESERVOIR	KIND OF FLUID	BEML STD.	VISCOSITY GRADE	CAPACITY (LITERS)	
ENGINE OIL PAN	ENGINE OIL	C6002-30	CF_4 15W40	25	17.5
SWING MACHINERY CASE	GEAR OIL	—	SAE80W90	5	4.5
SWING BRAKE				—	—
FINAL DRIVE CASE				4.5	4.0
TRAVEL BRAKE				—	—
HYDRAULIC SYSTEM		C6002-03	SAE 30 CD	250	150
FUEL TANK	DIESEL	C6002-01	HSD	280	-
COOLING SYSTEM	WATER	-	-	35	26.5
GREASE	NLGI – 2 (MOLEX)	C6003-02	MOLEX GREASE	-	-

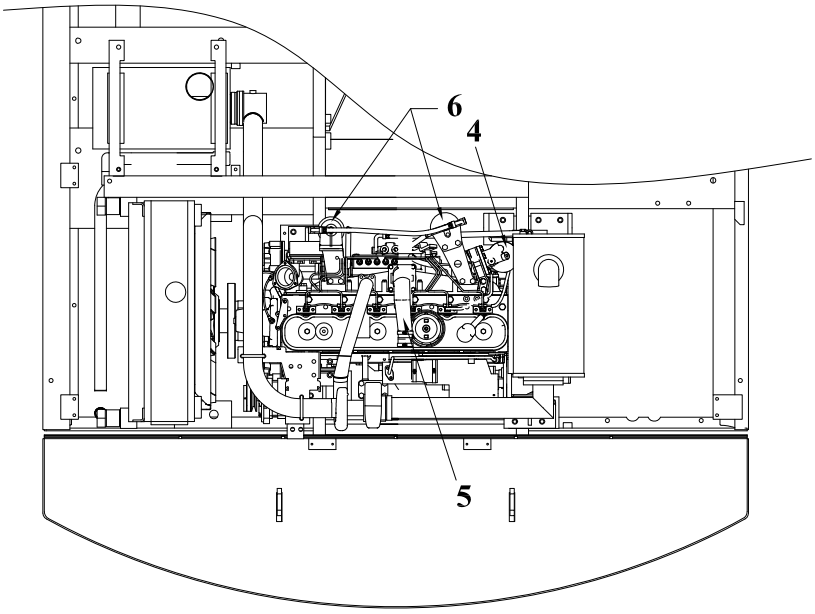
ENGINE

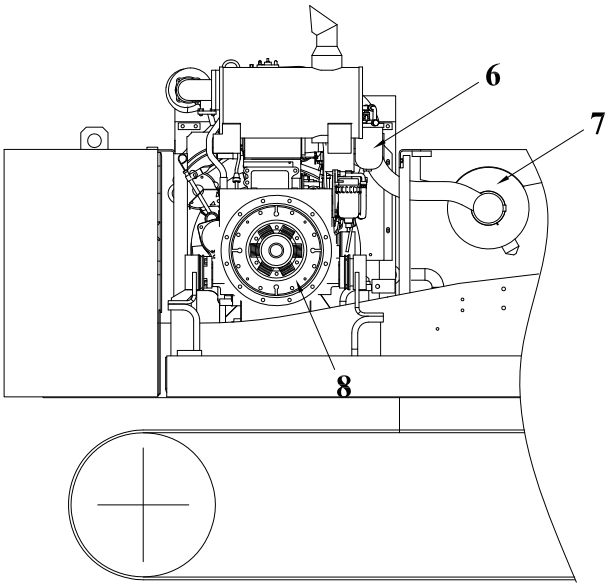
02 STRUCTURE AND FUNCTION



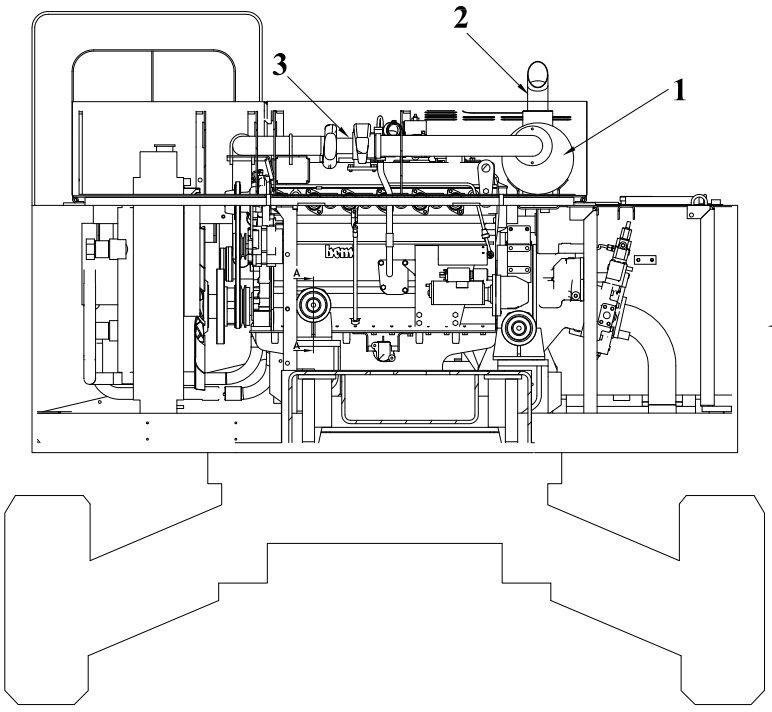
BE220G

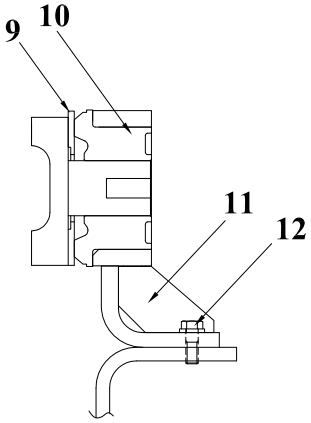
ENGINE MOUNT AND ENGINE ATTACHMENT PARTS





VIEW - Z

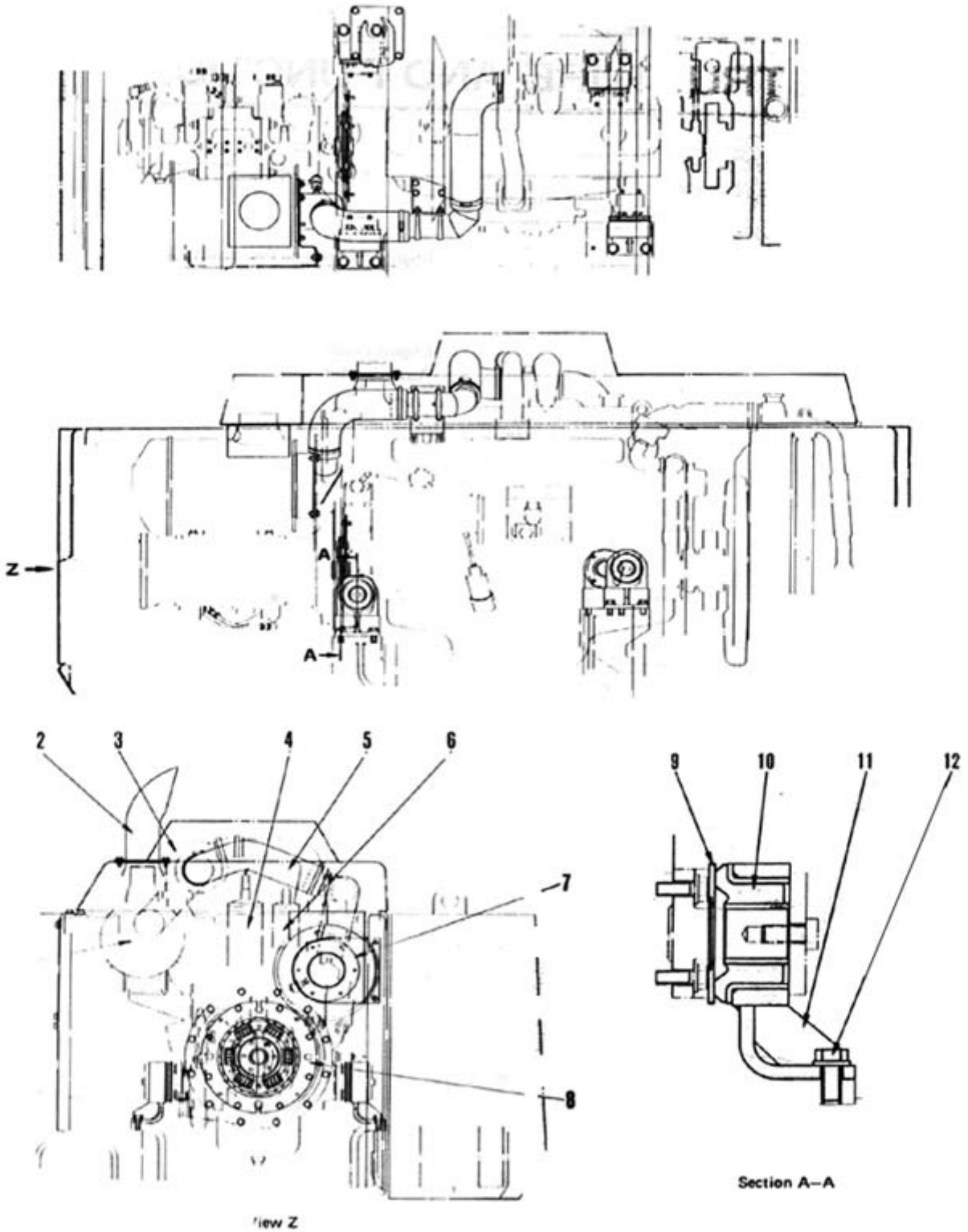


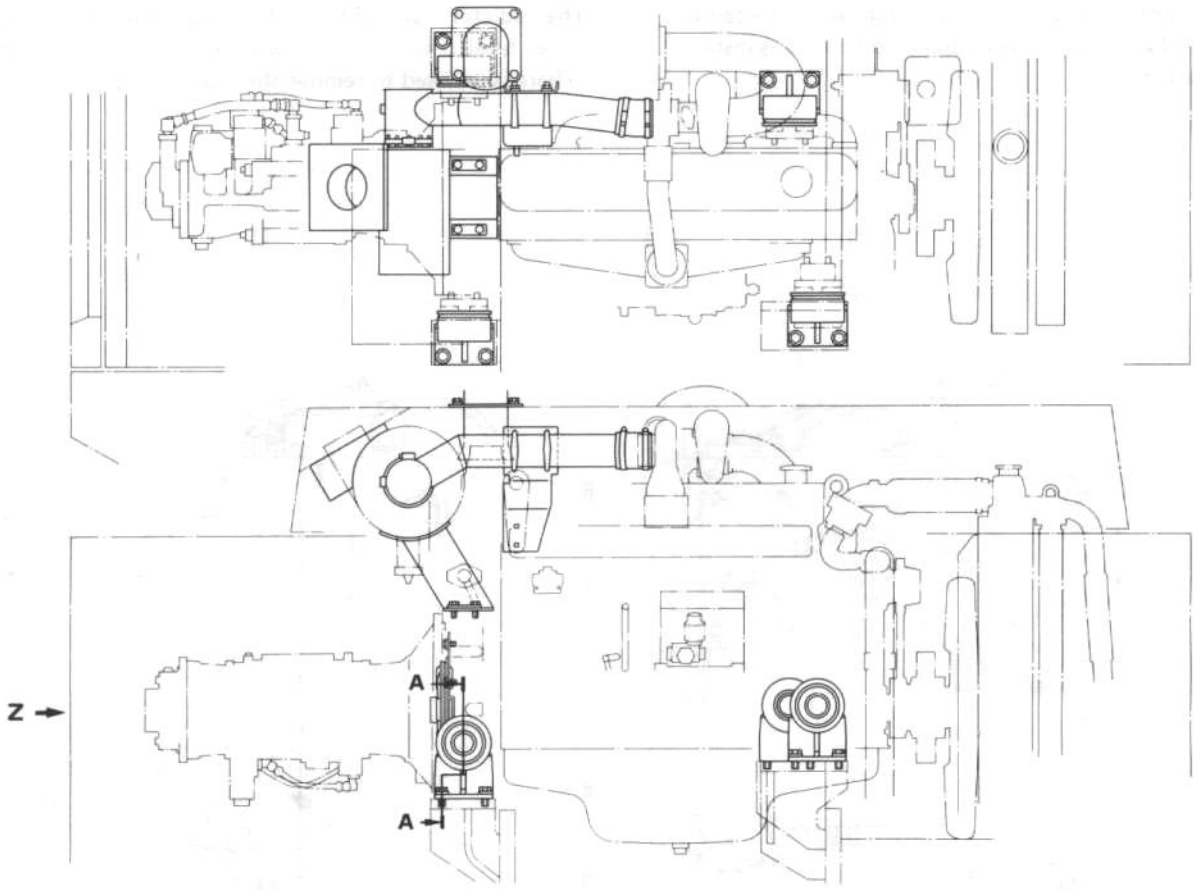


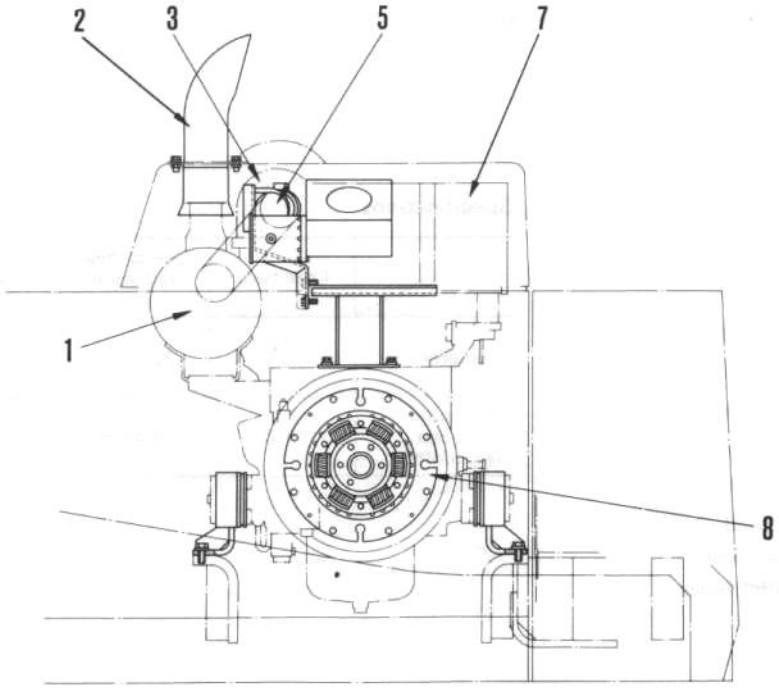
SECTION A-A

BE220 /BE220LC

ENGINE MOUNT AND ENGINE ATTACHED PARTS







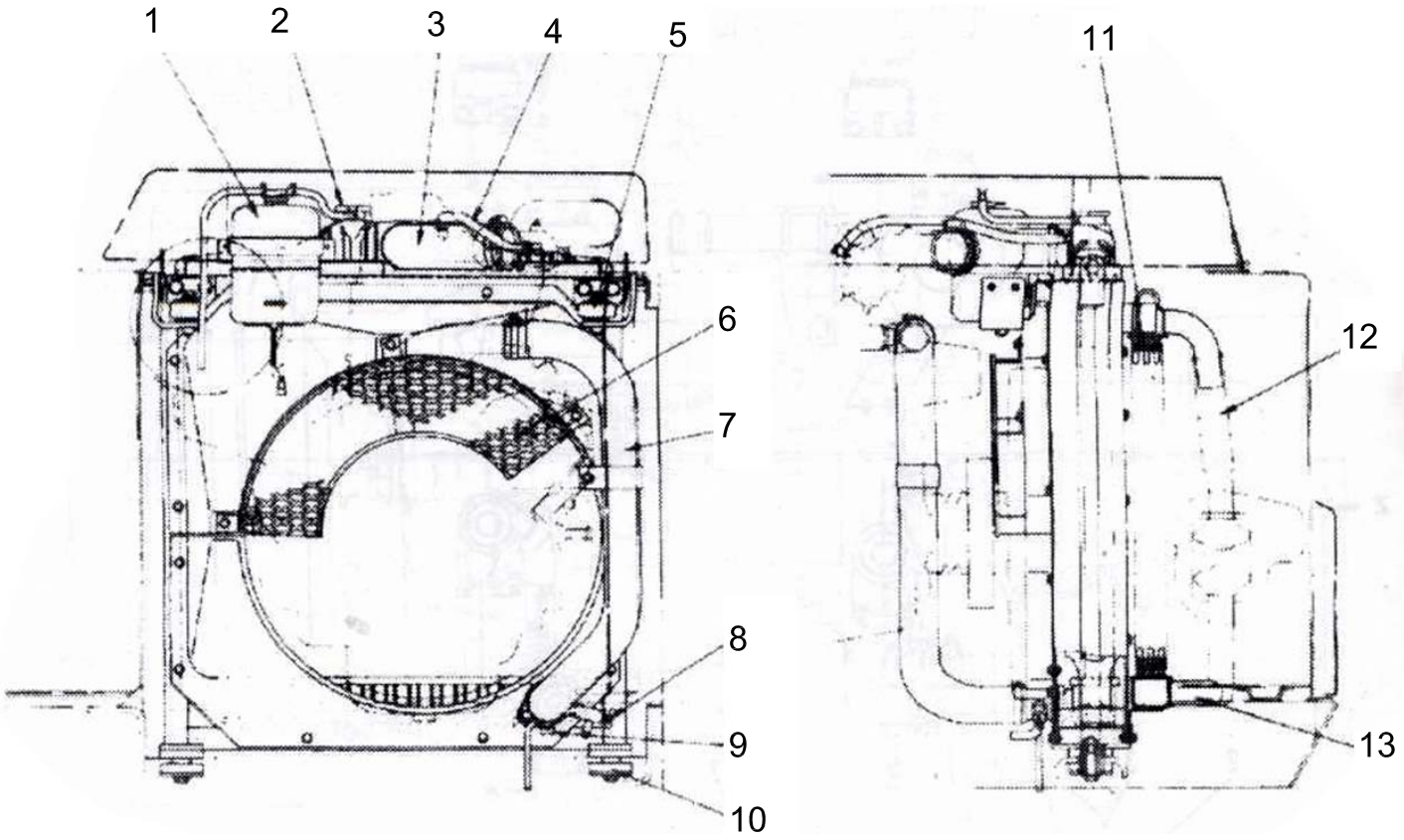
View Z

1. Muffler
2. Exhaust pipe
3. Turbocharger
4. Engine oil filter
5. Intake connector
6. Fuel filter
7. Air cleaner
8. Damper assembly
9. Spacer
10. Engine mount cushion rubber
11. Engine mount bracket
12. Engine mount bolt

RADIATOR AND COOLER

The radiator core is a D in-line type.
Air is forced out when the fan rotates.
The hydraulic oil cooler installed to the radiator.

The radiator has sub tank (1), so to check the cooling. Water level it is only necessary to look at the sub-tank.
(there is no need to remove the radiator cap.)

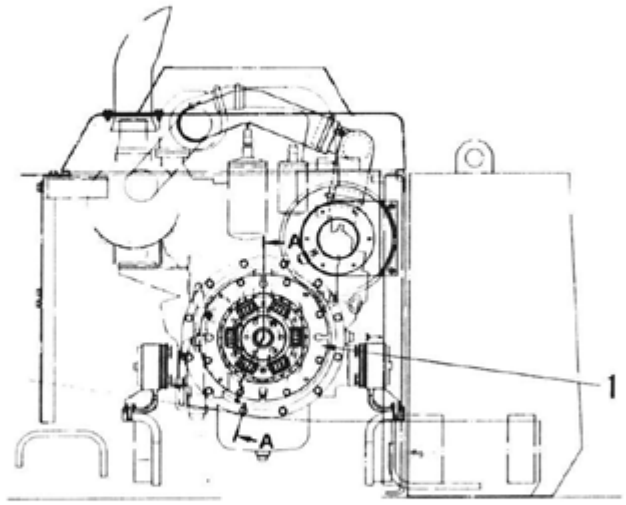


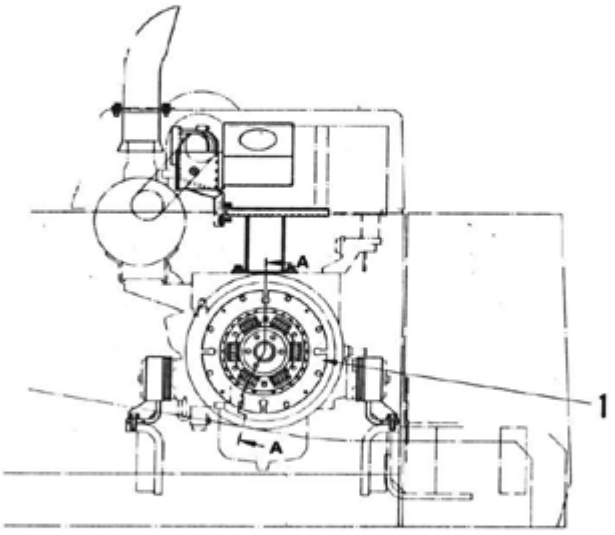
1. Sub-tank
2. Radiator cap
3. Radiator inlet hose
4. Aeration hose
5. Radiator upper mount
6. Fan guard
7. Radiator outler hose
8. Valve for heater
9. Drain valve
10. Radiator lower mount
11. Hydraulic oil cooler (air cooled)
12. Hydraulic oil cooler oil inlet hose
13. Hydraulic oil cooler oil oulet hose

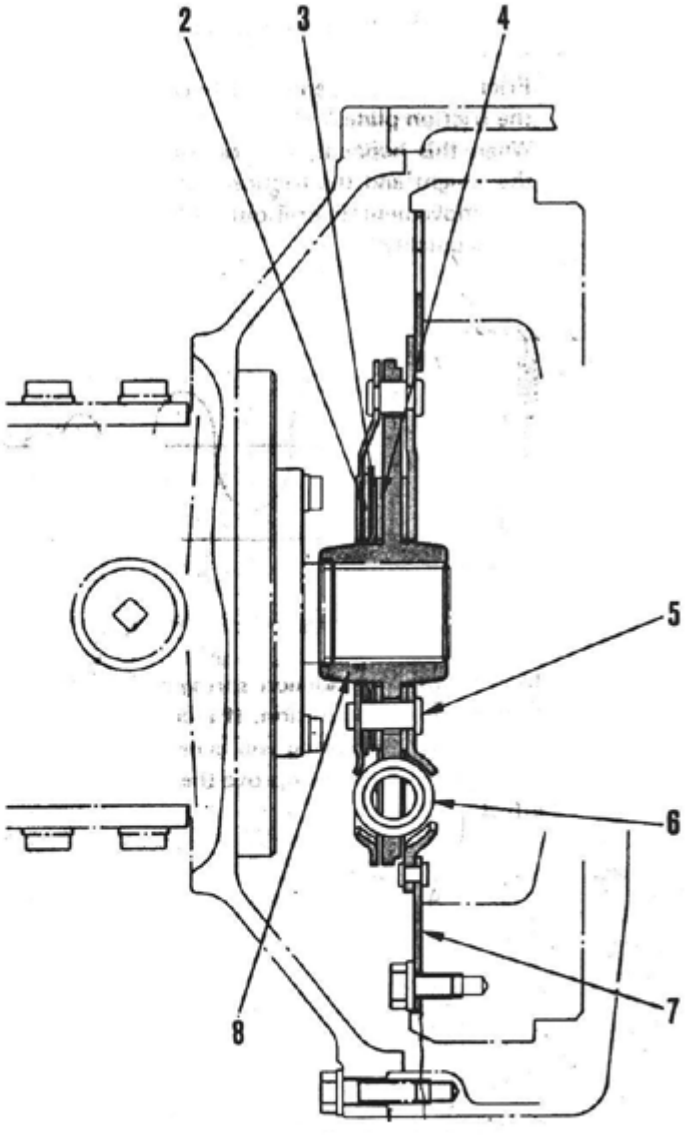
Specifications

	Core type	Overall heat radiation area	Capacity
Radiator	SF 6	55.14 m^3	36.5 ℓ
Hydraulic oil cooler (air cooled)	Fin & tube 4 rows	32.64 m^3	8.5 ℓ

DAMPER







SECTION-AA

1. Damper assembly
2. Friction plate
3. Cone spring
4. Friction washer
5. Stopper pin
6. Torsion spring
7. Drive plate
8. Hub

FUNCTION

- The rotating torque of the engine is not constant, and there is always a considerable amount of rotational vibration.
  To prevent this vibration from being transmitted to the gear and piston pumps, a damper is installed to absorb the vibration.
- In this way, the durability of the gear and piston pumps are increased by absorbing engine vibration and shock torque generated during sudden acceleration and heavy-duty excavtion.

STRUCTURE

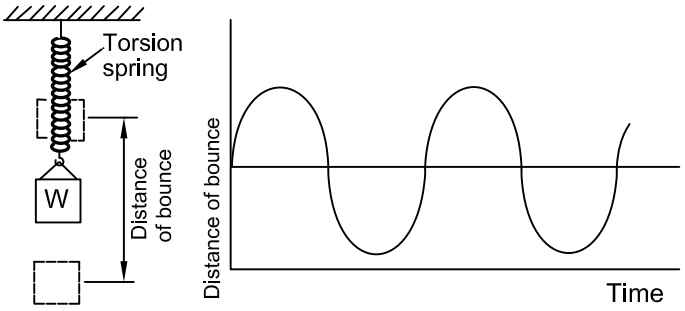
- Drive plate (7) is installed to the engine flywheel and hub (8) is fitted on shaft. There is a torsion spring (6) installed between the drive plate and hub
- Cone spring (3) pushes function plate (2) and function washer (4) against the flanged part of the hub. In this away it is stuctured to generate function torque.
- Even if friction washer (4) is worn, cone spring acts to maintain a constant torque.
- The vibration of the engine is absorbed by the torsion spring and friction washer. If any strong twisting force is brought (the transmitted torque becomes large), stopper pin (5) functions to transmit the movement of the flywheel directly to the hub.

PRINCIPLE OF OPERATION

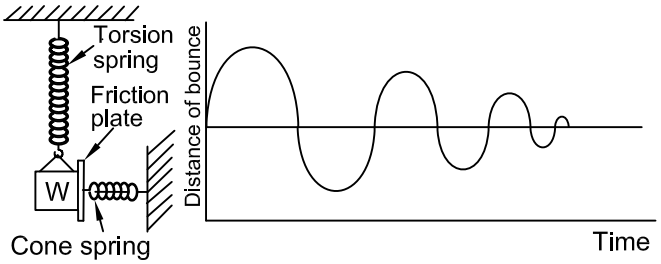
- The torsion spring of the damper acts a cushion to prevent the vibration of the engine from being transmitted directly to the gear and piston pumps. However, the vibration cannot be removed immediately just by installing a spring,becouse one spring cannot cushion the vibration completely. for this reason, a cone spring is used in addtion to the torsion spring to improve the reduction in vibration.

1. When only torsion is used

   If a weght is hung on a spring, as in the diagram below, and is then pulled down and released, it will bounce up and down freely.
   This bouncing (vibration) will not stop quickly, but will gradually become less over a period of time.

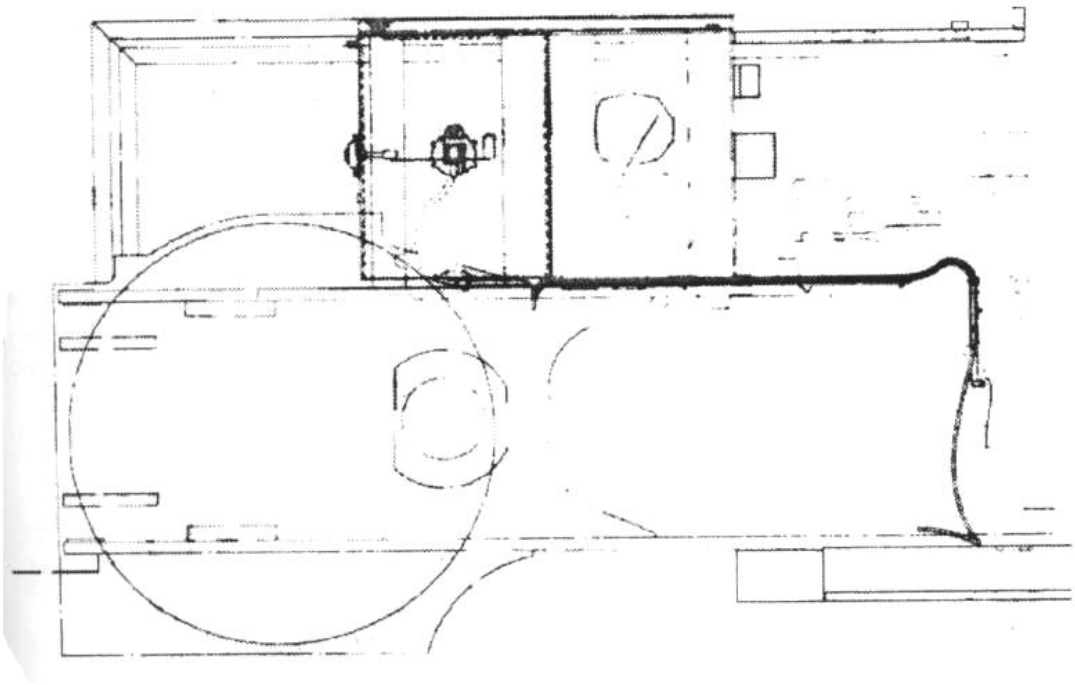


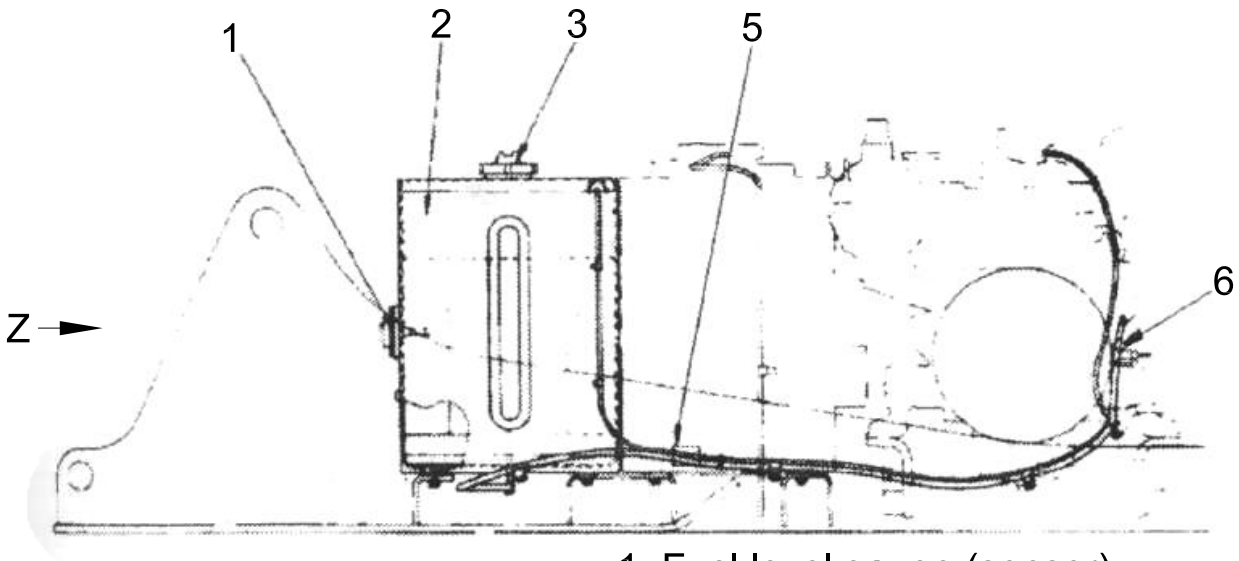
2. When torsion spring and cone spring are used in combination
   Let us now put a wall to the side of the weght, and use a spring to push a friction plate against the side of the weght.
   Friction will be generated between the weight and the friction plate.
   When this happens, the friction generated between the weght and the friction plate will act to stop the free movement (vibration) of the weght comparatively quickly.



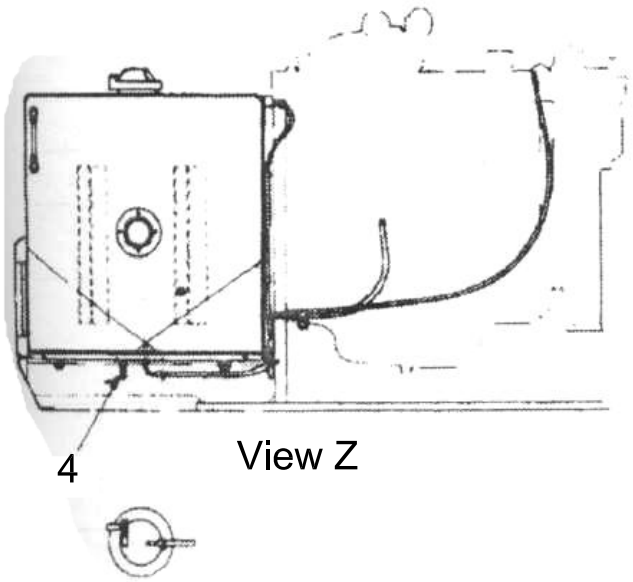
- In this way, the torsion spring acts to reduce the transmission of vibration, If a cone spring is added, the load of the spring will generate friction torque and this will further improve the vibration absorbing effect.

FUEL TANK AND PIPING





1. Fuel level gauge (sensor)
2. Fuel tank
3. Filler cap (with lock device (if equiped)
4. Drain valve
5. Fuel strainer
6. Water seperator

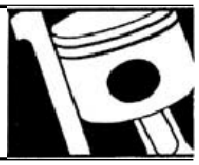


View Z

The fuel level sensor is installed in the fuel tank. When fuel level monitor indicates EMPTY, there is still 40L remaining.

ENGINE

03 TESTING AND ADJUSTING



⚠ Before performing inspection, adjustment or faultfinding, park the machine on level ground and check the safety pin and lock.

⚠ When performing joint work, make appropriate signals and allow only authorised personnel near the machine.

⚠ When checking the water level, allow the engine to cool down before removing the radiator cap to prevent the risk of being scalded by hot water which may spurt out if the engine is hot.

⚠ Take great care to avoid getting caught in rotating parts such as the fan, etc.

TESTING AND ADJUSTING DATA

Machine model				BE220G / BE220 / BE220LC	
Engine model				S6D105-1	
Classification	Item	Condition, etc.	Unit	Standard value	Parmissible value
Performance	Flywheel horsepower Maximum torque		HP/rpm kgm/rpm	146/2,100 56.5/1,400	
	Engine speed	Low idling speed High idling speed	rpm rpm	800 - 900 2,250 - 2,360	
	Necessary staring speed	0° C -20° C (using starting aid	rpm rpm	150 min 100 min	
Intak and exhaust system	Intake resistance Intake pressure Exhaust pressure Exhaust temperature	All speed All speed All speed All speed (intake air temperature : 20° C)	 mmHg mmHg ° C	162 max 50 max 650 max	635 max 75 650 max
	Exhaust gas colour	Low idling speed High idling speed	Boich scale	5.5 max 1.0 max	6.0 2.0
	Value clearance at 20° C	Intake value Exhaust value	mm mm	0.25 0.45	
Engine body	Comprression pressure	(Engine speed)	kg/cm^2 (rpm)	31.5 min (320 - 360)	
	Blow-by pressure	At high idling Oil temperature : min.60° C	mmH_2O	100 max	200
Lubraction system	Oil pressure (SAE30,Oil temperature 80° C min.)	At high idling At low idling	kg/cm^2 kg/cm^2	3.5 - 5.5 1.0 min.	2.5 0.8
	Oil temperature	All speed (Oil in oil pan)	° C	80 - 110	120
	Oil consumption ratio	At continuous rated out put (Ratio to fuel consumption)	%	0.5 max.	1.0
Fuel system	Fuel injection pressure	Nozzle tester	kg/cm^2	225	180
	Fuel injection time	B. T. D. C	Degree	20 ± 1	20
Cooling system	Coolant temperature	All speed (at engine outlet)	° C	70 - 80	100
	Thrmostat function	Valve cracking temperature Fuel operating temperature Fuel opening lift	° C ° C mm	74.5 - 78.5 90 10 ±0.5	74.5 - 78.5 90 10 ±0.5
	Radiator pressure valve function	All speed (at engine outlet)	kg/cm^2	0.75 ±0.1	0.75 ±0.1
	Fan speed	At high idling speed	mm	2,100	2,100
	Fan limit tension	Deflect when pushed with a force of 6 kg	mm	10	10

TESTING AND ADJUSTING TOOL LIST

No.	Testing measuring item	Fault finding tool	Remarks
1	Engine speed	Multi-tachometer	Digital reading 60 - 2,000 rpm (L range)
2	Battery S. G.	Battery coolant tester	1.100 - 1.300
3	Freezing temperature of cooling water		-6 - -60° C
4	water temperature, oil temperature, air intake temperature	Thermistor temperature gauge	0 - 200° C
5	Exhast temperature		0 - 1,000° C
6	Lubrication oil pressure	Engine pressure measuring kit	0 - 20 kg/cm^2
7	Fuel pressure		0 - 50 kg/cm^2
8	Intake pressure, exhast pressure		0 - 1,000 mmHg
9	Blow-by pressure		0 - 500 mmH_2O
10	Intake resistance		-1,000 - 0 mmH_2O
11	Compression pressure	Compression gauge	0 - 70 kg/cm^2
12	Blow-by pressure	Blow-by checker	0 - 500 mmH_2O
13	Valve clearance	Feller guage	0.25, 0.45 mm
14	Exhaust gas colour	Handy smoke checker	Dirtiness 0 - 70% with standard lolour (Dirtiness % x 1/10=Bosch scale)
15	Water fuel content in oil	Engine oil checker	Provide with 0.1 and 0.2 water contents standard sample
16	Fuel injection pressure fuel injection nozzle spray condition	Nozzle tester	0 - 300 kg/cm^2
17	Coolant quelity	Water quelity tester	PH, nitrite ion concentration
18	Pressure valve function Leakage in cooling water system	Radiator cap tester	0 - 2 kg/cm^2
19	Radiator blockage (wind speed)	Anemometer (Air speed gauge)	0 - 40 m/s
20	Engine cranking	Cranking kit	Engine with DC24V starting motor
21	Electrical circuits	Tester	Current, Voltage, Resistance

ADJUSTING VALVE CLEARANCE

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

MEASURING COMPRESSION PRESSURE

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

MEASURING BLOW-BY PRESSURE

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

TESTING AND ADJUSTING FUEL INJECTION TIMING

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

MEASURING EXHAUST GAS COLOR

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

TESTING AND ADJUSTING FAN BELT TENSION

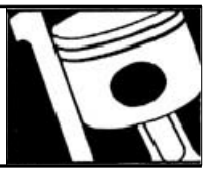
Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

ADJUSTING FUEL CONTROL LEVER

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

ENGINE

04 DISASSEMBLY AND ASSEMBLY



* When operating the hydraulic cylinders for the first time after reassembling cylinders,pumps and piping always bleed the air as follows :
1. Start engine and run at low idling.
2. Operate hydraulic cylinder 4 to 5 times,stopping 100 mm from stroke end.
3. Next,operate cylinder 3 to 4 times to stroke end.
4. After doing this,run engine at normal speed.

* After repair or long storage,follow the same procedure.

REMOVEL OF STARING MOTOR ASSEMBLY

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

REMOVEL OF ALTERNATOR ASSEMBLY

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

REMOVEL OF ENGINE OIL COOLER ASSEMBLY

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

REMOVEL OF FUEL INJECTION PUMP ASSEMBLY

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

INSTALLATION OF FUEL INJECTION PUMP ASSEMBLY

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

REMOVEL OF WATER PUMP ASSEMBLY

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

REMOVEL OF NOZZLE HOLDER ASSEMBLY

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

REMOVEL OF TURBOCHARGER ASSEMBLY

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

REMOVEL OF CYLINDER HEAD ASSEMBLY

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

INSTALLATION OF CYLINDER HEAD ASSEMBLY

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

REMOVAL OF RADIATOR ASSEMBLY

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

REMOVAL OF HYDRAULIC OIL COOLER ASSEMBLY

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

REMOVAL OF ENGINE AND MAIN PUMPASSEMBLY

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

INSTALLATION OF ENGINE AND MAIN PUMPASSEMBLY

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

REMOVAL OF DAMPER ASSEMBLY

Refer engine shop manual of SE 105 M 06 00 07
B(S)6D105 series diesel engine.

BE220G

POWER TRAIN

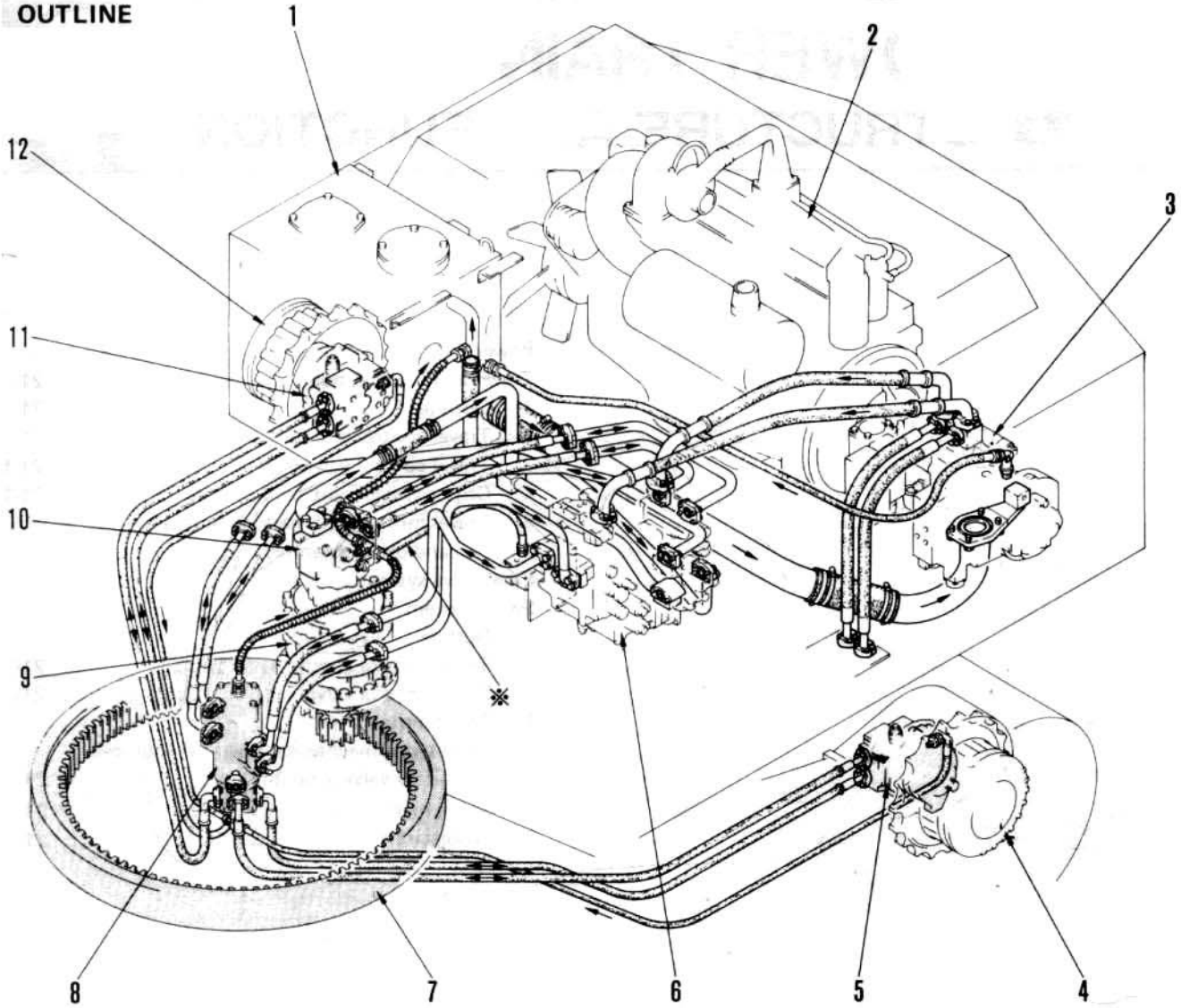
OUT LINE

Refer PMP instruction manual of PMCI. M001

BE220 / BE220LC

POWER TRAIN

OUTLINE



※ : This pipe is installed only on machines with a swing mechanical brake.

1. Hydraulic tank
2. Engine
3. Main pump
4. L.H. final drive
5. L.H. travel motor
6. Control valve assembly
7. Swing circle
8. Center swivel joint
9. Swing machinery
10. Swing motor
11. R.H. travel motor
12. R.H. final drive

- The mechanical power from engine (2) is converted to hydraulic power by main pump (3).
  The hydraulic power from main pump (3) is divided to each actuator by control valve (6). It then goes to travel motors (5) and (11), swing motor (10) and the hydraulic cylinders, and is converted back to mechanical power. This actuates the travel, swing and work equipment circuits.

BE220G

POWER TRAIN CIRCUIT

Refer PMP instruction manual of PMCI. M001

BE220 / BE220LC

POWER TRAIN CIRCUIT

Refer Rexrot instruction manual of HS-64-05-E0403-1-3

BE220G

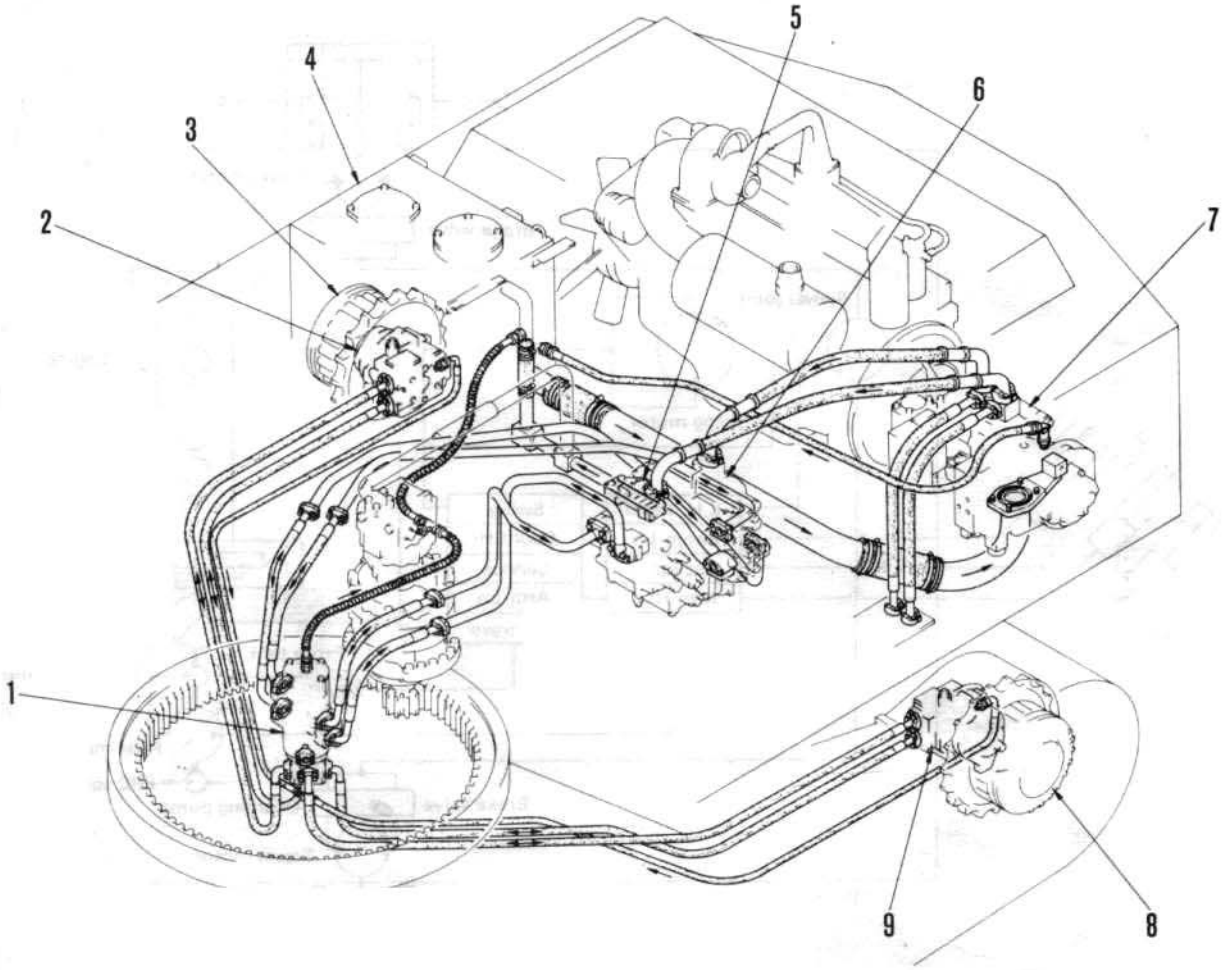
OUTLINE

Refer PMP instruction manual of PMCI. M001

BE220 /BE220LC

TRAVEL AND BRAKE SYSTEM

1. OUTLINE



1. Center swivel joint
2. R.H. travel motor
3. R.H. final drive
4. Hydraulic tank
5. Travel shuttle valve
6. Control valve assembly
7. Main pumps
8. L.H. final drive
9. L.H. travel motor

- The travel control system consists of the following components.
  - Travel levers: These are used by the operator to steer the machine and to select FORWARD or REVERSE.
  - Travel control valve (6) (interconnected with travel levers): This regulates the direction of flow of the oil from main pumps (7).
  - The oil from travel control valve (6) flows through center swivel joint (1) to travel motors (2), (9). A parking brake is installed to the travel motor.
  - Final drives (3), (8): This reduces the travel motor speed and transmits to sprocket.
  - Straight-travel valve (built-in control valve (6)): This acts to prevent the machine from deviating when the machine is traveling, and the operator uses the swing, boom, arm or bucket circuit.
- The function of travel brake is carried out by the travel motor itself. When travel levers are moved from "TRAVEL" position to "NEUTRAL", the inlet and outlet ports to motor are closed, so the machine stops.
- For operation of the travel control levers and direction of travel, see OPERATION & MAINTENANCE MANUAL.
- For details of main pumps (7) and control valves (6), see Section 61 HYDRAULIC SYSTEM.

BE220G

TRAVEL CONTROL CIRCUIT

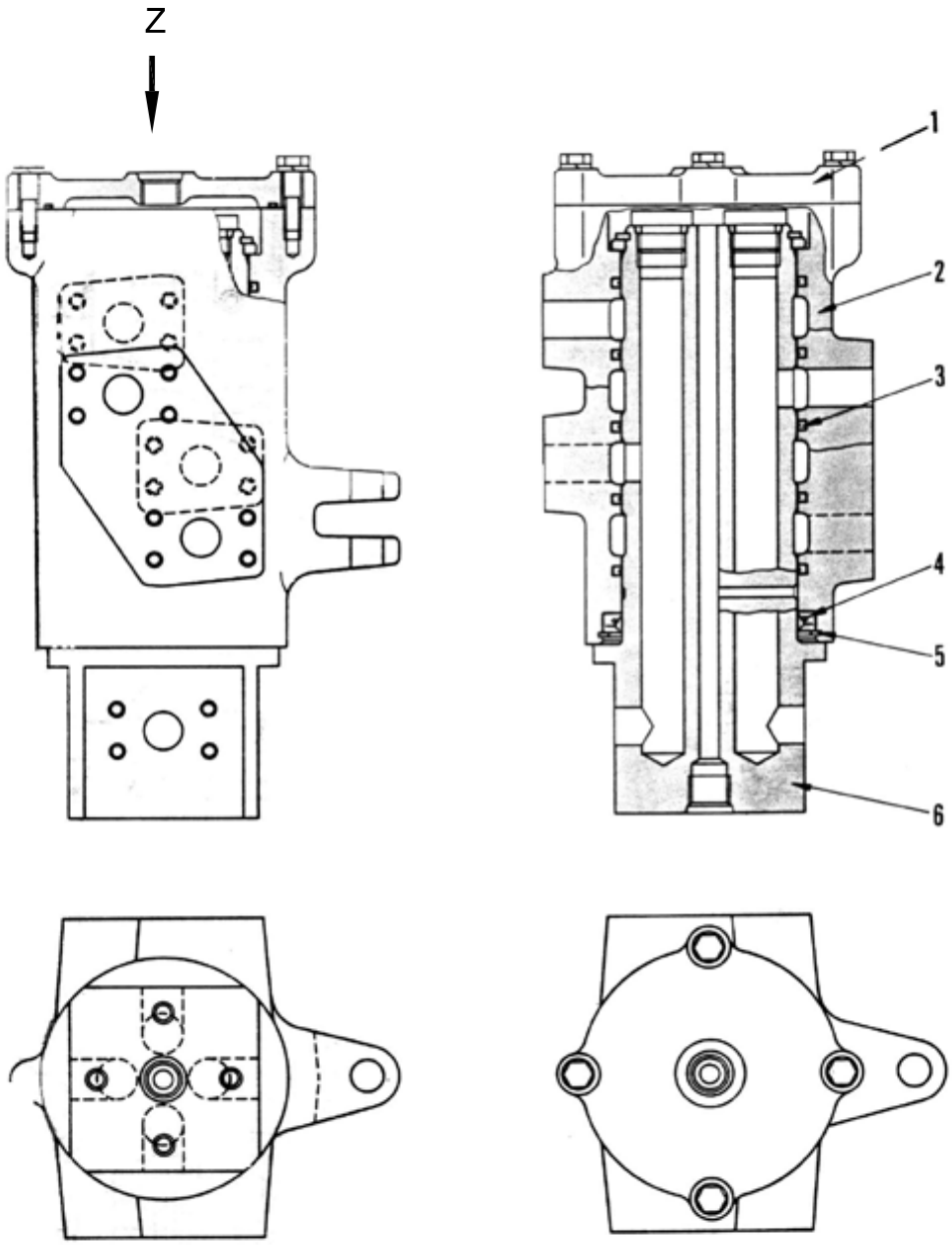
Refer PMP instruction manual of PMCI. M001

BE220 BE220LC

TRAVEL CONTROL CIRCUIT

Refer Rexrot instruction manual of HS-64-05-E0403-1-3

CENTER SWIVEL JOINT



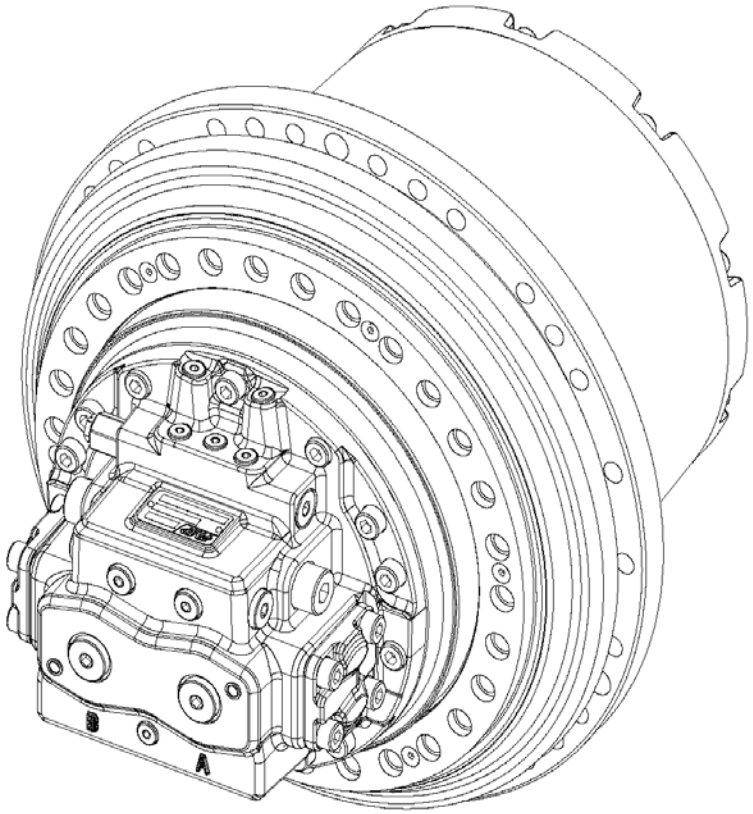
View Z

1. Cover
2. Body
3. Slipper seal
4. Oil seal
5. Snap ring
6. Shaft

- The center swivel joint is used for the piping between the upper structure (which swings) and the under-carriage (which is fixed). Oil is sent from the control valves installed in the upper structure and goes to the travel motors installed in the undercarriage.
- The oil from the travel control valve enters the hole in the port of body (2), flows through the grooves on the outside circumference of body (2) and enters the vertical holes on shaft (6). From here it is sent to the travel motor.
- Slipper seal (3) is intalled to prevent the oil from leaking outside or from flowing into the neighboring port.

TRAVEL MOTOR (WITH PARKING BREAK) AND BREAK ASSEMBLY

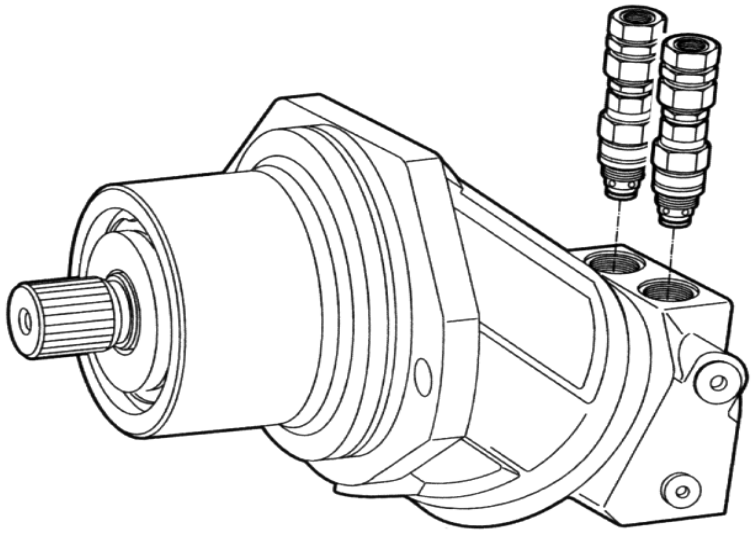
Refer PMP instruction manual of PMCI. M001



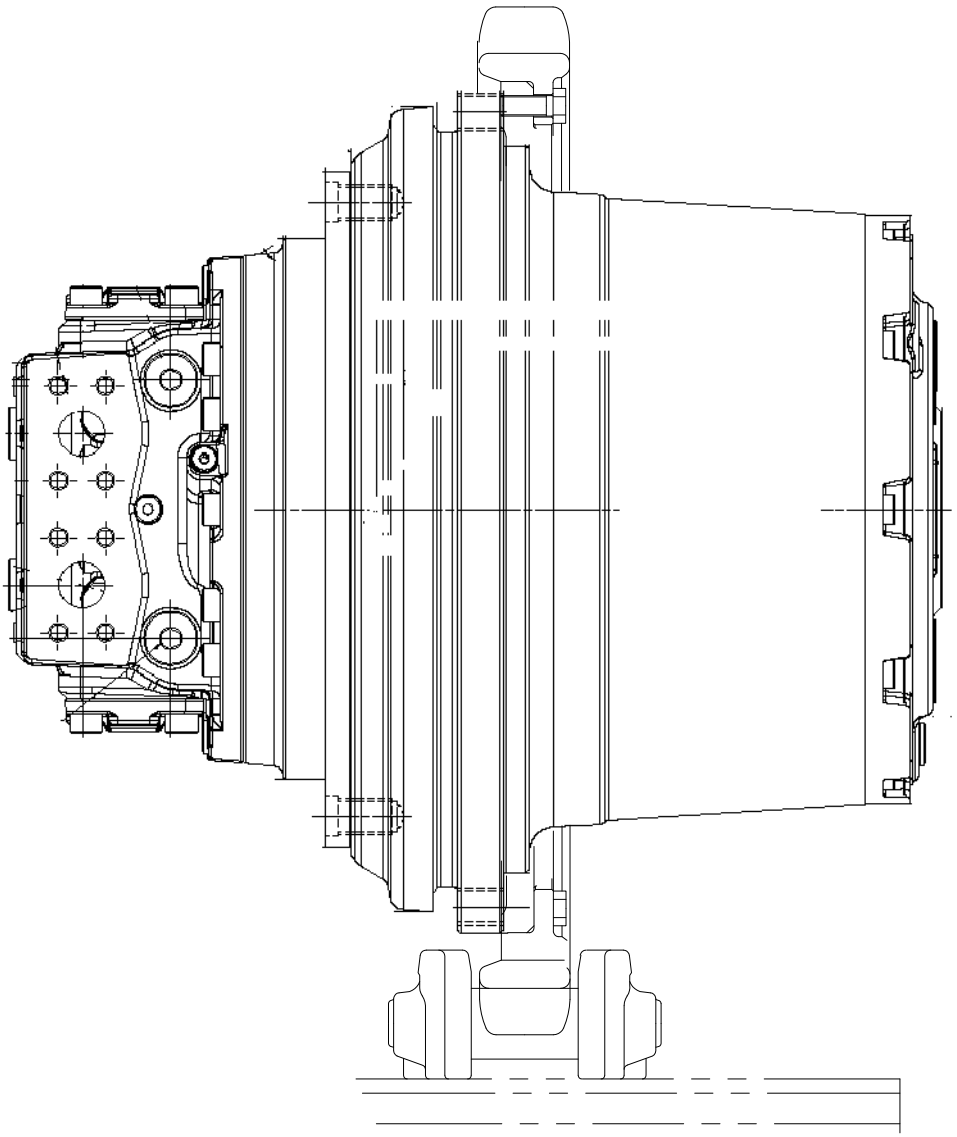
BE220 / BE220LC

TRAVEL MOTOR (WITH PARKING BRAKE) AND BREAK ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3



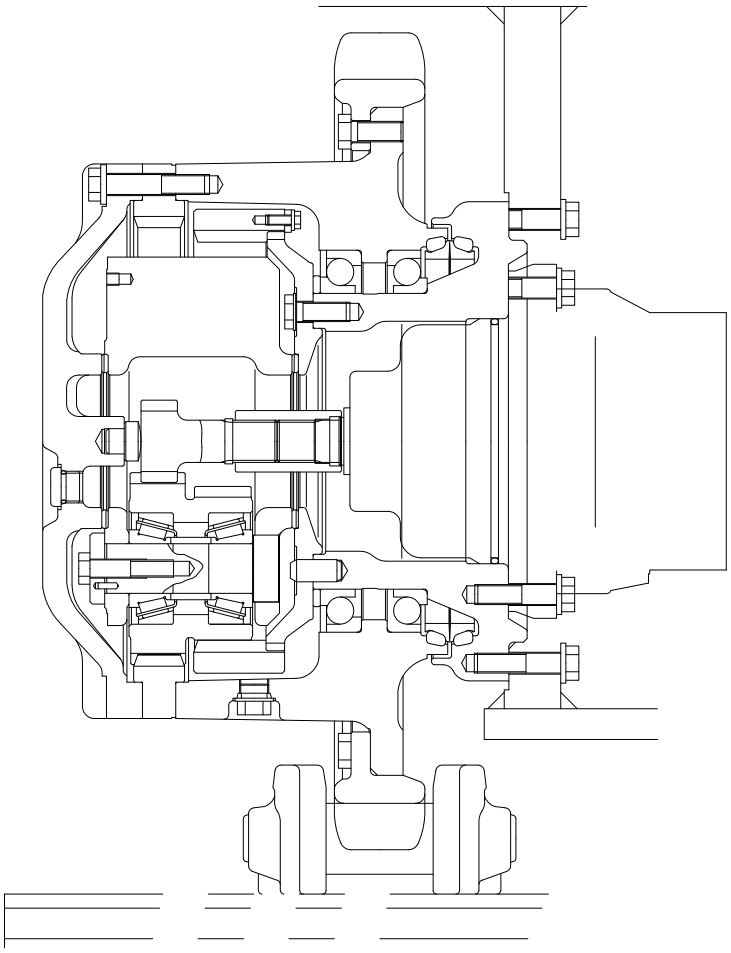
Refer PMP instruction manual of PMCI. M001



BE220 / BE220LC

FINAL DRIVE SYSTEM

Refer Rexrot instruction manual of HS-64-05-E0403-1-3



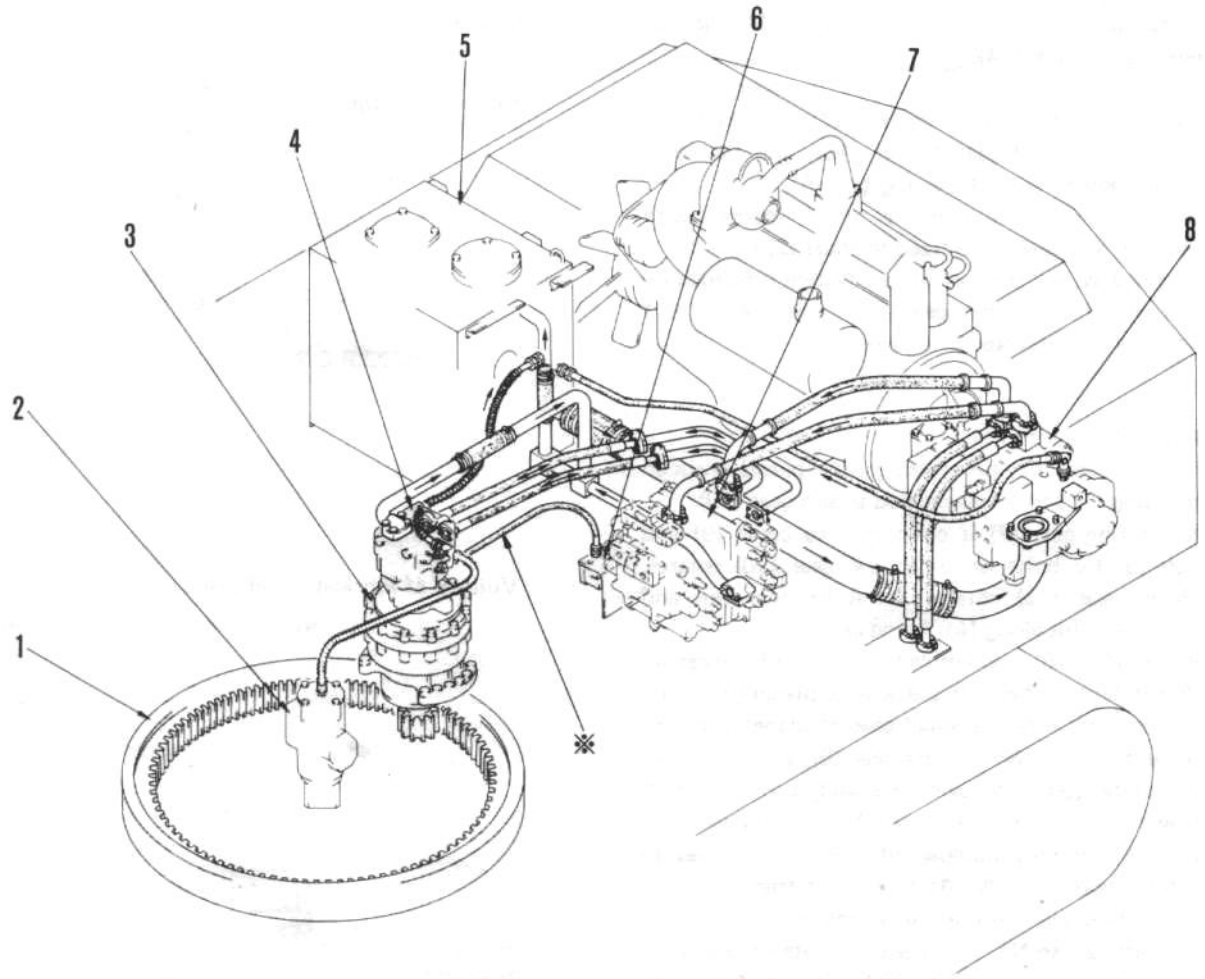
BE220G

SWING SYSTEM

Refer PMP instruction manual of PMTE. M001

SWING SYSTEM

OUTLINE



Note:

※ : This pipe is installed only on machines with a swing mechanical brake.

1. Swing circle
2. Center swivel joint
3. Swing machinery
4. Swing motor
5. Hydraulic tank
6. Solenoid valve (for swing mechanical brake (if equipped))
7. Swing control valve
8. Main pumps

The hydraulic excavator has a swing mechanism which allows the work equipment to swing 360 degrees. Thus digging work and loading dump trucks can be done without moving the machine.

The swing mechanism consists of swing motor (4) which rotates the upper structure, reduction gears (swing machinery) (3), swing circle (1), and center swivel joint (2) through which the hydraulic oil is delivered from the revolving upper structure to the undercarriage.

★ As for CENTER SWIVEL JOINT, see page 21-15.

BE220G

SWING CONTROL CIRCUIT

Refer PMP instruction manual of PMTE. M001

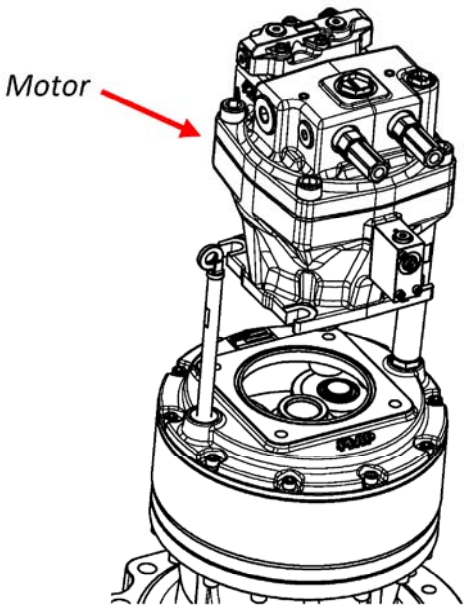
BE220 BE220LC

SWING CONTROL CIRCUIT

Refer Rexrot instruction manual of HS-64-05-E0403-1-3

SWING MOTOR

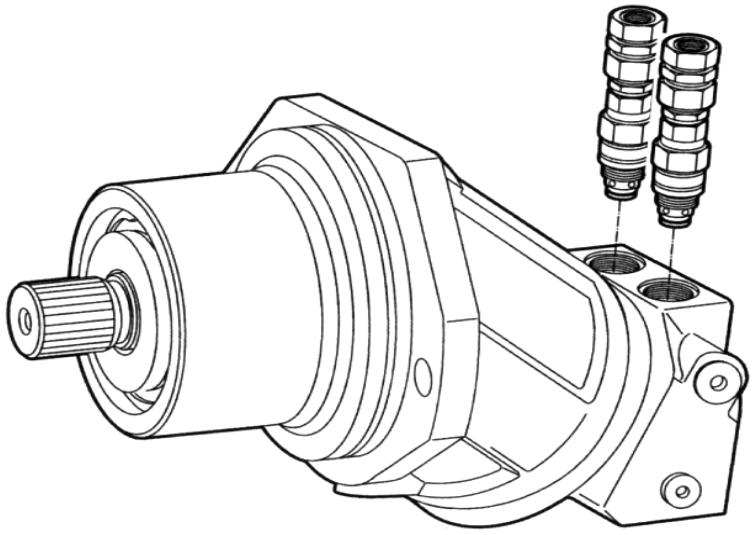
Refer PMP instruction manual of PMTE. M001



BE220 / BE220LC

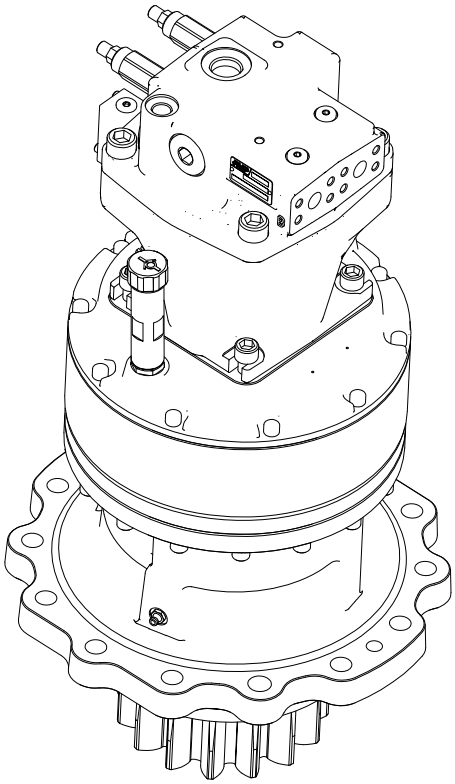
SWING MOTOR

Refer Rexrot instruction manual of HS-64-05-E0403-1-3



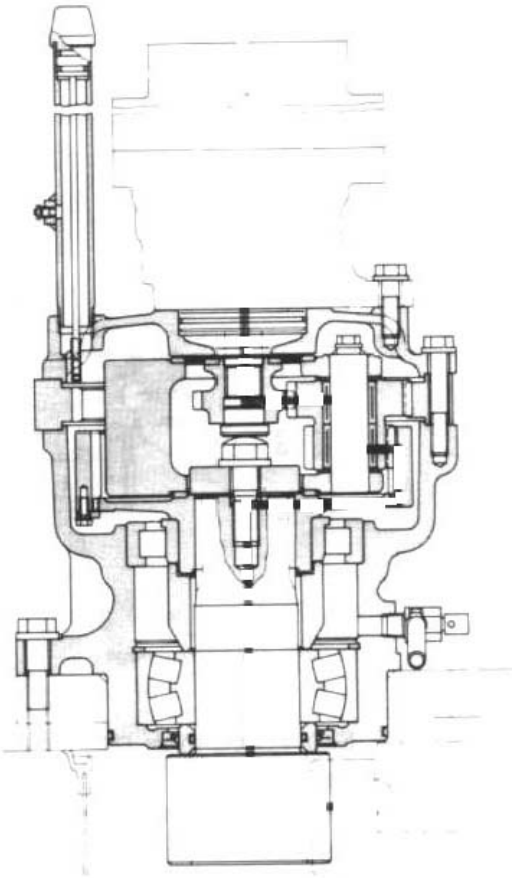
SWING MACHINERY

Refer PMP instruction manual of PMTE. M001

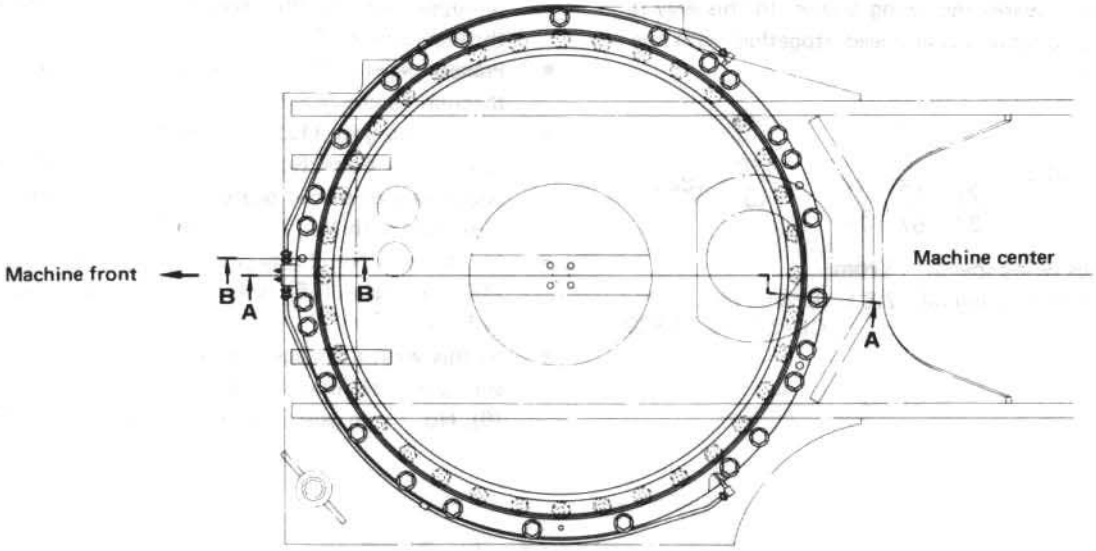


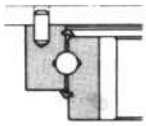
BE220 / BE220LC

SWING MACHINERY

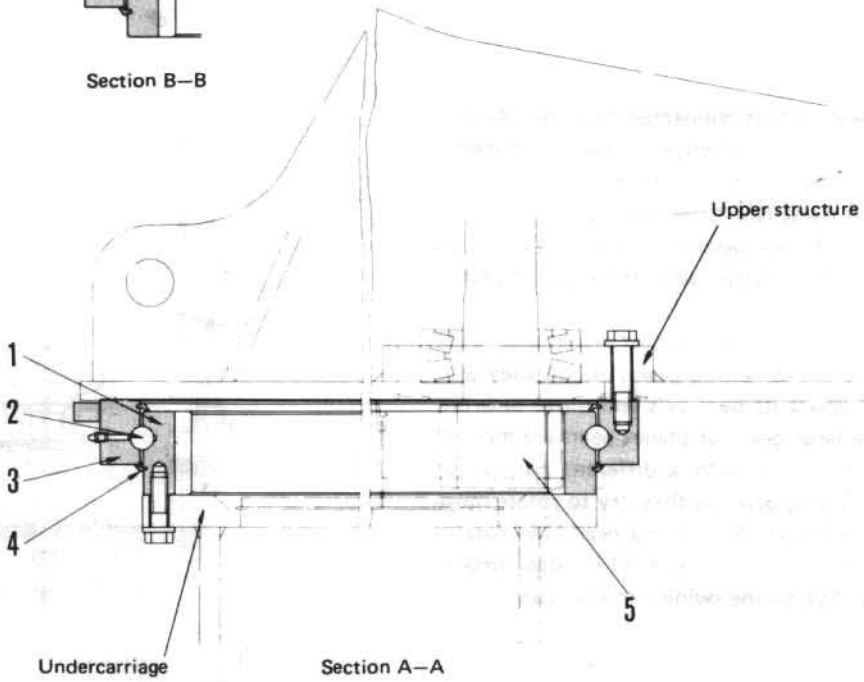


SWING CIRCLE





Section B–B



Section A–A

1. Swing circle inner race
2. Ball bearing
3. Swing circle outer race
4. Seal
5. Swing pinion

Grease volume: 18.7ℓ

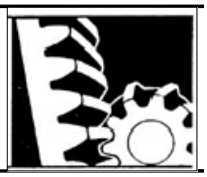
SWING CIRCLE

OPERATION

- The poer (revolution transmitted to swing pinion (5) via the swing machinery from the swing motor rotates on its own axis and it also revolves round the center of swing circle inner race which is bolted to the undercarriage.
- Swing circle outer race (3) is rotated together with the upper strucure because swing circle outer race (3) is bolted to the upper structure.
- In other words, the upper structure and the under-carriage can swing independently by this swing circle mechanism.

POWER TRAIN

06 DISASSEMBLY AND ASSEMBLY



* When operating the hydraulic cylinders for the first time after reassembling cylinders,pumps and piping always bleed the air as follows :
1. Start engine and run at low idling.
2. Operate hydraulic cylinder 4 to 5 times,stopping 100 mm from stroke end.
3. Next,operate cylinder 3 to 4 times to stroke end.
4. After doing this,run engine at normal speed.

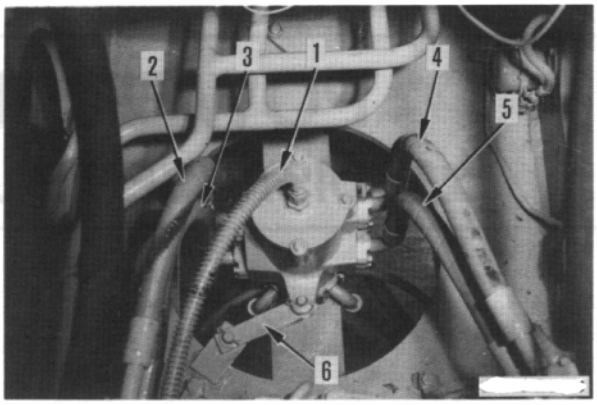
* After repair or long storage,follow the same procedure.

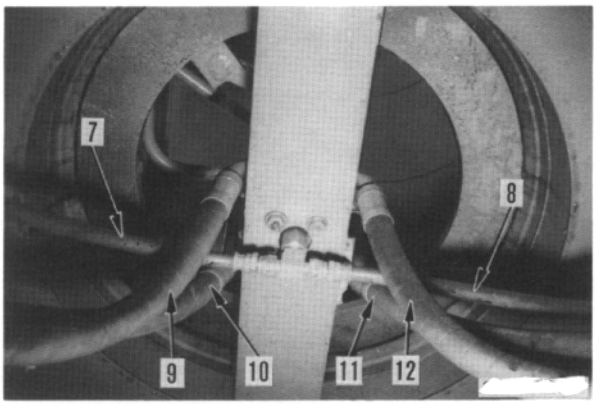
REMOVAL OF CENTER SWIVEL JOINT ASSEMBLY

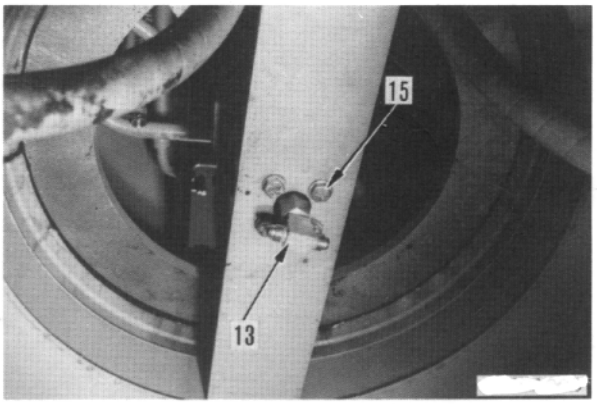
Lower the work equipment completely to the ground and stop the engine. Operate the control lever several times to release the remaining pressure in the hydraulic piping. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

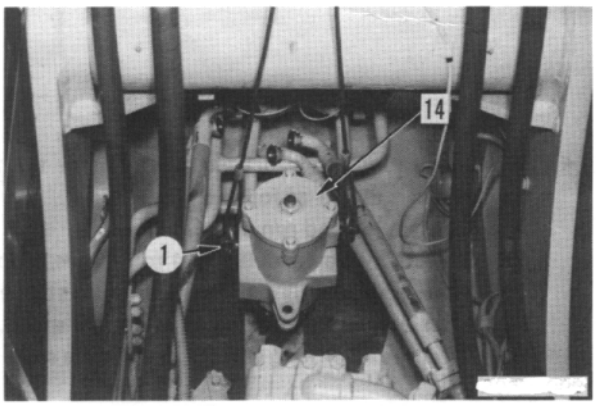
1. Disconnect upper drain hose (1) of travel motor.
   ★ Fit a blind plug in the hose.
2. Disconnect upper travel hoses (2), (3), (4) and (5).
3. Pull out pin and disconnect plate (6).
4. Disconnect lower drain hoses (7) and (8) of travel motor.
   ★ Fit a blind plug in the hose.
5. Disconnect lower travel hoses (9), (10), (11) and (12).
6. Remove tee (13) at bottom of swivel joint.
7. Using eye bolts ① (Dia. = 8 mm, Pitch = 1.25 mm), sling center swivel joint assembly (14) and remove 4 mounting bolts (15).
8. Lift off center swivel joint assembly (14).

kg Center swivel joint assembly: 30 kg



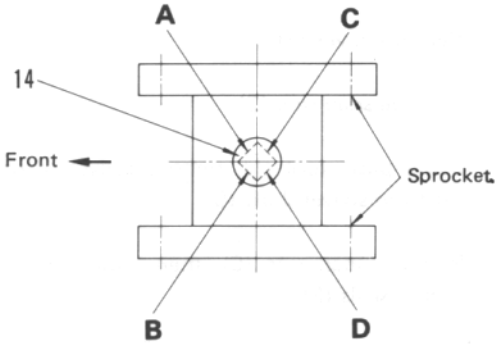






INSTALLATION OF CENTER SWIVEL JOINT ASSEMBLY

1. Using eye bolts (Dia. = 8 mm, Pitch = 1.25 mm), raise center swivel joint assembly (14). Align stamped marks **A**, **B**, **C** and **D** on port with positions shown in diagram on right, then set on frame.

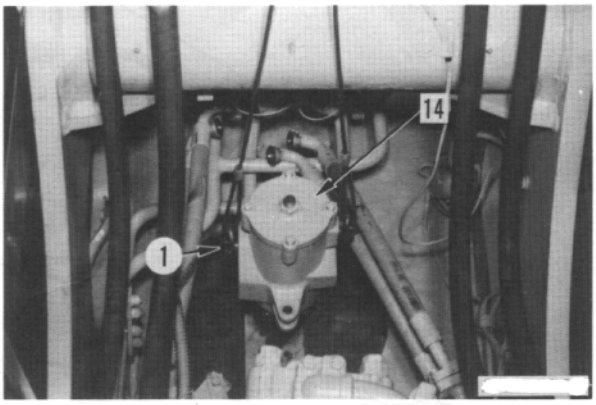


2. Tighten 4 mounting bolts (15).

3. Fit O-ring and install tee (13) at bottom of swivel joint.

4. Fit O-rings and connect lower travel hoses (12), (11), (10) and (9).
   ★ Install hose without twisting or interference.

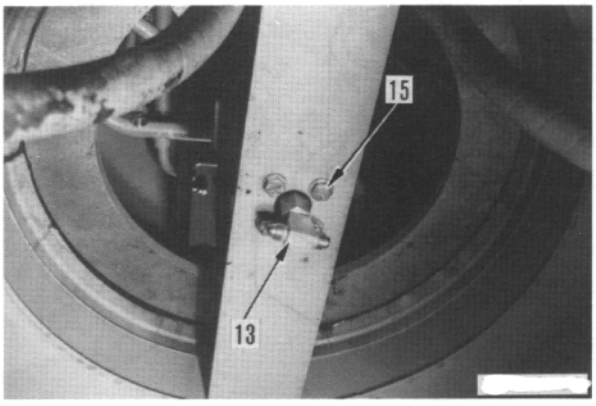
5. Connect lower drain hoses (8) and (7) of travel motor.
   kgm Sleeve nut: 5 ± 2 kgm
   (Width across flats: 24 mm)
   ★ Install hose without twisting or interference.



6. Install plate (6) with pin.

7. Fit O-rings and connect upper travel hoses (5), (4), (3) and (2).

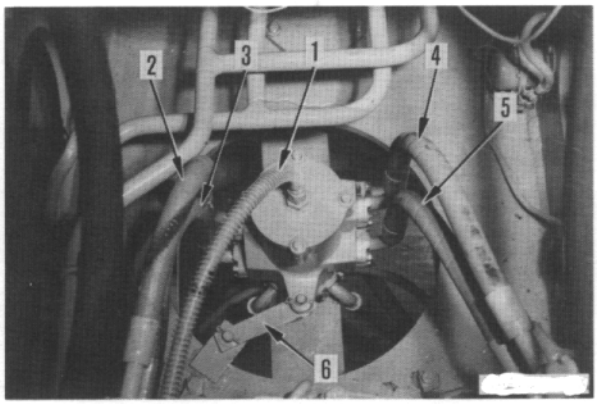
8. Connect upper drain hose (1) of travel motor.
   kgm Sleeve nut: 5 ± 2 kgm
   (Width across flats: 24 mm)
   ★ Install hose without twisting or interference.

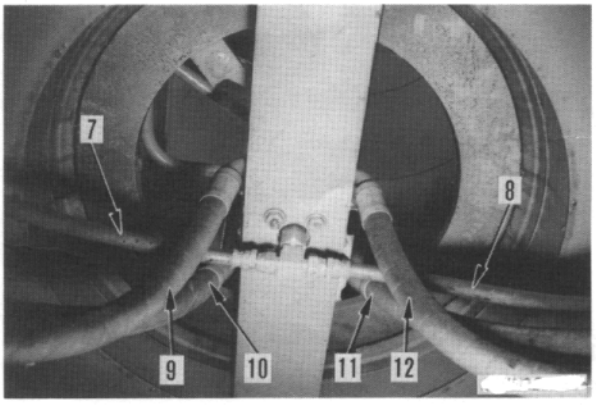


★ Start the engine and bleed the air from the travel motor.

★ For details, see section 62, TESTING AND ADJUSTING, BLEEDING AIR FROM TRAVEL MOTOR.

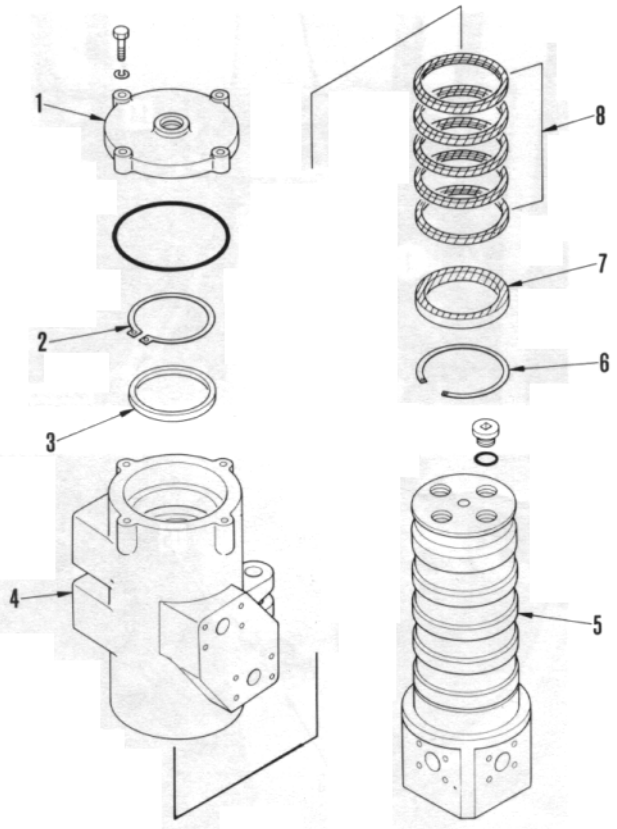
★ After bleeding the air, add oil to the hydraulic tank to the specified level.

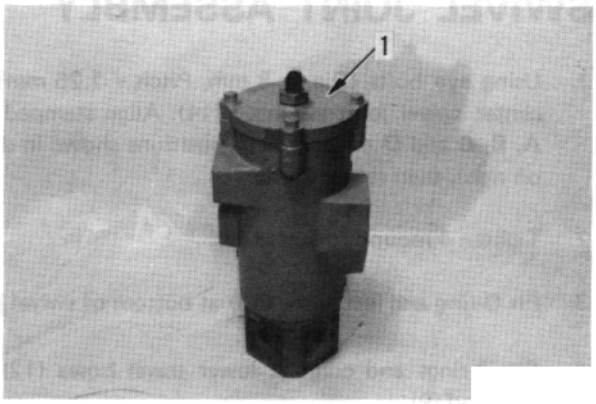


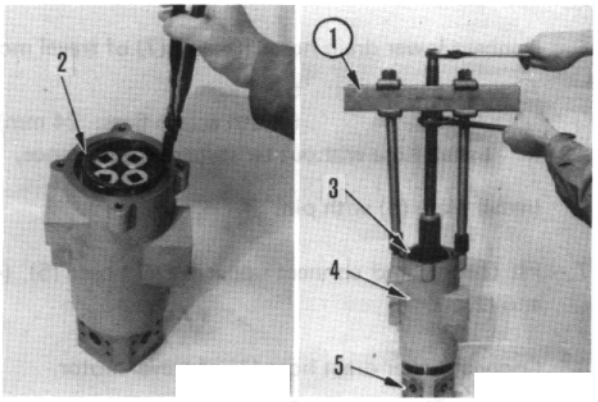


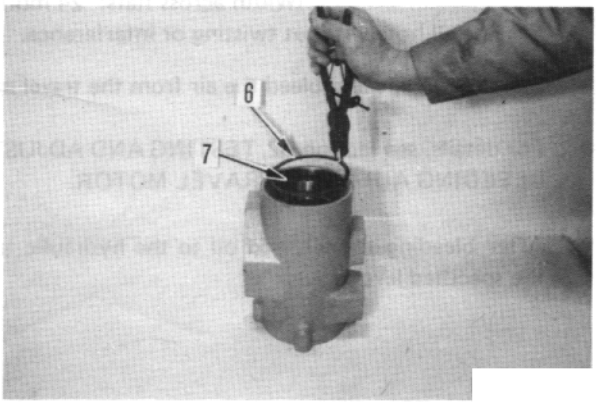
DISASSEMBLY OF CENTER SWIVEL JOINT ASSEMBLY

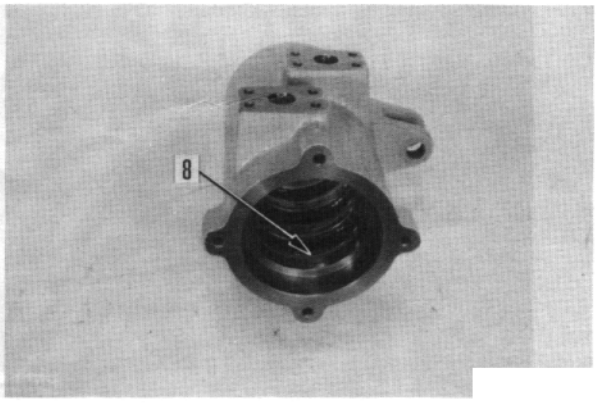
1. Remove cover (1).
2. Remove snap ring (2).
3. Using push tool ①, remove swivel rotor (4) and ring (3) from swivel shaft (5).
4. Remove snap ring (6), then remove oil seal (7) and 5 slipper seals (8).











ASSEMBLY OF CENTER SWIVEL JOINT ASSEMBLY

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil or grease (G2-LI) before installing.

1. Assemble 5 slipper seals (8) in swivel rotor (4).

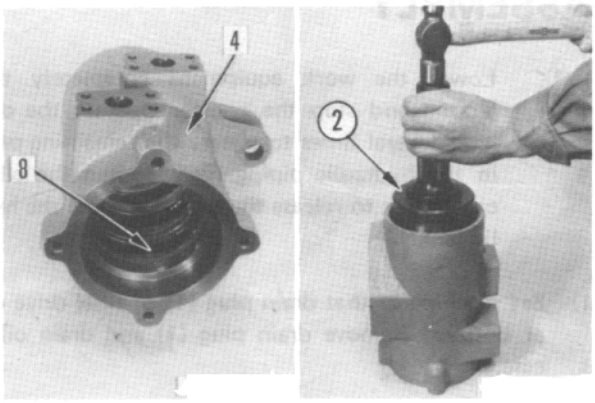
2. Using push tool ② (outside diameter: 110 mm), press fit oil seal (7) in swivel rotor (4), then install snap ring (6).

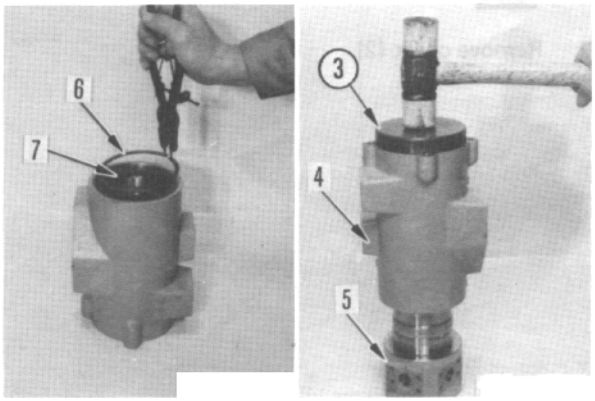
   Oil seal lip: Grease (G2-LI)

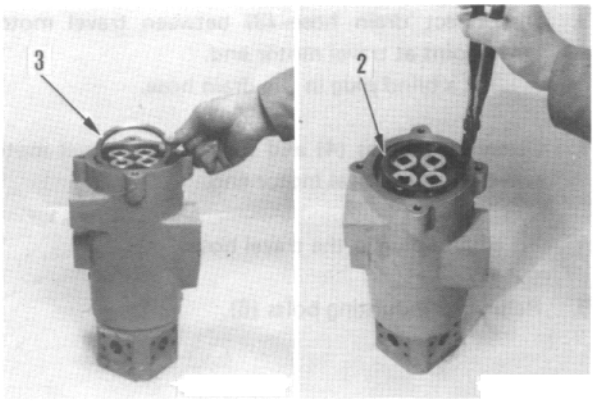
3. Set swivel shaft (5) on block, then using push tool ③ (outside diameter: 130 mm), tap swivel rotor (4) with a plastic hammer to install.
   ★ When installing the rotor, be careful not to damage the lip of the slipper seals or oil seal.

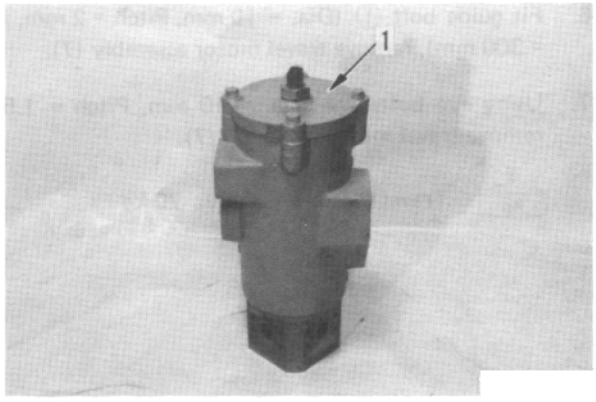
4. Install ring (3), then secure with snap ring (2).

5. Fit O-ring and install cover (1).



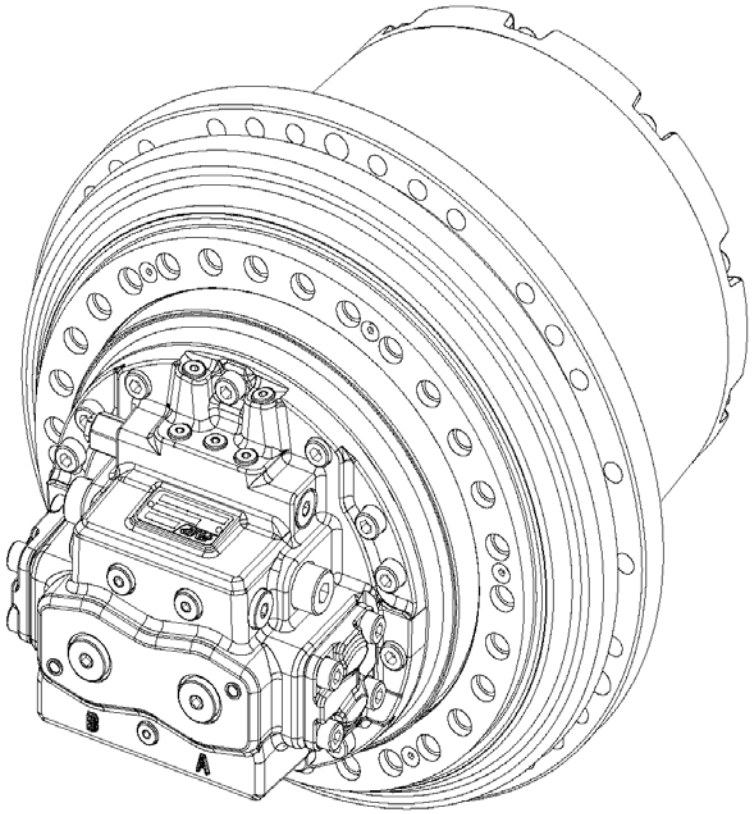






REMOVAL OF TRAVEL MOTOR ASSEMBLY

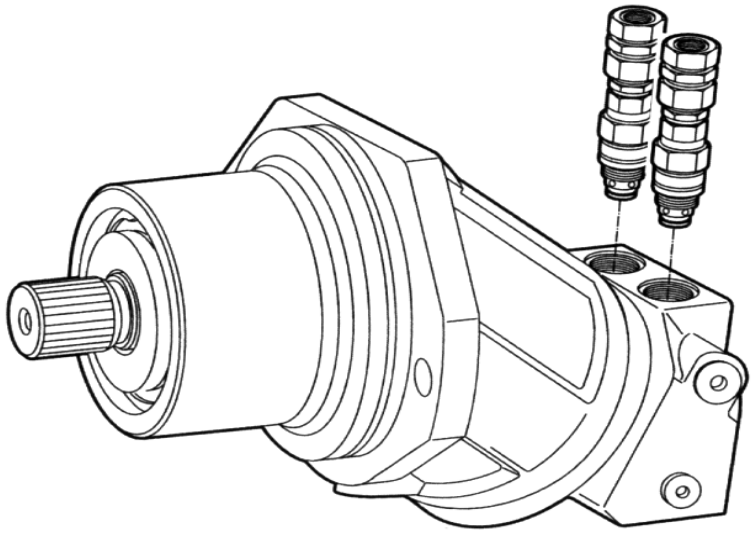
Refer PMP instruction manual of PMCI. M001



BE220 / BE220LC

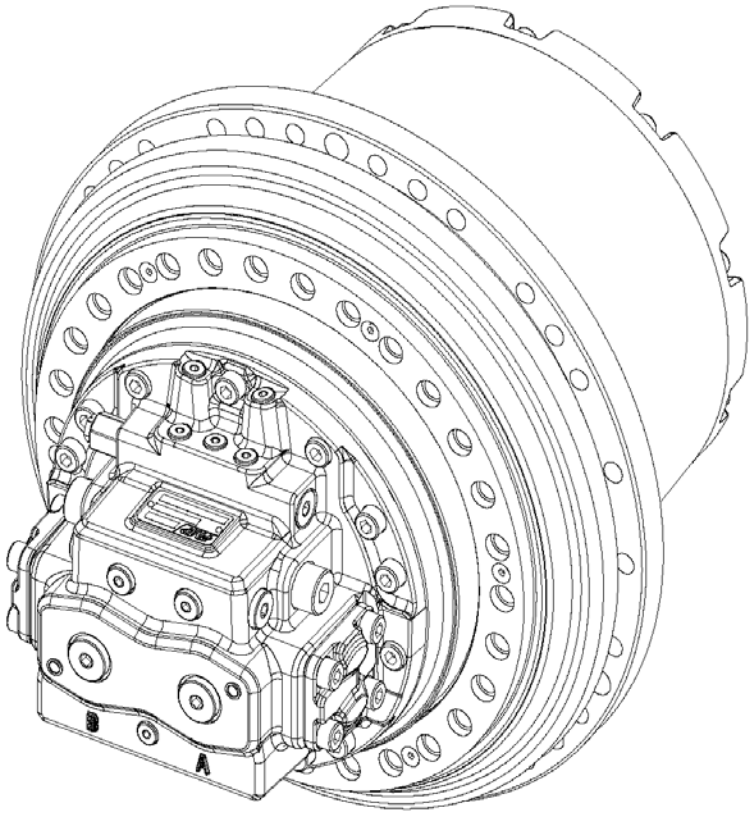
REMOVAL OF TRAVEL MOTOR ASSEMBLY

Refer Rexroth instruction manual of HS-64-05-E0403-1-3



INSTALLATION OF TRAVEL MOTOR ASSEMBLY

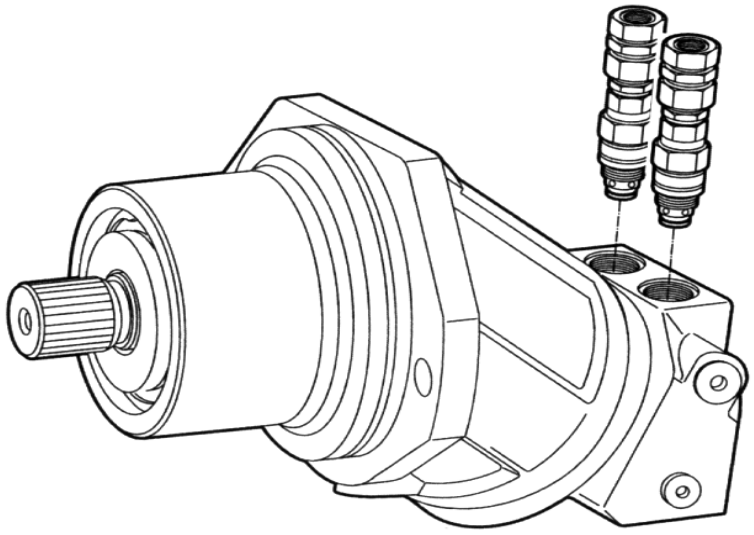
Refer PMP instruction manual of PMCI. M001



BE220 / BE220LC

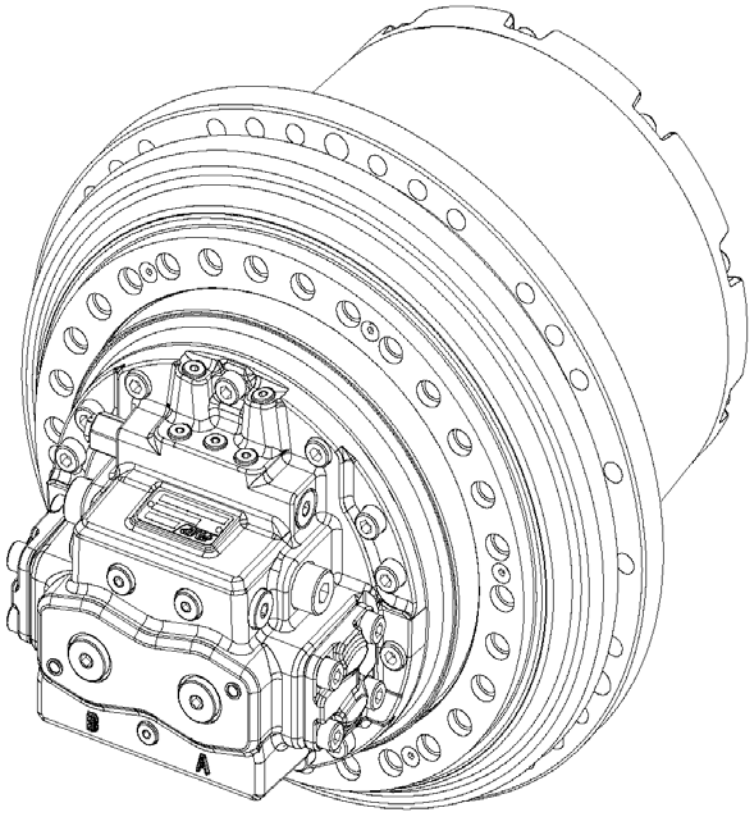
INSTALLATION OF TRAVEL MOTOR ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3



DISASSEMBLY OF TRAVEL MOTOR ASSEMBLY

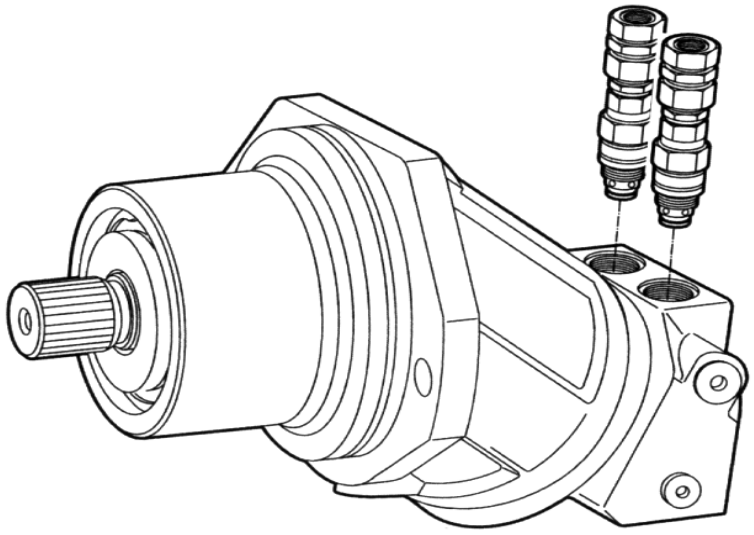
Refer PMP instruction manual of PMCI. M001



BE220 / BE220LC

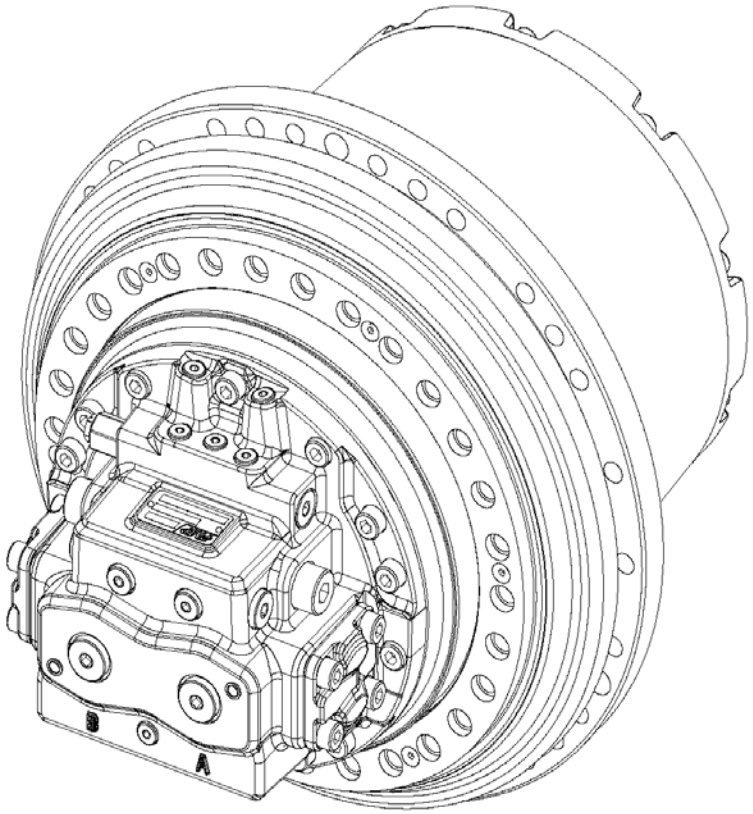
DISASSEMBLY OF TRAVEL MOTOR ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3



ASSEMBLY OF TRAVEL MOTOR ASSEMBLY

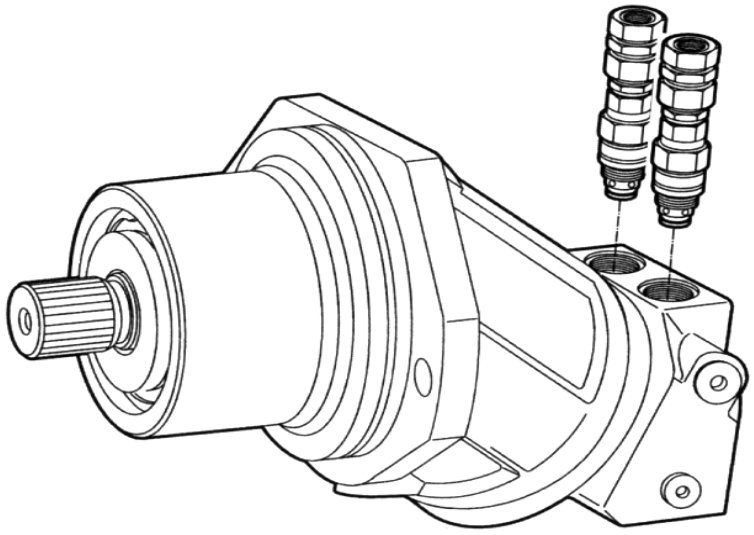
Refer PMP instruction manual of PMCI. M001



BE220 / BE220LC

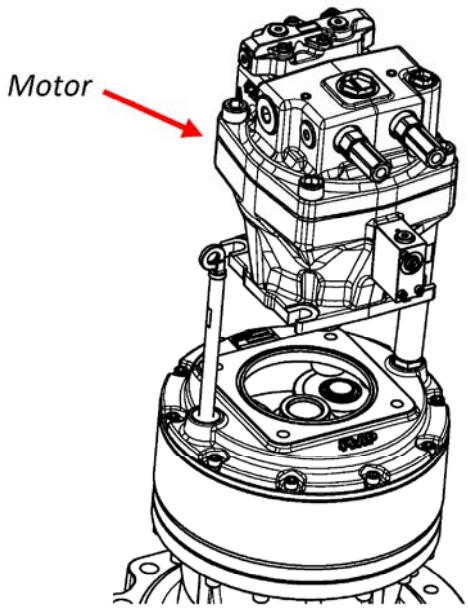
ASSEMBLY OF TRAVEL MOTOR ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3



REMOVEL AND INSTALLATION OF SWING MOTOR ASSEMBLY

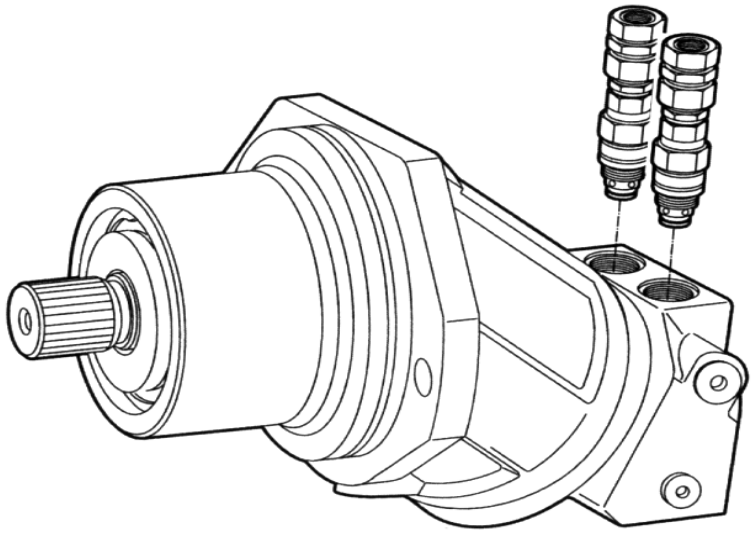
Refer PMP instruction manual of PMTE. M001



BE220 / BE220LC

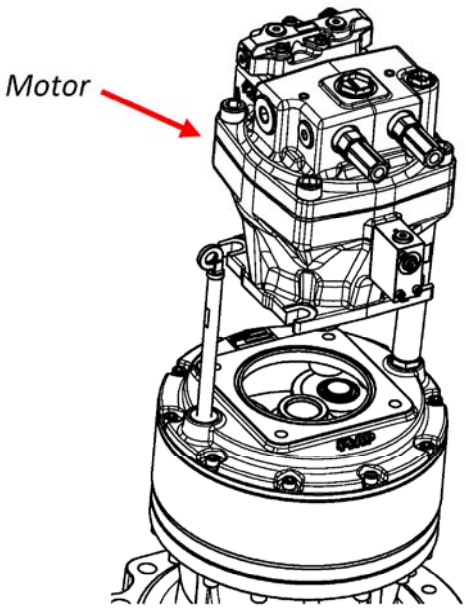
REMOVEL AND INSTALLATION OF SWING MOTOR ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3



DISASSEMBLY OF SWING MOTOR ASSEMBLY

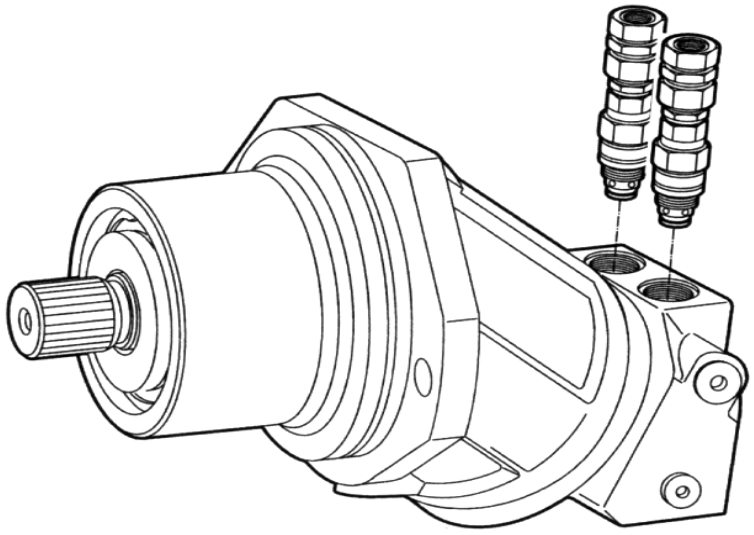
Refer PMP instruction manual of PMTE. M001



BE220 / BE220LC

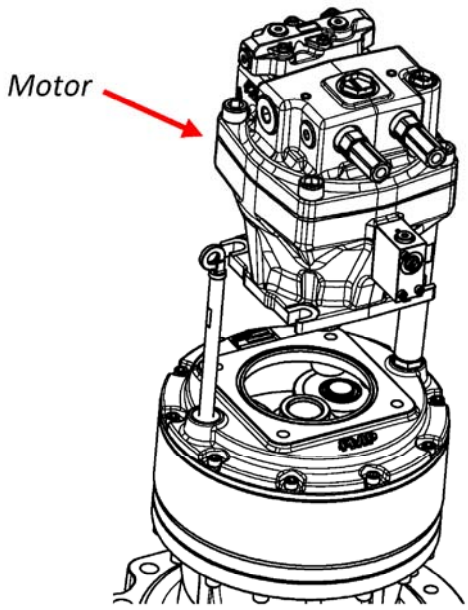
DISASSEMBLY OF SWING MOTOR ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3



ASSEMBLY OF SWING MOTOR ASSEMBLY

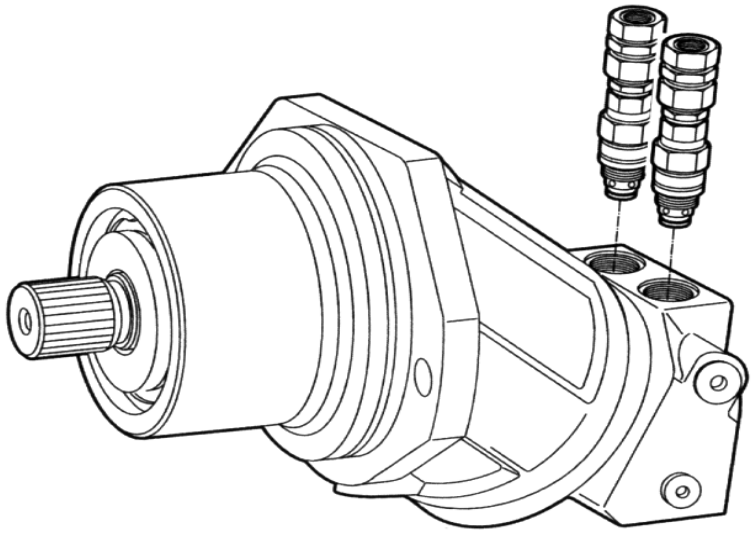
Refer PMP instruction manual of PMTE. M001



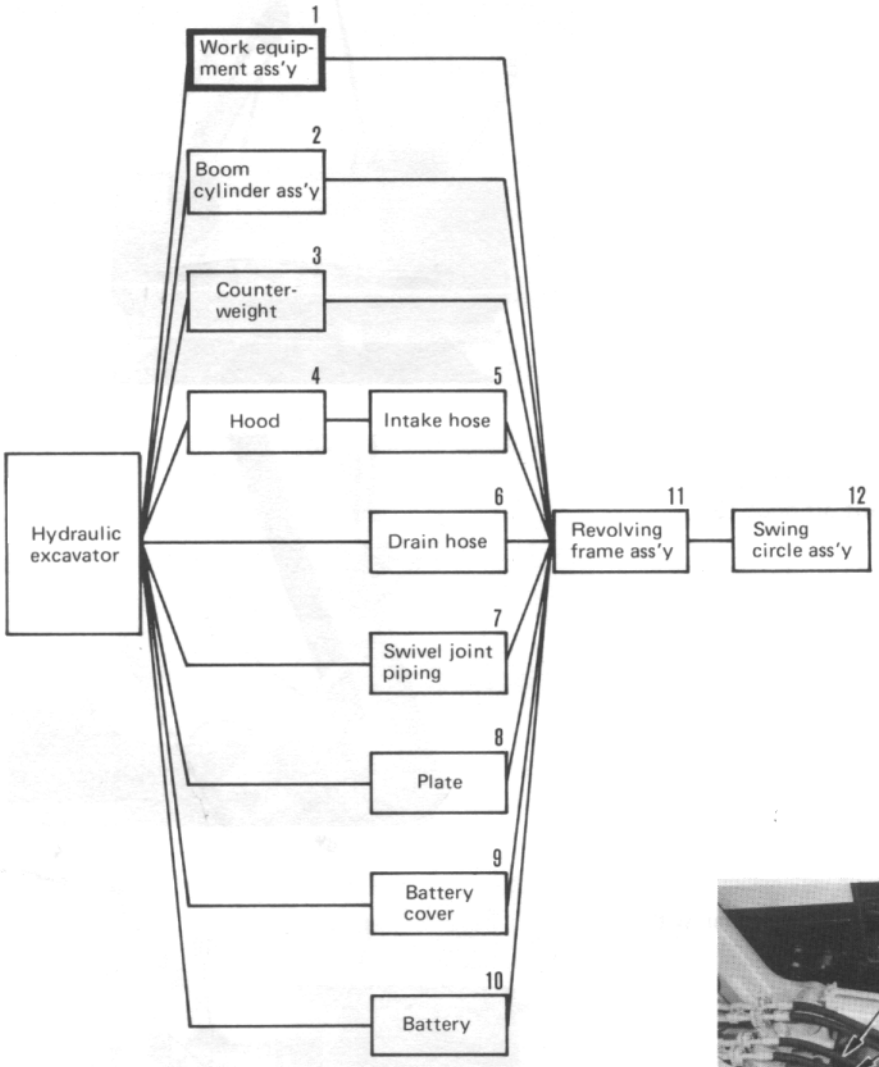
BE220 / BE220LC

ASSEMBLY OF SWING MOTOR ASSEMBLY

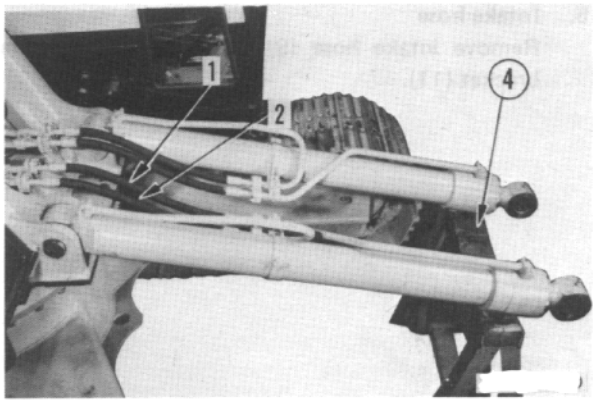
Refer Rexrot instruction manual of HS-64-05-E0403-1-3



REMOVAL OF SWING CIRCLE ASSEMBLY



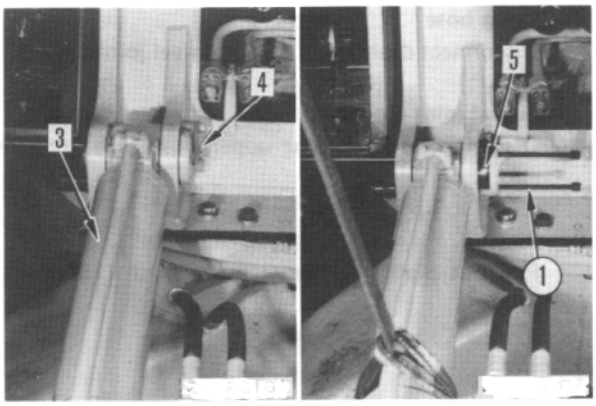
1. **Work equipment assembly**
   Remove work equipment assembly. For details, see section 63, REMOVAL OF WORK EQUIPMENT ASSEMBLY.



2. **Boom cylinder assembly**
   1) Set boom cylinder on stand ④. Disconnect boom cylinder hoses (1) and (2).
   2) Sling boom cylinder assembly (3), and remove lock plate (4). Using forcing screw ① (Dia. = 12 mm, Pitch = 1.75 mm), pull out pin (5), then remove boom cylinder assembly (3).

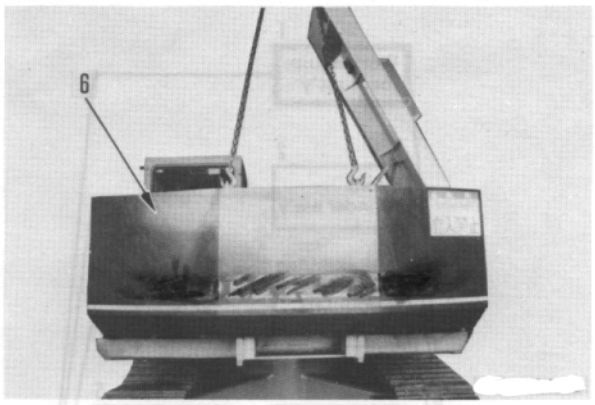
   kg Boom cylinder assembly: 185 kg

   ★ Remove the other boom cylinder assembly in the same way.



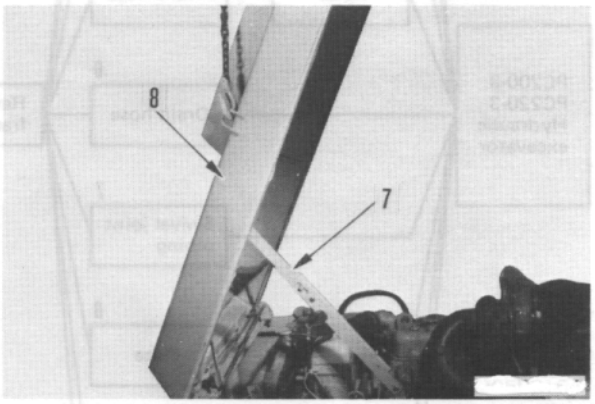
3. **Counterweight**
Sling counterweight (6), remove 4 mounting bolts, then lift off counterweight.

kg Counterweight: 3000 kg

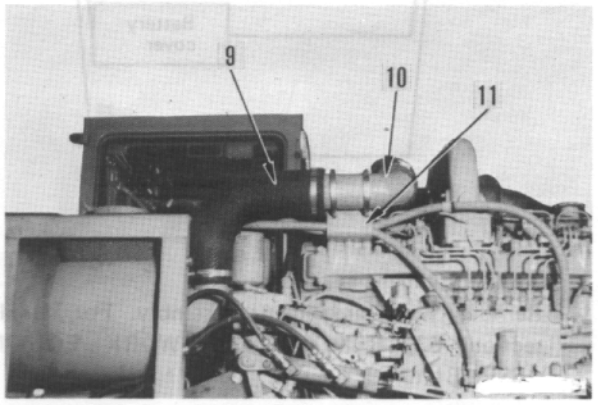


4. **Hood**
1) Sling hood, pull out pin and disconnect stay (7).
2) Remove 4 mounting bolts and lift off hood (8).

kg Hood: 55 kg



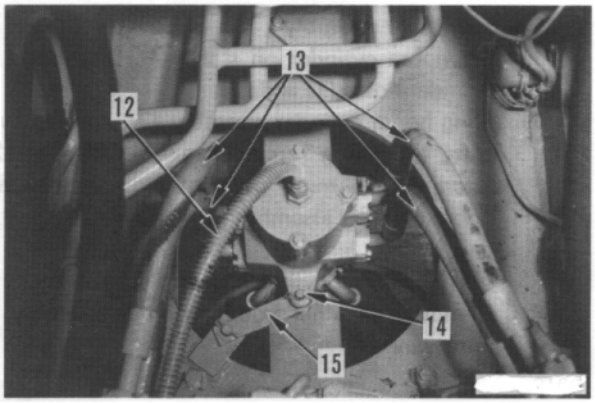
5. **Intake hose**
Remove intake hose (9) and tube (10) together with bracket (11).



6. **Drain hose**
Disconnect drain hose (12) at swivel joint end.

7. **Swivel joint piping**
Disconnect swivel joint upper hose (13) at swivel joint end.

8. **Plate**
Pull out pin (14), then remove plate (15) from swivel joint.

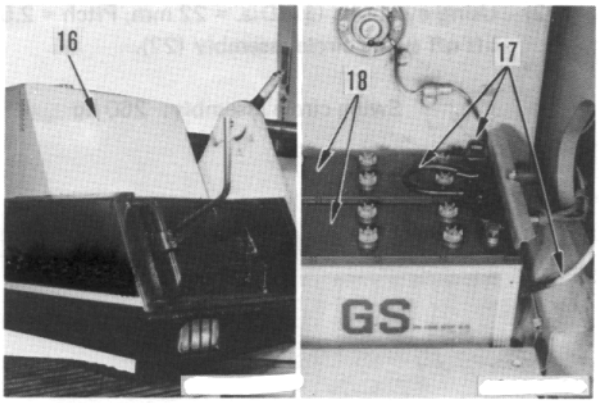


9. Battery cover

Remove battery cover (16).

10. Battery

1) Disconnect 3 battery wires (17).
   ★ Disconnect the lead from the negative (–) terminal of the battery first.
2) Remove 2 batteries (18).

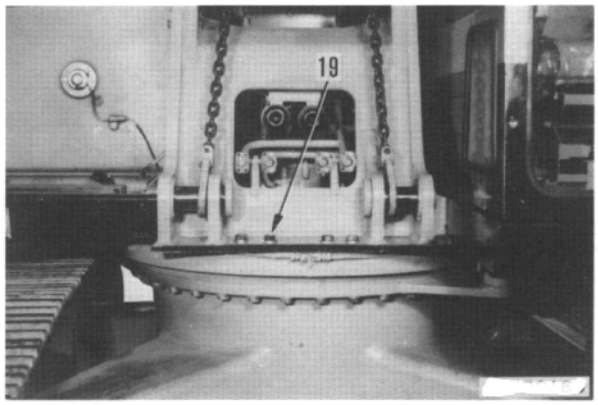


11. Revolving frame assembly

1) Remove mounting bolts (19) of revolving frame assembly, leaving 2 or 3 mounting bolts at front and rear.

2) Sling revolving frame assembly (20).
   ★ The wire is hooked to the mounting frame of the counterweight and will contact the engine, so fit the blocks securely in position. At the front, hook the wire to the boom cylinder bottom mount.
   ★ Use lever block ② at the front and adjust the length of the wire. This makes it easier to center the load.

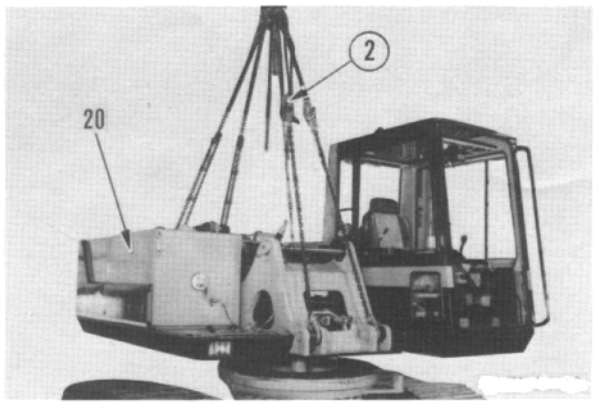
   ⚠ The load is extremely heavy, so check that the lifting tool is free from damage.



3) In this position, loosen remaining mounting bolts, then raise revolving frame assembly and check that load is center to front, rear, left and right.
   ★ If the load is not centered, tighten the mounting bolts and adjust the length of the wire again.

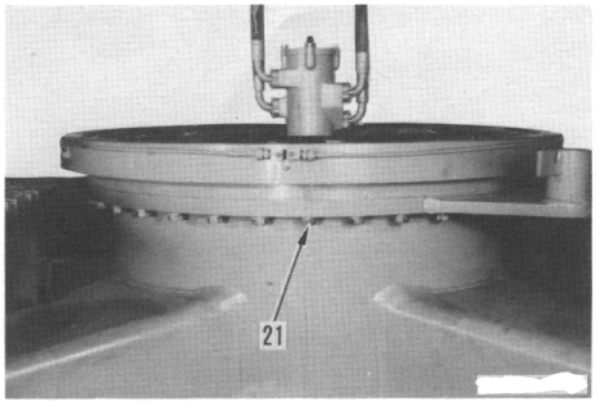
4) Repeat Step 3), and when load is centered, remove remaining mounting bolts and lift off revolving frame assembly.

   kg Revolving frame assembly: 4465 kg



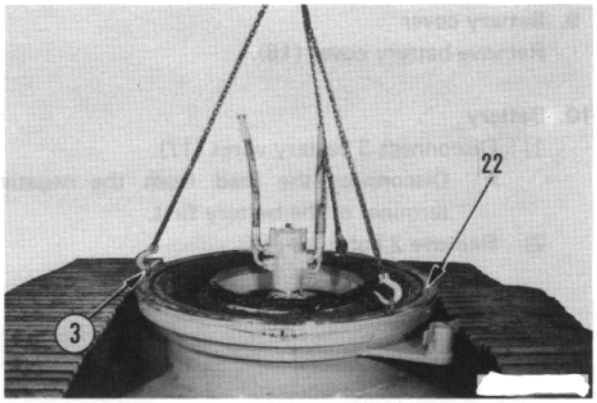
12. Swing circle assembly

1) Remove 36 mounting bolts (21).

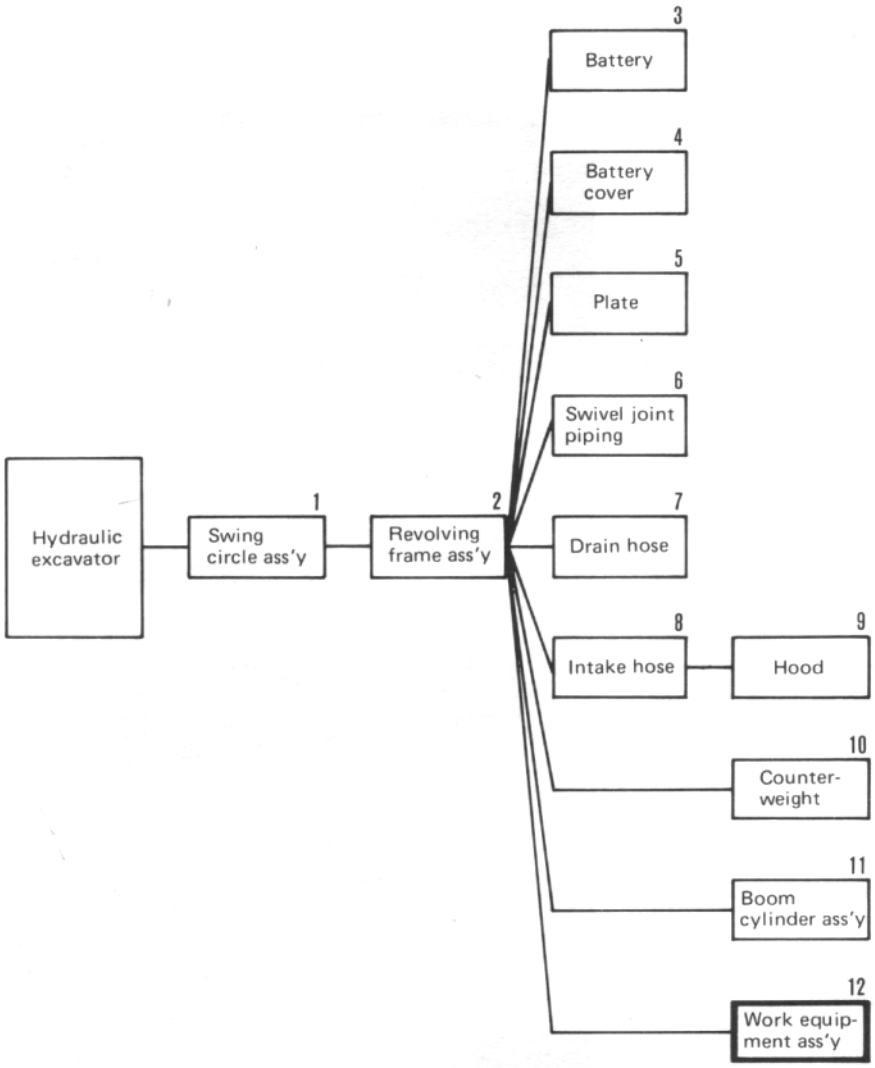


2) Using eye bolts ③ (Dia. = 22 mm, Pitch = 2.5 mm), lift off swing circle assembly (22).

kg Swing circle assembly: 260 kg

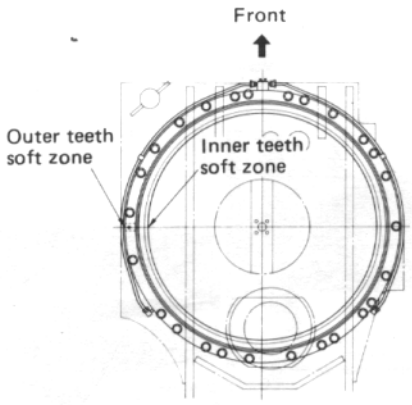


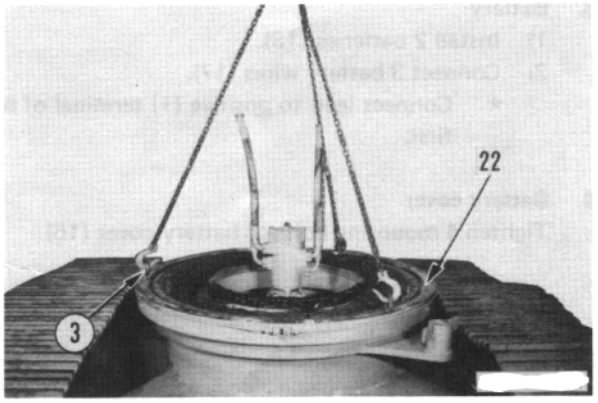
INSTALLATION OF SWING CIRCLE ASSEMBLY



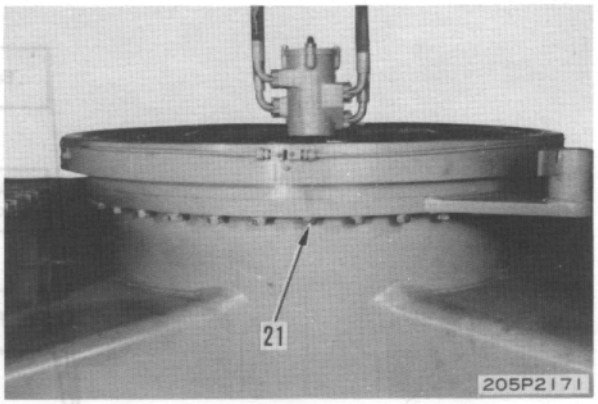
1. Swing circle assembly

1) Using eye bolts ③ (Dia. = 22 mm, Pitch = 2.5 mm), raise swing circle assembly (22). Align with inner teeth soft zone as shown in diagram, then set in position on frame.





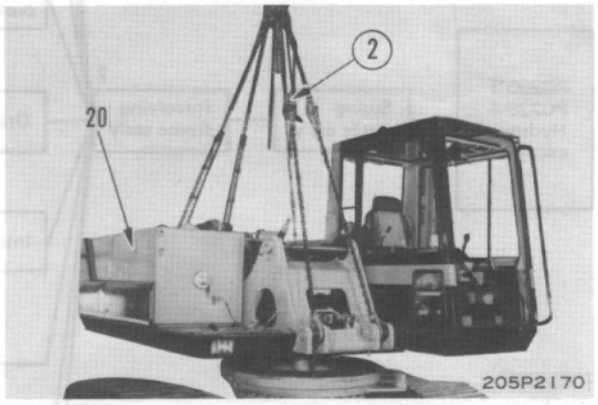
2) Tighten 36 mounting bolts (21).
   - Mounting bolts: Thread tightener (LT-2)
   - kgm Mounting bolt: 56 ± 6 kgm
   - Inner teeth of circle: Grease (G2-LI)



2. Revolving frame assembly

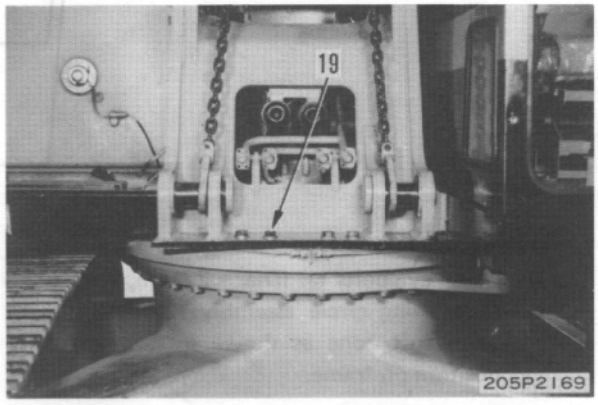
1) Raise revolving frame assembly (20) horizontally.
   - ★ The wire is hooked to the mounting frame of the counterweight and will contact the engine, so fit the blocks securely in position. At the front, hook the wire to the boom cylinder bottom mount.
   - ★ Use lever block ② at the front and adjust the length of the wire. This makes it easier to center the load.

   ⚠ The load is extremely heavy, so check that the lifting tool is free from damage.



2) Lower revolving frame assembly slowly, align swing pinion with circle gear, then align with dowel pin and set in position. Tighten 2 or 3 mounting bolts (19) at front and rear.
   - Top face of swing circle: Gasket sealant (LG-1)

3) Tighten all 26 mounting bolts (19).
   - Mounting bolt: Thread tightener (LT-2)
   - kgm Mounting bolt: 76 ± 8.5 kgm

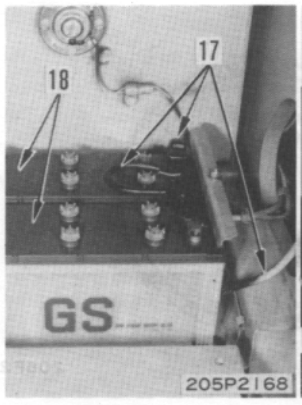


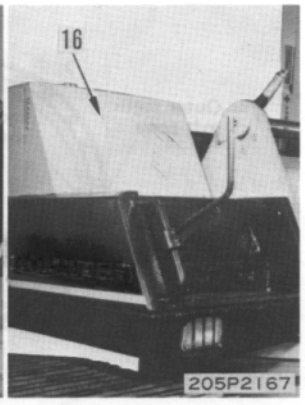
3. Battery

1) Install 2 batteries (18).
2) Connect 3 battery wires (17).
   - ★ Connect lead to positive (+) terminal of battery first.

4. Battery cover

Tighten 4 mounting bolts of battery cover (16).

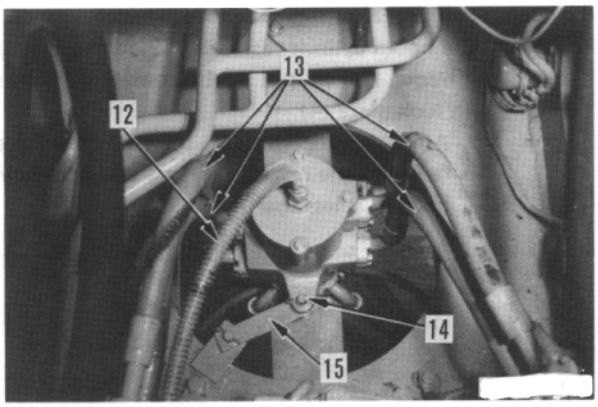




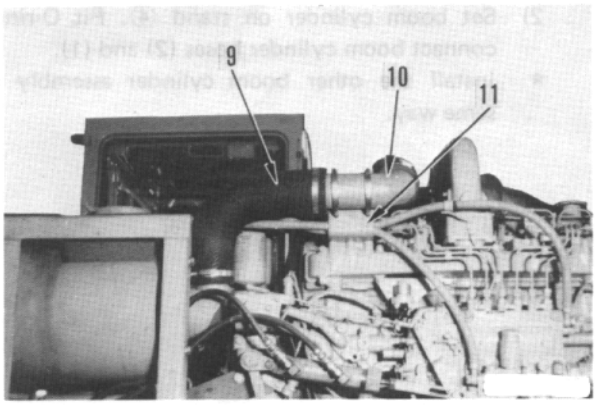
5. Plate
Set plate (15) on swivel joint, then install pin (14).

6. Swivel joint piping
Fit O-ring and connect swivel joint upper hose (13).
★ Install hose without twisting or interference.

7. Drain hose
Connect drain hose (12).
kgm Sleeve nut: 5 ± 2 kgm
(Width across flats: 24 mm)
★ Install hose without twisting or interference.

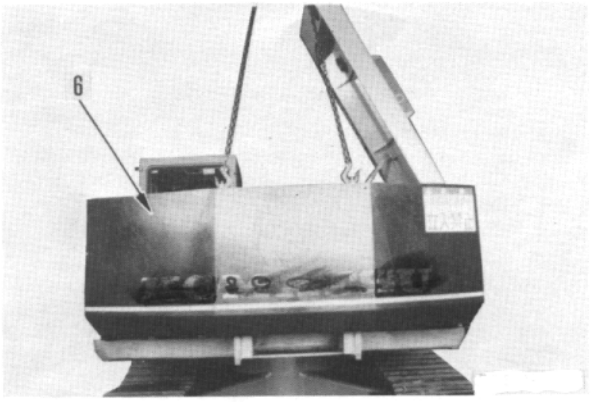


8. Intake hose
Install intake hose (9) and tube (10) together with bracket (11).



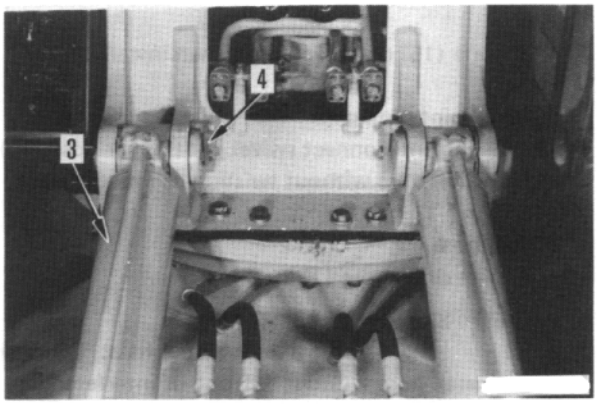
9. Hood
Raise hood (8) and set in position on frame. Tighten 4 mounting bolts, then connect stay (7).

10. Counterweight
Raise counterweight (6), set in position on frame, then tighten 4 mounting bolts.

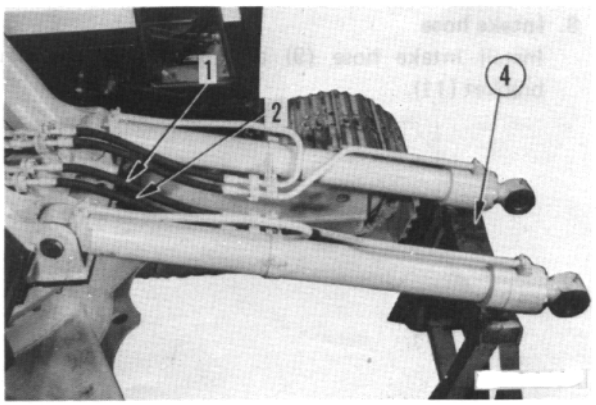


11. Boom cylinder assembly

1) Raise boom cylinder assembly (3), and set in position on frame. Knock pin at bottom end, then secure with lock plate (4).
   ★ Adjust with spacers so that the clearance between the revolving frame and boom cylinder bottom is less than 1 mm.



2) Set boom cylinder on stand ④. Fit O-rings and connect boom cylinder hoses (2) and (1).
★ Install the other boom cylinder assembly in the same way.



12. Work equipment assembly

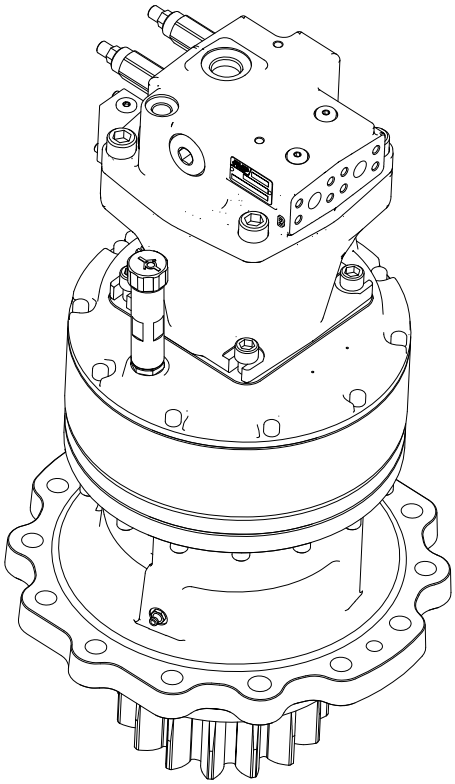
Install work equipment assembly. For details, see section 63, INSTALLATION OF WORK EQUIPMENT ASSEMBLY.

★ For details, see section 62, TESTING AND ADJUSTING, BLEEDING AIR FROM TRAVEL MOTOR.

★ After bleeding the air, add oil to the hydraulic tank to the specified level.

REMOVEL AND INSTALLATION SWING MACHINERY ASSEMBLY

Refer PMP instruction manual of PMTE. M001



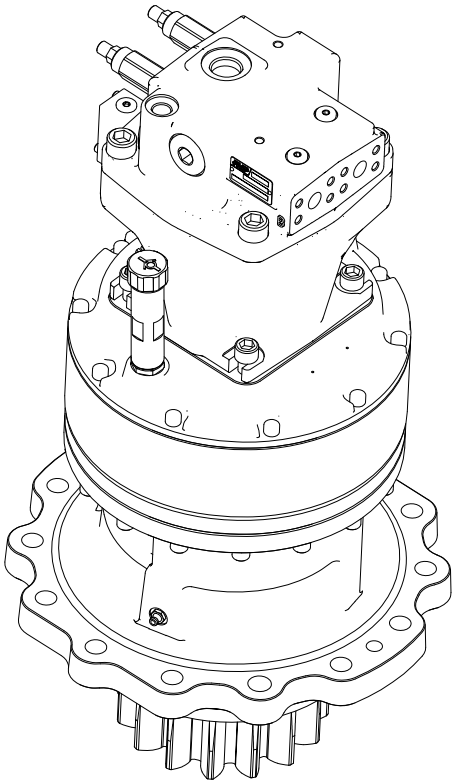
BE220 / BE220LC

REMOVEL AND INSTALLATION OF SWING MACHINERY ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3

DISASSEMBLY OF SWING MACHINERY ASSEMBLY

Refer PMP instruction manual of PMTE. M001



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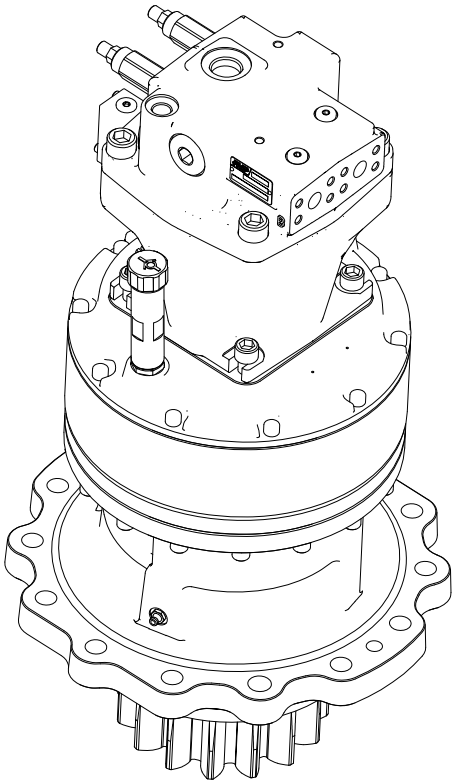
DISASSEMBLY OF SWING MACHINERY ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3

ASSEMBLY OF SWING MACHINERY ASSEMBLY

Refer PMP instruction manual of PMTE. M001



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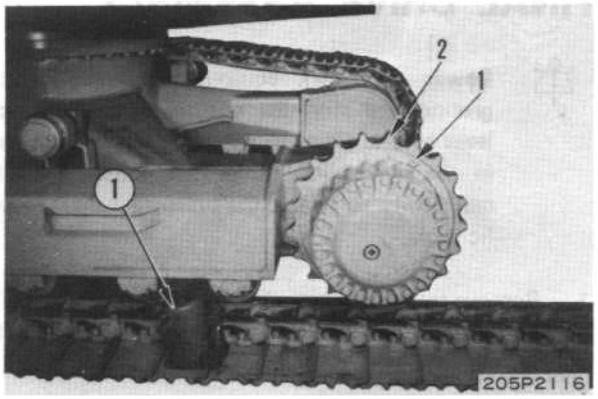
ASSEMBLY OF SWING MACHINERY ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3

REMOVAL OF SPROCKET



1. Remove track shoe assembly.
   For details, see section 33, REMOVAL OF TRACK SHOE ASSEMBLY.
2. Using hydraulic jack ① (30 t), raise track frame.
3. Remove 20 mounting bolts (1) of sprocket, then remove sprocket (2).

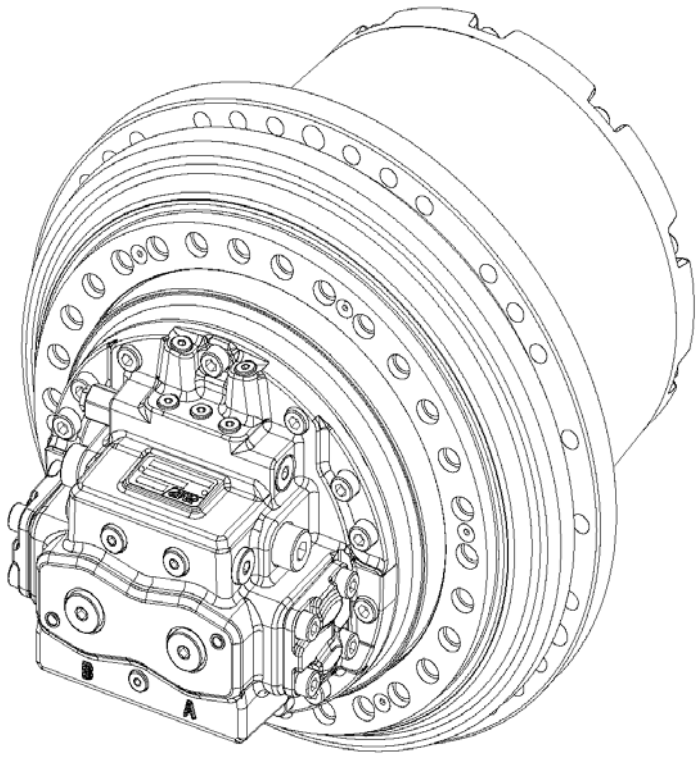
   kg Sprocket: 40 kg

INSTALLATION OF SPROCKET

1. Set sprocket (2) in position, then tighten 20 mounting bolts (1).
2. Slowly release hydraulic jack ①, and return track frame to original position.
3. Install track shoe assembly.
   For details, see section 33, INSTALLATION OF TRACK ASSEMBLY.

REMOVEL OF TRAVEL MOTOR AND FINAL DRIVE ASSEMBLY

Refer PMP insruction manual of PMCI. M001



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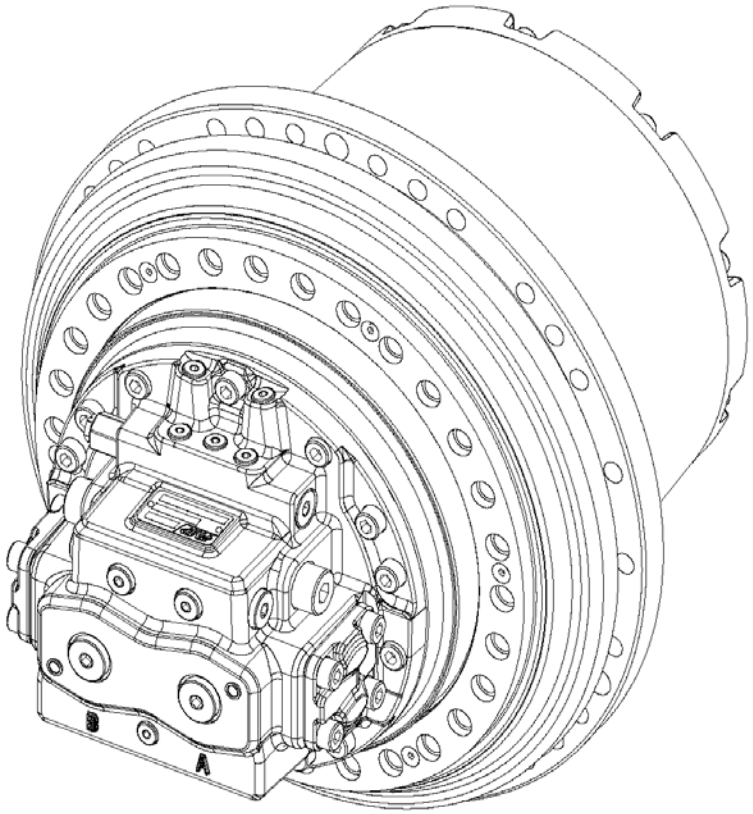
REMOVEL TRVEL MOTOR AND FINAL DRIVE ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3

INSTALLATION OF TRAVEL MOTOR AND FINAL DRIVE ASSEMBLY

Refer PMP instruction manual of PMCI. M001



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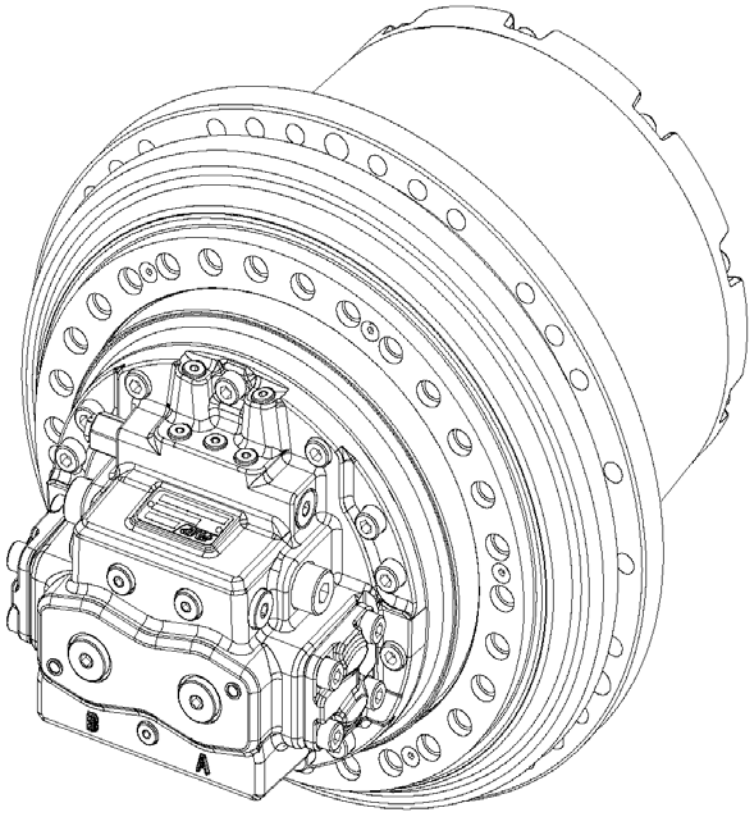
INSTALLATION TRVEL MOTOR AND FINAL DRIVE ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3

DISASSEMBLY OF FINAL DRIVE ASSEMBLY

Refer PMP instruction manual of PMCI. M001



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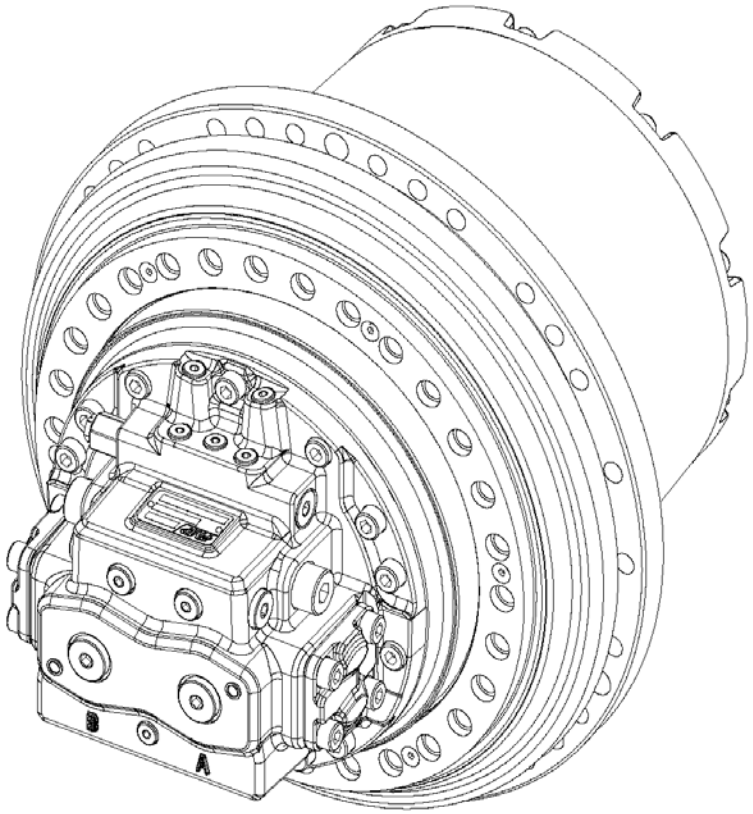
DISASSEMBLY OF FINAL DRIVE ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3

ASSEMBLY OF FINAL DRIVE ASSEMBLY

Refer PMP instruction manual of PMCI. M001



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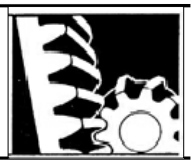
ASSEMBLY OF FINAL DRIVE ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3

POWR TRAIN

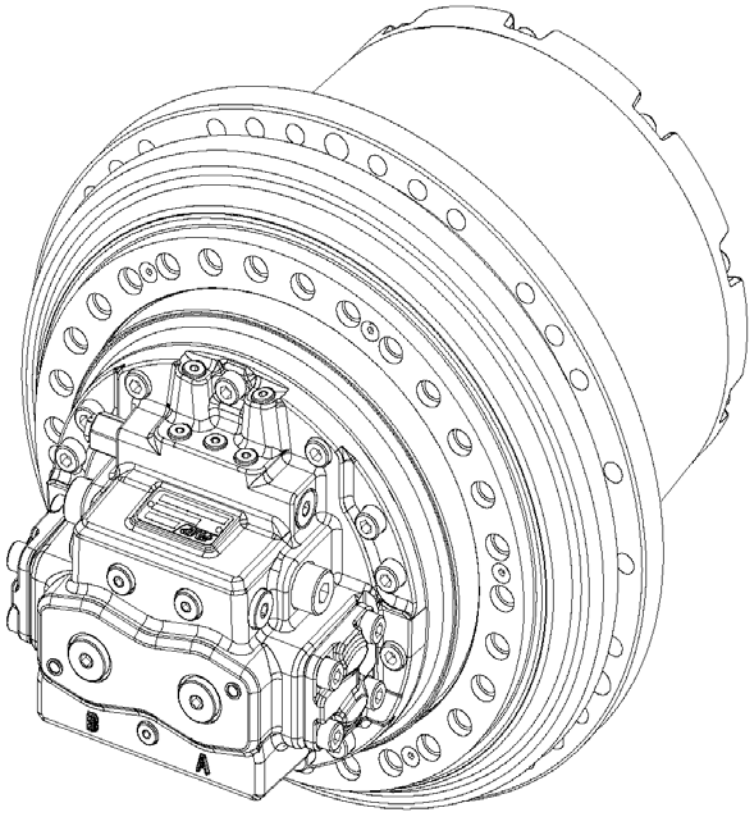
07 MAINTENANCE STANDARD



BE220G

TRAVEL MOTOR

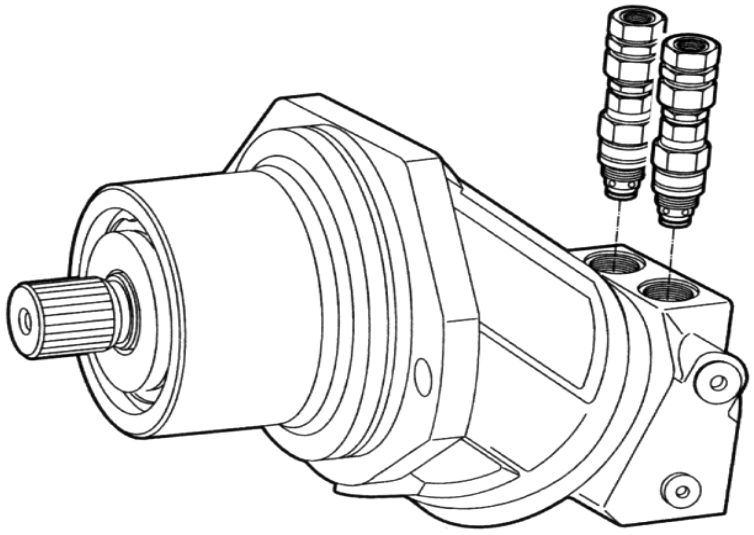
Refer PMP instruction manual of PMCI. M001



BE220 / BE220LC

TRAVEL MOTOR

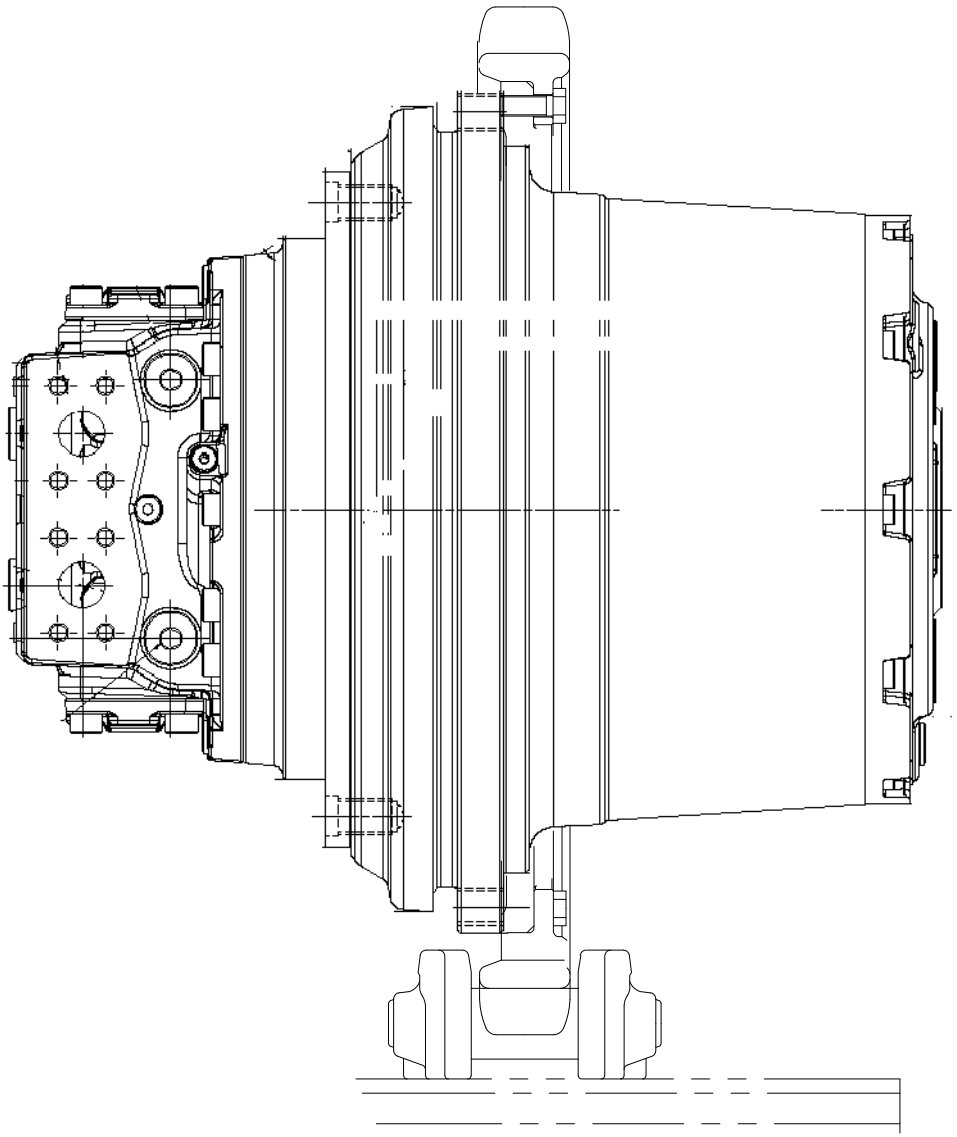
Refer Rexrot instruction manual of HS-64-05-E0403-1-3



BE220G

FINAL DRIVE

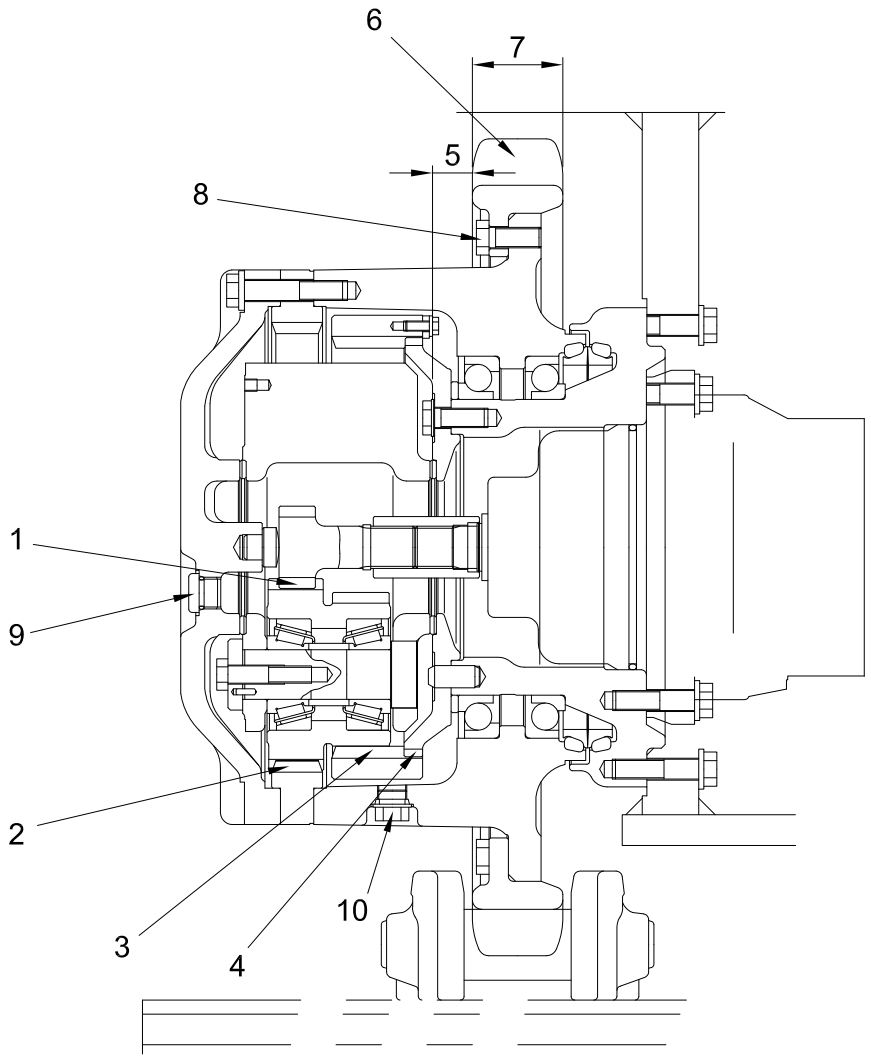
Refer PMP instruction manual of PMCI. M001



BE220 / BE220LC

FINAL DRIVE

Refer Rexrot instruction manual of HS-64-05-E0403-1-3



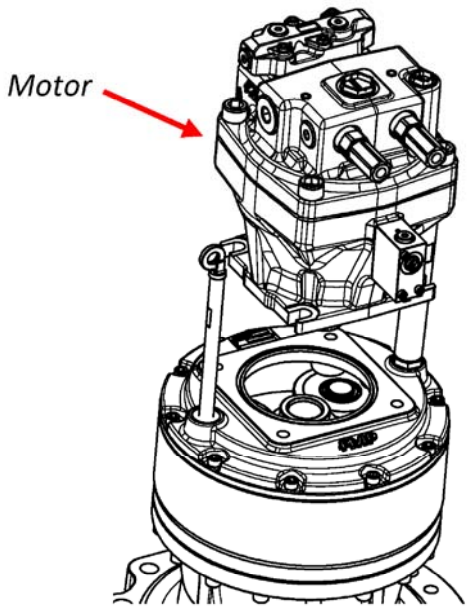
Unit : mm

No.	Check item	Criteria		Remedy
		Standard clarance	Clearance limit	replace
1	Backlash between sun gear and plannet gear	0.19 - 0.51	1.00	
2	Backlash between plannet gear and No.1 ring gear	0.20 - 0.59	1.10	
3	Backlash between plannet gear and No.2 ring gear	0.22 - 0.60	1.10	
4	Backlash between No.2 ring gear and gear	0.22 - 0.63	1.10	
5	End play of sprocket shaft	0 - 0.1	—	
6	Amount of wear on sprocket tooth	Repair limit : 6		Repair by build up welding or replace rims
		Standard size	Repair limit	
7	Width of sprocket tooth	68	65	
8	Tightening torque of sprocket mounting bolt	25 ±6.5 kgm		Tighten
9	Tightening torque of oil filler plug	15.5 ±2.5 kgm		
10	Tightening torque of drain plug	15.5 ±2.5 kgm		

BE220G

SWING MOTOR

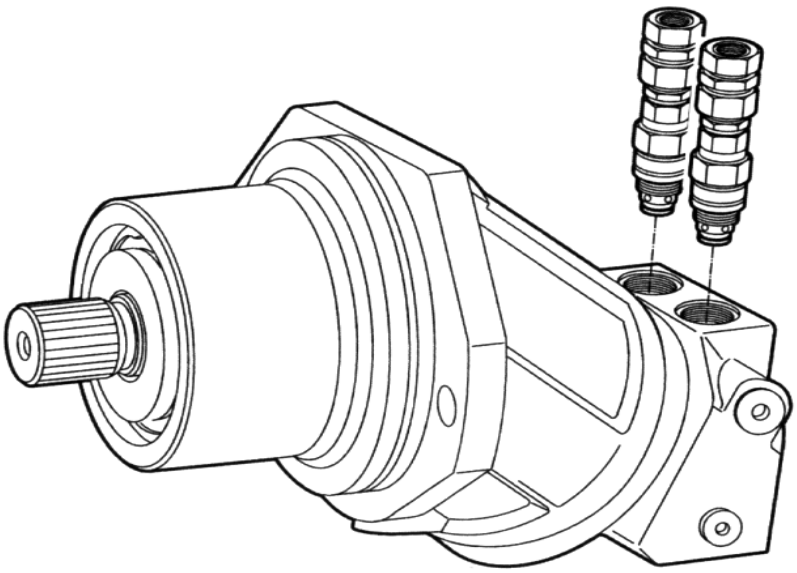
Refer PMP instruction manual of PMTE. M001



BE220 / BE220LC

SWING MOTOR

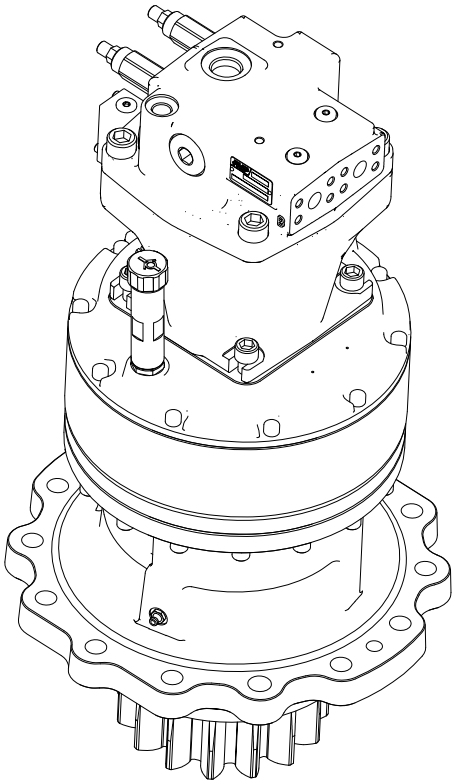
Refer Rexrot instruction manual of HS-64-05-E0403-1-3



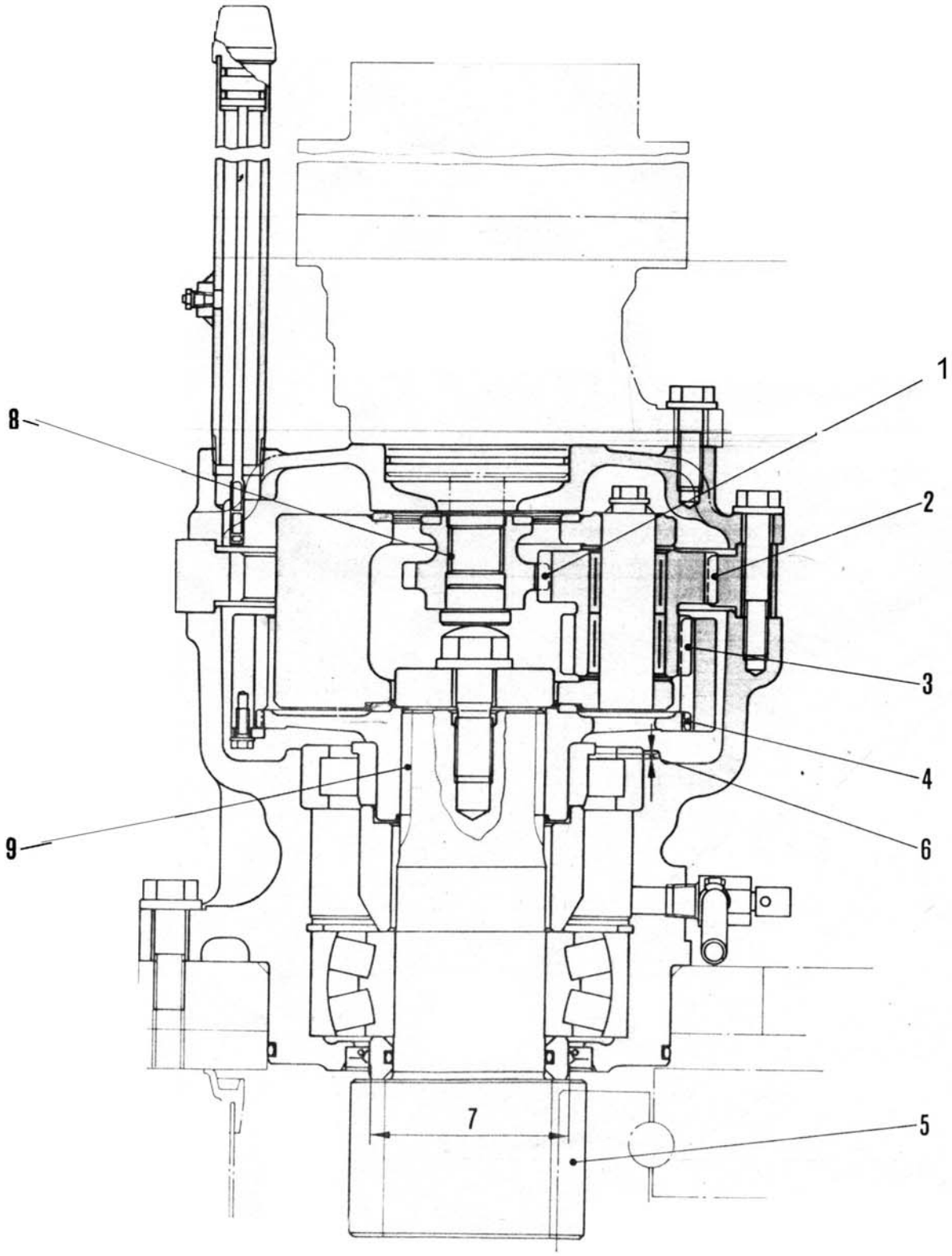
BE220G

SWING MACHINERY

Refer PMP instruction manual of PMTE. M001



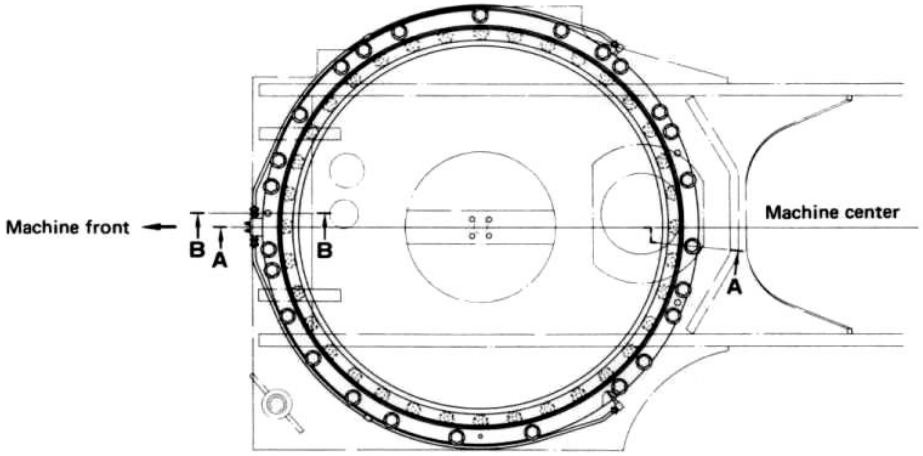
SWING MACHINERY

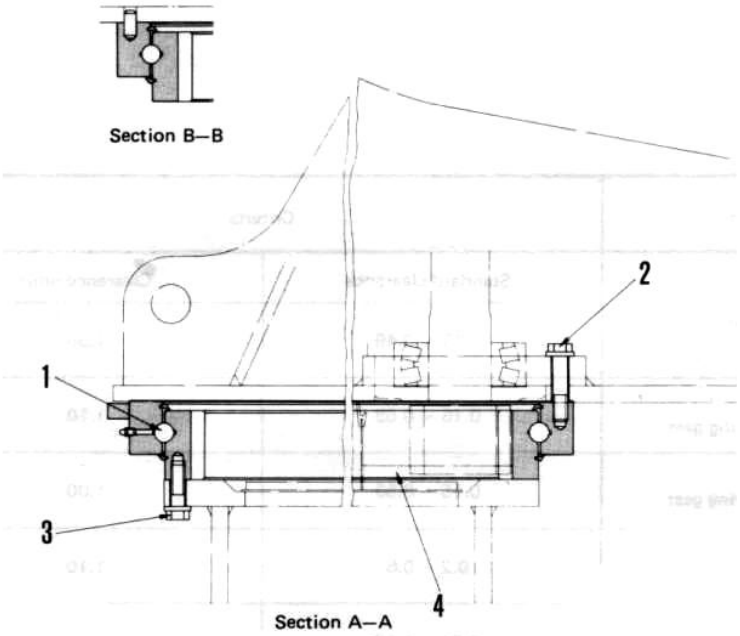


Unit : mm

No.	Check item	Criteria		Remedy
		Standard clarance	Clearance limit	
1	Backlash between sun gear and plannet gear	0.13 - 0.49	1.00	
2	Backlash between plannet gear and No.1 ring gear	0.16 - 0.58	1.10	replace
3	Backlash between plannet gear and No.2 ring gear	0.15 - 0.53	1.00	
4	Backlash between No.2 ring gear and gear	0.2 - 0.6	1.10	
5	Backlash between output shaft (pinoin) and swing circle	0.24 - 1.29	2.00	Adjust
6	End play of swing pinion	1.78 - 2.22	—	
		Standard size	Repair limit	Apply hard chrome plasting recondition or replace
7	Width of output shaft collar surface contacting with oil seal	Ø125 $^{0}_{-0.100}$	124.7	
		Standard clearance	Clearance limit	
8	Clearance between sun gear and swing motor output shaft spline in rotating direction.	0.06 -0.15	—	Replace
9	Clearance between output and idle gear spline in rotating direction	0.09 -0.27	—	

SWING CIRCLE





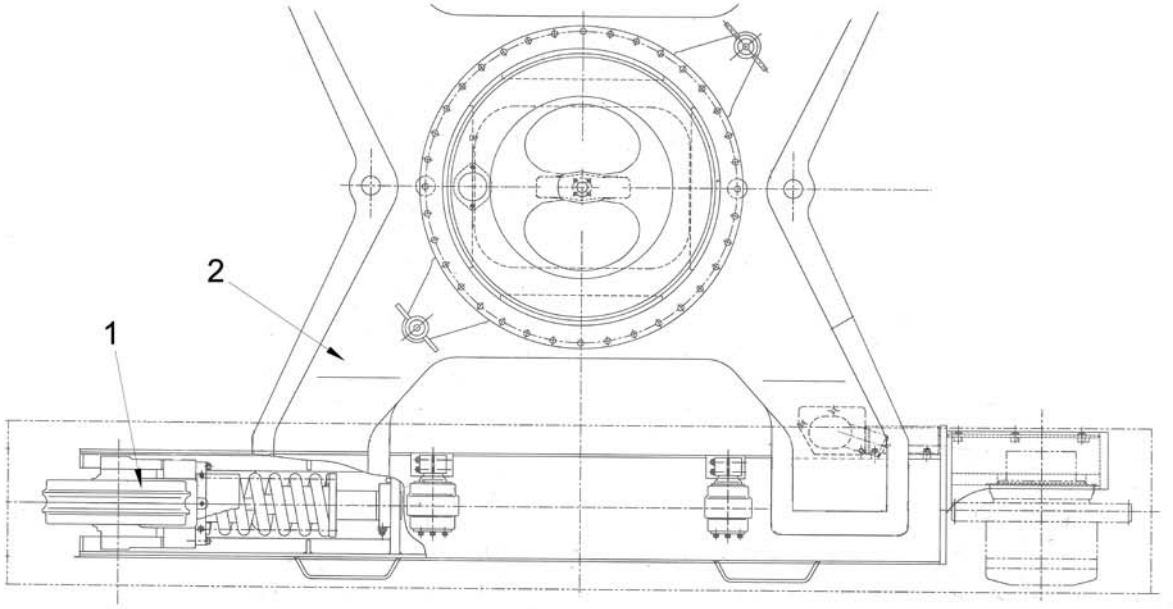
Unit : mm

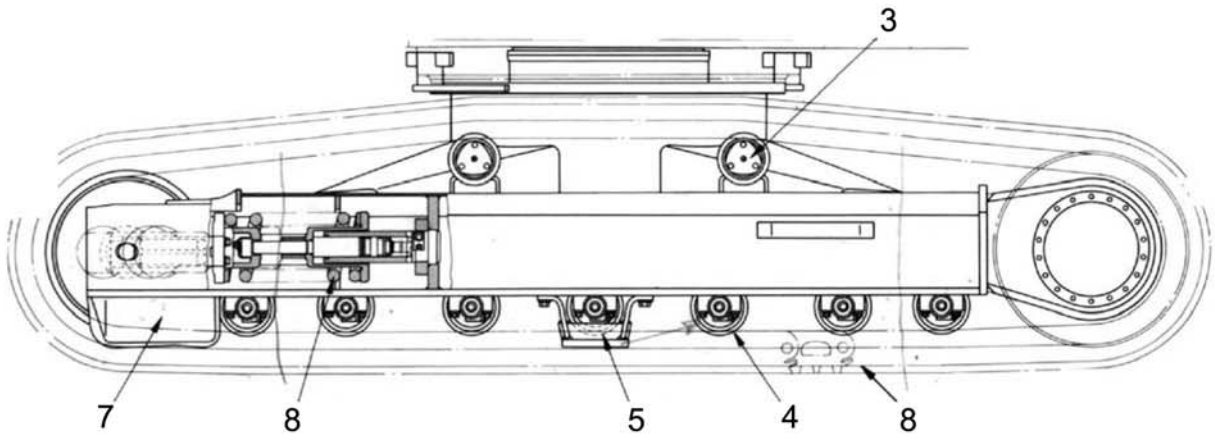
No.	Check item	Criteria		Remedy
1	Clearance of bearing in axial direction	Standard clearance: 0.15 - 0.35	Clearance limit: 1.00	Replace
2	Tightening torque of outer race mounting bolt	76 ± 8.5 kgm		Tighten
3	Tightening torque of inner race mounting bolt	56 ± 6 kgm		
4	Grease	Grease must not be badly contaminated or fould in white (capacity : 13 ℓ)		Replace

UNDERCARRIAGE

08 STRUCTURE AND FUNCTION

TRACK GROUP

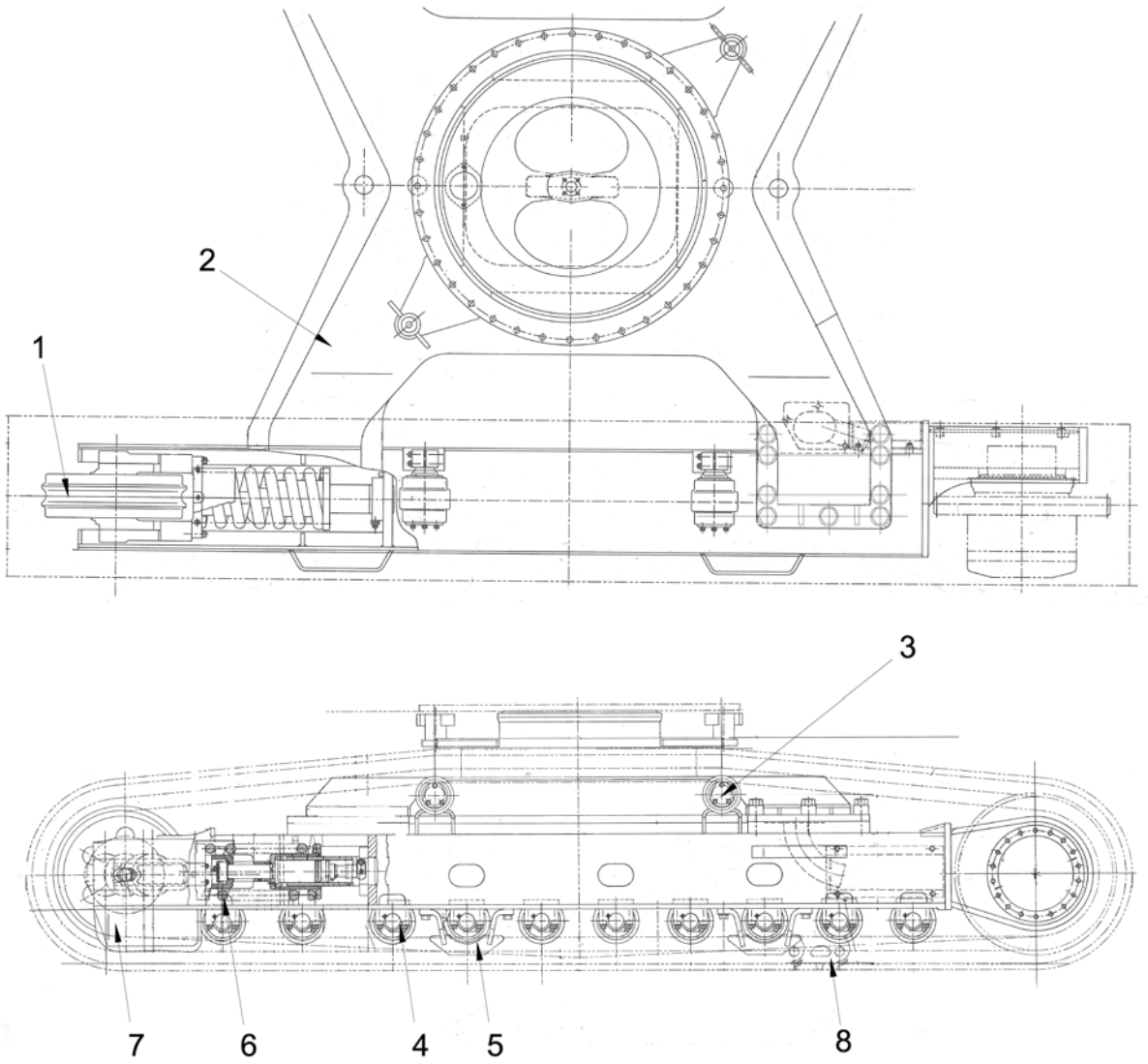




1. Idler
2. Track frame
3. Carrier roller
4. Track roller
5. Center guard
6. Recoil spring
7. Front guard
8. Track

The tracks which bear and spread the weight of the machine on the ground convert the driving power transmitted from the sprockets into tractional force.
The track group includes a pair of right and left track frames (2), front idlers (1), carrier rollers (3) and track rollers (4) are mounted. The track (8) looped around each track frame is driven by the sprocket wheel and its rolling is guided by the front idler, carrier roller and track rollers. Thetrack roller guards (4) and (7) attached on the bottom surface of each track frame prevents thetrack from slipping off due to intrusion of stones.

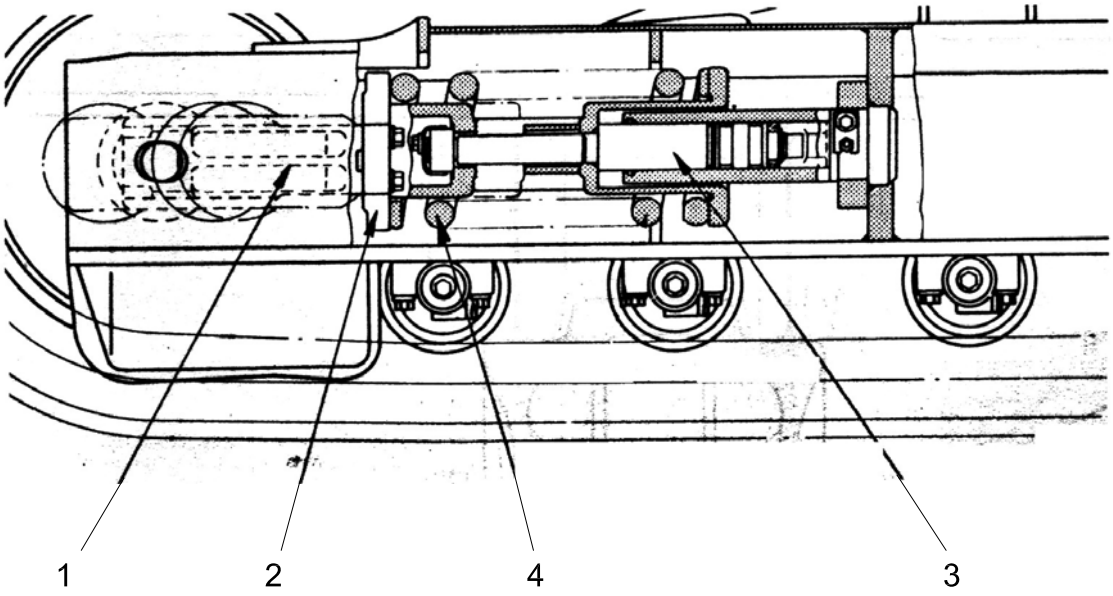
TRACK GROUP



1. Idler
2. Track frame
3. Carrier roller
4. Track roller
5. Center guard
6. Recoil spring
7. Front guard
8. Track

The tracks which bear and spread the weight of the machine on the ground convert the driving power transmitted from the sprockets into tractional force.
The track group includes a pair of right and left track frames (2), front idlers (1), carrier rollers (3) and track rollers (4) are mounted. The track (8) looped around each track frame is driven by the sprocket wheel and its rolling is guided by the front idler, carrier roller and track rollers. Thetrack roller guards (4) and (7) attached on the bottom surface of each track frame prevents thetrack from slipping off due to intrusion of stones.

RECOIL SPRING



The idler cushion is mounted om the track frame between the front idler and the sprocket wheel. It performs the following functions :

1) Maintaining proper track tension
2) Absorbing shocks which the front idler is subjected to during traveling of the machine.

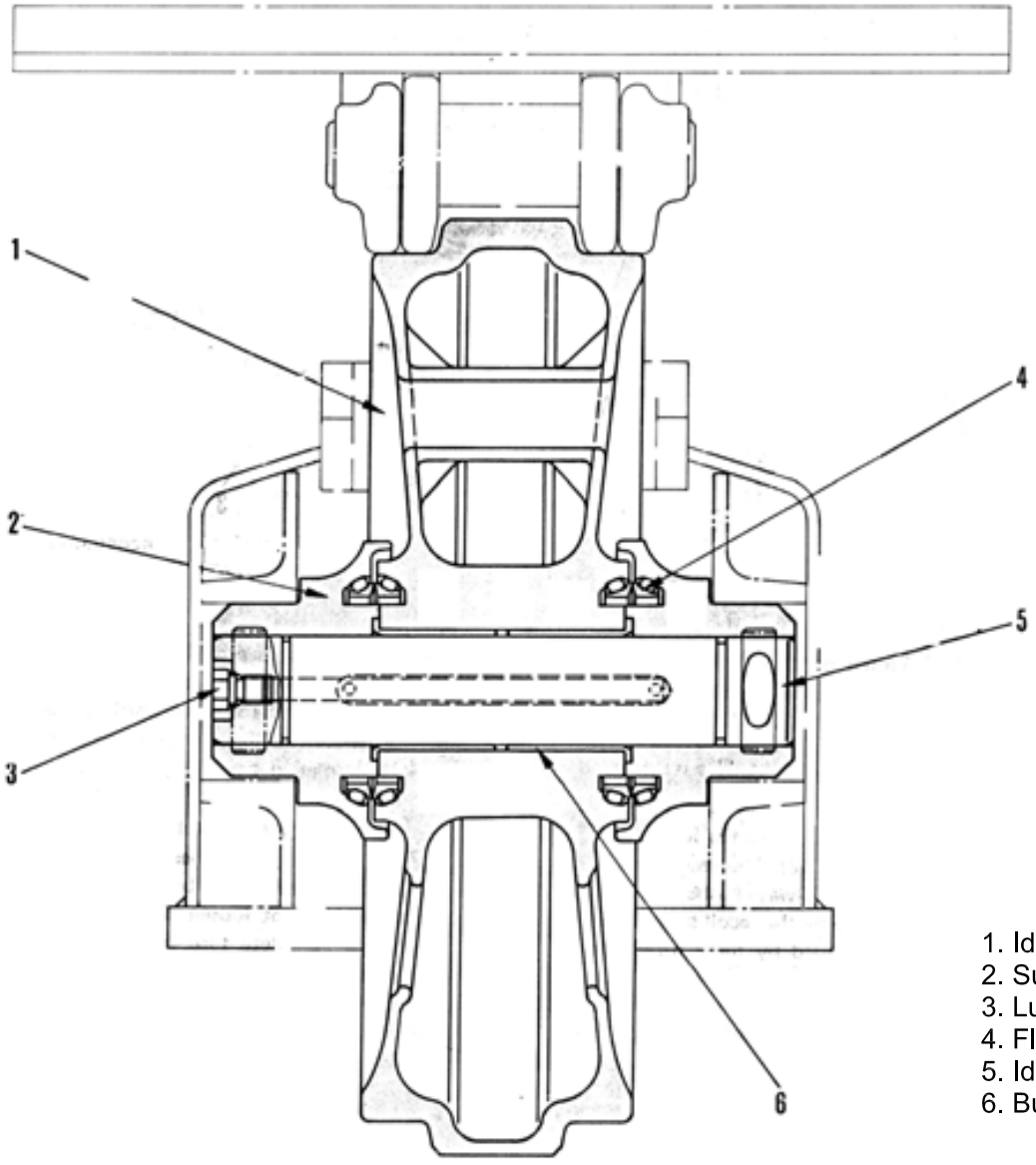
One end of the rod (1) is connected to the idler yoke and the other end to the support (2). The recoil spring support (2) and the piston (3) are always pushed toward the forward part of the machine by the recoil spring (4), and rod is also pushed forwaed by force from the piston through the grase filling the cylinder.

When the front idler, connected to the recoil spring through the adjusting cylinder, is subjected to an impact exceeding the initial preload of the recoil spring, the recoil spring will retract to absorb the shock. Also, when mud, stones or snow get lodged between the track and the sprocket wheel, the recoil spring will absorb the shock caused by a sudden increase of track tension, thus preventing damage to the track, sprocket or other roller.

The adjjusting cylinder is provided with the lubricator. Feeding grease through the lubricator causes the cylinder piston to push the other hand, track tension is decreased by loosening the lubricator to discharge the grease

To loosen track tension, loosen the lubricator by one turn. if grease does not ooze out easily, try moving the machine back and forth a short distance. Do not loosen the lubricator more than one complete turn in order to prevent dangerous spurting of grease under high pressure. Although the protector is provided to prevent the lubricator from flying out, this precaution should be kept in mind for safety.

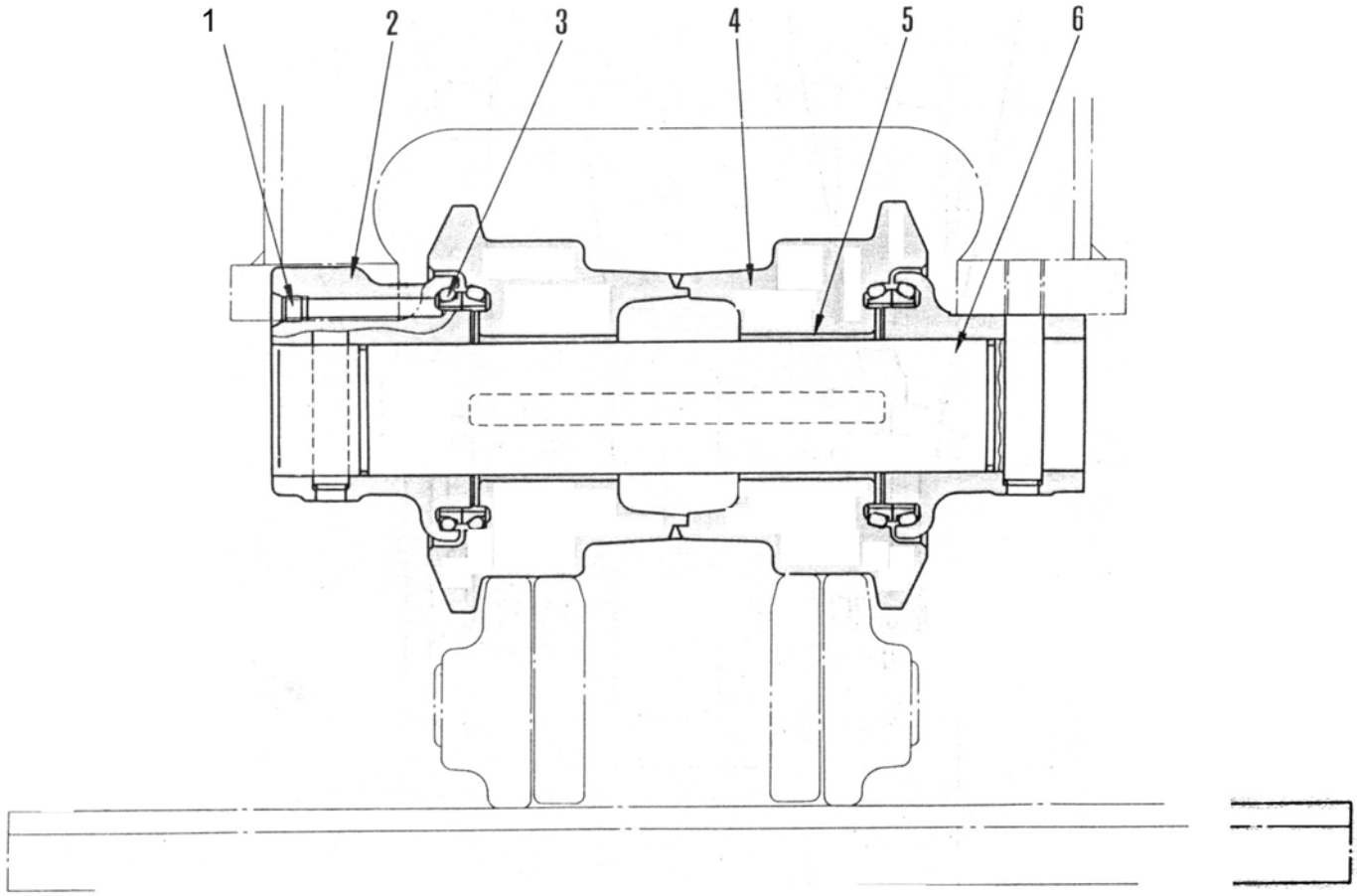
IDLER



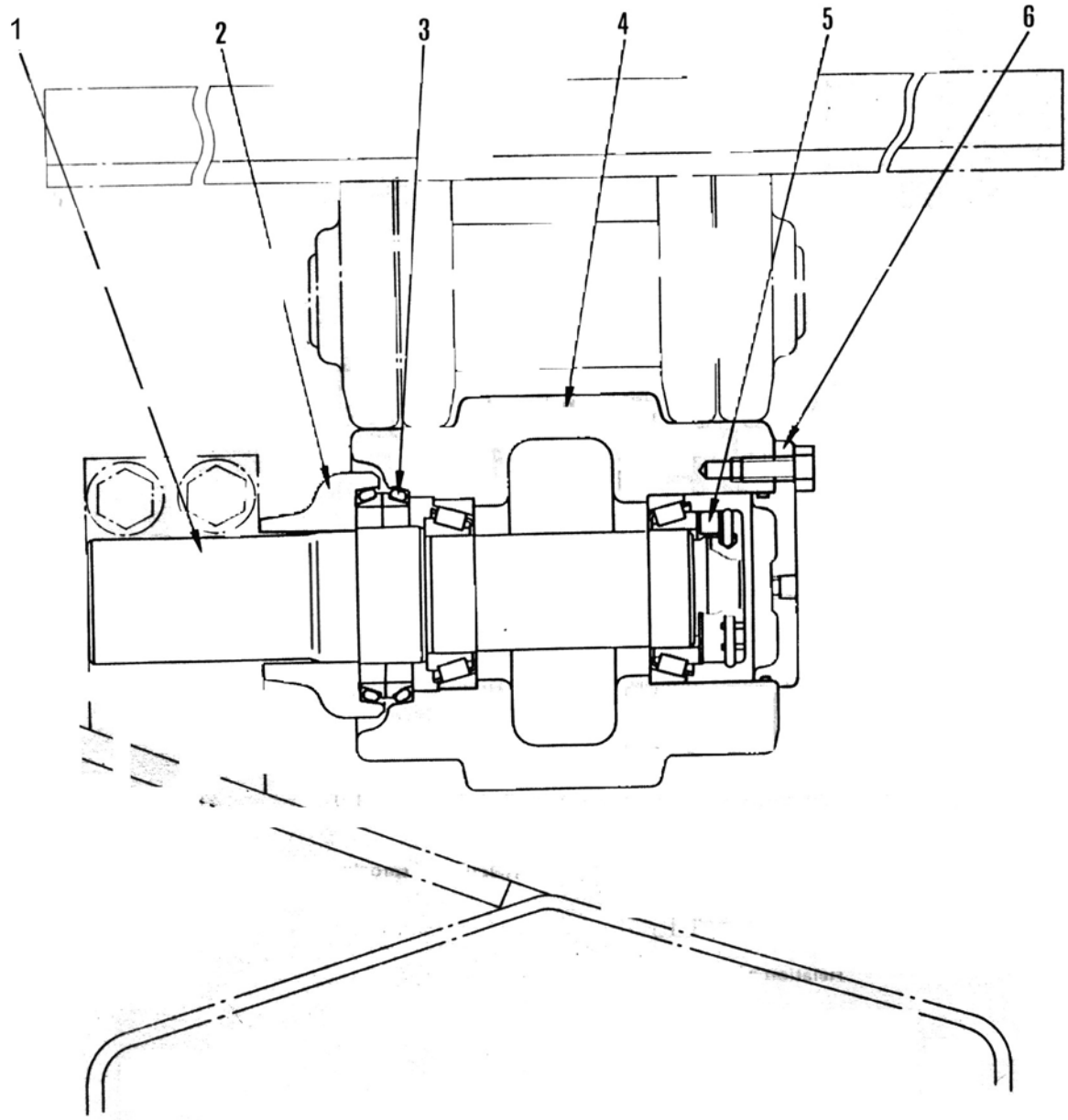
1. Idler
2. Support
3. Lubracting plug
4. Floating seal
5. Idler shaft
6. Bushing

The front idler (1) mounted at the front end of each track frame is supported on the idler shaft (5) through the guide and bushing (6).
The idler assembly including the yoke, hich is connected to the idler shaft bearings, is slidable back and forth along the track frame by the guideplates attached to the underside of the bearings and the cover so that smooth rolling of the track can always be maintained.

Lubrication oil (engine oil) enters the oil hole provided in the shaft to lubricate the sliding surface of the bushing. Each end of the bushing is provided with a floating seal to prevent both leakage of oil and inclusion of mud and water.
To improve its wear-resistant property, the idler is made of siliconmanganese steel casting, the tread of the idler which the track link contacts, is hardened by highfrequency hardening treatment.

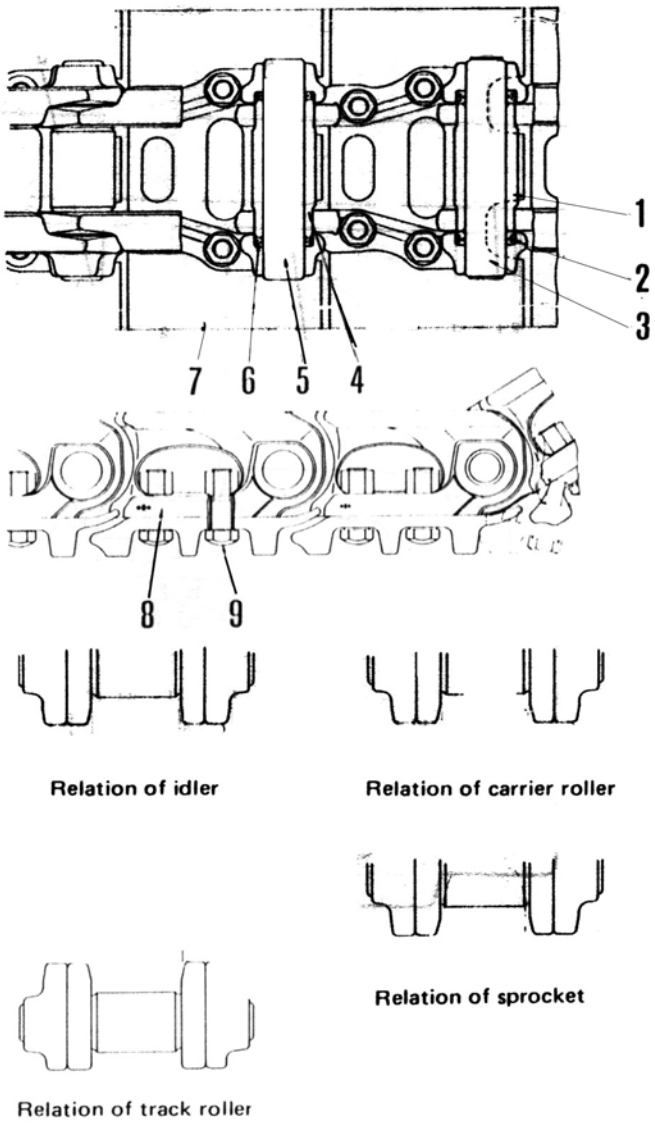


1. Lubricating plug
2. Collar
3. Floating seal
4. Track roller
5. Bushing
6. Shaft



1. Shaft
2. Collar
3. Floating seal
4. Carrier roller
5. Ring
6. Cover

TRACK SHOE



1. Master bushing
2. Master dust seal
3. Master pin
4. Regular bushing
5. Regular pin
6. Regular dust seal
7. Shoe
8. Link
9. Shoe bolt

610 mm triple-shoe
Link pitch: 190 mm
Number of shoe: 102

UNDERCARRIAGE

09 DISASSEMBLY AND ASSEMBLY

REMOVAL OF IDLER, RECOIL SPRING ASSEMBLY

1. Remove track shoe assembly.
   For details, see section 33, REMOVAL OF TRACK SHOE ASSEMBLY.

2. Using eye bolts ① (Dia. = 16 mm, Pitch = 2 mm), raise idler and recoil spring assembly (1), and pull out to front.

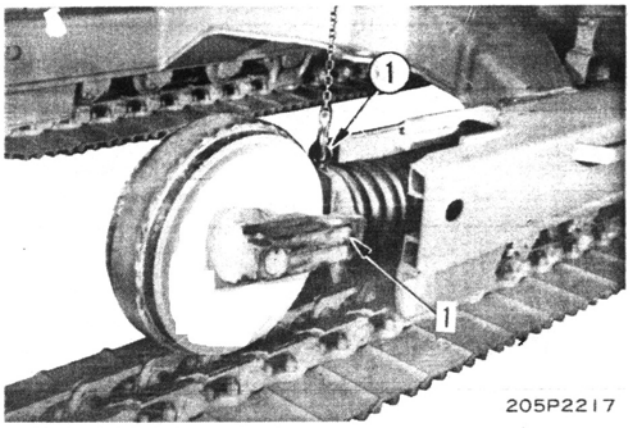
   kg Idler, recoil spring assembly: 270 kg

3. Fix recoil spring on block ②, and sling idler with crane.

4. Remove 4 mounting bolts (2), then disconnect idler assembly (3) and recoil spring assembly (4).
   ★ Make match marks on the contact faces of the idler and recoil spring before removing.

   kg Idler assembly: 130 kg

   kg Recoil spring assembly: 140 kg



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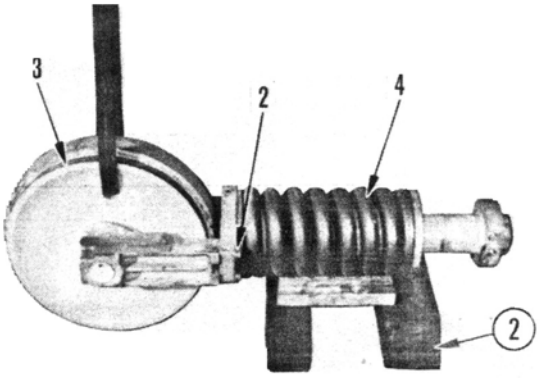

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INSTALLATION OF IDLER, RECOIL SPRING ASSEMBLY

Fix recoil spring assembly (4) on block ②, then raise idler assembly (3) with crane, and tighten 4 mounting bolts (2).

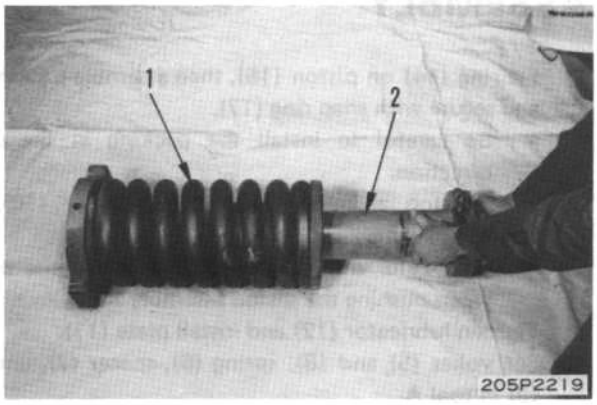
2. Raise idler and recoil spring assembly (1), and push into track frame.
   ★ Install so that the oil filler plug of the idler is on the right.

3. Install track shoe assembly.
   For details, see section 33, INSTALLATION OF TRACK SHOE ASSEMBLY.

DISASSEMBLY OF RECOIL SPRING ASSEMBLY

Special tools

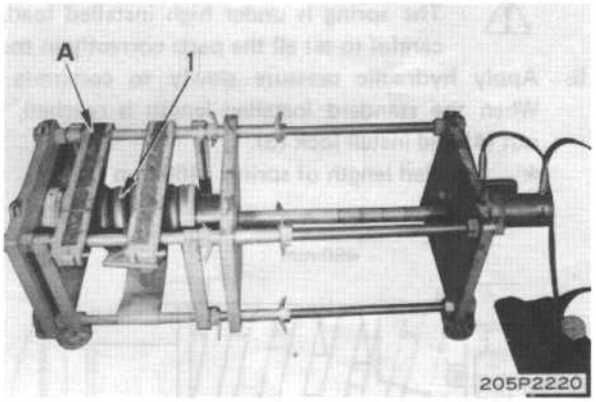
	Part No.	Part Name	Q'ty
A	791-685-8003	Compressor kit	1
A_1	790-101-1600	Cylinder ass'y (70 t)	1
A_2	790-101-1102	Pump ass'y	1



1. Divide into recoil spring assembly (1) and cylinder assembly (2).

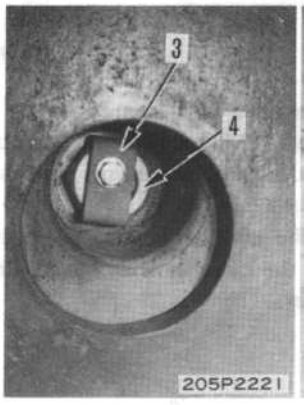
2. Set recoil spring assembly (1) on tool **A**.

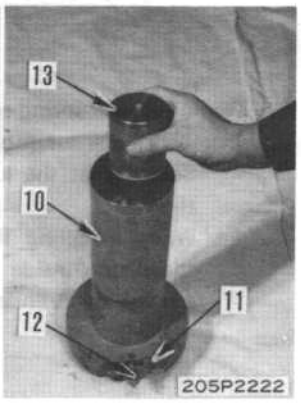
   ⚠ The spring is under high installed load, so be careful to set correctly.
   ★ Installed load of spring: 11,700 kg



3. Apply hydraulic pressure slowly to compress spring, then remove lock (3) and nut (4).
   ★ Compress the spring until the nut is loose.

4. Release hydraulic pressure slowly to remove tension of spring.
   ★ Free length of spring: 583 mm



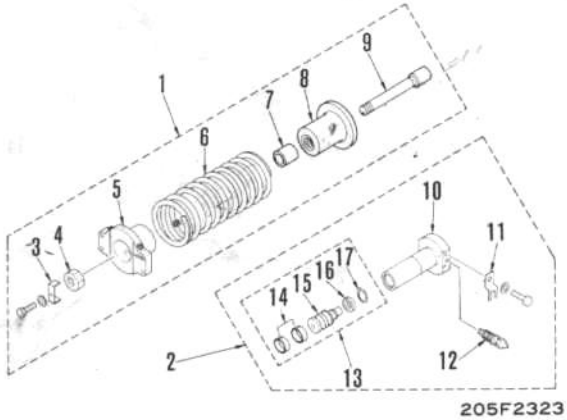


5. Disassemble into yokes (5) and (8), spring (6), spacer (7), and shaft (9).

6. Remove plate (11) from cylinder (10), then remove lubricator (12).

7. Remove O-ring, then pull out piston assembly (13).

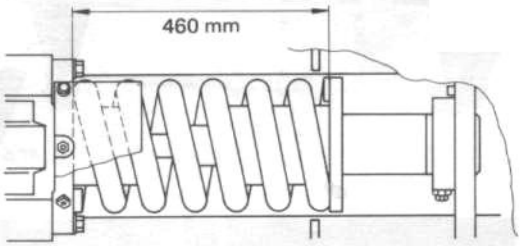
8. Remove ring (14) from piston (15), then remove snap ring (17), and packing (16).



ASSEMBLY OF RECOIL SPRING ASSEMBLY

1. Fit ring (14) on piston (15), then assemble packing (16) and secure with snap ring (17).
   ★ Be careful to install the packing in the correct direction.
2. Push piston assembly (13) into cylinder (10), then assemble O-ring.
   ★ Be careful not to damage the lip of the packing when pushing the piston assembly in.
3. Tighten lubricator (12) and install plate (11).
4. Set yokes (5) and (8), spring (6), spacer (7), and shaft (9) in tool **A**.

   ⚠ The spring is under high installed load, so be careful to set all the parts correctly in tool **A**.
5. Apply hydraulic pressure slowly to compress spring. When the standard installed length is reached, tighten nut (4) and install lock (3).
   ★ Installed length of spring: 460 mm



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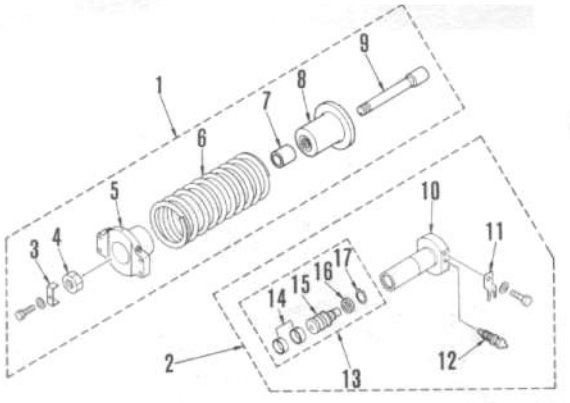
6. Remove recoil spring assembly (1) from tool **A**.
7. Install cylinder assembly (2) in recoil spring assembly (1).
   ★ Set so that the lubricator mounting position is at the side.
   ★ When installing the cylinder assembly, check that the piston inside the cylinder is at the outside end face of the cylinder.



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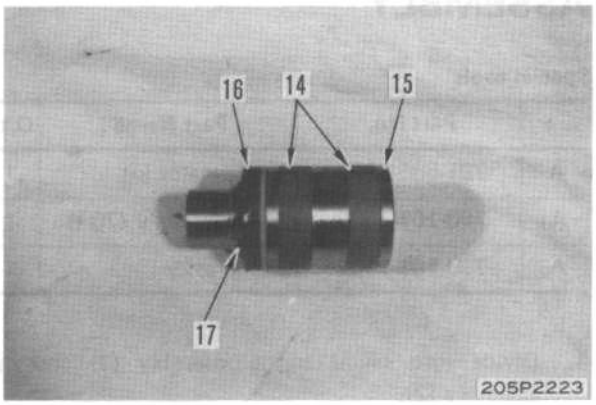

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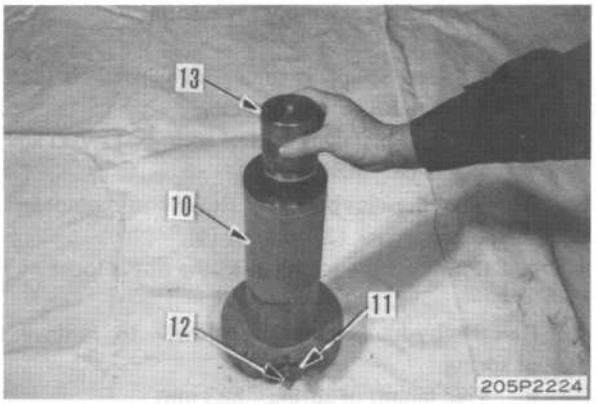

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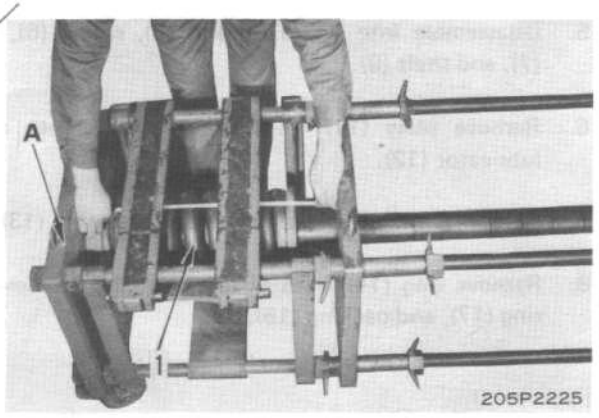

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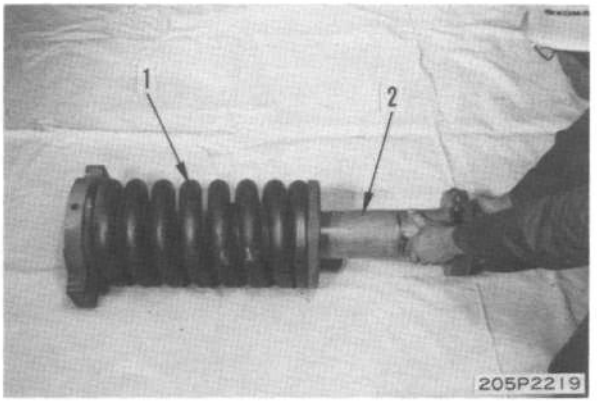

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REMOVAL OF TRACK ROLLER ASSEMBLY

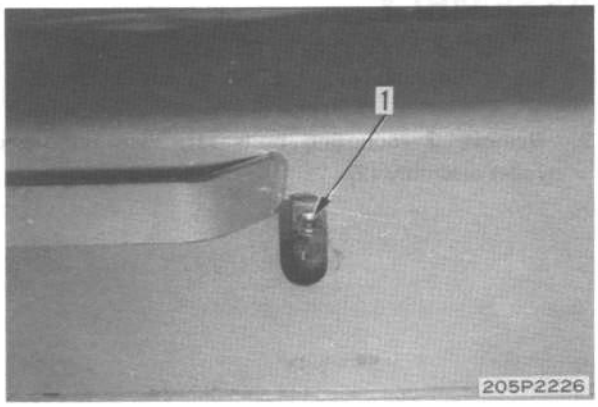
1. Lower the work equipment completely to the ground. Loosen lubricator (1) to relieve track tension.

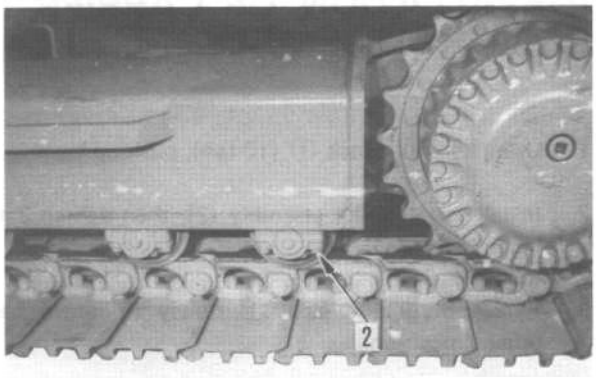
   The adjustment cylinder is under extremely high pressure. Never loosen the lubricator more than one turn. If the track tension is not relieved, move the machine backwards and forwards.

2. Remove 4 mounting bolts (2) of track roller.

3. Use work equipment to raise machine, then remove track roller assembly (3).

   kg Track roller assembly: 40 kg





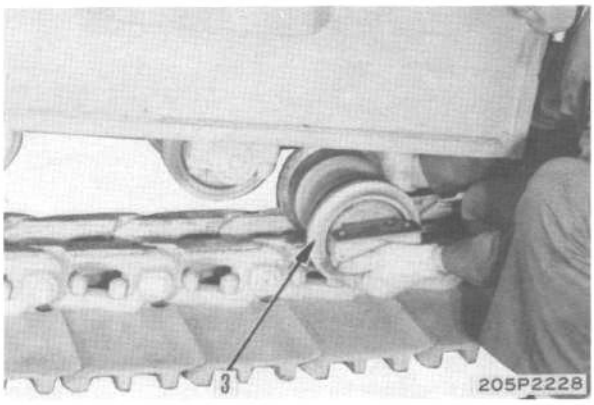
INSTALLATION OF TRACK ROLLER ASSEMBLY

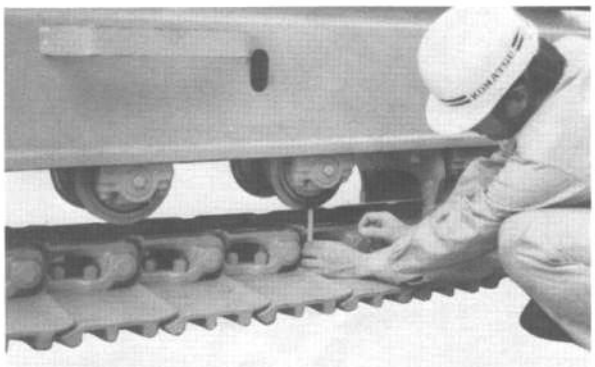
1. Set track roller assembly (3) on track link.
   ★ Set the track roller with the oil filler plug on the outside.

2. Use work equipment to raise boom, then partially tighten mounting bolts (2).

3. Lower machine completely to ground, then fully tighten mounting bolts (2).

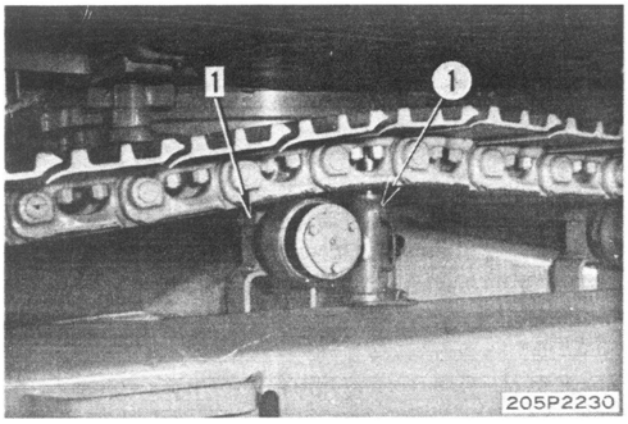
4. Install lubricator (1), then pump in grease to adjust track tension.
   ★ Adjust the track tension to give a clearance of 60 – 100 mm between the contact surfaces of the track link and track roller at the 4th roller from the sprocket when the track is raised from the ground.





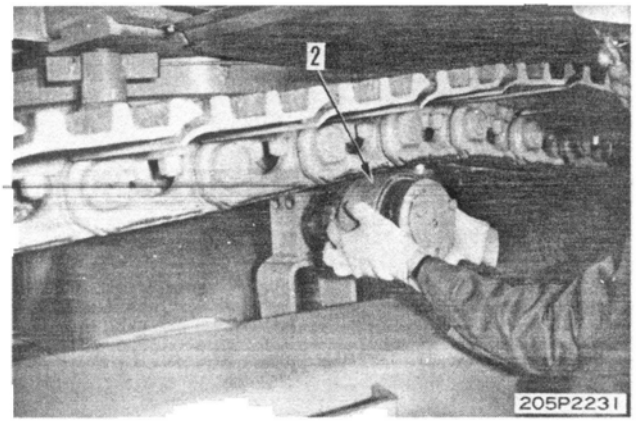
REMOVAL OF CARRIER ROLLER ASSEMBLY

1. Using hydraulic jack ① (10 ton), push up track.
2. Remove 2 mounting bolts (1), then remove carrier roller assembly (2).



INSTALLATION OF CARRIER OLLER ASSEMBLY

1. Using hydraulic jack ① (10 ton), push up track.
2. Install carrier roller assembly (2), then tighten 2 mounting bolts (1).
3. Release hydraulic jack ① slowly to return track to original position.



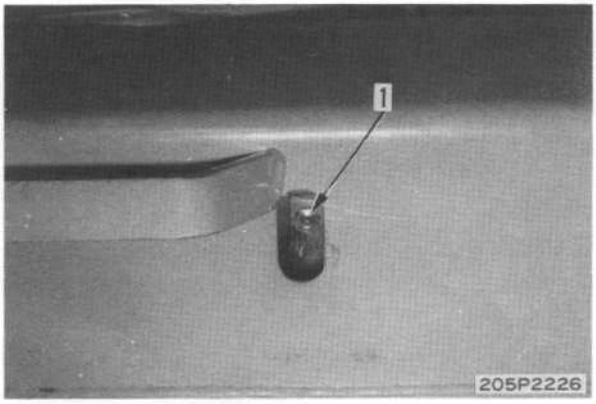
REMOVAL OF TRACK SHOE ASSEMBLY

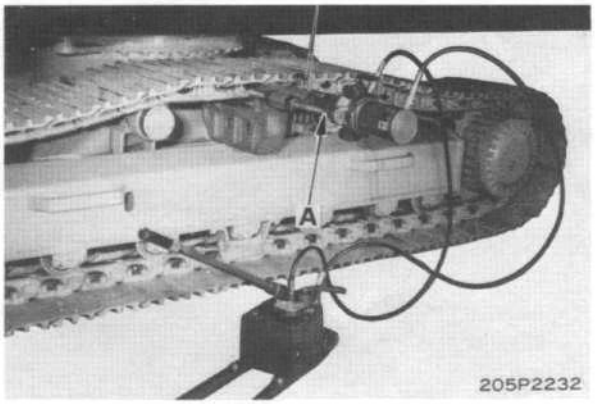
Special tools

	Part No.	Part Name	Q'ty
A	791-630-3000	Remover & installer	1
A_1	790-101-1300	Cylinder (100 ton)	1
A_2	790-101-1102	Pump	1

1. Stop machine with master pin midway between idler and carrier roller.
   ★ Make sure that there is enough space to lay out the track shoe behind and in front of the machine.
2. Lower the work equipment completely to the gound. Loosen lubricator (1) to relieve track tension.

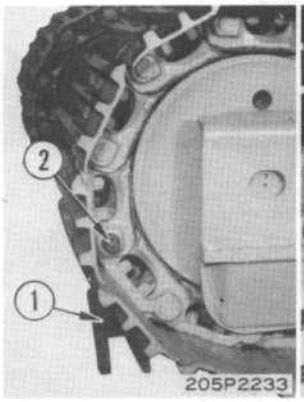
   The adjustment cylinder is under extremely high pressure. Never loosen the lubricator more than one turn. If the track tension is not relieved, move the machine backwards and forwards.
3. Using tool **A**, remove master pin.
4. Remove tool **A** and move machine forward so that temporary pin is in front of idler, then set block ① in position.
5. Remove temporary pin ② and move machine in reverse to remove track (2).

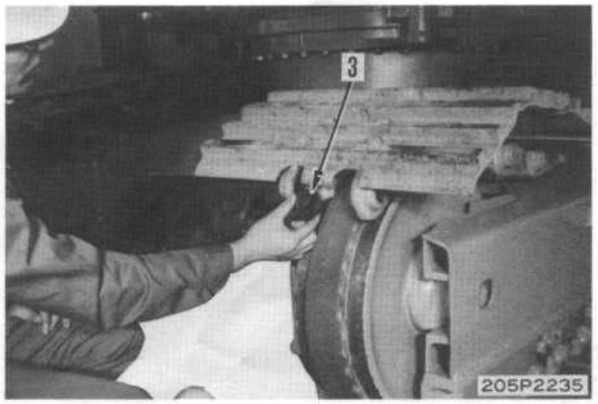




INSTALLATION OF TRACK SHOE ASSEMBLY

1. Position track under track frame, fit link bushing in sprocket, then move machine slowly forward to wind on track (2).
   ★ Assemble the track with the link bushing at the front.
2. Set block ① in position, assemble dust seal (3) on link, then insert temporary pin ②.
3. Move machine in reverse, and stop when temporary pin is midway between idler and carrier roller.
4. Using tool **A**, press fit master pin.
5. Install lubricator (1), then pump in grease to adjust track tension.
   ★ Adjust the track tension to give a clearance of 60 – 100 mm between the contact surfaces of the track link and track roller at the 4th roller from the sprocket when the track is raised from the ground.

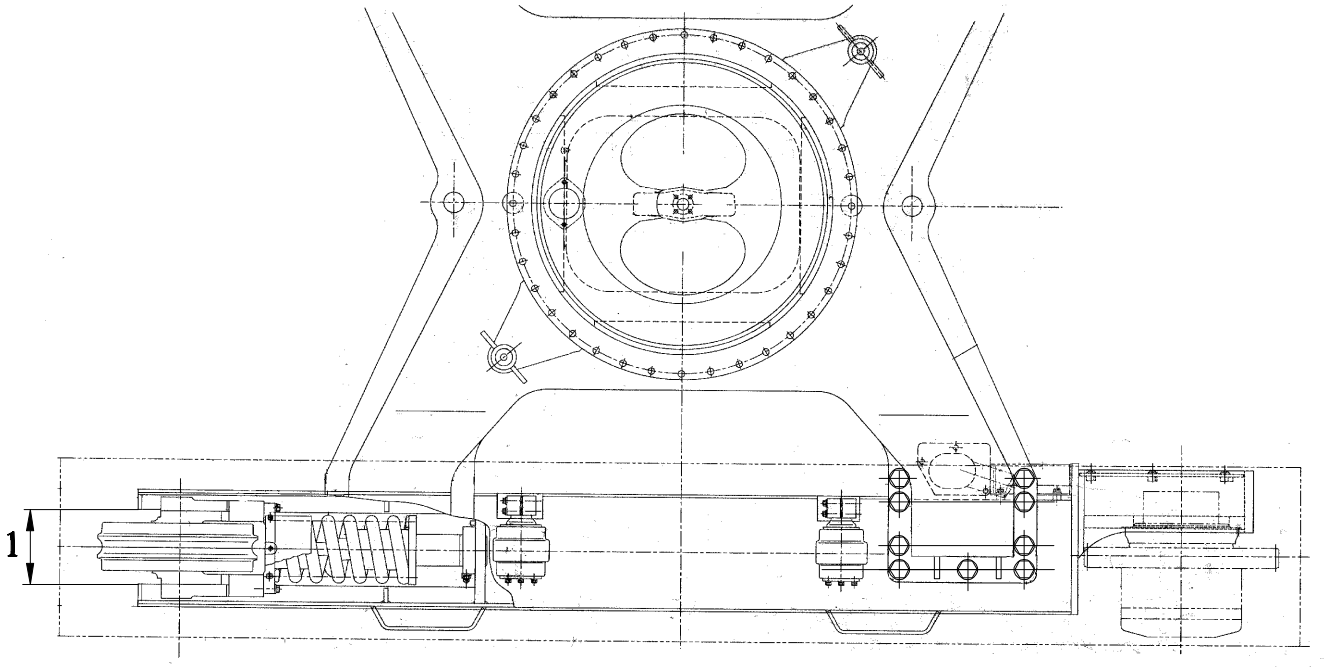


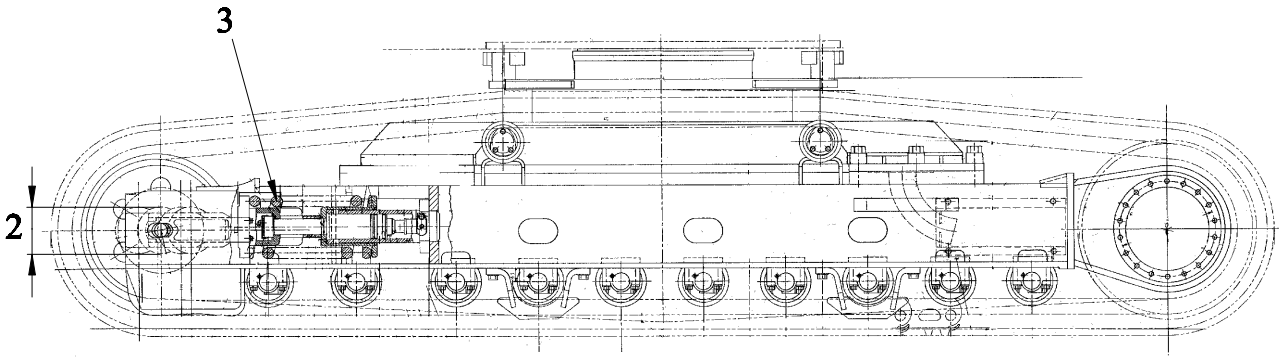


UNDERCARRIAGE

10 MAINTENANCE STANDARD

BE220LC
TRACK FRAME AND RECOIL SPRING





Unit : mm

No.	Check item	Criteria					Remedy
			Standard size		Repair limit		
1	Vertical width of idler guide	Track frame	107		111		Rebuild or replace
		Idler support	105		103		
2	Horizontal width of idler guide	Track frame	250		255		Rebuild or replace
		Idler support	247		245		
3	Recoil spring	Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	Replace
		583	460	11,700 kg	—	9,360 kg	

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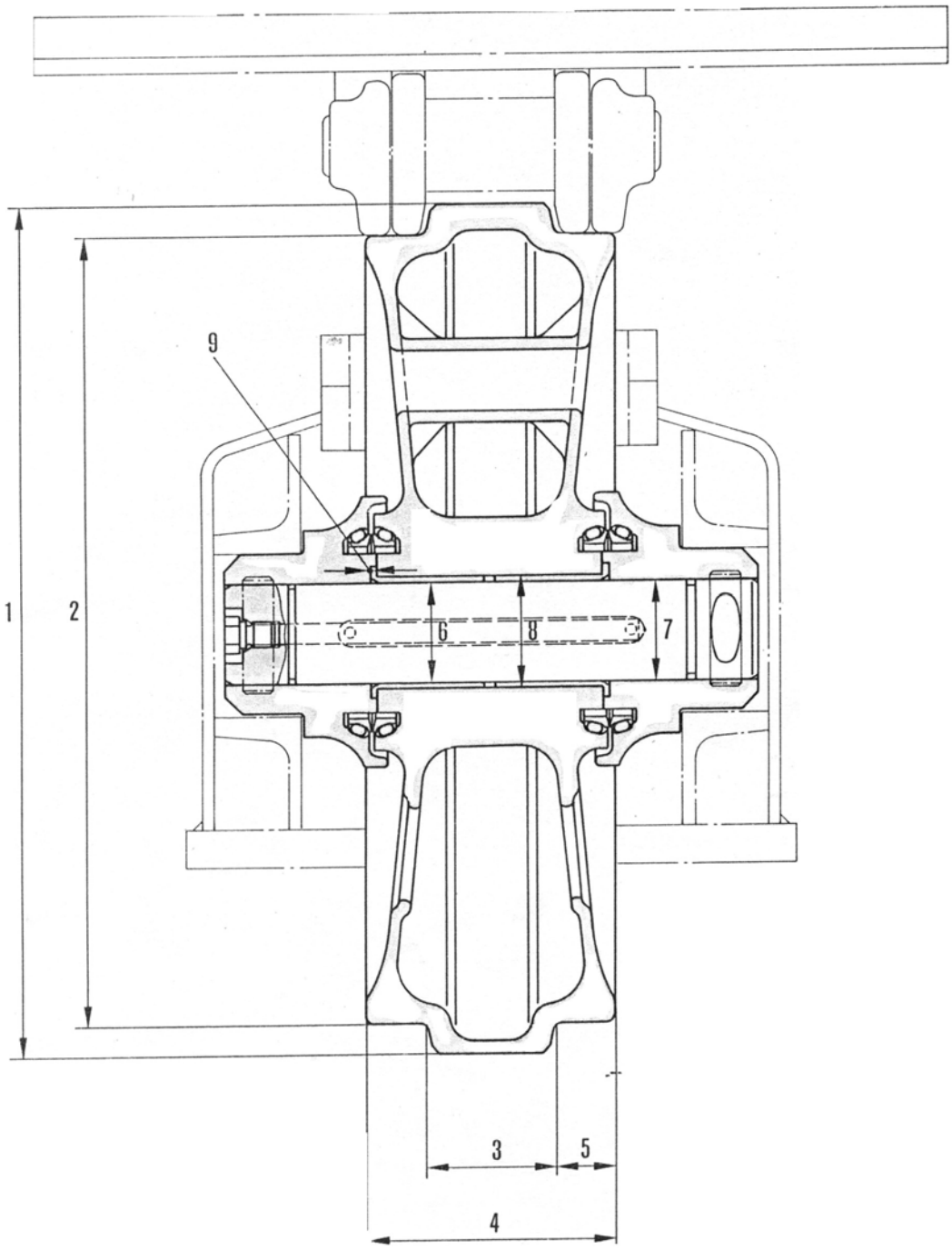
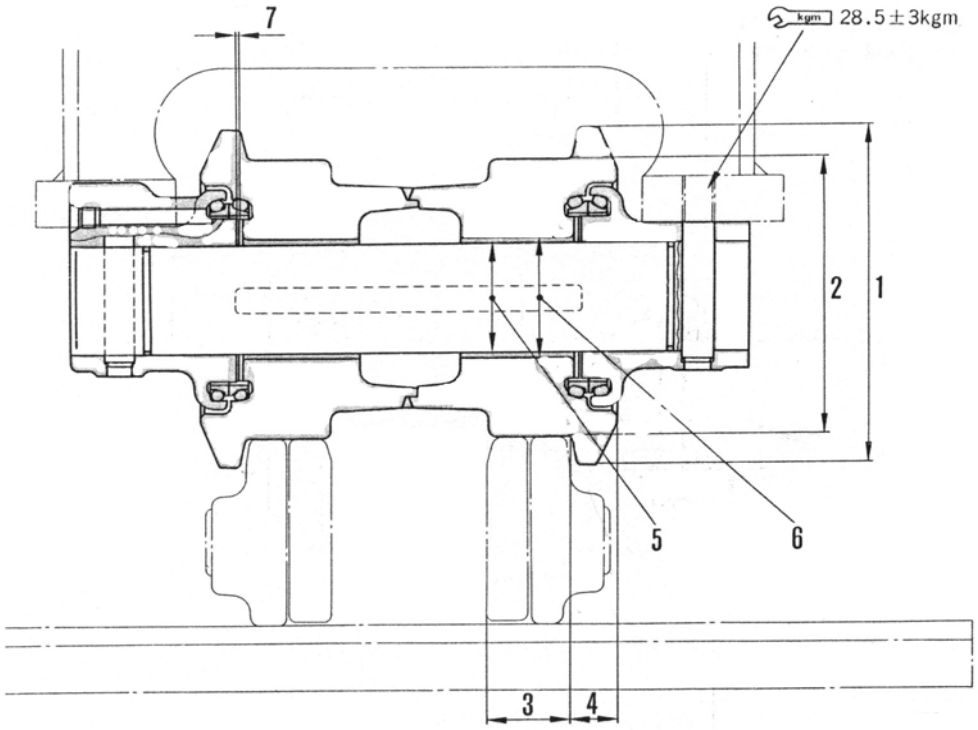
IDLER



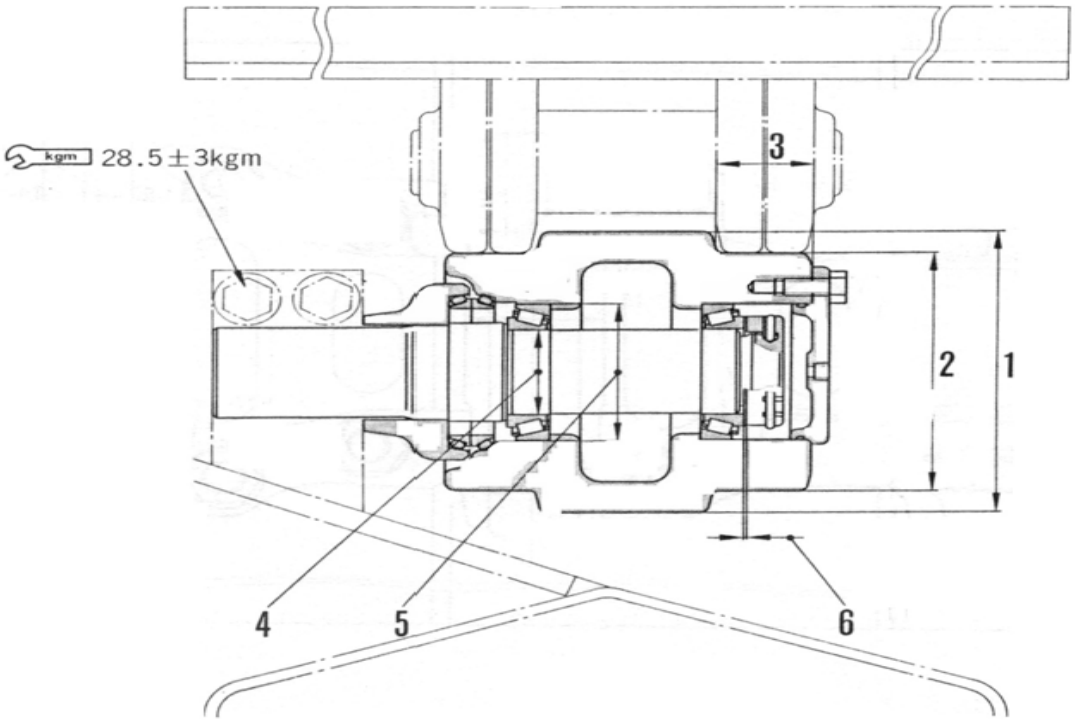
Unit : mm

No.	Check item	Criteria					Remedy
1	Out side diameter of protrusion	Standard size: 560		Repair limit: -			Rebuild or replace
2	Out side diameter of tread	520		508			
3	Width of protrusion	85		73			
4	Total width	164		156			
5	Total of tread	39.5		45.5			Replace bushing
6	Clearance between shaft and bushing	Standard size: 65	Tolerance shaft: -0.250 -0.350	Tolerance hole: +0.074 - 0.036	Standard clearance: 0.214 - 0.424	Clearance limit: 1.5	
7	Clearance between shaft and support	65	-0.250 -0.290	-0.110 -0.220	0.036 - 0.180	-	Replace
8	Interference between idler and bushing	Standard size: 72	Tolerance shaft: -0.089 -0.059	Tolerance hole: -0.006 -0.072	Standard Interference: 0.065 - 0.161	Interference limit: -	Replace bushing
9	Side clearance of idler (each)	Standard clearance: 0.165 - 0.395		Clearance limit: 1.5			
10	Tightening torque of oil filler plug	21 ±5 kgm					Tighten



Unit : mm

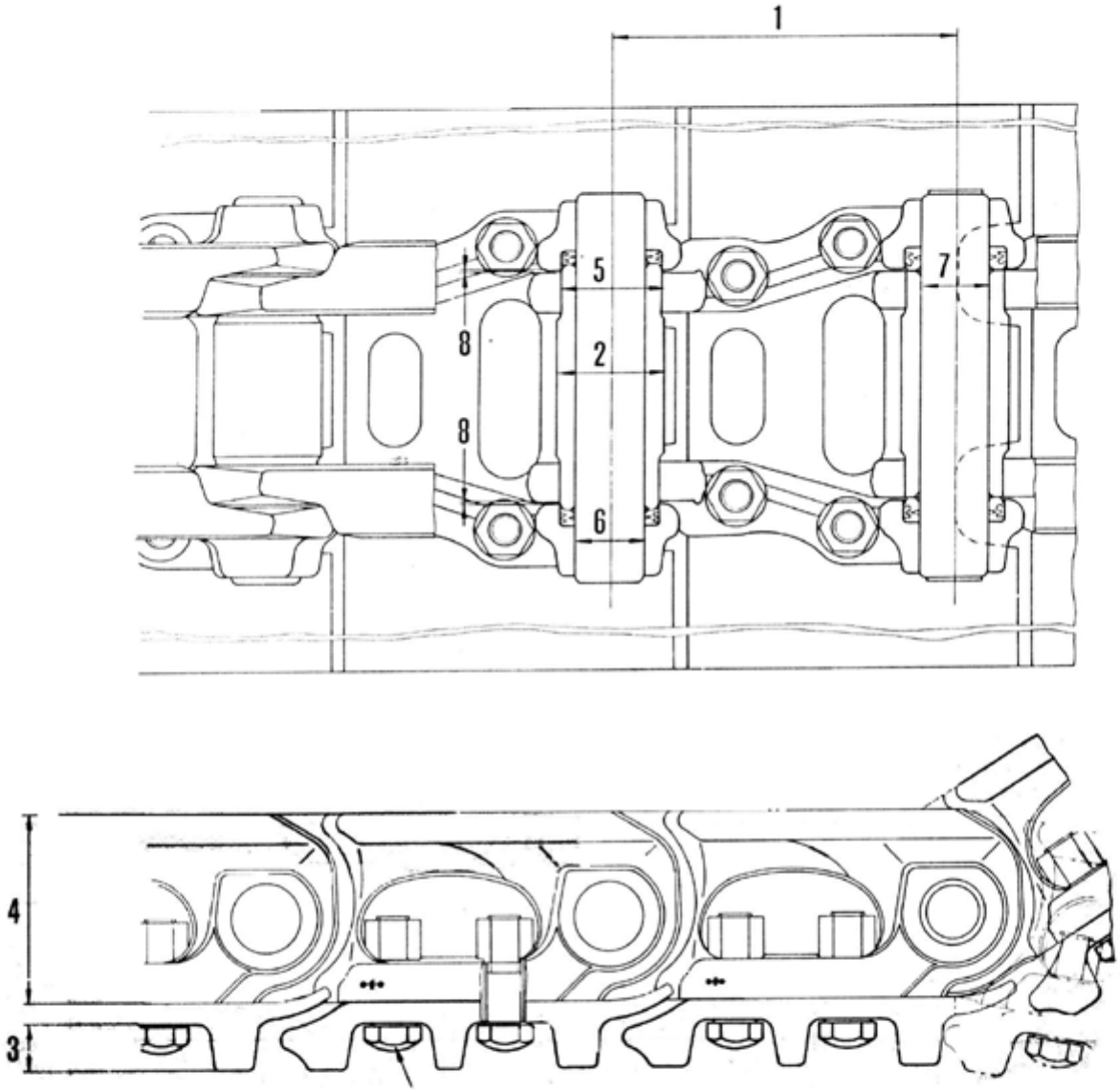
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Out side diameter of flange (out side)	188			-		
2	Out side diameter of tread	156			144		Rebuild or replace
3	Width of tread	44.5			62		
4	Width of flange	25.5			-		
		Standard size	Tolerance		Standard clearance	Clearance limit	
			shaft	hole			
5	Clearance between shaft and bushing	60	-0.215 -0.315	+0.196 0	0.215 - 0.510	1.5	Replace bushing
		Standard size	Tolerance		Standard Interference	Interference limit	
			shaft	hole			
6	Interference between roller and bushing	67	-0.153 -0.053	-0.030 0	0.023 - 0.153	-	Replace bushing
		Standard clearance			Clearance limit		
7	Side clearance of roller (both)	0.41 - 0.95			1.5		Replace



Unit : mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Out side diameter of flange (out side)	165			-		
2	Out side diameter of tread	140			128		Rebuild or replace
3	Width of tread	43			50		
		Standard size	Tolerance		Standard clearance	Clearance limit	
			shaft	hole			
5	Clearance between shaft and bushing	60	0 -0.016	0 -0.012	0.012 - 0.018	-	
		Standard size	Tolerance		Standard Interference	Interference limit	
			shaft	hole			
6	Interference between roller and bushing	80	0 -0.013	-0.021 -0.051	0.008 - 0.061	-	Replace bushing
		Standard clearance			Clearance limit		
7	Side clearance of roller	0 - 0.18			1.5		

TRACK SHOE

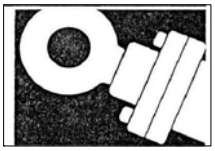


Unit : mm

No.	Check item	Criteria					Remedy
1	link pitch	Standard size: 190.25		Repair limit: 193.25			Turn or replace
2	Out side diameter of bushing	59.48		56.48			
3	Height of grouser	Triple : 26		15			lug welding rebuild or replace
4	Height of link	105		97			rebuild or replace
5	Interference of bushing and link	Standard size: 55	Tolerance shaft: +0.304 +0.264	Tolerance hole: +0.074 0	Standard Interference: 0.190 - 0.304	Interference limit: 0.1	Replace
6	Interference of pin and link	Shaft: 38 Hole : 37.8	+0.172 +0.072	+0.062 0	0.210 - 0.372	0.14	
7	Interference of master pin and link	37.8	+0.230 +0.200	+0.062 0	0.138 - 0.230	0.08	Replace with longer one
8	Side clearance of bushing	Standard clearance (one side): 0 - 0.9		Standard clearance (both side): 0 - 1.8		Clearance limit (both side): —	
9	Tightening torque of shoe bolt	Initial tightening torque : 40 ±4 kgm Additional tightening angle : 120 ±10°					Tighten

HYDRAULIC SYSTEM

11 STRUCTURE AND FUNCTION



HYDRAULIC PIPING

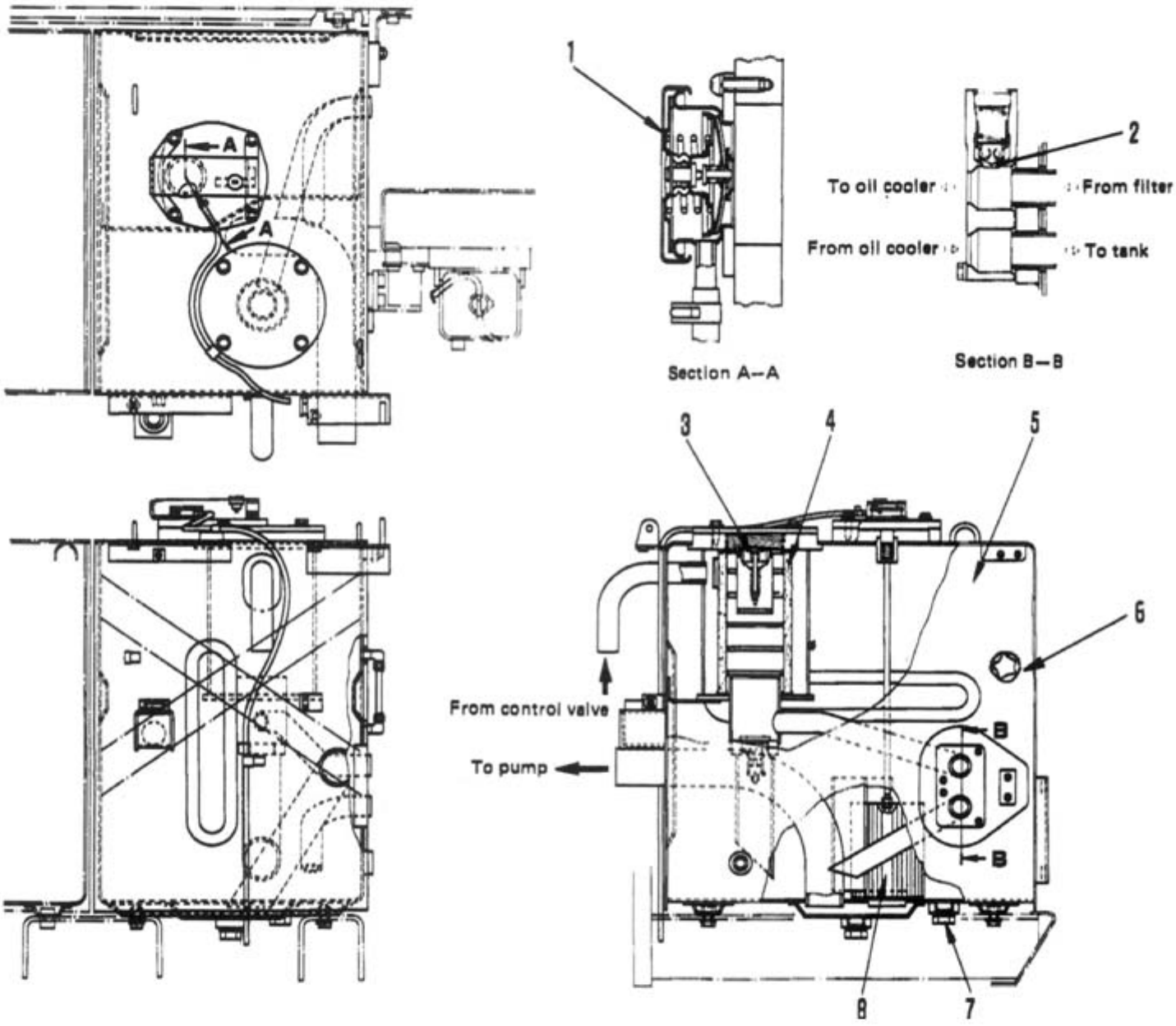
- Hydraulic pumps driven by this engine consist of two main pumps (variable displacement piston type) and one charging pump (gear pump type).
  The main pumps deliver the oil from the hydraulic tank to the control valves, while charging pump delivers the oil to the solenoid valve and to the PPC valve (or in-line servo valve).
- When the OLSS system is used, the main pumps help save energy and keepthe hydraulic pressure loss to minimum.
- The travel, steering and work equipment operations are all hydraulically controlled by operating the corresponding hydraulic motor and hydraulic cylinder, when control lever in the operators cab is operated to change the oil flow in circuit
- Each control valve has a main relief valve, a safety valve, and a suction valve.
- The main relief valve is in the circuit between the hydraulic pump and the control valve, it keeps the maximum pressure of the oil delivered from the hydraulic pump at the preset value.
- The safety valve,located in the circuit between the control valve and the actuators (hydraulic motor, hydraulic cylinder, etc.), protects the hydraulic equipment from external overloading when the control valve is in NEUTRAL, and ensures operational safety.
- The suction valve prevents the occurrence of negative pressure in the circuit.
- In addition, an oil cooler is provided in the hydraulic circuit to prevent the oil from getting too hot and to minimise the degradation of the oil.
- The oil flows in the circuit in one direction. All of the oil passes through a filter in the tank in order to protect theequipment.
- Each boom and arm circuit forms a two-pump merged circuit. When the arm and the swing operations are performed concurrently, the arm circuit from one of the pumps is restricted so that the swing circuit is given priority.
- The auto-deceleration system (if equipped) helps save energy by automatically decelerating the engine while the control levers are in neutral.

HYDRAULIC SCHEMATICS

Refer Rexrot instruction manual of HS-64-05-E0403-1-3

HYDRAULIC CIRCUIT DIAGRAM

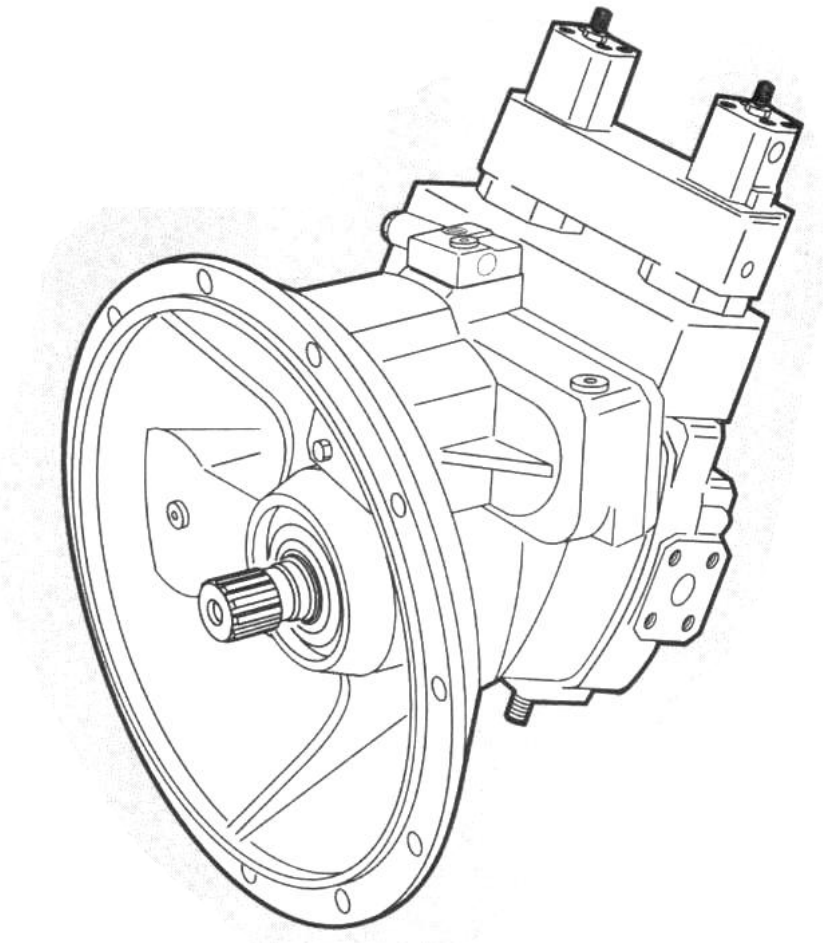
Refer Rexrot instruction manual of HS-64-05-E0403-1-3



1. filler cap (with lock device (if equiped))
2. Bypass check valve
3. Bypass valve
4. Filter element
5. Tank
6. Sight-gauge
7. Drain plug
8. Strainer

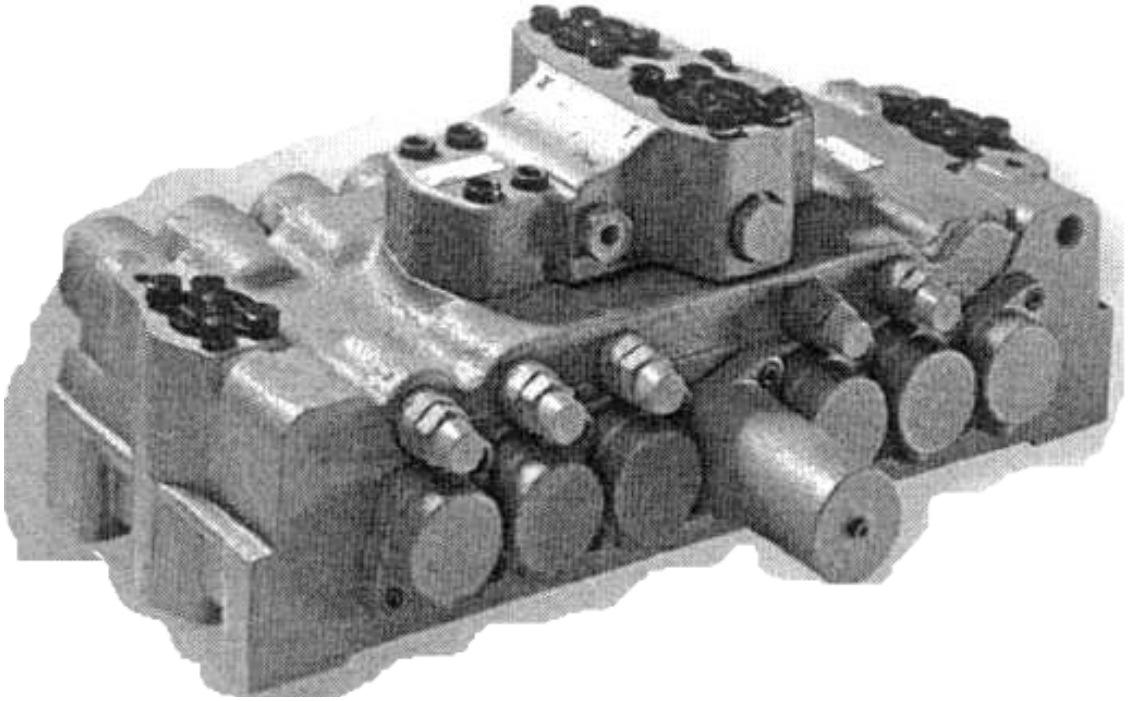
MAIN PUMP

Refer Rexrot instruction manual of HS-64-05-E0403-1-3



HYDRAULIC CONTROL VALVE

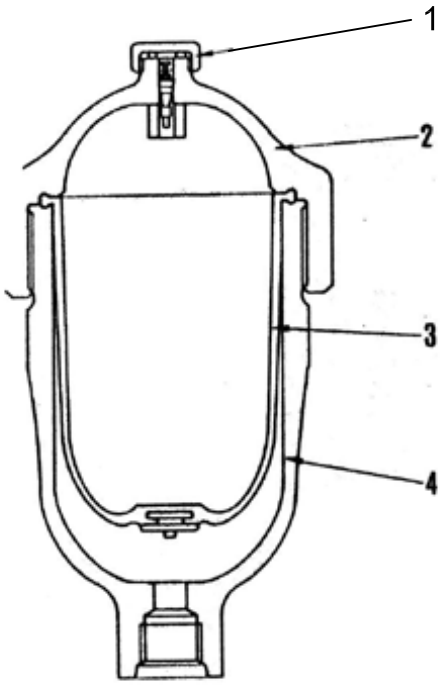
Refer Rexrot instruction manual of HS-64-05-E0403-1-3



ACCUMULATOR

FUNCTION

- The accumulator uses a flexible rubber bag (3) containing nitrogen (N_2) gas to maintain the hydraulic oil pressure.



1. Cap
2. Cover
3. Rubber bag
4. Body

OPERATION

- When the PPC valve is at neutral, the chamber A in the rubber bag (3) (nitrogen gas capacity : 480 cc) is compressed by the oil pressure in chamber B.

(Fig. 1)

- As oil pressure in chamber B lowers to 30 kg/cm^2 or below when relieving residual pressure, the rubber bag (3) expands due to the nitrogen. The working pressure is 12 to 30 kg/cm^2.

(Fig. 2)

Nitrogen is sealed in the rubber bag

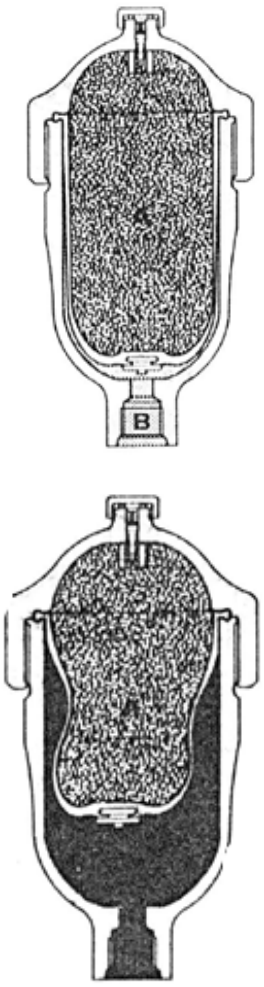


Fig. 1

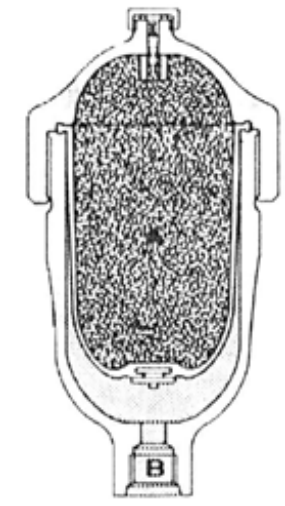
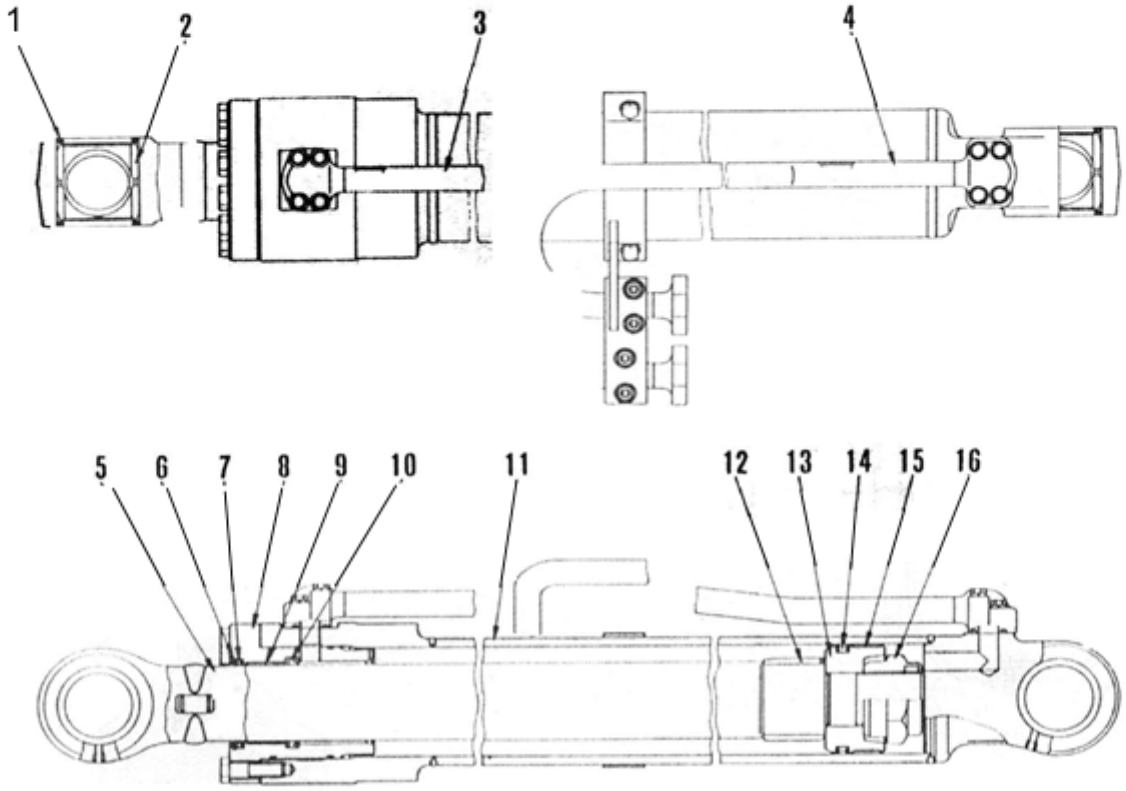


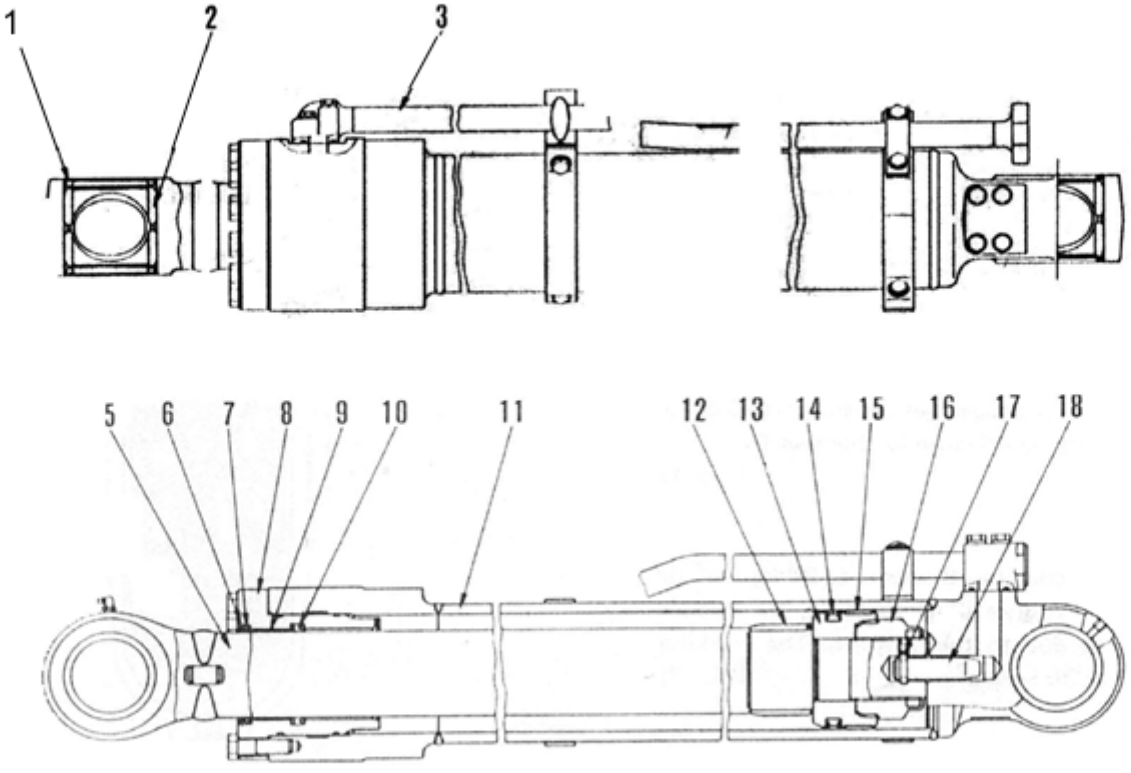
Fig. 2

HYDRAULIC CYLINDER

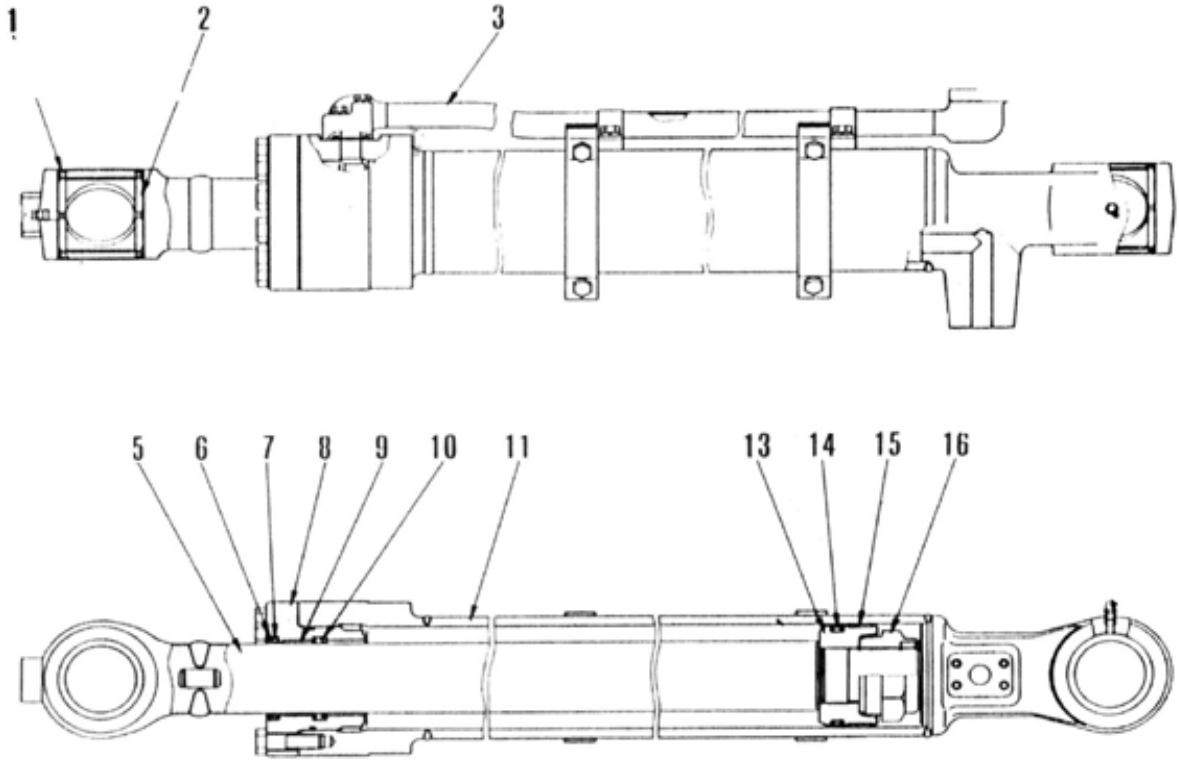
1. Boom cylinder



2. Arm cylinder



BUCKET CYLINDER



1. Dust seal
2. Bushing
3. Head side tube
4. Bottom side tube
5. Piston rod
6. Snap ring
7. Dust seal
8. Cylinder head
9. Bushing
10. Rod packing
11. Cylinder
12. Plunger
13. Piston
14. Slipper seal
15. Wear ring
16. Piston nut
17. Ball
18. Plunger

Unit : mm

Item	Boom	Arm	Bucket
Rod O.D	90	100	90
Cylinder I.D	130	140	130
Stroke	1234	1628	989
Max. length	3020	3825	2575
Min. length	1786	2197	1586
Piston nut width across flats	95	95	95

CUSHION CYLINDER: For boom cylinder head and arm cylinder head and bottom sides

1. PURPOSE

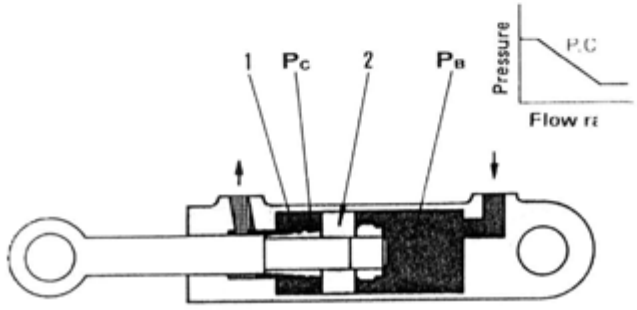
- Reducing the piston striking speed at the stroke ends alleviates the shock loads on the chassis, contributing to improved productivity and performance reliability.
- The piston striking sound is reduced.
- Durability of cylinders and their piping is improved, resulting in high operational safety and reliability.

2. FEATURES

- The construction is simple, yet a large decelerating effect is ensured.
- There is a cylinder aligning effect resulting in high durability and performance reliability of cylinders.

3. Operating principle

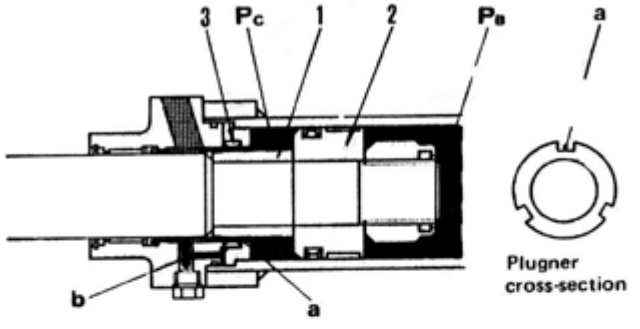
- If piston (2) approaches the stroke end, causing a cushion plunger (1) to throttle oil, the cushion pressure Pc goes up.
  Consequently, P_B also goes up. In a variable displacement pump, the flow rate is decreased along a PC curve, causing the piston speed to slow down.
  Further, if P_B continues going up, exceeding the main relief pressure setting, the cylinder speed is reduced more, resulting in a sufficient cushioning (shock absorbing) effect.



4. OPERATION

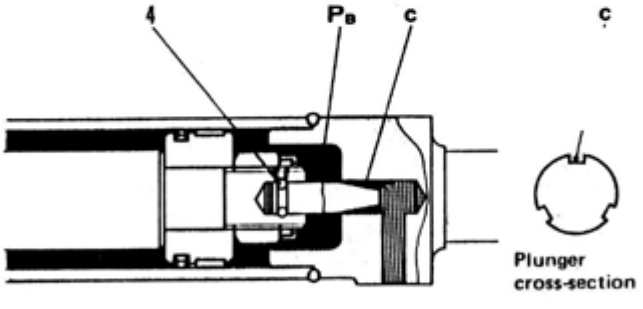
In boom cylinder head and arm cylinder head

- When the piston (2) approaches its stroke end, the plunger (1) enters the cylinder head, causing oil to be confined in chamber Pc. Then, the oil in chamber Pc flows from the cylinder head section through slits a (3 slits) around the plunger and restrictor b. This cushioning effect plus a reduced delivery from a variable displacement pump responding to the pressure variation in chamber P_B ensures a thorough shock absorbing effect for the boom cylinder.



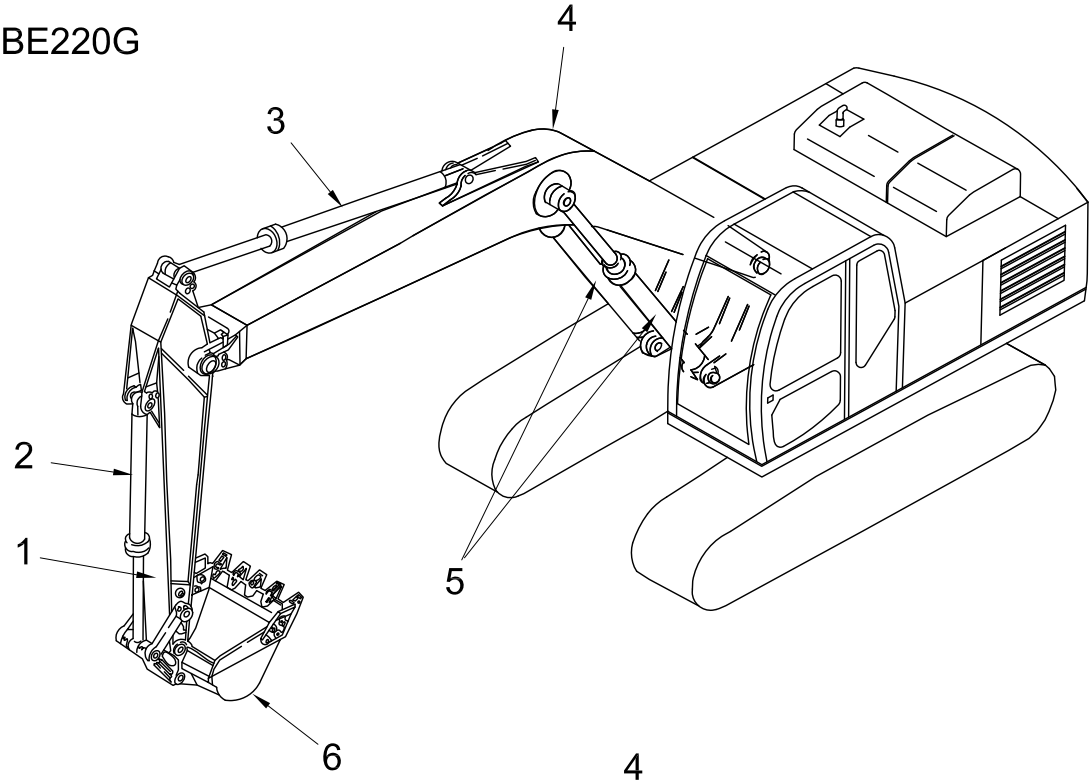
In arm cylinder bottom

- Similarly in the boom cylinder head, the oil in chamber P_B is confined and the shock absorbing effect is available through slits C (3 slits) around the plunger. Steel balls (4) aid the plunger in its self-alignment.

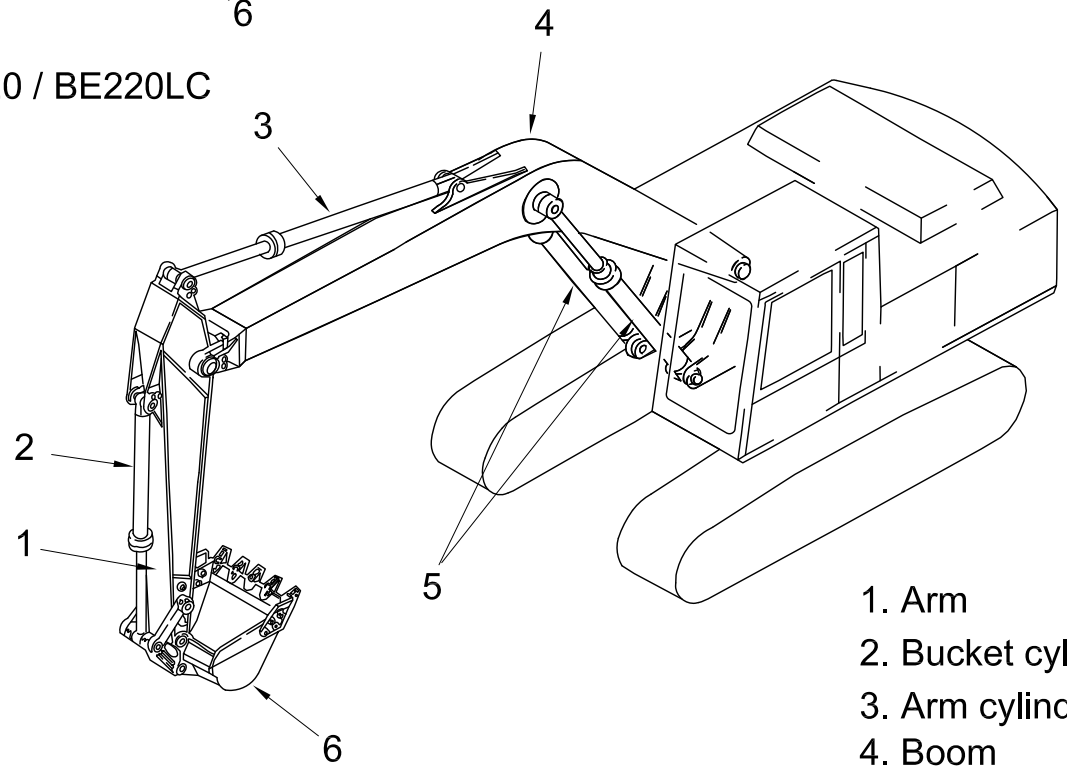


WORK EQUIPMENT

BE220G

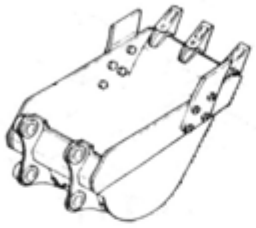
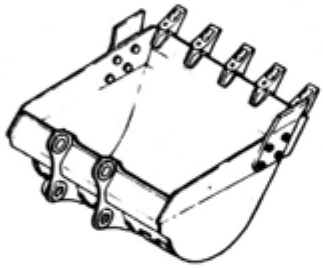
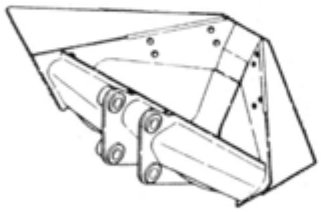
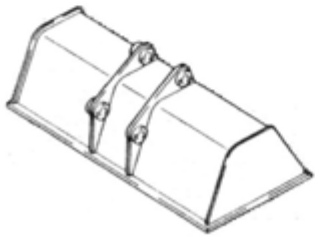


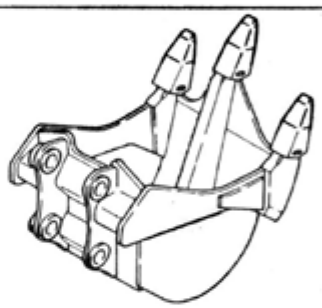
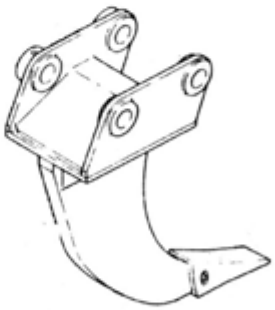
BE220 / BE220LC

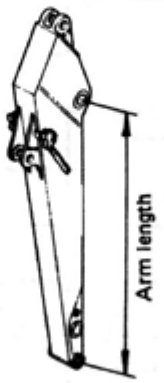


1. Arm
2. Bucket cylinder
3. Arm cylinder
4. Boom
5. Boom cylinder
6. Bucket

ATTACHMENT

Name	Style	Application	Specification	
Narrow bucket		Used for digging narrow trenches or for digging hard ground beyond ability of standard bucket	Capacity SAE (m^3)	0.72
			Bucket width (mm)	1005
			Weight (kg)	
			Reversible	YES
Light-duty bucket		Used for loading a large quantity of relatively light material	Capacity SAE (m^3)	1.12
			Bucket width (mm)	1405
			Weight (kg)	911
			Reversible	Yes
Trapezoidal bucket		Used for digging trapezoidal channels in farms and paddy fields	Capacity (m^3) SAE	0.5
			Ditching angle (deg.)	45
			Bucket width (mm)	
			Weight (kg)	830 (incl. side plate 220 kg)
Slope finishing bucket		Suitable for slope forming work	Compaction area (m^2)	2.00
			Compaction width (mm)	2,000
			Capacity (m^3)	0.35
			Weight (kg)	700

Name	Style	Application	Specification		
Clamshell bucket		Suitable for digging and loading work in a restricted spot such as bridge girder foundation digging work	Capacity (m^3) SAE	Loading type	
				0.60	
			Bucket width (mm)	866	
			Opening width (mm)	1,782	
			Weight (kg)	1,140	
			Rotation type	360° manual slide	
			Opening time (sec.)	2.0	
			Closing time (sec.)	1.2	
Ripper bucket		Used for digging hard ground rockbed and pavements	Capacity (m^3) SAE		
			Bucket (mm)		
			Weight (kg)	935	
			Reversible	No	
Ripper		Suitable for digging rocks and pavements and tree roots	Shank width (mm)	1-shank	3-shank
				76	53.5
			Ripper digging force (bucket) (kg)	15,400	15,500
			Weight (kg)	363	620
Short arm		Suitable for digging on general purpose	Arm length (Overall) (mm)		2,000
			Maximum digging depth (mm)		5670
			Weight (kg)		671

Name	Style	Application	Specification	
Long arm		Used for deep excavation work	Arm length (mm)	
			Max. digging depth (mm)	7,160
			Weight (kg)	

Attachment name	Standard arm 2.5 m	Short arn 2.0 m	Long arm 3.05 m 3.5 m
Narrow bucket (bucket width 1005 mm)	○	○	○
Standard bucket (bucket width 1250 mm)	○	○	△
Light-duty bucket (bucket width 1405 mm)	△	△	×
Light-duty bucket (bucket width 1505 mm)	△	△	×
Slope finishing bucket	○	○	○
Trapezoidal bucket (bucket width 3370 mm)	○	○	
Ripper bucket (bucket width 950 mm)	○	○	×
Clamshell bucket (bucket width 864 mm)	○	○	○
T-shank ripper	○	○	×

○ : For normal operation

△ : For light-duty operation

× : Unattachable

HYDRAULIC SYSTEM

12 TESTING AND ADJUSTING

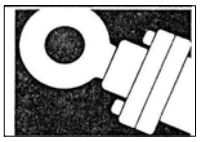
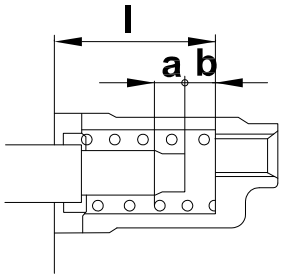
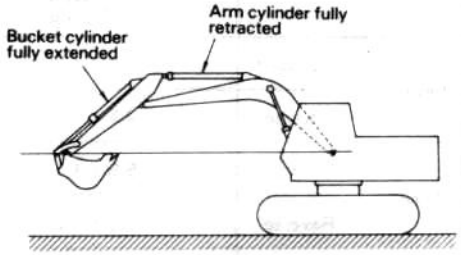


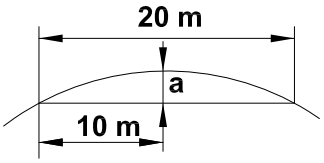
TABLE OF JUDGEMENT STANDARD VALUE

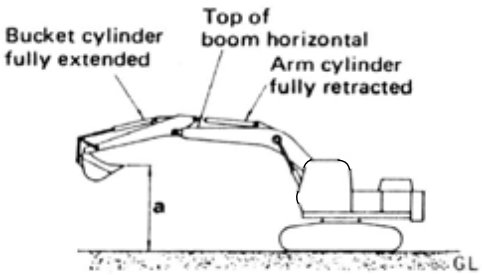
* Standard value and permissible value in following table are the value when 2-stage mode selector switch is at S position

Classi-fication	Item	Condition		Standard value	Permisable value
Enine speed (rpm)	Engine low idling speed	• Engine oil pressure: in correct range • Engine water temparature : in correct range		730 - 830	Min. 2150
	Engine high idling speed			2250 - 2350	
	Engine speed when one or two main pump circuit oil is relief	• Hydraulic oil tempareture : 45 - 55°C • Engine coolant temparature : in correct range • Engine oil pressure: in correct range • At one pump relief: Bucket circuit relief • At two pump relief: Bucket and arm circuit relief		2150 - 2250	
	Engine reted speed			2100	
	Engine speed when auto deceleration acts. (If equipped)	• Fuel control lever at " FUll " • Work equipment control lever at " Neutral "		1200 ± 50	1200 ± 50
Spool travel (mm)	Boom control valve			l: 35 a: 9.5±05 b: 9.5±05	l: 35 a: 9.5±05 b:
	Arm control valve				
	Bucket control valve				
	Swing control valve				
	L.H. Travel control valve				
	R.H. Travel control valve				
	Boom Hi control valve				
	Straight travel valve				
	Service valve				
Control lever travel (mm)	Boom control lever	• At centre of lever knob	Neutral → Raise and Lower	65 ± 10	65 ± 10
	Arm control lever		Neutral → Arm IN and OUT	65 ± 10	65 ± 10
	Bucket control lever	• Measure at end of travel	Neutral → Curl and Dump	65 ± 10	65 ± 10
	Swing control lever		Neutral → RH and LH swing	65 ± 10	65 ± 10
	Travel control lever		Neutral → Forward and Reverse	130 ± 15	130 ± 15
	Travel pedal	• Do not start engine	Neutral → Forward and Reverse F	45 ± 20	45 ± 20
			Neutral → Forward and Reverse R	40 ± 5	40 ± 5
	Fuel control lever	Stop ↔	Low idling	45 ± 20	45 ± 20
		Low idling ↔	Full speed	175 ± 30	175 ± 30

Classification	Item	Condition		Standard value	Permisable value
Control lever operating force (kg)	Boom control	• At engine full speed • Hydraulic oil temperature 45° - 55° C • Hook push-pull scale on center of lever knob measure		$3.0^{+0.5}_{-0.8}$	3.4
	Arm control			$2.5^{+0.5}_{-0.8}$	2.7
	Bucket control			$2.5^{+0.5}_{-0.8}$	2.7
	Swing control			$3.0^{+0.5}_{-0.8}$	3.4
	Travel control		Lever Forward	2.5 ±1.0	3.8
			Lever Reverse	2.5 ±1.0	3.8
			Pedal Forward	5.5 ±1.1	8.3
			Pedal Reverse	6.0 ±1.2	9
	Fuel control lever		Low idling ⟷ Stop	$12.0^{+2.0}_{-1.0}$	10
			Low idling ⟷ Full speed	$10.0^{+3.2}_{-2.0}$	
Hydraulic pressure (kg/cm^2)	Boom circuit	• Hydraulic oil temperature 45° - 55° C • Relief pressure at engine full speed (Be relieved oil in only measuring circuit)		320^{+10}_{-6}	320^{+25}_{0}
	Arm circuit				
	Bucket circuit				
	Travel circuit				
	Swing circuit			297^{+15}_{-10}	275^{+25}_{0}
	Charging circuit			30^{+5}_{0}	
	TVC valve outlet pressure	• Hydraulic oil temperature 45° - 55° C • At engine full speed	Lower at neutral		Min 18
			At one pump relier (320 kg/cm^2) Average pressure of two pump (160-170 kg/cm^2)		16 x 1.5
	NC valve outlet pressure	• Hydraulic oil temperature 45° - 55° C • At engine full speed	Lower at neutral	Max. 7	Max. 7
			Lower at strock end Raise track on one side than rotate sprocket	Max. 18	Max. 18
	Difference pressure jet sensor	• Hydraulic oil temperature 45° - 55° C	Lower at neutral	15 ±1.0	15 ±1.0
		• At engine full speed	Lower at full stroke	Max. 2	Max. 2
	Lowered hydraulic pressure	• Hydraulic oil temperature 45° - 55° C Difference oil relief pressure between at engine full speed and at engine half speed (Measure pressure in one circuit only)		Max. 5	Max. 5

Classification	Item	Condition		Standard value	Permissible value
Air pressure	In hydraulic tank (kg/cm²)	• Hydraulic oil temperature: 45 – 55°C • Open filler cap and run engine for 5 minutes. Fix filler cap and operate work equipment. And position work equipment to measure air pressure in tank.		Max. 0.39	± 0.15
Swing system	Swing brake angle (degree)	 (Fig. 1) • Engine speed: Full speed • Work equipment in posture in Fig. 1 • Hydraulic oil temperature: 45 – 55°C • Bucket unloaded • Braking angle after swing work equipment 180° with boom horizontal, arm cylinder fully retracted and bucket empty. (angle)		85 ± 10	120
	Time taken to start swing (sec.)	• Engine speed: Full speed • Hydraulic oil temperature: 45 – 55°C • Bucket unloaded • Measure time taken for 90° and 180° swing from starting point with work equipment in posture in Fig. 1	90°	3.2 ± 0.3	3.8
			180°	4.6 ± 0.5	5.5
	Time taken to swing (sec.)	• Engine speed: Full speed • Hydraulic oil temperature: 45 – 55°C • Work equipment in posture in Fig. 1 • Measure time taken to swing for 5 turns, after swinging one turn as an approach swing		24 ± 2	30
	Hydraulic drift of swing (mm)	• Engine speed: Stopped • Hydraulic oil temperature: 45 – 55°C • Work equipment in posture in Fig. 1 • Bucket unloaded • Stop the machine on 15° slope and set boom at 90° angle across the slope • Write the mach marks on the swing circle outer race and track frame. After 5 minutes, measure the lag of match marks.		471	471
	Leakage from swing motor (ℓ/min.)	• Engine speed: Full speed • Hydraulic oil temperature: 45 – 55°C • Relieve oil in swing circuit • Measure leakage from swing motor with measuring cylinder		Max. 2.5	4

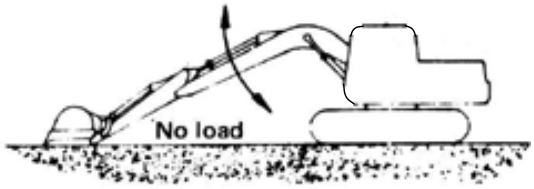
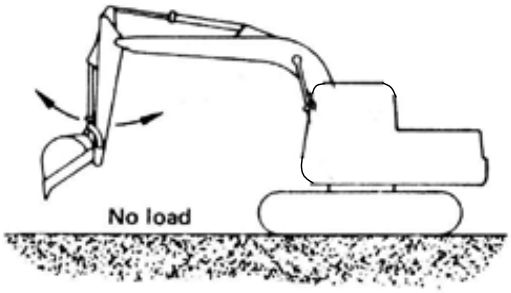
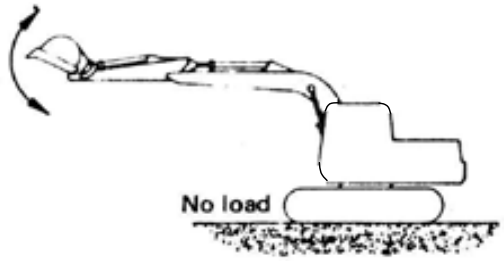
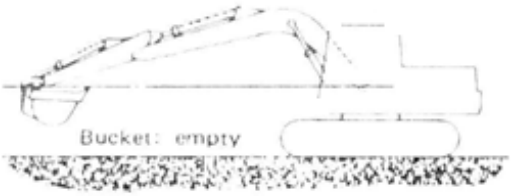
Classi-fication	Item	Condition	Permisable value	
Travel	Travel speed (1) (sec.)	• Engine speed : Full speed • Hydraulic oil tempareture : 45 - 55°C • Raise track on one side, then measure time : taken to rotate for 5 turns after rotating one turn as an approach travel • Repeat same way with track on other side	50^{+5}_{-3}	
	Travel speed (2) (sec.)	• Engine speed : Full speed • Hydraulic oil tempareture : 45 - 55°C • Machine is on level ground • measure time taken to travel for 20 m after travel 10 m as an approach travel	21^{+4}_{-2}	
	Travel deviation (mm.)	 • Engine speed : Full speed • Hydraulic oil tempareture : 45 - 55°C • Run of the machine for about 30 min on firm and level ground. • Lay out a 20 m string from a point 5 - 6 m from the start, and measure the deviation. (a) of the machine at the mid way point (10 m mark)	Max. 200	220
	Hydraulic drift of travel (mm.)	• Engine speed : Stopped • Hydraulic oil tempareture : 45 - 55°C • stop the machine on 12 ° slope with setting sprocket on uphill • Measure the distance moved by the mahine in 5 min.	0	0
	Leakage from travel motor (ℓ / min.)	• Engine speed : Full speed • Hydraulic oil tempareture : 45 - 55°C • Relieve oil in travel circuit with lock track shoe	Max. 3	4

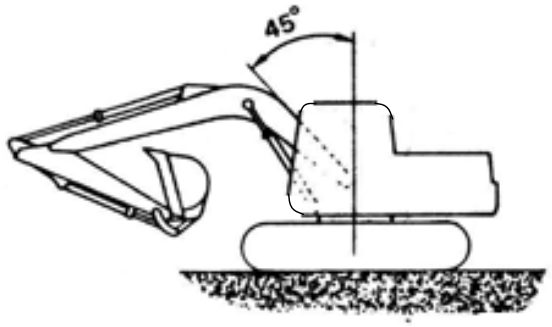
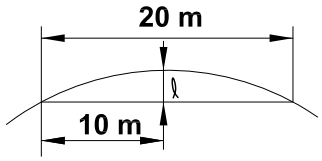
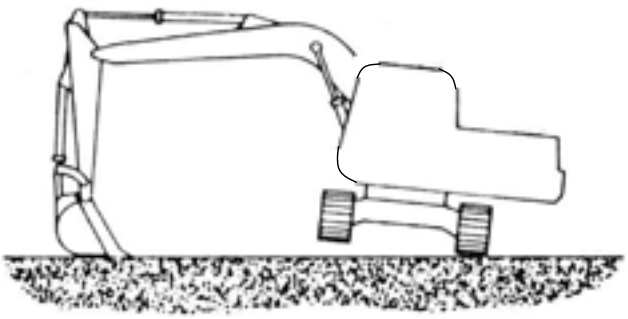
Classification		Item	Condition	Standard value		Permisable value
Work equipment	Work equipment speed	Boom (sec.)	• Engine speed: Full speed • Hydraulic oil temperature 45° - 55° C • Bucket unloaded • Arm and bucket cylinder fully retracted • Measuring time taken from bucket tooth touching the ground to cylinder fully extended (RAISE) • Measuring time taken from cylinder fully extended bucket tooth touching the ground (LOWER)	RAISE		4.1
				LOWER		4.2
		Arm (sec.)	• Top of boom is in horizontal, and bucket cylinder fully retracted • Measure time taken from cylinder fuuly retracted position to cylinder fully extended position (IN) • Measure time taken cylinder fuuly extended position to cylinder fully retracted position (OUT)	IN		5.9
				OUT		3.9
		Bucket (sec.)	• Top of boom is in horizontal, and bucket cylinder fully extended • Measure time taken from cylinder fuuly retracted position to cylinder fully extended position (CURL) • Measure time taken cylinder fuuly extended position to cylinder fully retracted position (DUMP)	CURL		5.0
				DUMP		3.6
	Hydraulic drift	Total work equipment (mm)	 (Fig. 2) • Engine speed: full speed • Hydraulic oil temperature 45° - 55° C • Bucket unload • Work equipment in posture in Fig.2 • Measure amount bucket tooth moved down (distance "a") in 15 min. • Measure immediately after setting	Max. 600		Max. 960
		Boom cylinder (mm)	• Measure amount each cylinder retracted in 15 min.	Max. 30		Max. 45
		Arm cylinder (mm)		Max. 110		Max. 165
		Bucket cylinder (mm)		Max. 20		Max. 20

Classification		Item	Condition	Standard value	Permisable value
Work equipment	Time lag	Boom (sec.)	• Engine speed: Low idling • Hydraulic oil temperature 45° - 55° C • Bucket unloaded • Arm and bucket cylinder fully retracted • Measuring time taken from bucket tooth touching the ground to the machine raised	0	1.2 (Time lag is 0 sec, run the engine at min 1500 rpm)
		Arm (sec.)	• Top of boom is in horizontal, bucket cylinder fully retracted • Measure time taken from arm stopped when arm came into vertical to arm moved again	0	2.8 (Time lag is 0 sec, run the engine at min 1500 rpm)
		Bucket (sec.)	• Arm is in vertical • Measure time taken from bucket stopped when bucket tooth came in bottom to bucket moved again	0	3.6 (Time lag is 0 sec, run the engine at min 1500 rpm)
Combination operation performance	Boom or arm operation and swing	Boom and swing 90°	• Engine speed: full speed • Hydraulic oil temperature 45° - 55° C • Bucket unload • Arm is in vertical and boom cylinder is extended fully • Operate at "boom raise" and in "swing" at the same time, and measure the time taken and the amount arm top pin moved up when swing for 90°	Time (sec.)	3.5 ± 0.4	3.5 ± 0.4
				Height arm top pin (mm)		Min. 3400
		Arm and swing 90°		Time (sec.)		
				Height arm top pin (mm)		
		Charging pump discharge (l/min.)	• Engine speed: 210 rpm • Hydraulic oil temperature 45° - 55° C • Fuel pressure is 30 kg/cm^2	Max. 44.5	40.5
Heat balance		Hydraulic oil temperature	• Oil level and coolant level within specifications • Convert the atmospheric temperature reading in °F to °C, using the formula $\frac{5}{9}$ (F - 32) = C. • Estimate the temperature inside the cab on the basis of the known temperature difference between the atmospheric temperature • Drain the antifreeze and use a forcibly open type thermostat • Wind velocity, maximumely bad weather Surface conditions: Flat and sandy soils with Nd Value 10-20 No: niobium • When engine running at full speed, dig a ditch whose width is about the same as the machine and whose depth is about 2/3 the max. digging depth, swing 90°, and dump. Continue until the heat balance is achieved. • AS far as possible keep the oil pressure below the set pressure of the relief valve and use simultaneous operation while digging.	Max. 100	Max. 100
		Engine coolant temperature		Max. 100	Max. 100
		Engine oil temperature		Max. 120	Max. 120
		Swing gear case oil temperature		Max. 120	Max. 120
		Final drive case oil temperature		Max. 120	Max. 120

TABLE OF L POSITION VALUE

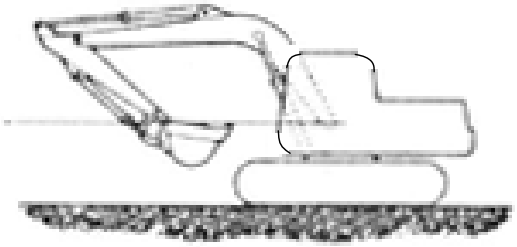
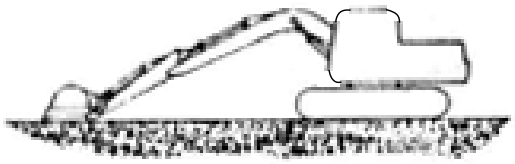
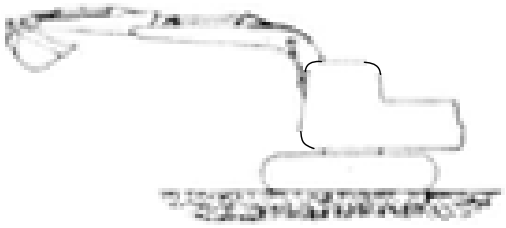
- The following table indicates the reference values for various actions when the mode selector switch is changed over from S position to L position.

Classi-fication		Item	Condition		L position
Work equipment	Work equipment speed	Boom Bucket teeth on the ground ↕ Cylinder fully extended (sec.)	Posture of work equipment  • Engine speed High idling • Oil temp. : 45 - 55°C		BE220G/BE220
				RAISE	3.7 ±0.4
				LOWER	3.4 ±0.3
		Arm Cylinder fully retracted ↕ Cylinder fully extended (sec.)	Posture of work equipment  • Engine speed High idling • Oil temp. : 45 - 55°C	IN	5.4 ±0.5
				OUT	3.6 ±0.4
		Bucket Cylinder fully retracted ↕ Cylinder fully extended (sec.)	Posture of work equipment  • Engine speed High idling • Oil temp. : 45 - 55°C	CURL	4.2 ±0.4
				DUMP	2.7 ±0.5
	Swing	Narmal swing speed (sec.)	Posture of work equipment Max. reach  • Engine speed High idling • Oil temp. : 45 - 55°C • Measure time to swing for 2 turns, after swinging one turn as an approach swing.		9.7 ±0.5

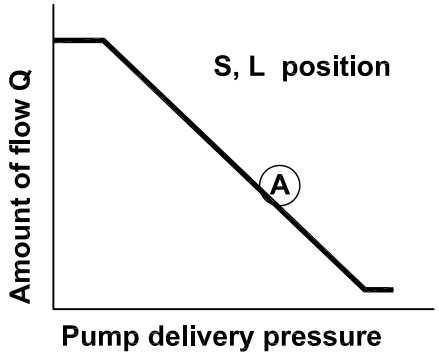
Classi-fication	Item	Condition	L position
Travel	Travel deviation (mm)	Travel posture  • Engine speed High idling • Oil temp. : 45 - 55°C • On a flat surface, make an approach run of at least 10 M, than travel another 20 m. Measure the travel deviation  • Measure dimension ℓ	BE220LC Max. 200
	Travel speed (sec.)	Machine posture with track spinning  • Engine speed High idling • Oil temp. : 45 - 55°C • Raise one track off the ground, let it spin one revolution, then measure the time required. Repeat this procedure for the other track.	22±2

FLOW CONTROL FEATURE TVC VALUE

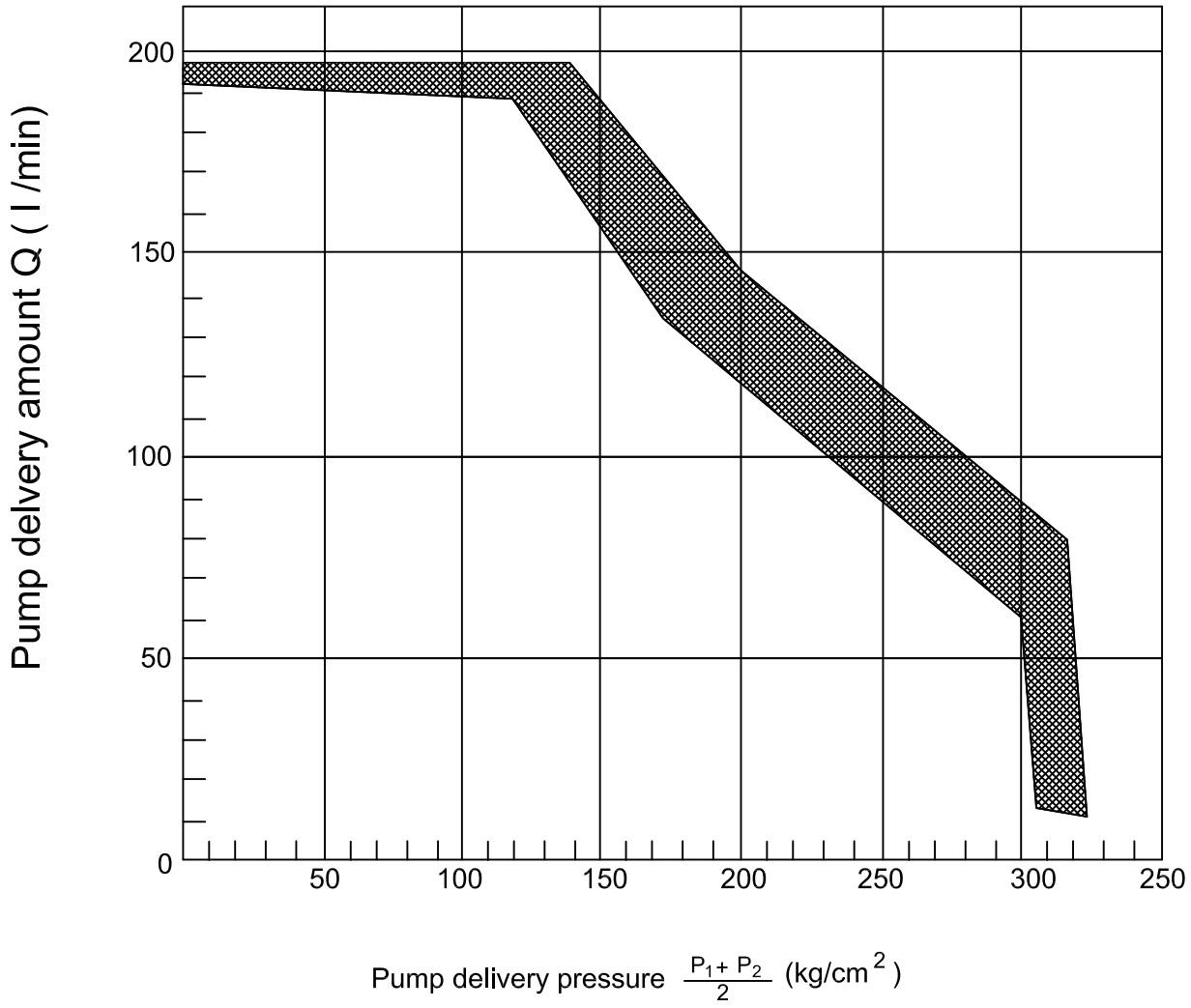
- The following table shows the reference valves for use when troubleshooting.

Classi-fication	Item	Condition	S position	L position
Combination operation performance	Boom and swing 90° (sec.)	Posture of work equipment  • Engine speed High idling • Hydraulic oil temperature : 45 - 55°C • Bucket loaded • Operate at "Boom raise" and in "Swing"at the same time,and measure the time taken when swing for 90°	3.6 ±0.4	3.8 ±0.4
Flow control feature	Minimum engine speed (rpm) at boom raise, and boom raise speed (sec.)	Posture of work equipment  • Engine speed: Full speed • Hydraulic oil temperature : 45 - 55°C • Measure time taken from bucket tooth touching the ground to cylinder full extended (RAISE)	3.5 ±0.3 (2150 ± 50)	4.0 ±0.5 (2200 ± 50)
	Note. Bucket dump speed when reliewing oil in swing circuit (sec.)	Posture of work equipment  • Engine speed: Full speed • Hydraulic oil temperature : 45 - 55°C	3.4 ±0.5	2.9 ±0.5

Note: When the control performance check of the TVC vlave, it becomes control position (approximately position A on the curve) when (swing relief pressure 297^{+15}_{-10} + bucket operation pressure) ÷ 2 = average pressure.



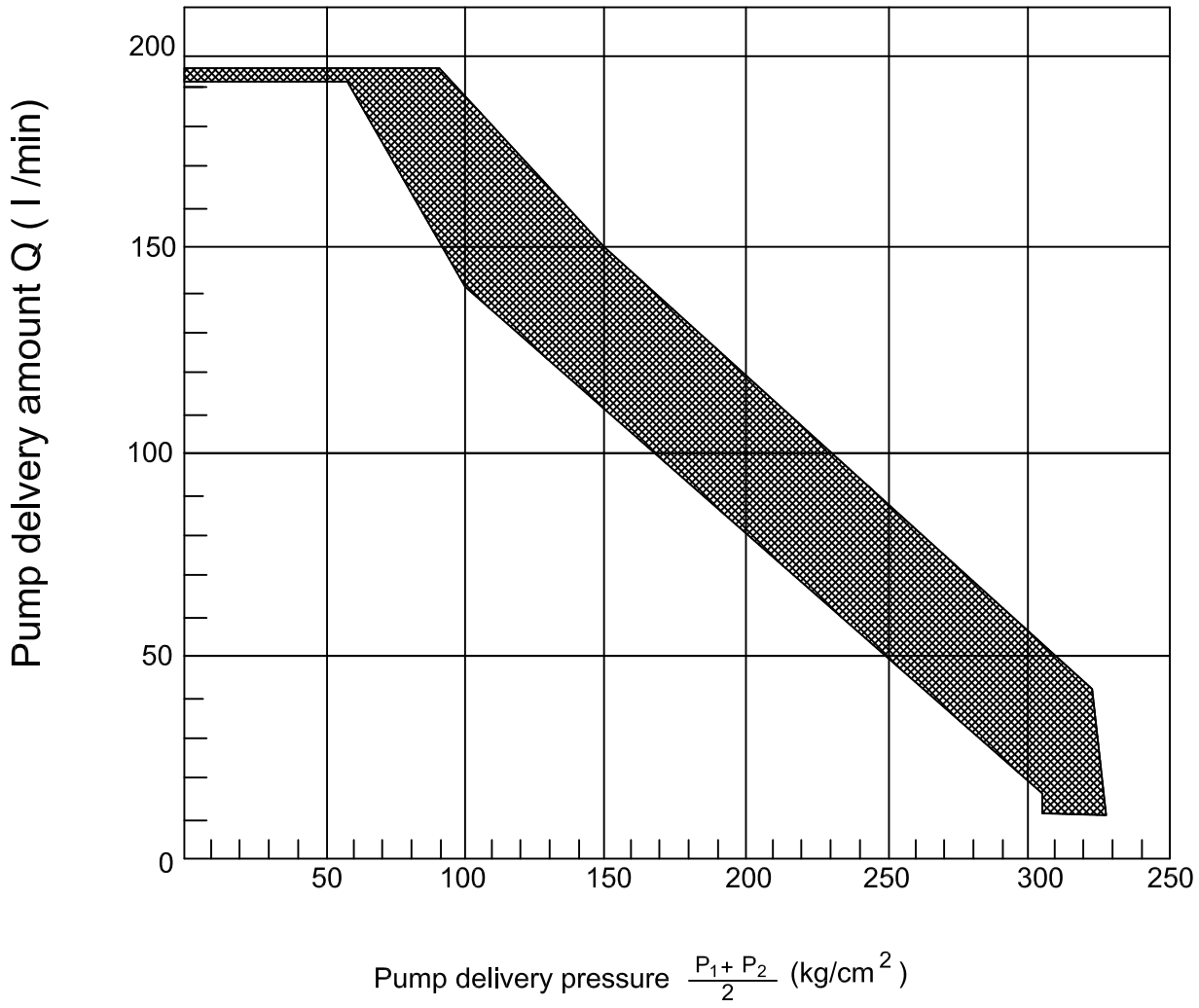
Main Piston Pump (S Mode)



Check point	Test Pump delivery pressure (kg/cm^2)	Other pump delivery pressure (kg/cm^2)	Average pressure (kg/cm^2)	Standard value for delivery Q (new machine) (l / min)	Judgement standard for delivery Q (l / min) (bottom level)
(1)	P_1	P_2	$\frac{P_1+P_2}{2}$	See graph	See graph
(2)	320	0 - 20	Note	27 ± 20	0
(3)	280	320	300	70 ± 20	50
(4)	180	320	250	100 ± 20	80
(5)	300 - 280	0 - 20	150	170 ± 20	150
(6)	0 - 20	0 - 20	0 - 20	195^{+5}_{-10}	185

Note : The CO valve is working, so the average pressure in unnecessary.

Main Piston Pump (L Mode)



Check point	Test Pump delivery pressure (kg/cm^2)	Other pump delivery pressure (kg/cm^2)	Average pressure (kg/cm^2)	Standard value for delivery Q (new machine) (l / min)	Judgement standard for delivery Q (l / min) (bottom level)
(1)	P_1	P_2	$\frac{P_1+P_2}{2}$	See graph	See graph
(2)	320	0 - 20	Note	27 ± 20	0
(3)	280	320	300	40 ± 20	20
(4)	80	320	200	100 ± 20	80
(5)	100 - 80	0 - 20	100	195^{+30}_{-20}	140
(6)	0 - 20	0 - 20	0 - 20	195^{+5}_{-10}	185

Note : The CO valve is working, so the average pressure in unnecessary.

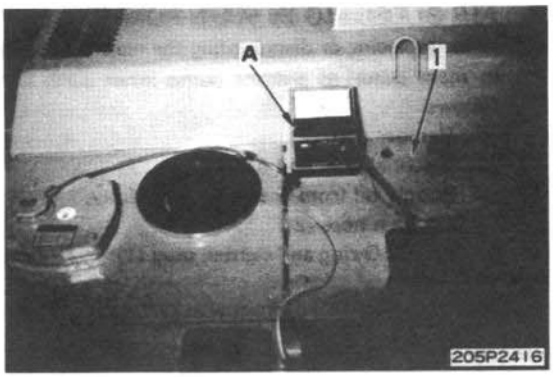
MEASURING HYDRAULIC OIL TEMPERATURE

Special tool

	Part No.	Part Name	Q'ty
A	790-500-1300	Thermistor temperature gauge	1

⚠ Lower the work equipment completely to the ground and stop the engine. Operate the control lever several times to release the remaining hydraulic pressure in the hydraulic piping. Then loosen the oil filler cap slowly to release the remaining oil pressure in the hydraulic tank.

- Remove cover (1), then measure the oil temperature using thermistor A.
- When hydraulic oil temperature is lower than 45°C, raise the oil temperature as follows.
- Start the engine and warm up running. Operate the arm or bucket control lever fully to relieve oil from main relief valve so that oil temperature is raised.
  - ★ Continued operation in above is within 30 seconds.



Note:

When relieving oil in boom, arm, bucket or travel circuit, CO valve acts and main pump delivery is minimum. In result, as oil flows only for hydraulic tank – main pump – main relief valve – hydraulic tank, operate boom, arm and bucket cylinders to raise the temperature of components sometimes.

AIR BLEEDING

1. AIR BLEEDING IN HYDRAULIC SYSTEM
2. AIR BLEEDING IN MAIN PUMP
3. REMIAN PRESSURE RELIEVING PPC CIRCUIT
4. AIR BLEEDING IN TRAVEL MOTOR

Refer Rexrot instruction manual of HS-64-05-E0403-1-3

TESING AND ADJUSTING MAIN RELIEF VALVE

Refer Rexrot instruction manual of HS-64-05-E0403-1-3

TESING PRESSURE OF CONTROL CIRCUIT

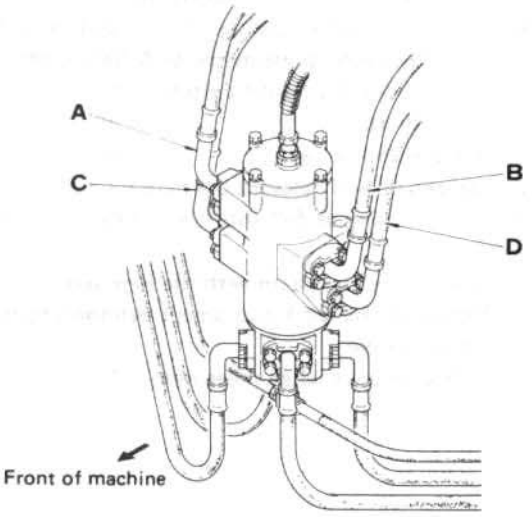
Refer Rexrot instruction manual of HS-64-05-E0403-1-3

TESTING OIL LEAKAGE FROM SWIVEL JOINT

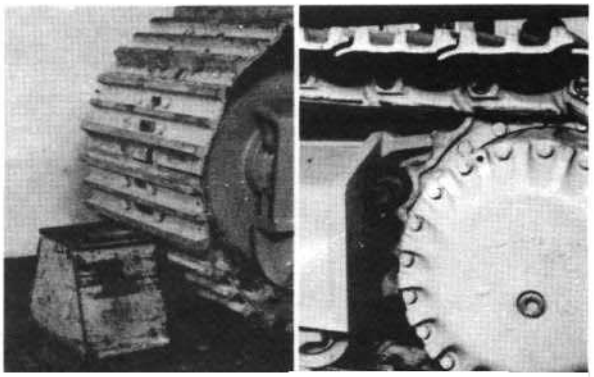
- If there is any abnormality (deviation, lack of speed, in the travel system, and there is no abnormality in the hydraulic pump, control valve, or travel motor assembly, test as follows.
  - ★ Oil temperature when measuring: 45 – 55°C

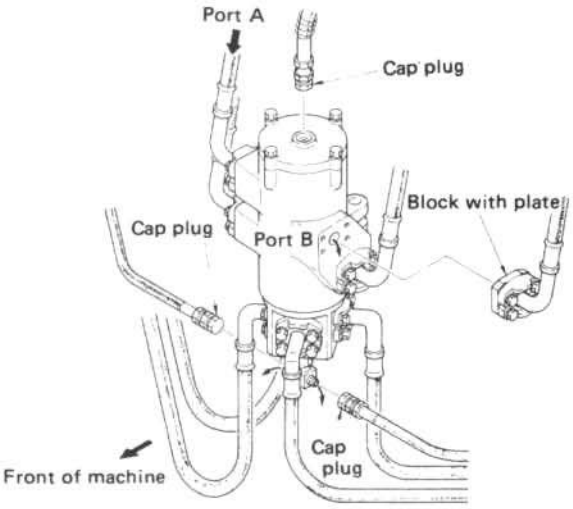
Testing for leaking from packing inside swivel joint

Inlet port of swivel joint	Direction of rotation of swing motor	Port to measure leakage inside swivel joint
A	Right REVERSE	B · Drain
B	Left FORWARD	A · C
C	Right FORWARD	B · D
D	Left REVERSE	C . Drain



1) Oil leakage from port **A (D)**
   - i) Put a block at the rear of the right track (rear of left track), move the machine slowly to put the track in contact with the block, then stop the engine.
     - Loosen the oil filler cap slowly to release pressure inside the hydraulic tank.
   - ii) Disconnect the drain hoses at the top and bottom of the swivel joint, and block both hoses with caps.
   - iii) Disconnect the hose at port **B (C)** for measuring at the top of the swivel joint, then block the hose with a plate.
   - iv) Start the engine, and run at full throttle to check.
     Relieve the circuit slowly.
   - v) Catch the oil leaking from the measuring port **B (C)** and the lower drain port in a measuring cylinder.
   - vi) Wait for one minute, then measure the leakage for the next minute.
   - ★ Use the following part as blind plug and flange hoses.
     Drain hose: Plug (CPL1150315) x 3





2) Oil leakage from port B (C)

i) Put a block at the front of the left track (front of right track), move the machine slowly to put the track in contact with the block, then stop the engine.

Loosen the oil filler cap slowly to release pressure inside the hydraulic tank.

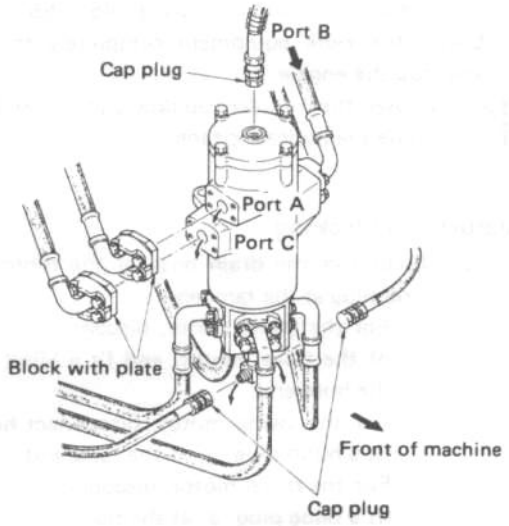
ii) Disconnect the hoses at ports **A** and **C** (**B** and **D**) for measuring at the top of the swivel joint, then block the hoses with plates.

iii) Start the engine, and run at full throttle to check.
Relieve the circuit slowly.

iv) Catch the oil leaking from the measuring ports **A** and **C** (**B** and **D**) in a measuring cylinder.

v) Wait for one minute, then measure the leakage for the next minute.

★ Use the following part as blind plug and flange hoses.
Drain hose: Plug (CPL1150315) x 3)

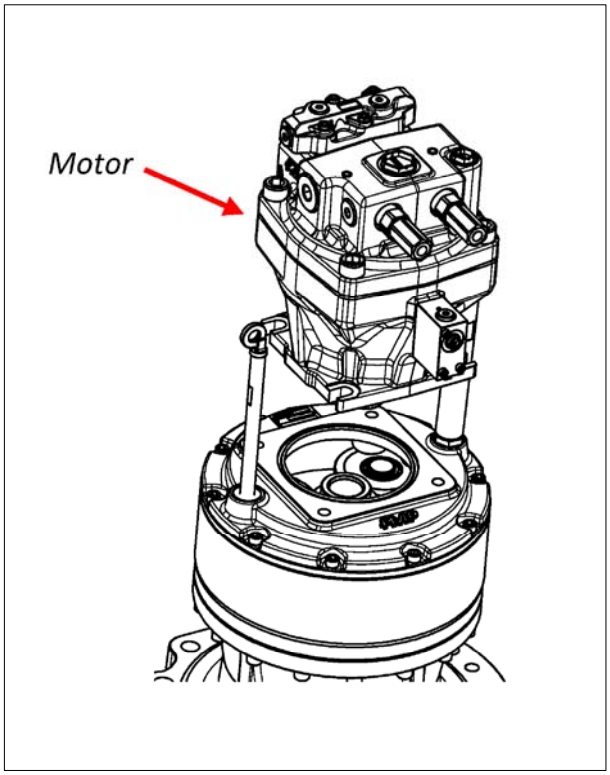


BE220G

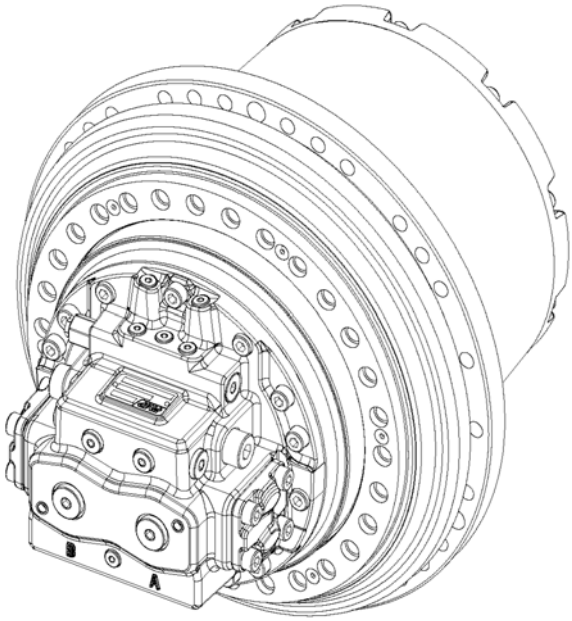
MEASURING OIL LEAKAGE OF SWING, TRAVEL MOTOR

Refer PMP instruction manuals of PMCI. M001 and PMTE. M001

1. SWING MOTOR



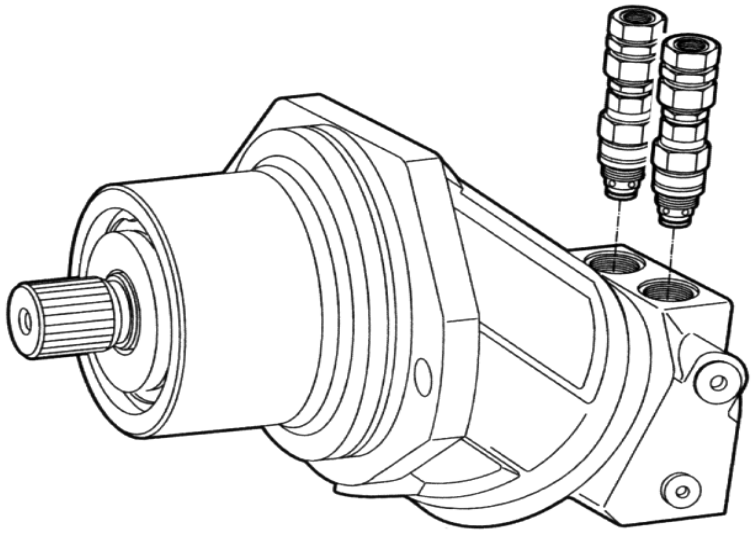
2. TRAVEL MOTOR



BE220 / BE220LC

MEASURING OIL LEAKAGE OF SWING, TRAVEL MOTOR

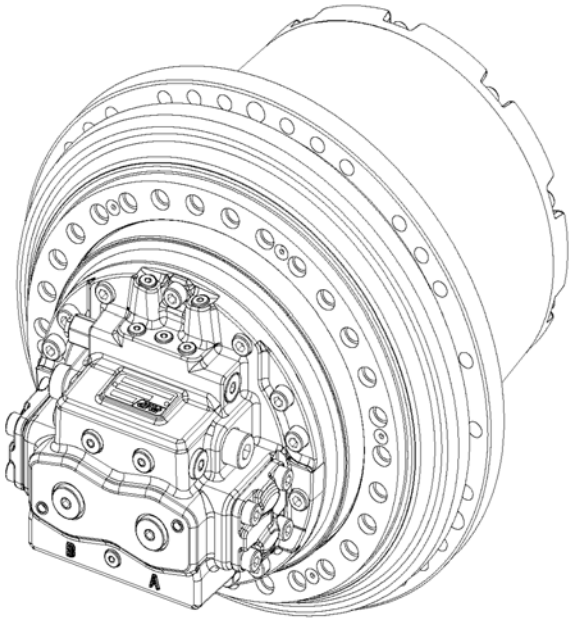
Refer Rexrot instruction manual of HS-64-05-E0403-1-3



BE220G

CHECKING AND ADJUSTING TRAVEL MOTOR FERFORMANCE

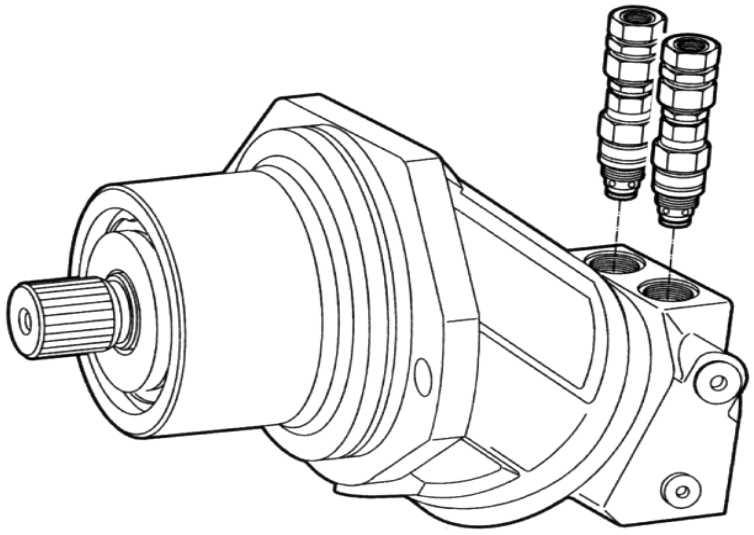
Refer PMP instruction manual of PMCI. M001



BE220 / BE220LC

CHECKING AND ADJUSTING TRAVEL MOTOR FERFORMANCE

Refer Rexrot instruction manual of HS-64-05-E0403-1-3



HYDRAULIC SYSTEM

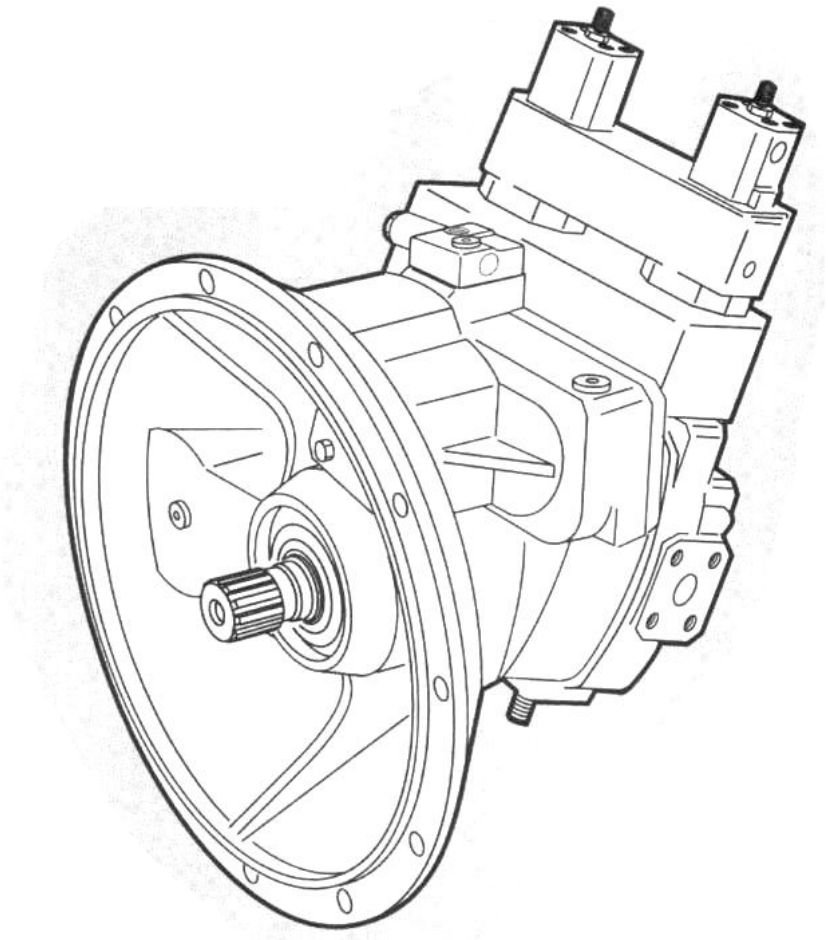
13 DISASSEMBLY AND ASSEMBLY

* When operating the hydraulic cylinders for the first time after reassembling cylinders,pumps and piping always bleed the air as follows :
  1. Start engine and run at low idling.
  2. Operate hydraulic cylinder 4 to 5 times,stopping 100 mm from stroke end.
  3. Next,operate cylinder 3 to 4 times to stroke end.
  4. After doing this,run engine at normal speed.

* After repair or long storage,follow the same procedure.

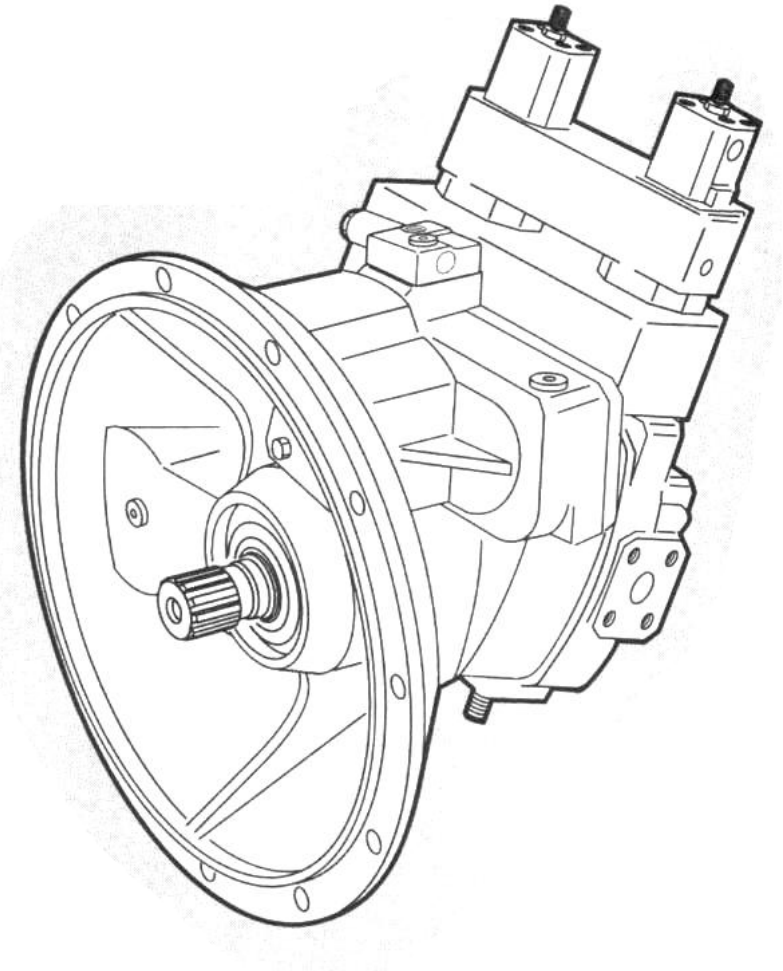
REMOVEL OF MAIN PUMP ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3



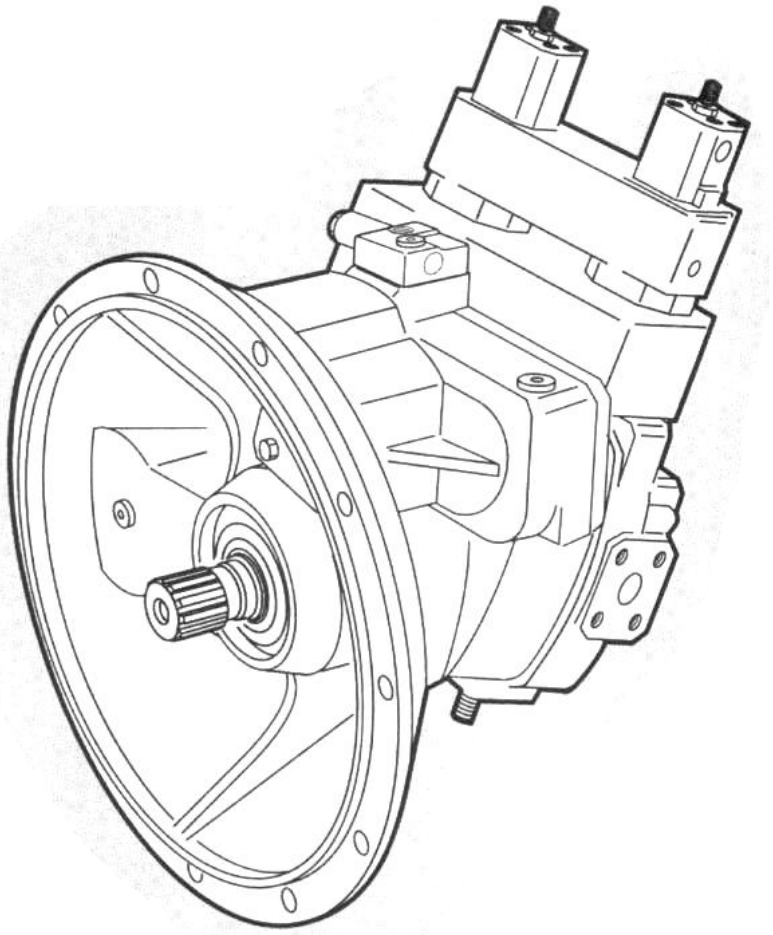
INSTALLATION OF MAIN PUMP ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3



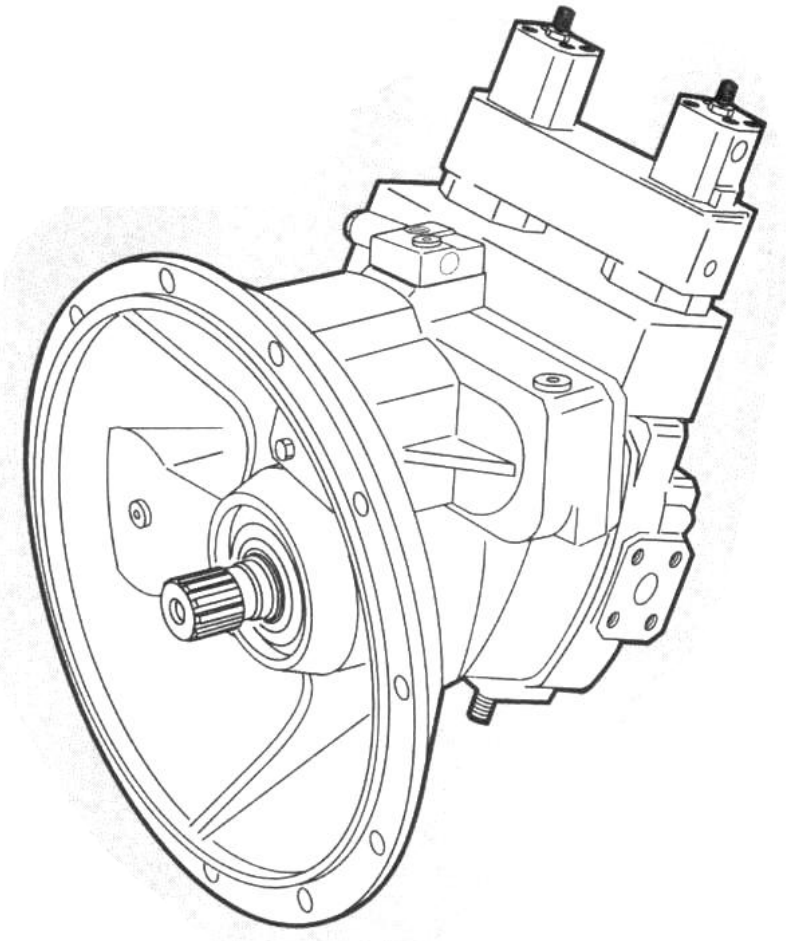
DISASSEMBLY OF MAIN PUMP ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3



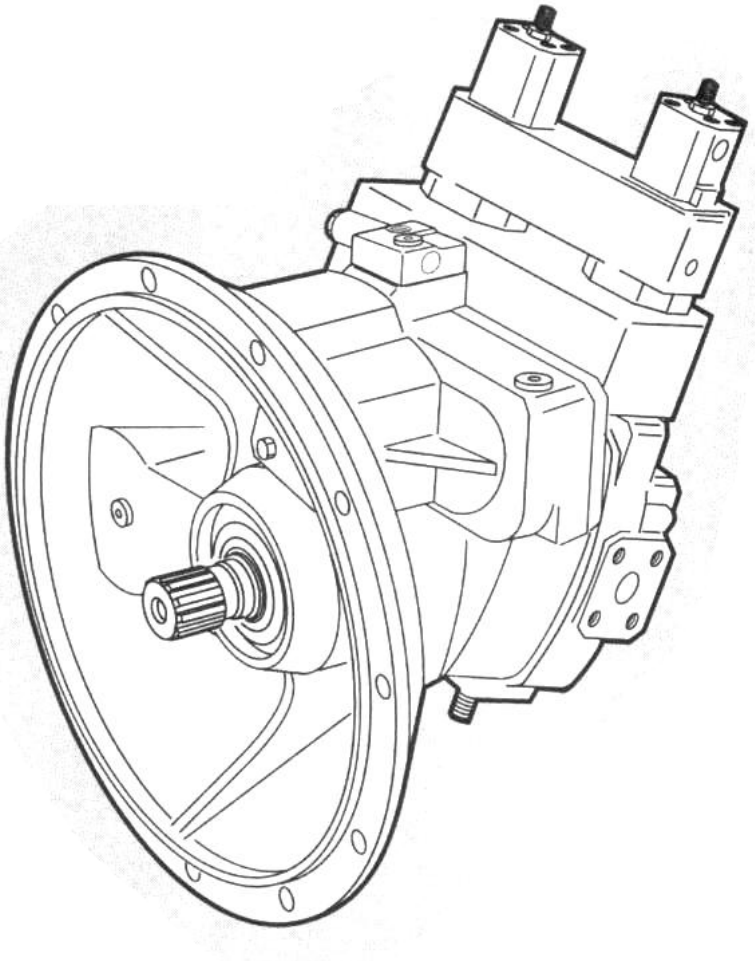
ASSEMBLY OF MAIN PUMP ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3



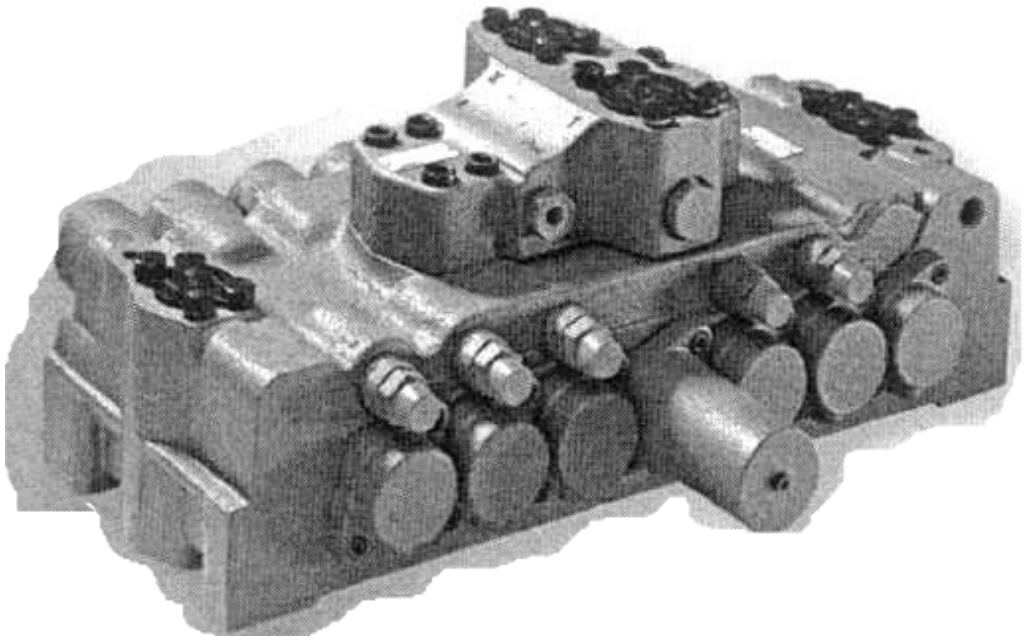
INSTALLATION OF MAIN PUMP ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3



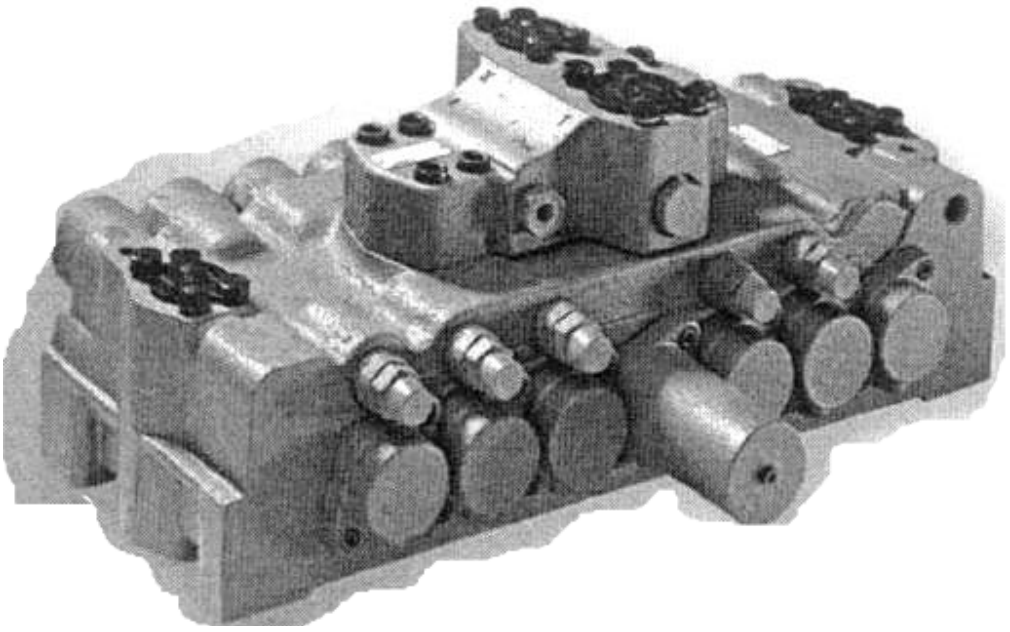
REMOVEL OF CONTROL VALVE ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3



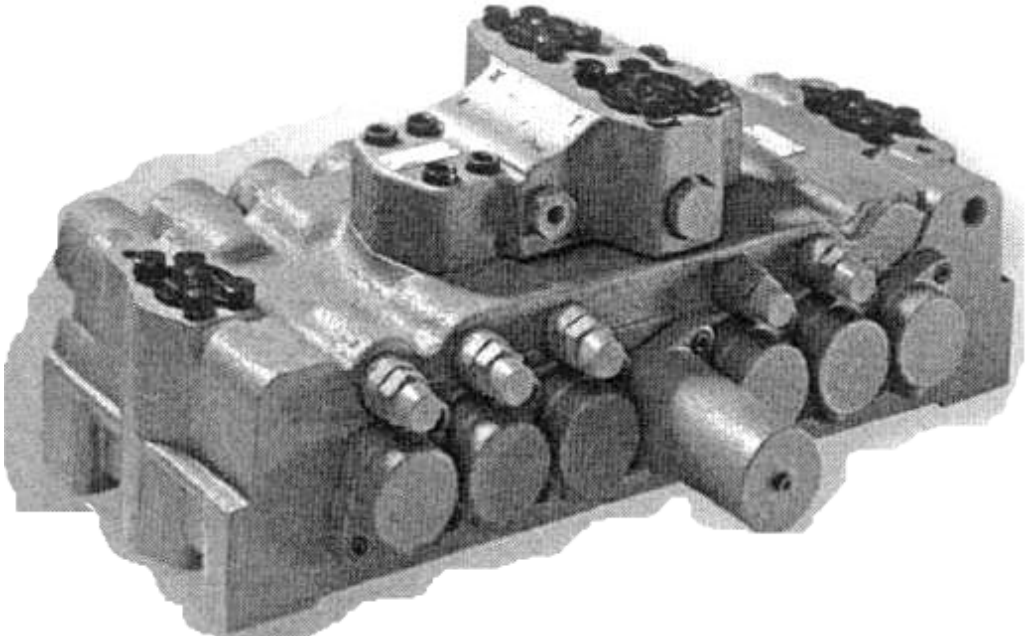
INSTALLATION OF CONTROL VALVE ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3



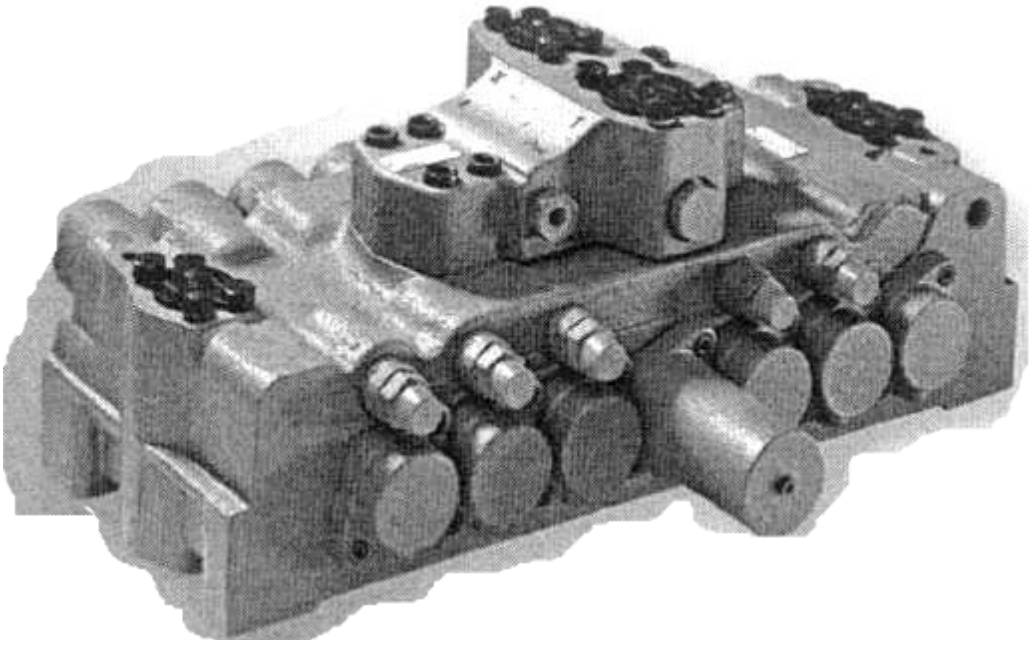
DISASSEMBLY OF CONTROL VALVE ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3



ASSEMBLY OF CONTROL VALVE ASSEMBLY

Refer Rexrot instruction manual of HS-64-05-E0403-1-3



REMOVAL OF BOOM CYLINDER ASSEMBLY

⚠ Extend the arm and bucket fully, lower the work equipment completely to the ground and stop the engine.

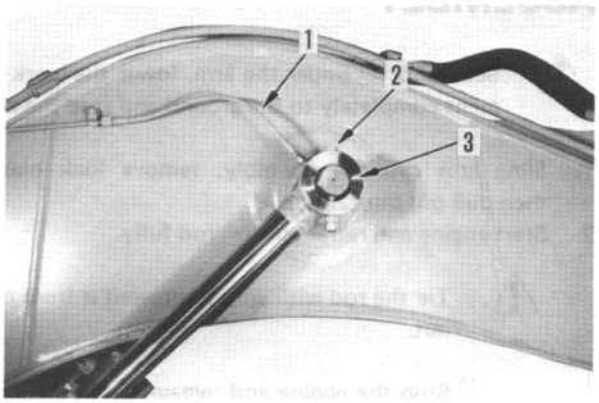
1. Disconnect greasing tube (1).
2. Remove lock bolt (2), then remove plates (3).
3. Sling boom cylinder assembly (4), push connecting pin (5) to opposite side, then remove piston rod from boom.
4. Start engine and retract piston rod fully.

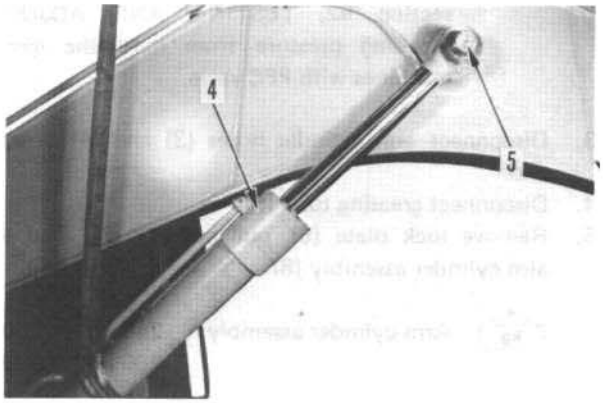
⚠ Tie the rod with wire to prevent it from coming out.

⚠ Stop the engine and release the hydraulic pressure in the hydraulic piping. For details, see section 62, TESTING AND ADJUSTING, Bleeding pressure from hydraulic circuit in machines with PPC valve.

5. Raise boom cylinder assembly (4), then set on stand ①.
6. Disconnect hoses (6) and (7).
7. Sling boom cylinder assembly (4) and remove lock plate (8). Using forcing screw ② (Dia. = 12 mm, Pitch = 1.75 mm), remove pin (9), then lift off boom cylinder assembly (4).

kg Boom cylinder assembly: 200 kg

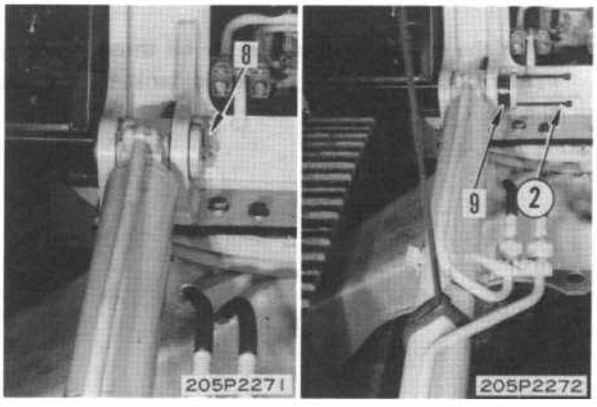




INSTALLATION OF BOOM CYLINDER ASSEMBLY

1. Raise boom cylinder assembly (4), and position bottom connecting pin hole on frame. Assemble spacer, knock in pin (9), and install lock plate (8).
   ★ Adjust with spacers so that the clearance between the revolving frame and the cylinder bottom is less than 1 mm.
2. Fit O-rings and connect hoses (7) and (6).
3. Raise boom cylinder assembly (4). Start engine, extend piston rod and align with pin hole, then knock in pin (5).
4. Fit plate (3), then secure with lock bolt (2).
5. Connect greasing tube (1).

★ Run the engine to circulate the oil through the system. Then add oil to the hydraulic tank to the specified level.



REMOVAL OF ARM CYLINDER ASSEMBLY

⚠ Set stand ① under the arm, lower the work equipment completely to the ground and stop the engine.

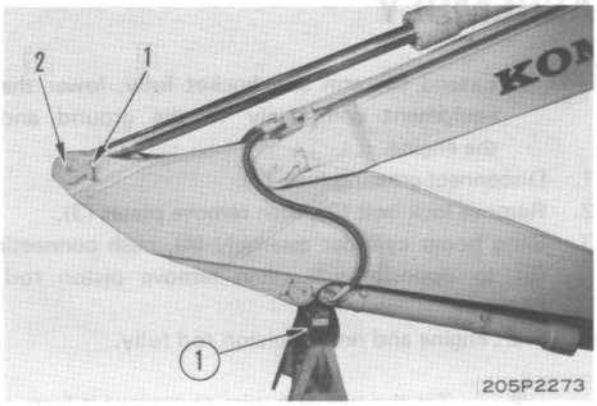
1. Sling arm cylinder assembly, remove lock plate (1), then pull out pin (2).
2. Start engine and retract piston rod fully.

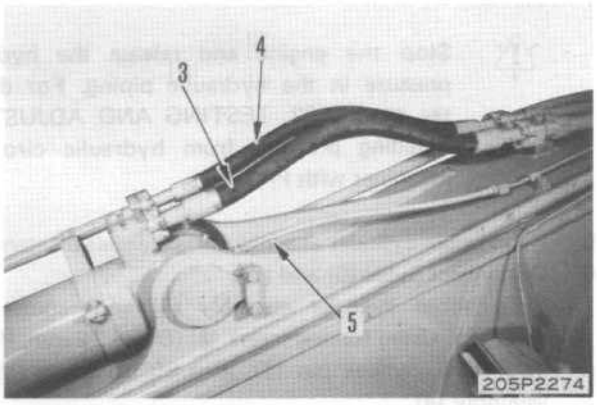
⚠ Tie the rod with wire to prevent it from coming out.

Stop the engine and release the hydraulic pressure in the hydraulic piping. For details, see section 62, TESTING AND ADJUSTING, Bleeding pressure from hydraulic circuit in machines with PPC valve.

3. Disconnect arm cylinder hoses (3) and (4) at cylinder end.
4. Disconnect greasing tube (5).
5. Remove lock plate (6), pull out pin (7), then lift off arm cylinder assembly (8).

kg Arm cylinder assembly: 280 kg



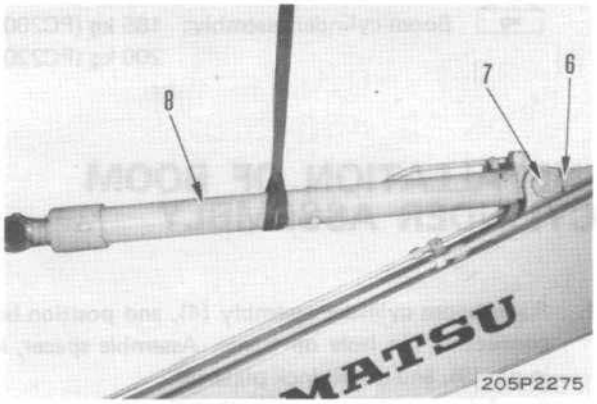


INSTALLATION OF ARM CYLINDER ASSEMBLY

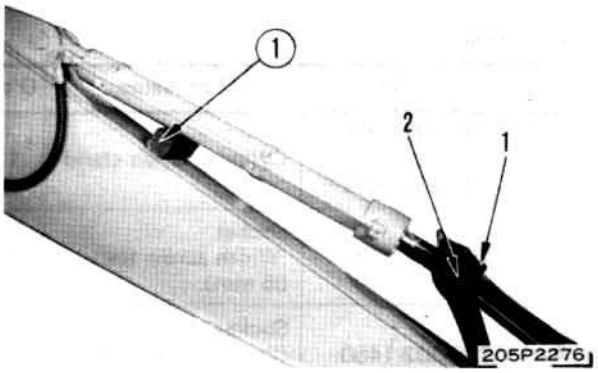
1. Raise arm cylinder assembly (8) and position bottom connecting pin hole. Knock in pin (7), then secure with lock plate (6).
2. Connect greasing tube (5).
3. Fit O-rings and connect arm cylinder hoses (4) and (3).
4. Start engine, extend piston rod, knock in pin (2), then secure wth lock plate (1).

★ Adjust with spacers so that the clearance between the boom and arm cylinder bottom is less than 1 mm.

★ Run the engine to circulate the oil through the system. Then add oil to the hydraulic tank to the specified level.



REMOVAL OF BUCKET CYLINDER ASSEMBLY

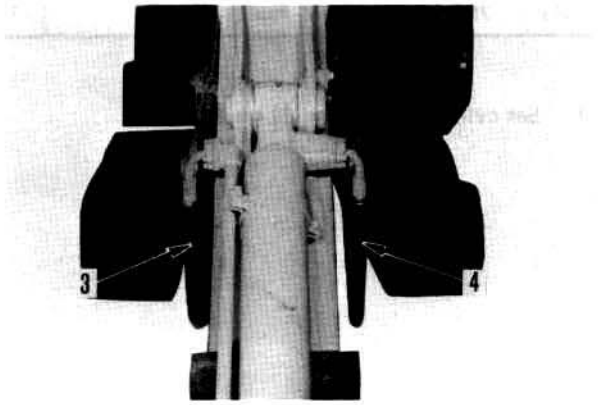


Lower the work equipment completely to the ground and stop the engine.

1. Remove lock bolt (1), then pull out pin (2).
   - ★ Insert block ① between the cylinder and the arm.
   - ★ Pull out pin (2) until the piston rod comes out.
2. Start engine and retract piston rod fully.

Tie the bucket cylinder rod with wire to prevent it from coming out.

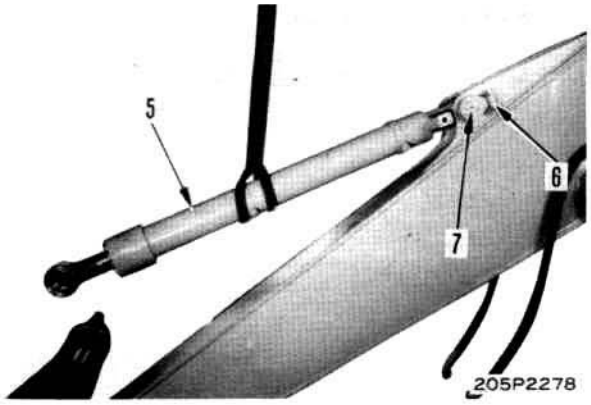
Stop the engine and release the hydraulic pressure in the hydraulic piping. For details, see section 62, TESTING AND ADJUSTING, Bleeding pressure from hydraulic circuit in machines with PPC valve.



3. Disconnect bucket cylinder hoses (3) and (4) at cylinder end.
4. Sling bucket cylinder assembly (5), remove lock plate (6), then pull out pin (7).
5. Lift off bucket cylinder assembly (5).

kg Bucket cylinder assembly: 185 kg

INSTALLATION OF BUCKET CYLINDER ASSEMBLY



1. Raise bucket cylinder assembly (5) and position bottom connecting pin hole. Knock in pin (7), then secure with lock plate (6).
2. Fit O-rings and connect bucket cylinder hoses (4) and (3).
   - ★ Install hose without twisting or interference.
3. Start engine, extend piston rod and align link and hole. Knock in pin (2), then install lock bolt (1).

★ Adjust with spacers so that the clearance between the arm and bucket cylinder bottom is less than 1 mm.

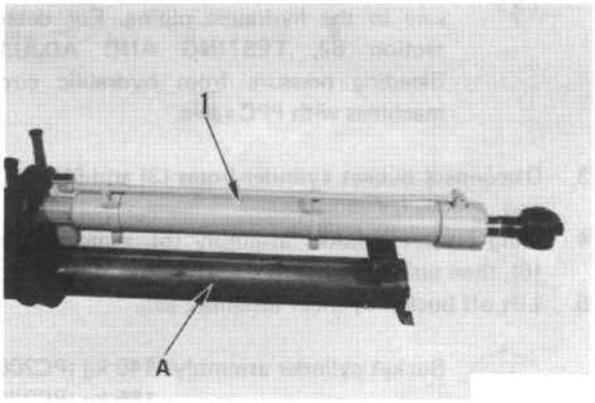
★ Run the engine to circulate the oil through the system. Then add oil to hydraulic tank to the specified level.

DISASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY

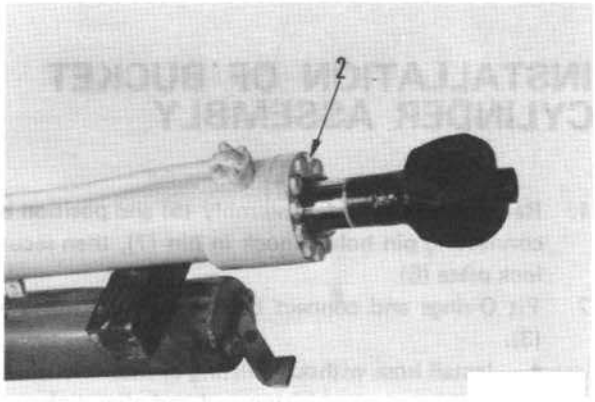
Special tool

	Part No.	Part Name	Q'ty
A	790-502-2000 or 790-502-1001	Cylinder repair stand	1
A_1	790-302-1430	Socket (Width across flats: 85 mm)	1
A_2	790-302-1450	Socket (Width across flats: 95 mm)	1
A_3	790-101-1102	Pump	1

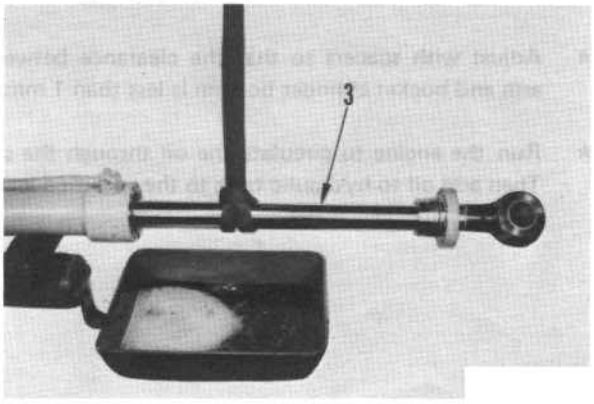
1. Set cylinder assembly (1) on tool **A**.



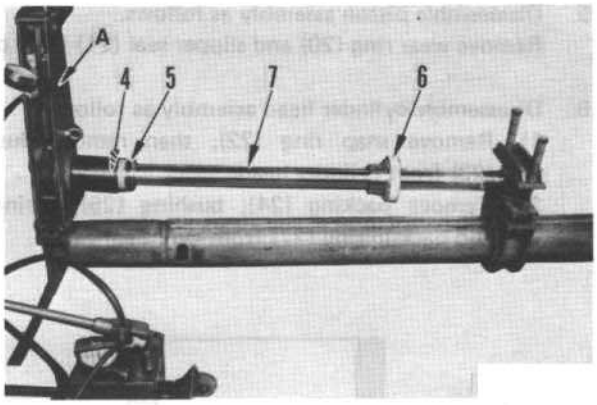
2. Remove head bolts (2).



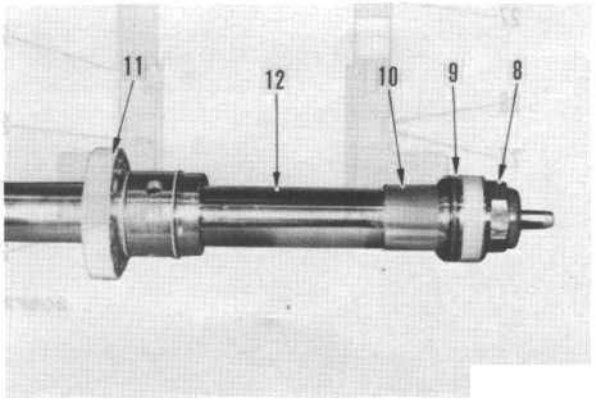
3. Pull out piston rod assembly (3) about 1 m, then lift off.
   - ★ Prepare a container to catch the oil which comes out when the piston rod assembly is removed.
   - ★ Remove the cylinder from tool **A**.



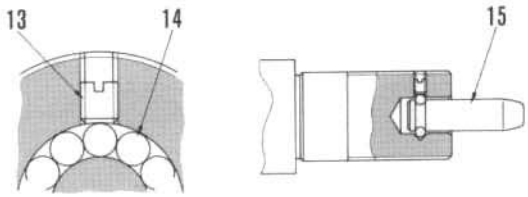
4. Disassemble piston rod assembly as follows.
   - Bucket cylinder
     1) Set piston rod assembly in tool **A**.
     2) Using tool **A**, remove nut (4).
        ★ Width across flats of nut: 95 mm
     3) Remove piston assembly (5) and cylinder head assembly (6) from piston rod (7).

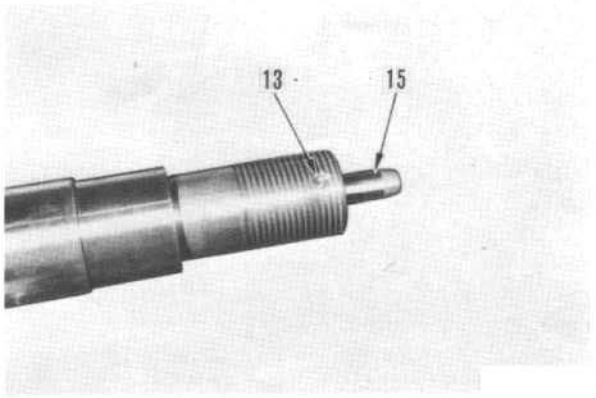


   - Arm cylinder
     1) Set piston rod assembly in tool **A**.
     2) Using tool **A**, remove nut (8).
        ★ Width across flats of nut: 95 mm
     3) Remove piston assembly (9), plunger (10) and cylinder head assembly (11) from piston rod (12).

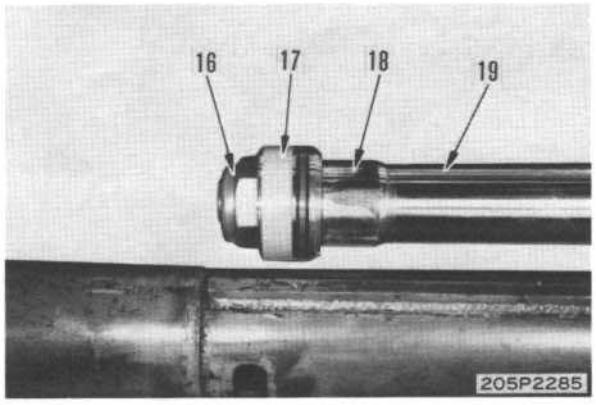


     4) Remove screw (13), take out 12 balls (14), then remove plunger (15).



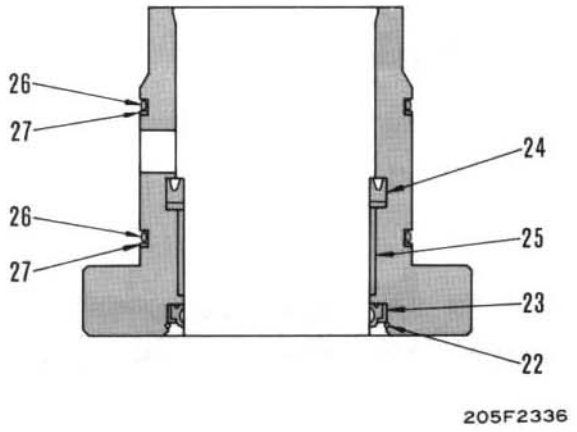


   - Boom cylinder
     1) Set piston rod assembly in tool **A**.
     2) Using tool **A**, remove nut (16).
        ★ Width across flats of nut: 95 mm
     3) Remove piston assembly (17), plunger (18) and cylinder head assembly from piston rod (19).



5. Disassemble piston assembly as follows.
   Remove wear ring (20) and slipper seal (21) from piston.

6. Disassemble cylinder head assembly as follows.
   1) Remove snap ring (22), then remove dust seal (23) from cylinder head.
   2) Remove packing (24), bushing (25), O-ring (26) and backup ring (27) from cylinder head.



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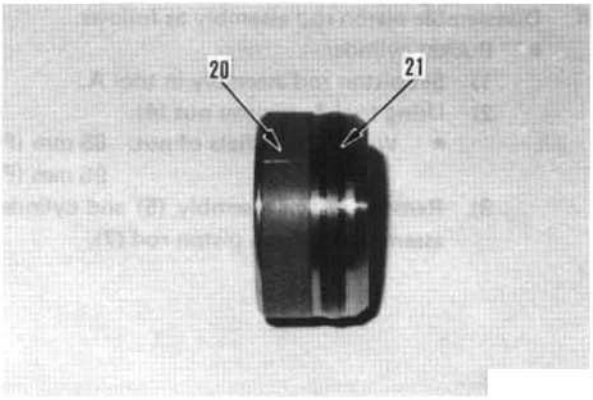
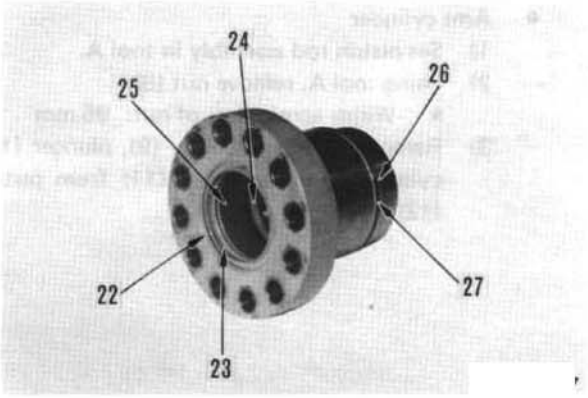




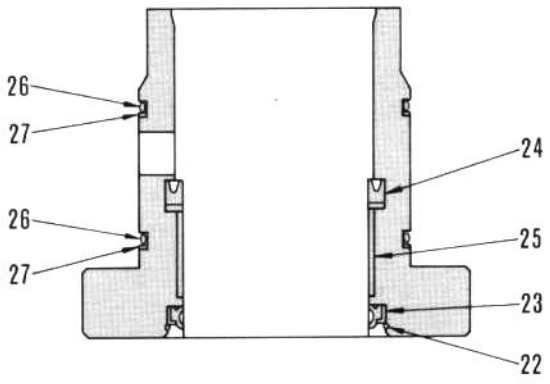
ASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY

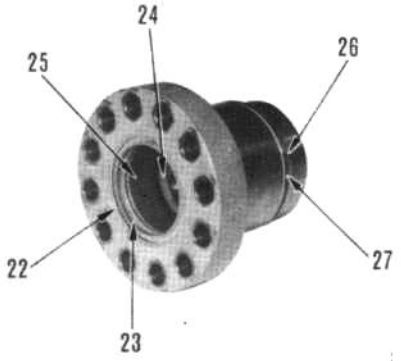
Special tool

	Part No.	Part Name	Q'ty
A	790-502-2000 or 790-502-1001	Cylinder repair stand	1
A_1	790-302-1430	Socket (Width across flats: 85 mm)	1
A_2	790-302-1450	Socket (Width across flats: 95 mm)	1
A_3	790-101-1102	Pump	1
B	790-702-1000	Expander	1

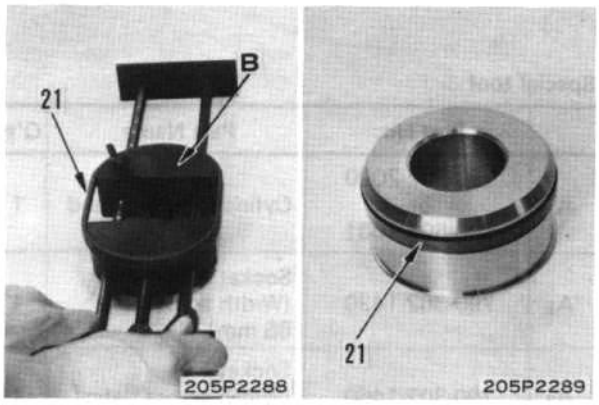
★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing. Be careful not to damage packing, dust seals or O-ring when installing.

1. Assemble cylinder head assembly as follows.
   1) Using push tool, install bushing (25) on cylinder head.
      ★ Outside diameter of bushing:
      95mm (boom, bucket)
      105mm (arm)
      ★ Be careful not to deform the bushing when press fitting.
   2) Install packing (24).
      ★ Be careful to install the packing facing in the correct direction.
   3) Install backup rings (27) and O-rings (26) in turn on cylinder head.
      ★ Do not try to force the slipper seal into position. Warm it in warm water (50 – 60 °C) before fitting it.
   4) Using push tool, install dust seal (23) and secure with snap ring (22).



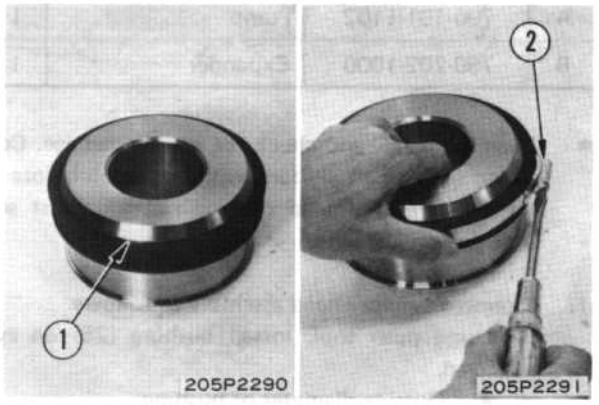


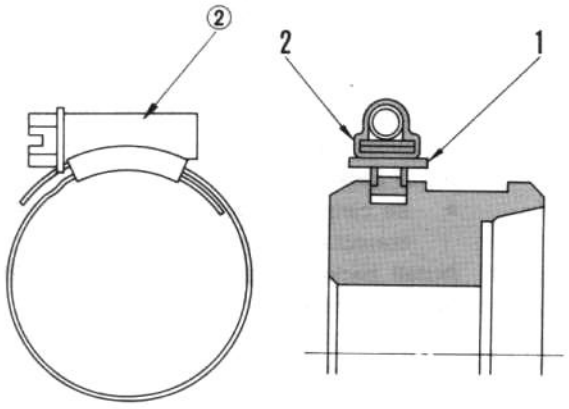
2. Assemble piston assembly as follows.
   1) Using tool **B**, expand slipper seal (21).
      ★ Set the slipper seal on the expander and turn the handle 8 – 10 times to expand the ring.
   2) Remove slipper seal (21) from tool, and install on piston.



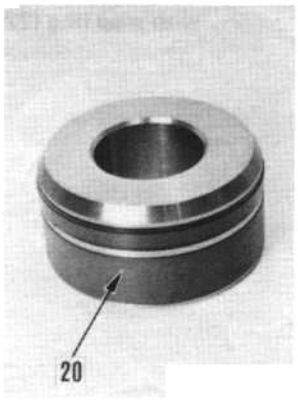
   3) Set ring ① in position, then using clamp ②, compress slipper seal (21).
      ★ Part number of ring
      796-720-1670 (bucket boom cylinder)
      796-720-1680 (arm cylinder)

      ★ Part number of clamp
      07281-01589 (bucket, boom cylinder)
      07281-01919 (arm cylinder)



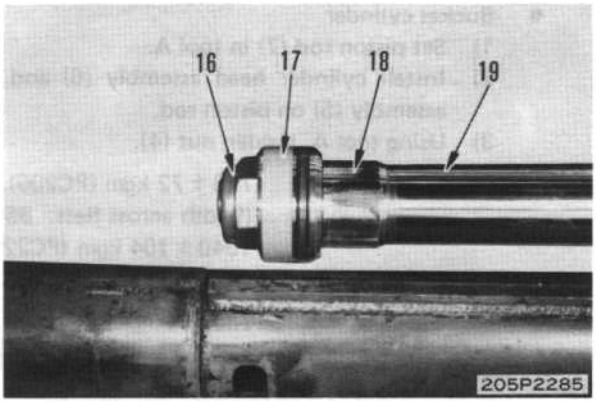


   4) Install wear ring (20) on piston.

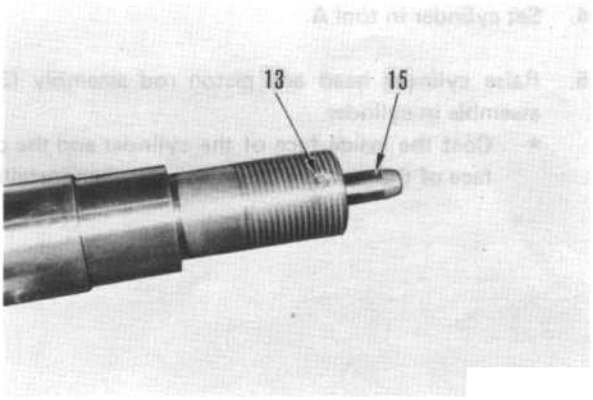


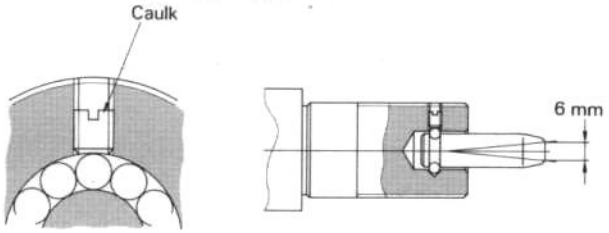
3. Assemble piston rod assembly as follows.
   - Boom cylinder
     1) Set piston rod (19) in tool **A**.
     2) Install cylinder head assembly, plunger (18) and piston assembly (17) on piston rod (19).
     3) Using tool **A**, tighten nut (16).

        kgm Nut: 1040 ± 104 kgm
        (Width across flats: 95 mm)



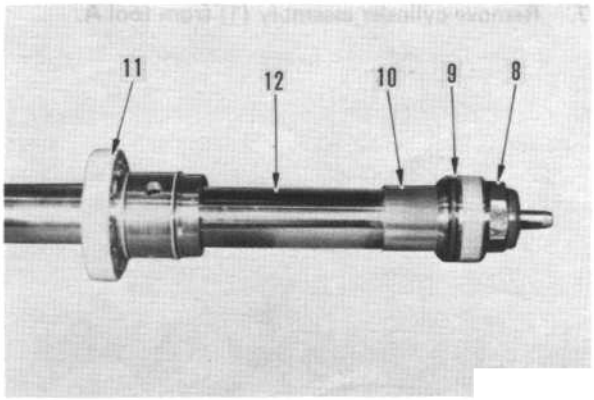
   - Arm cylinder
     1) Set piston rod (12) in tool **A**.
     2) Position plunger (15) on piston rod, then assemble 12 balls (14).
     3) Tighten screw (13) fully, then turn back about 1/2 turn. Check play at tip of plunger, then caulk.
        ★ Play at tip of plunger: Approx. 6 mm





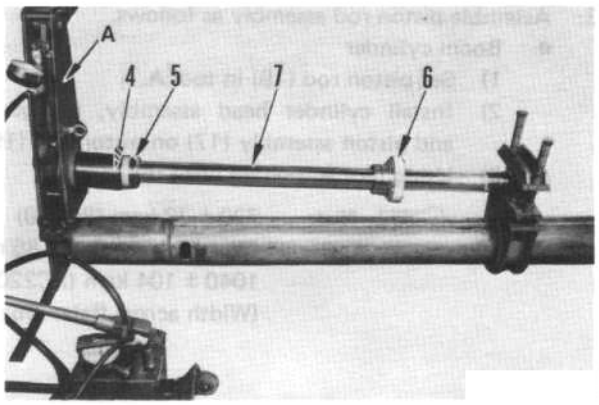
     4) Install cylinder head assembly (11), plunger (10) and piston assembly (9) on piston rod (12).
     5) Using tool **A**, tighten nut (8).

        kgm Nut: 1040 ± 104 kgm
        (Width across flats: 95 mm)



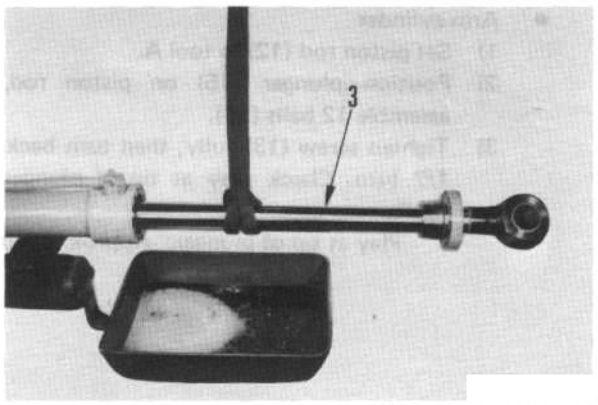
- Bucket cylinder
  1) Set piston rod (7) in tool **A**.
  2) Install cylinder head assembly (6) and piston assembly (5) on piston rod.
  3) Using tool **A**, tighten nut (4).

     kgm Nut: 1040 ± 104 kgm
     (Width across flats: 95 mm)

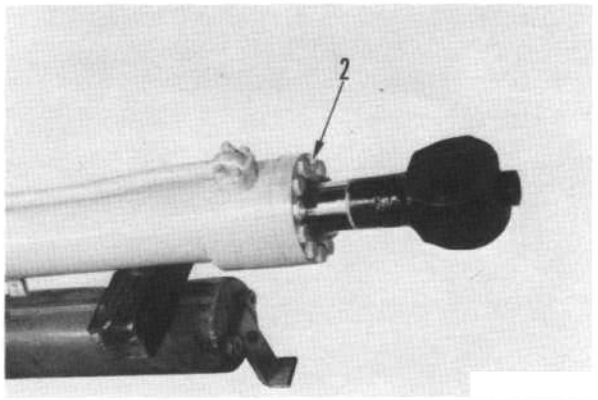


4. Set cylinder in tool **A**.

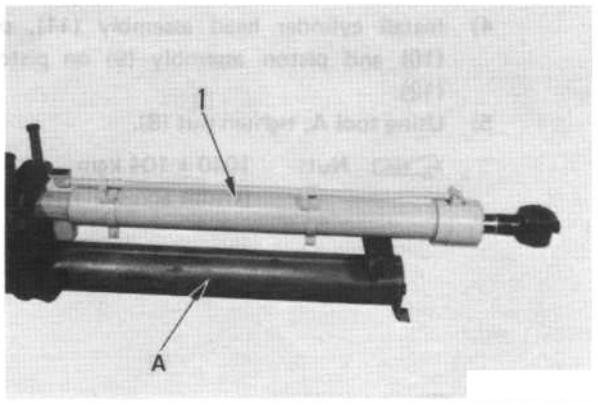
5. Raise cylinder head and piston rod assembly (3), and assemble in cylinder.
   ★ Coat the inside face of the cylinder and the outside face of the piston with engine oil when installing.



6. Assemble cylinder head assembly in cylinder, then tighten head bolts (2).
   ★ Align the punch marks and ports when assembling.
   (There is no punch mark on the bucket cylinder.)



7. Remove cylinder assembly (1) from tool **A**.



REMOVAL OF WORK EQUIPMENT ASSEMBLY

Special tool

	Part No.	Part Name	Q'ty
A	796-900-1200	Remover	1
A_1	790-101-3800	Cylinder (50 ton)	1
A_2	790-101-1102	Pump	1

⚠ Extend the arm and bucket fully, lower the work equipment completely to the ground and stop the engine.

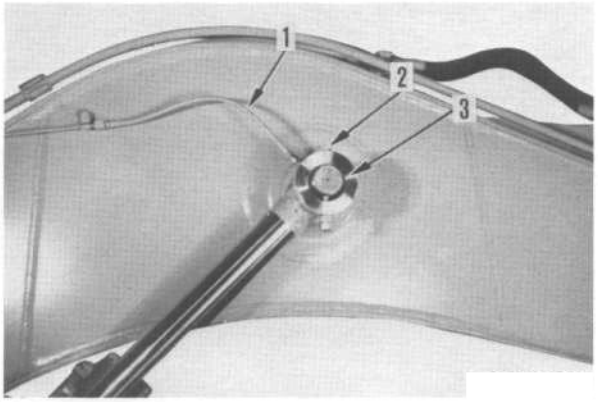
1. Disconnect greasing tube (1).
2. Remove lock bolt (2), then remove plates (3).
3. Sling boom cylinder assembly (4), push connecting pin (5) to opposite side, then remove piston rod from boom.
4. Start engine and retract piston rod fully.

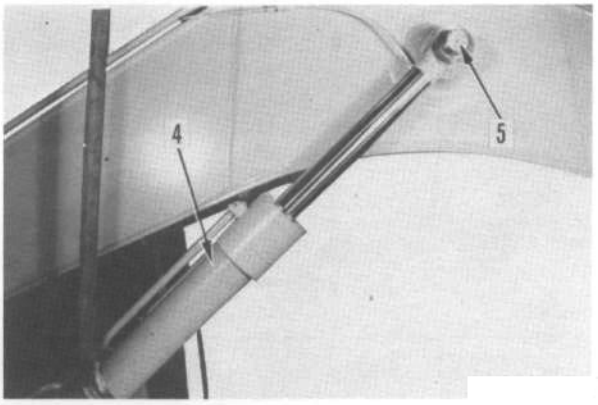
⚠ Tie the rod with wire to prevent it from coming out.

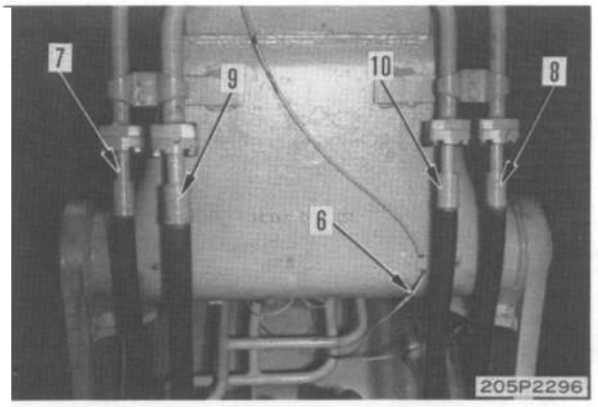
⚠ Stop the engine and release the hydraulic pressure in the hydraulic piping. For details, see section 62, TESTING AND ADJUSTING, Bleeding pressure from hydraulic circuit in machines with PPC valve.

5. Raise boom cylinder assembly (4) and lower on to stand ①.
   ★ Remove the other boom cylinder assembly in the same way, and lower on to the stand.
6. Disconnect head lamp wiring (6) at connector.
7. Disconnect bucket cylinder hoses (7) and (8), and arm cylinder hoses (9) and (10).
8. Sling work equipment assembly, and remove lock plate (11). Using tool A, remove pin (12).
9. Lift off work equipment assembly (13).

kg Work equipment assembly: 3700 kg







INSTALLATION OF WORK EQUIPMENT ASSEMBLY

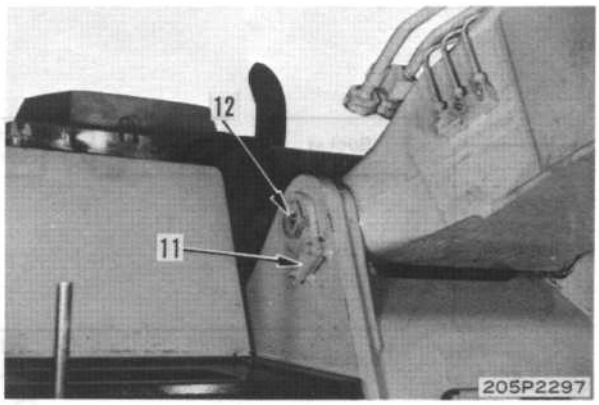
1. Raise work equipment assembly (13), and position boom foot connecting pin hole on revolving frame. Knock in pin (12), then secure with lock plate (11).
2. Fit O-rings and connect arm cylinder hoses (9) and (10) and bucket cylinder hoses (7) and (8).
   ★ Install hose without twisting or interference.
3. Connect head lamp wiring (6) at connector.
4. Raise boom cylinder assembly (4). Start engine, extend piston rod and align with pin hole, then push in pin (5).
5. Fit plate (3), then secure with lock bolt (2).
6. Connect greasing tube (1).

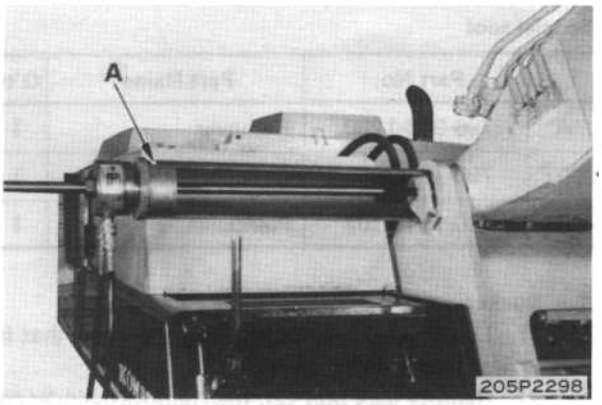
★ Install the other boom cylinder in the same way.

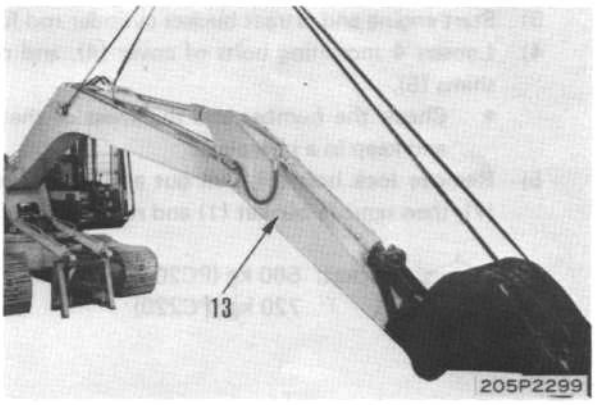
★ Adjust with spacers so that the clearance between the revolving frame and the boom foot is less than 1 mm.

★ Run the engine to circulate the oil through the system. Then add oil to the hydraulic tank to the specified level.

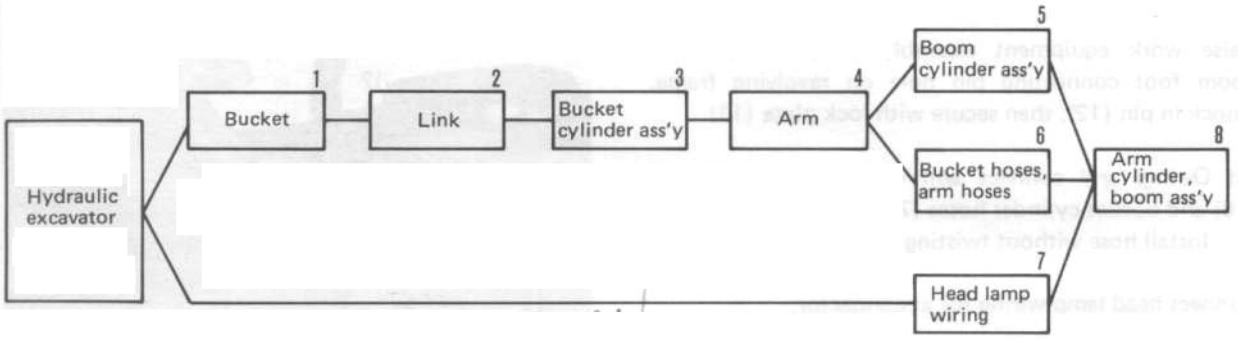
★ After installing the work equipment assembly, grease all the pins with grease (G2-LI).







DISASSEMBLY OF WORK EQUIPMENT ASSEMBLY



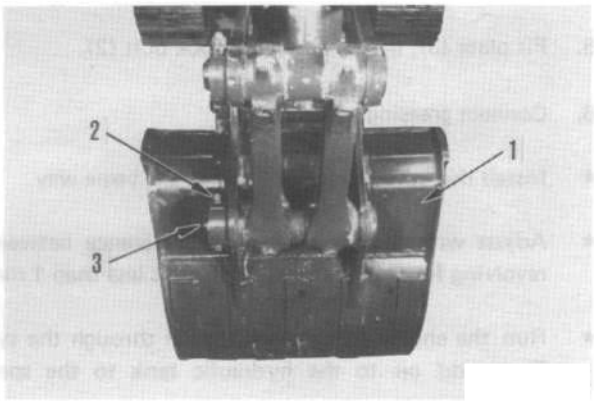
Special tool

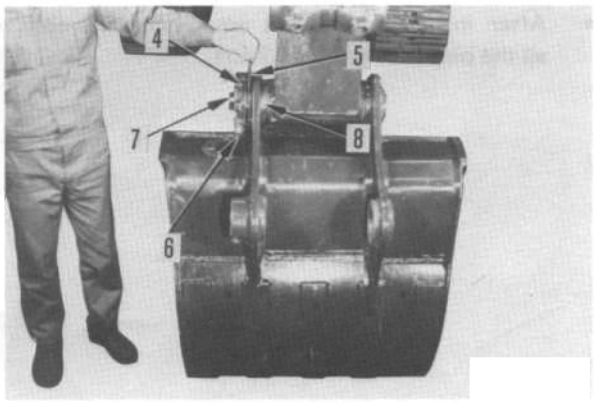
	Part No.	Part Name	Q'ty
A	796-900-1200	Remover	1
A_1	790-101-3800	Cylinder (50 ton)	1
A_2	790-101-1102	Pump	1

1. Bucket

1) Lower work equipment to ground so that bottom of bucket (1) is on ground.
2) Remove lock bolt (2), then remove cylinder connecting pin (3).
3) Start engine and retract bucket cylinder rod fully.
4) Loosen 4 mounting bolts of cover (4), and remove shims (5).
   ★ Check the number and thickness of the shims, and keep in a safe place.
5) Remove lock bolt (6), pull out arm connecting pin (7), then remove bucket (1) and retainer (8).

kg Bucket: 720 kg

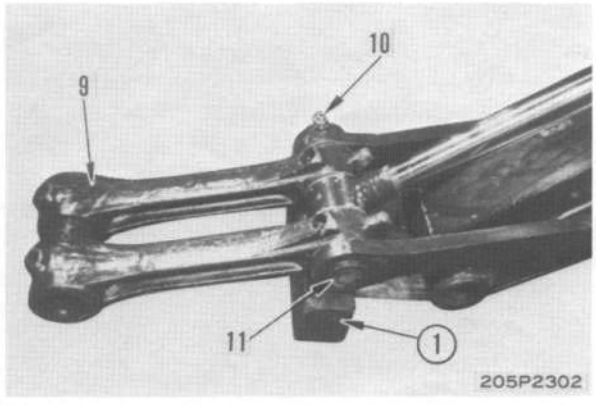




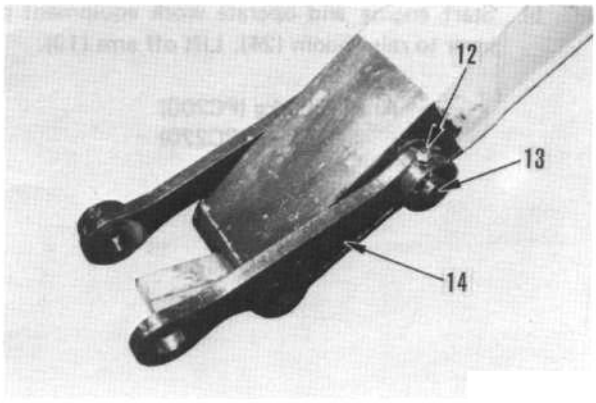
2. Link

1) Lower tip of arm to ground.
2) Set link (9) on block ①, then remove lock bolt (10). Pull out pin (11), and remove link (9).
3) Start engine and retract bucket cylinder rod fully.

⚠ Tie the bucket cylinder rod with wire to prevent it from coming out.



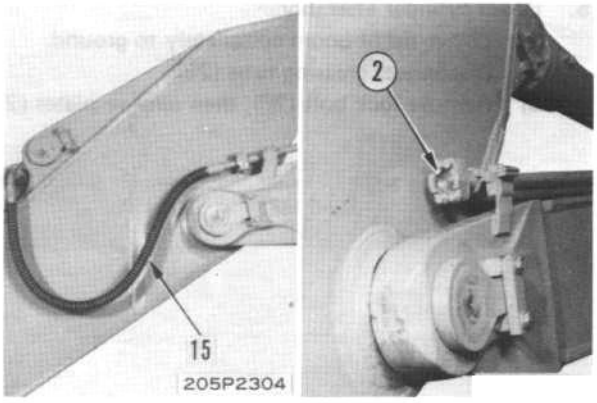
4) Remove lock bolt (12), pull out link pin (13), and remove link (14).



3. Bucket cylinder assembly

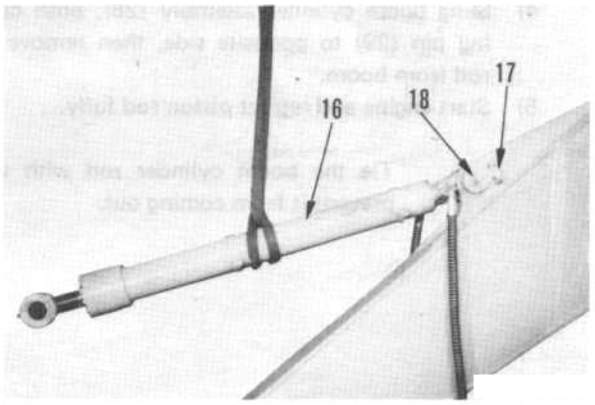
Release the hydraulic pressure in the hydraulic piping. For details, see section 62, TESTING AND ADJUSTING, Bleeding pressure from hydraulic circuit in machine with PPC valve.

1) Disconnect 2 bucket cylinder hoses (15).
   ★ After disconnecting the hoses, fit blind plug ② in the tube flange to prevent oil from coming out.



2) Sling bucket cylinder assembly (16), then remove lock plate (17). Pull out pin (18) and lift off bucket cylinder assembly (16).

kg Bucket cylinder assembly: 160 kg

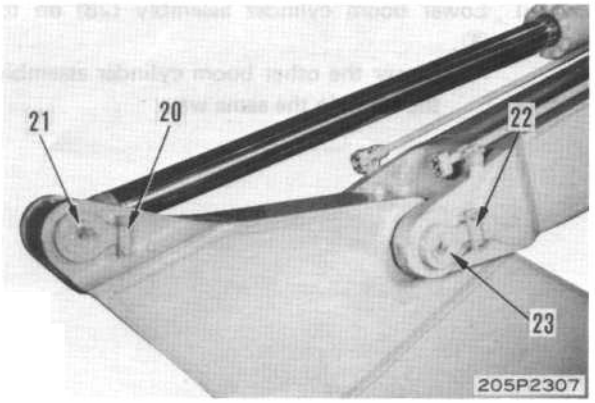


4. Arm

1) Pull in arm fully, and lower on to block (height: approx. 500 mm).
2) Remove lock plate (20), then remove pin (21).
3) Start engine and retract arm cylinder rod fully.

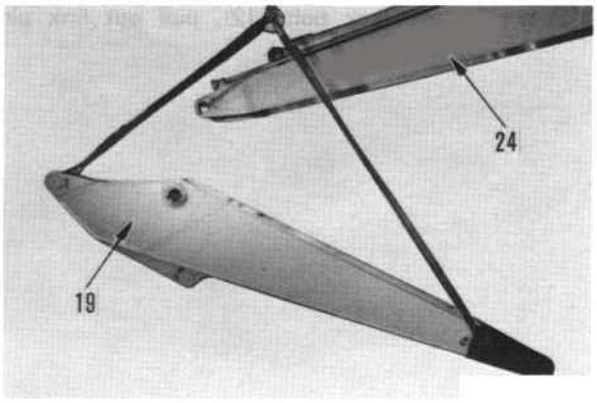
Tie the arm cylinder rod with wire to prevent it from coming out.

4) Remove lock plate (22), then remove pin (23).



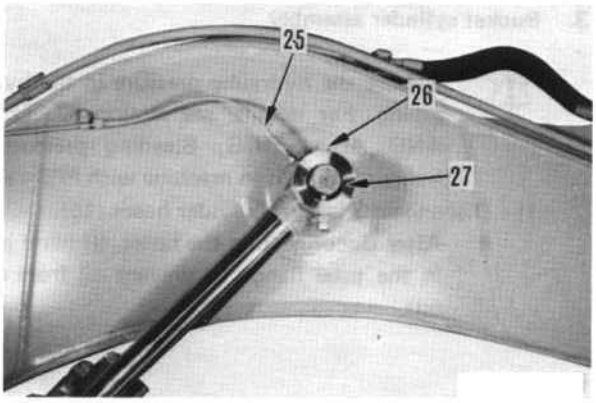
5) Start engine and operate work equipment control lever to raise boom (24). Lift off arm (19).

kg Arm: 700 kg



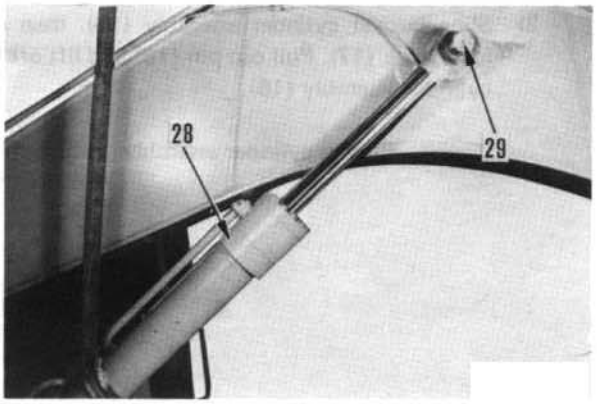
5. Boom cylinder assembly

1) Lower tip of boom completely to ground.
2) Disconnect greasing tube (25).
3) Remove lock bolt (26), then remove plates (27).



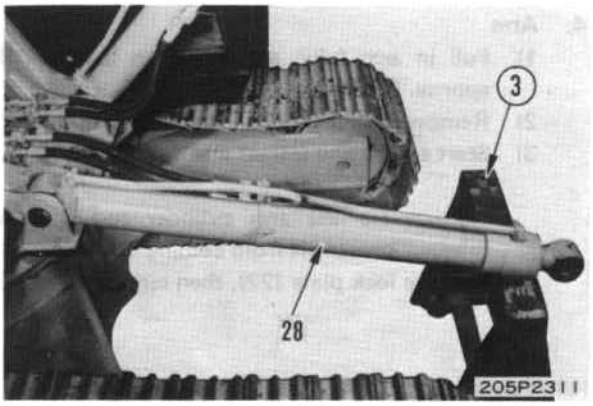
4) Sling boom cylinder assembly (28), push connecting pin (29) to opposite side, then remove piston rod from boom.
5) Start engine and retract piston rod fully.

⚠ Tie the boom cylinder rod with wire to prevent it from coming out.



6) Lower boom cylinder assembly (28) on to stand ③.

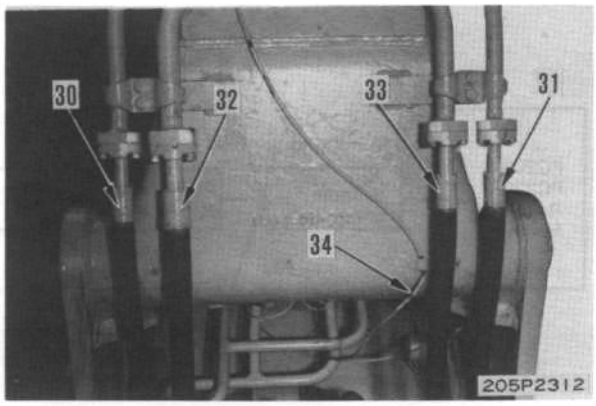
★ Lower the other boom cylinder assembly on to the stand in the same way.



6. **Bucket hoses, arm hose**

Release the hydraulic pressure in the hydraulic piping. For details, see section 62, TESTING AND ADJUSTING, Bleeding pressure from hydraulic circuit in machines with PPC valve.

Disconnect bucket cylinder hoses (30) and (31), and arm cylinder hoses (32) and (33).

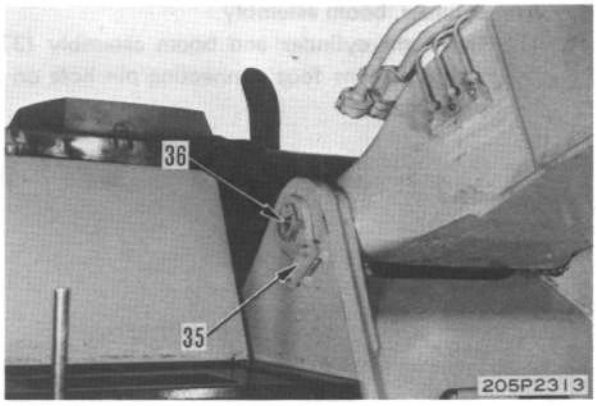


7. **Head lamp wiring**

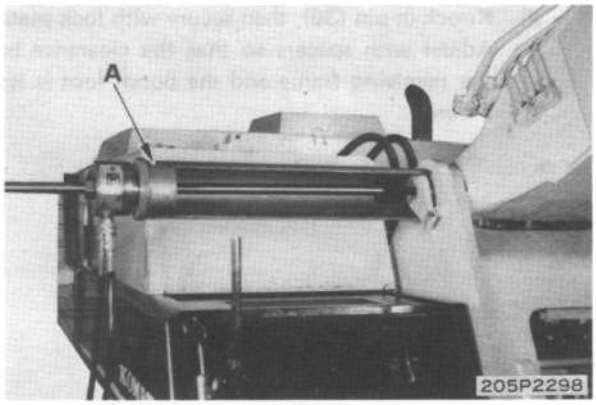
Disconnect head lamp wiring (34) at connector.

8. **Arm cylinder, boom assembly**

1) Remove lock plate (35).

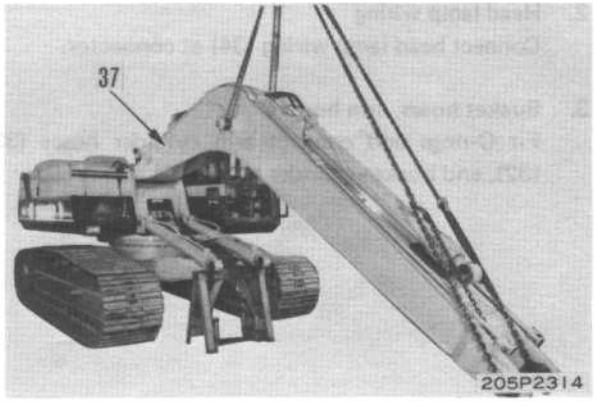


2) Sling boom, then pull out pin (36) with tool A.

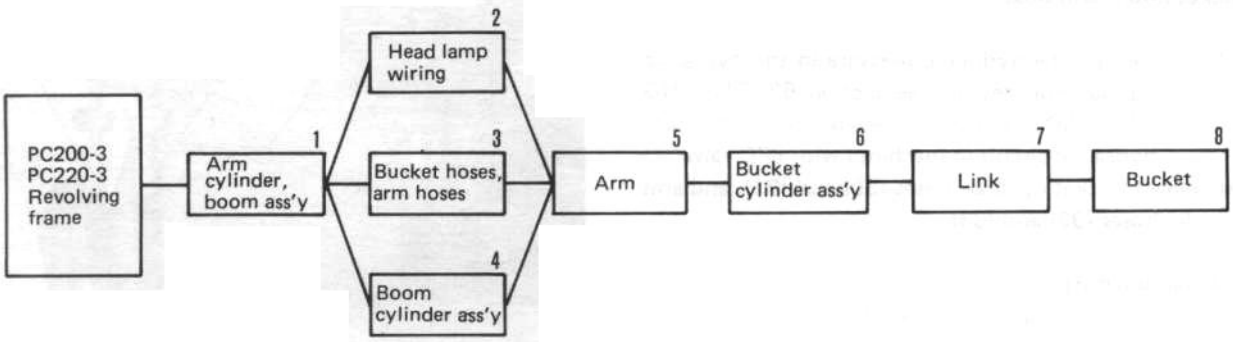


3) Raise arm cylinder and boom assembly (37), and pull out to front to remove.

kg Arm cylinder, boom assembly: 2000 kg

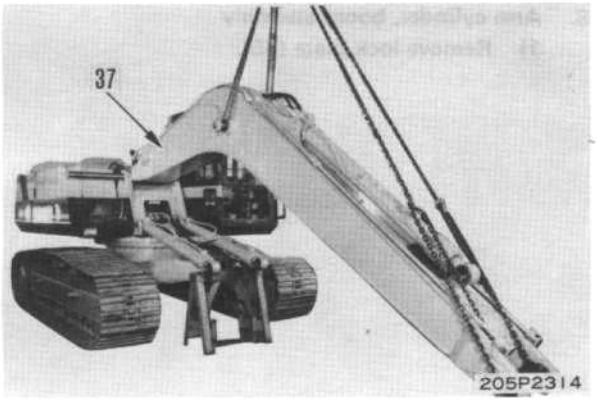


ASSEMBLY OF WORK EQUIPMENT ASSEMBLY



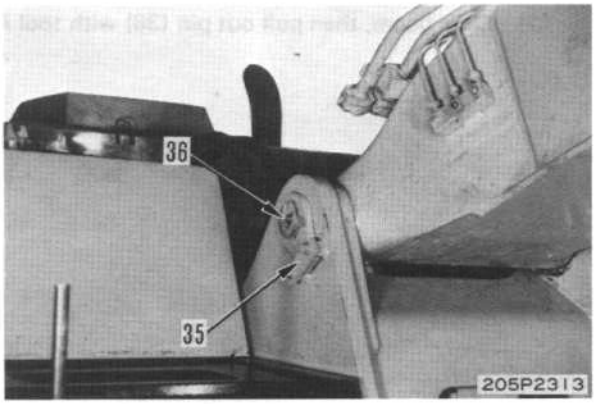
1. Arm cylinder, boom assembly

1) Raise arm cylinder and boom assembly (37), and position boom foot connecting pin hole on revolving frame.



2) Knock in pin (36), then secure with lock plate (35).

★ Adjust with spacers so that the clearance between the revolving frame and the boom foot is less than 1 mm.

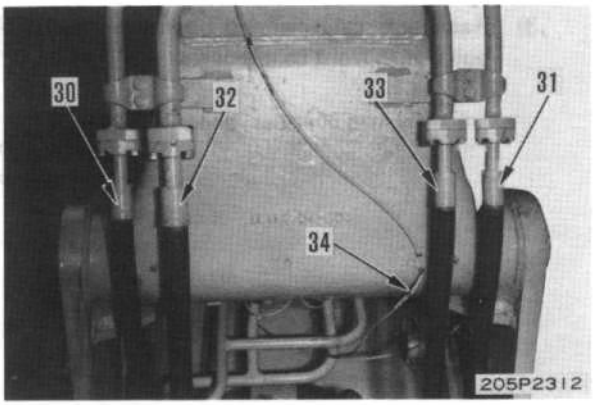


2. Head lamp wiring

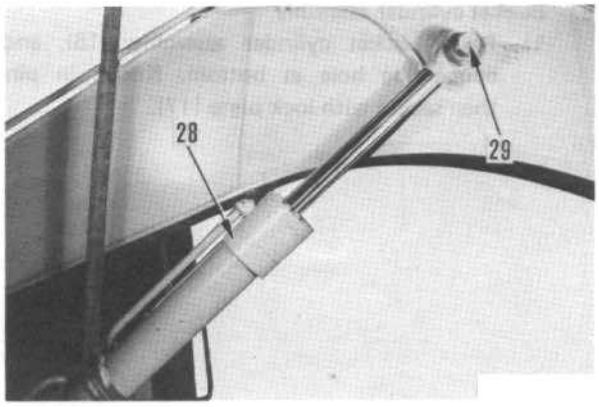
Connect head lamp wiring (34) at connector.

3. Bucket hoses, arm hoses

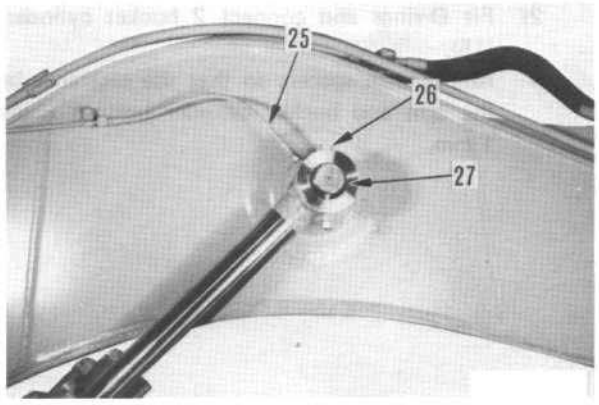
Fit O-rings and connect arm cylinder hoses (33) and (32), and bucket cylinder hoses (31) and (30).



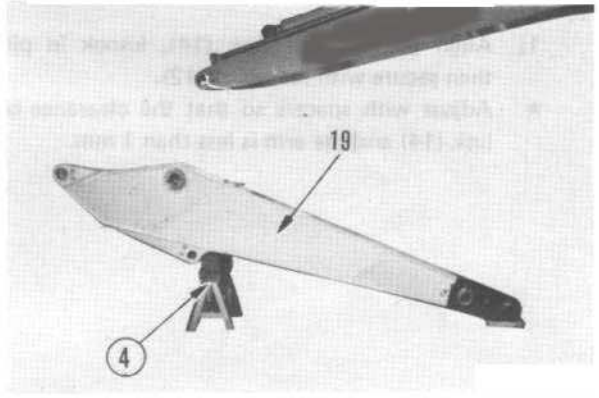
4. **Boom cylinder assembly**
   1) Sling boom cylinder assembly (28). Start engine, extend piston rod and align with pin hole, then push in pin (29).



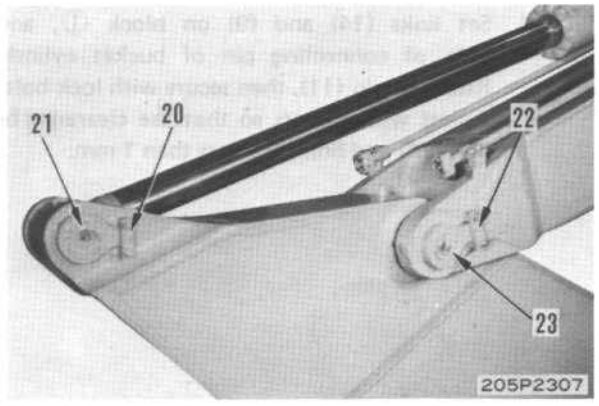
   2) Fit plate (27), then secure with lock bolt (26).
   3) Connect greasing tube (25).
   ★ Install the other boom cylinder in the same way.



5. **Arm**
   1) Raise arm (19), and lower on to block ④ (height: approx. 500 mm).

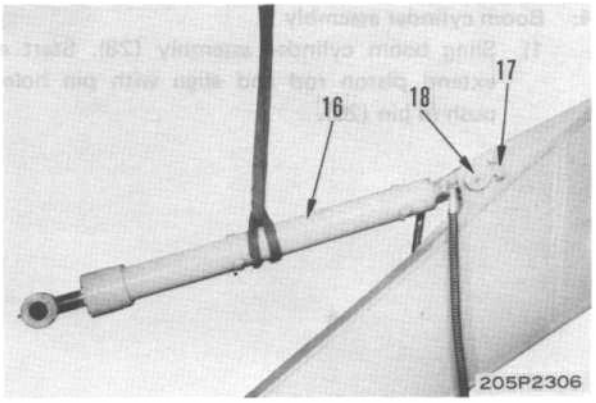


   2) Operate control lever and align pin holes of boom and arm (19). Knock in connecting pin (23), then secure with lock plate (22).
   3) Start engine, extend piston rod. Knock in connecting pin (21), then secure with lock plate (20).
   ★ Adjust with spacers so that the clearance at the joint of the arm and boom is less than 1 mm.



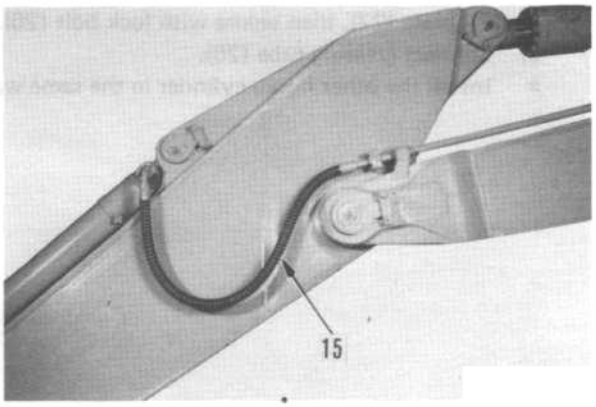
6. Bucket cylinder assembly

1) Raise bucket cylinder assembly (16), and align connecting hole at bottom. Knock in pin (18), then secure with lock plate (17).



2) Fit O-rings and connect 2 bucket cylinder hoses (15).

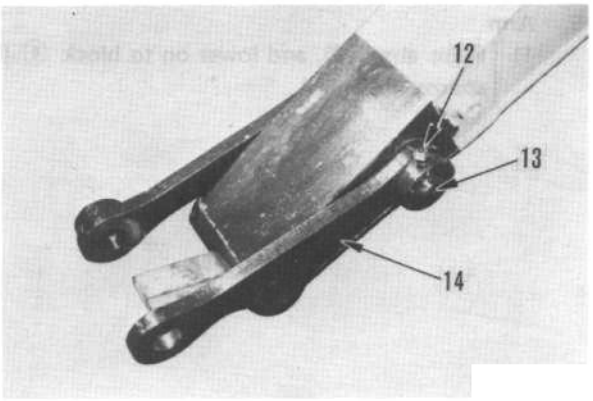
★ Adjust with spacers so that the clearance between the arm and bucket cylinder bottom is less than 1 mm.



7. Link

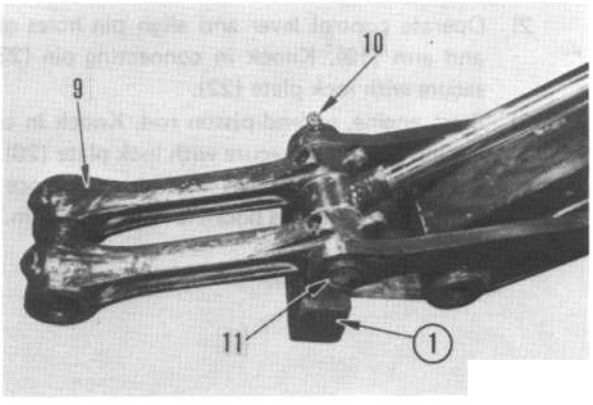
1) Align pin hole of link (14), knock in pin (13), then secure with lock bolt (12).

★ Adjust with spacers so that the clearance between link (14) and the arm is less than 1 mm.

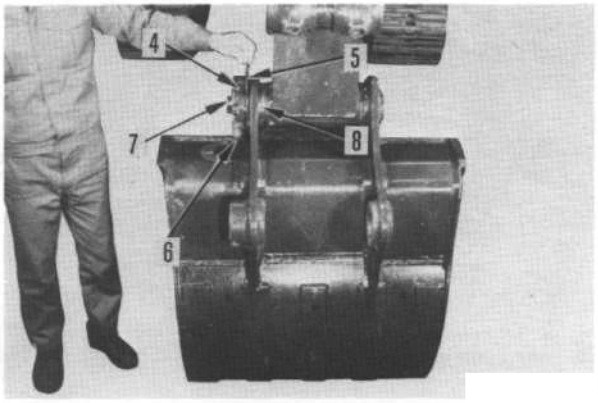


2) Set links (14) and (9) on block ①, and align hole of connecting pin of bucket cylinder rod. Knock in pin (11), then secure with lock bolt (10).

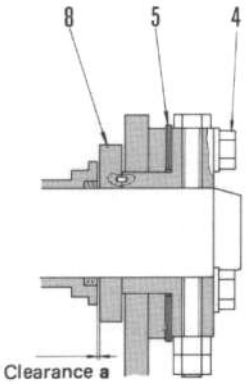
★ Adjust with spacers so that the clearance between link (14) and link (9) is less than 1 mm.



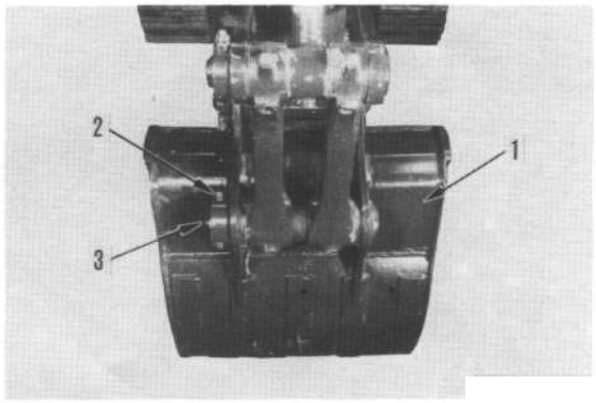
8. **Bucket**
   1) Set bottom of bucket (1) on ground.
   2) Operate control levers, and align bucket (1) and retainer (8) with arm pin hole. Knock in arm connecting pin (7), then secure with lock bolt (6).



   3) Adjust with shim (5) so that clearance "a" between arm and retainer (8) is 0.5 – 1.0 mm, then tighten 4 mounting bolts of cover (4).

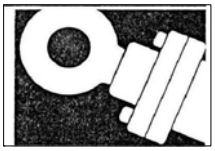


   4) Extend bucket cylinder rod and align pin hole. Knock in cylinder connecting pin (3), then secure with lock bolt (2).



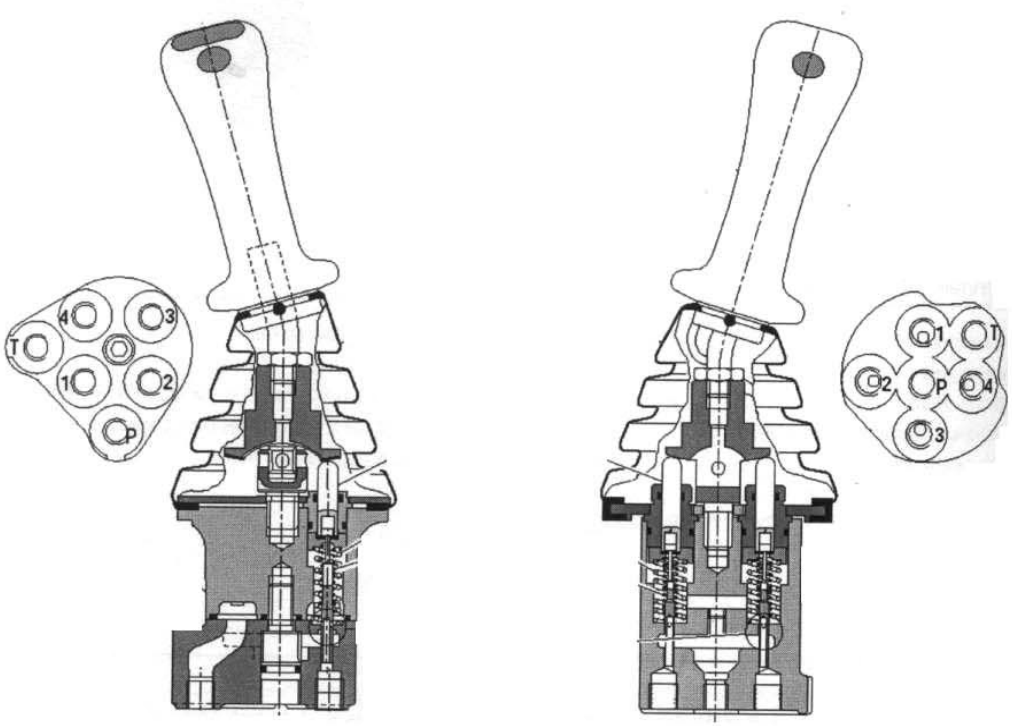
HYDRAULIC SYSTEM

14 MAINTENANCE AND STANDARD



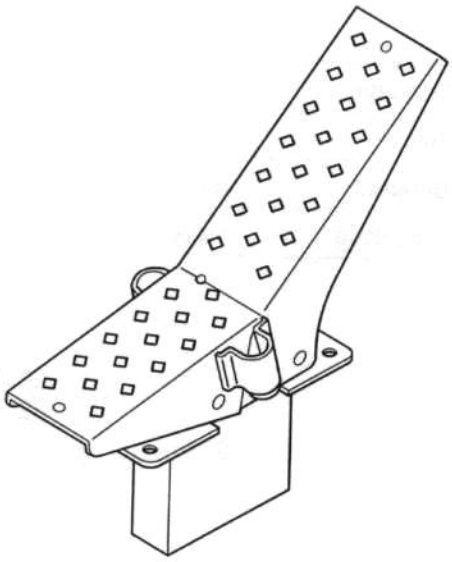
WRIST CONTROL

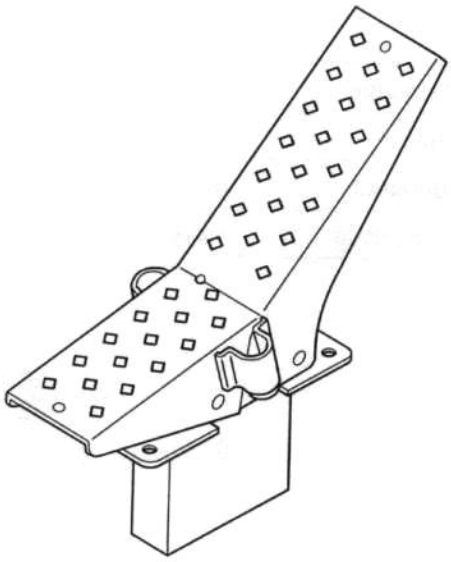
Refer Rexroth instruction manual of HS-64-05-E0403-1-3



PPC SHUTTLE VALVE

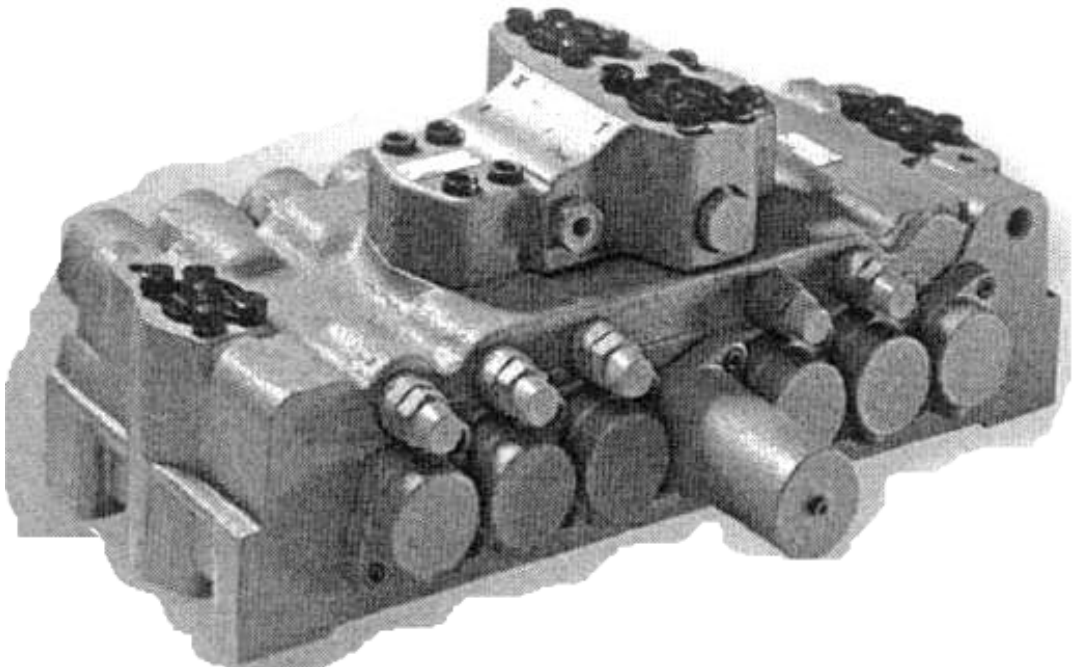
Refer Rexroth instruction manual of HS-64-05-E0403-1-3



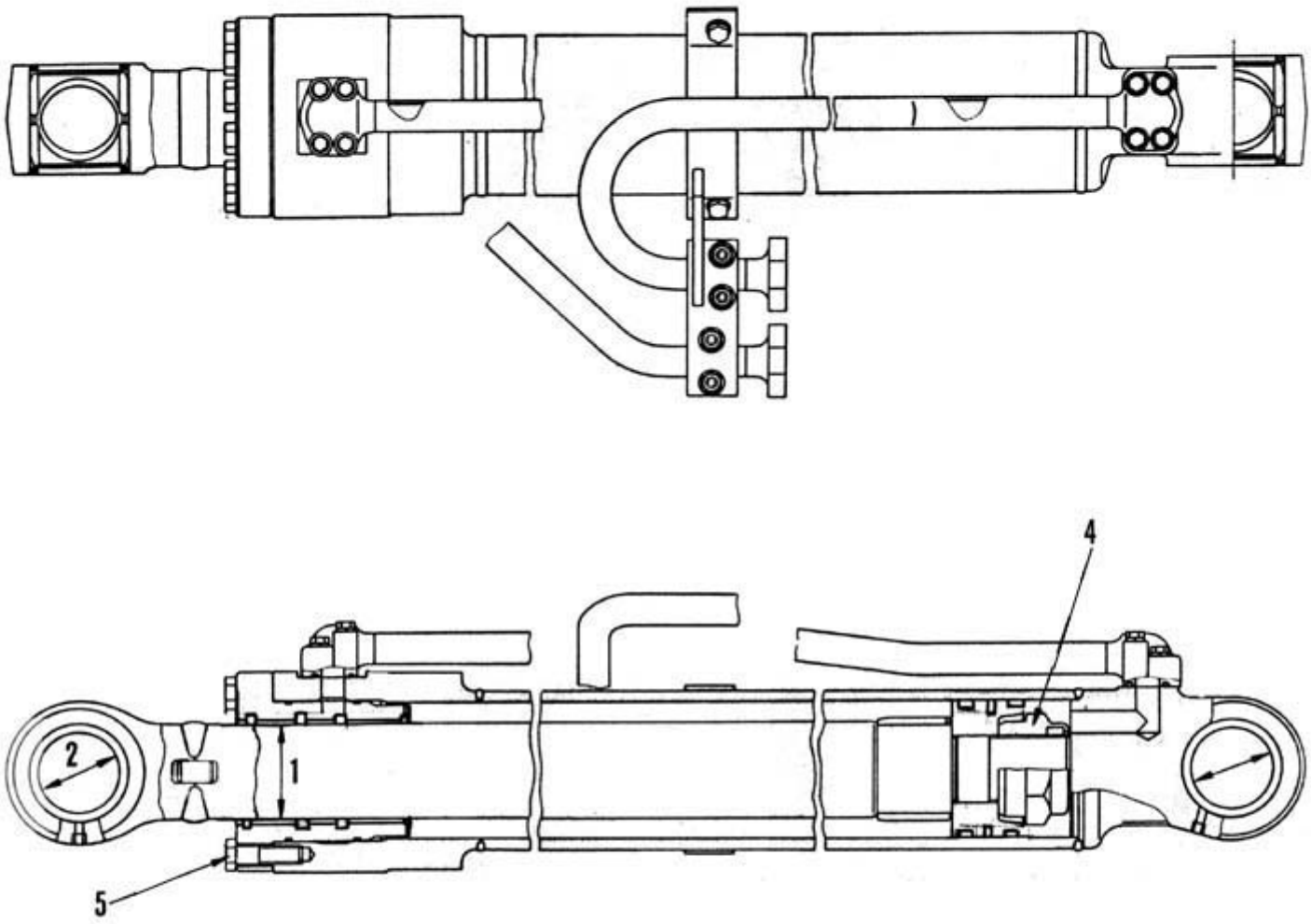


CONTROL VALVE

Refer Rexroth instruction manual of HS-64-05-E0403-1-3



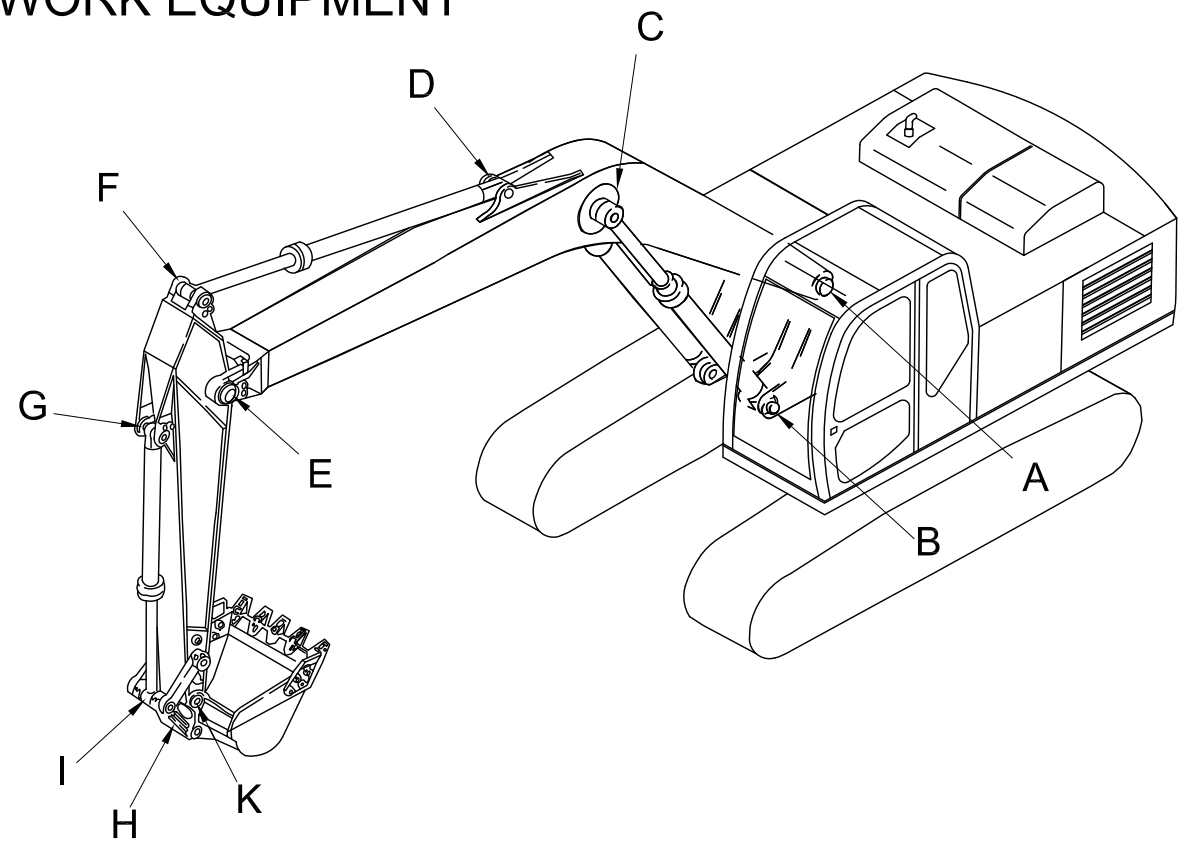
HYDRAULIC CYLINDER

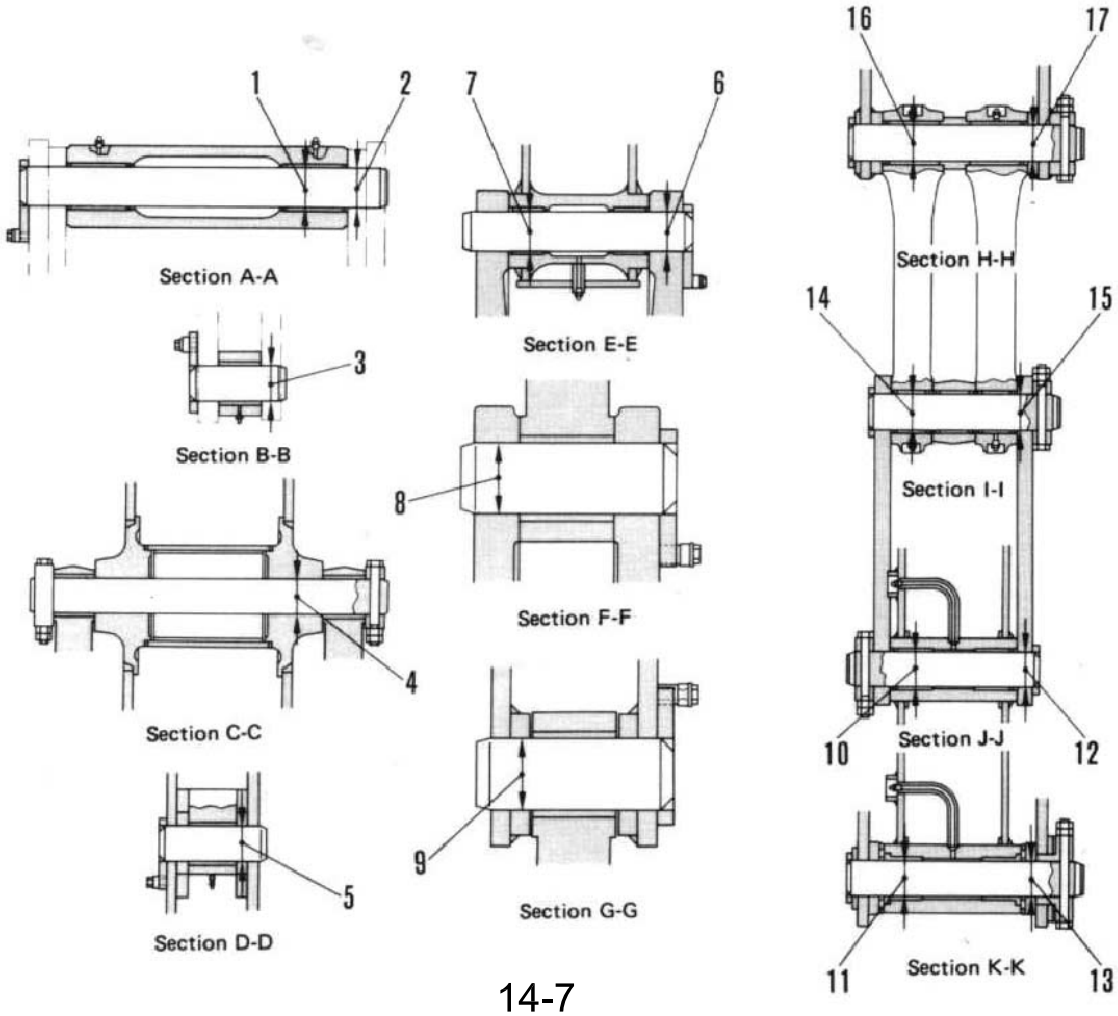


Unit : mm

No.	Check item	Criteria							Remedy
		Cylinder name	Application	Standard size	Tolerance		Standard clearance	Clearance limit	
					shaft	hole			
1	Clearance between piston rod and bushing	Boom cylinder	BE220G BE220 BE220LC	90	-0.036 -0.123	+0.257 +0.048	0.084 - 0.380	0.680	Replace bushing
		Arm cylinder	BE220G BE220 BE220LC	100	-0.036 -0.123	+0.222 +0.047	0.083 - 0.345	0.645	
		Bucket cylinder	BE220G BE220 BE220LC	90	-0.036 -0.123	+0.222 +0.047	0.083 - 0.345	0.645	
2	Clearance between piston rod support and bushing	Boom cylinder	BE220G BE220 BE220LC	80	-0.030 -0.076	+0.457 +0.370	0.400 - 0.533	1.0	Replace pin and bushing
		Arm cylinder	BE220G BE220 BE220LC	80	-0.030 -0.076	+0.457 +0.370	0.400 - 0.533	1.0	
		Bucket cylinder	BE220G BE220 BE220LC	80	-0.030 -0.076	+0.457 +0.370	0.400 - 0.533	1.0	
3	Clearance between cylinder bottom support and bushing	Boom cylinder	BE220G BE220 BE220LC	80	-0.030 -0.076	+0.457 +0.370	0.400 - 0.533	1.0	
		Arm cylinder	BE220G BE220 BE220LC	80	-0.030 -0.076	+0.457 +0.370	0.400 - 0.533	1.0	
		Bucket cylinder	BE220G BE220 BE220LC	80	-0.030 -0.076	+0.457 +0.370	0.400 - 0.533	1.0	
4	Tightening torque for piston nut	Boom cylinder	BE220G BE220 BE220LC	1,040 ±104 kgm (with across flats : 95)					
		Arm cylinder	BE220G BE220 BE220LC	1,040 ±104 kgm (with across flats : 95)					
		Bucket cylinder	BE220G BE220 BE220LC	1,040 ±104 kgm (with across flats : 95)					
5	Tightening torque for cylinder head mounting bolt	Boom cylinder	BE220G BE220 BE220LC	27.5 ±4.0 kgm					
		Arm cylinder	BE220G BE220 BE220LC	38.0 ±5.5 kgm					
		Bucket cylinder	BE220G BE220 BE220LC	27.5 ±4.0 kgm					

WORK EQUIPMENT





Unit : mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			shaft	hole			
1	Clearance between boom-revolving frame mounting pin and bushing	90	-0.036 -0.090	+0.342 +0.269	0.305 - 0.269	1.0	Replace
2	Clearance between boom-revolving frame mounting pin and boss hole	90	-0.036 -0.090	+0.1 0	0.036 - 0.190	1.0	
3	Clearance between boom cylinder revolving frame mounting pin and boss hole	80	-0.030 -0.076	+0.15 0	0.030 - 0.226	1.0	
4	Clearance between boom-boom cylinder rod mounting rod and boss hole	80	-0.030 -0.076	+0.17 +0.07	0.030 - 0.246	1.0	
5	Clearance between boom-arm cylinder mounting pin and boss hole	80	-0.030 -0.076	+0.1 0	0.030 - 0.176	1.0	
6	Clearance between boom-arm mounting pin and boss hole	90	-0.036 -0.090	+0.1 0	0.036 - 0.190	1.0	
7	Clearance between boom-arm mounting pin and bushing	90	-0.036 -0.090	+0.343 +0.271	0.307 - 0.433	1.0	
8	Clearance between arm-arm cylinder mounting pin and boss hole	80	-0.030 -0.076	+0.1 0	0.030 - 0.176	1.0	
9	Clearance between arm-bucket cylinder mounting pin and boss hole	80	-0.030 -0.076	+0.1 0	0.030 - 0.176	1.0	
10	Clearance between arm-link mounting pin and bushing	80	-0.030 -0.076	+0.337 +0.273	0.303 - 0.413	1.0	
11	Clearance between arm-bucket mounting pin and bushing	80	-0.030 -0.076	+0.337 +0.273	0.303 - 0.413	1.0	
12	Clearance between arm-link mounting pin and link	80	-0.030 -0.076	+0.1 0	0.030 - 0.176	1.0	
13	Clearance between arm-bucket mounting pin and boss hole	80	-0.030 -0.076	+0.1 0	0.030 - 0.176	1.0	
14	Clearance between bucket cylinder-link mounting pin and bushing	80	-0.030 -0.076	+0.337 +0.273	0.303 - 0.413	1.0	
15	Clearance between bucket cylinder-link mounting pin and link	80	-0.030 -0.076	+0.1 0	0.030 - 0.176	1.0	
16	Clearance between link-bucket mounting pin and bushing	80	-0.030 -0.076	+0.331 +0.265	0.295 - 0.408	1.0	
17	Clearance between link-bucket mounting pin and boss hole	80	-0.030 -0.076	+0.1 0	0.030 - 0.176	1.0	

ENGINE

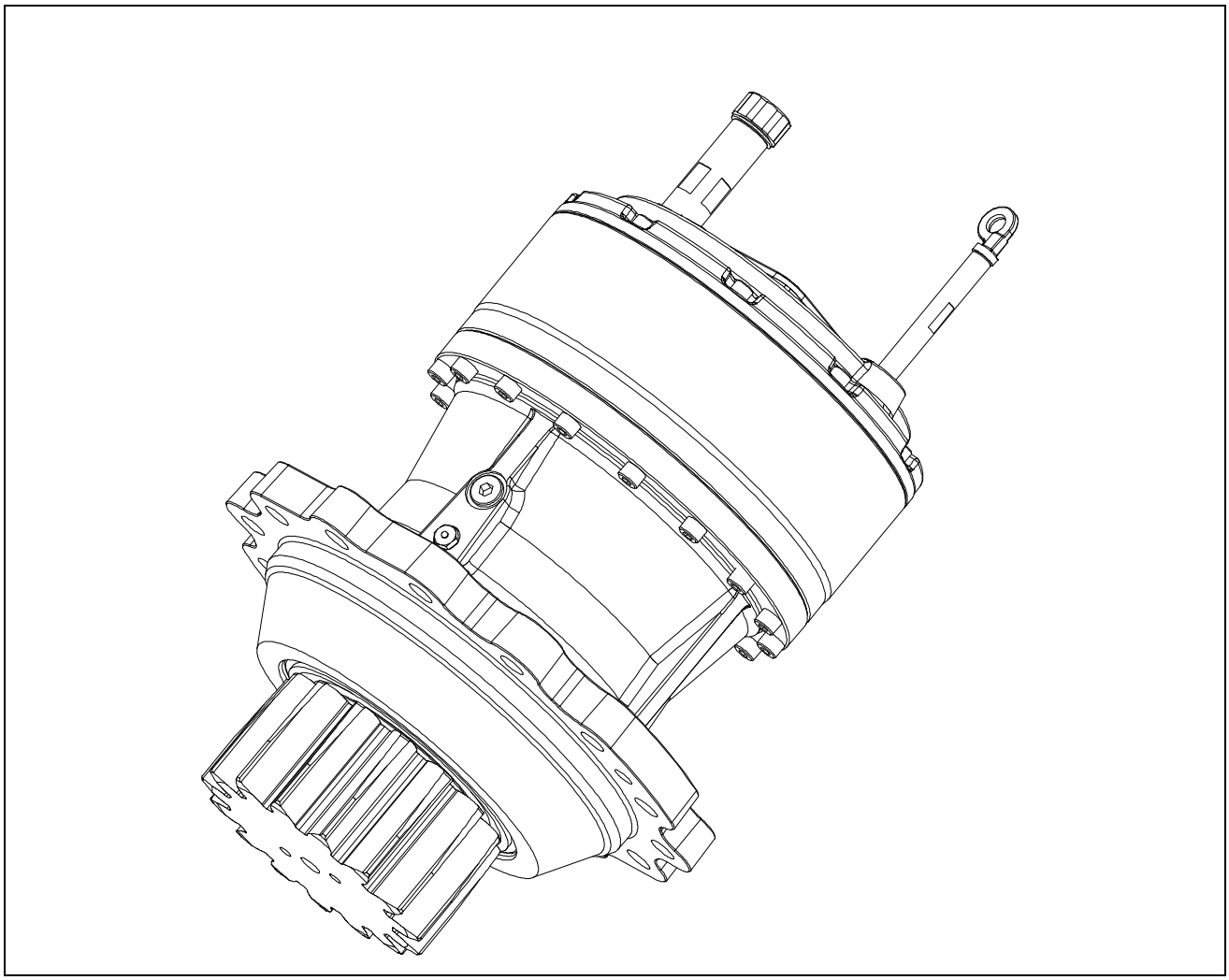
REFER ENGINE SHOP MANUAL OF SE 105 M 06 00 07
B(S)6D105-1 SERIES DIESEL ENGINE

SWING AND TRAVEL SYSTEM

PMP INSTRUCTION MANUALS

1. Swing drive service manual (PMTE. M001)
2. Intergrated drive unit service manual (PMCI. M001)

1. SWING DRIVE SERVICE MANUAL



PMT/PMTE

SWING DRIVES
Service Manual

1) CRONOLOGIA REVISONI 2) *MANUAL REVISIONS*

Rev. 01-2012	Data: 04/12/2012	Approvato (PostVendita)_____
Prima emissione del manuale		
Rev. 02-2013	Data: 11/02/2013	Approvato (PostVendita)_____
Controllato e aggiornato traduzione e formato		

INDICE

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	**ATTENZIONE AI PIEDI, ALLA SCHIENA E ALLE MANI: OGGETTO PESANTE DA MOVIMENTARE CON CAUTELA !!!** *WATCH YOUR FEET, YOUR BACK AND YOUR HANDS: THE COMPONENT IS HEAVY, MOVE IT CAREFULLY !!!*
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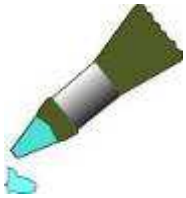	**APPLICAZIONE DI SIGILLANTI/COLLANTI** *APPLICATION OF SEALING/LOCKING FLUID*
	**NON DISPERDERE L'OLIO NELL'AMBIENTE** *DISPOSE IN ACCORDANCE TO ENVIRONMENTAL LAWS*

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Ogni singolo riduttore è dotato di una targhetta di identificazione (fig. 1).
In caso di richiesta ricambi, informazioni ed assistenza, identificare e specificare il modello del prodotto ed il N° di serie rilevabili sulla targhetta.

La targhetta di identificazione deve essere mantenuta integra e visibile

3) *PRODUCT IDENTIFICATION*

Each gearbox is supplied with an identification nameplate. (fig. 1).
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The data stamped on the nameplate must always be visible and undamaged.

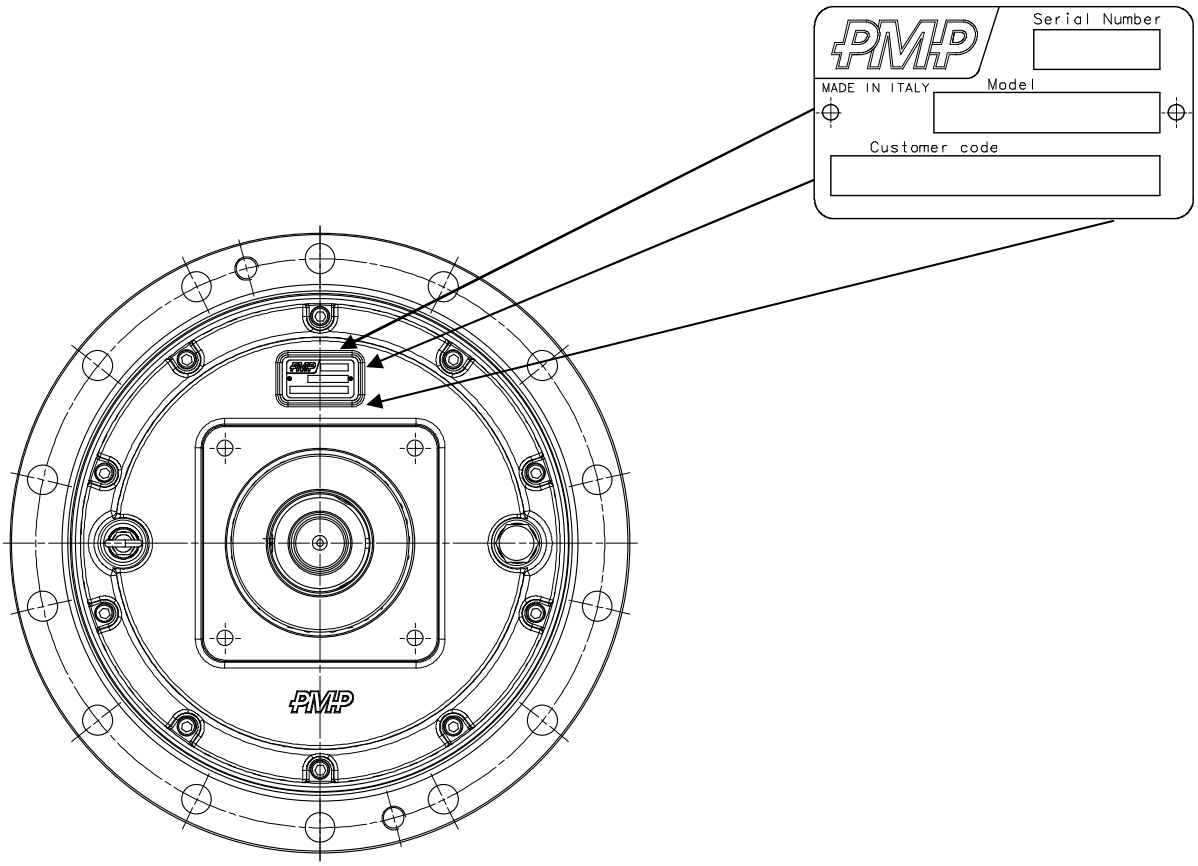


Fig.1

3) INSTALLAZIONE DEL RIDUTTORE

Nella figura seguente sono riportate le tolleranze dimensionali da rispettare per un corretto montaggio dell'unità (fig.2). Per riduttori con doppio centraggio si consiglia di eseguire il foro "L" con una dimensione di 0,5÷1 mm superiore alla misura del diametro del componente. Per tutte le dimensioni e le specifiche fare riferimento al disegno costruttivo fornito insieme al riduttore.

3) *GEARBOX MOUNTING*

In the following picture there are the geometrical tolerances for assembly (fig.2).
On gearboxes with double centering surfaces, it is recommended that the dimension of hole"L" is 0,5÷1 mm greater than the diameter of the gearbox centering surface.
For dimensions and technical data please refer to the specific drawing provided with the gearbox

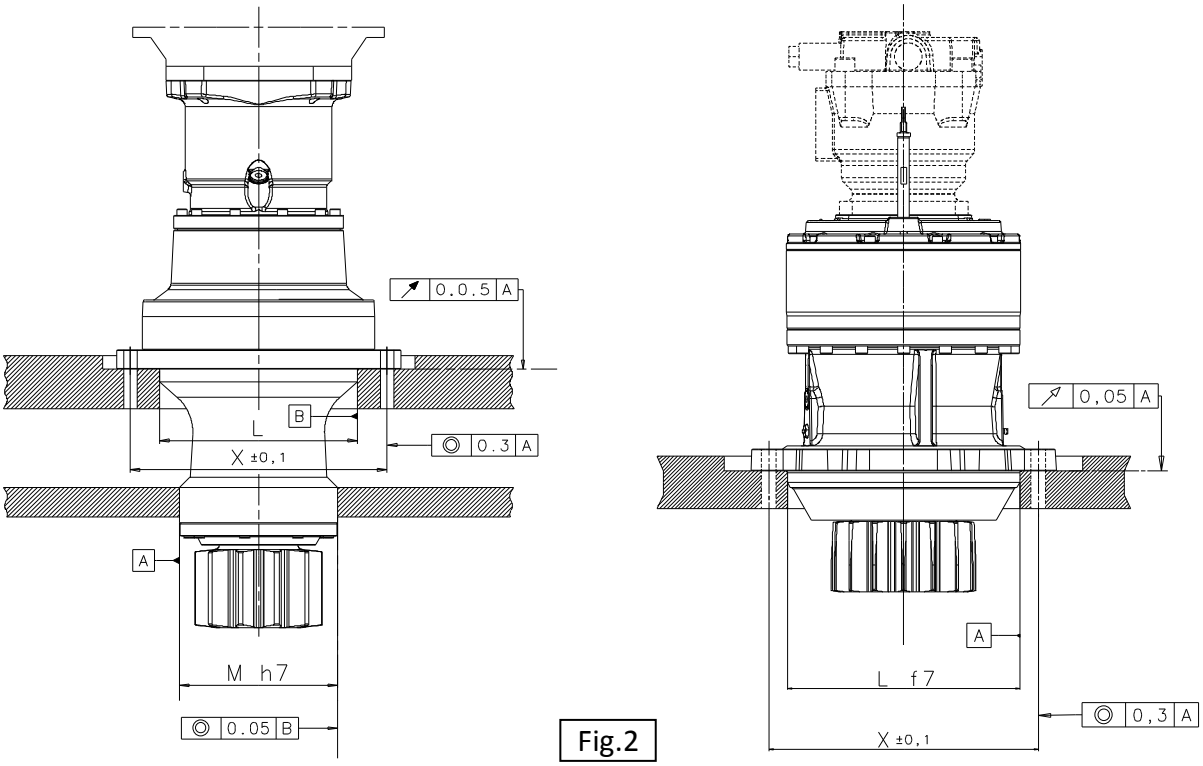


Fig.2

3.1) FISSAGGIO AL TELAIO

Per una corretta operatività del riduttore è necessario che:

- il telaio di fissaggio sia rigido con una superficie di appoggio ben pulita
- i centraggi ed i piani di accoppiamento del riduttore devono essere puliti e privi di ammaccature
- Lubrificare con grasso o olio tutti i centraggi del riduttore e della sede di alloggiamento

Questi controlli sono importanti per ottenere un corretto accoppiamento tra pignone e ralla ed evitare deformazioni alla struttura che compromettono il corretto funzionamento del riduttore.
I riduttori PMT e PMTE è fissato al telaio tramite viti inserite nei fori del corpo (fig.3). Per i riduttori con una sede di centraggio è disponibile un foro spina per il posizionamento corretto.

Nota: per un eventuale estrazione del riduttore utilizzare i gli appositi fori.

3.1) FRAME MOUNTING

To ensure the correct operation of the gearbox, follow the rules below:

- *the unit must be fixed to a rigid structure and the supporting surface should be thoroughly cleaned*
- *the centring and the coupling surfaces of the unit must be clean and undamaged*
- *Lubricate all the centering diameters of the gear unit and the housing seat with grease or oil*

The measures described above are important for ensuring perfect meshing between gearbox pinion and the slewing ring and to prevent any damage to the structure which could cause the gearbox to malfunction.
PMT and PMTE gearboxes must be fixed on the frame with screws inserted in the through holes of the gearbox housing (fig.3). Some gearboxes feature pin holes for accurate positioning.

Note: for gearbox extraction, dedicated threaded holes are available on the gearbox housing.

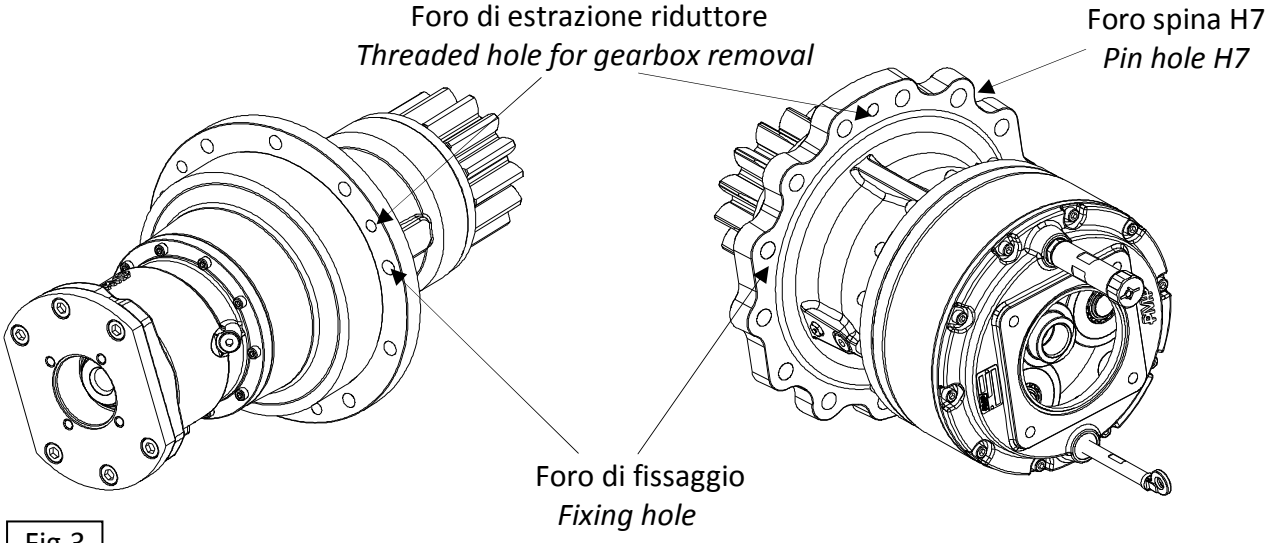


Fig.3

3.2) FISSAGGIO DEL MOTORE

Per il fissaggio del motore il riduttore è predisposto con 4 fori filettati (fig.4).
Nella fase di assemblaggio del motore è necessario lubrificare l'accoppiamento con un leggero strato di grasso.
Inserire l'albero motore nello scanalato del riduttore prestando attenzione che il centraggio del motore si accoppi perfettamente con il centraggio del riduttore.
Dopo aver controllato il corretto inserimento del motore bloccarlo con 4 viti applicando una coppia di serraggio come da tabella 1 riportata di seguito.

ATTENZIONE: durante l'inserimento prestare attenzione a non danneggiare l'Oring di tenuta

3.2) MOTOR ASSEMBLY

Connect the motor using the 4 threaded holes on the gearbox upper flange (fig.4).
While assembling the motor onto the gearbox, the motor shaft must be lubricated with a thin layer of grease.
Insert the motor shaft into the coupling and make sure that the motor centering diameter perfectly matches the gear unit centering diameter.
Check that the motor is properly centered, and then block it with 4 screws. Tightening torque are indicated on table 1.

ATTENTION: during the motor assembly pay attention not to damage the O-Ring

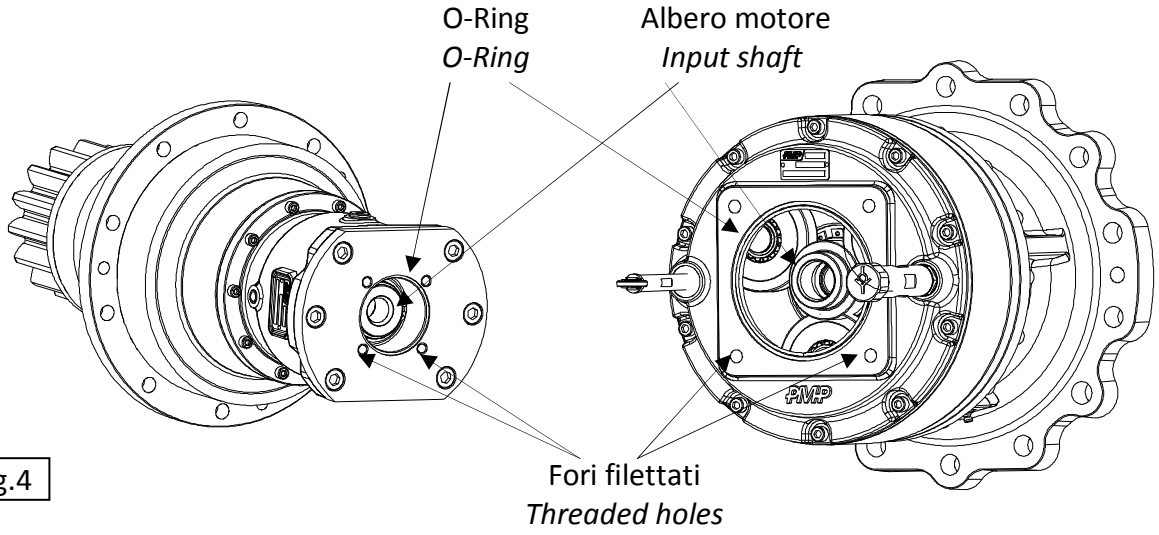


Fig.4

Tabella 1 Valori coppie di serraggio viti / *Table 1 Tightening torque table*	
Filettatura / *Thread*	Coppia / *Torque* Classe / *Grade*. 12.9
M10	70 Nm
M12	120 Nm
M14	190 Nm
M16	300 Nm
M20	680 Nm

4) UTILIZZO E MANUTENZIONE RIDUTTORE

4) *GEARBOX OPERATION AND MAINTENANCE*

4.1) NORME GENERALI

ATTENZIONE!

Intervallo di temperatura consigliato per l'utilizzo: -20°C / +90°C (-4°F / 194 °F)
Nel caso venga superata la temperatura di 90°C (194° F) si raccomanda di interromperne l'utilizzo e di attendere il raffreddamento dell'unità

Tutte le attività di manutenzione devono essere eseguite in sicurezza

- Il riduttore viene fornito senza olio
- La manutenzione ordinaria prevede la sostituzione puntuale dell'olio
- Ad ogni cambio dell'olio controllare che nel tappo magnetico del riduttore non siano presenti parti metalliche di dimensioni inconsuete
- Non mescolare olii diversi tra loro
- Eseguire i controlli secondo la seguente tabella 2:

4.1) GENERAL INSTRUCTIONS

ATTENTION!

Admissible oil temperature range (working conditions): -20°C / +90°C (-4°F / 194 °F)
Gearbox must be immediately stopped and cooled down if oil temperature reaches +90°C (194°F)

All maintenance activities must be carried out under safety conditions

- *The gearbox is supplied without oil*
- *The routine maintenance includes only the regular substitution of the oil*
- *At every oil change, check the magnetic plug for metallic parts with unusual dimensions*
- *Do not mix different types of oil*
- *Use the following table 2 for maintenance intervals of the gearbox:*

Tabella 2 Utilizzo e manutenzione riduttore / ***Table 6 Gearbox operation and maintenance***

Controllo ***Operation***	**Frequenza** ***Interval***
Livello olio *Oil level control*	Ogni 150 ore di lavoro del riduttore *Every 150 operating hours of the gearbox*
Primo cambio olio *First oil change*	A 100 ore di lavoro del riduttore *After 100 operating hours of the gearbox*
Cambi olio successivi *Regular oil change*	Ogni 1000 ore di lavoro o 1 volta all'anno *Every 1000 operating hours or 1 year*
Primo controllo serraggio viti *First screw tighteness control*	Dopo le prime 50 ore di lavoro *After the first 50 operating hours*
Controllo serraggio viti *Regular screw tighteness control*	Ogni 1000 ore di lavoro *Every 1000 operating hours*

Gli intervalli di manutenzione indicati nella tabella 2 sono basati su condizioni di lavoro standard. Nel caso di condizioni di lavoro gravose o in ambienti particolari, è opportuno contattare la PMP

Maintenance intervals indicated in table 2 are based on standard working conditions. In case of intense working conditions or special environmental conditions, recommended maintenance intervals shall be discussed with PMP

4.2 RIEMPIMENTO RIDUTTORE

4.2) OIL FILLING

ATTENZIONE: Il riduttore è fornito senza olio!
Non utilizzare il riduttore prima di aver effettuato il rifornimento

Per la corretta quantità di olio fare riferimento al disegno costruttivo fornito insieme al riduttore.
Per un corretto utilizzo dell'unità, si consiglia l'uso di olio tipo:

ATTENTION: The gearbox is supplied without oil! *Make sure to fill the gearbox with the appropriate oil quantity prior to operating it*

For the proper oil quantity refer to the specific drawing provided with the gearbox.
For correct use of the unit you are recommended to use oil type:

SAE 80W90 / API GL5

SAE 80W90 / API GL5

La tabella 3 di seguito riporta un elenco di olii consigliati (per climi temperati):

The following table 3 shows a list of suggested lubricants (for temperate climate):

Tabella 3 tipi di olio consigliati / Table 3 Suggested lubricants	
Produttore *Manufacturers*	**Tipo di olio *Oil type***
AGIP	*Agip rotra MP*
MOBIL	*Mobilube HD*
REPSOL	*Repsol EP*

Per l'operazione di riempimento operare rispettando i seguenti passi:

For oil-filling operation, follow the steps below:

Rispetta l'ambiente!
Non far cadere olio sul pavimento

Respect the environment!
Dispose in accordance to environmental laws

- **step1**: svitare i tappi di carico e livello olio (vedi fig. 5a pag.11)
- **step2**: Assicurarsi che il tappo di scarico olio sia serrato
- **step3**: inserire il lubrificante dal tappo di carico.

- ***step1:*** *Unscrew the fill plug (see fig.5a pag11)*
- ***step2:*** *Check that the drain plug is tightened*
- ***step3****: fill the gearbox from the fill plug.*
  For PMTE the quantity of oil is sufficient when the level on the oil dipstick is within the

Per il PMTE la quantità è corretta quando il livello di olio è compreso tra le tacche di livello Min e Max dell'asta di livello (fig.5b pag.12). Per il PMT la quantità è corretta quando il livello di olio è compreso tra il bordo inferiore e la tacca di Max dell'asta di livello (fig.5b pag.12). Per la corretta quantità di olio fare riferimento al disegno costruttivo fornito con il prodotto

- **step4**: riavvitare i tappi di carico e livello con la relativa rondella

Min and Max range (fig 5b pag.11).
For PMT the quantity of oil is sufficient when the level on the oil dipstick is within the oil dipstick edge and Max range (fig. 5b *pag.12)*
For an indication of the approximate oil quantity needed, please refer to the specific drawing provided with the gearbox

- ***step4:** put the plugs with their washers back in place*

4.3) RIMOZIONE DELL'OLIO

Per l'operazione di svuotamento operare rispettando i seguenti passi:

Rispetta l'ambiente!
Non far cadere olio sul pavimento!

- **step1:** svitare il tappo di carico dell'olio per favorire la fuoriuscita dello stesso dall'unità
- **step2:** svitare il tappo di scarico dell'olio ed attendere la completa fuoriuscita dell'olio
- **step3:** procedere alla sostituzione dell'olio come riportato a pag. 10

4.3) OIL DRAINING

For oil-draining operation, follow these steps:

Respect the environment!
Dispose in accordance to environmental laws

- ***step1**: in order to facilitate draining it is suggested to remove the oil filling plug*
- ***step2:** remove the drain plug and allow all the oil to flow out of the gearbox*
- ***step3:** refill the gearbox following the steps described on pag.10*

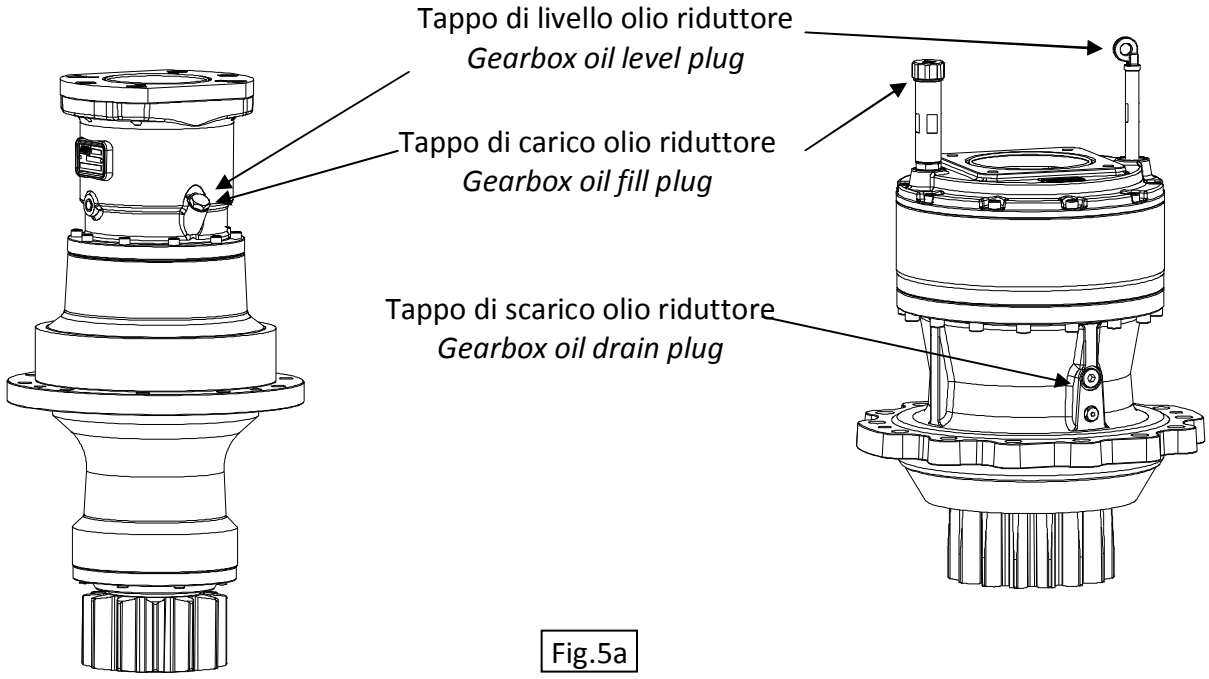
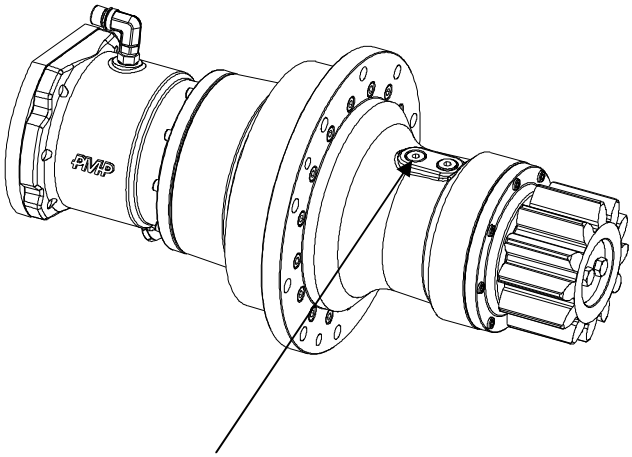


Fig.5a



Tappo di scarico olio riduttore
Gearbox oil drain plug

Fig.5a

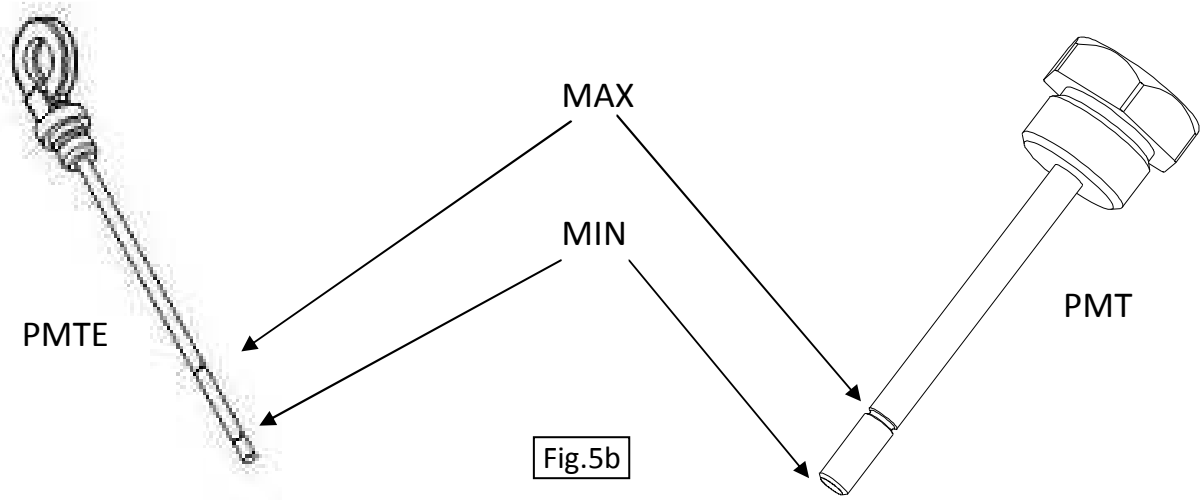


Fig.5b

Tappo di livello olio riduttore
Gearbox oil level plug

4.4) LUBRIFICAZIONE A GRASSO DEL CUSCINETTO IN USCITA

Il riduttore per il corretto funzionamento necessita della lubrificazione del cuscinetto a rulli lato pignone con grasso.

Il riduttore viene fornito con grasso già inserito!

L'utilizzatore è tenuto ad effettuare ogni 1000 ore il controllo del corretto livello di grasso nell'unità.

Per un corretto utilizzo dell'unità, si consiglia l'uso di grasso Mobilgrease XPH222 avente le seguenti caratteristiche:

Tipo di ispessente	Litio complesso
Consistenza:	NLGI N°2
Olio base:	Minerale con viscosità a 40°C di 220 mm^2/s
Punto di goccia	260 °C

4.4) LUBRICATION OF THE OUTPUT BEARING WITH GREASE

During operation, PMTE gearboxes output bearing chamber must have the correct quantity of grease

PMT and PMTE gearboxes are supplied with the output bearing chamber already filled with grease

Grease level must be checked regularly every 1000 hours.

It is recommended to use Mobilgrease XHP222.

Alternatively grease with the following characteristics can be used:

Thickener type	Li-complex
Consistency	NLGI N°2
Base oil:	Mineral oil with viscosity 220 mm^2/s at 40°C
Dropping point	260°C

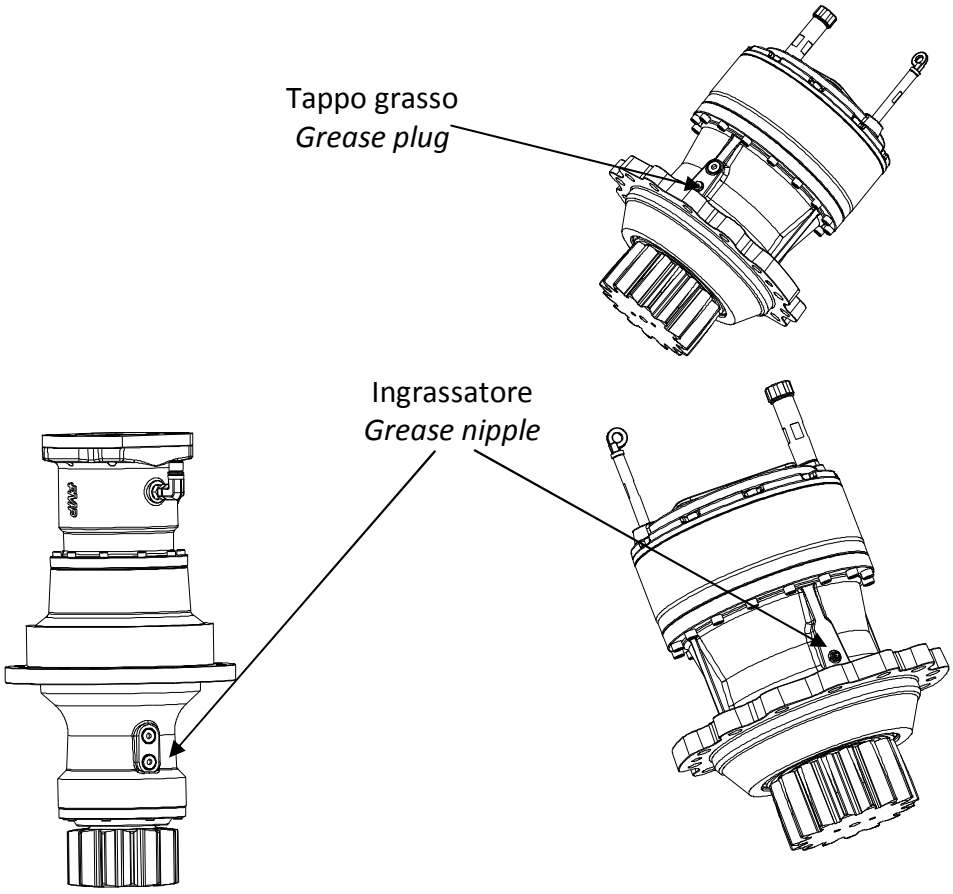
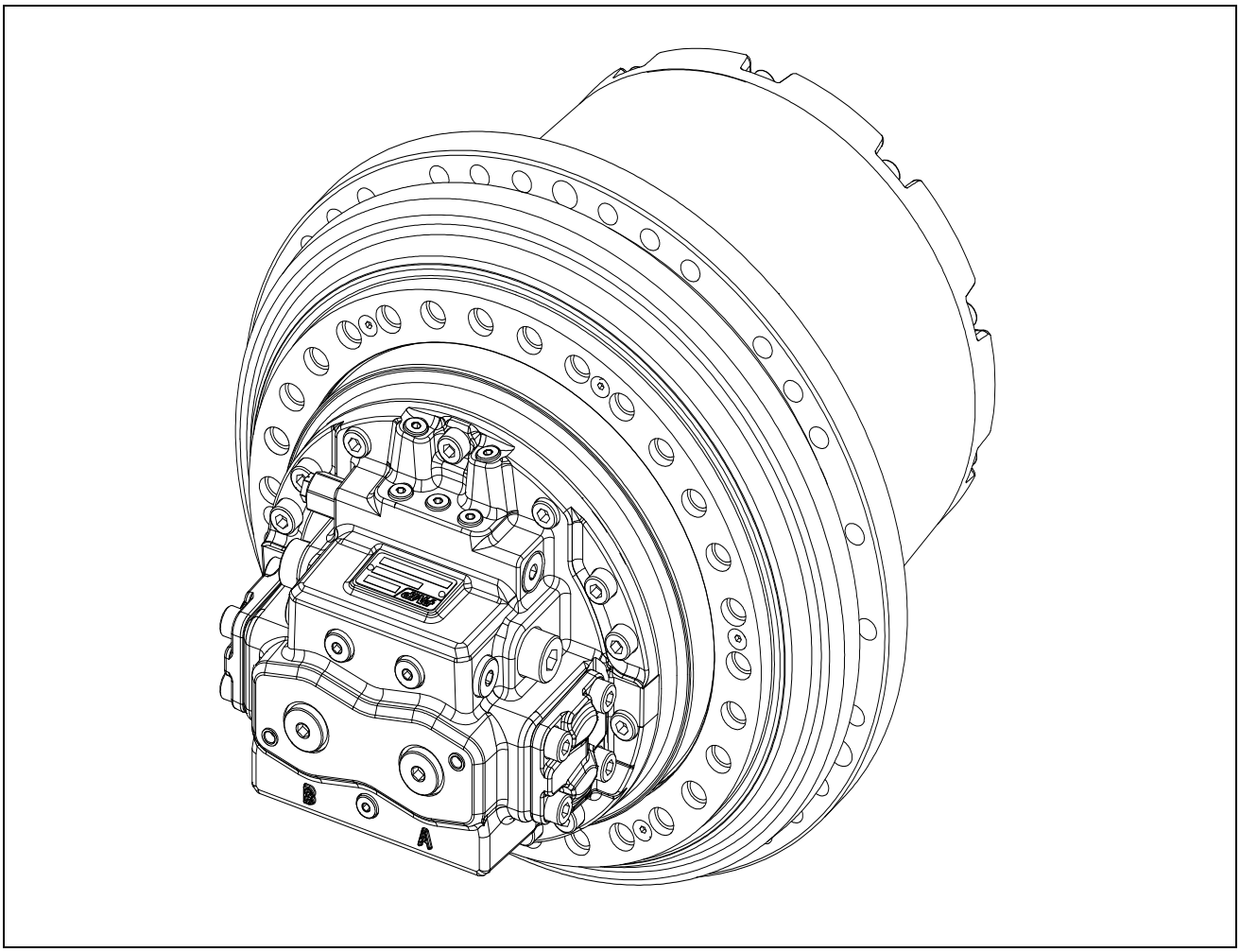


Fig.6

2. TRAVEL DRIVE SERVICE MANUAL

PMP INDUSTRIES



PMCI

INTEGRATED DRIVE UNIT
Service Manual

1) CRONOLOGIA REVISIONI 1) *MANUAL REVISIONS*

Rev. 01-2013	Data: 06/02/2013	Approvato (PostVendita)_____
Prima emissione del manuale		

Questa pubblicazione annulla e sostituisce ogni precedente edizione o revisione.

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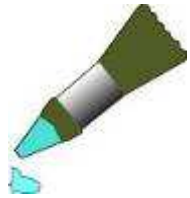	**APPLICAZIONE DI SIGILLANTI/COLLANTI** *APPLICATION OF SEALING/LOCKING FLUID*
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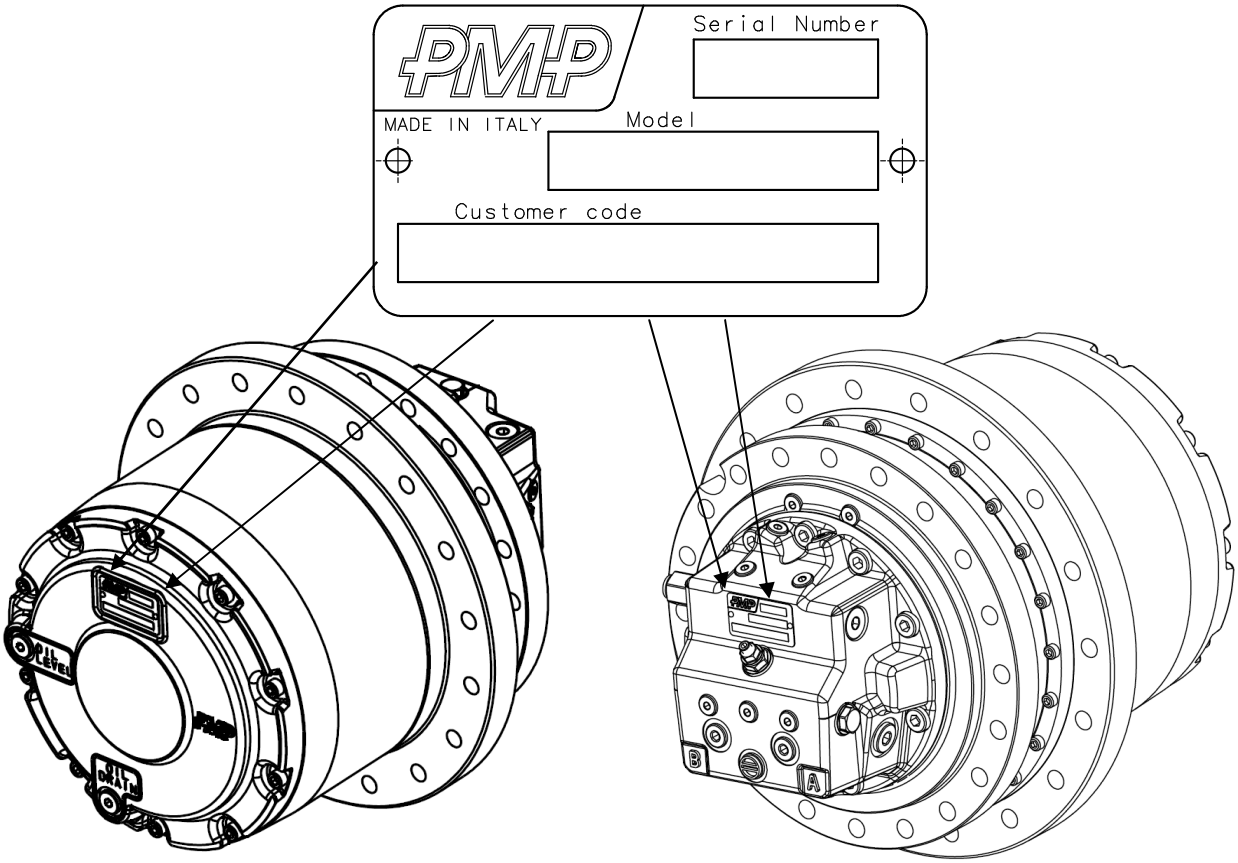


Fig.1a

Fig.1b

4) INSTALLAZIONE DEL RIDUTTORE

Di seguito vengono riportate le indicazioni di accoppiamento per il fissaggio corretto del riduttore (fig.2).
Per tutte le caratteristiche tecniche e le dimensioni fare riferimento al documento costruttivo fornito insieme al prodotto.

4) *GEARBOX MOUNTING*

The geometrical indications and tolerances for the correct mounting are shown here below (fig.2).

For d1 and d2 dimensions and additional technical data, refer to the specific drawing provided with the drive.

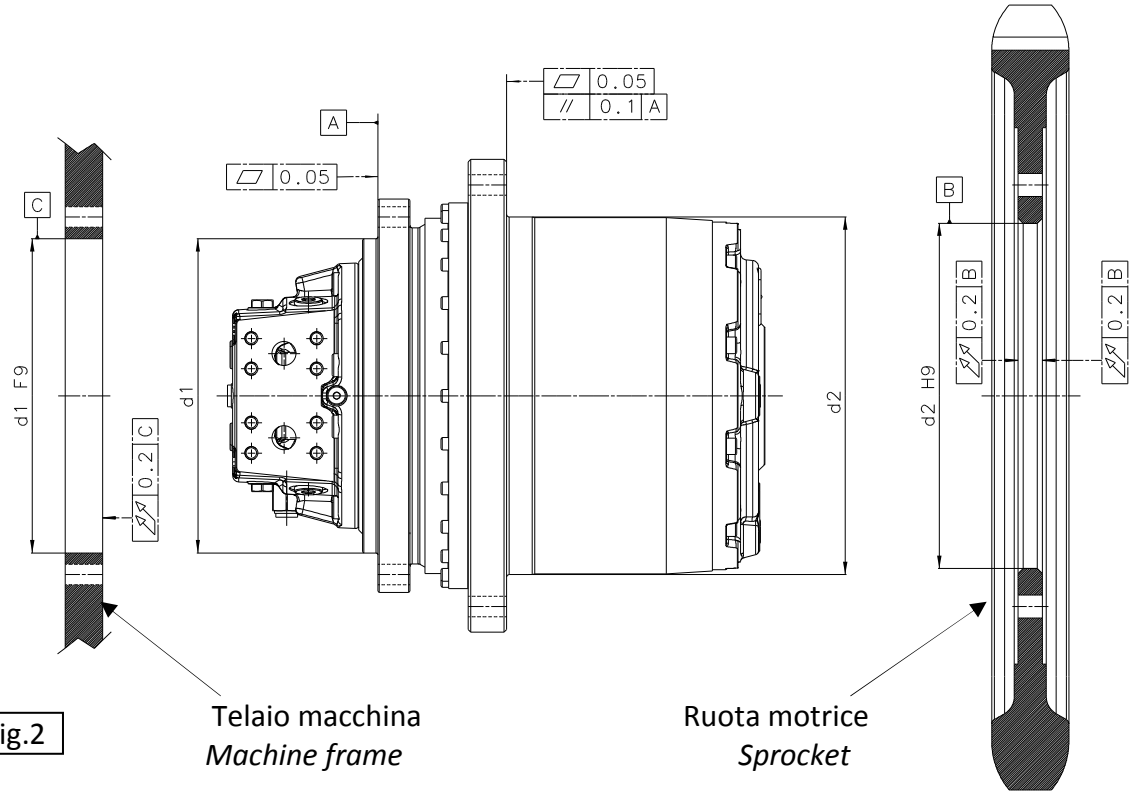


Fig.2

Riduttore / *Gearbox* [mm]		Ruota motrice / *Sprocket* [mm]
d2	*≤300*	*d2 H9*
	>300	*(d2+0.2) H9*

4.1) FISSAGGIO AL TELAIO

Per una corretta operatività del riduttore è necessario:

- verificare che il telaio di fissaggio abbia caratteristiche tali da sopportare il peso del riduttore e le forze che si generano durante il funzionamento
- controllare che i centraggi ed i piani di accoppiamento del riduttore siano puliti e privi di ammaccature per favorire il bloccaggio del riduttore nella sua sede

-  applicare sul filetto delle viti del frena filetti ad alta resistenza
-  serrare alla coppia riportata nella seguente tabella 1

4.1) FRAME MOUNTING

To ensure the correct operation of the gearbox, it is necessary to:

- *check that the structure to which the gearbox is mounted is sufficiently robust and rigid to support its weight and operating stresses*
- *check that the centring and the coupling surfaces of the drive unit are clean and undamaged, for correct and secure locking*

-  *apply high strength threadlocker on the screw threads*
-  *tighten at the torque indicated on table 1*

4.2) FISSAGGIO RUOTA MOTRICE

- Pulire accuratamente le zone di accoppiamento ed installare la ruota motrice sul riduttore (fig.3)

-  applicare sul filetto delle viti del frena filetti ad alta resistenza
-  serrare alla coppia riportata nella tabella 1

4.2) SPROCKET MOUNTING

- *Clean mating surfaces and install the sprocket on the gearbox (fig.3)*

-  *apply high strength threadlocker on the screw threads*
-  *tighten at the torque indicated on table 1*

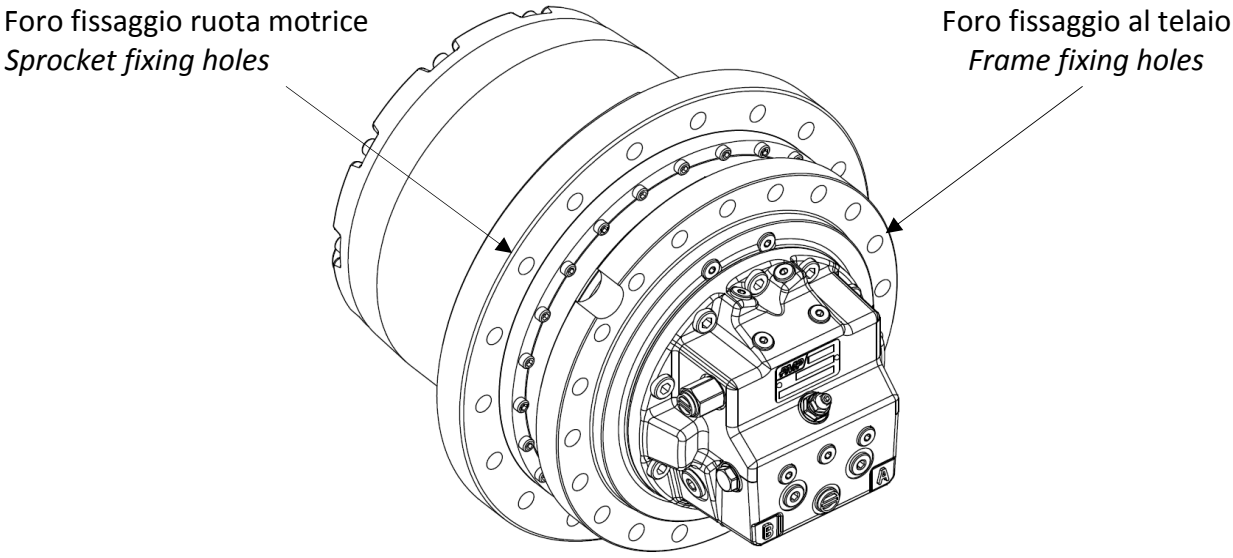


Fig.3

Tabella 1 Valori coppie di serraggio viti / *Table 1 Tightening torque table*	
Filettatura / *Thread*	Coppia / *Torque* Classe / *Grade*. 12.9
M10	70 Nm
M12	120 Nm
M14	190 Nm
M16	300 Nm
M20	680 Nm
M24	1220 Nm
M30	2430 Nm

5) COLLEGAMENTO ALL'IMPIANTO IDRAULICO

I motoriduttori PMCI possono essere applicati su macchine per il comando della traslazione con azionamento in circuito chiuso o aperto in base al tipo di applicazione.
Le caratteristiche tecniche e lo schema idraulico del motore sono riportate nel disegno costruttivo fornito insieme al prodotto.

Per una corretta operatività è necessario:

- verificare che tutti i tubi di connessione siano puliti e privi di qualsiasi incrostazione
- evitare l'immissione di qualsiasi corpo estraneo nelle tubazioni; è utile quindi rimuovere le protezioni delle porte di connessione solo al momento dell'installazione
- effettuare, dopo l'assemblaggio delle tubazioni, la filtrazione dell'olio
- evitare di mescolare fra loro olii con proprietà differenti

5.1) FLUIDO IDRAULICO

Il motore deve utilizzare un fluido idraulico a base minerale ad alto indice di viscosità.
Nella tabella 2 vengono evidenziate le caratteristiche dell'olio:

5) CONNECTION TO THE HYDRAULIC SYSTEM

PMCI drives can be used on machines equipped with open or closed loop hydraulic circuit.

For motor technical data and hydraulic schematics please refer to the specific drawing provided with the drive.

To ensure the correct operation, it is necessary to:

- *make sure that all hydraulic hoses and connections are clean and free from any internal obstruction*
- *prevent that any foreign particles enter into the hoses*
  remove the plastic caps only at the time of the connection
- *filter the oil after hoses are connected to the motor*
- *not mix different kinds of oil*

5.1) HYDRAULIC FLUID

The motor must be operated with high viscosity mineral oil.
The following table 2 indicates the recommended characteristics of the hydraulic fluid:

Tabella 2 Campo di viscosità olio / *Table 2 Hydraulic fluid viscosity range*

Fluido idraulico *Hydraulic fluid*	*Mineral Oil* *High Viscosity index*	
Campo di viscosità in esercizio (min-max) *Operating viscosity range (min-max)*	cSt	16-36
Campo di viscosità limite per brevi transitori *Acceptable viscosity range for very short periods*	cSt	7-1600

Per quanto riguarda i limiti di temperature di esercizio è utile rispettare i campi di applicazione riportati nella tabella 3

During operation the temperature of hydraulic fluid must be controlled and stay within the range of table 3 below

Tabella 3 Limiti di temperature olio / *Table3 Hydraulic fluid temperature range*		
Temperatura olio in esercizio *Operating temperature range (min-max)*	°C [°F]	20÷90 [68÷194]
Massima temperatura dell'olio *Maximum oil temperature*	°C [F]	90 [194]
Minima temperatura di azionamento *Minimum temperature at operation start*	°C [F]	-20 [-4]

5.2) FILTRAZIONE

Al fine di garantire un migliore funzionamento ed una maggiore durata del motore, si raccomanda di garantire un grado di pulizia come riportato nella tabella 4:

5.3) FILTRATION

For efficient and durable performances it is recommended to maintain a solid particle contamination level as for table 4:

Tabella 4 Grado di pulizia dell'olio / *Table 4 Solid particle contamination level*
Class 7 in accordance to NAS 1638
18/16/13 in accordance to ISO 4406

5.3) DETTAGLI CONNESSIONI

Di seguito vengono riportate le posizioni delle porte per i collegamenti all'impianto idraulico (fig. 4). Per le dimensioni ed il tipo fare riferimento al documento costruttivo fornito insieme al prodotto.

5.3) CONNECTION DETAILS

Connect the hydraulic circuit hoses to the hydraulic motor ports as per the Picture 4 below. For specific dimensions and hoses size refer to the specific drawing provided with the drive.

Porte motore idraulico per circuito aperto *Motor ports for open loop configuration*

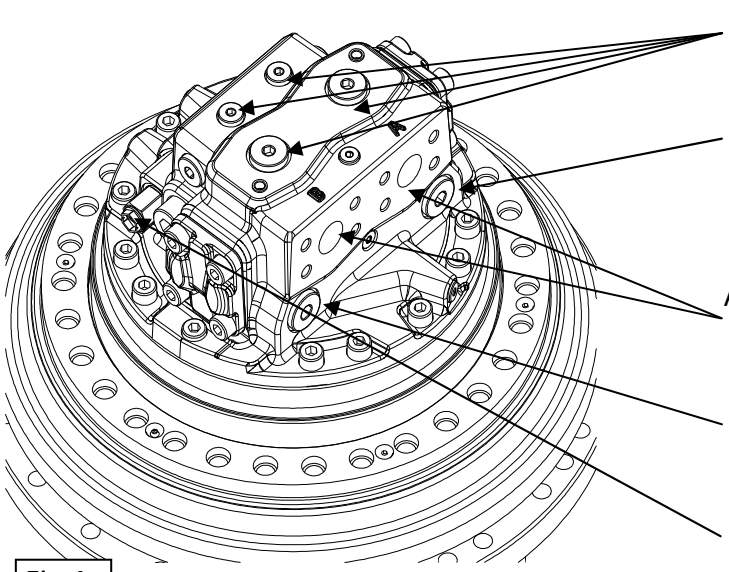


Fig.4a

Porte motore idraulico per circuito chiuso *Motor ports for closed loop configuration*

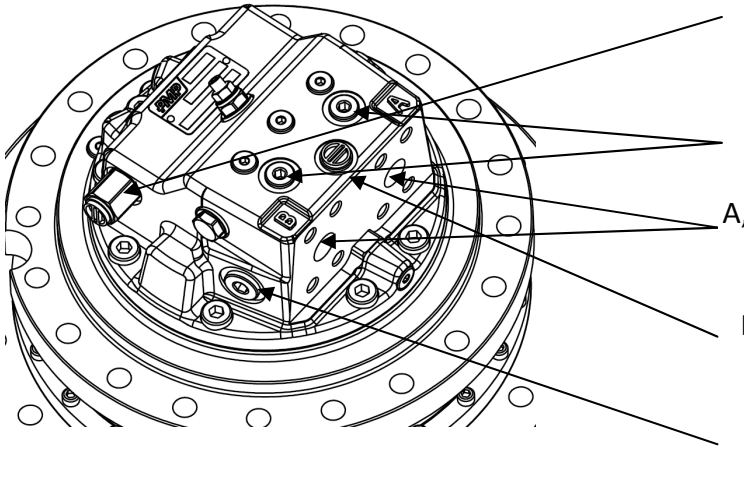


Fig.4b

5.4) CLINDRATA MOTORE

La condizione standard per motori a cilindrata variabile è operare con il motore ad alta cilindrata (pressione su Ps non applicata).
Quando è applicata una pressione su Ps il motore si porta a bassa cilindrata.
Nei motori equipaggiati con commutazione automatica quando nelle linea A o B viene raggiunto un valore specifico di pressione il motore si porta ad alta cilindrata anche se è applicata una pressione in Ps.
Il motore può essere anche fornito a cilindrata fissa.

5.4) MOTOR DISPLACEMENT

The standard for variable displacement motors is to operate with the motor in the high-displacement (no pilot pressure Ps applied). When pilot pressure (Ps) is applied, the motor shifts to the low-displacement position.
Motors equipped with automatic auto-shift will automatically return to high displacement, despite pilot pressure Ps being applied, when A-B pressure hits a specific value.
Motors can also be supplied in the fixed displacement configuration upon request.

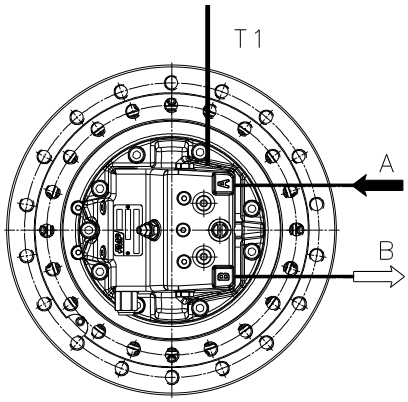
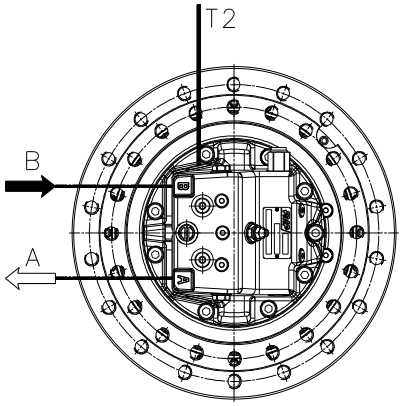
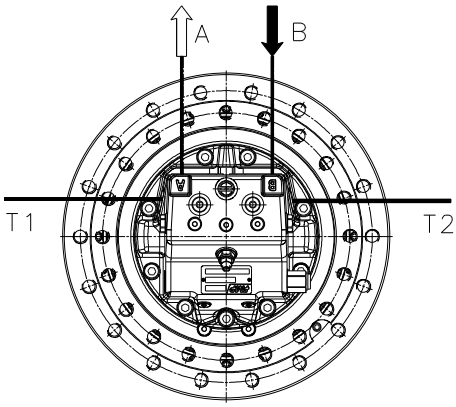
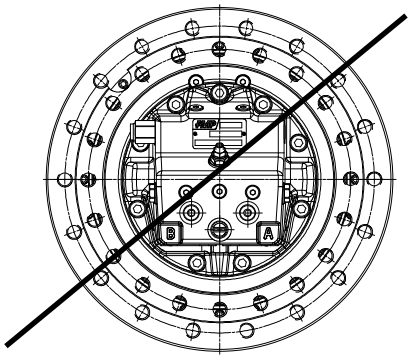
5.5) ORIENTAZIONE MOTORE

Nella tabella 5 viene presentato il corretto montaggio delle connessioni.
Una condizione fondamentale che consente il corretto avviamento iniziale dell'unità è che il motore venga riempito di olio idraulico pre-filtrato.
La mancanza del rispetto di tale condizione può danneggiare irrimediabilmente l'unità.
Dopo aver riempito di olio il motore farlo funzionare a vuoto per consentire il flussaggio dell'impianto e per controllare eventuali perdite di olio da tubi e raccordi.
Eliminare eventuale aria residua dal circuito idraulico; la presenza di aria residua nel circuito idraulico causa un funzionamento a strappi del motore ed una eccessiva rumorosità.

5.5) MOTOR ORIENTATION

Table 5 below explains the correct positioning of the motor connections.

An important condition is that the motor must be filled with pre filtered hydraulic oil.
Lack of compliance with this condition can damage the unit irreparably.
After the motor has been filled, operate the machine with no load to allow the flushing of the circuit and check for leaks in hoses or fittings.
Bleed air from every part of the hydraulic circuit; the presence of residual air in the hydraulic circuit will lead to irregular functioning of the motor as well as excessive noise

Tabella 5 Posizionamento dell'unità / ***Table 5 Motor positioning***	**Annotazioni /** ***Notes***
	La linea di drenaggio deve essere collegata alla porta posta più in alto (T_1). Tappare il drenaggio più basso con un tappo metallico *The case drain hose must always be connected to the highest port (T_1). Plug the lower drain port with a metallic plug*
	La linea di drenaggio deve essere collegata alla porta posta più in alto (T_2). Tappare il drenaggio più basso con un tappo metallico *The case drain hose must always be connected to the highest port (T_2). Plug the lower drain port with a metallic plug*
	La linea di drenaggio può essere collegata alla porta T_1 o T_2. Tappare il drenaggio rimanente con un tappo metallico *The case drain hose can be connected either to port T_1 or T_2.* *Plug the remaining drain port with a metallic plug*
	Montaggio sconsigliato *Not recomended connection*

5.6) COLLEGAMENTO DEL FRENO

Il motoriduttore è provvisto di un freno negativo montato nel motore con sblocco a comando idraulico. Per le caratteristiche e le informazioni relative al freno ed alla dimensione della porta fare riferimento al documento costruttivo fornito insieme al prodotto.
In caso di motore idraulico per circuito aperto l'apertura del freno avviene automaticamente con l'alimentazione del motore, quindi il freno non necessita di un comando autonomo (fig.4a pag.11)
Nel caso di motore idraulico per circuito chiuso il freno necessita di un comando esterno (fig.4b pag.11).

Nel caso di circuiti chiusi è fondamentale assicurarsi che il freno sia completamente sbloccato prima di azionare il motoriduttore

5.6) CONNECTION OF THE BRAKE

PMCI drives are normally supplied with a spring applied hydraulic release parking brake, integrated into the motor.
For motor brake details please refer to the specific drawing provided with the drive.

*In case of motors for open loop hydraulic circuits, brake release is automatically operated when pressure is delivered to the motor, so there is no need for external pilot pressure (fig.*4a *pag.11).*
*In case of motors for closed loop hydraulic circuits, the brake requires a dedicated external pilot pressure to be released prior to motor operation (fig.*4b *pag.11)*

In closed loop applications, the parking brake must be fully released before motor is operated and during operations.

6) UTILIZZO E MANUTENZIONE RIDUTTORE

6) GEARBOX OPERATION AND MAINTENANCE

6.1) NORME GENERALI

ATTENZIONE!

Intervallo di temperatura consigliato per l'utilizzo: -20°C / +90°C (-4°F / 194 °F)
Nel caso venga superata la temperatura di 90°C (194° F) si raccomanda di interromperne l'utilizzo e di attendere il raffreddamento dell'unità

Tutte le attività di manutenzione devono essere eseguite in sicurezza

6.1) GENERAL INSTRUCTIONS

ATTENTION!

Admissible oil temperature range (working conditions): -20°C / +90°C (-4°F / 194 °F)
Gearbox must be immediately stopped and cooled down if oil temperature reaches +90°C (194°F)

All maintenance activities must be performed under safety conditions

- Il riduttore viene fornito senza olio
- La manutenzione ordinaria prevede la sostituzione puntuale dell'olio
- Non mescolare olii diversi tra loro
- Eseguire i controlli secondo la seguente tabella 6:

- *The gearbox is supplied without oil*
- *The routine maintenance includes only the regular substitution of the oil.*
- *Do not mix different types of oil*
- *Use the following table 6 for maintenance intervals of the gearbox:*

Tabella 6 Utilizzo e manutenzione riduttore / *Table 6 Gearbox operation and maintenance*	
Controllo ***Operation***	**Frequenza** ***Interval***
Livello olio *Oil level control*	Ogni 150 ore di lavoro del riduttore *Every 150 operating hours of the gearbox*
Primo cambio olio *First oil change*	A 100 ore di lavoro del riduttore *After 100 operating hours of the gearbox*
Cambi olio successivi *Regular oil change*	Ogni 1000 ore di lavoro o 1 volta all'anno *Every 1000 operating hours or 1 year*
Primo controllo serraggio viti *First screw tighteness control*	Dopo le prime 50 ore di lavoro *After the first 50 operating hours*
Controllo serraggio viti *Regular screw tighteness control*	Ogni 1000 ore di lavoro *Every 1000 operating hours*

Gli intervalli di manutenzione indicati nella tabella 6 sono basati su condizioni di lavoro standard. Nel caso di condizioni di lavoro gravose o in ambienti particolari, è opportuno contattare la PMP

Maintenance intervals indicated in table 6 are based on standard working conditions. In case of intense working conditions or special environmental conditions, recommended maintenance intervals shall be discussed with PMP

6.2) RIEMPIMENTO RIDUTTORE

ATTENZIONE: Il riduttore è fornito senza olio!
Non utilizzare il riduttore prima di aver effettuato il rifornimento

Per un corretto utilizzo dell'unità, si consiglia l'uso di olio tipo:

SAE 80W90 / API GL5

La tabella 7 di seguito riporta un elenco di olii consigliati (per climi temperati):

6.2) OIL FILLING

ATTENTION: The gearbox is supplied without oil! *Make sure to fill the gearbox with the appropriate oil quantity prior to operating it*

For correct use of the unit, it is recommended to use the following oil type:

SAE 80W90 / API GL5

The following table 7 shows a list of suggested lubricants (for temperate climate):

Tabella 7 tipi di olio consigliati / *Table 7 Suggested lubricants*

Produttore / *Manufacturers*	**Tipo di olio */ Oil type***
AGIP	*Agip rotra MP*
MOBIL	*Mobilube HD*
REPSOL	*Repsol EP*

Per l'operazione di riempimento operare rispettando i seguenti passi:

Rispetta l'ambiente
Non disperdere l'olio nell'ambiente

- **step1:** ruotare il riduttore in modo che il tappo di livello, identificato con la scritta "OIL LEVEL", risulti disposto orizzontalmente (vedi fig.5a pag.17). Il tappo di carico, identificato con la scritta "OIL DRAIN" dovrà posizionarsi in alto
- **step2**: svitare i tappi di carico e livello olio (vedi fig.5a pag.17)
- **step3**: inserire il lubrificante dal tappo di carico. La quantità è corretta quando l'olio fuoriesce dal foro di livello (per la quantità corretta fare riferimento al documento costruttivo fornito insieme al prodotto)
- **step4**: riavvitare i tappi di carico e livello
- **step5**: azionare l'unità per qualche minuto e controllare il livello di olio
- **step6**: rabboccare se necessario

For oil-filling operation, follow the steps below:

Respect the environment
Dispose in accordance to environmental laws

- ***step1:*** *rotate the gearbox until the "OIL LEVEL" level plug, is set horizontally (see fig.*5a *pag.17)*
  The "OIL DRAIN" fill plug, must be above the level plug
- ***step2:*** *unscrew the fill plug and the level plug (see fig.*5a *pag.17)*
- ***step3****: fill the gearbox from "OIL DRAIN" fill plug.*
  The oil quantity is sufficient when the oil reaches "OIL LEVEL" level plug.
  An indication of the approximate oil quantity needed to fill the gearbox is reported in the specific drawing provided with the drive
- ***step4:*** *put the plugs with their washers back in place*
- ***step5:*** *run the unit and after few minutes*

check the oil level

- ***step6:*** *top up with oil if necessary*

6.3) RIMOZIONE DELL'OLIO

Per l'operazione di svuotamento operare rispettando i seguenti passi:

Rispetta l'ambiente
Non disperdere l'olio nell'ambiente!

- **step1**: ruotare il riduttore in modo che il tappo di livello, identificato con la scritta "OIL LEVEL", risulti disposto orizzontalmente (vedi fig.5b). Il tappo di carico, identificato con la scritta "OIL DRAIN" dovrà posizionarsi in basso;
- **step2:** svitare il tappo di livello dell'olio per favorire la fuoriuscita dello stesso dall'unità
- **step3:** svitare il tappo di scarico dell'olio ed attendere la completa fuoriuscita dell'olio
- **step4:** procedere alla sostituzione dell'olio come riportato a pag. 16

6.3) OIL DRAINING

For oil-draining operation, follow the steps below:

Respect the environment
Dispose in accordance to environmental laws

- ***step1*** *rotate the gearbox until the plug level, identify as "OIL LEVEL" is set horizontally (see on fig.*5b*).*
  The fill plug, identify as "OIL DRAIN", must be on the bottom
- ***step2****: in order to facilitate oil draining it is recommended to remove the oil level plug*
- ***step3:*** *remove the drain plug and allow all the oil to flow out of the gearbox*
- ***step3:*** *refill the gearbox following the steps described on pag.16*

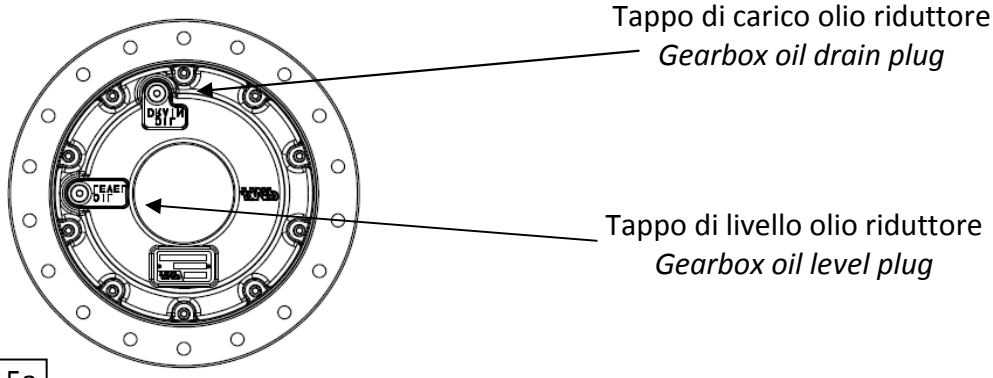


Fig.5a

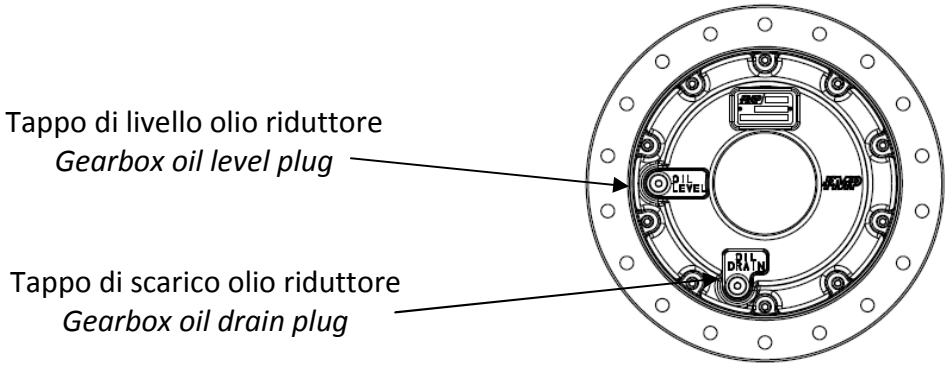


Fig.5b

6.4) DISINNESTO MECCANICO

Il riduttore può essere fornito con disinnesto meccanico che permette di trainare la macchina a motore fermo.

Il disinnesto deve essere inserito o disinserito solo con riduttore fermo su superficie piana
Quando il riduttore è sbloccato il freno ed il motore non sono operativi quindi la macchina può muoversi

Prestare attenzione durante l'operazione di disinnesto poiché rimuovendo il tappo vi è fuoriuscita di olio

Per l'operazione di disinnesto operare rispettando i seguenti passi:

- **step1:** svitare il tappo dal coperchio di chiusura con l'apposita chiave
- **step2:** avvitare una vite M6 nel filetto del pignone I epc (fig.6 pag.19)
- **step3:** tirando la vite sfilare il pignone I epc

- **step4:** avvitare il tappo nel coperchio e serrare alla coppia indicata nella seguente tabella 8

6.4) MECHANICAL DISENGAGEMENT

PMCI drives can be supplied with mechanical disengagement, to allow towing the machine.

The disengagement must be connected or disconnected only when the machine is fully stopped and blocked on flat ground
When the gearbox is mechanically disengaged, the brake and the motor are not operating on the final drive. Pay attention as the machine can move unexpectedly.

Pay attention when performing the mechanical disengagement operation: some oil will flow out when removing the cover plug.

For disengaged operation, follow these steps:

- ***step1:*** *unscrew the plug from the cover using the appropriate wrench*
- ***step2:*** *tighten an M6 screw in threaded hole on the sun gear of the low torque planetary stage (fig.*6 *pag.19)*
- ***step3:*** *remove the sun gear*

- ***step4:*** *screw the plug on the cover and tighten it with the torque indicated in the following table 8*

Tabella 8 Coppie di serraggio tappi / Table 8 *Tightening torque table*		
Tappo / *Plug*	**Chiave/ *Key***	**Coppia / *Torque***
M55	22	150 Nm
M90	22	190 Nm

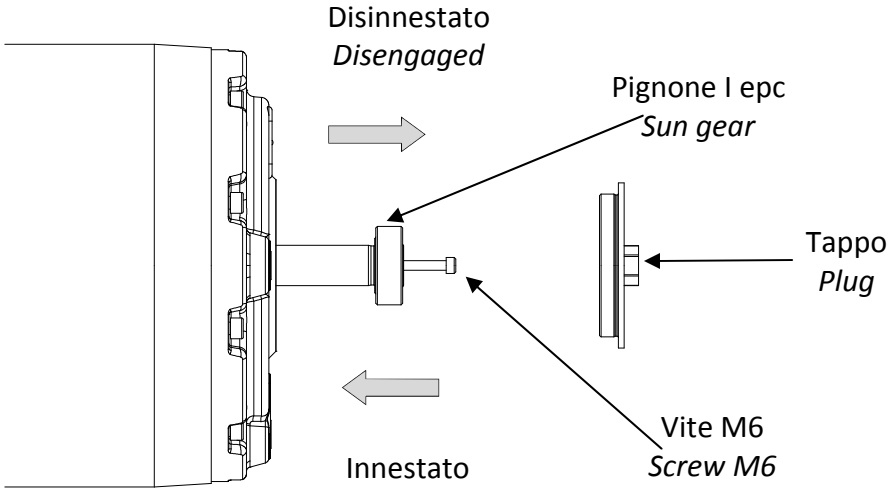


Fig.6

Per l'operazione di innesto operare rispettando i seguenti passi:

- **step1:** svitare il tappo dal coperchio di chiusura con l'apposita chiave
- **step2:** inserire il pignone I epc

- **step3:** avvitare il tappo nel coperchio e serrare alla coppia corretta
- **step4:** ripristinare il livello dell'olio se necessario

For re-engagement operation, follow these steps:

- ***step1:*** *unscrew the plug from the cover using the appropriate wrench*
- ***step2:*** *insert the sun gear of the low torque planetary stage back into position, aligning gear teeth.*

- ***step3:*** *screw the plug on the cover and tighten it with the correct torque*
- ***step4:*** *if necessary top in with lubricant*

HYDRAULIC SYSTEM

REXROTH INSTRUCTION MANUALS

1. Axial piston variable double pump
2. Positive conrtrol block M9
3. Hydraulic pilot contorl units for armrest installation
4. Pilot contorl device in pedal design
5. Direct operated pressure reducing valve (Type ZDR 6 D)
6. Direct operated pressure sequence valve (Type DZ 6 DP)