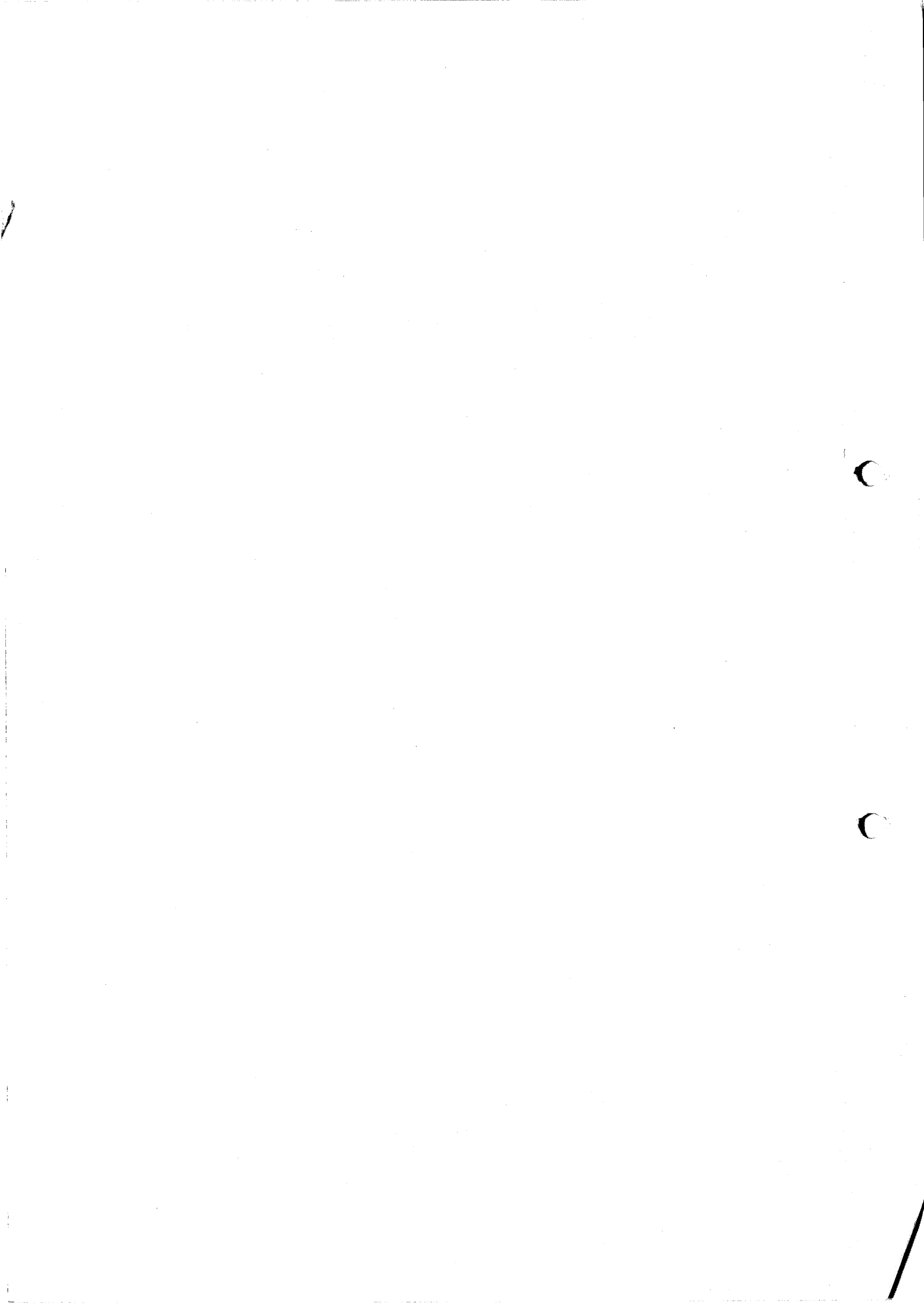


# **SHOP MANUAL**

***MODEL SV91.SV91T.SV91D.SV91DP***  
***VIBRATING ROLLER***

**SAKAI**



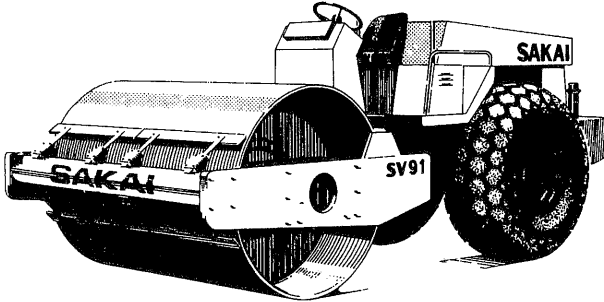
## FOREWORD

Built with the latest design, SAKAI SV91, SV91D & SV91T Vibration Rollers provide outstanding performances at the minimum operating costs.

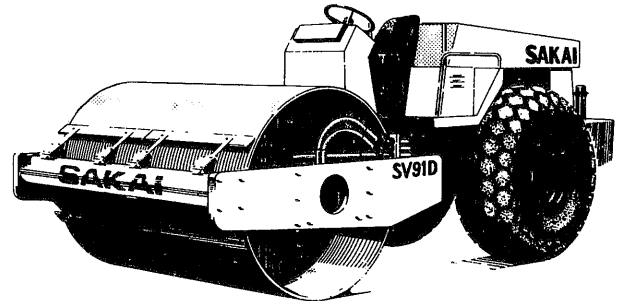
Proper maintenance operations are of vital importance to ensure continued reliability and performances.

Study this manual carefully to conduct correct and efficient service operations.

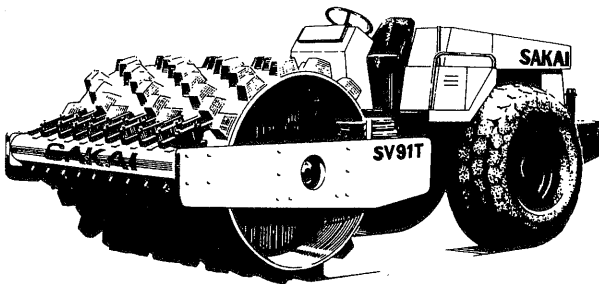
This manual is based on the data as of 1982.



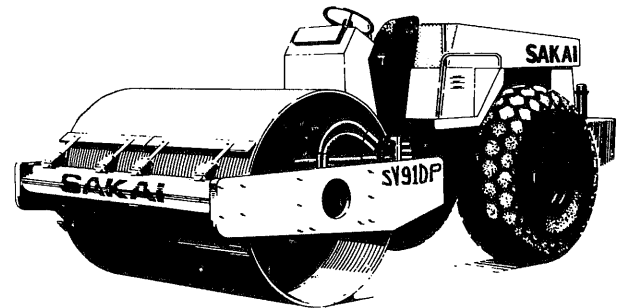
SV91



SV91D



SV91T



SV91DP





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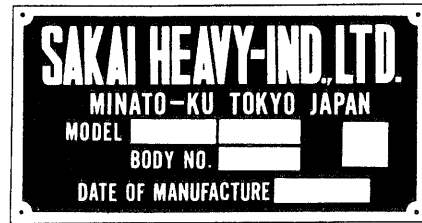
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# IDENTIFICATION NUMBERS

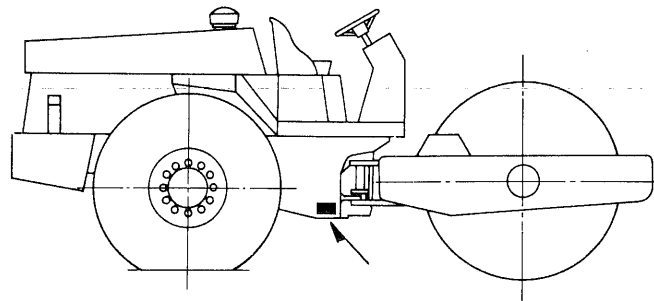
To order parts or in case of trouble, quote the following:

## 1. Month and year of manufacture

See on instrument panel.



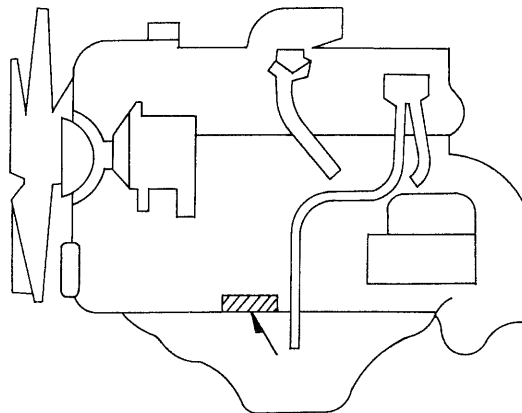
## 2. Chassis number



Location of chassis number    SV91-00000  
  SV91T-00000  
  SV91D-00000  
  ↑            ↑  
  MODEL    NUMBER

## 3. Engine number

Location of engine number    6BD1-00000  
  ↑            ↑  
  MODEL    NUMBER



## SPECIFICATIONS

Weight	SV91	SV91T	SV91D	SV91DP
Gross weight	9,800 kg	12,000 kg	10,300 kg	11,500 kg
Front wheel	5,100 kg	7,300 kg	5,600 kg	6,800 kg
Rear wheel	4,700 kg	4,700 kg	4,700 kg	4,700 kg

### Dimension

Overall length	5,450 mm	5,710 mm	5,450 mm	5,710 mm
Overall width	2,330 mm	2,340 mm	2,330 mm	2,340 mm
Overall height	2,970 mm	2,970 mm	2,970 mm	2,970 mm
Wheelbase	2,850 mm	2,970 mm	2,850 mm	2,970 mm
Ground clearance	440 mm	440 mm	440 mm	440 mm

### Performance

#### Travel speed (Forward & Reverse)

Low	1st	0 ~ 5 km/H	0 ~ 4 km/H	0 ~ 4 km/H	0 ~ 4 km/H
	2nd	0 ~ 7 km/H	0 ~ 7 km/H	0 ~ 5 km/H	0 ~ 7 km/H
	3rd	0 ~ 10 km/H	0 ~ 13 km/H	0 ~ 7 km/H	0 ~ 13 km/H
High	1st	0 ~ 14 km/H	—	0 ~ 9 km/H	—
	2nd	0 ~ 21 km/H	—	0 ~ 11 km/H	—
	3rd	0 ~ 28 km/H	—	0 ~ 13 km/H	—

#### Vibrator

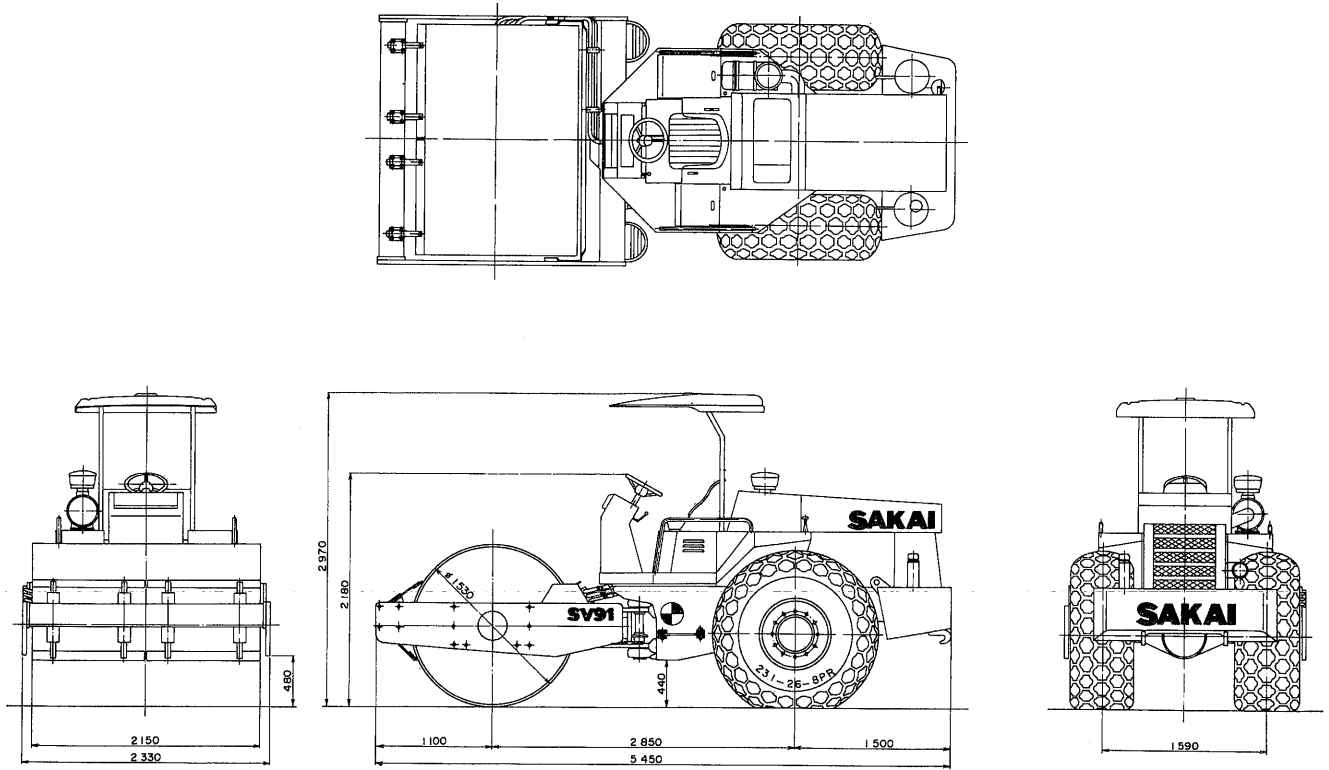
Low amplitude kg/vpm	1	8,500 / 1,700	15,000 / 1,300	8,500 / 1,700	6,400 / 1,300
	2	17,000 / 2,400	25,000 / 1,700	17,000 / 2,400	11,000 / 1,700
High amplitude kg/vpm	1	11,000 / 1,300	—	11,000 / 1,300	15,000 / 1,300
	2	21,000 / 1,800	—	21,000 / 1,800	25,000 / 1,700
Gradability		20 deg.	24 deg.	24 deg.	24 deg.
Turning radius		5.7 m	6.0 m	5.7 m	6.0 m

### Engine

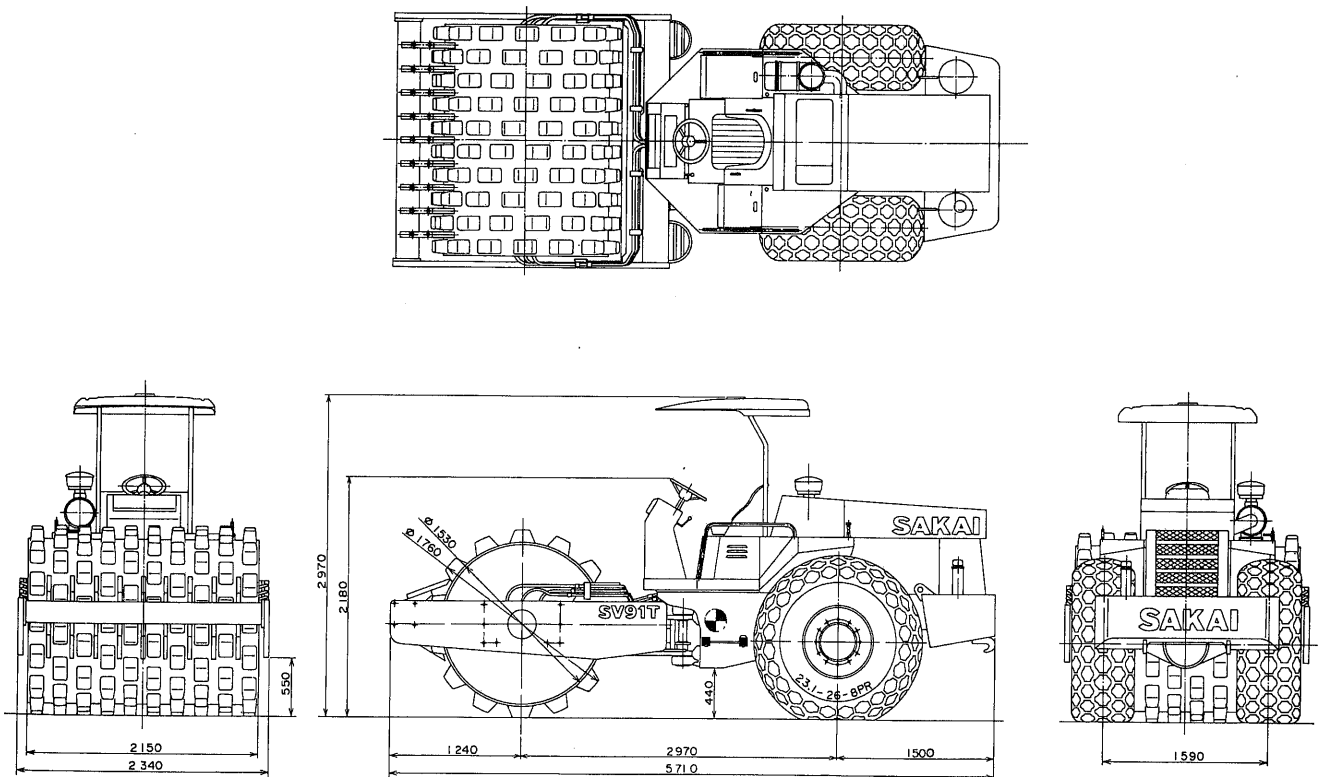
Model	ISUZU 6BD1 Diesel Engine
Type	4-cycle, water-cooled, overhead valve, in-line, direct injection type with turbo charger
Total displacement	5,785 cc
Rated output	133 ps / 2,200 rpm
Max. torque	46 kg·m / 1,600 rpm
Fuel consumption	175 g / PS·H / 2,200 rpm

# DIMENSIONS

(1) SV91

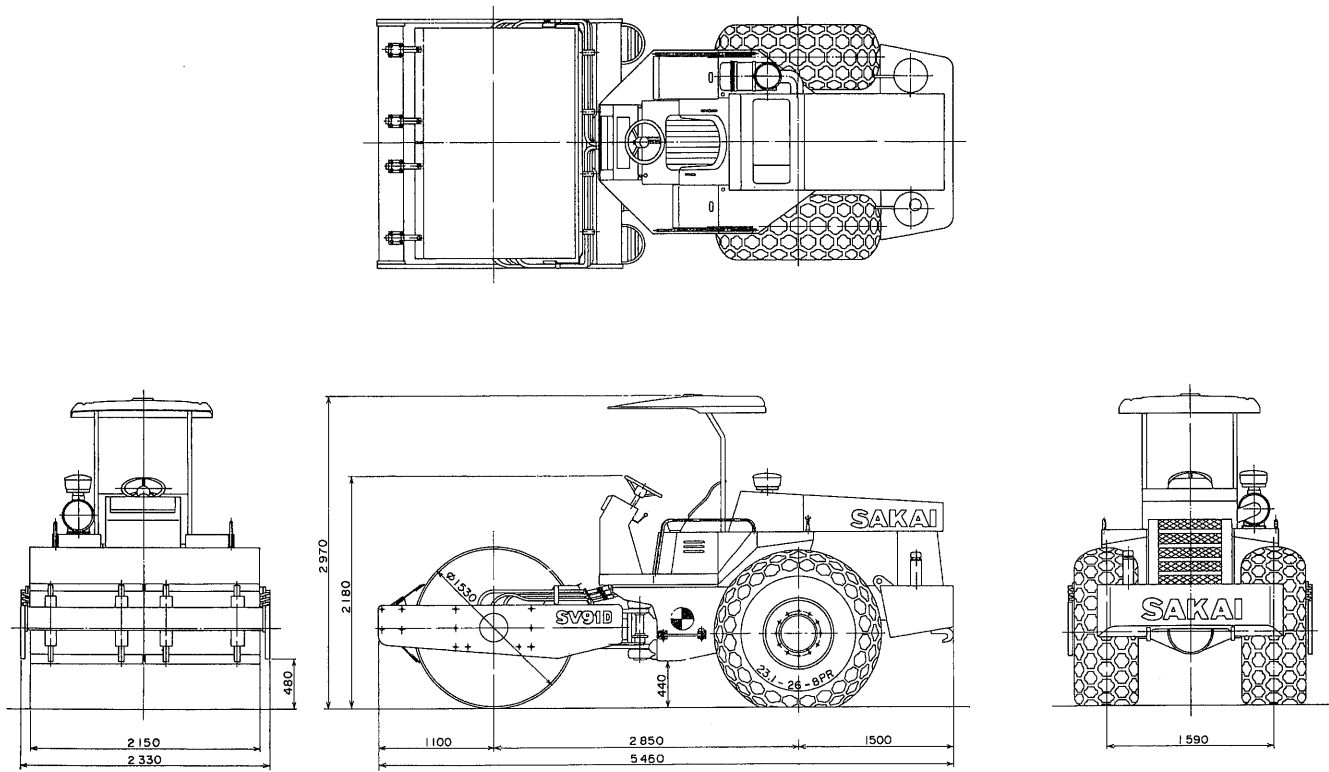


(2) SV91T

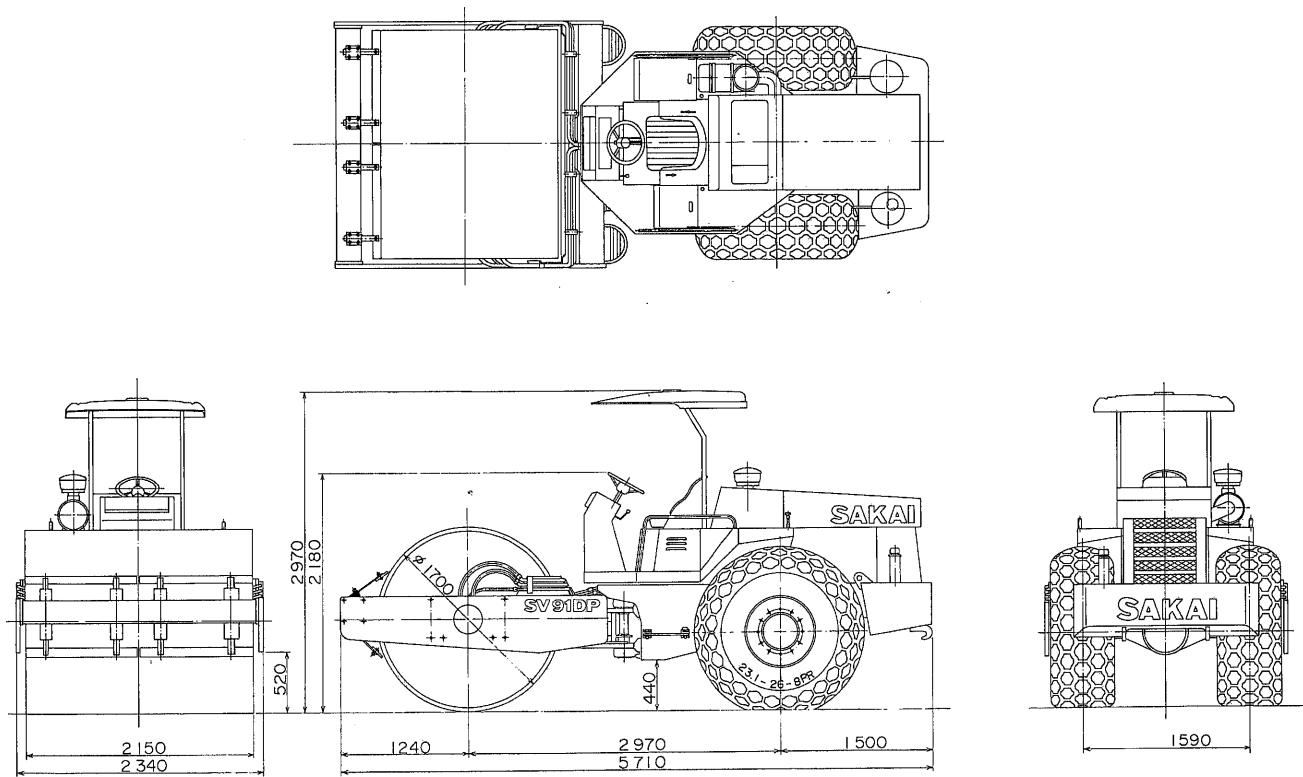




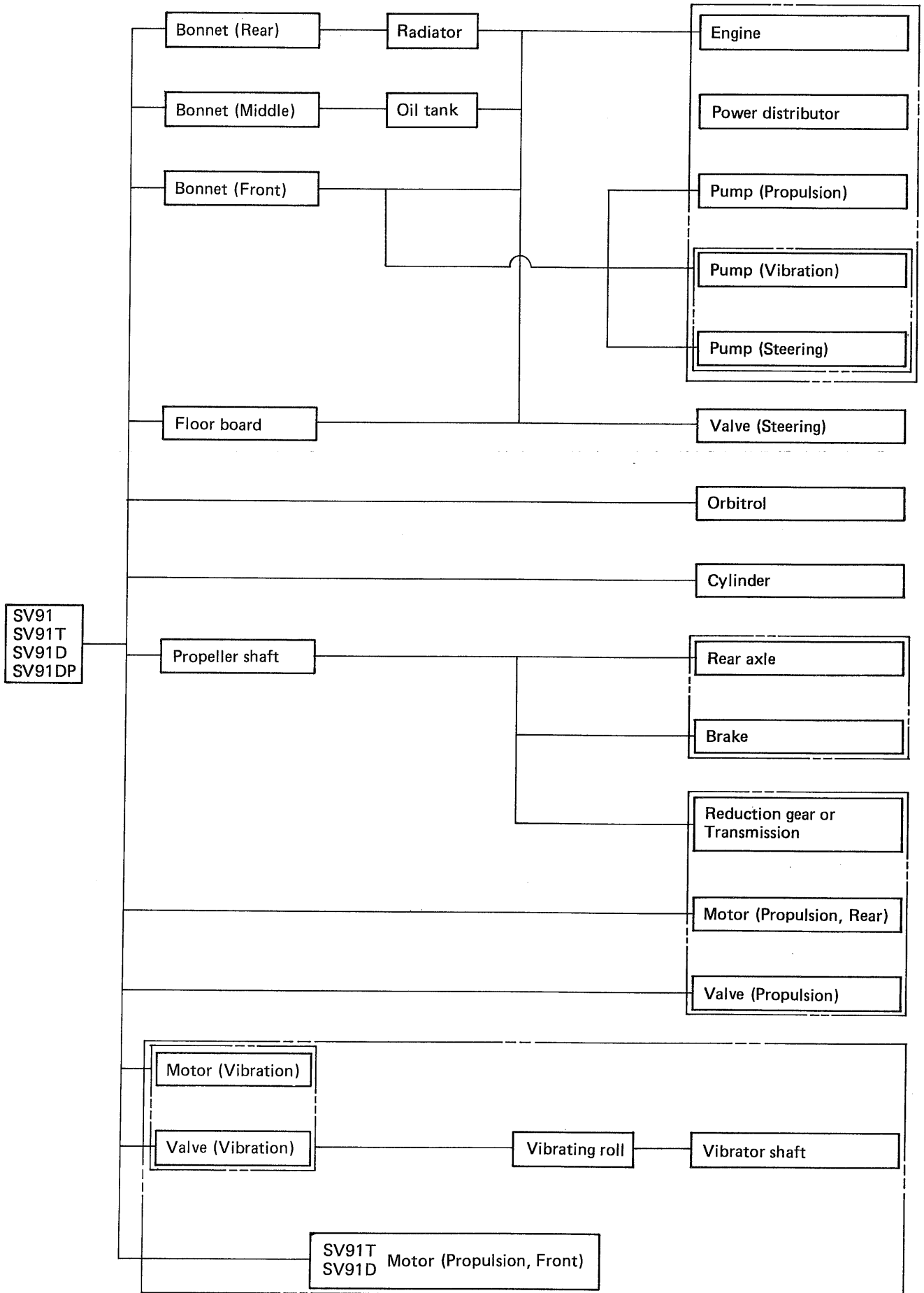
(3) SV91D



(4) SV91DP



✓ DISASSEMBLING CHART



## SERVICING PRECAUTIONS

Observe the following precautions to achieve maintenance properly.

### Preliminary steps

- (1) Wash Vehicle before disassembling.
- (2) Disassemble carefully after pinpointing faulty parts. Refer to disassembling chart to remove units in proper order. Any unit should not be removed unless it needs repair or replacement.

### Removal and disassembly

- (1) Close up openings of removed pipes, hoses and hydraulic devices with tape to keep out dust.
- (2) Make a matching mark on electric wires when disconnecting.
- (3) Inspect oil reservoirs for water and sediment. Do not reuse drained oil.
- (4) Clean each unit before proceeding to disassembly.

### Assembly and installation

- (1) Clean parts before reassembly or installation.
- (2) Apply grease or oil to the following parts when assembling:
  - 1) Fit of press-fitted part
  - 2) Oil seal lip and sealing surface
  - 3) Bearing and fit of bearing
- (3) Use liquid packing (LG-1) for the following:
  - 1) Bolts that secure cover to oil holding case.
  - 2) Fitting surfaces of cover and oil holding case.
  - 3) Oil seal periphery.
- (4) Make sure that bent end of lock plate is seated on a flat of screw.
- (5) Tighten bolts following torque charts unless otherwise specified.

**Bolt tightening torque standard**

with spring washer (Unit in kg-m)

Classification		4T		7T		9T		11T	
Tensile strength		30 kg/mm <sup>2</sup>		55 kg/mm <sup>2</sup>		70 kg/mm <sup>2</sup>		99 kg/mm <sup>2</sup>	
		min.	max.	min.	max.	min.	max.	min.	max.
Metric fine screw thread	M 8 x 1.0	1.3	1.5	2.3	2.9	3.1	3.7	4.3	5.3
	M10 x 1.25	2.6	3.2	4.8	5.8	5.9	7.3	8.5	10.3
	M12 x 1.25	4.6	5.6	8.5	10.3	10.8	13.2	15.3	18.7
	M14 x 1.5	7.3	8.9	13.2	16.2	16.9	20.7	23.9	29.2
	M16 x 1.5	11.0	13.4	20.1	24.5	25.6	31.2	36.1	44.1
	M18 x 1.5	15.9	19.5	29.2	35.6	37.1	45.3	52.4	64.0
	M20 x 1.5	22.1	27.1	40.6	49.6	51.7	63.1	73.1	89.3
	M22 x 1.5	29.6	36.2	54.3	66.3	69.0	84.4	97.7	119.4
	M24 x 2.0	37.5	45.9	68.7	83.9	87.4	106.8	123.7	151.1
	M27 x 2.0	54.9	67.1	100.7	123.1	128.2	156.6	181.3	221.5
	M30 x 2.0	76.6	93.6	140.5	171.7	178.7	218.5	252.8	309.0
Metric coarse screw thread	M 5 x 0.8	0.27	0.33	0.5	0.7	0.7	0.9	1.0	1.2
	M 6 x 1.0	0.5	0.7	0.9	1.1	1.2	1.4	1.7	2.1
	M 8 x 1.25	1.3	1.5	2.3	2.8	2.8	3.4	4.0	4.8
	M10 x 1.5	2.4	3.0	4.4	5.4	5.7	6.9	8.0	9.8
	M12 x 1.75	4.2	5.2	7.7	9.5	9.8	12.0	13.9	16.9
	M14 x 2.0	6.7	8.1	12.2	15.0	15.6	19.0	22.4	27.4
	M16 x 2.0	10.2	12.4	18.6	22.8	23.8	29.0	33.6	41.0
	M16 x 2.5	14.0	17.2	25.7	31.5	32.7	39.9	46.2	56.4
	M20 x 2.5	19.8	24.2	36.3	44.3	46.2	56.4	65.3	79.9
	M22 x 2.5	26.8	32.8	49.1	60.0	62.5	76.3	88.3	107.9
	M24 x 3.0	34.1	41.7	62.5	76.3	79.6	97.2	112.5	137.5
	M27 x 3.0	50.6	61.8	92.7	113.3	118.1	144.3	167.0	204.1
	M30 x 3.5	68.6	83.8	125.7	153.7	159.9	195.5	226.3	276.5

**Bolt tightening torque standard**

without spring washer (Unit in kg-m)

Classification		4T		7T		9T		11T	
Tensile strength		20 kg/mm <sup>2</sup>		55 kg/mm <sup>2</sup>		70 kg/mm <sup>2</sup>		99 kg/mm <sup>2</sup>	
		min.	max.	min.	max.	min.	max.	min.	max.
Metric fine screw thread	M 8 x 1.0	1.5	1.9	2.8	3.4	3.6	4.4	5.0	6.2
	M10 x 1.25	3.1	3.7	5.6	6.8	7.0	8.6	10.0	12.2
	M12 x 1.25	5.4	6.6	10.0	12.2	12.7	15.5	18.0	22.0
	M14 x 1.5	8.6	10.5	15.6	19.0	19.9	24.3	28.1	34.3
	M16 x 1.5	12.9	15.7	23.6	28.8	30.1	36.7	42.5	51.9
	M18 x 1.5	18.7	22.9	34.3	41.9	43.7	53.4	61.7	75.4
	M20 x 1.5	26.0	31.8	47.8	58.4	60.8	74.3	86.0	105.1
	M22 x 1.5	34.8	42.6	63.8	78.0	81.2	99.2	114.8	140.4
	M24 x 2.0	44.1	53.9	80.8	98.8	102.8	125.6	145.4	177.8
	M27 x 2.0	64.6	79.0	118.4	144.8	150.8	184.3	213.0	160.6
	M30 x 2.0	90.1	110.1	165.2	202.2	210.3	257.1	297.5	363.6
Metric coarse screw thread	M 5 x 0.8	0.36	0.44	0.6	0.8	0.8	1.0	1.2	1.4
	M 6 x 1.0	0.6	0.8	1.1	1.3	1.4	1.7	2.0	2.4
	M 8 x 1.25	1.4	1.8	2.6	3.2	3.3	4.1	4.7	5.7
	M10 x 1.5	2.9	3.5	5.2	6.4	6.7	8.1	9.5	11.6
	M12 x 1.75	5.0	6.1	9.1	11.1	11.5	14.1	16.3	19.9
	M14 x 2.0	7.8	9.6	14.4	17.6	18.3	22.3	25.8	31.6
	M16 x 2.0	12.0	14.6	22.0	26.8	28.0	34.2	39.5	48.3
	M18 x 2.5	16.5	20.1	30.2	37.0	38.4	47.0	54.4	66.4
	M20 x 2.5	23.3	28.5	42.7	52.1	54.4	66.4	76.9	93.9
	M22 x 2.5	31.5	38.5	57.7	70.5	73.4	89.8	103.9	126.9
	M24 x 3.0	40.1	49.1	73.5	89.9	93.6	114.4	132.4	161.8
	M27 x 3.0	59.5	72.7	109.1	133.3	138.9	169.7	196.4	240.0
	M30 x 3.5	80.6	89.6	247.9	180.7	188.2	230.0	266.2	325.4



# MAINTENANCE

**NOTE:** The circled numbers in the top figure under each chapter correspond to those in the figures that follow.

## 1. POWER DISTRIBUTOR

1.1	General .....	11
1.2	Trouble Shooting .....	12
1.3	Disassembly.....	12
1.4	Inspection .....	14
1.5	Reassembly .....	15

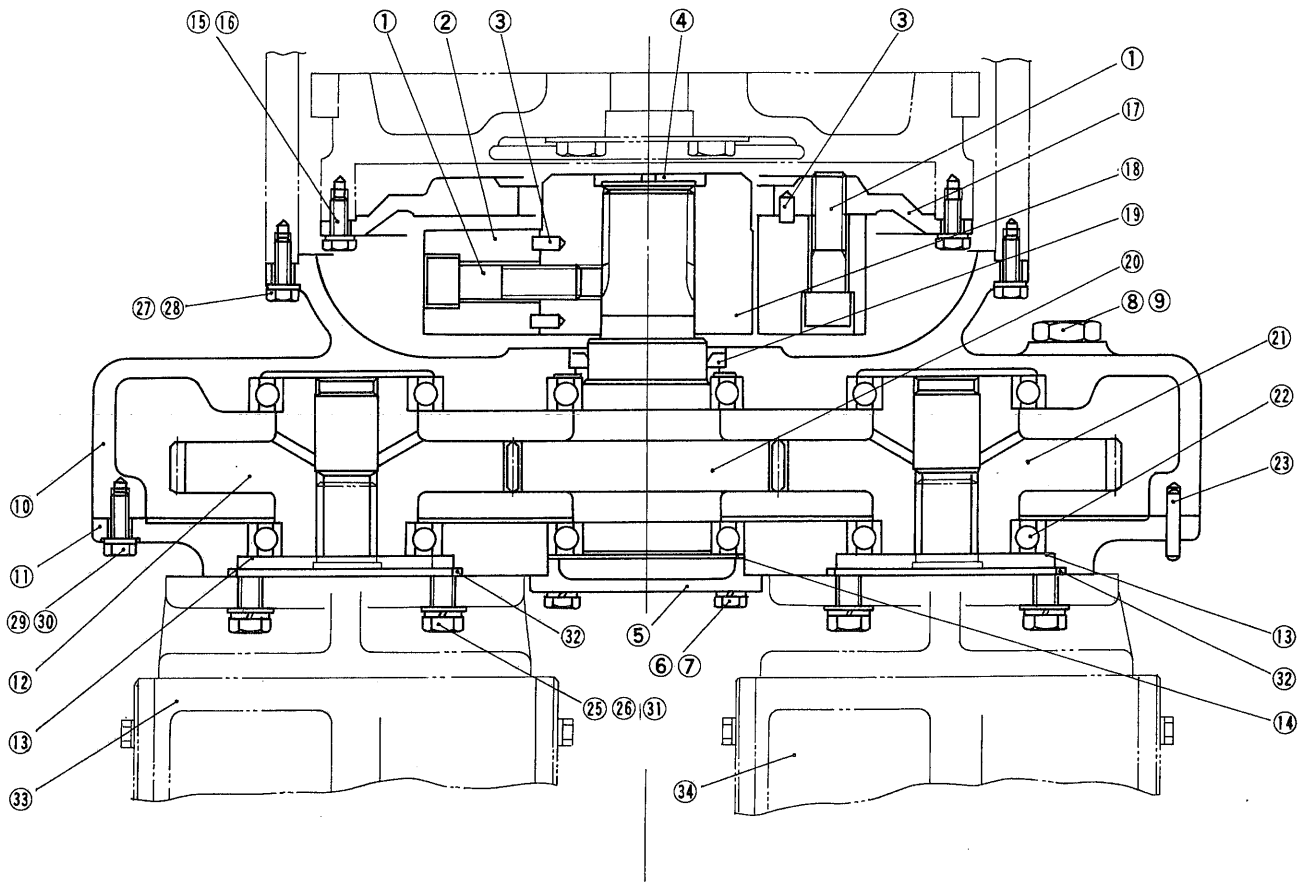
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# 1. ✓ POWER DISTRIBUTOR

## 1.1 General

Power distributor is of gear type, taking power of engine through flywheel and conveying it to propulsion and vibrator pumps. Distributor case is directly connected to clutch housing.



- |                  |                   |                   |
|------------------|-------------------|-------------------|
| 1. Bolt          | 13. Shim          | 24. Air breather  |
| 2. Coupling      | 14. Shim          | 25. Bolt          |
| 3. Spring pin    | 15. Spring washer | 26. Spring washer |
| 4. Cover         | 16. Bolt          | 27. Bolt          |
| 5. Cover         | 17. Disc          | 28. Spring washer |
| 6. Spring washer | 18. Boss          | 29. Bolt          |
| 7. Bolt          | 19. Oil seal      | 30. Spring washer |
| 8. O-ring        | 20. Gear          | 31. Washer        |
| 9. Plug          | 21. Gear          | 32. O-ring        |
| 10. Case         | 22. Ball bearing  | 33. Pump          |
| 11. Cover        | 23. Taper pin     | 34. Pump          |
| 12. Gear         |                   |                   |

Fig. 1

## 1.2 Trouble Shooting

Trouble	Cause	Remedy
Abnormal sounds	1. Insufficient or dirty lubricant. 2. Gears, bearings or splines worn or broken.	Add or replace. Replace.
Oil leaks	1. Oil seals defective. 2. Covers loosely installed.	Replace. Tighten.
Overheating	1. Insufficient or dirty lubricant. 2. Bearings worn or broken.	Add or replace. Repalce.

## 1.3 Disassembly

- (1) Remove bolts ① that secure power distributor to engine, and separate power distributor from engine. (Fig. 2)



Fig. 2

- (2) Remove bolts ① and dismount propulsion and vibrator pumps. (Fig. 3)



Fig. 3

- (3) Remove bolts ① and remove cover ②. (Fig. 4)

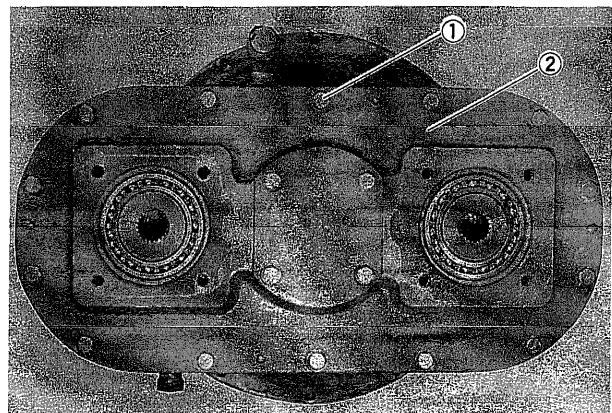


Fig. 4

- (4) Take out all gears from case. Separate bearings from gears using a puller.
- (5) Remove oils seals from each case.
- (6) Remove bolts (16), disc (17), coupling (2) as one body. (Fig. 5)

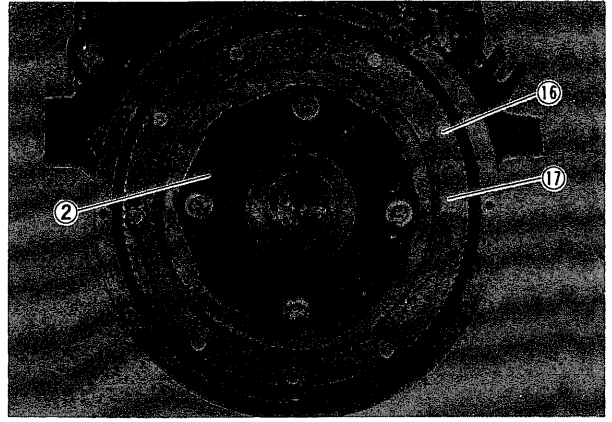


Fig. 5

- (7) Remove bolts (1) and separate disc (17) from coupling (2). Be careful not to lose positioning pin. (Fig. 6)

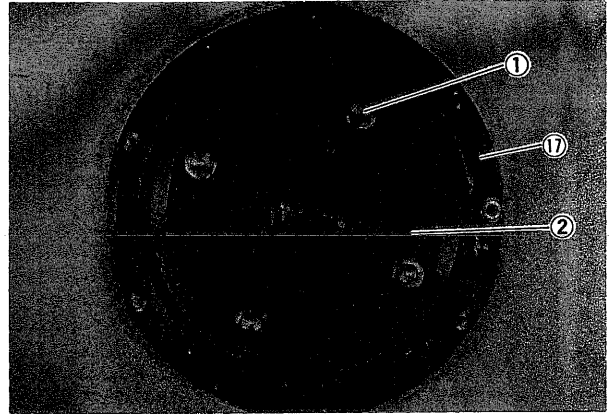


Fig. 6

- (8) Remove bolts and separate coupling (2) from boss (18). Be careful not to lose positioning pin (3). (Fig. 7)

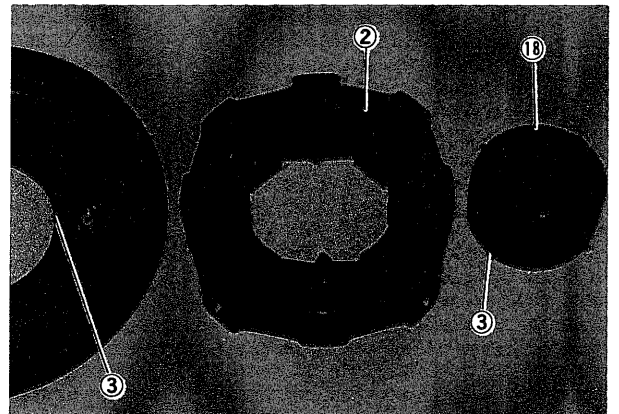


Fig. 7



## 1.4 Inspection

### (1) Gear

Check gears for wear and damage. Measure distance across given teeth of each gear using vernier calipers. Replace gears if found to be damaged or measured values are beyond service limit (Fig. 8).

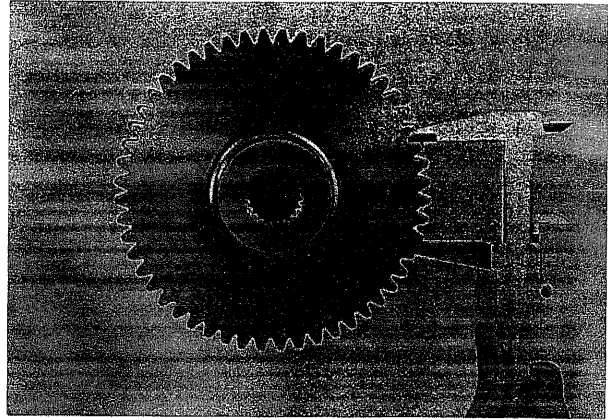


Fig. 8

Parts	Given teeth	Standard value	Limit for use
Gears 12 , 21 (1704-29005-0)	6	67.69 mm	67.29 mm
Gear 20 (1520-29003-0)	5	55.32 mm	54.92 mm

### (2) Splines

Check splines and replace if marked dent or wear is noticeable.

Assemble shaft into gear and determine play in rotating direction at outer edge of gear. If measured values are in excess of limit for use, replace the shaft and gear as a set (Fig. 9).

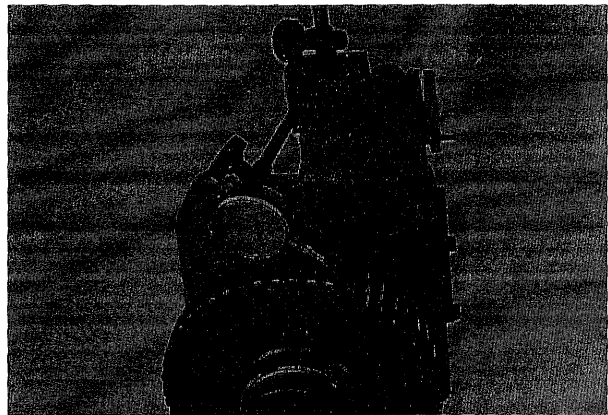


Fig. 9

Parts	Standard value	Limit for use
Gear 20 (1520-29003-0) and boss 18 (1520-29002-0)	0.121 ~ 0.298 mm	0.745 mm
Gear 12 (1704-29005-0) and pump 33 (4205-01000-0)	0.043 ~ 0.538 mm	2.156 mm
Gear 21 (1704-29005-0) and pump 34 (4202-28000-0)	0.043 ~ 0.538 mm	2.156 mm

## 1.5 Reassembly

Reverse disassembly procedure noting the following:

- (1) Install spring pins (3), when installing coupling (2) to boss (18) and disc (17). Tighten coupling mounting bolts (1) to 50 kg-m.

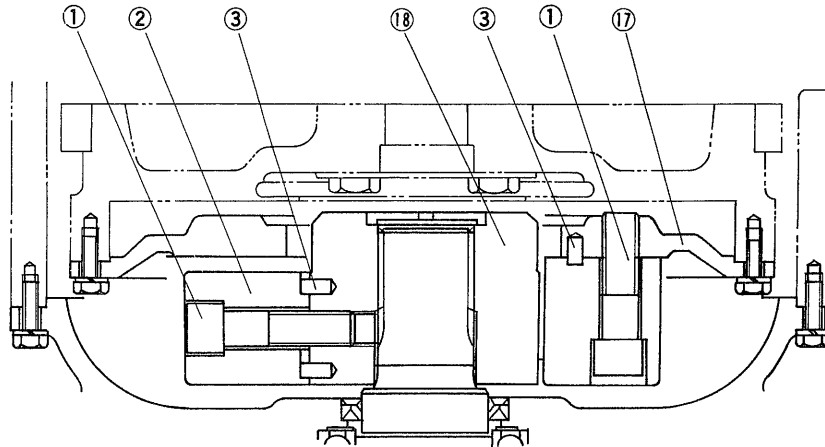


Fig. 10

- (2) Apply molybdenum disulfide grease on mating surfaces between gear No. 1 and boss.
- (3) When installing pumps and bearing cover to case, allow a clearance (A) of 0.2 to 0.3 mm between fitting surfaces of pumps and bearing outer races, and also of cover and bearing outer race by placing proper amount of shims. (Fig. 11)

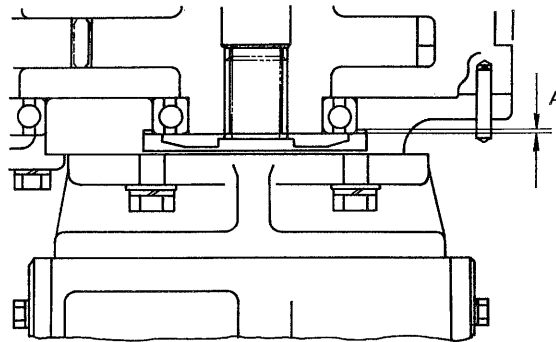


Fig. 11

- (4) Refill capacity of power distributor is 2.0 liters. Remove level plug and check that fluid is at lower brink of level plug hole. (Fig. 12)

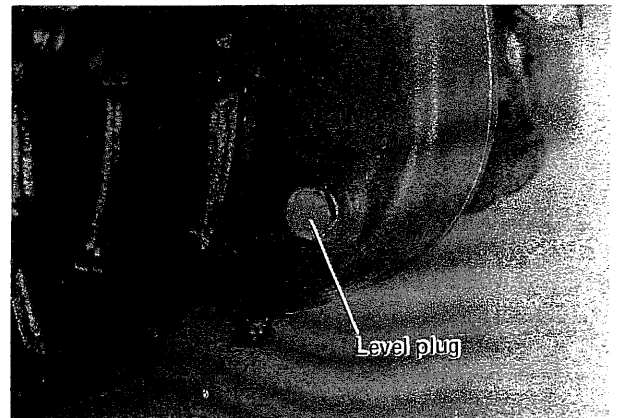


Fig. 12



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## 2. HYDROSTATIC TRANSMISSION (PROPULSION)

2.1	General .....	19
2.2	Trouble Shooting .....	20
2.3	Inspection .....	23
2.4	Maintenance .....	24
2.4.1	Hydraulic pump .....	24
2.4.2	Hydraulic motor .....	26





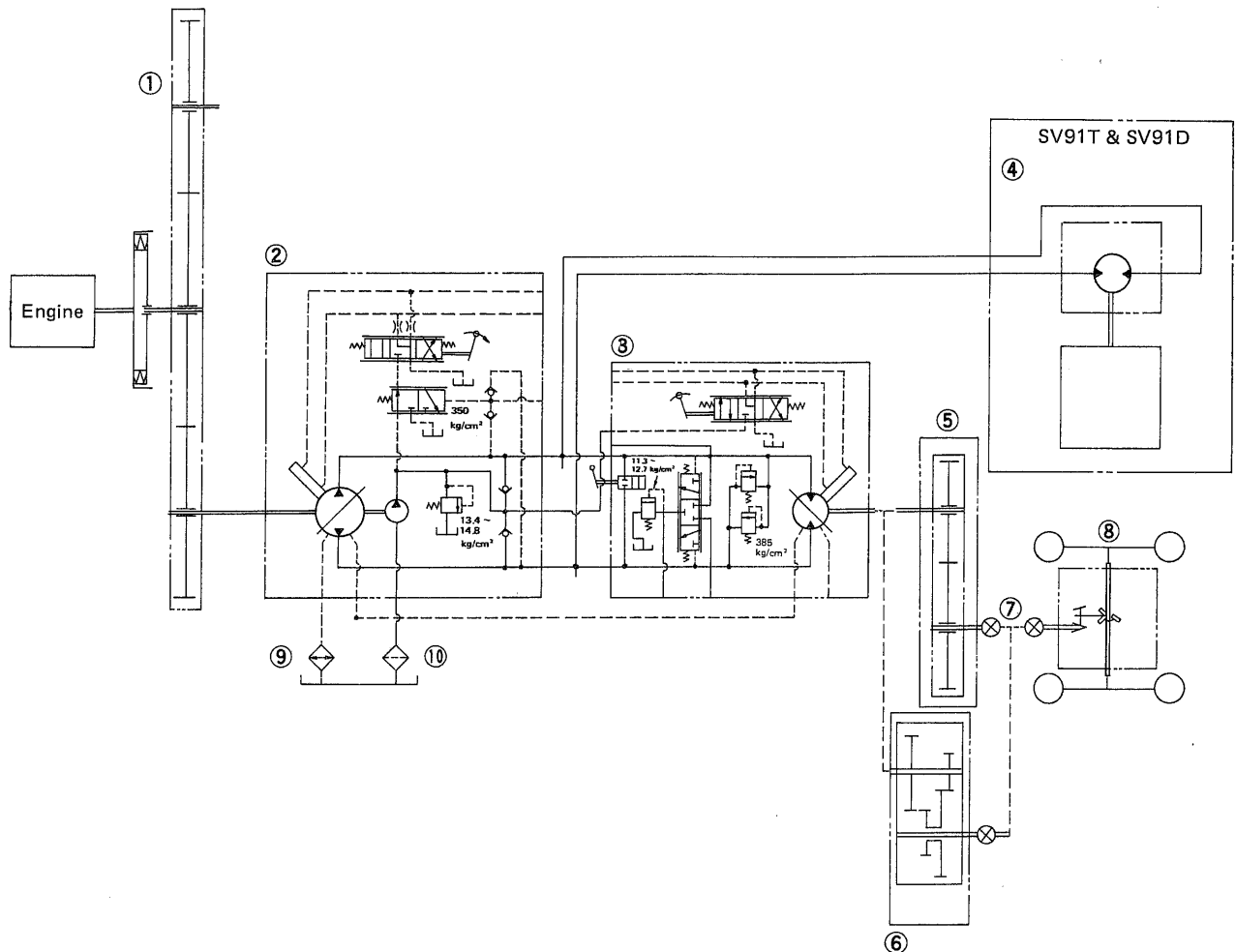
## ✓ 2. HYDROSTATIC TRANSMISSION (PROPULSION)

### 2.1 General

Propulsion line utilizes a hydrostatic transmission consisting of a variable displacement pump mounted on power distributor and variable displacement motor on reduction gear. The transmission provides three speed ranges by changing displacement of motor in three steps.

Within each range, speed is steplessly changeable by operation of F-R lever.

Travel direction is changed by changing direction of oil flow in pump.



- |                                    |                                |
|------------------------------------|--------------------------------|
| 1. Power distributor               | 6. Transmission (SV91 & SV91D) |
| 2. Pump                            | 7. Propeller shaft             |
| 3. Motor (rear axle)               | 8. Rear axle assembly          |
| 4. Motor (front axle)              | 9. Oil cooler                  |
| 5. Reduction gear (SV91T & SV91DP) | 10. Suction filter             |

Fig. 13

## 2.2 Trouble Shooting

### (1) Machine would not travel (Motor shaft not rotating).

Trouble	Cause	Remedy
Pump input shaft not rotating.	Coupling defective.	Replace.
	Insufficient hydraulic fluid.	Add.
Charge pump not sucking fluid.	See below.	To check, loosen inlet connection.
Charge pressure almost zero.	Charge pump or charge relief valve (pump side) faulty.	Clean or replace charge pump or charge relief valve.
Charge pressure is above 9 kg/cm <sup>2</sup> with F-R lever in neutral, decreasing when F-R lever is operated.	Charge relief valve (motor side) faulty.	Clean or replace.
Charge pressure fluctuating.	Air getting into suction line between hydraulic reservoir and charge pump inlet.	Tighten connections.
Charge pressure is stable remains constant irrespective of F-R lever operation.	Linkage from pump to F-R lever incorrectly adjusted.	Adjust.

**NOTE:** If Machine still would not travel despite of above corrective measures taken, pump will be defective. Replace pump.

### (2) Motor lacks power

Trouble	Cause	Remedy
Fluid pressure builds up but motor would not gain speed.	Motor faulty.	Check motor, replace if necessary (Measure pressure at manifold valve gauge port).
Motor runs at high speed but fluid pressure in high pressure line is low.	Pump faulty.	Check pump, replace if necessary (Measure pressure as above).
Fluid pressure in low pressure line is high.	Relief valve faulty.	Replace (Measure pressure as above).

**(3) Motor runs in one direction only.**

Trouble	Cause	Remedy
	Linkage from F-R lever to pump incorrectly adjusted.	Adjust.
	Linkage from control valve to pump disconnected.	Connect.
	Control valve defective.	Replace.
	Neutral positioning spring (inside control valve) defective.	Replace control valve.
	One of high pressure relief valves malfunctioning.	Exchange two relief valves one another and see motor runs in another direction: If so, replace relief valve.
	Shuttle valve is sticking.	Remove shuttle valve and check. If faulty, replace manifold ass'y.
	Check valve is malfunctioning.	Demount charge pump, exchange check valves one another and see if motor runs in opposite direction. If so, replace check valve.

**(4) F-R lever neutral position fluctuates.**

Trouble	Cause	Remedy
	Linkage from F-R lever to pump incorrectly adjusted.	Disconnect linkage, check and adjust.
Little resistance in moving F-R lever.	Linkage from control lever to pump disconnected.	Connect.
	Neutral position controlling spring (inside control valve) defective.	Replace control valve ass'y.
Control lever would not return to neutral.	Control valve defective.	Replace control valve.
	Pump is defective (Faulty condition remaining after correcting control valve and linkage.)	Replace.

**(5) Hydraulic fluid too hot.**

Trouble	Cause	Remedy
	Insufficient hydraulic fluid.	Add.
	Oil cooler clogged.	Clean.
	Filter clogged.	Replace element.
	Restricted flow in suction line.	Correct or replace suction line.
	High pressure relief valve remaining open.	Exchange two relief valves each other and see if relief pressure changes. If so, replace relief valve.

**(6) Pump and motor noisy.**

Trouble	Cause	Remedy
	Insufficient hydraulic fluid.	Add.
	Air in fluid	Tighten connections between hydraulic reservoir and charge pump inlet.
	Charge pump mounting bolts loosened.	Tighten.
	Pump or motors defective. See item (2), "Motor lacks power".	Repalce.
	Relief valve in charge line hunting.	Repalce.

**(7) Poor acceleration or deceleration.**

Trouble	Cause	Remedy
Machine responds poorly to F-R lever operation.	Control orifice clogged.	Repalce.
	Pump defective.	Replace pump.
	Linkage from F-R lever to pump incorrectly adjusted.	See item (3), "Motor runs one direCTIONS only".
	Linkage from F-R lever to pump disconnected.	Ditto.
	Control valve defective.	Ditto.
	Neutral positioning spring defective.	Ditto.

**(8) Others**

Trouble	Cause	Remedy
Oil leaking past oil seals.	Pressure inside motor case too high.	Repair restriction in oil lines.
	Mechanical seal damaged.	Repalce.
Metal particles in hydraulic fluid.	Pump or motors defective (noisy).	Replace pump or motors.

## 2.3 Inspection

### (1) Hydraulic pump

For trouble shooting, inspect hydraulic pump for the following items. (Fig. 14)

Checking item	Standard value
Delivery (max.)	69.8 cc/rev.
Charge relief valve opening pressure	13.4 – 14.8 kg/cm <sup>2</sup>
Rated pressure	350 kg/cm <sup>2</sup>
Maximum pressure inside casing	2.8 kg/cm <sup>2</sup>
Rated flow through check valve	37.8 lit./min.
Charge pump delivery	18.0 cc/rev.

A: Delivery pressure gage port

B: Charge pressure gage port

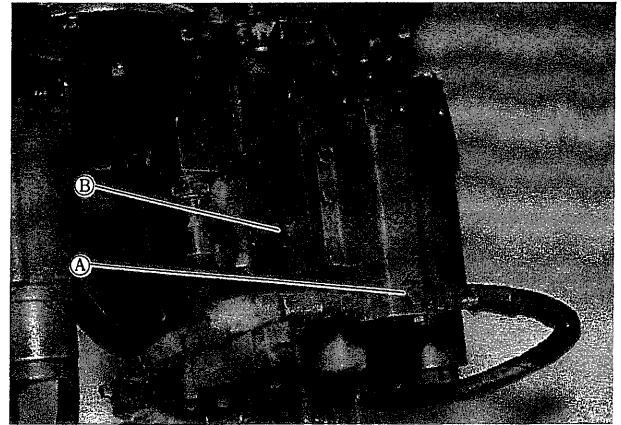


Fig. 14

### (2) Hydraulic motor

For trouble shooting, check hydraulic motors for the items below as required. (Fig. 15)

Checking item	Standard value
Propulsion motor delivery	89.0 cc/rev.
Vibrator motor delivery	33.6 cc/rev.
Charge relief valve opening pressure	11.3 – 12.7 kg/cm <sup>2</sup>
High pressure relief valve opening pressure	385 kg/cm <sup>2</sup>
Maximum pressure inside casing	2.8 kg/cm <sup>2</sup>

A: High pressure gage ports (7/16-20UNF-2B O-ring boss)

B: Charge pressure gage port (7/16-20UNF-2B O-ring boss)

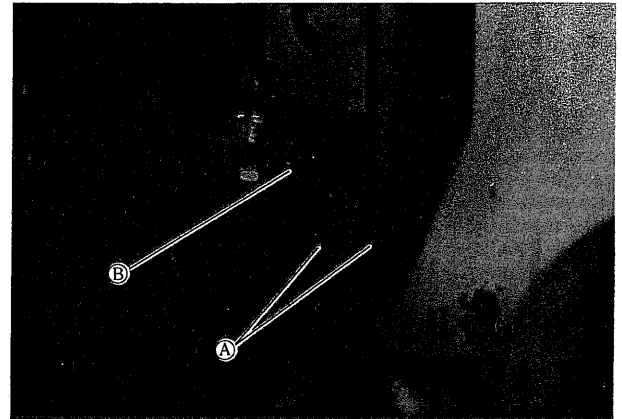


Fig. 15

**NOTE:** The highest pressure, if measured at ports (A), is limited to 350 kg/cm<sup>2</sup>.

## 2.4 Maintenance

### 2.4.1 Hydraulic pump

#### (1) Disassembly

For disassembly, refer to shop manual "HYDRAULIC PUMP & MOTOR" furnished separately. However, for charge pump mounted on vibration pump, follow procedure described below:

- 1) Dismount steering pump
- 2) Remove bolts ① using a hex wrench, and demount charge pump assembly ②. (Fig. 16)

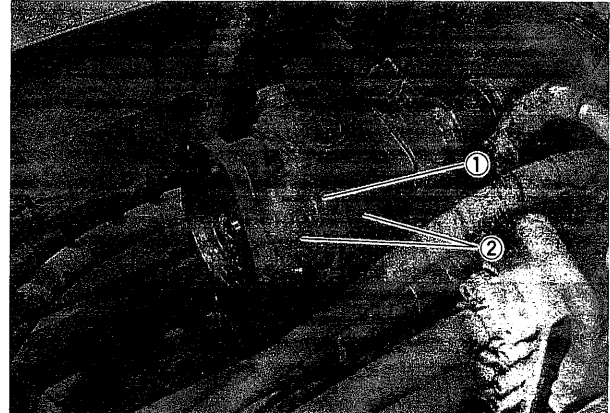


Fig. 16

- 3) Remove bolts ① and ② using a hex. wrench, and separate valve body ③ from pump body ④. (Fig. 17)

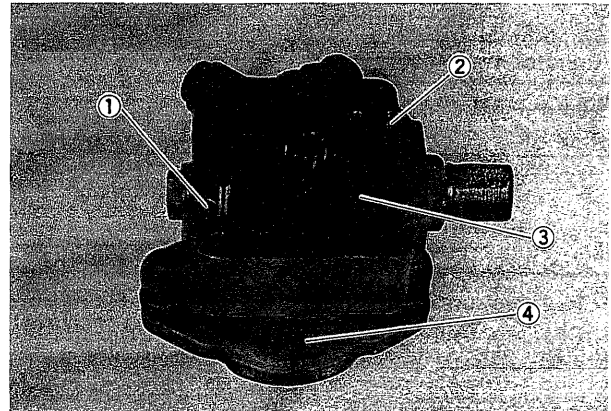


Fig. 17

- 4) Pull off pump shaft ② from pump body ①. Then take out outer rotor ③ and bearing ④. (Fig. 18)

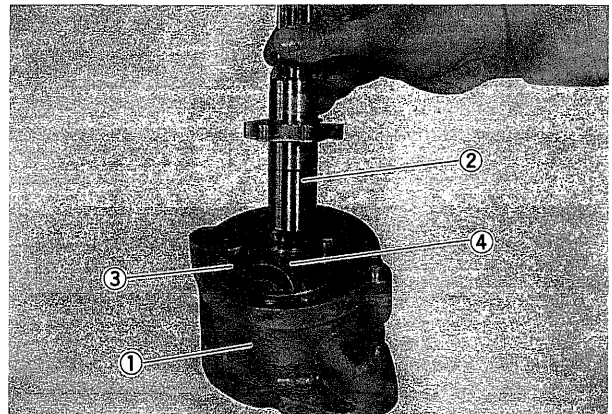


Fig. 18

- 5) Remove charge relief valve (2) from valve body (1). (Fig. 19)

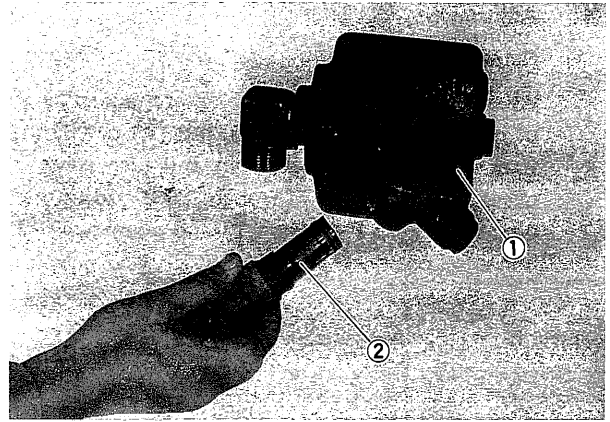


Fig. 19

- 6) Take off cap (1) and pull off spring (2) and valve (3) from valve body (4). (Fig. 20)

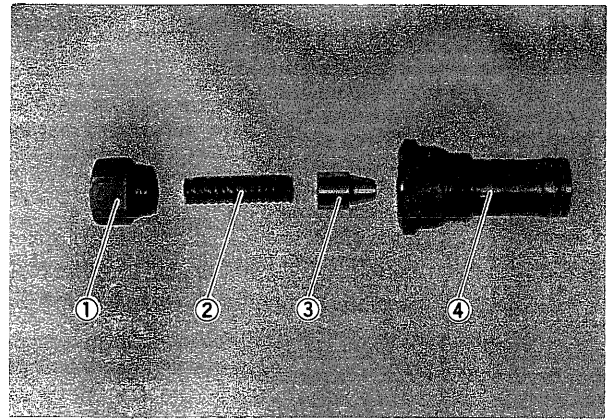


Fig. 20

## (2) Inspection

- 1) Sliding surface between piston and cylinder block

Inspect cylinder block inner surface and piston outer surface for damage and abnormal wear. If found to be defective, replace cylinder block kit or pump assembly.

**CAUTION:** Even slight scores can cause marked performance reduction, since hydraulic pressure applied is high.

- 2) Sliding surface of valve plate

Check valve plate sliding surface for damage and abnormal wear. If defective, replace cylinder block kit or pump assembly.

- 3) Charge relief valve and check valve

Check seating portion of each valve. Replace if damaged or excessive wear is noticed. Also check if functions smoothly.

## (3) Reassembly

For assembly, reverse disassembly procedure. To assemble pump, see shop manual "HYDRAULIC PUMP & MOTOR."

**CAUTION:** To mount pump to power distributor, adjust mounting location by inserting shims. Refer to 1.5-(3) on page 15.

#### (4) Adjustment

##### 1) Neutral position

When pump installation is complete, adjust length of rod (3). To adjust, loosen nut (4) or (5) that fixes clevis, remove clevis pin and turn clevis by necessary amount. Through the adjustment procedure, keep F-R lever (2) and pump lever (1) in neutral position. (Fig. 21)

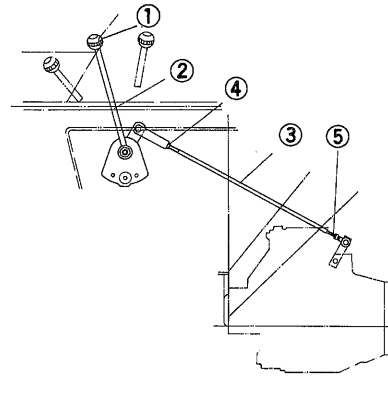


Fig. 21

#### 2.4.2 Motor

##### (1) Disassembly

For disassembling of front roll drive motor and rear wheel drive motor, refer to shop manuals "HYDRAULIC MOTOR No. 2" and "HYDRAULIC PUMP & MOTOR" respectively.

##### (2) Inspection

###### 1) Sliding surfaces between cylinder block and piston

Check cylinder block inner surface and piston outer surface. If scores or abnormal wear is found, replace cylinder block kit or motor assembly.

Even a slight score will cause marked decline of performance, since motors are subjected to high pressure.

###### 2) Valve plate sliding surface

Inspect valve plate sliding surface. Replace cylinder block kit or motor assembly if scores or abnormal wear is noticeable.

###### 3) High pressure relief valve

Check high pressure relief valve for worn or dented valve seat and for fatigued spring. Excessive wear or damage is noticed, replace the high pressure relief valve assembly. (Fig. 22).

This valve is non-adjustable type. Replace, therefore, valve assembly if it is in disorder.

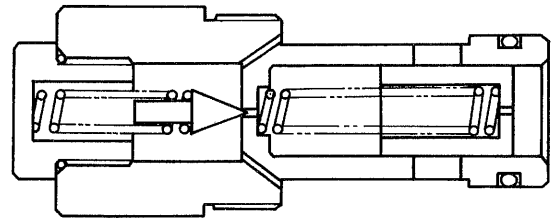


Fig. 22

###### 4) Shuttle valve

Examine shuttle valve for worn or damaged sliding surface and for fatigued spring. Replace manifold valve assembly with excessive wear or damage. (Fig. 23)

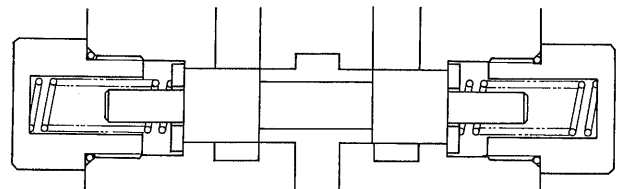


Fig. 23



5) Charge relief valve

Examine charge relief valve for damaged or dented seating portion or for fatigued spring. If abnormal, replace manifold assembly. (Fig. 24)

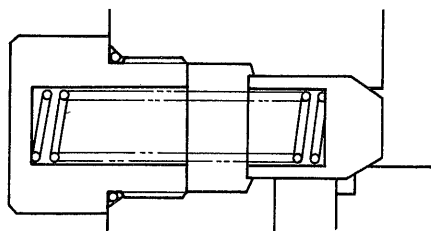


Fig. 24

6) Bypass valve (Unload valve)

Check sliding surface for scores or wear. Replace the valve assembly if marked scores or abnormal wear are noticeable. (Fig. 25)

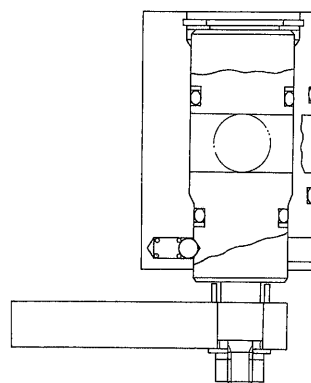


Fig. 25

(3) Reassembly

Reverse disassembly procedure referring to shop manual "HYDRAULIC PUMP & MOTOR" furnished separately. When replacing high pressure relief valve with new one, note valve opening pressure scribed on top of the valve. (Fig. 26)

Valve opening pressure for SV91D/T: scribed number 55 (385 kg/cm<sup>2</sup>)

Scribed No.	Valve opening pressure	
	PSI	kg/cm <sup>2</sup>
55	5,500	385
50	5,000	350
45	4,500	315
40	4,000	280

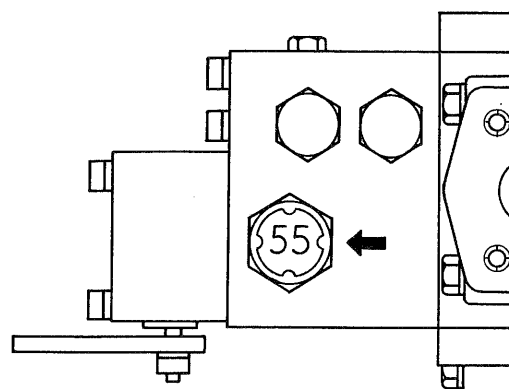


Fig. 26

(4) Adjustment

1) Neutral position

Determine neutral position of F-R lever (2) by adjusting length of rod (3). Let F-R lever (2) and motor lever (1) remain in neutral position. Loosen lock nut (4) or (5), remove clevispin and rotate clevis as needed. (Fig. 27)

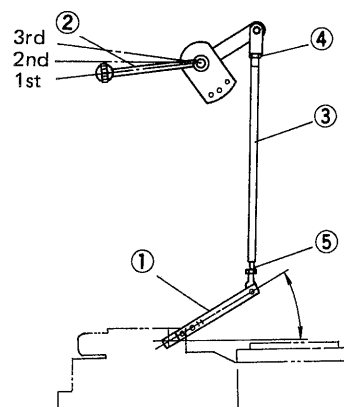


Fig. 27



### 3. REDUCTION GEAR

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### 3. REDUCTION GEAR (SV91T & SV91DP)

#### 3.1 General

Reduction gear is for only SV91T and SV91DP. SV91 and SV91D are equipped with a 2 speed, mechanical transmission instead. Reduction gear is of spur gear type providing proper speed reduction after hydraulic transmission. On input side is mounted a variable displacement hydraulic motor. On output side is mounted propeller shaft.

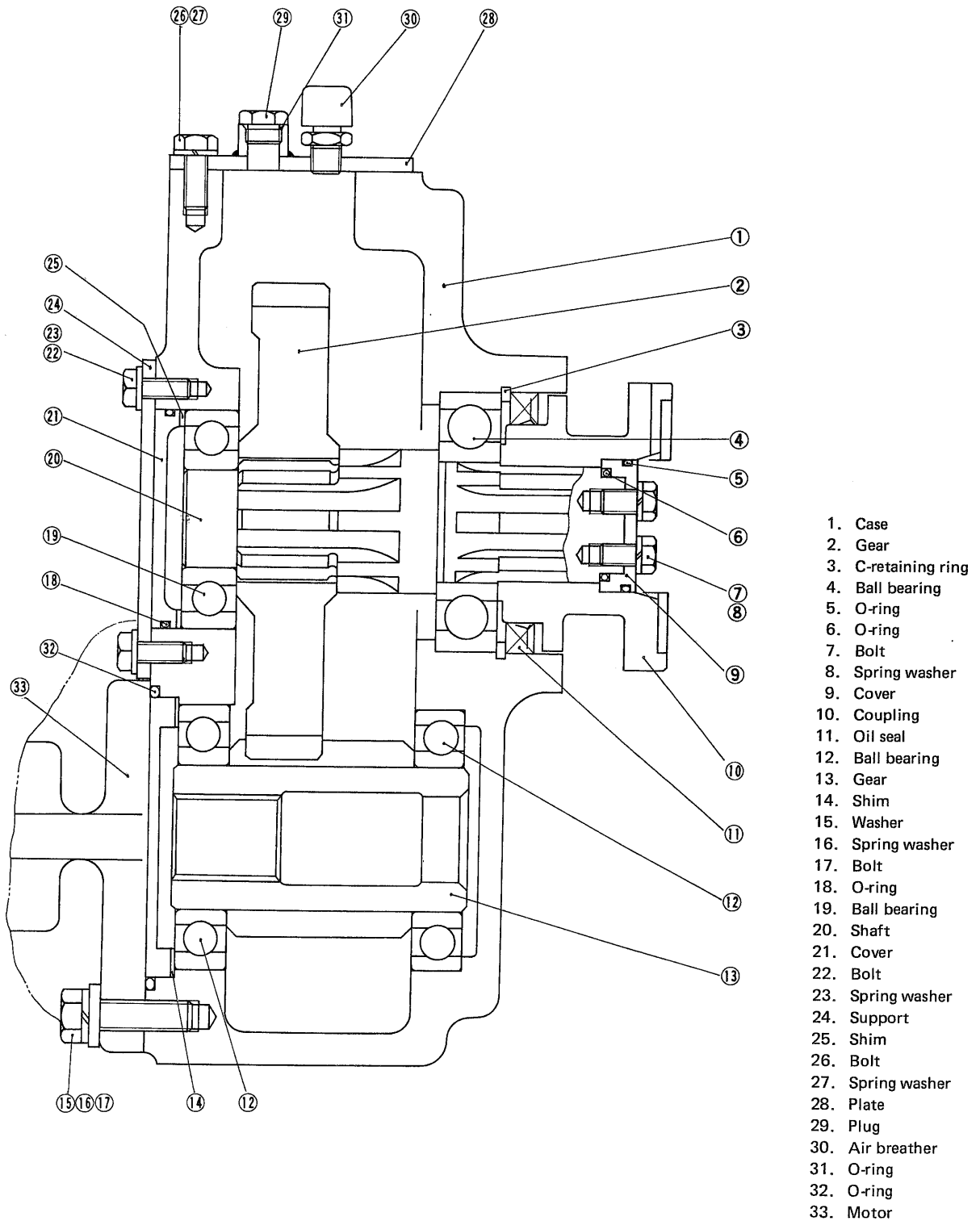


Fig. 28

### 3.2 Trouble Shooting

Trouble	Cause	Remedy
Unusual sounds.	1. Insufficient or deteriorated lubricant. 2. Gear teeth, bearings or splines worn or damaged.	Add or change. Correct or replace.
Oil leakage.	1. Oil seal defective. 2. Loose bolts or worn surface where seal is in contact.	Replace. Tighten or correct.
Overheating.	1. Insufficient or deteriorated lubricant. 2. Bearings damaged or worn.	Add or replace. Replace.
Oil spouting out from air breather.	1. Excessive lubricant.	Correct to proper level.

### 3.3 Disassembly

- (1) Remove bolts (17) and dismount motor.

**CAUTION:**

Be careful not to lose shims. (Fig. 29)

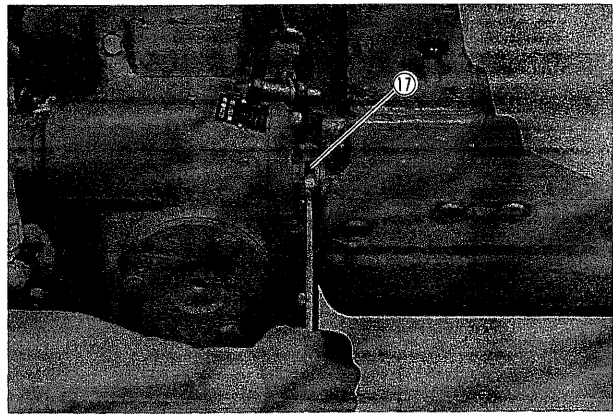


Fig. 29

- (2) Remove bolts (26) and remove plate (28).  
(Fig. 30)

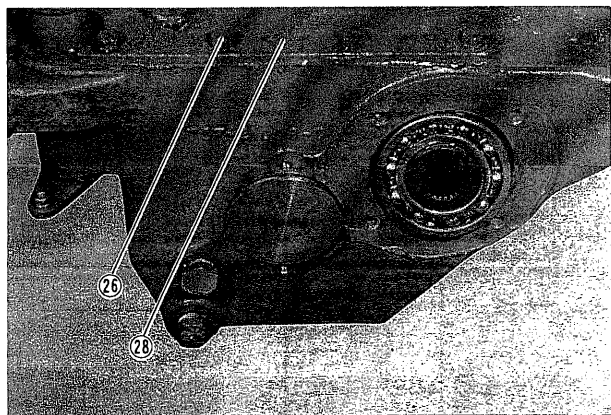


Fig. 30

- (3) Remove bolts (7) and take off cover (9) and pull off coupling (10). (Fig. 31)

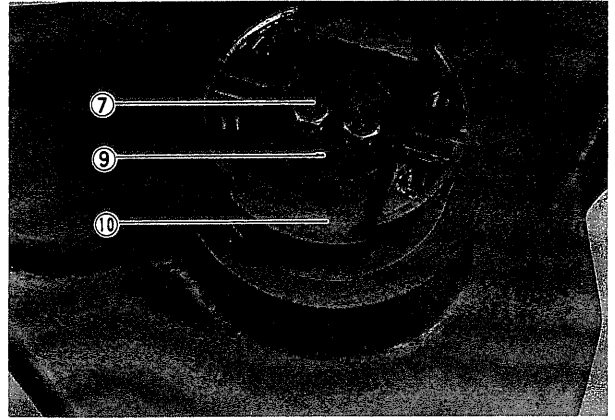


Fig. 31

- (4) Remove bolts (22) and remove support (24). (Fig. 32)

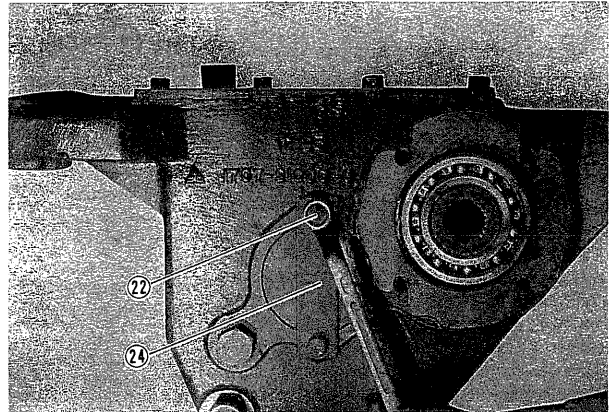


Fig. 32

- (5) Take off oil seal (11) and retaining ring (3). (Fig. 33)

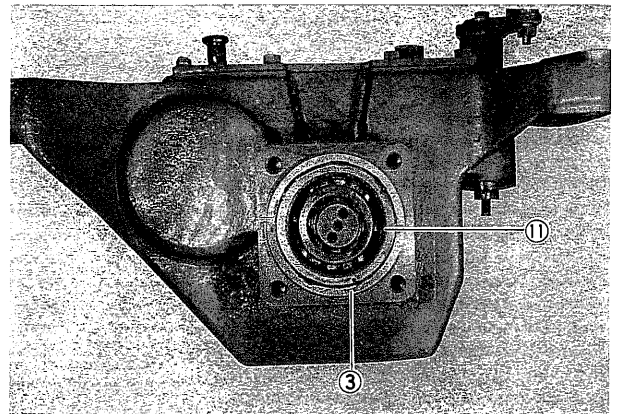


Fig. 33

- (6) Put shaft (20) into case (1) from coupling side and push off cover (21). (Fig. 28, Fig. 34)

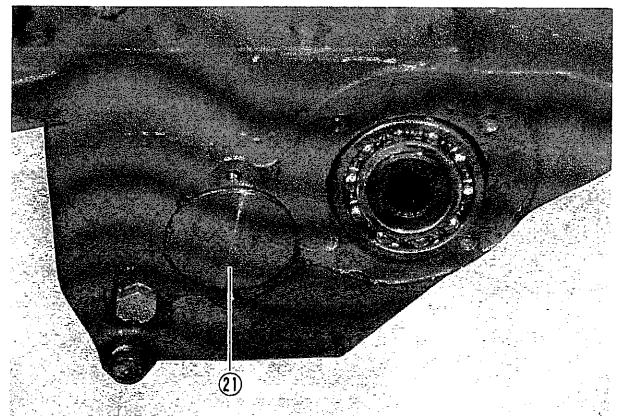


Fig. 34

(7) Tap out shaft (20) toward coupling. (Fig. 35)

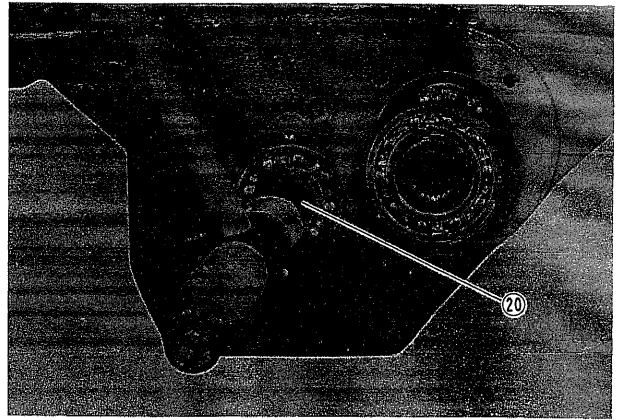


Fig. 35

(8) Take out gears (2), (13) from case (1). (Fig. 36)

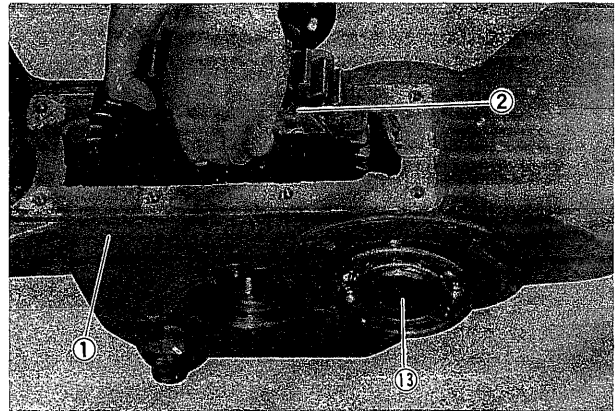


Fig. 36



### 3.4 Inspection

#### (1) Gear

Examine and replace gears if found to be damaged or excessively worn. Determine distance across given teeth of each gear by means of vernier calipers. Replace gears that is beyond service limit. (Fig. 37)

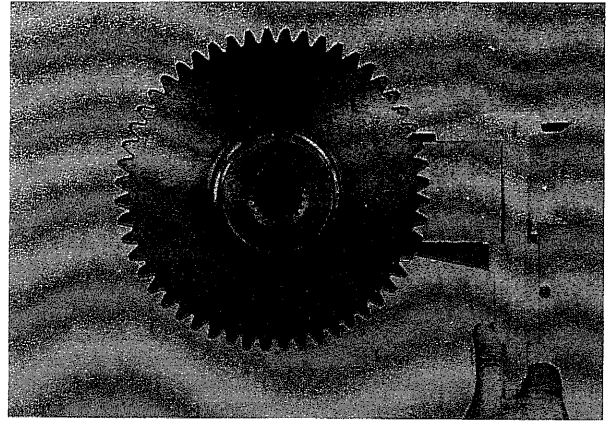


Fig. 37

Inspection item	Given teeth	Standard value	Limit for use
Gear 13 (1707-21001-0)	3	39.66 mm	39.21 mm
Gear 2 (1707-21003-0)	6	85,764 mm	85,364 mm

#### (2) Splines

Inspect splines and replace if considerable dent or wear is noticed.

Assemble shaft into gear and measure play in rotative direction at outer edge of gear. If measured value is beyond limit for use, replace shaft and gear as a set. (Fig. 38)

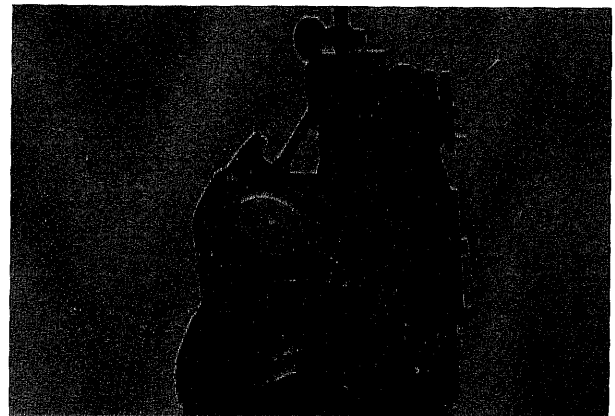


Fig. 38

Play in splines between:	Standard value	Limit for use
Gear 2 (1707-21007-0) and Shaft 20 (1521-21002-0)	0.259 ~ 0.39 mm	0.975 mm
Coupling 10 (1521-21003-1) and Shaft 20 (1521-21002-0)	0.085 ~ 0.209 mm	0.523 mm
Gear 13 (1707-21001-0) and Motor 30 (4203-96000-1)	0.016 ~ 0.204 mm	0.819 mm

### 3.5 Reassembly

Reverse disassembly procedure noting the following:

- (1) When installing motor and cover **(B)** to gear case, provide a clearance **(A)** of 0.15 mm as shown by placing shims. (Fig. 28, Fig. 39)

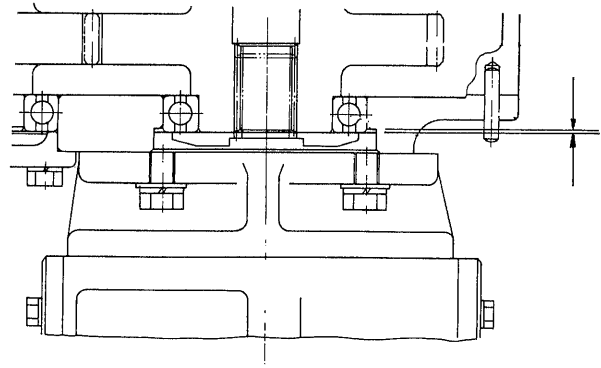


Fig. 39

- (2) When reassembling is complete, refill specified fluid to specification after removing filler plug and level plug. (Fig. 40)

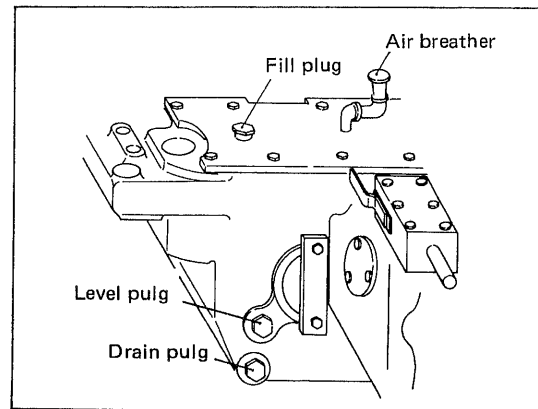


Fig. 40

#### 4. MECHANICAL TRANSMISSION (SV91 & SV91D)

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2

2

## 4. MECHANICAL TRANSMISSION (SV91, SV91D)

### 4-1 General

In addition to the hydrostatic transmission, SV91T is equipped with a mechanical reduction gear (see Chapter 3, REDUCTION GEAR), while SV91 and SV91D have a sliding mesh, 2-speed mechanical transmission to provide a wide range of speed changing. The transmission is located behind the hydrostatic transmission, conveying power through the propeller shaft to the rear wheels.

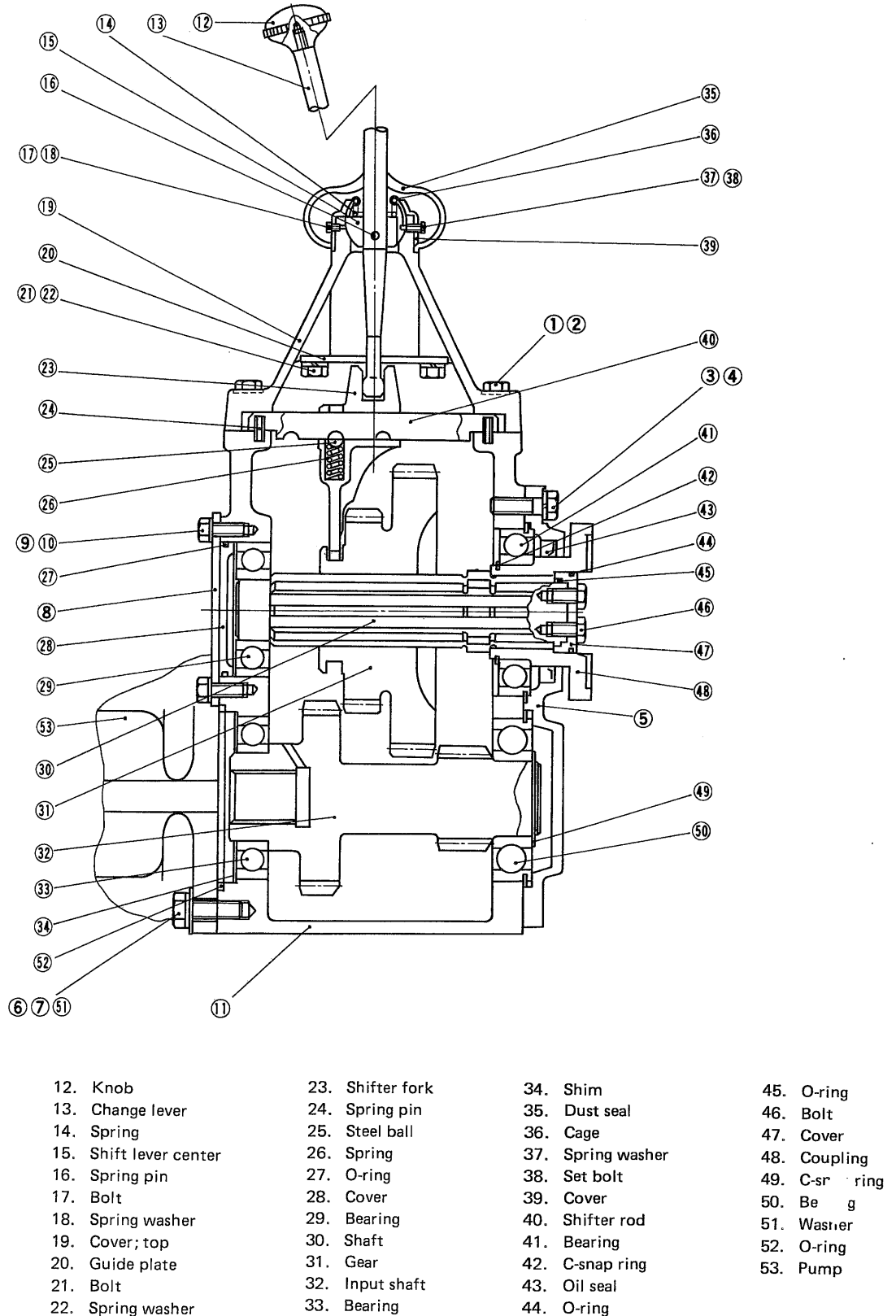


Fig. 41

## 4-2. Trouble Shooting

Trouble	Cause	Remedy
Abnormal sounds	<ol style="list-style-type: none"> <li>1. Insufficient or deteriorated lubricant</li> <li>2. Gears, bearings, or splines worn or broken</li> </ol>	Add or replace Correct or replace
Hard or not shifted into gears	<ol style="list-style-type: none"> <li>1. Gears defective</li> <li>2. Foreign material in case</li> <li>3. Gear shift lever end worn</li> </ol>	Correct or replace Remove Replace
Gears slip out of mesh	<ol style="list-style-type: none"> <li>1. Gears poorly meshing</li> <li>2. Lock spring in shifting mechanism weakened or broken</li> <li>3. Gear shift lever end worn</li> </ol>	Determine source of poor meshing Replace Replace
Oil leaking	<ol style="list-style-type: none"> <li>1. Oil seals defective</li> <li>2. Covers loosely installed</li> <li>3. Coupling oil seal worn</li> </ol>	Replace Tighten Replace
Overheating	<ol style="list-style-type: none"> <li>1. Insufficient or deteriorated lubricant</li> <li>2. Bearings worn or broken</li> </ol>	Add or replace Replace

## 4.3 Disassembly

(1) Remove bolts ⑥ securing hydraulic motor ⑤③ and remove hydraulic motor. (Fig. 42)

(2) Remove shifter rod ④① together with shifter arm ②③. (Fig. 43)

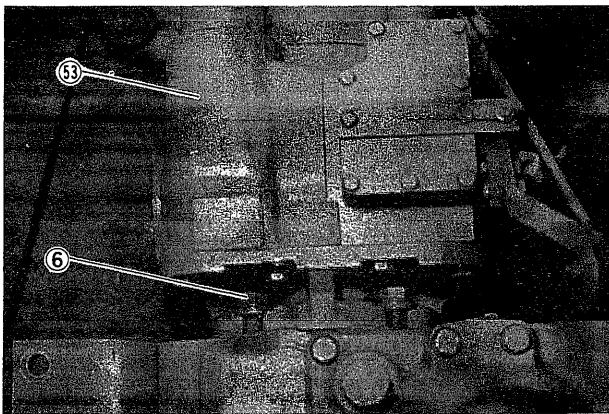


Fig. 42

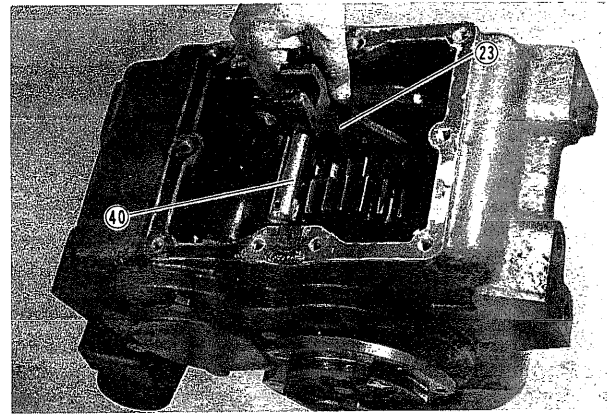


Fig. 43

- (3) Remove shifter arm from shifter rod. Remove lock ball and lock spring from shifter arm. (Fig. 44)

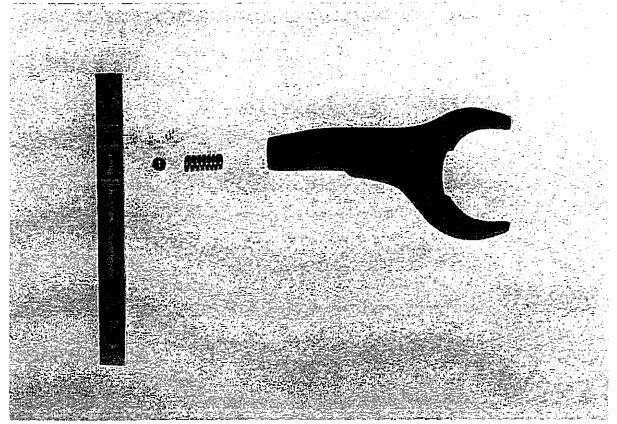


Fig. 44

- (4) Remove support fixing bolts (9) to remove support (8). (Fig. 45)

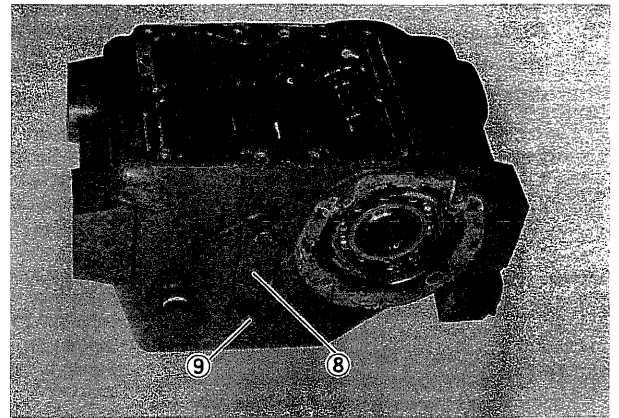


Fig. 45

- (5) Remove attaching bolts (3) and (46) and remove cover (47) together with coupling (48) and cover (5). (Fig. 46)

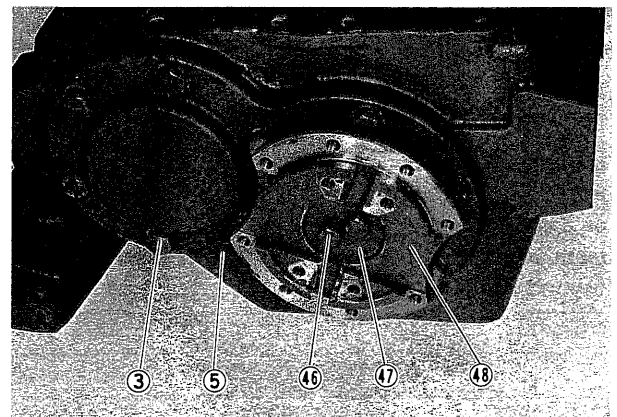


Fig. 46

- (6) Drive splined shaft toward hydraulic pump side until bearing and its retainer slip out of transmission case. Pull off bearing from shaft. (Fig. 47)

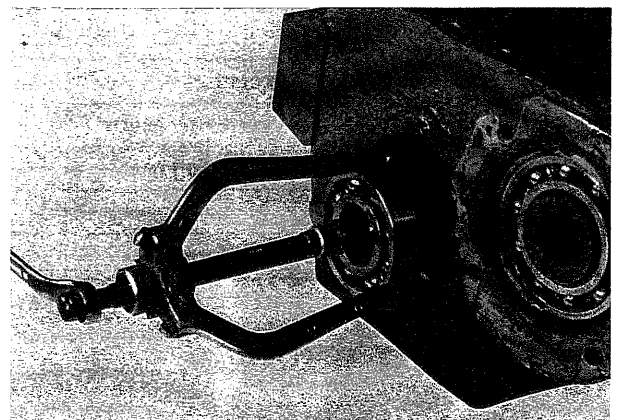


Fig. 47

- (7) Take out shaft and gear from transmission case. (Fig. 48)

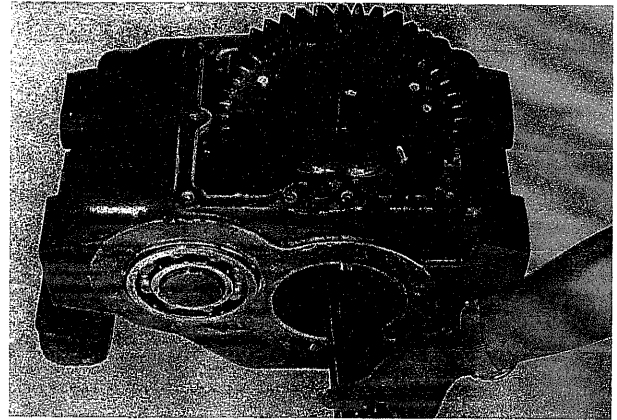


Fig. 48

- (8) Remove snap ring and drive input shaft toward hydraulic pump side until bearing on opposite side slips off case. Pull out bearing from hydraulic pump end of input shaft. Take out input shaft from transmission. (Fig. 49)

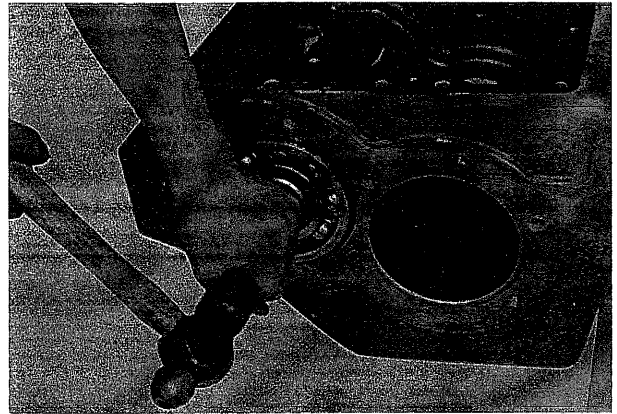


Fig. 49

#### 4.4 Inspection

##### (1) Gears

Inspect gears for worn, chipped or otherwise damaged teeth. Replace gears as a pair if chipping, excessive wear or damage is noticeable. Measure distance across given teeth of gears and replace gears if measured values are beyond service limit. (Fig. 50)

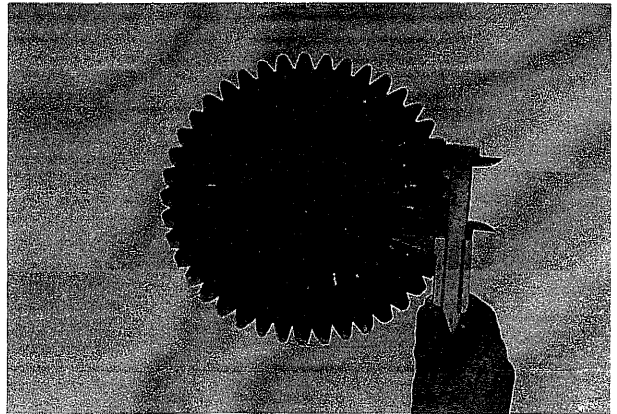


Fig. 50

Parts to be inspected		Given teeth	Standard value	Limit for use
Sliding gear 31 (1704-21003-0)	Large gear	6	85.57 mm	85.27 mm
	Small gear	4	55.16 mm	54.86 mm
Input shaft 32 (1704-21009-0)	Large gear	4	55.02 mm	54.72 mm
	Small gear	2	24.61 mm	24.31 mm



## (2) Splines

Inspect inner and outer splines for damage and step wear. Replace parts if found to be abnormal. Assemble sliding gear and coupling to main shaft and measure amount of play in rotating direction at outer edge of gear and coupling using a dial indicator. Replace parts if measured values are in excess of limit. Replace shaft or both gear and coupling if measured values are beyond limit. (Fig. 51)

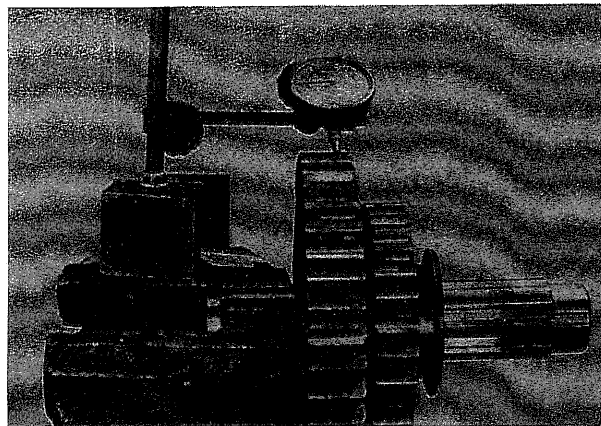


Fig. 51

Play between:	Standard value	Limit for use
Coupling 51 (1520-21001-0) and Shaft 33 (1520-21004-0)	0.085 ~ 0.209 mm	0.523 mm
Gear 34 (1704-21003-0) and Shaft 33 (1520-21004-0)	0.159 ~ 0.39 mm	0.975 mm
Shaft 35 (1704-21009-0) and Motor 57 (4203-96000-1)	0.026 ~ 0.337 mm	1.348 mm

## (3) Shifter Fork and Its Related Parts

Check shifter fork for bending and fork ends for wear. Slight scores can be corrected with an oil stone. Measure clearance between shifter fork and gear groove and replace if measured value is in excess of limit.

Inspect lock ball for scores and replace if found to be abnormal. Check lock spring for damage and weakness and replace as necessary. Measure lock spring free length and replace if measured value is beyond limit.

Item to be inspected	Standard value	Limit for use
Clearance between shifter fork and gear groove	0.1 – 0.3 mm	1.5 mm

Item to be inspected	Standard value	Limit for use
Lock spring free-length	26.7 mm	26.0 mm

## 4.5 Reassembly

Reassemble transmission in reverse order of disassembly noting following instructions.

- (1) Assemble coupling to main shaft so that two threaded holes at splined shaft end and a groove on coupling are in alignment.
- (2) Install guide plate with short arm of guide slot directing to coupling side and long arm motor side respectively. (Fig. 52)

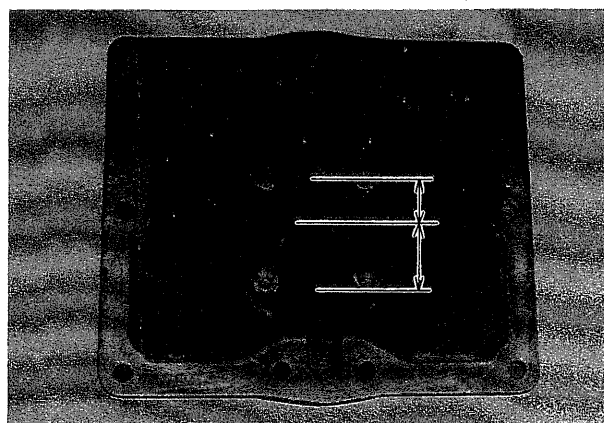


Fig. 52

- (3) Install the top cover so that its filler hole are located closest to the motor. (Fig. 53)

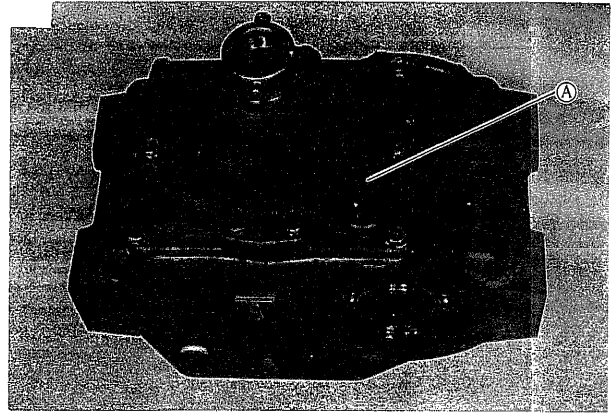


Fig. 53

- (4) Provide an end play of 0.2 to 0.3 mm between bearing outer race and motor mounting face.

## 5. REAR AXLE

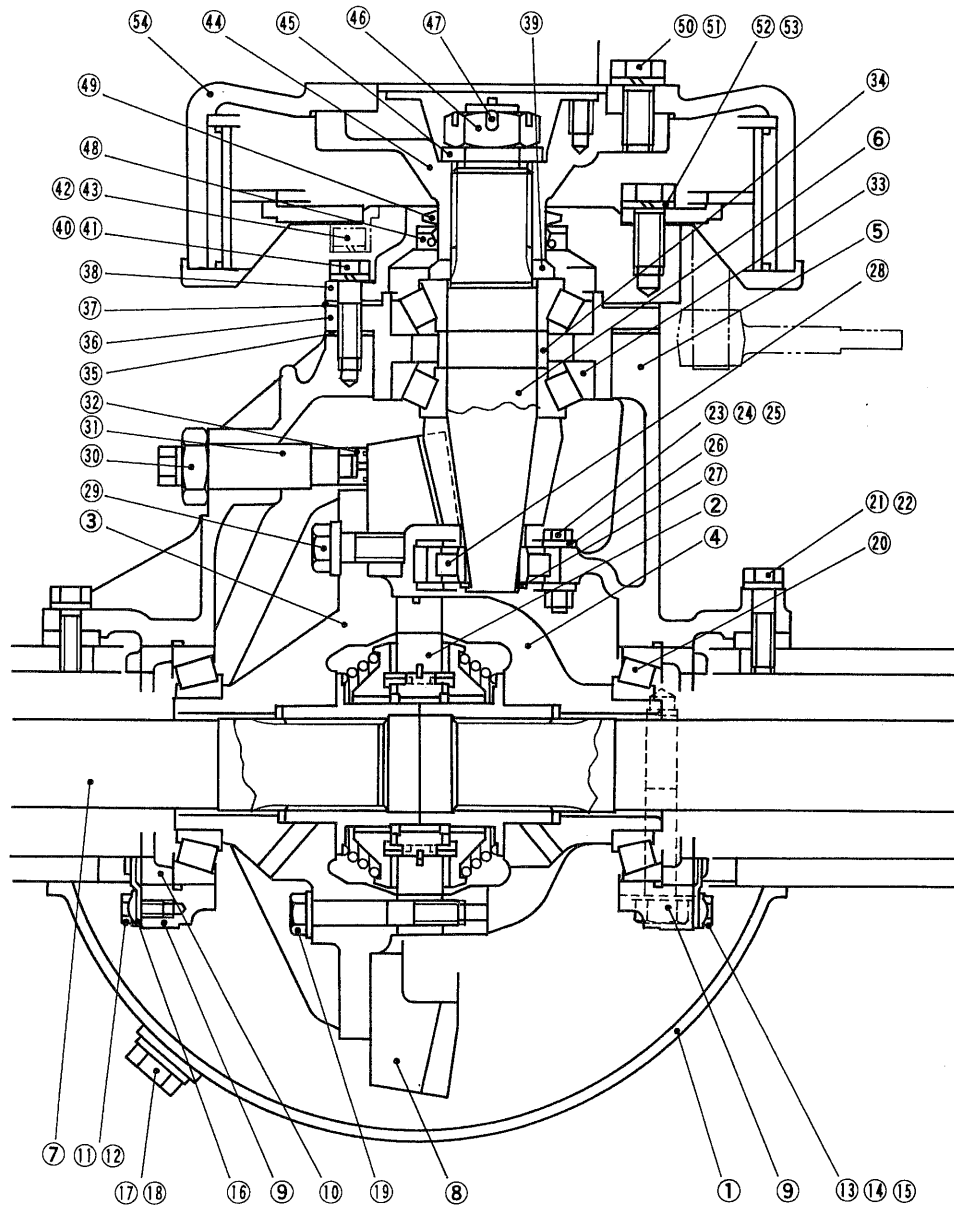
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## 5. REAR AXLE

### 5.1 General

Rear axle is of full floating type, being assembled into a differential (No-SPIN Differential) at center and a planetary-gear type final drive at each end. Drive shaft runs between reduction gear and differential.



- |                        |                   |                   |                           |                   |
|------------------------|-------------------|-------------------|---------------------------|-------------------|
| 1. Housing             | 12. Bolt          | 23. Bolt          | 34. Spacer                | 45. Washer        |
| 2. No-spin diff. ass'y | 13. Bolt          | 24. Castle nut    | 35. Shim set              | 46. Castle nut    |
| 3. Case                | 14. Lock washer   | 25. Split pin     | 36. Retainer              | 47. Cotter pin    |
| 4. Case                | 15. Lock plate    | 26. Retainer      | 37. Packing               | 48. Oil seal      |
| 5. Carrier             | 16. Lock plate    | 27. C-snap ring   | 38. Cover                 | 49. Felt seal     |
| 6. Bevel pinion        | 17. Plug          | 28. Bearing       | 39. Collar                | 50. Bolt          |
| 7. Shaft               | 18. Packing       | 29. Bolt          | 40. Bolt                  | 51. Spring washer |
| 8. Gear                | 19. Bolt          | 30. Lock nut      | 41. Spring washer         | 52. Bolt          |
| 9. Cap                 | 20. Bearing       | 31. Bolt          | 42. Hex. socket head bolt | 53. Spring washer |
| 10. Nut                | 21. Bolt          | 32. Thrust button | 43. Spring washer         | 54. Brake drum    |
| 11. Lock washer        | 22. Spring washer | 33. Bearing       |                           |                   |

Fig. 54

## √ 5.2 Trouble Shooting

Trouble	Cause	Remedy
Abnormal vibration and noise.	<ol style="list-style-type: none"> <li>1. Drive shaft joint kit bearings defective.</li> <li>2. Drive shaft bent or its attaching bolts loosened.</li> <li>3. Gears worn.</li> <li>4. Gears improperly meshing.</li> <li>5. Drive pinion bearings or differential cage bearings loosened or worn.</li> <li>6. Insufficient lubricant.</li> </ol>	Repalce bearings. Correct or replace shaft or tighten bolts. Replace. Adjust. Adjust preload or replace bearings. Add lubricant to proper level
Knocking sound when starting or while travelling.	<ol style="list-style-type: none"> <li>1. Gears damaged.</li> <li>2. Foreign matter in case.</li> <li>3. Excessive play in splines.</li> <li>4. Joint kits worn or damaged.</li> <li>5. Mounting portions loosened.</li> </ol>	Repalce. Remove. Replace. Replace. Tighten.
Leaky cases	<ol style="list-style-type: none"> <li>1. Oil seals defective.</li> <li>2. Differential carrier attaching bolts loosened.</li> <li>3. Cracks in case.</li> <li>4. Air bleeder plugged.</li> </ol>	Replace. Tighten. Replace. Clean or replace.
Machine would not travel.	<ol style="list-style-type: none"> <li>1. Axle shaft or drive shaft damaged.</li> <li>2. Gears damaged.</li> </ol>	Replace. Replace.

## 5.3 Maintenance

### 5.3.1 Differential and Drive Pinion Assembly

#### (1) Disassembly

- Differential Carrier Assembly
  - 1) Pull axle shaft (7) off differential (Fig. 54). See procedures under "Final drives".
  - 2) Remove differential carrier mounting bolts (21) and remove differential carrier assembly from axle housing. (Fig. 54)

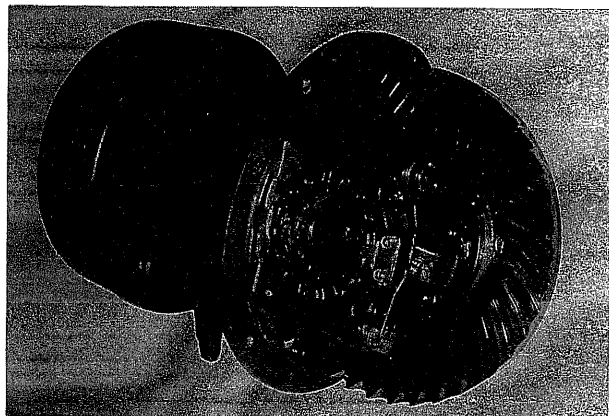


Fig. 55

- Differential Case Assembly

- 1) Loosen lock nut (30) and remove thrust bolt (31). (Fig. 56)

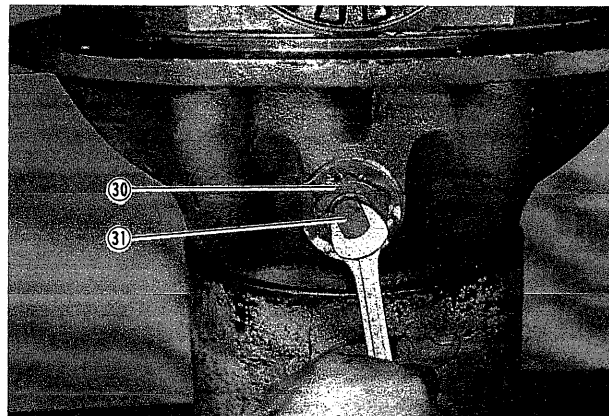


Fig. 56

- 2) Matchmark carrier (4) and bearing caps (9). (Fig. 57)

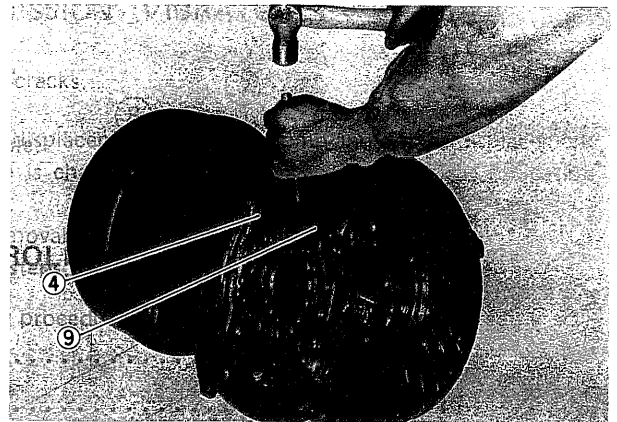


Fig. 57

- 3) Remove bearing cap attaching bolts (13) and remove bearing caps (9). Remove differential case assembly and adjusting nuts (10) (Figs. 54 & 58). Mark each bearing outer race and adjusting nut for reinstalling differential.

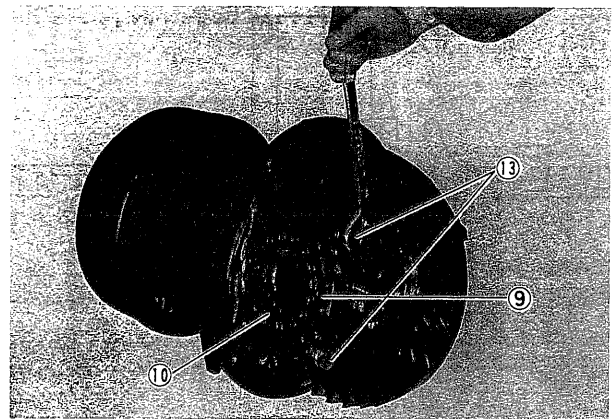


Fig. 58

- 4) Matchmark differential cases and remove case attaching bolt. Separate differential cases and take off No-SPIN differential assembly (A). (Fig. 59)

- 5) Remove bolt that secures bevel gear to case and take out bevel gears from differential cases.

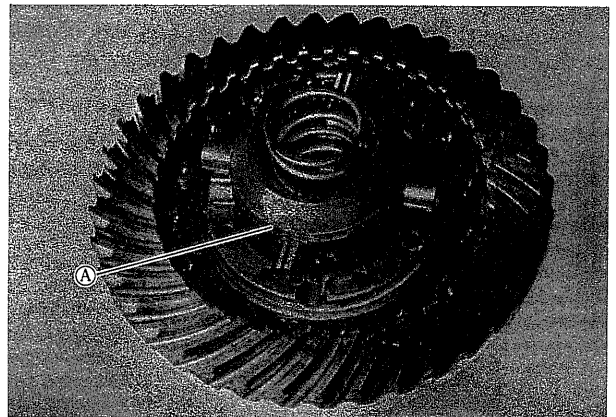


Fig. 59

• Drive Pinion Assembly

- 1) Remove nut (46) and remove brake drum (54) together with coupling (44). (Fig. 60)

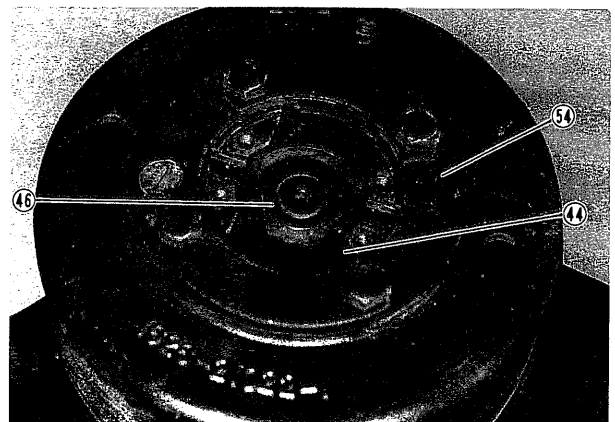


Fig. 60

- 2) Remove bolts (52) and separate brake assembly. (Fig. 61)

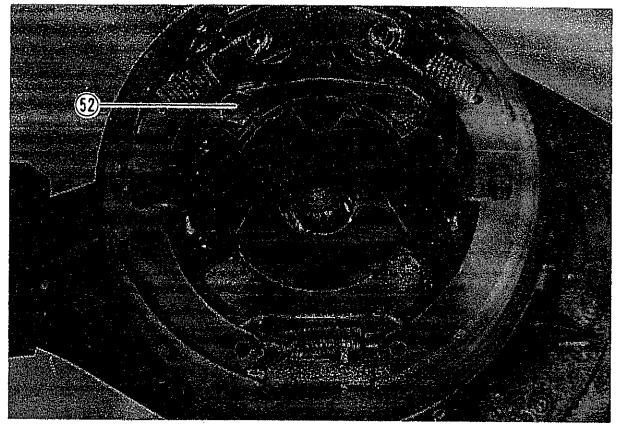


Fig. 61

- 3) Remove hex. socket head bolts and bolts (40). Remove cover (38). (Fig. 62)

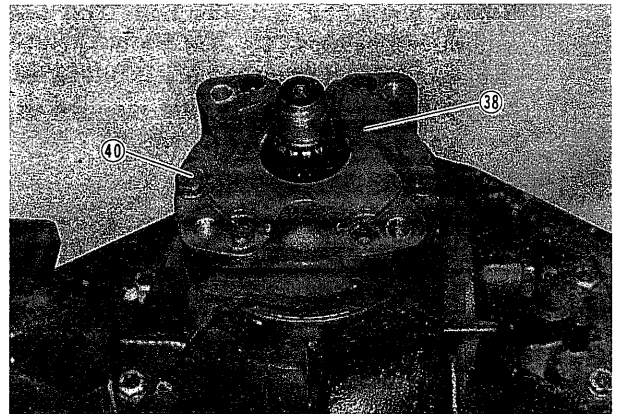


Fig. 62

- 4) Press out drive pinion (6) from cage (36) using a bench press or puller. Then bearing inner race, distance piece and shim will come off. (Fig. 63)
- 5) Remove remaining bearing inner race if required. When reassembling, make sure that each race is facing in correct direction.

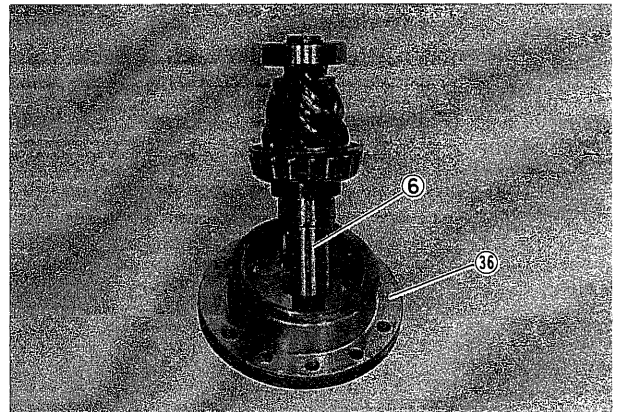


Fig. 63

- 6) Press out bearing from pinion gear.



- 7) Remove securing bolts and take off pinion pilot bearings together with retainer from diff. carrier. (Fig. 64)

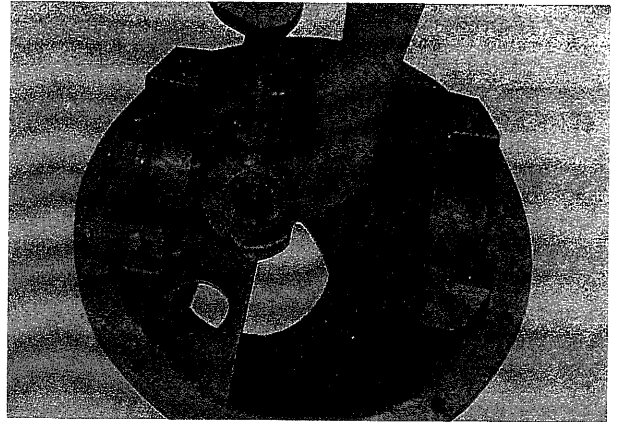


Fig. 64

## (2) Inspection

Check disassembled parts for cracks, wear, damage, deformation and seizure. Correct or replace parts if found to be abnormal.

## (3) Reassembly

Reverse disassembly procedure noting following:

- Drive Pinion Assembly
  - 1) Assemble drive pinion pilot bearing in advance and press it into drive pinion.
  - 2) To install bearings to drive pinion, check to be sure that they are facing in correct directions.
  - 3) Torque bolts and nuts to specification.
- Differential Case Assembly
  - 1) Replace all bevel gear fixing bolts with new ones, and crimp after tightened to specification to prevent going loose.

- 2) Make match marks on differential cases.

- 3) Assemble bearings so that they are facing in correct directions. If disassembled bearings are used again, be sure to put them back where they were.

### Tightening torque

Fixing bolts or nuts for:	Tightening torque (kg-cm)
Differential carrier 61	490 ~ 730
Bearing retainer 40	1,000 ~ 1,200
Differential cases 54	1,650 ~ 1,800
Bevel gear 48	2,400 ~ 2,800
Bearing cap 21	2,600 ~ 3,000
Thrust bolt 11	1,000
Yoke 46	3,000 ~ 4,000
Brake drum & brake ass'y	1,800 ~ 2,500

## (4) Adjustment

- 1) Drive pinion gear

After installation of drive pinion gear (6) to bearing retainer (36), adjust preload on bearings (33) (force required to rotate bearings (33)) by means of spacer with proper dimension placed between bearings (33). To determine preload, hook a pull scale to a bolt that secures companion yoke (44) to brake drum, and pull it in tangential direction. (Fig. 54)

Inspection item	Standard value
Drive pinion gear preload	3.8 to 4.5 kg

2) Drive pinion gear and bevel gear

When installing diff. case assembly to carrier (5), adjust backlash as follows:

Determine backlash between drive pinion and bevel gear using a dial indicator as shown. For correct backlash, adjust shims (35) between bearing retainer (36) and carrier (5) or turn adjust nut (10). (Fig. 54, Fig. 65)

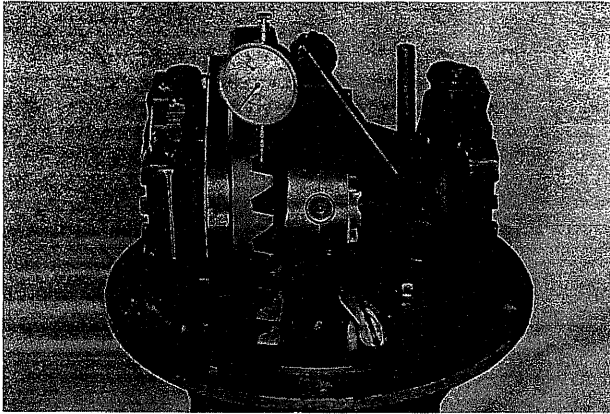


Fig. 65

Inspection item	Standard value
Backlash between drive pinion and bevel gear	0.2 to 0.3 mm

When adjustments described above are completed, adjust preload of diff. case bearings by equally screwing adjust nuts (10). To measure preload, hook a pull scale to bevel gear fixing bolt (29) and pull it in tangential direction. (Fig. 54)

Inspection item	Standard value
Diff. case bearing preload	4.6 to 6 kg

2) Bevel gear runout

Check bevel gear for runout at its back using a dial indicator. If measured value is beyond 0.1 mm, disassemble gears and readjust. If backlash is still over 0.1 mm even after the readjustment, replace bearings. (Fig. 66)

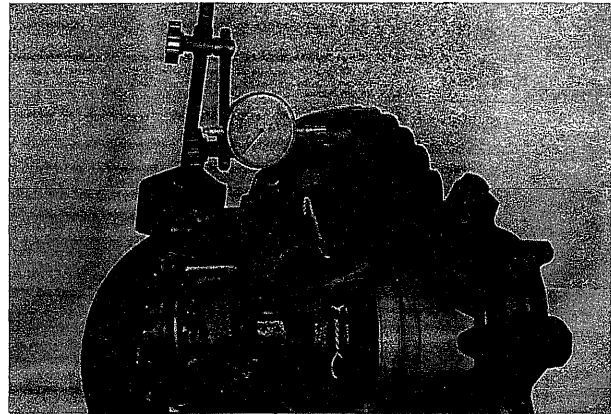


Fig. 66

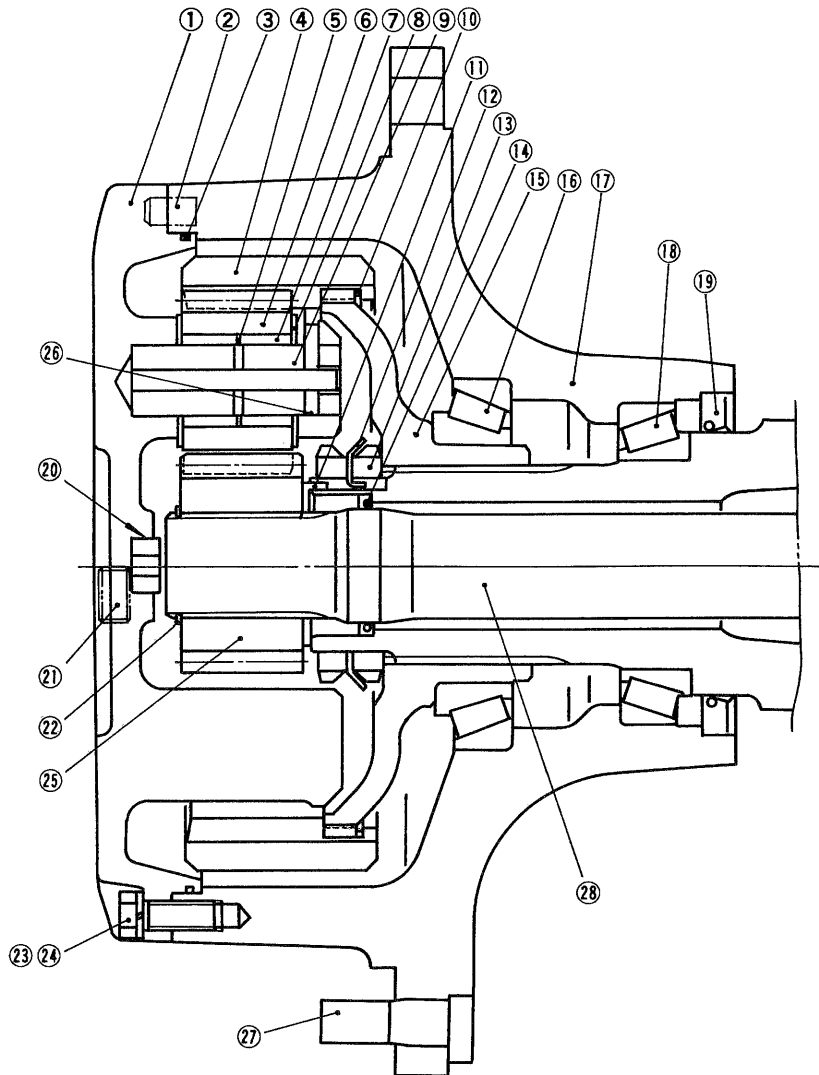
Inspection item	Standard value
Bevel gear runout	0.1 mm or less

4) Thrust bolt

Loosen lock nut (30) and screw in thrust bolt (31) until it slightly comes into contact with bevel gear then back off 1/8 of a turn and tighten lock nut. (Fig. 54)

Inspection item	Standard value
Clearance between thrust piece and bevel gear	0.25 mm (1/8 turns)

### 5.3.2 Final Drive



- |                  |                   |                           |                   |
|------------------|-------------------|---------------------------|-------------------|
| 1. Carrier       | 8. Thrust washer  | 15. Holder                | 22. C-snap ring   |
| 2. Pin           | 9. Shaft          | 16. Bearing               | 23. Bolt          |
| 3. O-ring        | 10. Circlip       | 17. Hub                   | 24. Spring washer |
| 4. Gear          | 11. Thrust washer | 18. Bearing               | 25. Gear          |
| 5. Collar        | 12. Lock washer   | 19. Oil seal              | 26. Spring pin    |
| 6. Gear          | 13. Nut           | 20. Thrust button         | 27. Hub bolt      |
| 7. Needle roller | 14. Oil seal      | 21. Hex. socket head plug | 28. Shaft         |

Fig. 67

#### CAUTION:

There are two identical final drives (hub and planetary assemblies) on axle shaft ends. Mark each part so as to install it back to where it was.

**(1) Disassembly**

- 1) Matchmark hub (17) and carrier (1). Remove cover fixing bolts (23) and remove carrier.
- 2) Do not pull axle shaft (28) off unless required, as this may score oil seal. To disassemble carrier assembly, pull axle shaft off.
- 3) Flatten out lock washer (12) and take off bearing nut (13). Then remove another lock washer and bearing nut. (Fig. 67, Fig. 68)

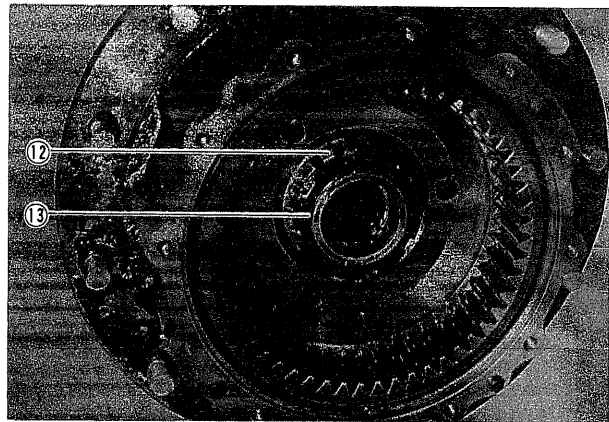


Fig. 68

- 4) Pull of spring pin (25) and pull off planetary gear shafts (9) and remove planetary gears (6), needle bearings (7) and thrust washer (8). (Fig. 69)
- 5) Remove oil seal (19) from wheel hub (17). Do not separate outer races of bearings (16) and (18) unless necessary. (Fig. 67)

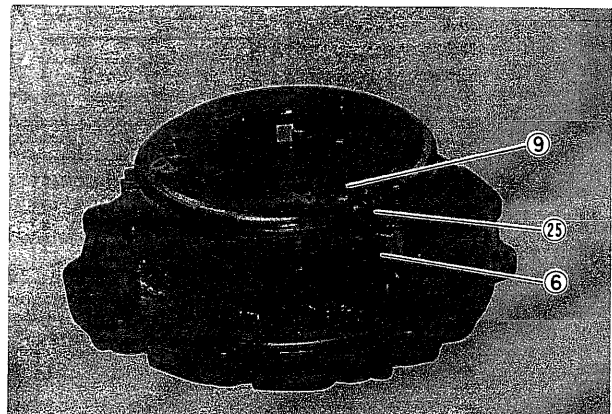


Fig. 69

**(2) Inspection**

- 1) Check each gear for wear and damage.
- 2) Check axle shaft for scores, cracks and bending.
- 3) Check splines for excessive play in rotative direction.
- 4) Check bearings for damage and wear. Replace parts if found to be abnormal.

**(3) Reassembly**

Reassemble final drives in reverse order of disassembly following directions below.

- 1) Let matchmarks coincide.
- 2) Assemble oil seal to hub.
- 3) Check to be sure each planetary gear shaft is facing in correct direction.
- 4) Tighten bolts and nuts as below:

Fixing bolts or nuts for:	Tightening torque (kg-m)
Carrier	11 ~ 13

- 5) Assemble carrier (1) to wheel hub (17) providing proper clearance between thrust button (20) and shaft (28). (Fig. 67)

Clearance between:	Standard value
Thrust button and shaft	0.5 mm or more

### 5.3.3 Drive shaft

#### (1) Disassembly

- 1) Separate drive shaft. (Fig. 70)

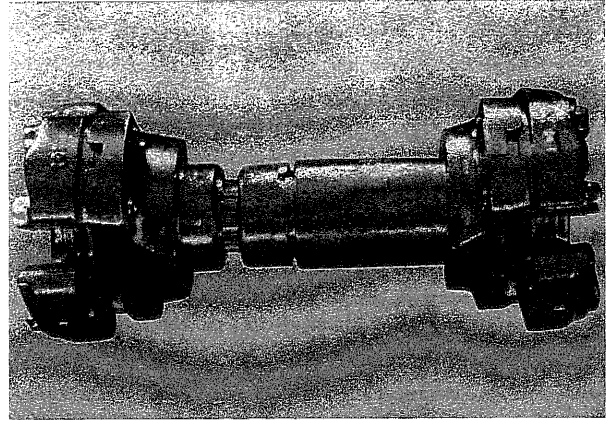


Fig. 70

- 2) After removal of universal joint assembly, remove snap ring (1) and separate flange (3) from shaft (2). (Fig. 71)

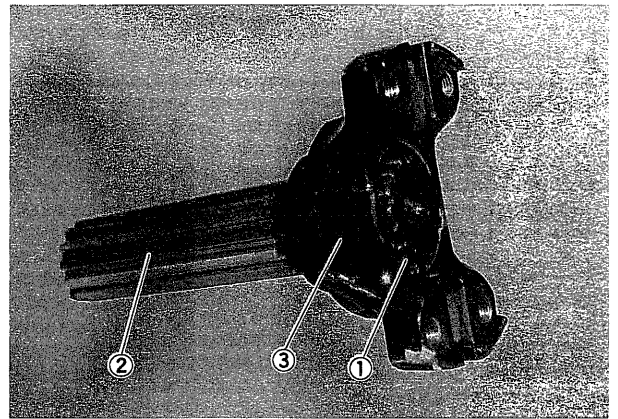


Fig. 71

#### (2) Inspection

- 1) Universal joint ass'y

Check spider pins and needle bearings for wear. Replace universal joint assembly if excessive wear or missing needles are noticeable. (Fig. 72)

- 2) Splines

Check splines and replace flange assembly if dent or excessive wear or abnormal wear is noticeable.

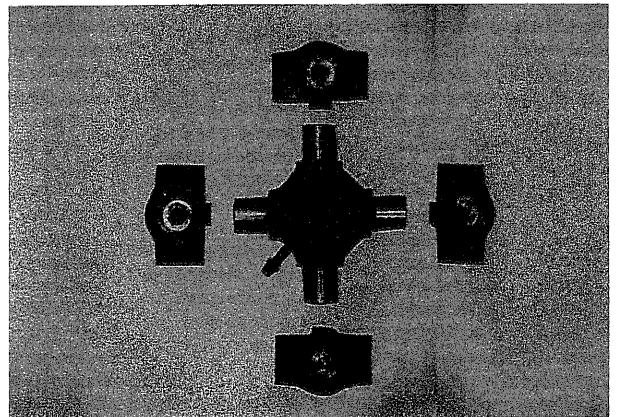


Fig. 72



## 6. FRONT ROLL

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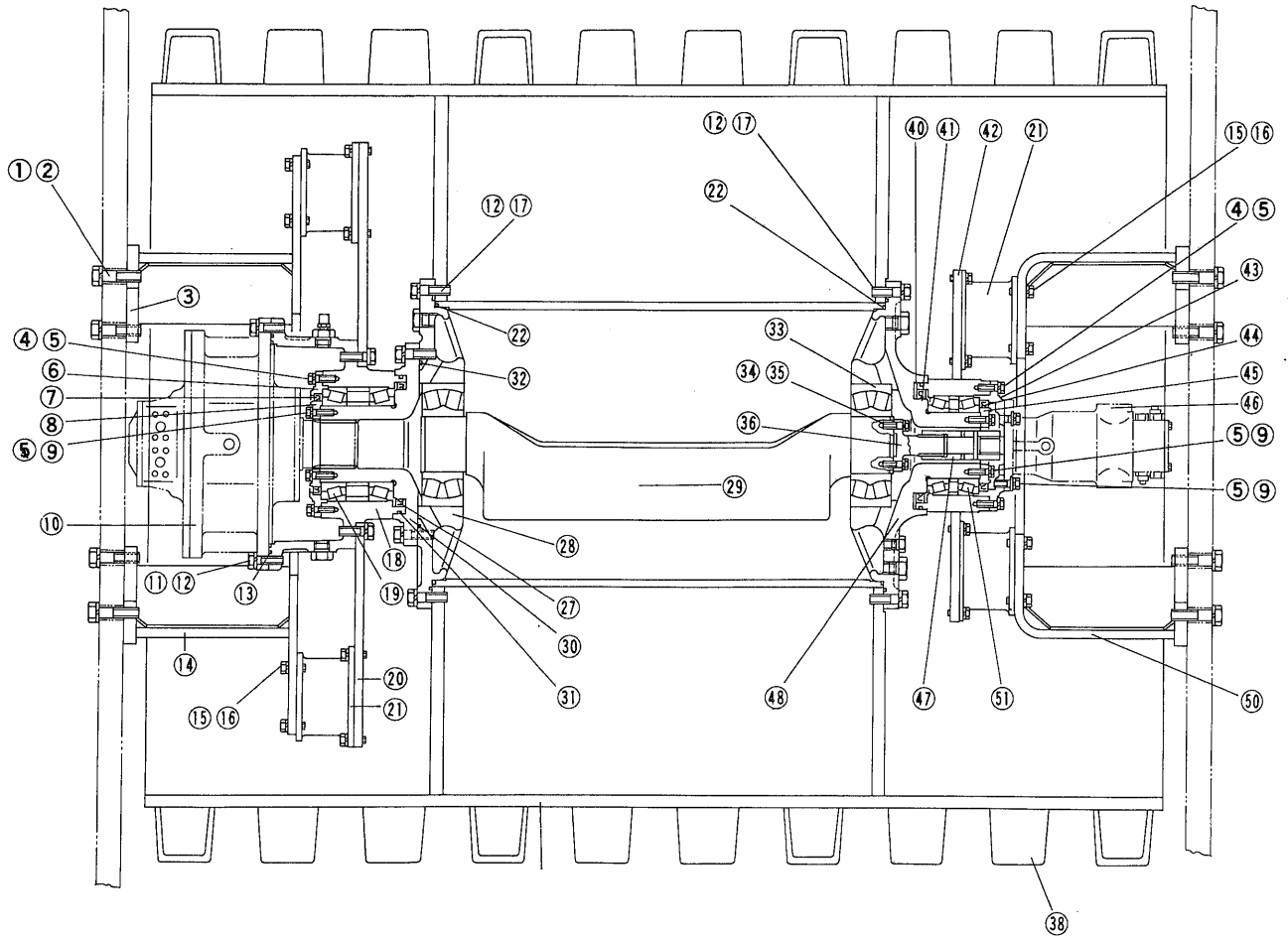
## 6. FRONT ROLL

### 6.1 General

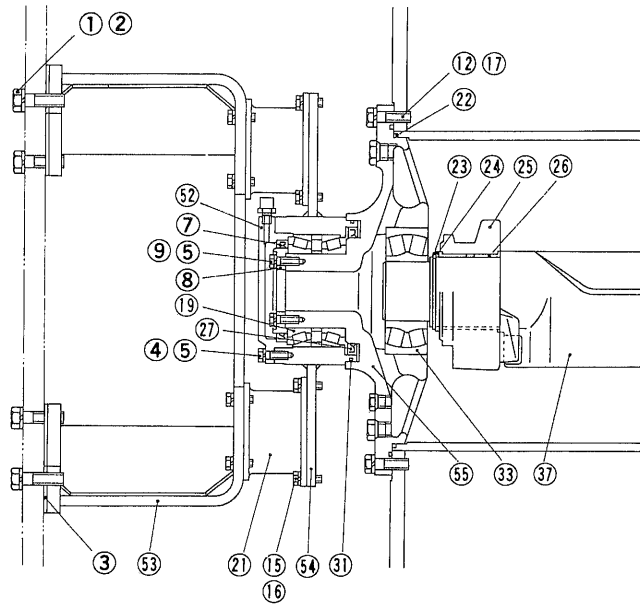
Major differences among models SV91, SV91T and SV91D lie in front roll pattern and drive type as:

Model	SV91	SV91T	SV91D
Roll pattern	Smooth	Tamping	Smooth
Drive type	Rear drive	All-wheel drive	All-wheel drive
Vibrator	Single shaft, variable amplitude	Single shaft mono-amplitude	Single shaft variable amplitude

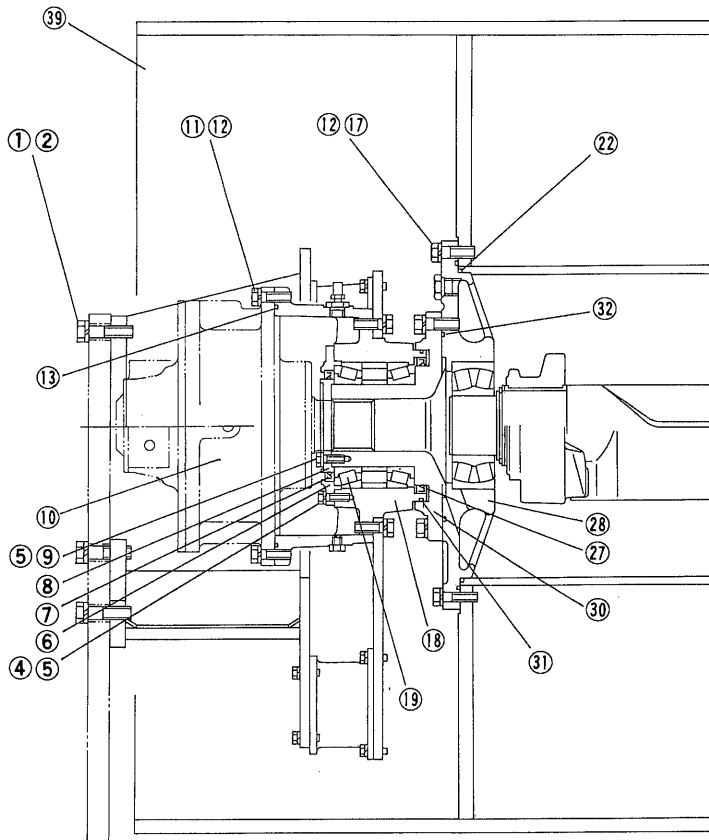
Roll is so mounted, utilizing rubber isolators, on machine frame to absorb vibration, with vibrator drive motor on right side, propulsion motor (SV91T, SV91D) on left side and vibrator shaft at center of roll.



SV91T



SV91



SV91D - SV91DP

- |                   |                      |                           |                |
|-------------------|----------------------|---------------------------|----------------|
| 1. Bolt           | 15. Bolt             | 29. Eccentric shaft ass'y | 43. Cover      |
| 2. Spring washer  | 16. Spring washer    | 30. Boss                  | 44. Oil seal   |
| 3. Shim           | 17. Bolt             | 31. Seal ring             | 45. Cover      |
| 4. Bolt           | 18. Axle housing     | 32. O-ring                | 46. Motor      |
| 5. Spring washer  | 19. Bearing          | 33. Bearing               | 47. Shaft      |
| 6. Cover          | 20. Disc             | 34. Bolt                  | 48. Axle shaft |
| 7. Oil seal       | 21. Shock mount      | 35. Spring washer         | 49. Shim       |
| 8. Cover          | 22. O-ring           | 36. Flange                | 50. Axle       |
| 9. Bolt           | 23. Snap ring        | 37. Eccentric shaft       | 51. Bearing    |
| 10. Motor         | 24. Spacer           | 38. Roll                  | 52. Cover      |
| 11. Bolt          | 25. Eccentric weight | 39. Roll                  | 53. Axle       |
| 12. Spring washer | 26. Bushing          | 40. Seal ring             | 54. Disc       |
| 13. O-ring        | 27. Oil seal         | 41. Oil seal              | 55. Axle shaft |
| 14. Axle          | 28. Axle shaft       | 42. Disc                  |                |

Fig. 73

## 6.2 Trouble Shooting

Trouble	Cause	Remedy
Roll dragging.	<ol style="list-style-type: none"> <li>1. Hydrostatic transmission inoperative.</li> <li>2. Bearings seized or damaged.</li> </ol>	See "HYDROSTATIC TRANSMISSION (PROPULSION)". Replace.
Vibrator does not work.	<ol style="list-style-type: none"> <li>1. Hydrostatic transmission inoperative.</li> <li>2. Splined shaft flange or splined shaft roll pin damaged.</li> <li>3. Bearing seized.</li> </ol>	See "HYDROSTATIC TRANSMISSION (PROPULSION)". Replace.  Replace.
Vibratory force not changeable.	<ol style="list-style-type: none"> <li>1. Hydrostatic transmission inoperative.</li> </ol>	See "HYDROSTATIC TRANSMISSION (VIBRATOR)".
Unusual vibration or sounds.	<ol style="list-style-type: none"> <li>1. Vibration absorbing rubber blocks extremely fatigued.</li> <li>2. Bearings seized or broken.</li> <li>3. Mounting bolts loosened or fallen off.</li> </ol>	Replace.  Replace. Tighten or install.

## 6.3 Disassembly

(Shown in figures that follow are SV91T)

- (1) Disconnect hoses from motor. Remove bolts (1). Raise roll on a hoist and separate from frame.

**CAUTION:**

Note number of shims (3) and (49) and their locations from where they were removed. (Fig. 73)

- (2) Stand roll with vibrator drive motor down.

(3)

- 1) SV91T, SV91D & SV91DP . . . . . Remove bolts (15) and remove axle (14). (Fig. 74)

- 2) SV91 . . . . . Remove bolts (15) and remove axle (53). (Fig. 73)

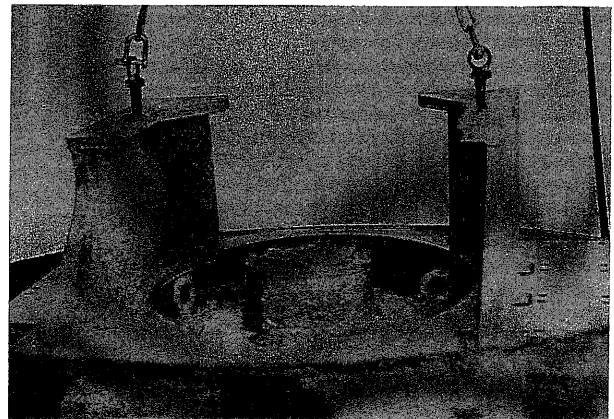


Fig. 74

- (4) Remove bolts (11) and dismount propulsion motor (10). (SV91T, SV91D & SV91DP) (Fig. 73, Fig. 75)

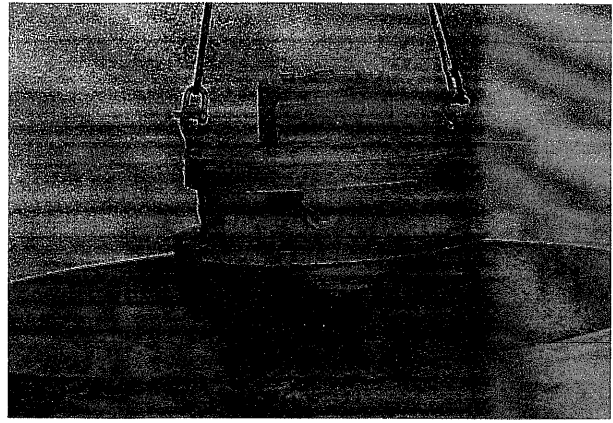


Fig. 75

- (5)
- 1) SV91T, SV91D & SV91DP . . . . . Remove bolts (4), and remove cover (6), and shim. After removal of bolts (9) and cover (8), separate axle housing (18) together with disc (20). (Fig. 76)

**CAUTION:**

Be careful not to damage bearings.

- 2) SV91 . . . . . Remove fixing bolts (4) and remove cover (52) and shims. Separate disc (54). (Fig. 73)

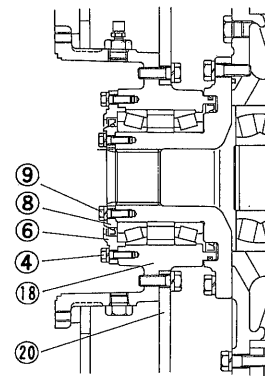


Fig. 76

- (6)
- 1) SV91T, SV91D & SV91DP . . . . . Remove bolts (17) and pull off boss (30). (Fig. 73, Fig. 77)
  - 2) SV91 . . . . . Remove bolts (17) and pull of axle shaft (55).

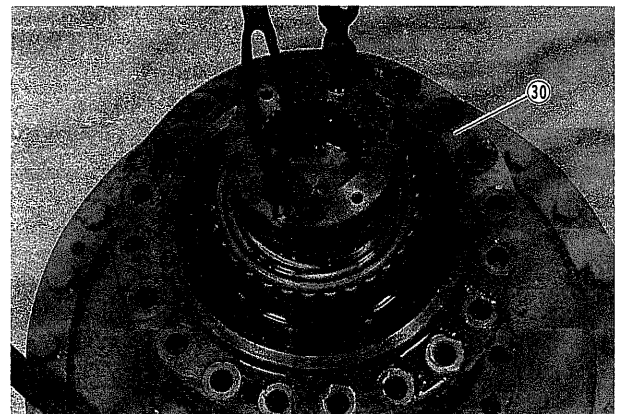


Fig. 77

- (7) Remove bolts (17) and remove axle shaft (28). (SV91T, SV91D & SV91DP) (Fig. 78)

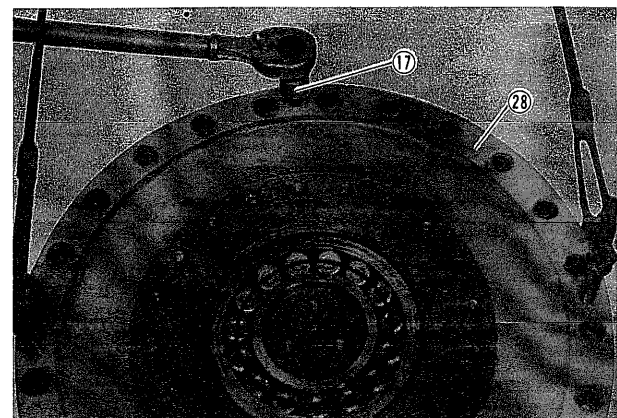


Fig. 78

- (8)
- 1) SV91T. . . . . Pull off eccentric shaft (37) . Reverse roll. (Fig. 79)
  - 2) SV91, SV91D & SV91DP . . . . . Pull off eccentric shaft (29) . Reverse roll. (Fig. 73)
  - (9) Remove bolts (9) and remove vibrator drive motor (46) . Pull off shaft (48) . (Fig. 73)

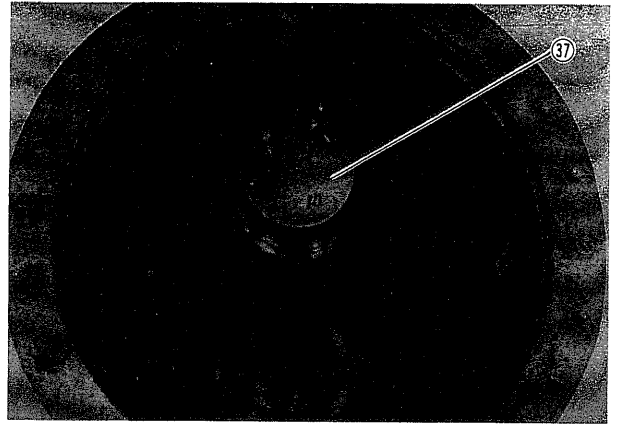


Fig. 79

- (10) Remove bolts (17) and remove axle (50) , disc (42) and axle shaft (48) as one body. (Fig. 73, Fig. 80)
- (11) Minor disassembly

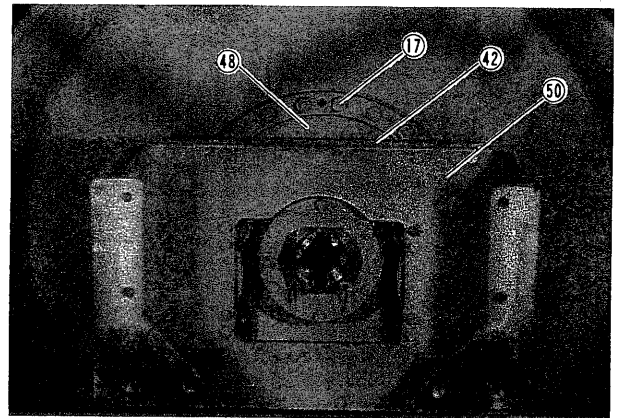


Fig. 80

- 1) Disc
  - (i) SV91T, SV91D & SV91DP . . . . . Take off oil seal (41) , seal ring (40) and outer race of bearing (19) from axle housing (30) (Fig. 81)
  - (ii) SV91 . . . . . Take off oil seal (41) , seal ring (40) and outer race of bearing (19) from disc (54) . (Fig. 73, Fig. 81)

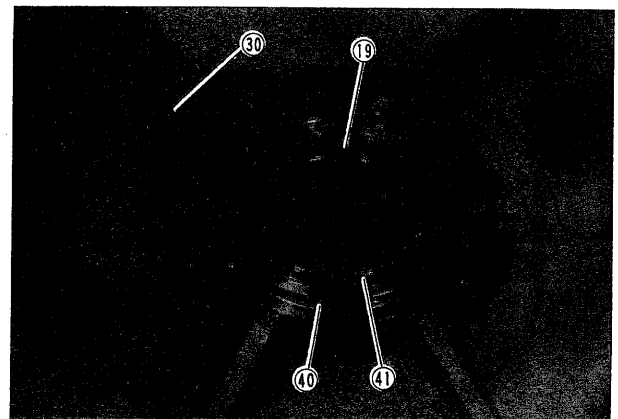


Fig. 81

**CAUTION:**

If bearings (19) are not faulty, outer races should not be removed. (Fig. 81)

- 2) Axle shaft (Left-hand side)  
Take off bearing (33) from axle shaft (28) (SV91T, SV91D & SV91DP) and axle shaft (55) (SV91) (Fig. 73, Fig. 82)

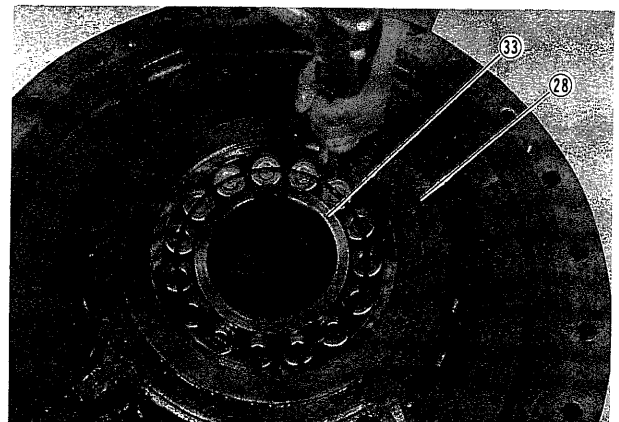


Fig. 82

3) Disc (Right-hand side)

- (i) Remove bolts (11) and remove axle (Right) (54). Remove bolts (4) and separate cover (43). Take off bolts (9) and remove collar (45). Take off oil seal (44) from cover (43). (Fig. 73, Fig. 83)

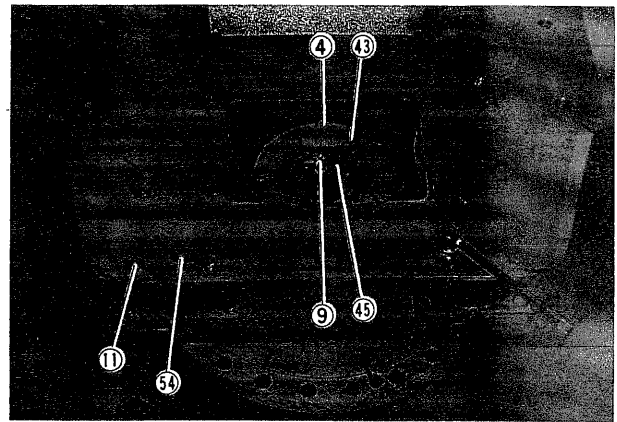


Fig. 83

- (ii) Separate disc (42) from axle shaft (48). Take off oil seal (41), seal ring (40) and outer races of bearings (19) from disc (42). (Fig. 73, Fig. 84)

**CAUTION:**

Outer races of bearings (19) should not be taken off if bearings are not faulty.

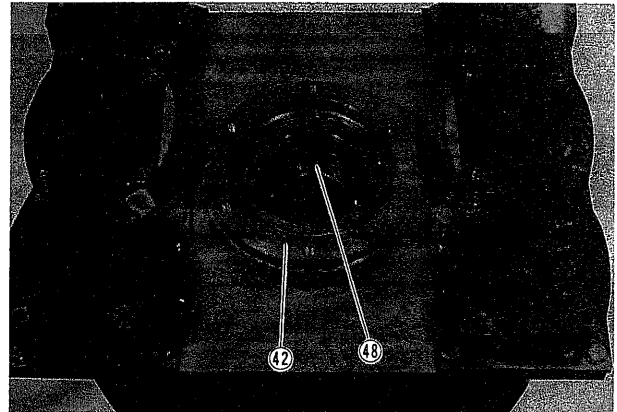


Fig. 84

4) Eccentric shaft (SV91T)

- Take off flange (36) from eccentric shaft (29). (Fig. 85)

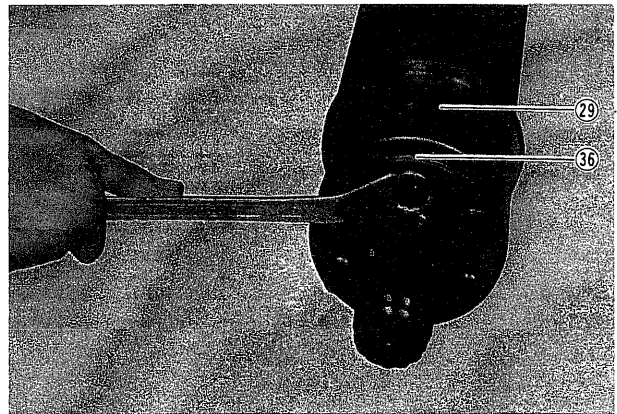


Fig. 85

5) Eccentric shaft (SV91, SV91D & SV91DP)

- (i) Take off snap ring (23) and remove collar (24), counter weight (25) from eccentric shaft (29).
- (ii) Take off bushings (26) from counter weight (25). (Fig. 86)

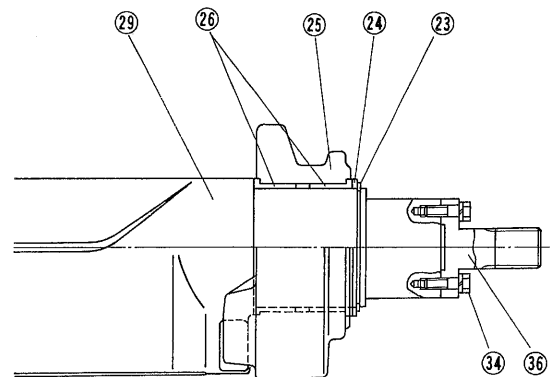


Fig. 86

## 6.4 Inspection

- (1) Check shock absorbing rubber blocks for fatigue, damage or cracks.
- (2) Check spline portions and replace if stepped wear is noticeable.

## 6.5 Reassembly

Reverse disassembly procedures. General description of reassembly procedures and matters to be attended to are:

### 6.5.1 Partial assembly

#### (1) Axle shaft (Right-hand)

- 1) Press bearing (33) and inner race of bearing (19) to axle shaft (30). (Fig. 73, Fig. 87)  
Tighten drain plug. Semi-tighten fill plug and level plug.

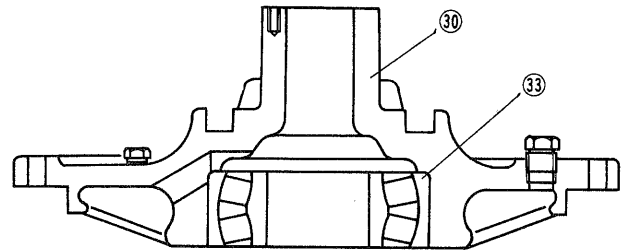


Fig. 87

- 2) Press outer races of bearings (60) into disc (42). Then install oil seal (41), seal ring (40) in disc (42). (Fig. 88)

#### CAUTION:

- 1) When installing seal ring (40), apply liquid packing on seal ring groove.
- 2) Coat grease on seal ring (40) and lip of oil seal (41).
- 3) Mount disc (42) to axle shaft (48) and press inner race of another bearing (60) to axle shaft (48). Install cover (45), semi-tighten cover mounting bolts (9) and then take off cover (45).

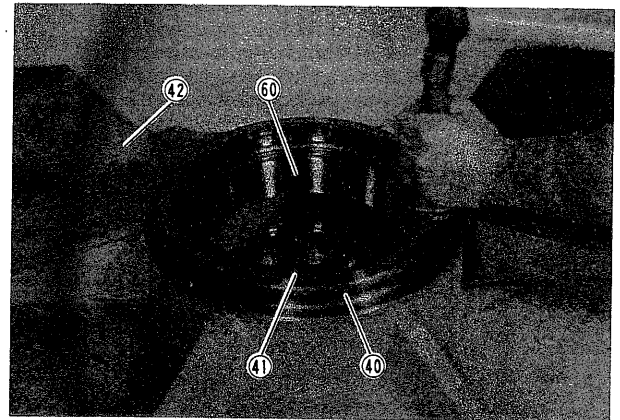


Fig. 88

- 4) Measure clearance (a)

Place proper shims to provide a interference of 0.1 mm between cover (45) and inner race of bearing (60).

Tighten bolts (9) to 15 kg-m. (Fig. 89)

#### CAUTION:

When assembling disc (42) to axle shaft (48) be careful not to damage oil seals (41), (44) and seal ring (40).

- 5) Install shockmounts (21) and axle (50) to disc assembly.

#### CAUTION:

Torque shockmount securing bolts to 15 kg-m.

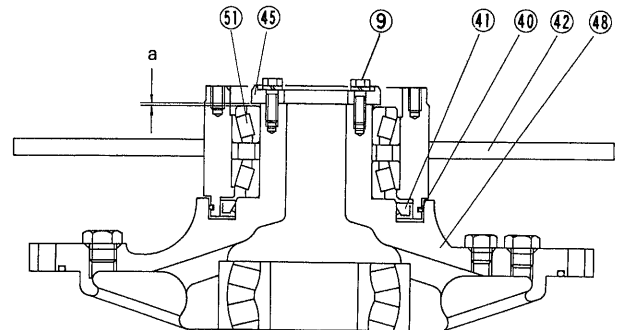


Fig. 89

**(2) Axle shaft (Left-hand)**

- 1) Assemble bearing (33) into axle shaft (28).
  - (i) SV91T, SV91D & SV91DP ..... Press inner race of bearing (19) to boss (30).
  - (ii) SV91 ..... Assemble bearing (33), inner race of bearing (19), oil seal (41) and seal ring (40) to axle shaft (55).
- 2) Install seal ring (40) and oil seal (41) to disc (18). (Fig. 73, Fig. 90)

**CAUTION:**

When installing seal ring (40) apply liquid packing on seal ring groove.

Apply liquid packing on seal ring groove. Apply grease on seal ring (40) and lip of oil seal (41). Install air breather and drain plug on disc (18).

Install shock mounts to disc (20). Tighten bolts 15 to 15 kg-m. (Fig. 73)

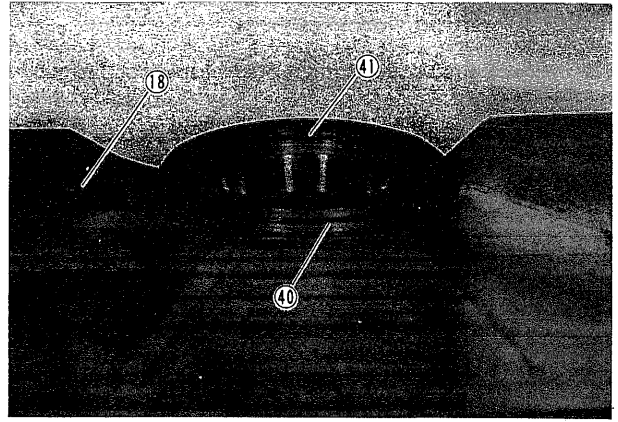


Fig. 90

**(3) Eccentric shaft**

- 1) Install flange (36) to eccentric shaft (37). Tighten securing bolts (34) to 12 kg-m. (SV91T) (Fig. 91)

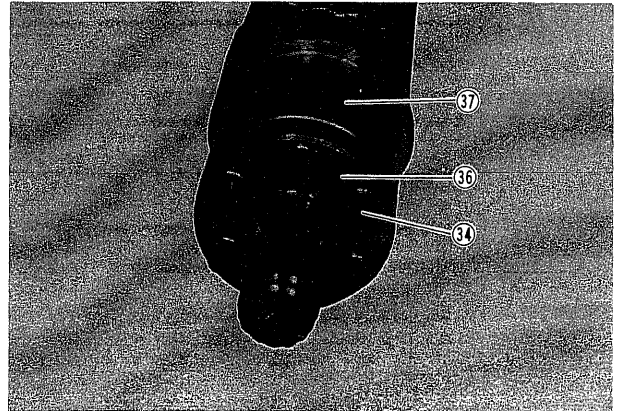


Fig. 91

- 2) Press bushing (26) into weight (25), and assemble weight (25), collar (24), snap ring (23) to vibrator shaft in this sequence. Furthermore, install flange (36) on vibrator shaft (29) and torque bolts (34) to 12 kg-m (SV91 & SV91D). (Fig. 92)

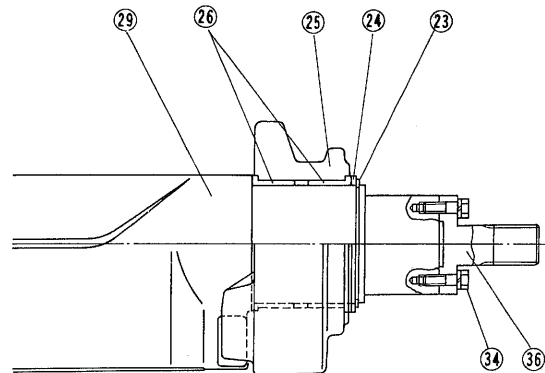


Fig. 92



## 6.5.2 Total Assembly

- (1) Mount right-hand axle shaft assembly in roll. Apply liquid packing on fitting surfaces between axle shaft and roll. (Fig. 93)

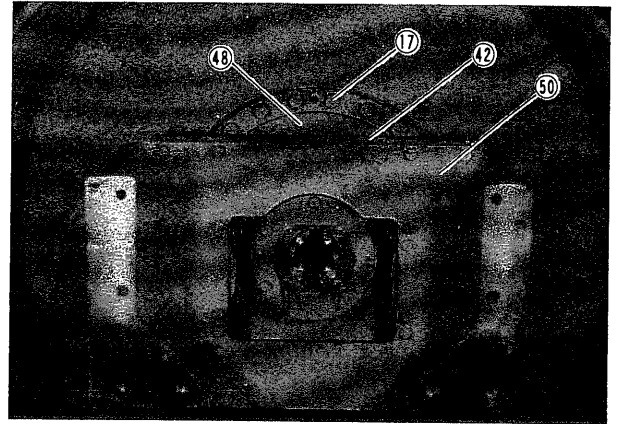


Fig. 93

- (2) Reverse roll and mount eccentric shaft. (Fig. 94)

**CAUTION:**

When assembling eccentric shaft, be careful not to dislodge bearings.

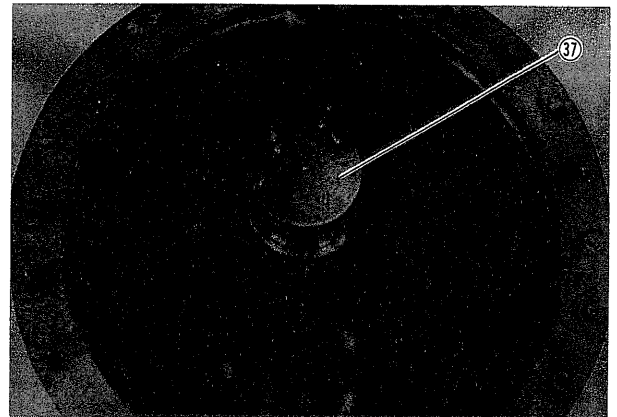


Fig. 94

- (3) Mount axle shaft in roll. (Fig. 95)

**CAUTION:**

When assembling axle shaft (28) -SV91T, SV91D & SV91DP, (53) -SV91, to eccentric shaft (37) -SV91T & SV91D, (29) -SV91, hold eccentric shaft (37) -SV91T & SV91D, (29) -SV91 as square as possible.

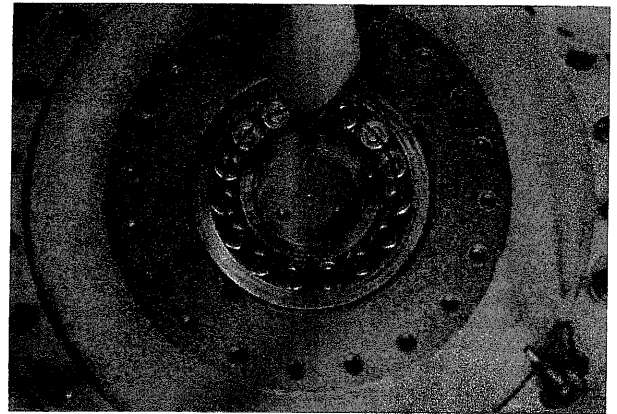


Fig. 95

- (4) Assemble boss assembly (30) in axle shaft (28). (SV91T, SV91D & SV91DP) (Fig. 96)

**CAUTION:**

Align oil fill hole of axle shaft (28) with that of boss ass'y (30).

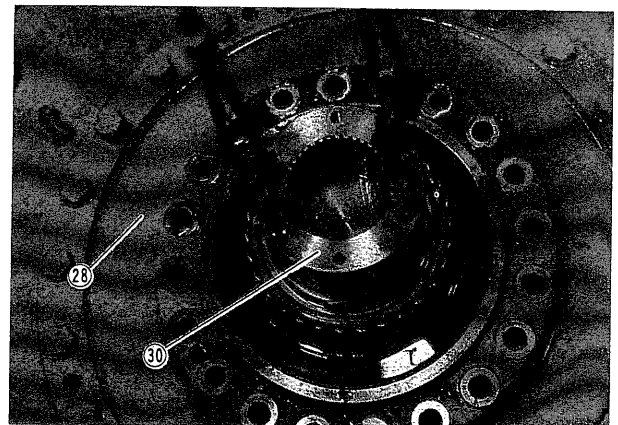


Fig. 96

- (5) Assemble disc (18) -SV91T & SV91D, (54) -SV91, and install bearings (19) to it being careful not to damage oil seals (27) and seal ring (31). (Fig. 97)

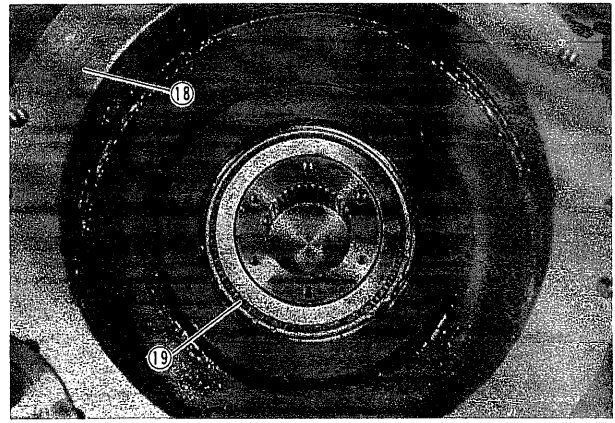


Fig. 97

- (6) Install cover (8), semi-tighten cover securing bolts (9) and then take off cover (8). Measure clearance (a) between cover (8) and inner race of bearing (19). Place proper shims to provide an interference of 0.1 mm between cover and inner race of bearing. Torque bolts to 12 kg-m. (Fig. 98)

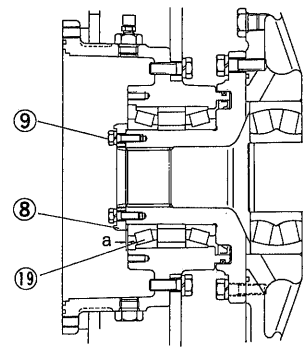


Fig. 98

- (7) Mount propulsion motor to disc (20) and axle housing (18) to rubber isolators (21) (SV91T, SV91D & SV91DP). (Fig. 73, Fig. 99)

**CAUTION:**

Torque rubber isolater fixing bolts to 15 kg-m. Apply liquid packing on fitting surfaces between propulsion motor and disc.

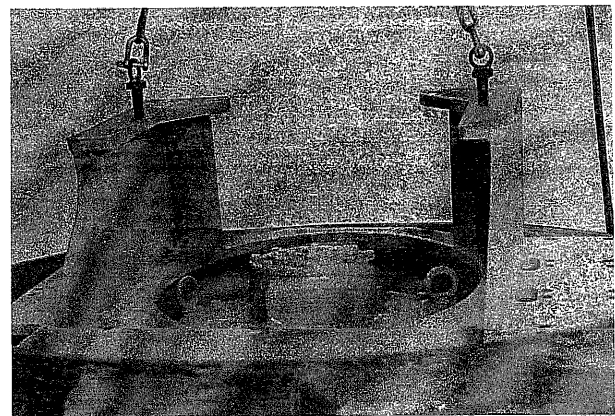


Fig. 99

- (8) Lay roll on work bench. Mount shaft (47) on eccentric shaft flange. Install vibrator drive motor to cover (43). (Fig. 100)

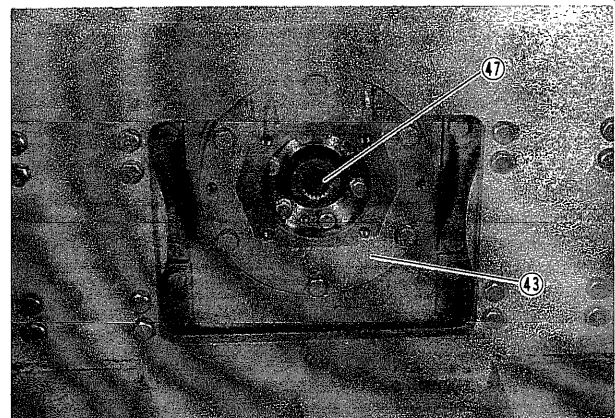
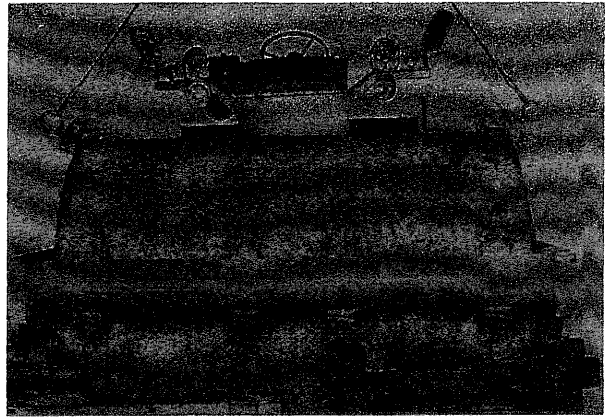


Fig. 100

- (9) Mount roll in front frame. Tighten fixing bolts to 70 kg-m. (Fig. 101)



**Fig. 101**

- (10) Refill vibrator case with 15 liters of SAE 90 gear oil. Also refill axle housing (18) with 6.5 liters of SAE 90 gear oil. (Fig. 73)

**CAUTION:**

Replace bolts that were treated with liquid packing with new ones.



## 7. HYDROSTATIC TRANSMISSION (VIBRATOR)

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## 7. HYDROSTATIC TRANSMISSION (VIBRATOR)

### 7.1 General

The vibrator uses a hydrostatic transmission including a variable displacement hydraulic pump and a fixed displacement hydraulic motor. In vibrator of SV91 and SV91D, amplitude is changeable due to an eccentric weight relocation mechanism when rotating direction of vibrator motor is reversed.

SV91T has no such amplitude-changing mechanism achieved by movable eccentric weights as above.

In all SV91 series rollers, vibrator motor speed is variable in two steps, in forward and reverse rotation each.

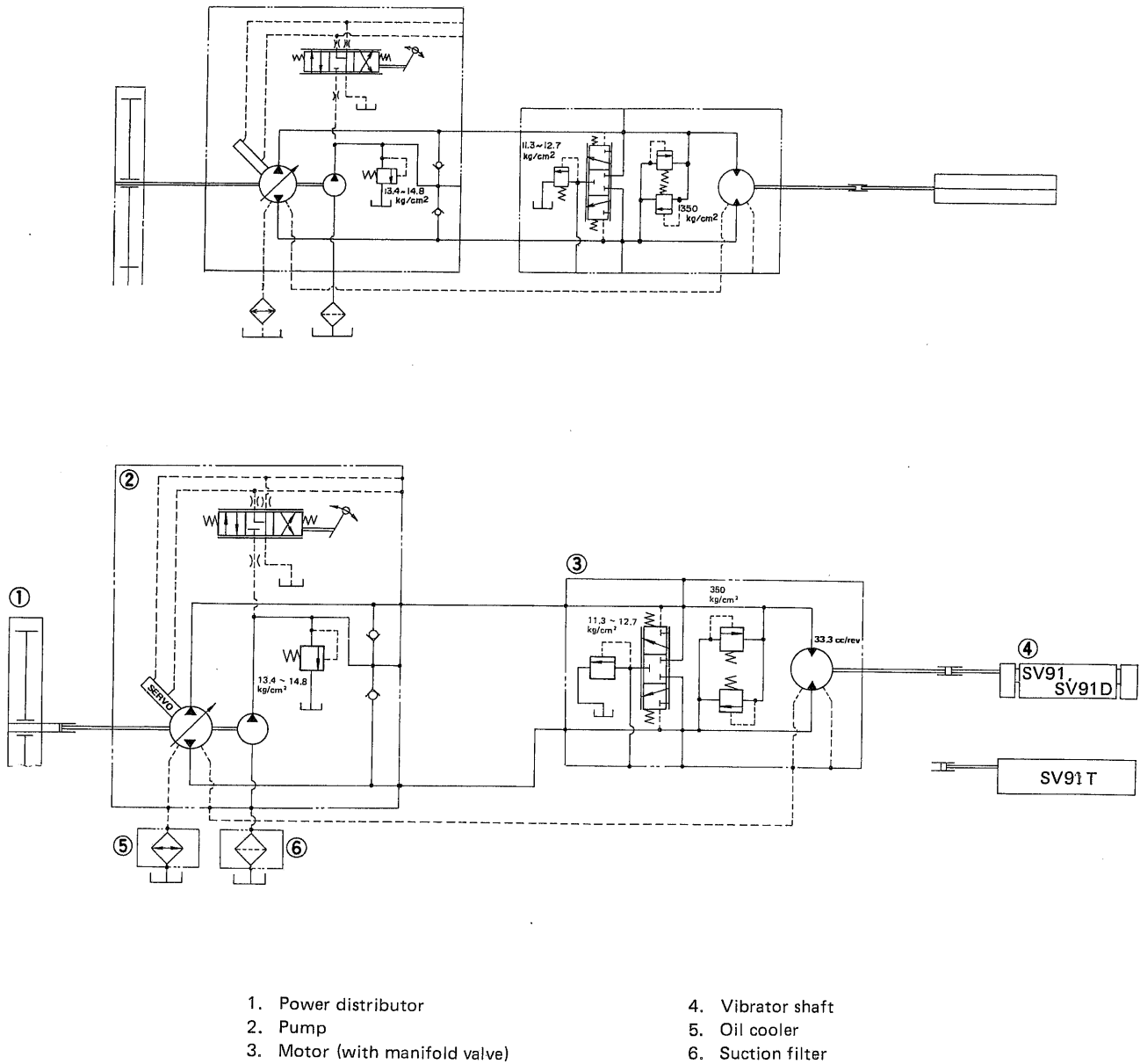


Fig. 102

## √ 7.2 Trouble Shooting

See "HYDROSTATIC TRANSMISSION (PROPULSION)" on page 17.

## 7.3 Inspection

For trouble shooting guide, check the following as necessary.

### (1) Hydraulic pump (Fig. 103)

Checking item	Standard value
Delivery (max.)	51.6 cc/rev.
Rated pressure	350 kg/cm <sup>2</sup>
Maximum pressure inside casing	2.8 kg/cm <sup>2</sup>
Rated fluid flow through Check valve	37.8ℓ/min.
Charge relief valve opening pressure	13.4 – 14.8 kg/cm <sup>2</sup>

A: Gage port to check charge pressure (7/16-20UNF-2B O-ring boss)

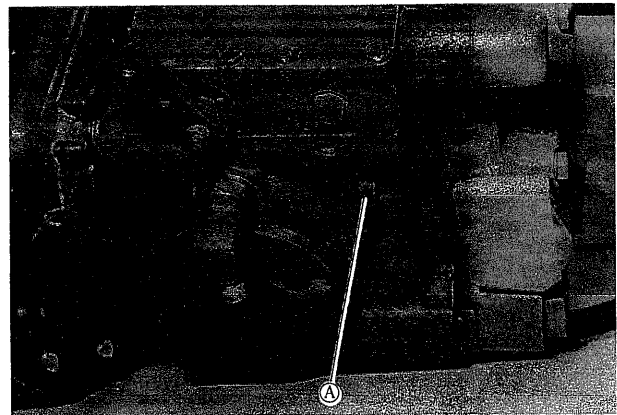


Fig. 103

### (2) Hydraulic motor (Fig. 104)

Checking item	Standard value
Max. intake	51.6 cc/rev.
Charge relief valve opening pressure	11.3 – 12.7 kg/cm <sup>2</sup>
High relief valve opening pressure	350 kg/cm <sup>2</sup>

A, B: High pressure gage ports  
C: Charge pressure port (7/16-20UNF-2B O-ring boss)

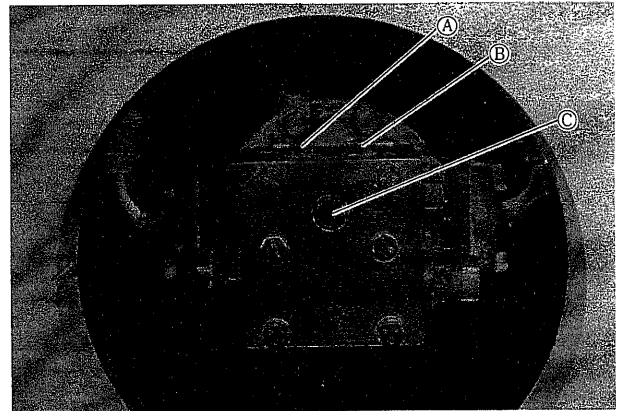


Fig. 104

## 7.4 Maintenance

See "HYDROSTATIC TRANSMISSION (PROPULSION)" on page 17.

## 7.5 Adjustment

For neutral position adjustment after completion of assembly, proceed as follows: (Fig. 105)

- (1) With pump free, install control lever ① at an angle of 30 degrees.
- (2) Set vibrator lever ② in neutral, and install rod ③.
- (3) After installation make certain that neutral position is correctly adjusted. If not, loosen lock nuts and turn rod ③ in either direction.

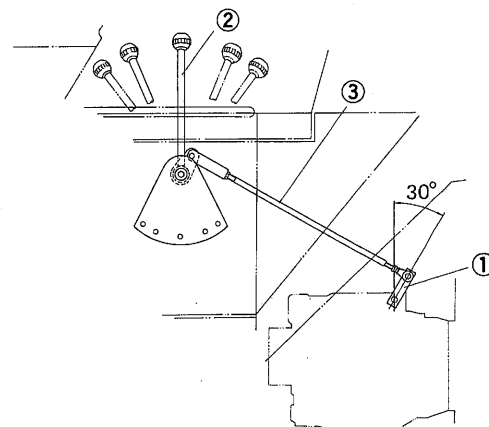


Fig. 105



## 8. STEERING SYSTEM

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## ✓ 8. STEERING SYSTEM

### 8.1 General

Steering system is of an articulated type with power assistance. Operation of steering wheel actuates control valve (Orbitrol) to admit hydraulic fluid under pressure from pump to steering cylinders, causing Machine to fold left or right at its center. Thus steering is performed.

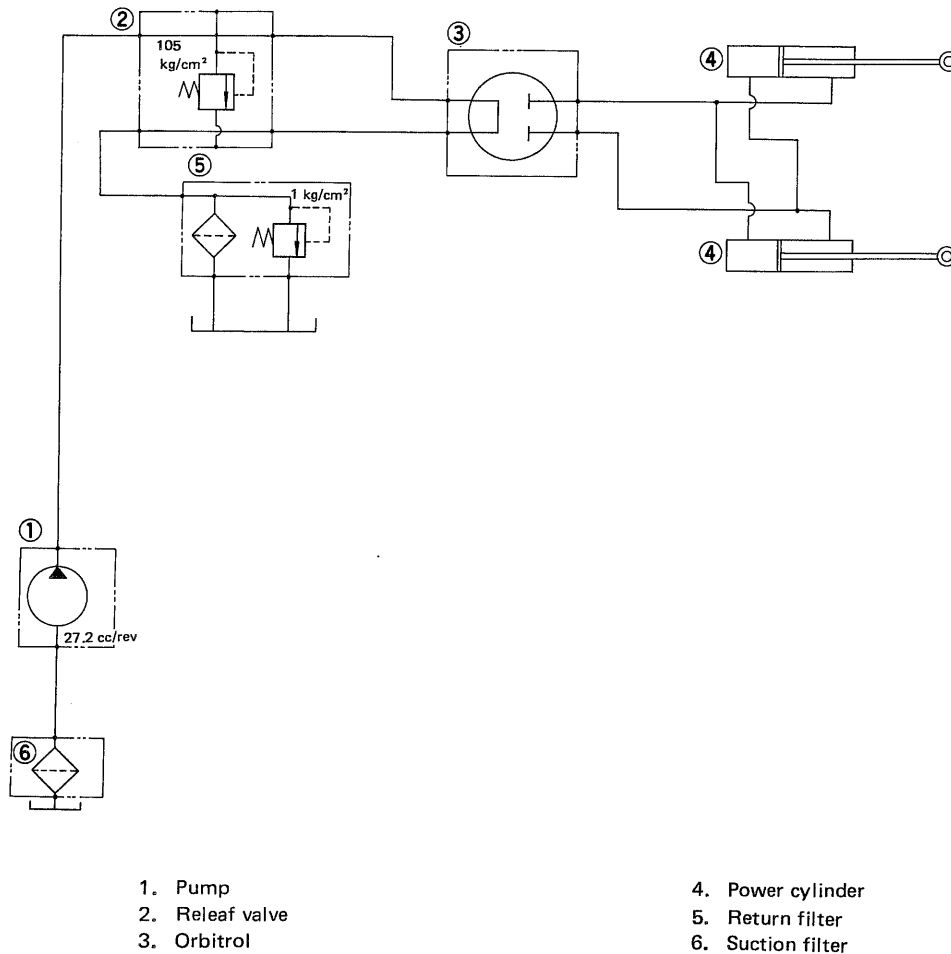
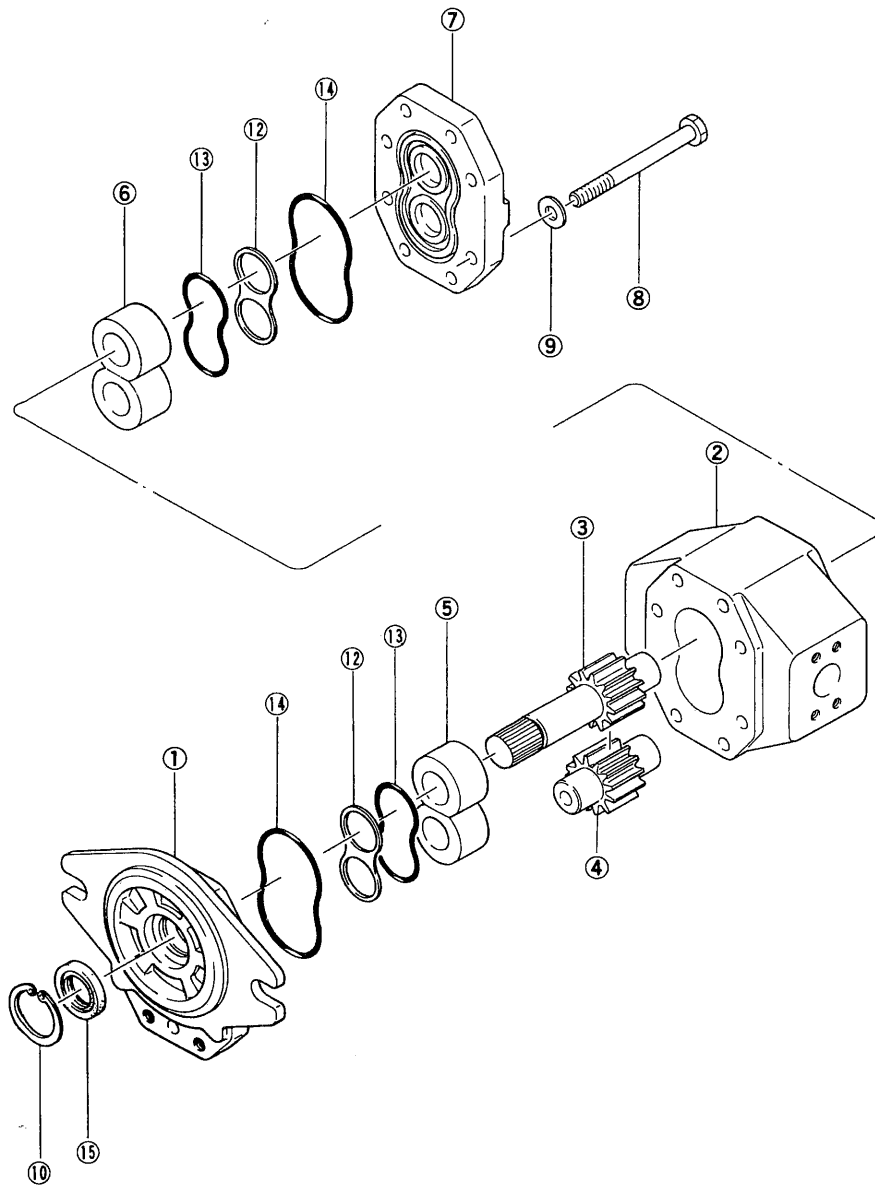


Fig. 106

### 8.2 Trouble Shooting

Trouble	Cause	Remedy
Hard steering.	<ol style="list-style-type: none"> <li>1. Oil leaking at hose joint</li> <li>2. Pump delivery pressure too low or insufficient delivery.</li> <li>3. Control valve (Orbitrol) defective.</li> <li>4. Leaky steering cylinder.</li> <li>5. Insufficient hydraulic fluid in reservoir.</li> <li>6. Cylinder defective.</li> <li>7. Center pin damaged.</li> </ol>	<p>Retighten or replace. Check, adjust or replace valve.</p> <p>Replace. Replace. Add fluid. Replace. Replace.</p>
Steering wheel shimmy.	<ol style="list-style-type: none"> <li>1. Air in hydraulic fluid</li> <li>2. Pulsating pump</li> <li>3. Control valve (Orbitrol) defective.</li> </ol>	<p>Bleed. Adjust or replace. Replace.</p>
Oil leaks.	<ol style="list-style-type: none"> <li>1. Loose connections.</li> <li>2. Cylinder seals defective.</li> <li>3. Pump seals defective.</li> </ol>	<p>Tighten. Replace seals. Replace seals.</p>

### 8.3 Hydraulic Pump



- |            |                 |                  |
|------------|-----------------|------------------|
| 1. Cover   | 6. Bearing      | 12. Back-up ring |
| 2. Body    | 7. Cover        | 13. Gasket       |
| 3. Gear    | 8. Bolt         | 14. Gasket       |
| 4. Gear    | 9. Washer       | 15. Oil seal     |
| 5. Bearing | 10. C-snap ring |                  |

Fig. 107

(1) Removal

- 1) Remove hoses ① and ②. (Fig. 108)

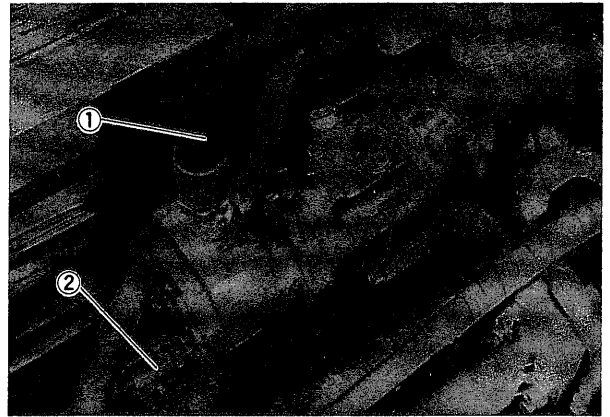


Fig. 108

- 2) Remove bolts ① and take out pump ②. (Fig. 109)

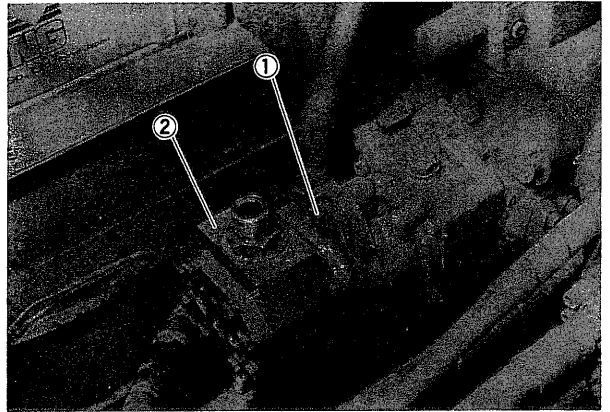


Fig. 109

(2) Disassembly

- 1) Remove bolts ⑧ and remove cover ⑦.

**CAUTION:**

Before disassembling, mark cover ⑦, body ② and cover ① for reassembly. (Fig. 109)

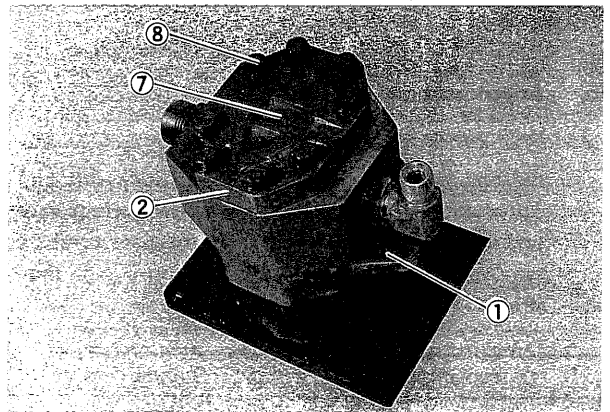


Fig. 110

- 2) Separate body ② together with bearings ⑤. (Fig. 111)

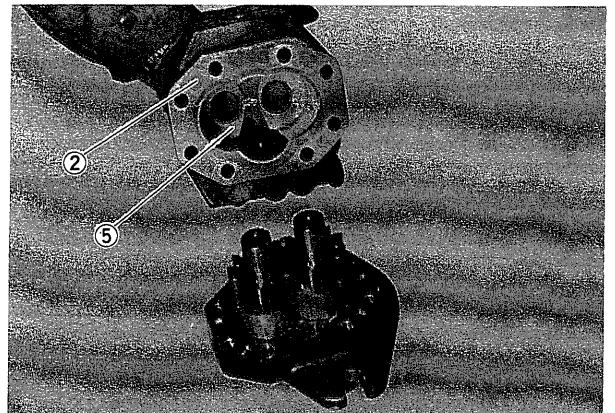


Fig. 111

- 3) Take off gears ③ and ④ along with bearing ⑤. (Fig. 112)

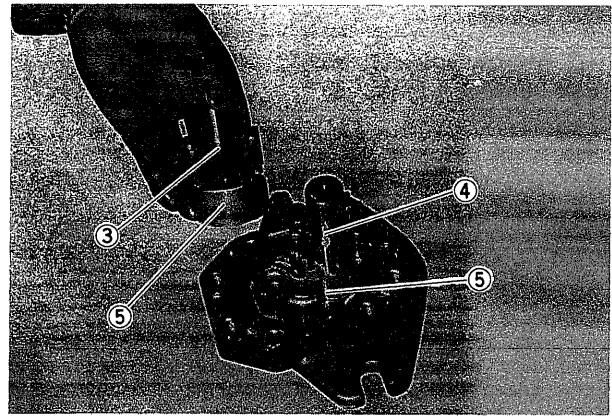


Fig. 112

**(3) Inspection**

- 1) Examine sliding surfaces of gears ①, ② and case ③. If excessive or abnormal wear is noticeable, replace. (Fig. 113)
- 2) Examine sliding surfaces of gears and bearings ④, ⑤. Replace parts with damage or excessive wear. (Fig. 113)
- 3) Inspect seating surfaces of valve seat ⑤ and body ⑥ for scores or excessive wear. Also check for fatigued springs. Replace if abnormal. (Fig. 114)

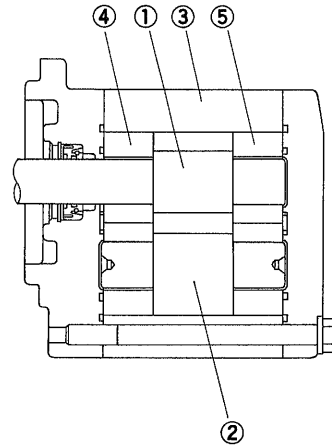


Fig. 113

**(4) Reassembly**

Reverse disassembly procedure.

**(5) Adjustment and bleeding**

- 1) High pressure relief valve

Remove cap nut ① and loosen lock nut ②. Turn adjust bolt ③ so as to allow correct valve opening pressure (Fig. 114). To measure pressure, remove plug ④ and connect pressure gage there. (Fig. 114, Fig. 115)

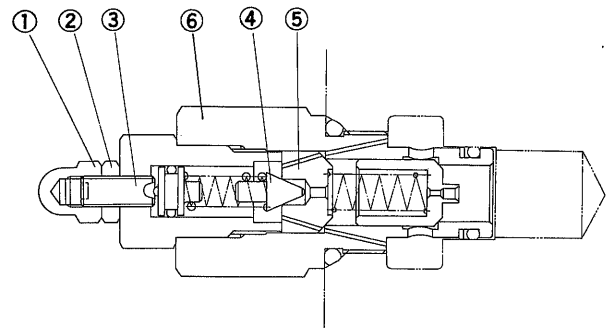


Fig. 114

Inspection item	Standard value
Relief valve opening pressure	105 kg/cm <sup>2</sup>

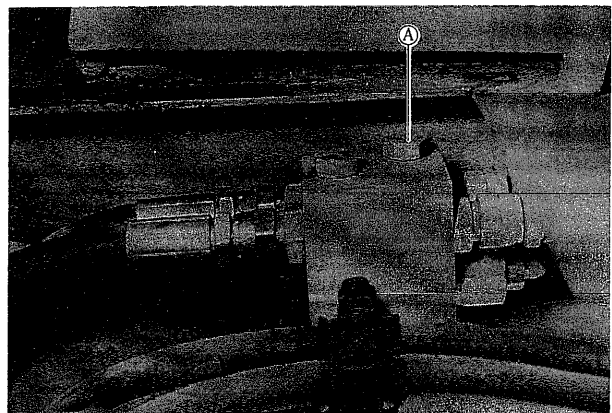
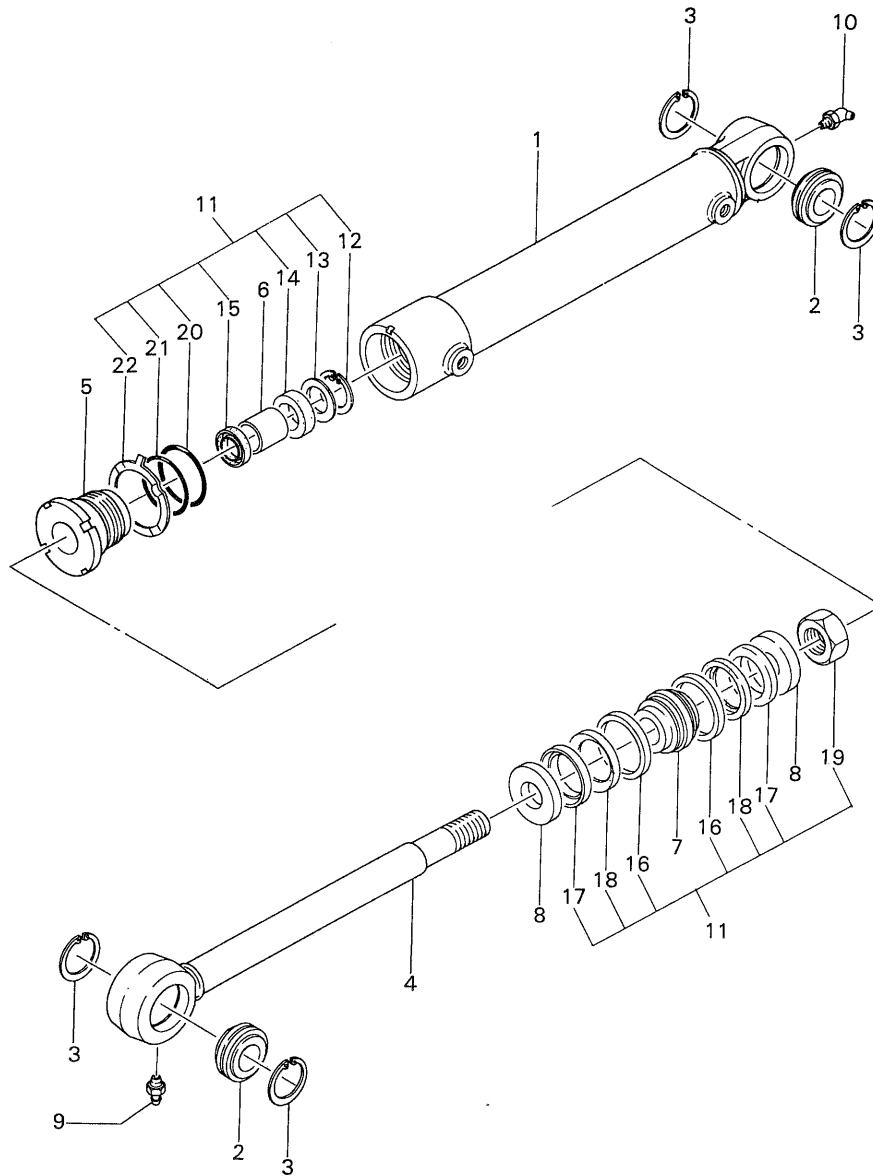


Fig. 115

## 8.4 Cylinder



- |                      |                      |
|----------------------|----------------------|
| 1. Cylinder Ass'y    | 12. C-retaining ring |
| 2. Spherical bearing | 13. Packing header   |
| 3. C-retaining ring  | 14. Back up ring     |
| 4. Piston rod        | 15. Dust seal        |
| 5. Cylinder head     | 16. Piston ring      |
| 6. Bush              | 17. Back up ring     |
| 7. Piston            | 18. Packing          |
| 8. Holder            | 19. Nut              |
| 9. Grease nipple     | 20. O-ring           |
| 10. Grease nipple    | 21. O-ring           |
| 11. Repair kit       | 22. Lock washer      |

Fig. 116

### 8.4.1 Disassembly

- (1) Mount cylinder in vise. Pull piston rod (4) part way about 150 mm. (Fig. 117)

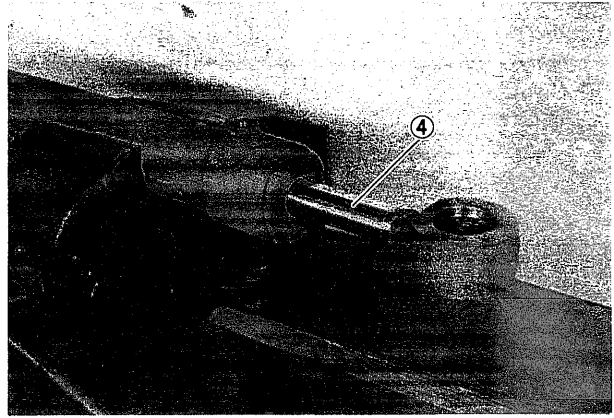


Fig. 117

- (2) Flatten out lock washer (22), screw out and remove cylinder head (5) from cylinder and pull off piston rod assembly. (Fig. 118)

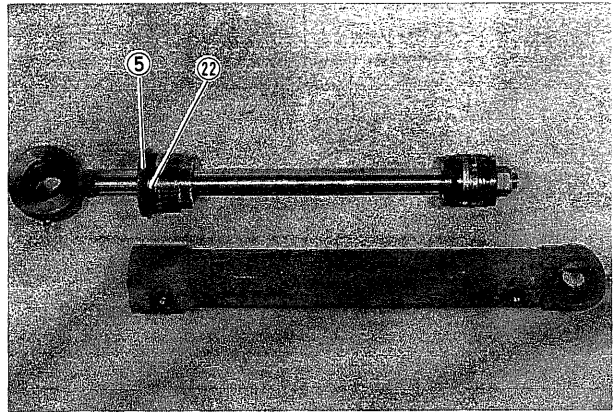


Fig. 118

- (3) Remove nut (19) and separate piston assembly.
- (4) Remove O-rings (20), (21) from cylinder head. Take off retaining ring (12) from inside of cylinder head and remove packing header (13), back-up ring (14), bush (6) and dust seal (15).
- (5) Remove piston rings (16), back-up ring (17) and packing (18) from piston.
- (6) Remove spherical bearing (2) from piston rod and cylinder. (Fig. 116)

### 8.4.2 Inspection

- (1) Inspect piston rod and cylinder inner surface for scores. Correct slight scores. Replace whole cylinder assembly if repair is not reasonable.
- (2) Check the piston rod for bending. Replace it if amount of bending is beyond limit.

Item to be checked	Standard value	Limit for use
Bending of rod	Below 0.03 mm	0.08 mm

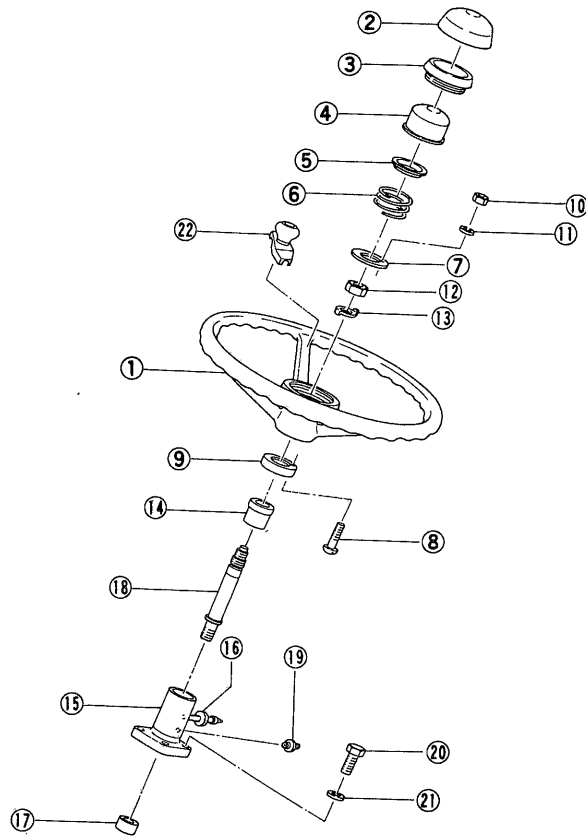
### 8.4.3 Reassembly

Reverse disassembly procedure. Discard all seals such as oil seals and O-rings.

Tightening torque of nut (19)	39 – 57 kg-m
-------------------------------	--------------



## 8.5 Steering Wheel



- |                     |                       |
|---------------------|-----------------------|
| 1. Steering wheel   | 12. Nut               |
| 2. Cap              | 13. Lock washer       |
| 3. Retainer         | 14. Column bush       |
| 4. Horn cap         | 15. Pipe              |
| 5. Contact plate    | 16. Grommet           |
| 6. Spring           | 17. Collar            |
| 7. Contact ring     | 18. Steering shaft    |
| 8. Bolt             | 19. Grease nipple     |
| 9. Connecting plate | 20. Bolt              |
| 10. Nut             | 21. Spring washer     |
| 11. Spring washer   | 22. Handle knob Ass'y |

Fig. 119

### 8.5.1 Disassembly

- (1) Take off cap (2) and retainer (3) by hand. Take out cap (4) contact plate (5) and spring (6) (Fig. 119, Fig. 120)

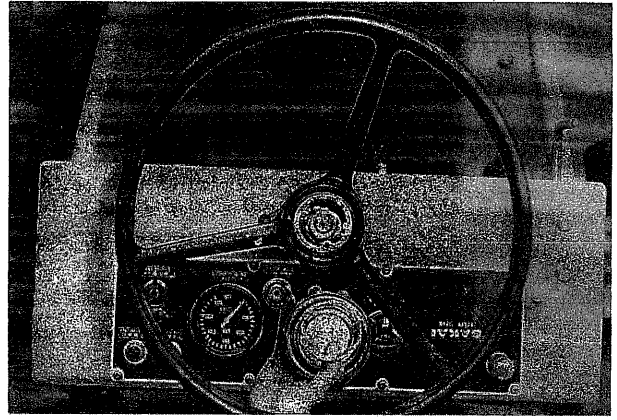


Fig. 120

- (2) Remove nut (12) and lockwasher (13). Separate steering wheel (1). (Fig. 119, Fig. 121)

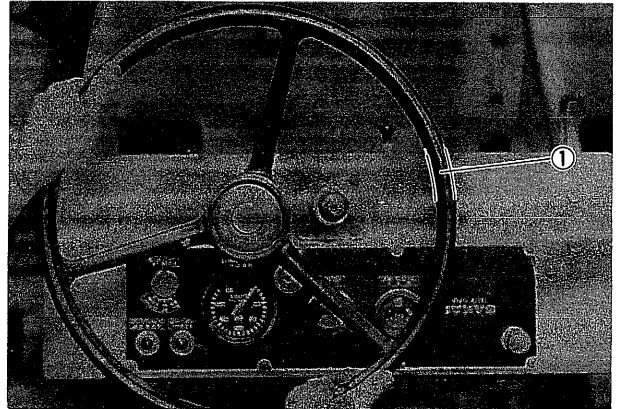


Fig. 121

- (3) Remove bolts (20), dismount pipe (15), shaft (18), column bushing (14) as one body. (Fig. 119, Fig. 122)

**CAUTION:**

Do not lose collar (17).

Hold Orbitrol (control valve) with hand, since bolts (20) secure Orbitrol to pipe (15).

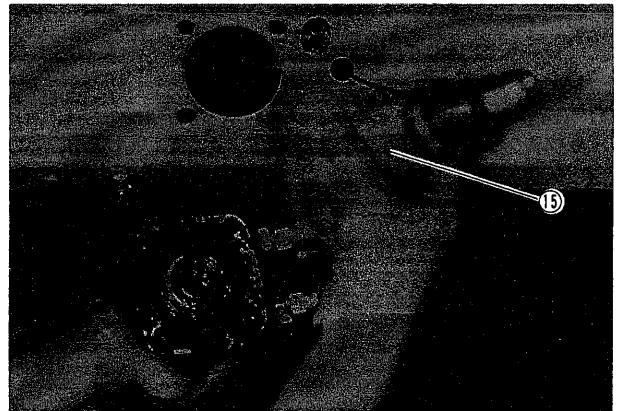


Fig. 122

- (4) Take off contact ring (7) by removing nut (10). (Fig. 123)

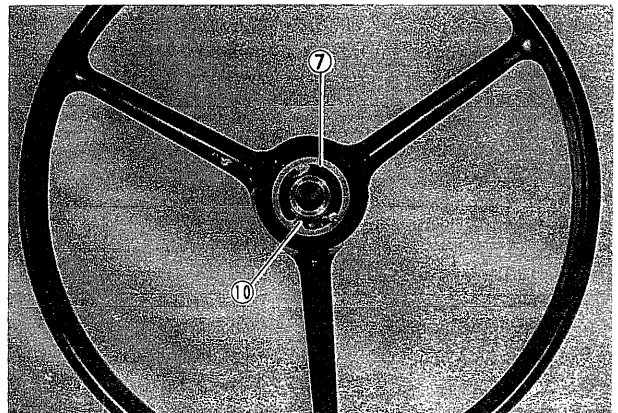
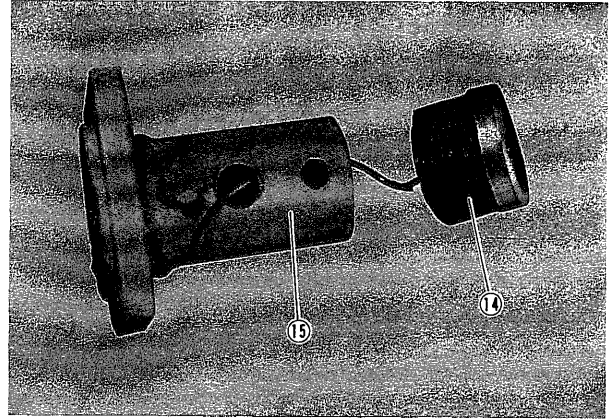


Fig. 123

- (5) Separate column bushing (14) from pipe (15) .  
(Fig. 124)

**CAUTION:**

Be careful not to cut electric line.



**Fig. 124**

**8.5.2 Inspection**

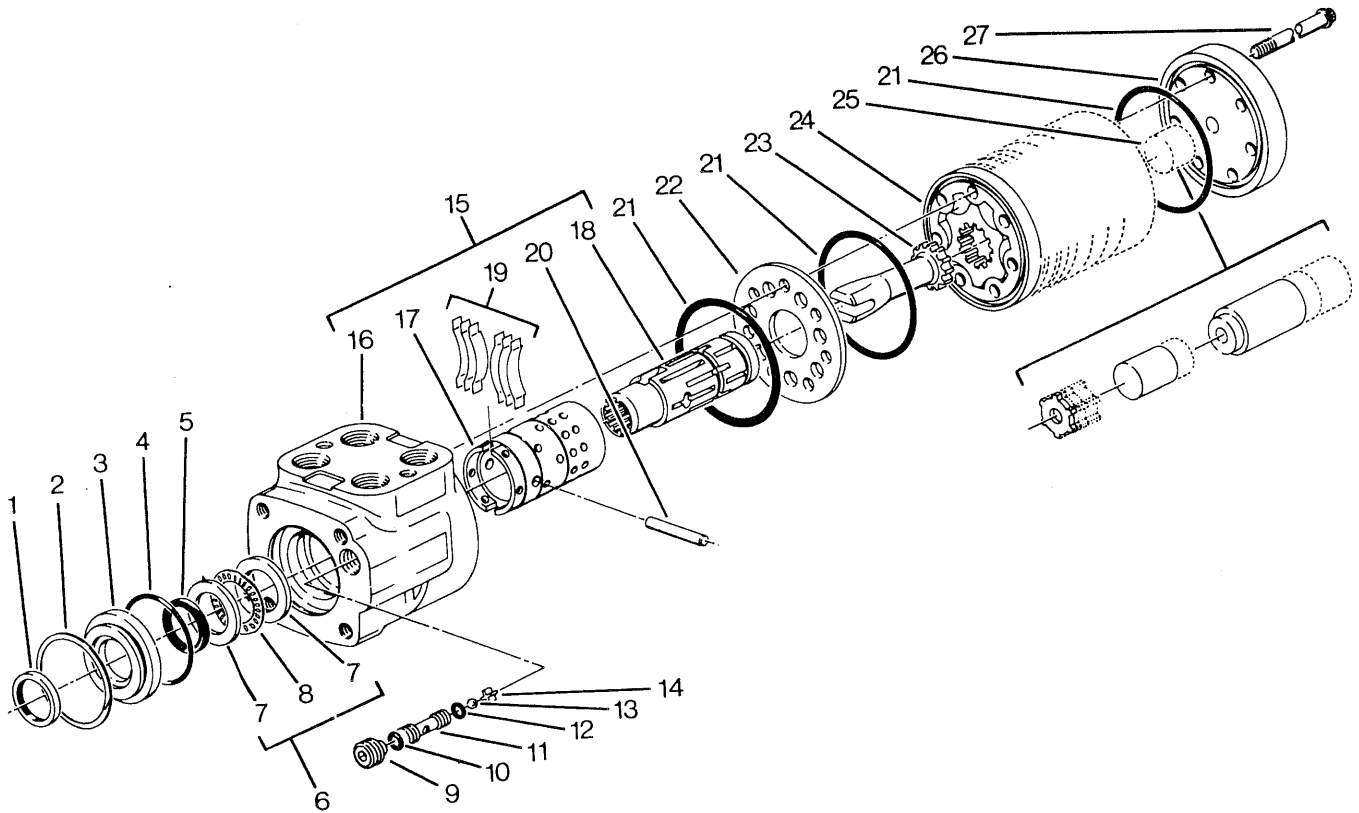
- (1) Inspect spline portions on splined shaft (18). Replace it if step wear is noticeable.
- (2) Inspect connecting plate (9) and contact plate (5). If rusty, correct or replace. (Fig. 119)

**8.5.3 Reassembly**

Reverse disassembly procedure. After reassembly, check for steering wheel play. If play is beyond specified value, worn spline or faulty Orbitrol is a possible cause. Reinspect and correct.

Steering wheel play in rotating direction	10 – 30 mm
---	------------

## 8.6 Orbitrol



- |                       |                         |                      |
|-----------------------|-------------------------|----------------------|
| 1. Dust seal          | 10. O-ring              | 19. Centering spring |
| 2. Retaining ring     | 11. Check seat          | 20. Pin              |
| 3. Seal grand bushing | 12. O-ring              | 21. O-ring           |
| 4. O-ring             | 13. Ball                | 22. Spacer plate     |
| 5. Oil seal           | 14. Check ball retainer | 23. Drive shaft      |
| 6. Needle bearing kit | 15. Control parts ass'y | 24. Rotor set        |
| 7. Bearing race       | 16. Housing             | 25. Spacer           |
| 8. Needle thrust      | 17. Control sleeve      | 26. End cap          |
| 9. Set screw          | 18. Control spool       | 27. Screw            |

Fig. 125

### 8.6.1 Disassembly

When servicing bearing units, the most important is cleanliness. Conduct services in a clean work shop. Clean around connections when disconnecting piping from hydraulic units. Remove accumulated dust around joints using a wire brush.

#### NOTE:

Few of the following sketches are shown clamped in a vise, however, use vise as often as practicable when disassembling.

- (1) Mount unit in a vise with rotor up.

#### CAUTION:

Clamp mounting flange lightly by applying copper plates (Fig. 126)

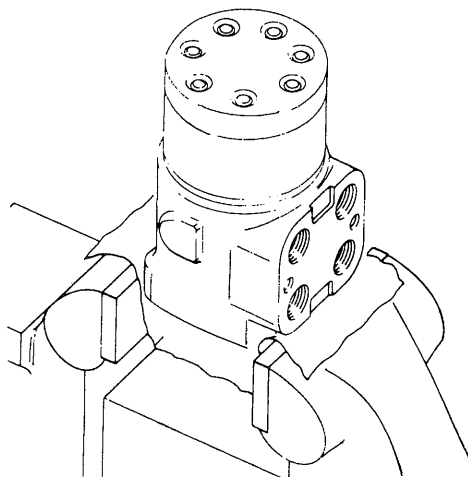


Fig. 126

- (2) Remove seven 5/16-inch screws (27) (Fig. 127)
- (3) Separate end cap (26) (Fig. 127)
- (4) Remove O-ring (21) from end cap (26) (Fig. 127)

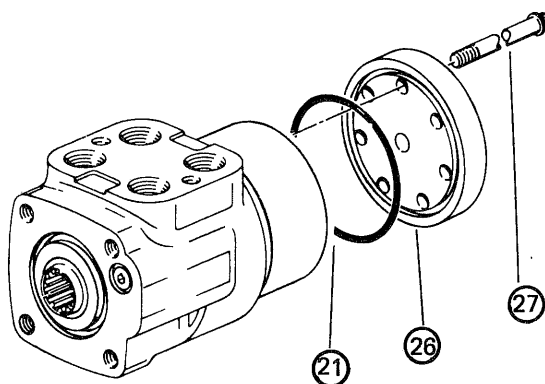


Fig. 127

- (5) Separate rotor assembly (24) being careful not to drop star (star-shaped splined rotor) (Fig. 128)
- (6) Remove O-ring (21) from rotor set (24) (Fig. 128)
- (7) Remove spacer (25) (not used for model B – oil flow 73 cc/rev.) (Fig. 128)

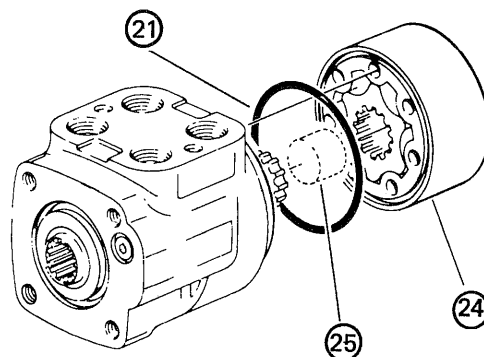


Fig. 128

- (8) Remove drive (23) (Fig. 129).
- (9) Separate spacer plate (22) (Fig. 129).
- (10) Remove O-ring (21) from housing (16) (Fig. 129).

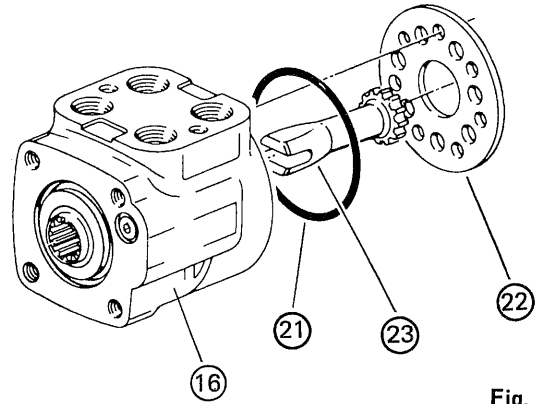


Fig. 129

**Control Disassembly**

- (11) Dismount housing from vise and place on a clean cloth being careful not to damage machined surfaces.  
Lever up end of retaining ring (2) using a small screw driver and remove the retaining ring. (Fig. 130)

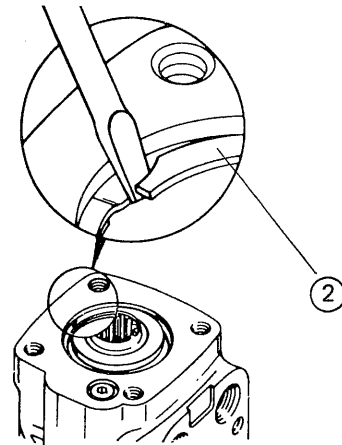


Fig. 130

- (12) Turn spool-sleeve assembly (17) (18) until pin (20) is in horizontal position (Fig. 125). Then push spool-sleeve assembly (Fig. 134) by thumb and separate seal grand bushing (3) from housing (Fig. 131, Fig. 134).

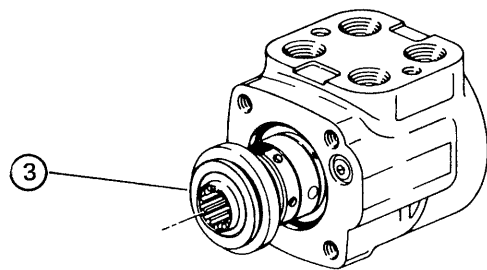


Fig. 131

- (13) Remove X-ring seal (5) from seal grand bushing (3) (Fig. 132).

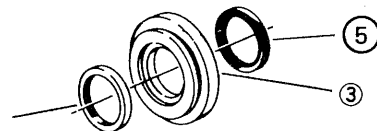


Fig. 132

- (14) Separate dust seal (1) from bushing (3) using a screw driver (Fig. 132).

**CAUTION:**

Be careful not to damage bushing (3).

- (15) Separate two bearing races (7) and thrust needle (8) from spool-sleeve assembly (17) (18). (Fig. 133)

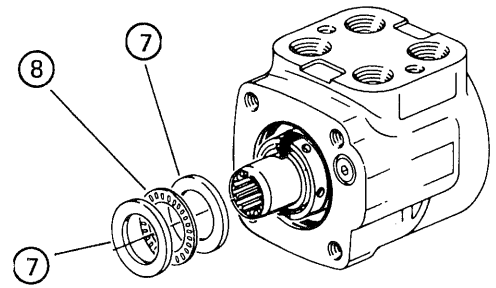


Fig. 133

- (16) Pull off spool-sleeve assembly (17) (18) from housing as shown (Fig. 134) while slowly turning the assembly clockwise and counterclockwise.

**CAUTION:**

Be careful not to allow spool-sleeve assembly (17) (18) to stick in housing.

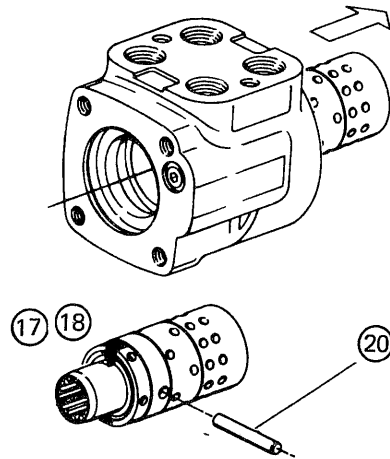


Fig. 134

- (17) Remove pin from spool-sleeve assembly (17) (18) (Fig. 134)

- (18) Drive spool (18) part way from sleeve (17) and remove six centering springs (19) carefully by hand (Fig. 135)

- (19) Drive off spool (18) in the opposite direction (Fig. 135)

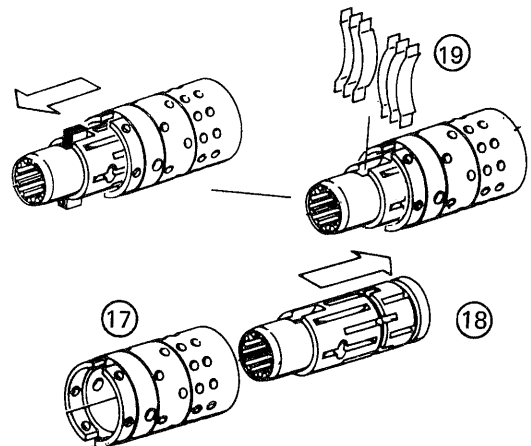


Fig. 135

- (20) Remove O-ring (4) from housing (Fig. 136)

- (21) Remove set screw (9) from housing (Fig. 136) The set screw has been locked by Seal Lock to prevent going loose.

- (22) Screw thread (No. 10-24) into check seat (11) and pull off from housing (Fig. 136)

- (23) Remove two O-rings (10), (12) from check seat (11).

- (24) Separate ball (13) and check ball retainer (14) from housing by tapping housing.

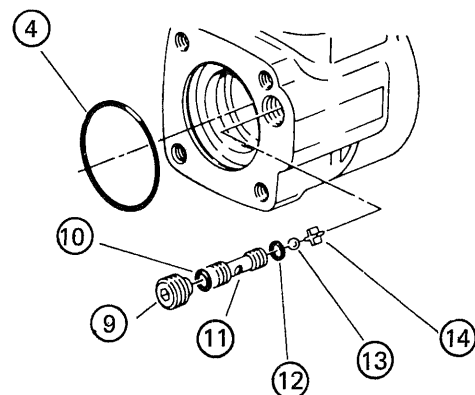


Fig. 136

### 8.6.2 Reassembly

Check fitting surfaces and replace parts with scratches or burrs, since they may cause fluid leakage. Clean all metal parts in a clean solvent and dry with compressed air.

Avoid cleaning with paper or cloth, as strings or pieces of paper might enter into complicated hydraulic system, causing troubles. Also never file or rub with coarse sand paper.

Lubricate all seals and O-rings with grease. New X-ring seal does not need grease lubrication when reassembling. Apply only a thin coat of grease on O-ring for rotor set.

When reassembling, all O-rings and seals should be replaced with new ones.

#### Control Reassembly

- (1) Put check ball retainer (14) into check valve hole in housing using a pincette. Make certain that retainer (14) is correctly in valve hole (Fig. 137).
- (2) Put check ball (13) into the same hole (Fig. 137).
- (3) Put 7.6 mm diameter O-ring (12) and 9.3 mm diameter O-ring (10) in place (Fig. 137).

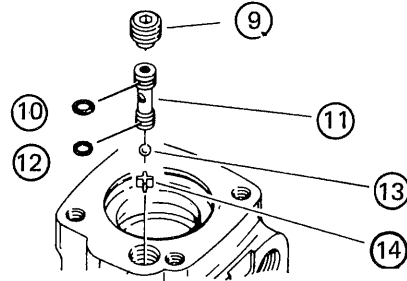


Fig. 137

- (4) Assemble check seat (11) into housing with hole side down, and drive until it would not go farther. Be careful not to damage O-rings (10) and (12) (Fig. 31).
- (5) Apply Locktight No. 242 on set screw (9) and tighten to 1.2 kg-m. Make certain that set screw (9) is slightly below housing surface.
- (6) Slide control spool (18) into control sleeve (17) by turning spool and making certain that spring notches align. For assembling control spool (18) and sleeve (17) that have positioning marks, utilize these marks for positioning (Fig. 138).

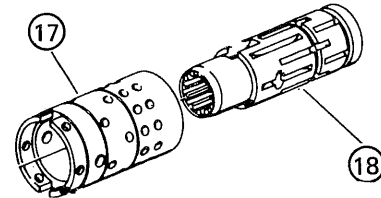


Fig. 138

- (7) Place spool-sleeve assembly (17) (18) on work bench with spring side up. Insert spring (19) into spring notches using a tool (No. 600057) as follows:  
Insert six springs (19) (with each spring notch down) into tool (No. 600057) so that three of them may be arranged back to back with other three. Lifting spool (18) slightly from sleeve (17) will make the insertion easy (Fig. 139).

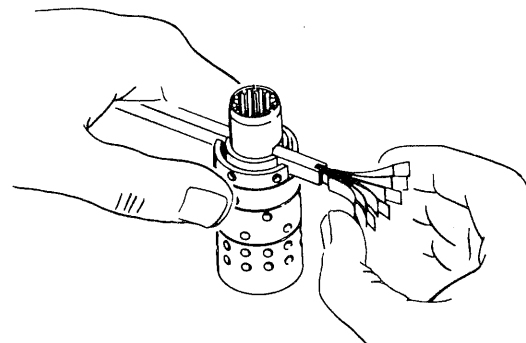


Fig. 139



- (8) Hold six springs (19) with hand, push them into spring notches together with the tool.
- (9) When springs (19) have been put into notches fully, make spring ends even, make end of spool (18) and end of sleeve (17) flush each other.
- (10) Put pin (20) into pin hole until flush with sleeve (17) (Fig. 140).

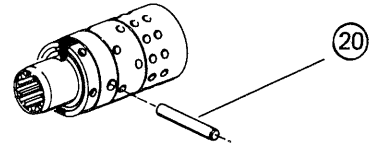


Fig. 140

- (11) Keep pin (20) horizontal and carefully slide spool-sleeve assembly (17) (18) straight into housing (Fig. 141) while slightly turning the assembly clockwise and counterclockwise until flush with rear face of housing. Then, check that the assembly can be rotated smoothly in housing.

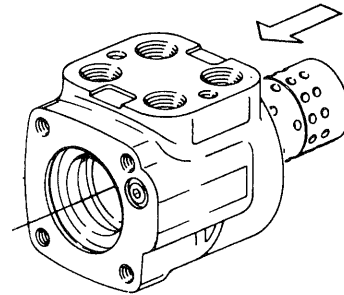


Fig. 141

- (12) Place housing on clean work bench and install 7.2 mm diameter O-rings (4) in housing (Fig. 142).

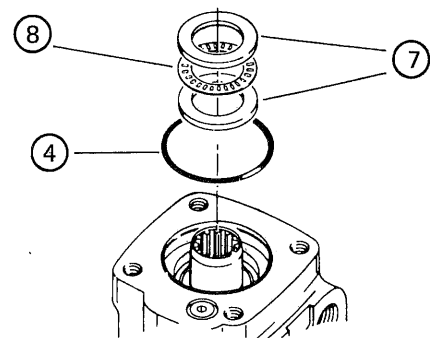


Fig. 142

- (13) Install two bearing races (7) and thrust needle (8) (Fig. 142).

- (14) Install dust seal (1) in seal ground bushing (3) with flat face of dust seal (1) toward bushing (3) (Fig. 144).

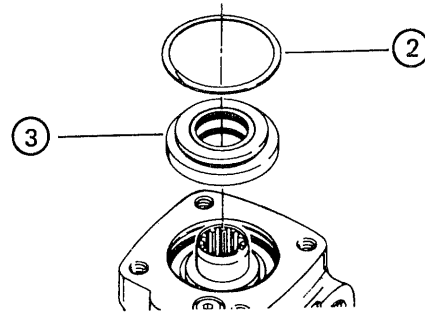


Fig. 143

- (15) Install X-ring (5) in seal grand bushing (3) evenly by holding it with fingers (Fig. 144).

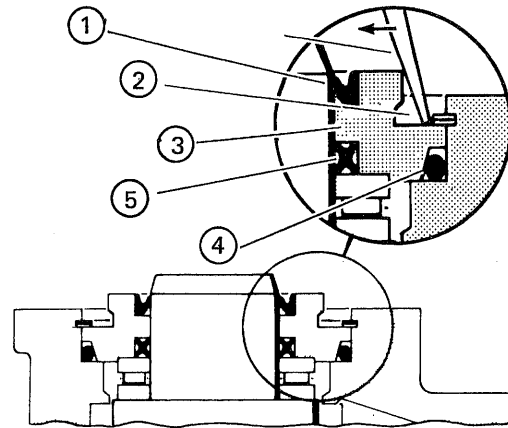


Fig. 144

- (16) Put seal grand bushing (3) into spool (17) by rotating bushing (3). Then, tap in bushing (3) using a soft hammer, until bushing (3) sits evenly on bearing race (7) (Fig. 144).
- (17) Install retaining ring (2) in housing. After installation, expand retaining ring (2) using a screw driver so that it fits correctly in groove (Fig. 114).

#### Rotor Reassembly

- (18) Clamp housing flange in a vise lightly (Fig. 145).

#### CAUTION:

Check that spool-sleeve assembly end is slightly below housing surfaces that have fourteen holes. Clean machined fitting surfaces of housing, spacer plate (22) and rotor (24) with clean hand.

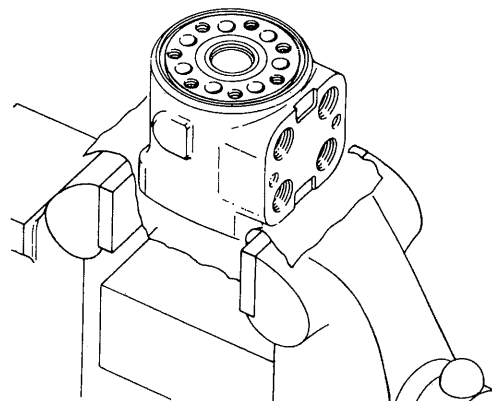


Fig. 145

- (19) Install 72.7 mm diameter O-ring (21) in housing (Fig. 146).

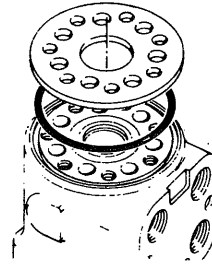


Fig. 146

- (20) Place spacer plate (22) on housing aligning screw holes in spacer plate (22) with screw holes in housing.

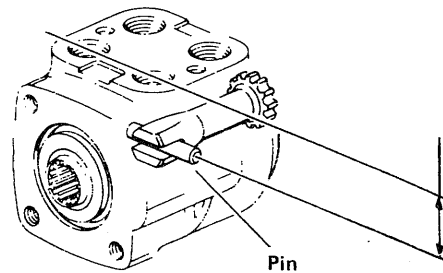


Fig. 147

- (21) Rotate spool-sleeve assembly (17) (18) to let pin (20) be parallel with port surface (Fig. 147). Insert drive (23) until drive yoke catches pin (20). For exact positioning, mark a line using a felt pen (Fig. 148).
- (22) Install O-ring (21) in rotor set (24) (Fig. 148).

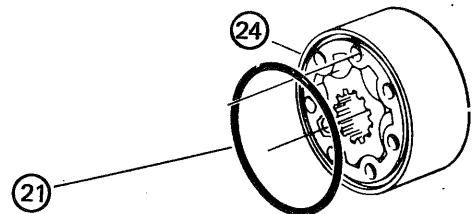


Fig. 148

- (23) Assemble rotor set (24) to housing with O-ring side toward housing aligning bottom lands of star (line A in Fig. 149) with top lands of drive (23) (line B in Fig. 149). Carefully check that liners A, B, C, and D are all parallel each other (Fig. 149). With star meshing with drive (23), align bolt holes in rotor set (24) with holes in spacer plate (22).

**CAUTION:**

Above procedure is very important to determine valve timing in the unit.

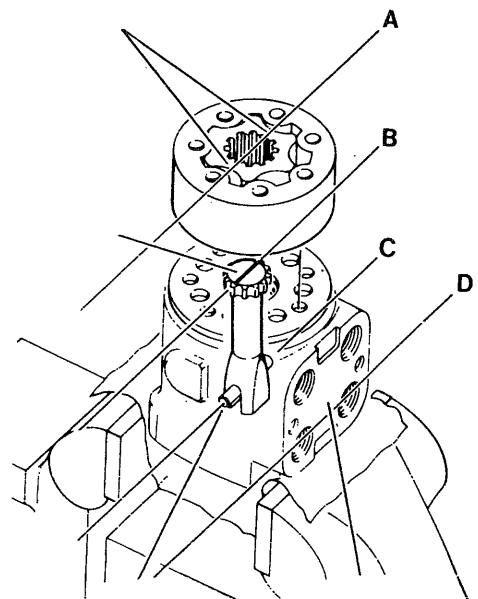


Fig. 149

(24) Put spacer (25) into rotor set (24) (Fig. 150).

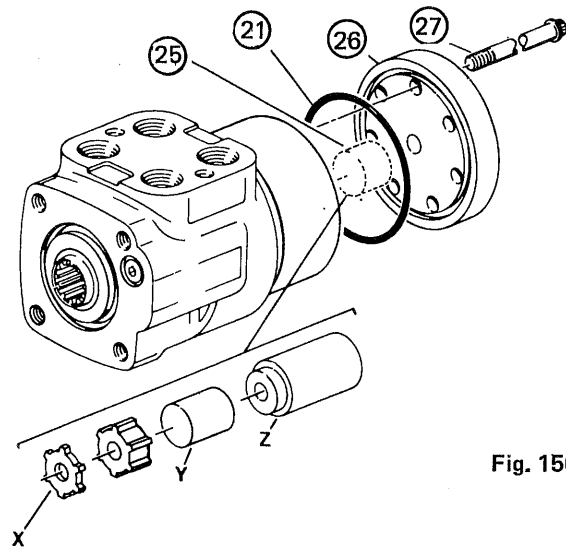


Fig. 150

(25) Install O-ring (21) in end cap (26) (Fig. 150).

(26) Place end cap (26) on rotor set (24), and align bolt holes.

(27) Lubricate seven screws (27) with oil and tighten to 1.5 kg-m. After that, tighten farther to 2.6–2.9 kg-m in sequence shown in Fig. 151.

Temporarily mount steering wheel (Fig. 125) to spool (18) and check to see if it can be rotated with ease.

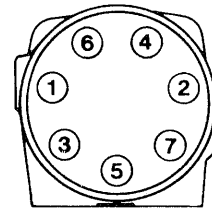
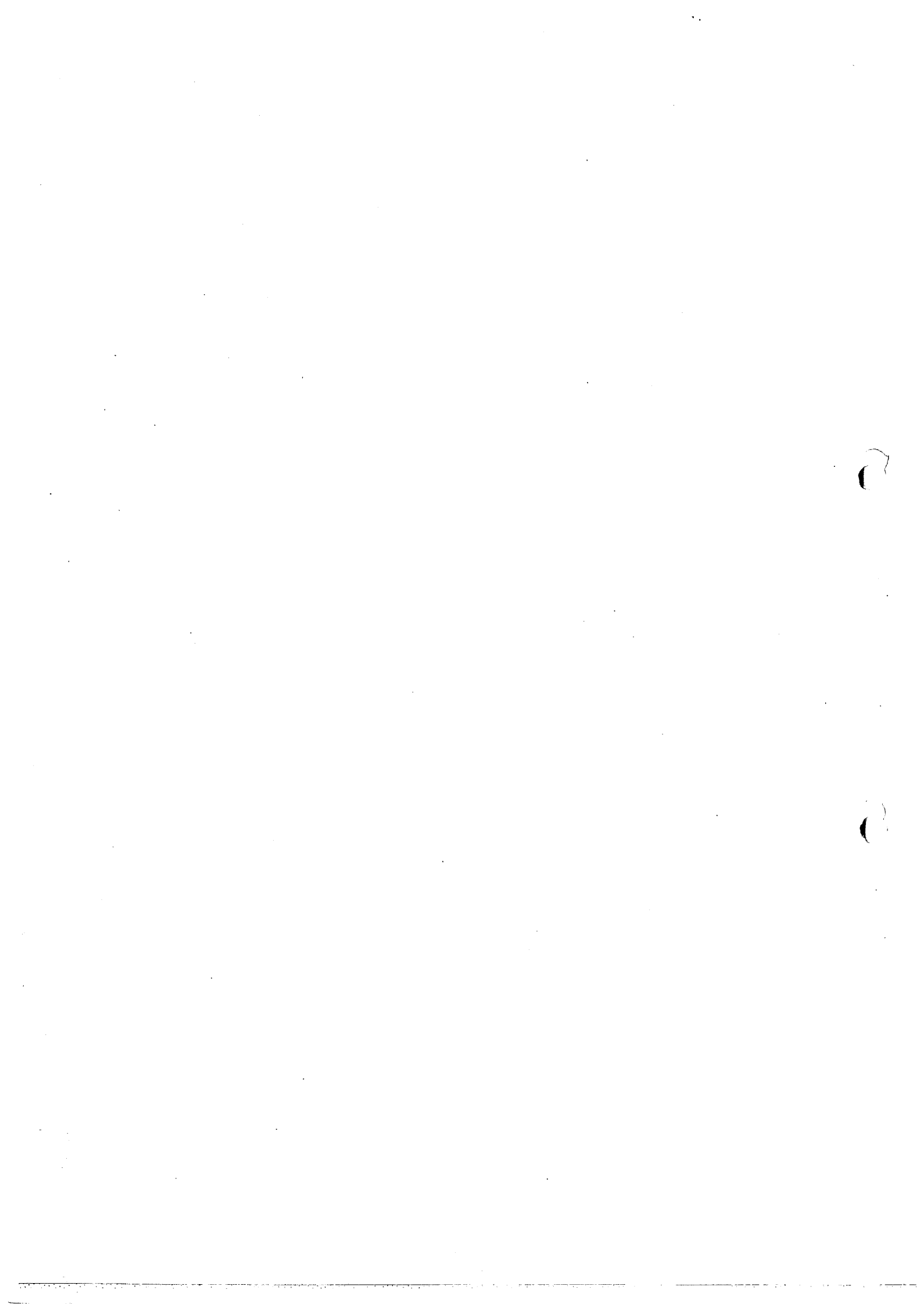


Fig. 151

## 9. BRAKE SYSTEM

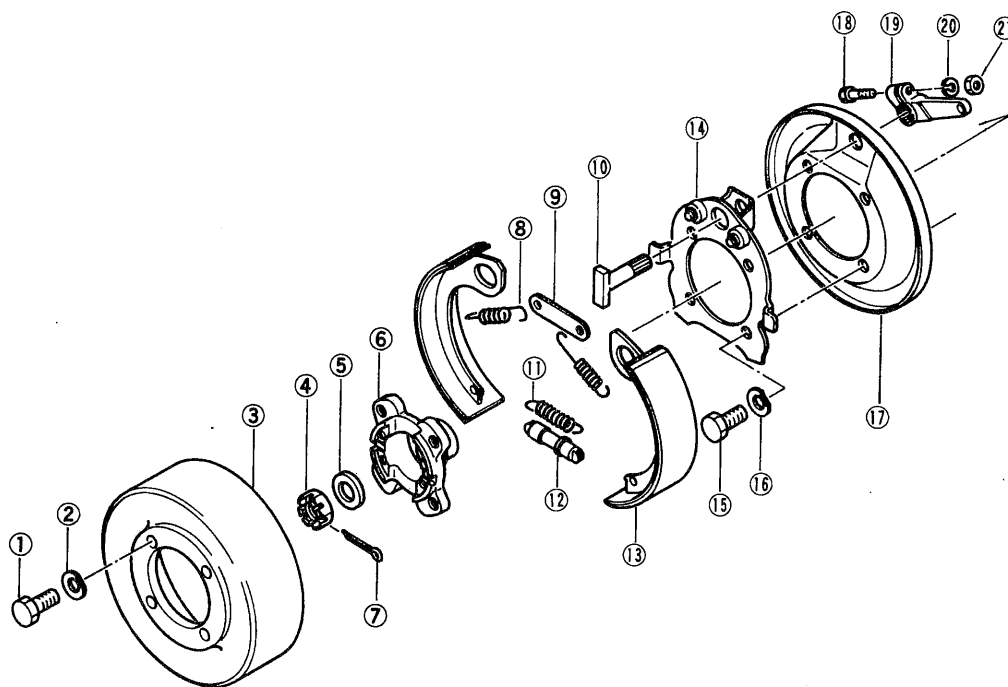
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9.6	Adjustment	100



## 9. BRAKE SYSTEM

### 9.1 General

SV91 series are propelled through a hydrostatic transmission. In this system, braking takes place when forward-reverse lever is brought to neutral. In addition, an internal expanding brake unit is mounted on input part of rear axle. Braking is achieved when brake pedal is depressed (service brake) or hand lever is operated (parking brake).



- |                   |                |                   |
|-------------------|----------------|-------------------|
| 1. Bolt           | 8. Spring      | 15. Bolt          |
| 2. Spring washer  | 9. Plate       | 16. Spring washer |
| 3. Brake drum     | 10. Cam        | 17. Plate         |
| 4. Castle nut     | 11. Spring     | 18. Bolt          |
| 5. Washer         | 12. Adjuster   | 19. Arm           |
| 6. Companion yoke | 13. Brake shoe | 20. Spring washer |
| 7. Sprit pin      | 14. Brake hub. | 21. Nut           |

Fig. 152

## 9.2 Trouble-Shooting

Trouble	Cause	Remedy
Brake inoperative	<ol style="list-style-type: none"> <li>1. Brake linkage improperly adjusted</li> <li>2. Improper lining clearance</li> <li>3. Oil or grease on linings</li> <li>4. Brake linings worn</li> <li>5. Brake drum in abnormal condition</li> </ol>	Adjust Adjust Clean or replace Replace Correct or replace
Brake dragging	<ol style="list-style-type: none"> <li>1. Brake pedal return spring fatigued or damaged</li> <li>2. Springs (inside brake unit) weakened or damaged</li> <li>3. Brake linings seized</li> </ol>	Replace Replace Disassemble and check

## 9.3 Disassembly

- (1) After removal of drive shaft, remove nut (4) and demount brake drum (3) and flange (6) as an assembly (Fig. 153).

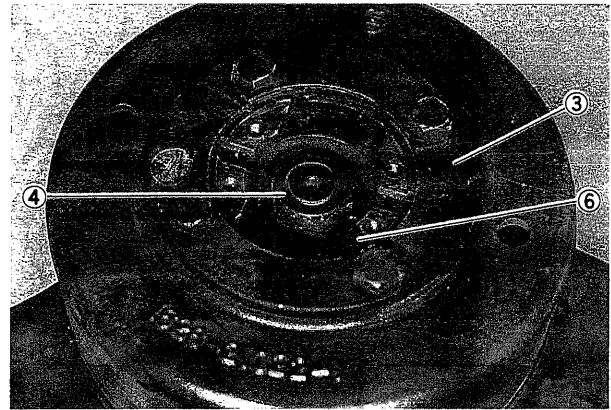


Fig. 153

- (2) Take off springs (8), (11) and remove plate (9) and adjuster (12). Then, remove brake shoes (13). (Fig. 152, Fig. 154)

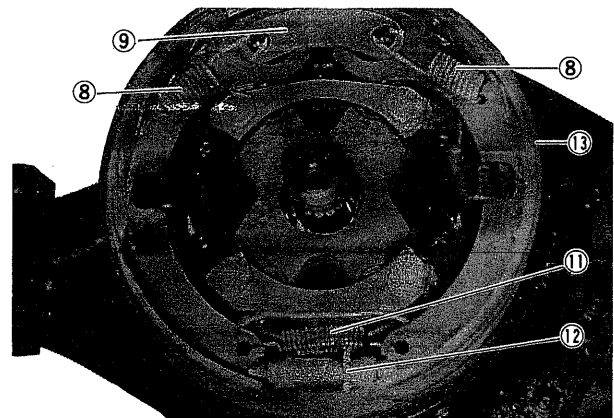


Fig. 154



## 9.4 Inspection

### (1) Brake shoe

Check brake linings for wear. Replace brake shoe assembly if cracks or abnormal wear is noticed or beyond service limit. To determine service life, measure rivet head depreciation (t) (Fig. 155).

Inspection item	Standard value	Limit for use
Rivet head depreciation	3 to 3.5 mm	0.3 mm

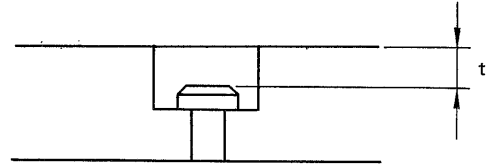


Fig. 155

### (2) Brake drum

Inspect brake drum. Replace drum that is beyond service limit or cracks, deformation or eccentric running is noticeable. To determine wear, measure inside diameter of drum (Fig. 156). To check drum runout, assemble drum to shaft and mount the assembly on a lathe and use dial indicator (Fig. 157).

Inspection item	Standard value	Limit for use
Brake drum inner dia.	304.8	305.8
Brake drum runout	Less than 0.05 mm	More than 0.2 mm

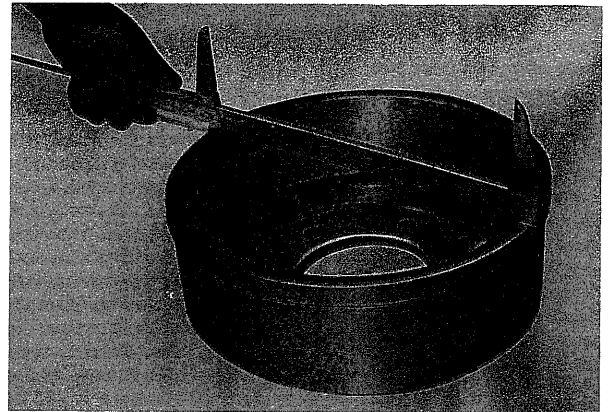


Fig. 156

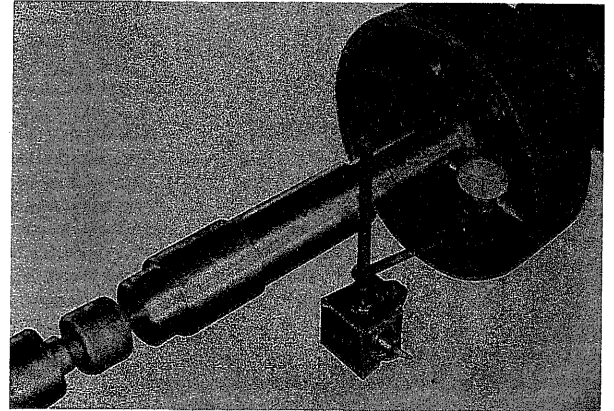


Fig. 157

## 9.5 Reassembly

Follow disassembly procedure in reverse order noting the following:

- 1) Keep brake linings out of oil or grease.
- 2) Apply a slight amount of grease on sliding portions.

## 9.6 Adjustment

### (1) Brake lining clearance

With a screw driver put into check hole, turn adjuster so that brake shoes expand until brake drums and adjuster turns no more. Then back off adjuster until correct clearance is obtained (Fig. 158).

Inspection item	Standard value
Brake lining clearance	0.1 to 0.25 mm

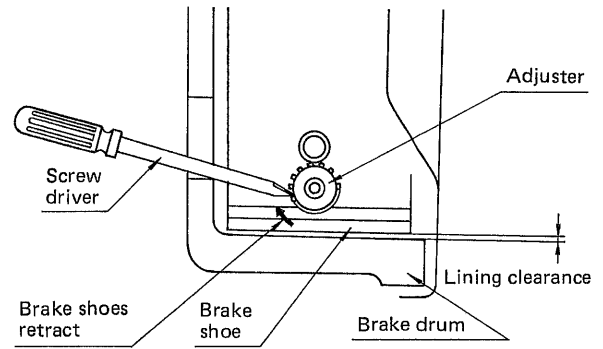


Fig. 158

### (2) Brake pedal and brake lever

#### Brake pedal

Examine brake pedal play and stroke\*. If measured values are in excess of standard values, adjust length of one of rods ①, ③ and ④. When rod ③ or ④ is adjusted, brake lever adjustment is needed (Fig. 159).

Inspection item		Standard value
Brake pedal	Play	20 to 30 mm
	Stroke*	60 mm

\* Stroke: Total stroke minus play.

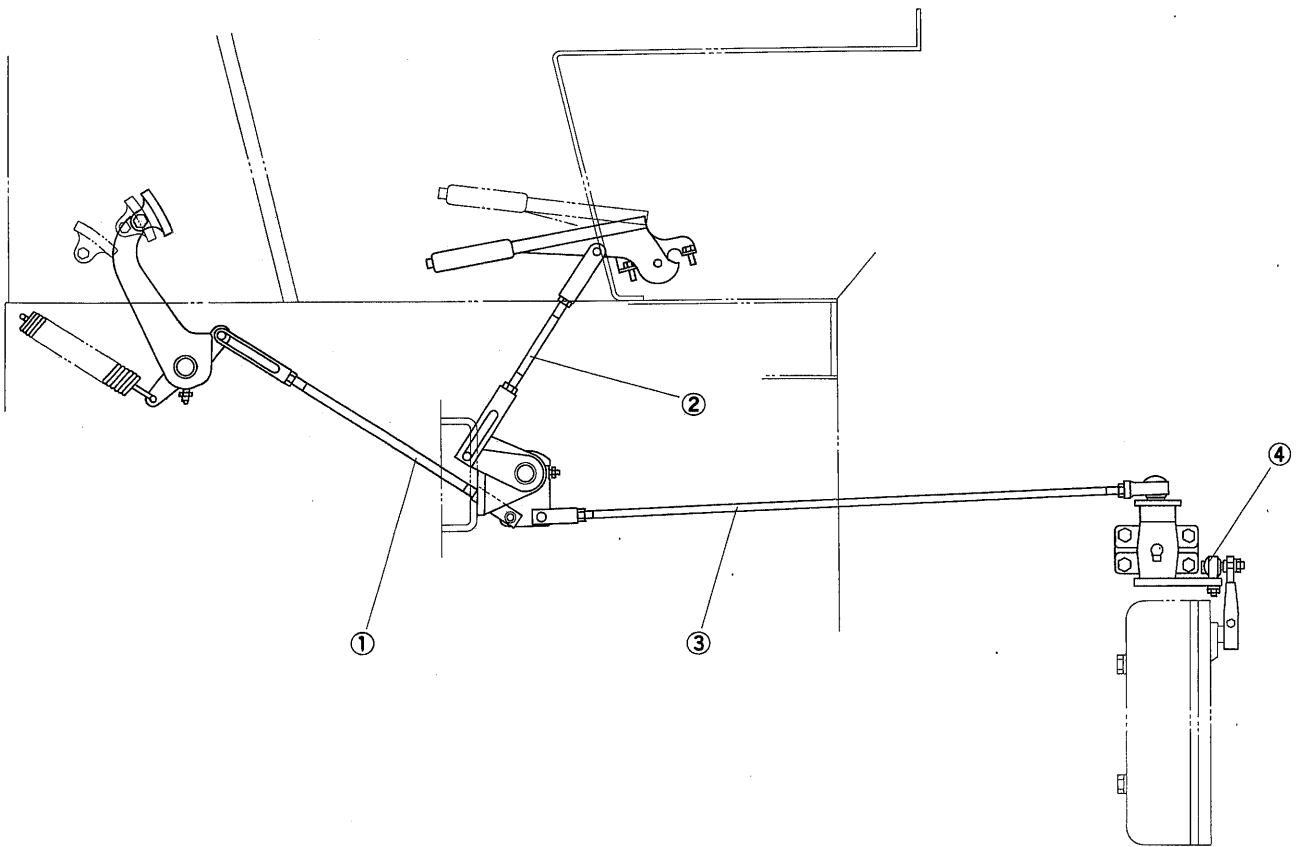
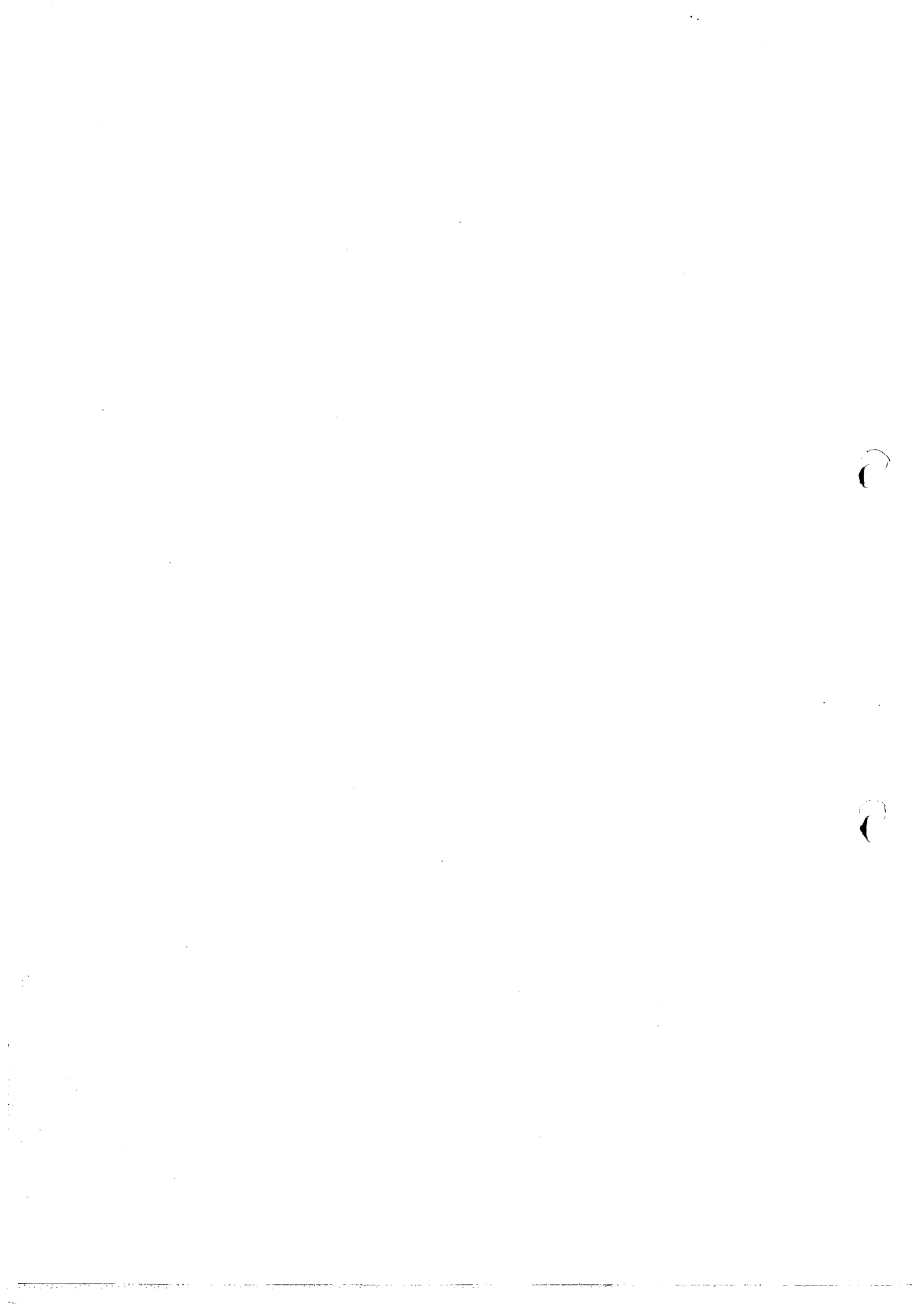


Fig. 159

## 10. SCRAPER BLADES

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## 10.1 General

Scrapers scrape off mud or asphalt mixes that have stuck to rolls. SV91T has stick-like scrapers in front of tamping roll to remove soils stuck between pads. In SV91 and SV91D synthetic resin blade is mounted on spring steel to scrape off soils or asphalt mixes stuck on roll surface.

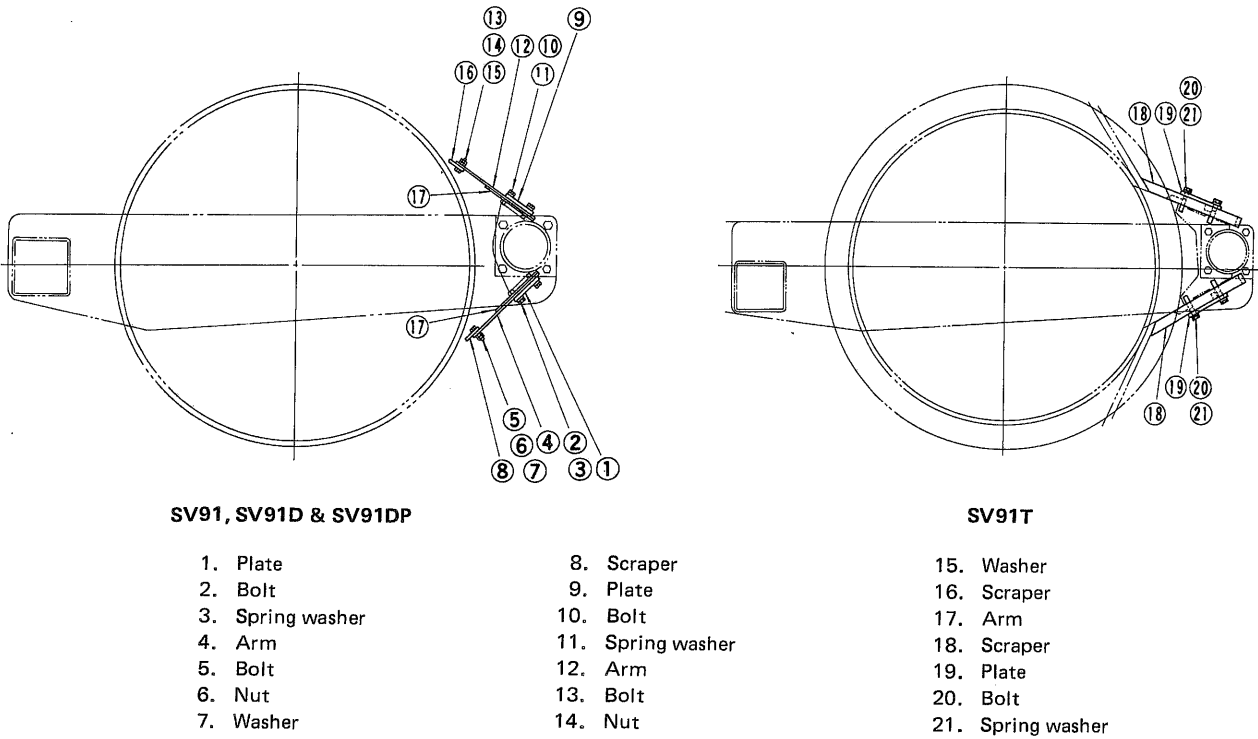


Fig. 160

## 10.2 Adjustment

### (1) SV91T

Loosen bolts (20) and move scraper (18) until proper distance (L) is provided between scraper and roll. (Fig. 160)

Inspection item	Standard value
Distance between scraper and roll (L) mm	30

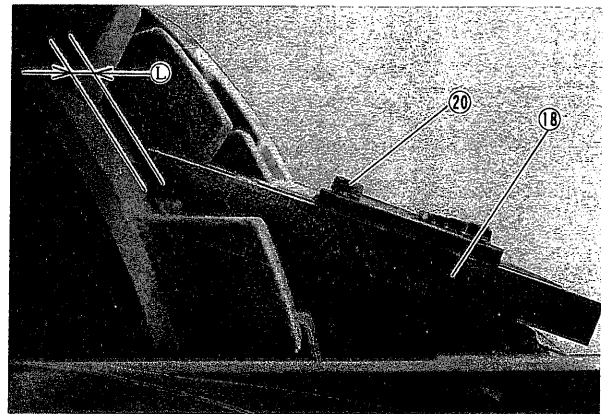


Fig. 161

### (2) SV91, SV91D & SV91DP

Loosen bolts (2) and move scraper blade (8) to provide proper clearance (L) between scraper blade and roll. (Fig. 162)

Inspection item	Standard value
Distance between blade and roll (L) mm	15

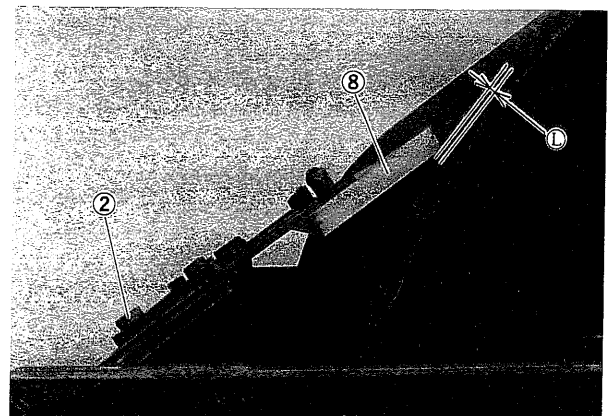


Fig. 162

# 11. HYDRAULIC CIRCUITS

## Drive system

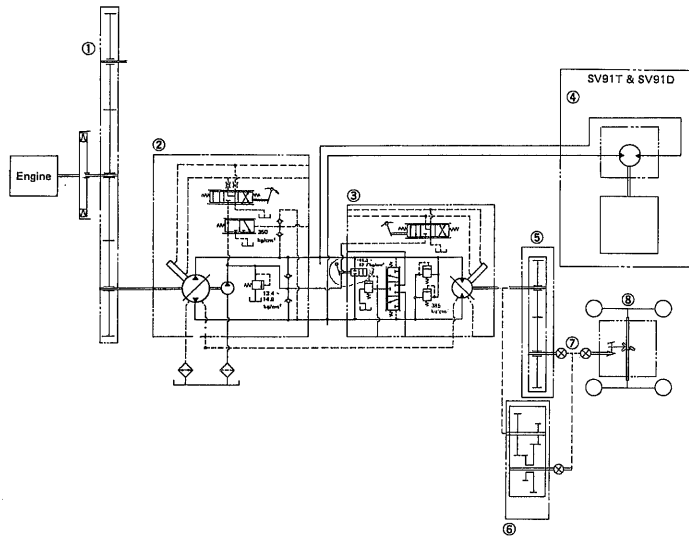


Fig. 163

## Vibrating system

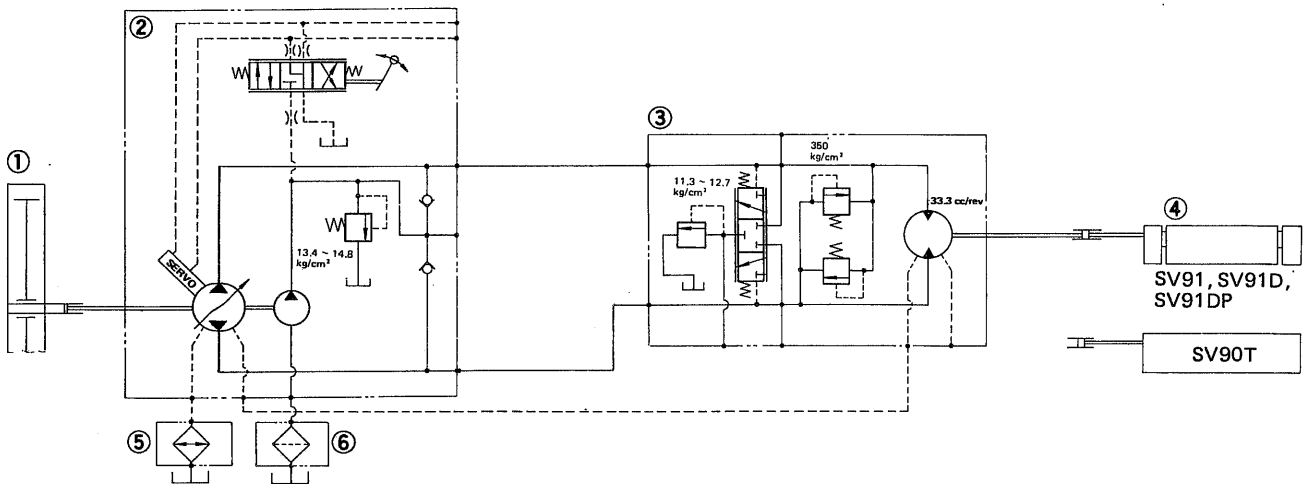


Fig. 164

## Steering system

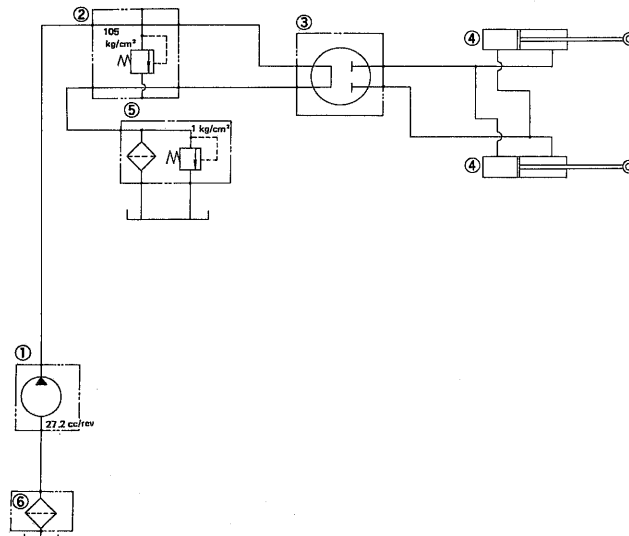
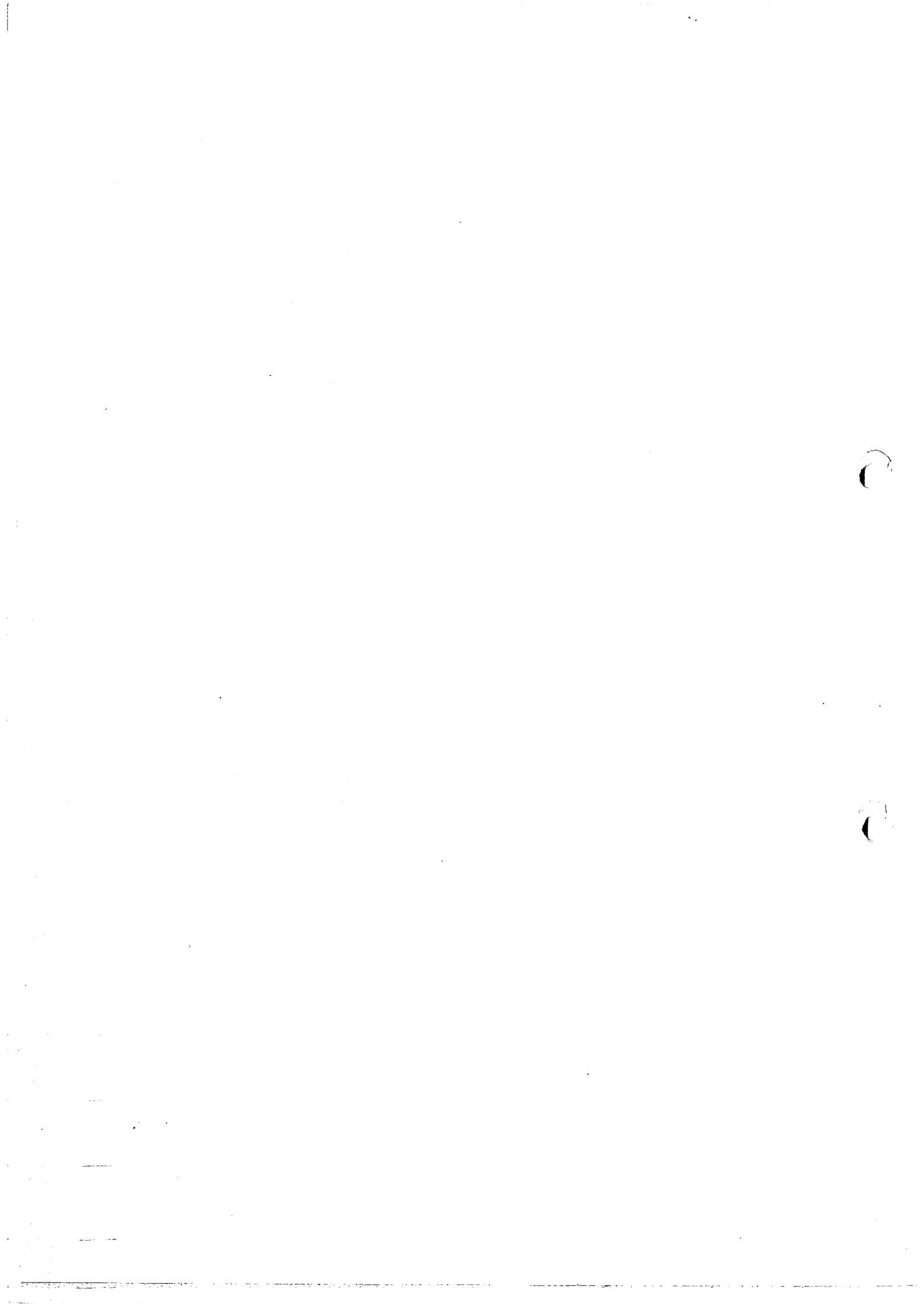


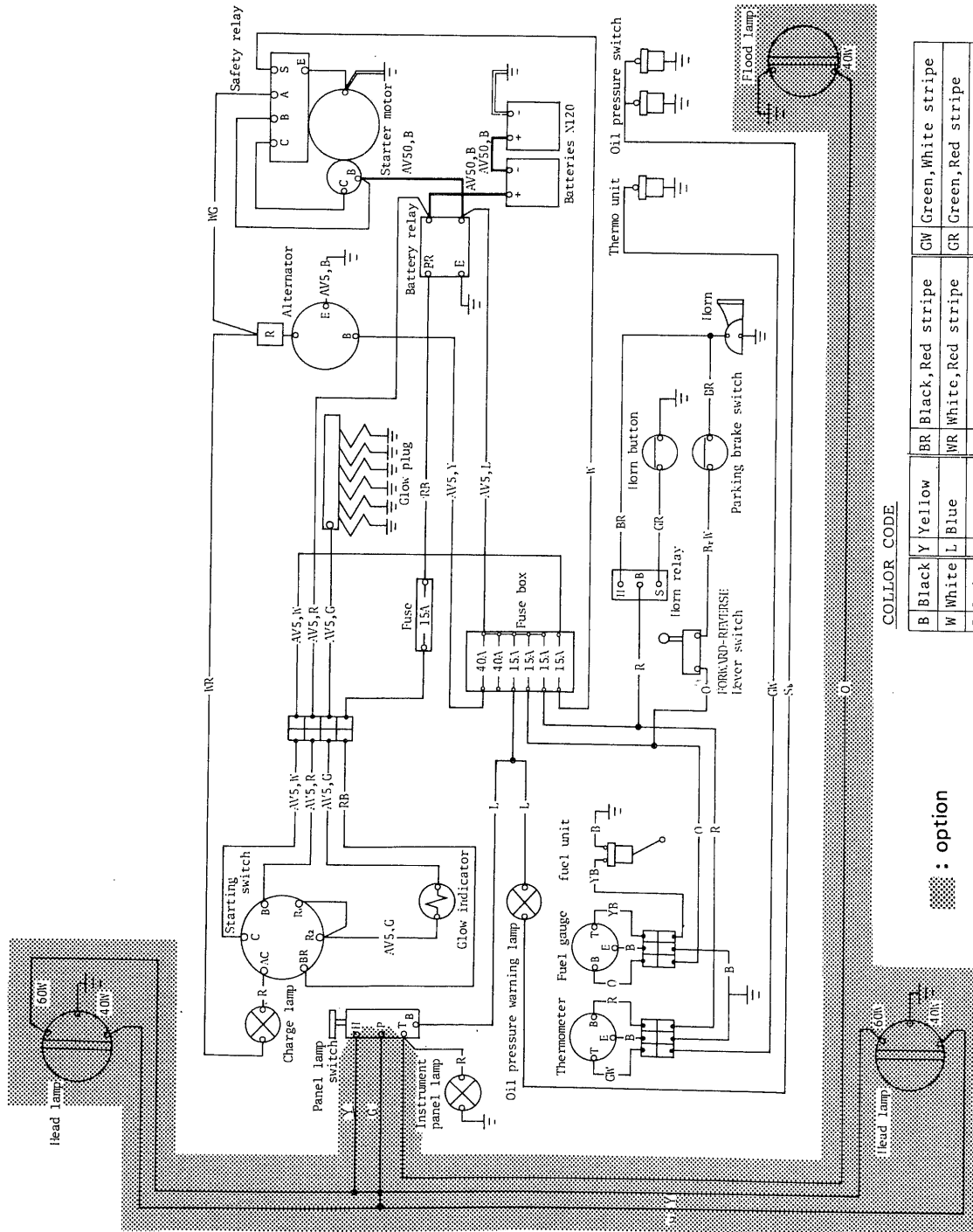
Fig. 165







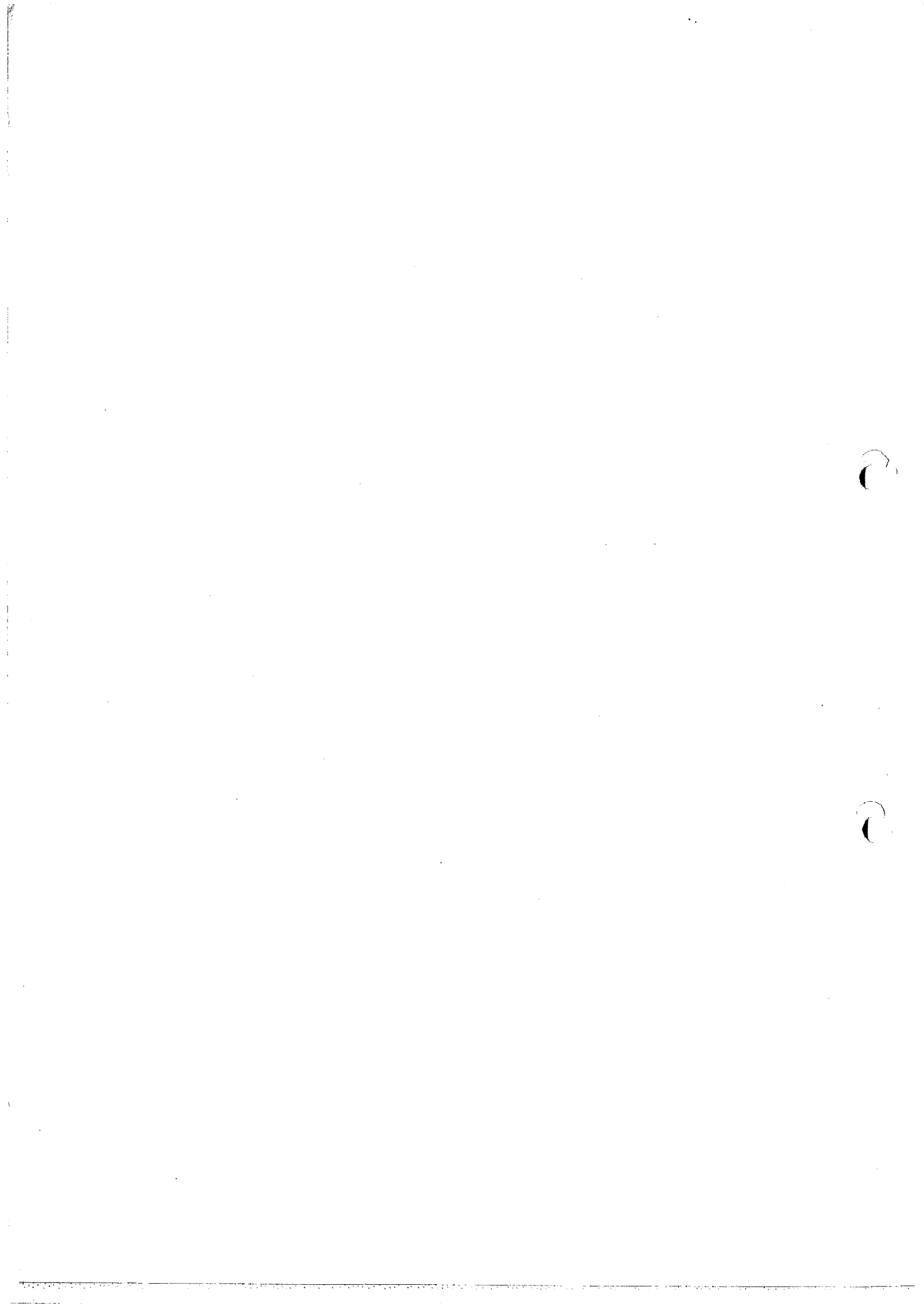
## 12. ELECTRIC WIRING DIAGRAM



COLLOR CODE

B	Black	Y	Yellow	BR	Black, Red stripe	GW	Green, White stripe
W	White	L	Blue	WR	White, Red stripe	GR	Green, Red stripe
R	Red	O	Orange	WG	White, Green stripe	YB	Yellow, Black stripe
G	Green	S	Sky blue	RB	Red, Black stripe	BW	Brown, White stripe

: option



# STANDARD OF USABLE LIMIT FOR ANTI-FRICTION-TYPE BEARINGS

## Service limit for antifriction-type bearings

The service limits for antifriction-type bearings must be determined by inspecting the outer and inner races, rolling members (rollers, balls, needles), and retainers in respect to the conditions specified below.

1. External appearance
2. Rotating condition, noise
3. Radial clearance

### 1. External appearance

#### a) Flaking

Flaking is surface exfoliation of the race way due to fatigue through repeated contact with loads,

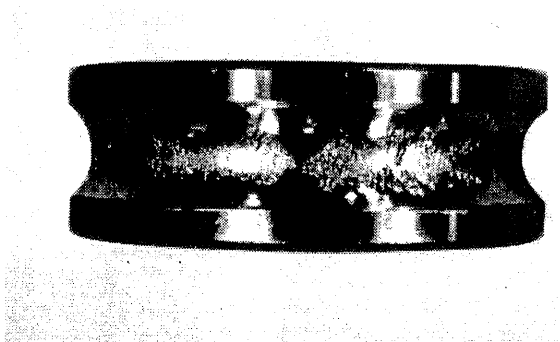


Fig. 1 Flaked race way

which is a sign of limitation to the service life of that particular bearing. Such bearings are no longer usable regardless of the extent of flaking. There occurs so-called "pitting" on the race way as an early stage of flaking. If it so happens, the bearing cannot be used.

#### b) Discoloration and seizure

Discoloration results from oil staining, corrosion, and heat and is a sign of seizure.

When the race way, rolling member, or retainer is violet-colored, the bearing has lost hardness and needs to be replaced.

A brown stain resulting from oil burning should not always be critical to the bearing. It is serviceable when the stain can be removed with solvent or thinner.

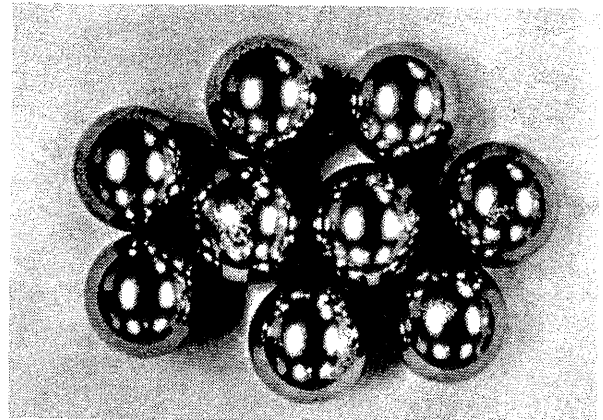


Fig. 2 Ball flaking

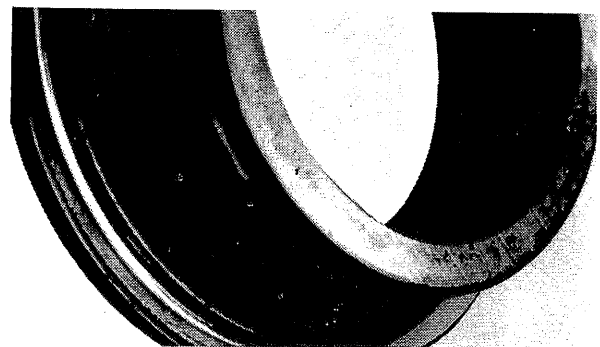


Fig. 3 Seizure

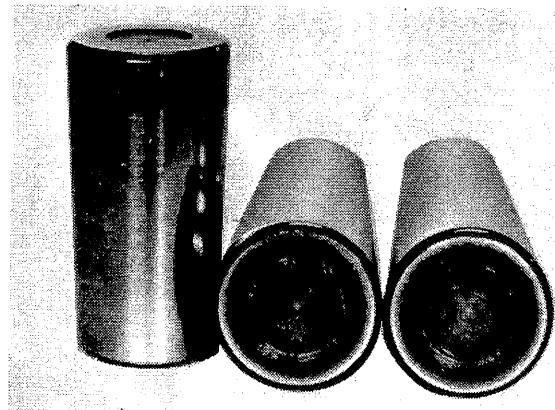


Fig. 4 Discoloration

#### c) Crack and fracture

A hair crack is sometimes invisible, but can easily be found by a dyeing crack-search method. Replace the bearing if hair-cracked even slightly. Fractures happen along the edge of the race way or roller-retaining rib and on the roller. The bearing be allowed for use after careful polishing with fine tone, if its fracture is off such critical parts of the bearing and very slight.

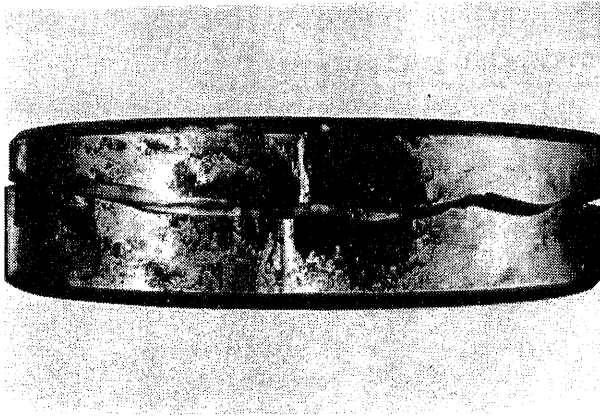


Fig. 5 Circular crack

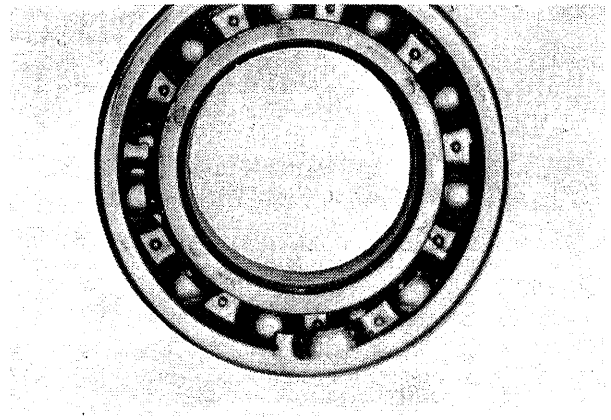


Fig. 8



Fig. 6 Axial crack

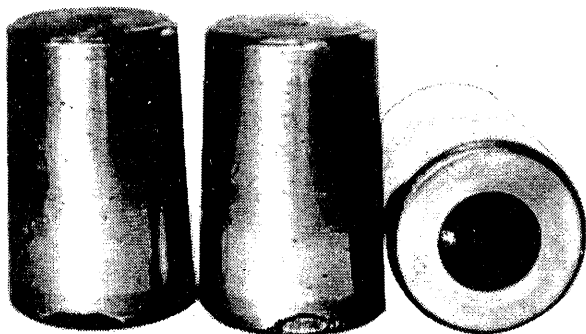


Fig. 7 Fracture

**d) Retainers**

Retainers can roughly be grouped into a pressed type and solid type by manufacturing process and into iron, gun metal and bakelite by material. The retainer, if broken or deformed, should be replaced regardless of the extent of damage.

**e) Rust and corrosion**

Moisture brings about a corrosive formation of ferrous oxide. Unlike wear, this corrosion is not

related directly to the fatigue of the bearing material, therefore, a slight extent of corrosion does not make the bearing unusable, unless the race way and rolling members suffer corrosion. However, deep corrosion will possibly be a cause of early exfoliation or fracture, and hence the bearing should not be used if it is so corroded.

Corrosion or a rusty swelling, even if slightest, must be completely removed by oil stone. Handle bearings with care, because fingerprints left on them often result in a corrosive formation thereof.

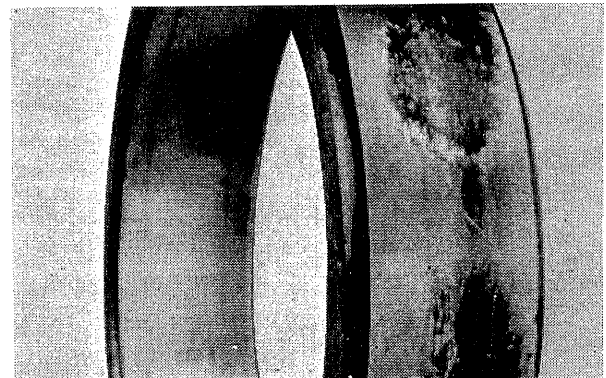


Fig. 9 Corroded bearing



Fig. 10 Fingerprint rust

**f) Wear**

Wear on a bearing is caused by the slippage of its race way or the entering of abrasive particles from worn gears, and accordingly wear has nothing to do with the fatigue of the material. As long as the bearing is evenly worn and rotates smoothly, it may be used until the wear reaches the service limit of its radial clearance. A tapered roller bearing may be used by adjusting the clearance when the race way and roller surfaces are merely worn and it turns smoothly. When a bearing is unevenly worn or indented, or has loosened retainer rivets, the bearing should not be used any longer.

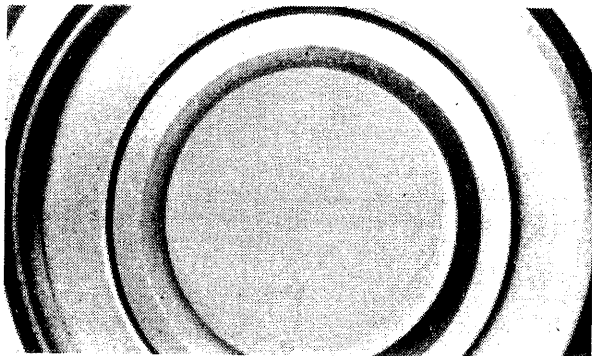


Fig. 11 Uneven wear

**g) Electric erosion**

The bearings used in this machine are designed to prevent an electric current from flowing, however, in those used on an electric motor, stray currents sometimes cause sparks to jump between the race ways and rolling members, thus developing a small melted point. A small electric erosion is permissible, but not a large one.

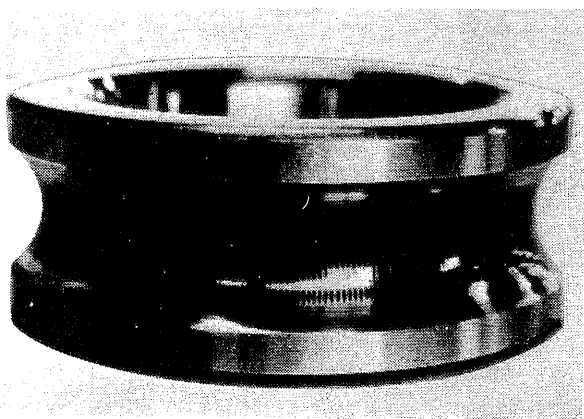


Fig. 12 Heavy electric erosion

**h) Indentation by local pressing**

Indentations by partial pressing are the result of plastic deformation caused by careless fitting, jamming obstacles, or impact load applied at installation. (ex. careless hammering).

An indented bearing should be replaced unless its indentation is very slight.

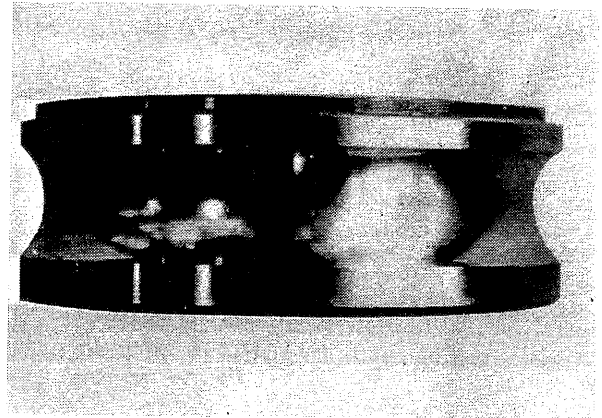


Fig. 13 Indentation caused by local pressing

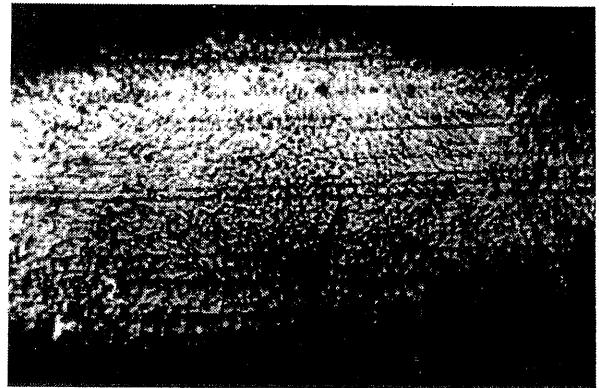


Fig. 14 Enlarged view of indentation by local pressing

Careless handling at mounting or jamming obstacles admitted cause scratches on the contact face of the race and rolling members. A shallow or slight scratch may be permissible, but a score or scuff forming any plastic flow around it prohibits the use of the bearing. Bearings with localized scratches or scores should preferably be replaced.

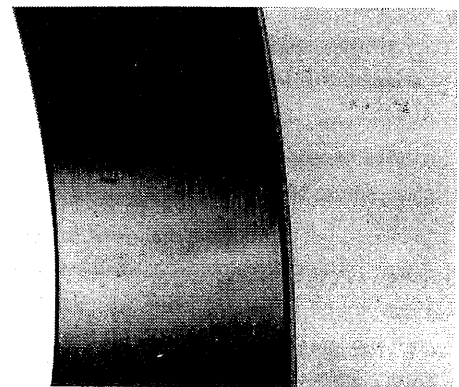


Fig. 15 Scratched outer race

**i) Smearing**

Smearing is a crowd of small abrasions which result from the slippage between the roller surfaces and race way due to improper lubrication. Smearing generally reduces the hardness of the bearing except tiny dots which may be permissible.

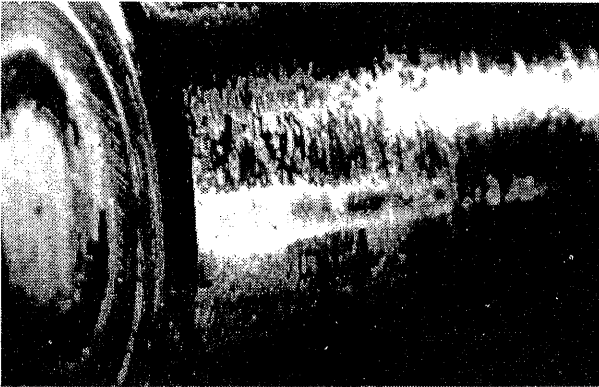


Fig. 16 Smear roller

**j) Creep**

When a bearing is not fitted properly, its outer or inner race slips on the fitted surface. This is called "Creep". A bearing being dragged must be replaced unless it is fitted in a position where the load is relatively small.

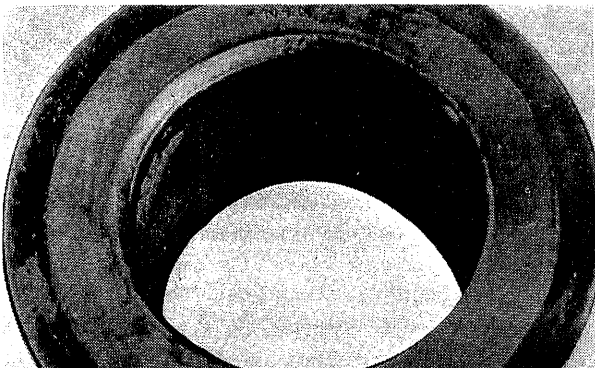


Fig. 17 Creep due to improper fitting

**3. Clearance**

What is meant by a clearance here is the clearance between the races and rolling members, that is, a radial clearance to be produced when one of the races is radially moved with the other one held stationary. When checking a radial clearance, hold one race stationary and measure the clearance with a dial gauge sensor by radially applying the load given below to the other free race. Check it at several points and take a mean value.

Bearing size Bore of inner race (mm)		Measuring load (Kg)
Over	To	
10	18	2.5
18	50	5
50	200	15

**2. Checking for rotation and noise**

To inspect a bearing for proper rotation, hold the inner race stationary, turn the outer race lightly, and change the position from vertical to horizontal and vice versa. If the bearing comes to a stop without noise or vibration, it proves to be in good condition, i.e., serviceable. Dust or grease must be completely removed from the bearing before this inspection. Foreign materials remaining inside the bearing cause irregular or noisy rotation. Further, excessively sticky oil or grease is a cause of misjudgement, as it acts as a damper to absorb vibration from the bearing being tested.

**Limit of usable clearance**

(Unit: mm)

		Radial ball		Radial roller		Spherical roller		Needle roller		.Measuring load Kg
Normal Over	size To	Normal max. gap	Limit	Normal max. gap	Limit	Normal max. gap	Limit	Normal max. gap	Limit	
24	30	0.025	0.075	0.045	0.135			0.065	0.195	5
30	40	0.025	0.075	0.050	0.150	0.040	0.124	0.070	0.210	5
40	50	0.028	0.085	0.055	0.165	0.045	0.135	0.080	0.240	5
50	65	0.036	0.100	0.070	0.210	0.055	0.165	0.090	0.270	15
65	80	0.038	0.105	0.080	0.240	0.070	0.210	0.100	0.300	15
80	100	0.044	0.130	0.085	0.255	0.085	0.255	0.105	0.315	15
100	120	0.049	0.145	0.090	0.270	0.105	0.315	0.120	0.360	15
120	140	0.056	0.170	0.105	0.315	0.120	0.360	0.130	0.390	15
140	160	0.061	0.185	0.115	0.345	0.140	0.420			15

# LUBRICATION GUIDE

## Recommended Fuel and Lubricants

### 1. Refill Capacities

Item	Lubricant	Capacity (ℓ)		
		SV91	SV91D	SV91T • SV91DP
Engine crank case	Engine oil	22	22	22
Transmission	Gear oil	2.7	2.7	—
Reduction gear	Gear oil	—	—	2.0
Power distributor	Gear oil	2.0	2.0	2.0
Hydraulic reservoir	Hydraulic oil	80	80	80
Vibrator	Gear oil	15	15	15
Radiator	Water	28	28	28
Final drive	Gear oil	1.8 x 2	1.8 x 2	1.8 x 2
Differential case	Gear oil	11.7	11.7	11.7
Fuel tank	Diesel fuel	280	280	280

### 2. Recommended Fuel and Lubricants

Lubricant	Service rating	Standard	Viscosity rating
Engine oil	*(1) API grade "CD"	*(2) MIL-L-45199B MIL-L-2104C	*(3)
Gear oil	API grade "GL-4"	MIL-L-2105	*(4) *(5) SAE 90
Hydraulic oil	Wear resisting hydraulic oil		*(6) ISO VG-56
Grease	Lithium type extreme-pressure grease		*(7) NLGI-2
Diesel fuel		*(8) ASTM D975-2D	

#### NOTES:

- \*(1) American Petroleum Institute.
- \*(2) Military Specifications and Standards.
- \*(3) See "Engine Instruction Book" furnished separately.
- \*(4) Society of Automotive Engineers.
- \*(5) In hot weather (above +30°C), use an SAE 140 gear oil.
- \*(6) In cold weather (below 0°C), use an wear resisting hydraulic oil with rating ISO VG-32, VI-150 or higher quality.
- \*(7) National Lubricating Grease Institute.
- \*(8) American Society of Testing Materials.



### 3. Brands of Lubricants

Lubricant Oil company	Engine oil	Gear oil	Hydraulic oil	Grease
SHELL	Shell Rimula CT Oil	Shell Spirax 90 EP	Shell Tellus Oil 56	Shell Alvania EP Grease 2
MOBIL	Mobil Delvac 1300	Mobil Pegasus Gear Oil 90	Mobil DTE Oil 26	Mobil Super Heavy Duty Brake Fluid
ESSO	Esso Lube D-3	Esso Gear Oil GP 90	Nuto H46	Beacon EP 2
CALTEX	RPM DELO 300 Oil	Universal Thuban 90	Rand Oil HD 46	Martifak EP 2

#### CAUTIONS:

- (1) Fill fluid reservoirs with filters installed.
- (2) Use recommended fuels and lubricants only.

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