

TY220 CRAWLER BULLDOZER

SHOP MANUAL



TIANJIN CONSTRUCTION MACHINERY WORKS  
THE PEOPLE'S REPUBLIC OF CHINA

## FOREWORD

In order to sustain the performance of the machine and engine over a long period, and to forestall breakdowns and trouble, correct operation, maintenance, trouble shooting and repairs are necessary.

This "Shop Manual" contains the following items which are necessary for carrying out checking and repairs of machines and engines mainly at a maintenance shop:










1. Outline
2. Structure and function
3. Checking and adjustment
4. Disassembly and assembly
5. Maintenance standard
6. Parts repair and replacement

This manual has been compiled in order to provide useful material for the serviceman to acquire correct knowledge of products and correct methods of performing repairs, and also to improve the quality of repairs through accurate judgement. Therefore, get a good grasp of its contents and make full use of it.

We intend to further improve the contents of this Shop Manual by revising it later on. Therefore, should you have any opinions or items you wish to point out, please do not hesitate to use and send in the proposal sheet at the end of this manual.

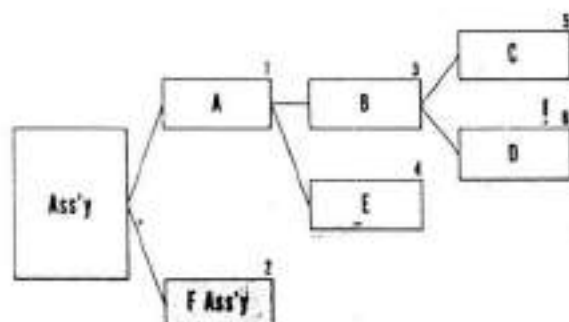
## Symbols

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

SYMBOL	ITEM	REMARKS
	Security	This indicates work that requires special precautions for the security of the machine when assembling.
	Safety	Special safety precautions are necessary when performing the work.
		Extra special safety precautions are necessary when performing the work because it is under internal pressure.
	Caution	Special technical precautions or precautions to preserve quality are necessary when performing the work.
	Weight	Weight of parts or systems. Caution necessary when selecting hoisting wire, or when working posture is important, etc.
	Tightening torque	Places that require special care with the tightening torque when assembling.
	Coat	Places to be coated with adhesives, etc. when assembling.
	Oil, water	Places for filling with oil, etc. Oil capacity.
	Drain	Places for drain oil, etc. Quantity to be drained.

**Network (Assembly  
and disassembly  
relationship drawings)**

In the shop manual the following network drawings show relationship between work items and sequence for assembly and disassembly.



In this network the sequence of disassembly is marked on the top right of each work item so that handling can be easily understood. For example, when taking D off the Ass'y follow the sequence A → B → D, when removing E follow the sequence A → E.

**F Ass'y** indicates a further separate disassembly, and indicates the existence of a previous work network. For assembly the sequence is shown using the same kind of network.



## MEANING OF TERMINOLOGY

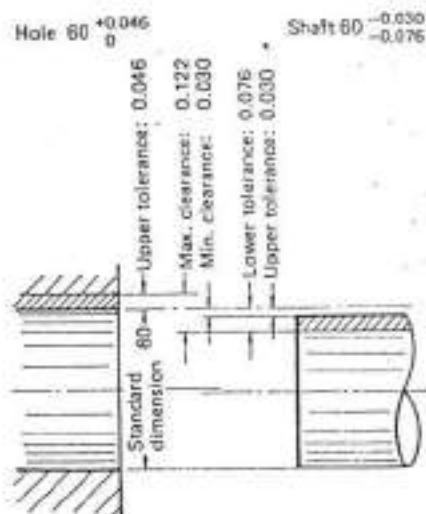
Standard Dimension,  
Tolerance

The dimensions of finished parts each differ a little in precision. Therefore, when determining the finished dimensions of parts, a dimension that will be standard is determined provisionally, and then how much difference from it is allowed is indicated. The former is called the standard dimension, and the latter the tolerance.

The way to show this is a plus or a minus sign with the tolerance is smaller numerals on the right side of standard dimensions.

Example:  $120 \begin{smallmatrix} -0.022 \\ -0.125 \end{smallmatrix}$

Moreover, usually when expressing the dimensions of a hole and the shaft that goes inside it, for the sake of convenience, the standard dimension for the hole and the shaft that fits in it is taken as the same, the tolerance changed and the tightness of the fit decided. For example, the fit of a revolving shaft is indicated as follows, and its relationship is shown in the drawing.



**Standard Clearance** Standard clearance is the clearance when new parts have been assembled, and shows the range of minimum and maximum clearance. In general, during repairs clearance is adjusted to this range.

**Allowable Limit** The dimensions of parts change from wear and distortion during use. The allowable limit is the limit which says parts may be used until they are of a certain dimension. When exceeding the allowable limit, parts replacement or repair is needed according to specifications.

**Allowable Clearance** Allowable clearance is the limit which says a part may be used until clearance progresses to a certain extent as it grows larger from wear. When exceeding allowable clearance, parts replacement or repair is needed according to specifications.

**Reading the Maintenance Standard Table** Mark in the No. of the pertinent item from the separate system chart corresponding to the No. on the left side of the table and it becomes easy to read.

NO.	ITEM	CRITERIA						REMEDY
4		Model	Standard dimension	Tolerance		Standard clearance	Allowable clearance	
				Shaft	Hole			

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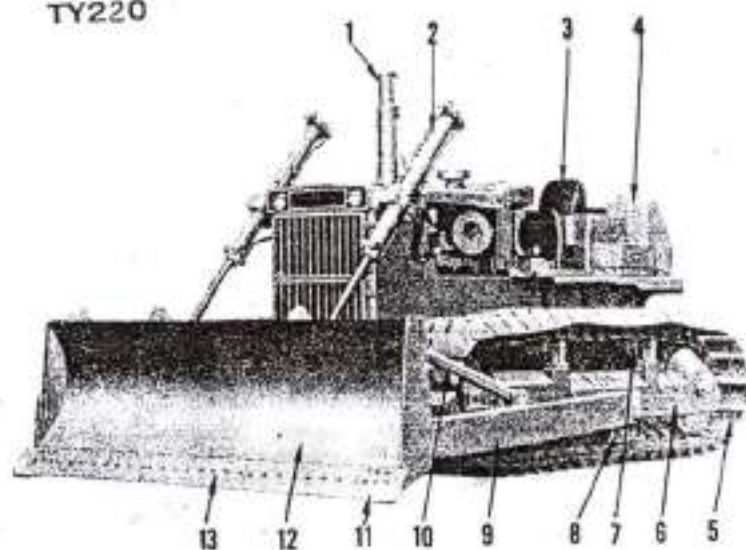
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# GENERAL

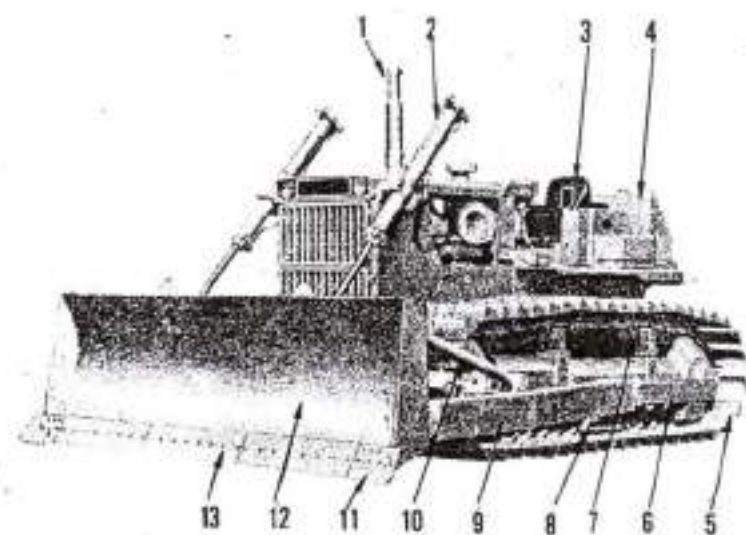
## GENERAL VIEW

## TY220



1. Muffler
2. Blade lift cylinder
3. Operator's seat
4. Fuel tank
5. Track shoe
6. Track frame
7. Carrier roller
8. Track roller guard
9. Frame
10. Brace
11. End bit
12. Blade
13. Cutting edge

## TS220



1. Muffler
2. Blade lift cylinder
3. Operator's seat
4. Fuel tank
5. Track shoe
6. Track frame
7. Carrier roller
8. Track roller guard
9. Frame
10. Brace
11. End bit
12. Blade
13. Cutting edge

## SPECIFICATION

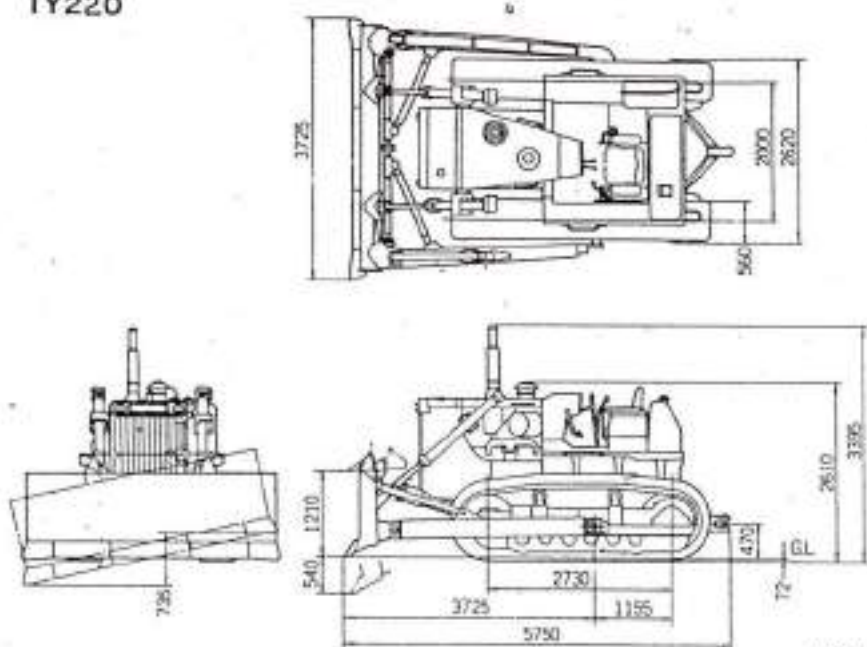
Machine Model			TY 220	TS 230
Weight	Operating weight (kg)		23,450	25,700
	Tractor weight (kg)		19,800	22,250
Dimension	Overall length	Tractor (mm)	4,575	4,715
		Bulldozer (mm)	5,750	6,060
	Overall width	Tractor (mm)	2,520	3,160
		Bulldozer (mm)	3,725	4,365
	Overall height	At top of exhaust pipe (mm)	3,395	3,435
		At upper surface of dashboard (mm)	2,445	2,485
	Track gauge (mm)		2,000	2,250
	Ground contact length (mm)		2,730	3,480
Shoe width (Standard) (mm)		560	910	
Ground contact pressure	Tractor (kg/cm <sup>2</sup> )	0.548	0.34	
	Bulldozer (kg/cm <sup>2</sup> )	0.763	0.41	
	Ground clearance (To transmission under-cover) (mm)	405	513	
Performance	Min. turning radius (m)		3.3	3.8
	Gradeability (°)		30	
	No. of speed steps		Forward: 3 Reverse: 3	

**SPECIFICATION** **GENERAL**

Machine Model		TY 220	TS 220
Power train	Torque converter	3 element, single stage single phase	
	TORQFLOW transmission	Planetary gear, multi-disc clutch, hydraulically actuated, forced lubrication Forward: 3 speeds Reverse: 3 speeds	
	Bevel gear shaft	Spiral bevel gear, splash lubrication	
	Steering clutch	Wet, multi-disc spring, hydraulically actuated, hand operated	
	Steering brake	Wet, contracting band, foot operated, interconnected with steering clutch (with hydraulic booster)	
	Final drive	Spur gear, double reduction, splash lubrication	
Undercarriage	Suspension	Semi-rigid, balanced beam type	
	Carrier roller	2, each side	
	Tank roller	6, each side	8, each side
	Shoe	Assembled, single grouser 38, each side  Pitch: 216 mm Width: 560 mm	Assembled, swamp shoe 45, each side Pitch: 216 mm Width: 910 mm
Work equipment	Type	Hydraulic tilt dozer Left side: Brace, Right side: Tilt cylinder	
	Max. pressure	140 kg/cm <sup>2</sup>	
	Hydraulic cylinder	Piston type, Double action	
	Control valve	Spool type	
	Pump delivery	257 l/min.	
	Hydraulic tank	Control valve built-in type	

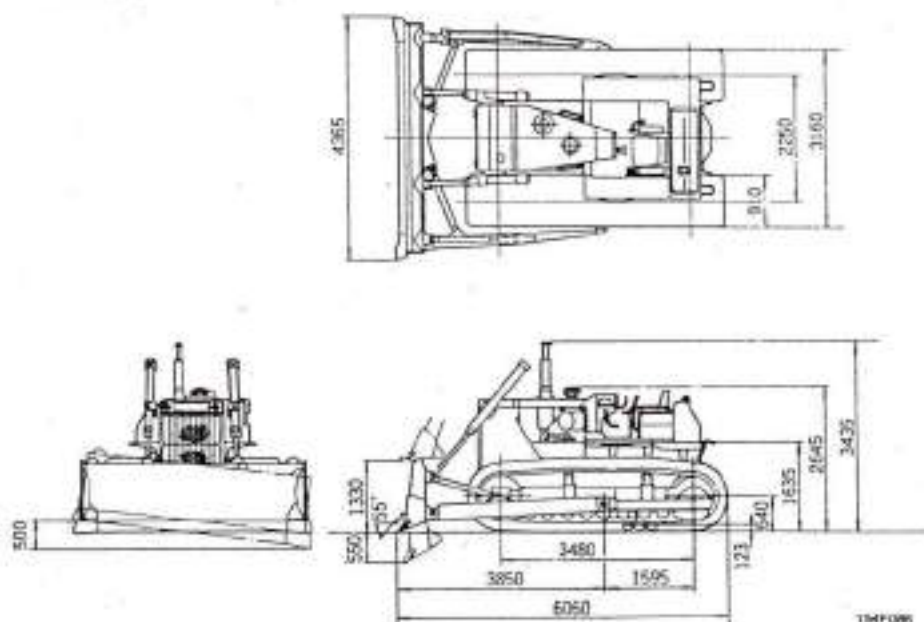
## GENERAL ASSEMBLY DRAWING OF MACHINE

TY220



154F084

TS220



154F086



## LIST OF WEIGHT

Machine Model	TY 220	TS 220
Engine, torque converter assembly	2,040	
• Engine assembly	1,750	
• Torque converter assembly	210	
• P.T.O. assembly	80	
Radiator guard, lift cylinder assembly	1,350	1,435
• Radiator guard	455	639
• Radiator assembly	250	250
• Lift cylinder assembly (R.L.)	270	320
Fuel tank assembly	185	
Universal joint assembly	10	
Tongflow transmission assembly	730	
• Control valve assembly		
Bevel gear shaft, steering clutch assembly		
• Steering clutch, brake band assembly (one side)	125	
• Bevel gear shaft	30	
• Bevel gear	27	
Steering control valve assembly	55	
Brake cover, link assembly	40	
Final drive case (one side)	210	
Sprocket hub, No.2 gear assembly (one side)	230	
No. 1 gear, No. 2 pinion assembly (one side)	80	
Sprocket assembly (one side)	230	
Main frame assembly	1,950	1,950
• Main frame, bevel gear case assembly	1,760	1,760
• Sprocket shaft (one side)	95	115
Track assembly	1,605	2,560

### LIST OF WEIGHT

## GENERAL

Machine Model	TY 220	TS 220
Track group assembly (one side)	2,200	2,560
• Idler assembly	380	380
• Track roller assembly (single one)	75	75
(double one)	80	80
• Carrier roller assembly (one)	55	55
• Recoil spring (one side)	170	170
• Track frame (left)	785	978
(right)	800	978
Equalizer bar	205	243
Engine underguard	132	
Transmission underguard	120	
Floor frame assembly	400	
Side frame (Fender)	205	
P.T.O. assembly	80	
• Work equipment pump assembly	45	
• Transmission pump assembly	10	
• Steering pump assembly	15	
Hydraulic tank assembly	250	
• Control valve assembly	105	
Blade tilt cylinder assembly (one side)	135	160
Blade tilt cylinder assembly	180	
Ripper cylinder assembly	100	
Work equipment assembly	100	
• Servo valve assembly	12	

GENERAL LIST OF WEIGHT

Machine Model	TV 220	TS 220
Straight tilt dozer assembly	3,020	3,015
• Straight blade	1,550	1,480
• Straight frame (left)	350	370
(right)	410	370
• Tilt cylinder assembly	180	180
Angle blade assembly	3,230	—
• Angle blade	1,375	—
• C frame assembly	1,390	—
Multi ripper assembly	2,390	—
• Shank assembly (one)	190	—
• Ripper cylinder assembly (one side)	100	—
Ripper bracket (one side)	125	—

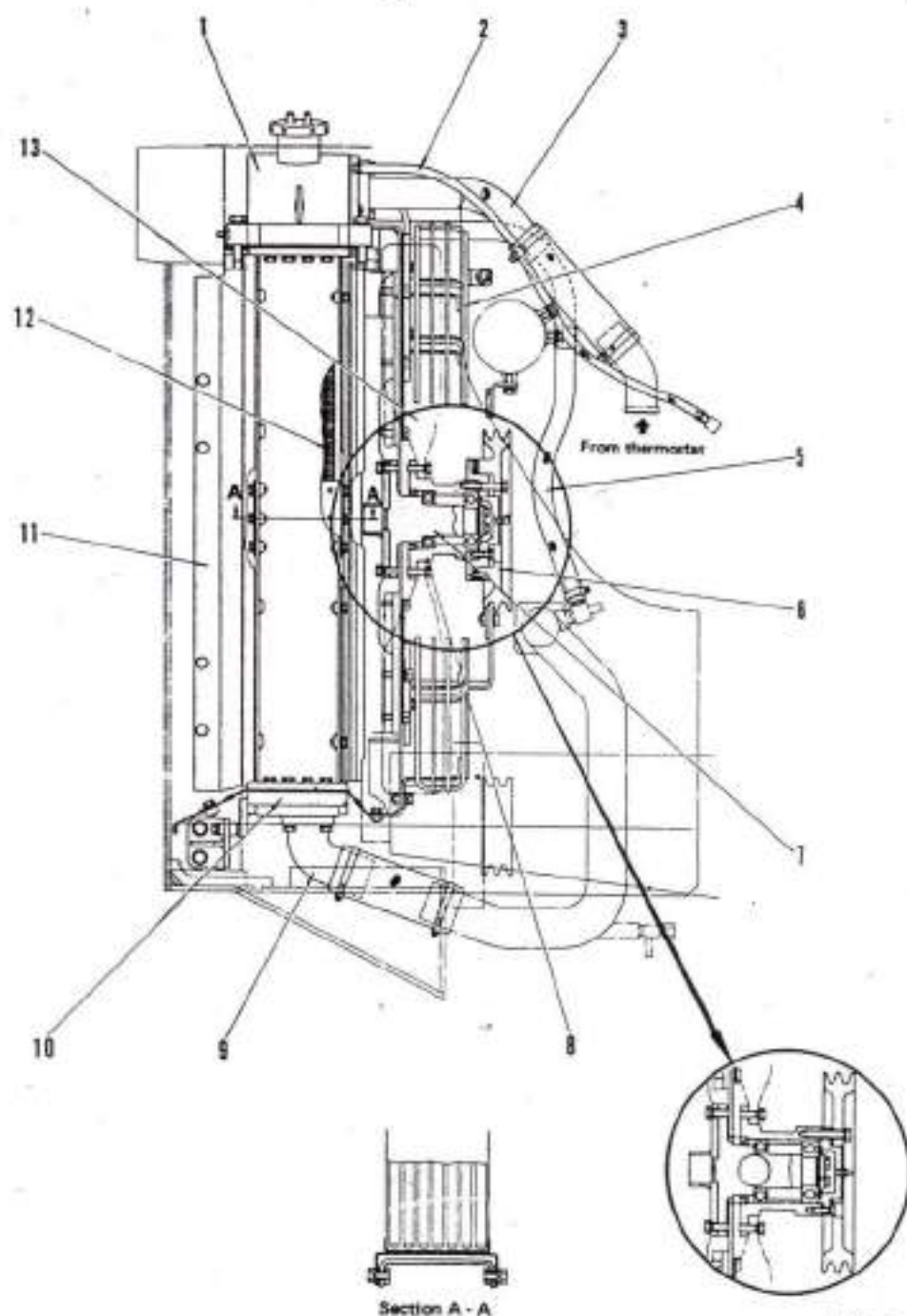
## LIST OF LUBRICANT AND WATER

				( ) Refill capacity
Machine Model	TY 220		TS 220	Remarks
Engine cooling water	79 ℓ			Water
Fuel tank	450 ℓ			Diesel oil ASTM D75 No. 2 or No. 1
Engine oil pan	45 ℓ (23 ℓ )			SAE 30 or SAE 10 W
Torque converter, transmission, steering case	122 ℓ (90 ℓ )			
Final drive case (one side)	41 ℓ		61 ℓ	
Hydraulic system	110 ℓ (70 ℓ )			SAE 10 W
Carrier roller (one)	470 ~ 550 cc			SAE 140
Track roller (one)	280 ~ 330 cc			
Idler (one)	280 ~ 330 cc			

# ENGINE

## STRUCTURE AND FUNCTION

## RADIATOR



1547090



## STRUCTURE

The radiator consists of an upper tank (1), radiator core (12) and lower tank (10).

Cooling water passes through the engine thermostat to the upper tank where it is deaerated. It then flows from the upper tank through the core into the lower tank. During this process, the water is cooled so as to maintain the engine temperature at an optimum value of 85 to 95°C.

The core is made up of a number of flat drawn tubes together with fins which raise the heat exchange efficiency. Types D, G and K, etc., which differ in respect of tube arrangement, are available. TY 220 and TS 220 machines employ type D, the tubes of which are arranged in series.

The cooled water which enters the lower tank is returned to the engine cylinder block by means of the water pump.

The operation pressure or pressure valve fitted to the upper tank is 0.75 kg/cm<sup>2</sup> of the gauge pressure (difference between the atmosphere) and the vacuum valve prevents the cooling water from being boiled below 100°C and air bubbles from entering into the cooling water.

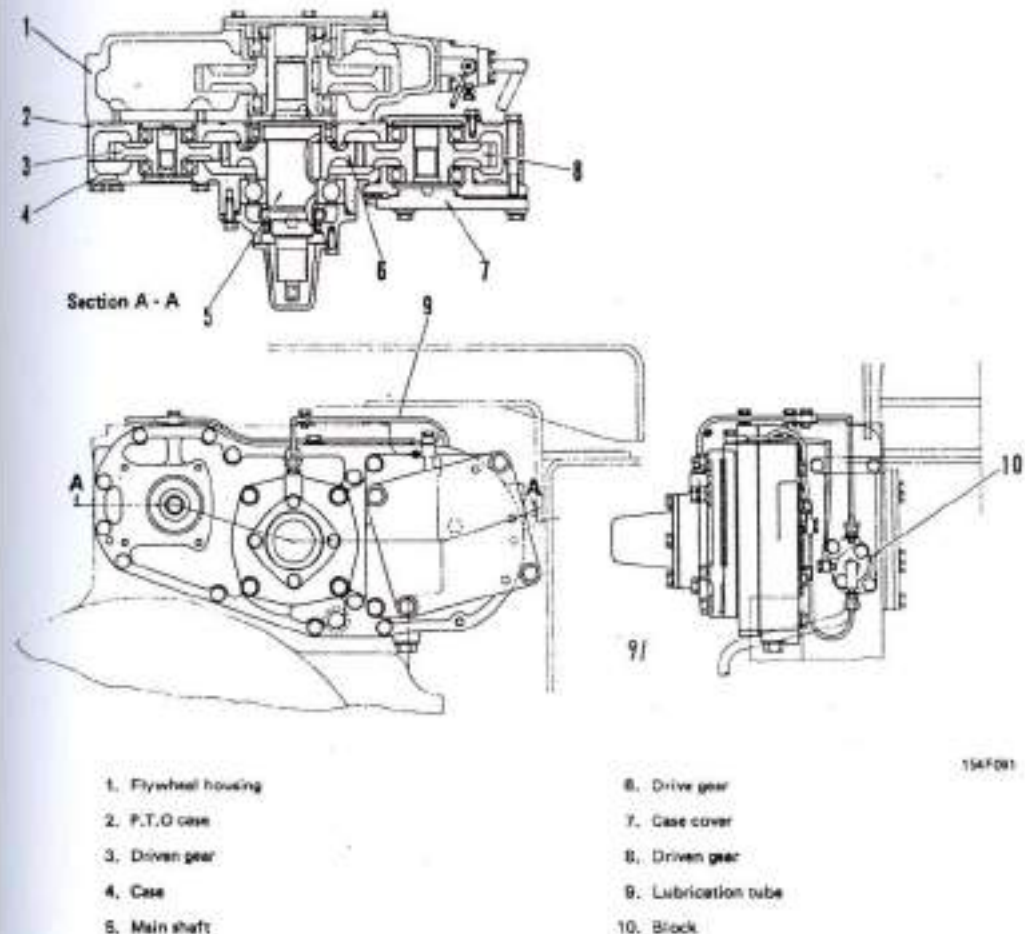
A hose (5) is connected between the upper tank and the water pump inlet tube to enable cooling water to be supplied directly from the upper tank, in order to prevent the formation of air bubbles at the inlet side of the water pump.

A fan (13), driven by a V-belt between the fan pulley (6) and the engine side pulley, provides forced wind for improved core heat dissipation.

TY 220 and TS 220 machines employ a push type fan which provides a blast of air to the radiator.

1. Upper tank
2. Hose
3. Inlet tube
4. Fan guard
5. Hose
6. Pulley
7. Shaft
8. Bolt
9. Outlet tube
10. Lower tank
11. Wind brake
12. Radiator core
13. Fan

# P.T.O (POWER TAKE OFF)

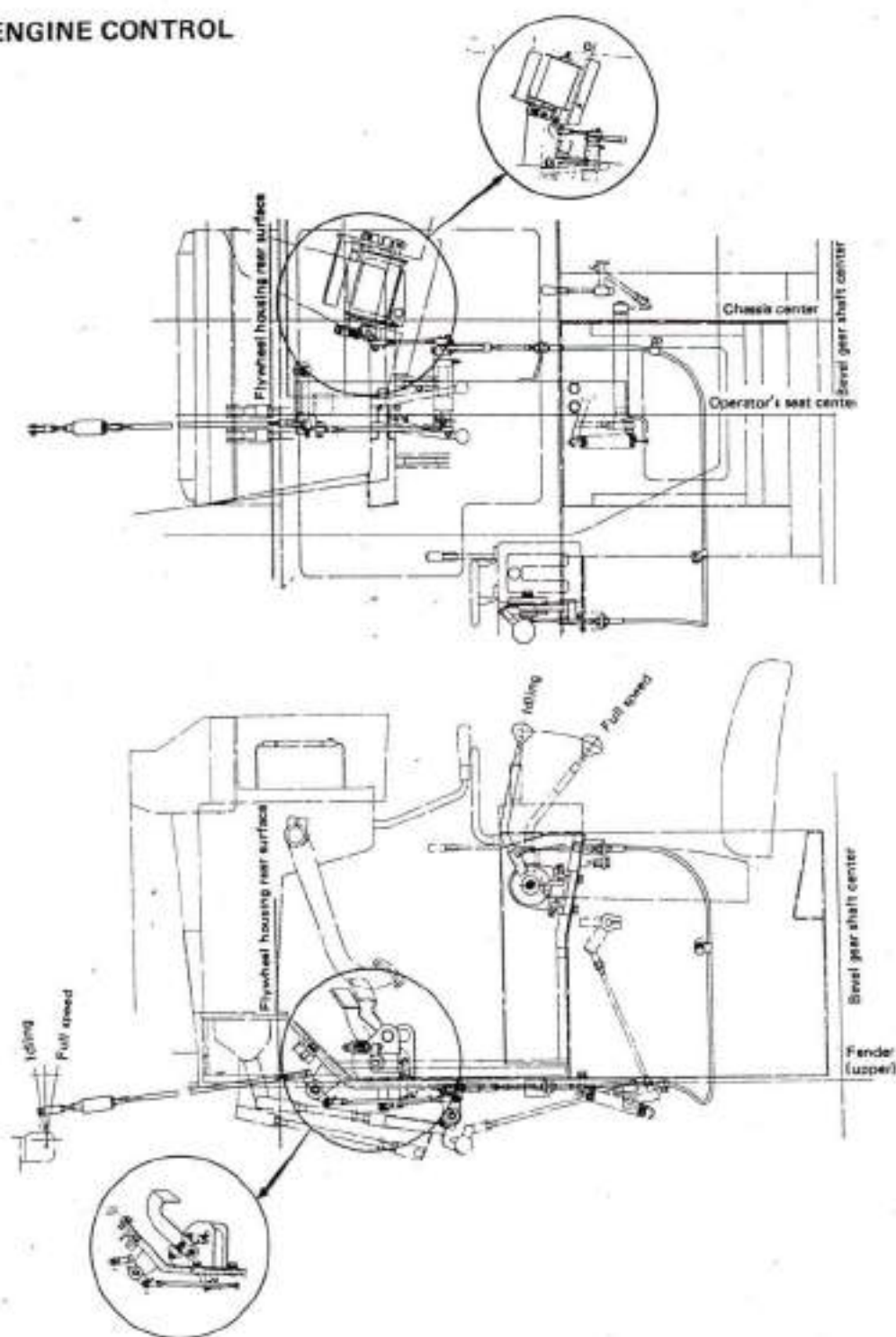


## STRUCTURE

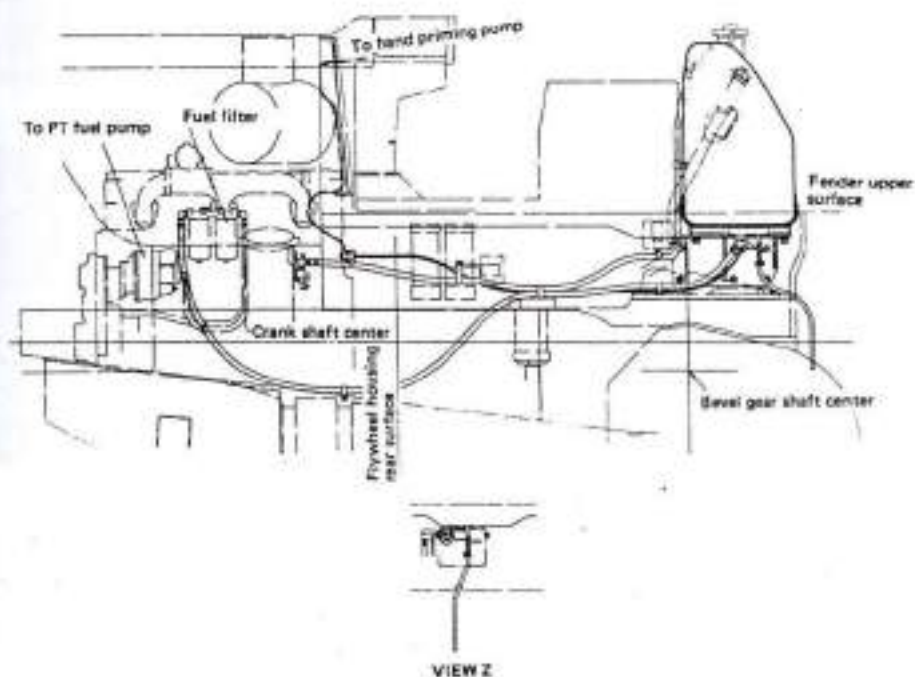
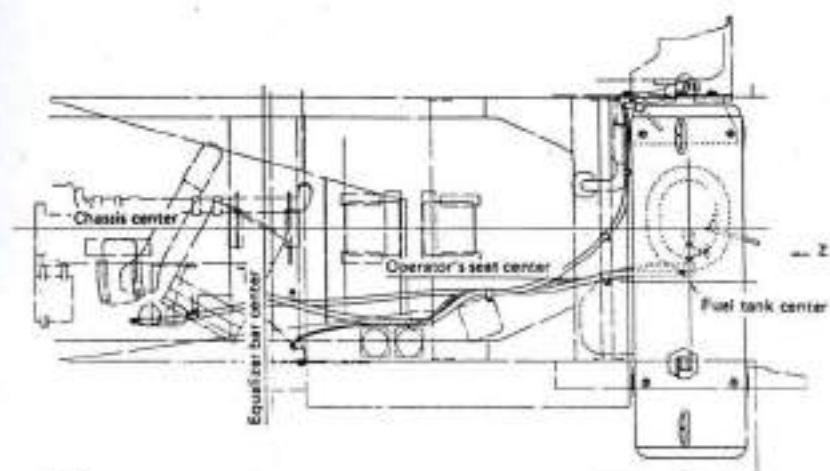
The P.T.O unit is installed on top of the engine flywheel housing. It consists of a main shaft (5) which fits into the spline of the gear engaging with the external teeth of the engine flywheel, a drive gear (6) on the main shaft and two driven gears (3) and (8) respectively. The work equipment pump is connected to the box spline of the driven gear (8) by removing the cover (7).

On machine, the transmission pump is connected thereto. The steering pump is installed on the front of the flywheel housing. The various gears and bearings in the P.T.O unit are lubricated via lubrication tubes (9) connected to a distribution block (10) which is connected to the oil cooler return hose.

# ENGINE CONTROL



## FUEL LINE



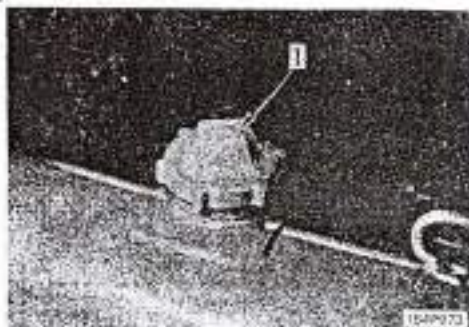
# INSPECTION AND ADJUSTMENT

## FUEL SYSTEM

### INSPECTION OF FUEL

#### INSPECTION OF FUEL LEVEL

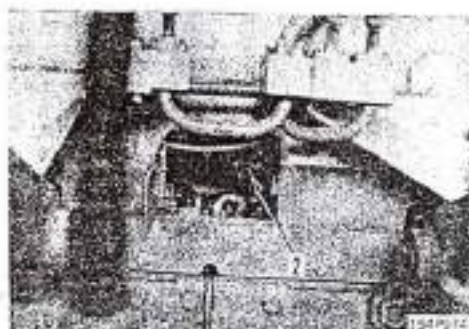
- Remove oil filler cap (1) on fuel tank, and check fuel level with level gauge.
- ★ After completion of work, replenish fuel by filling tank.  
If tank is not completely full, water vapor will condense in tank when temperature drops at night, and become mixed with fuel.



#### INSPECTION OF WATER AND DIRT INGRESS IN FUEL

- Fuel tank
  - 1) Gradually loosen drain cock (2) and check for presence of dirt and water.
  - 2) Remove strainer and check for presence of dirt. Clean strainer as necessary.
- Fuel filter (cartridge type)

Loosen plug on filter case. Gradually loosen drain cock and check for presence of dirt and water.



#### INSPECTION OF CLOGGING IN AIR VENT HOLE IN FUEL TANK CAP

- If air vent hole in oil filler cap (1) is clogged, a vacuum will be generated inside the tank, resulting in insufficient fuel supply.

#### INSPECTION OF AIR INGRESS IN FUEL SYSTEM AND REMOVAL OF AIR

- Remove air by filling filter with fuel.
- Be careful not to damage gasket of filter cover.



Inspect and adjust after parking machine on level ground and check safety pins and blocks.  
When working as a group, enforce signals and never let unauthorized persons approach machine.  
Be careful not to get caught in rotating parts or be burnt by heated parts.



## COOLING SYSTEM

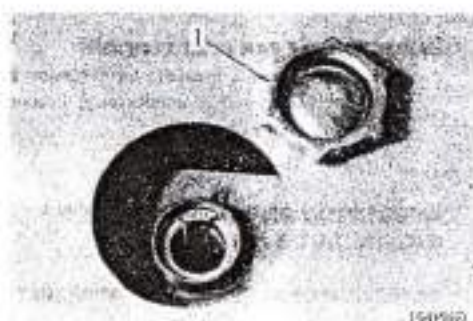
## INSPECTION OF COOLING WATER LEVEL

- Remove radiator cap (1) and check that cooling water comes as far as top of upper tank.



Avoid removing cap when engine is still hot because of possible scald from boiling water spouting out of tank.

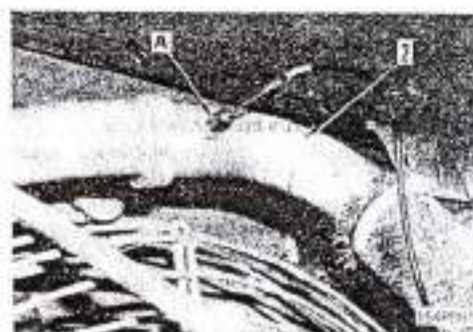
- ★ If level of cooling water has dropped, check for leakage and repair as necessary.
- ★ If engine oil level increases or cooling water contains oil, check for leakage and repair as necessary.



## WATER TEMPERATURE MEASUREMENT

1. Remove water temperature gauge pickup plug (PT 1/8) from radiator inlet pipe (2).
2. Fit temperature gauge sensor adaptor A together with sensor to taking-out outlet of water temperature gauge.
3. Connect sensor and thermistor temperature gauge, and measure water temperature.

- ★ If water temperature is excessively high, check cooling water level, wear and stretch of fan belt, flattening of radiator core and clogging due to dust and dirt.
- ★ If water temperature is too low, inspect thermostat.





## INSPECTION OF FAN BELT TENSION

## INSPECTION OF FAN BELT TENSION

- Because fan belt is provided with tension pulley, adjustment of tension is unnecessary, however inspect V-belt and pulley for wear.

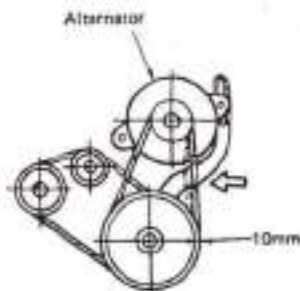
## INSPECTION AND ADJUSTMENT OF ALTERNATOR DRIVE BELT TENSION

## INSPECTION OF ALTERNATOR DRIVE BELT TENSION

- Check amount of sag of alternator drive belt when pressed with fingers with force of about 8 kg between alternator pulley (3) and accessory pulley (4).

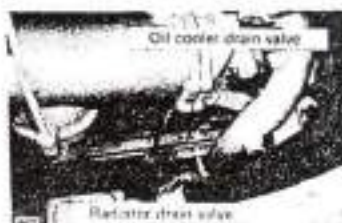
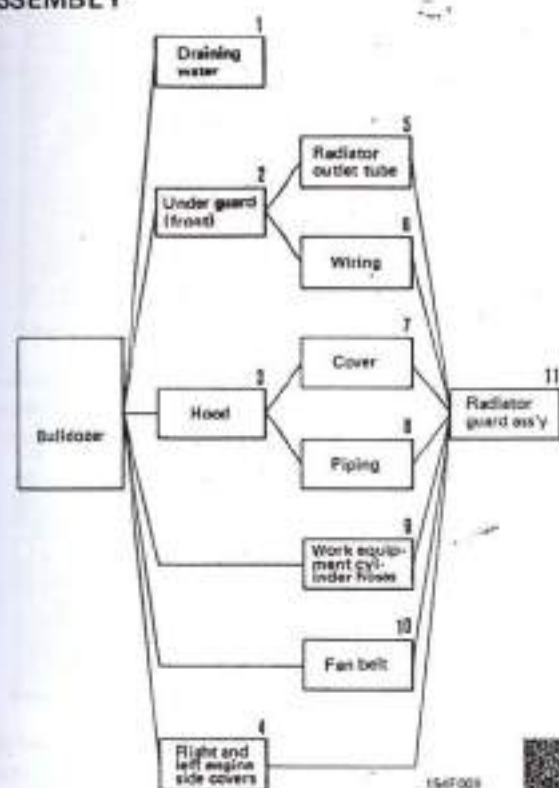
## ADJUSTMENT OF ALTERNATOR DRIVE BELT TENSION

- Loosen bolt (5) securing alternator and also mounting bolt on lower side of alternator. Adjust belt tension by suitably moving alternator.
- Alternator drive belt standard tension  
Amount of sag: approx. 10 mm
- Check for damage to pulleys, wear of V-grooves and also wear of V-belt. In particular, check that V-belt is not touching bottom of V-groove.
- If V-belt can no longer be adjusted, or is broken or cracked, replace it.
- Replace both fan belts or both alternator belts when replacing.
- If V-belt is replaced, readjust tension after running for about one hour.



154F083

## DISASSEMBLY AND ASSEMBLY

DISMOUNTING RADIATOR GUARD  
ASSEMBLY

## 1. Draining water

Remove cover (1), loosen radiator drain cock (2) and drain water.

\* When anti-freeze has been added to the water, dispose of the drained water as a chemical. Do not simply let the water drain away.

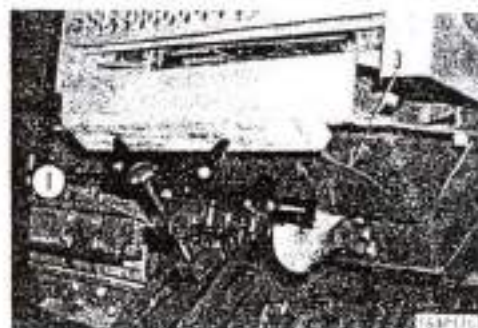


## 2. Underguard (front)

Support underguard (front) (3) with mission jack (1) and remove.



Underguard (front): 70 kg (TY 220)  
36 kg (TS 220)



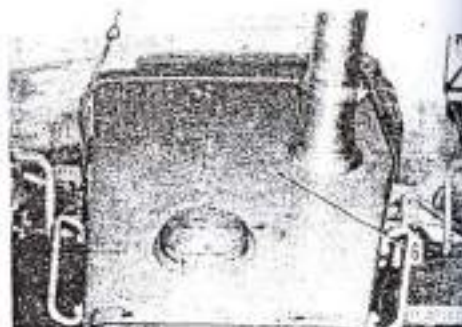
## 3. Hood

- 1) Remove cover (4) and air cleaner cover (5).



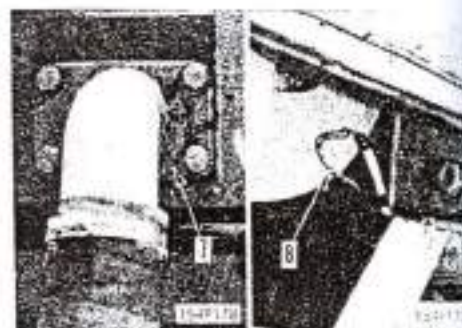
- 2) Lift off hood (6).

4. Right and left engine side covers.  
Remove right and left engine side covers.



5. Radiator outlet tube  
Disconnect radiator outlet tube (7).

6. Wiring  
Disconnect wiring (8).

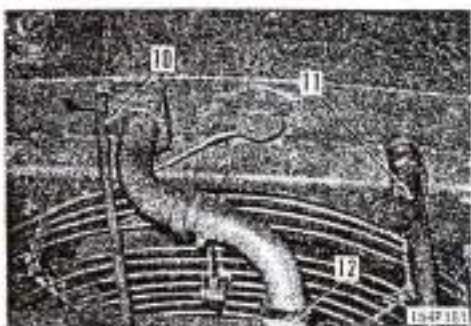


7. Cover  
Remove cover (9).

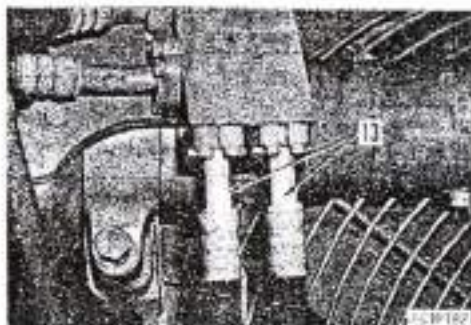


**8. Piping**

Disconnect hoses (10) and (11) and leave clamp of hose (12) loose.

**9. Work equipment cylinder hoses**

Disconnect both left and right work equipment cylinder hoses (13).

**10. Fan belt**

Force tension pulley (14) to inside with bar (2) and remove fan belt (15).

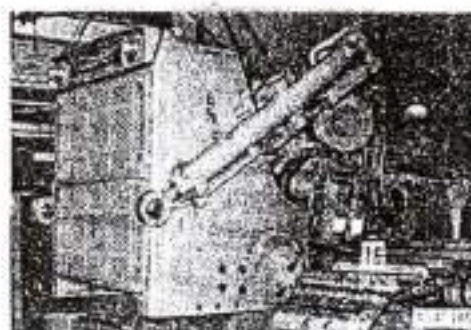
**11. Radiator guard assembly**

Hoist radiator guard assembly (16), remove radiator guard mounting bolts and lift away.

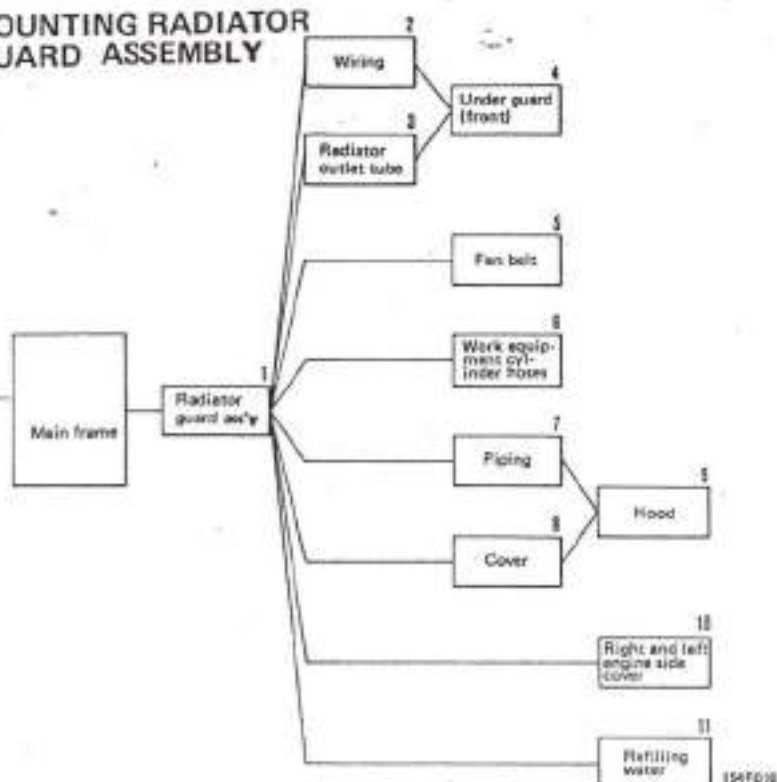
\* Lift while at the same time pulling radiator inlet tube from engine hose.



Guard assembly: 1,600 kg





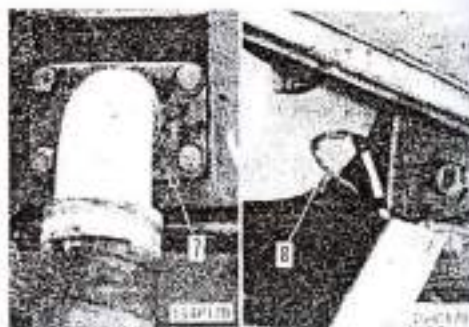
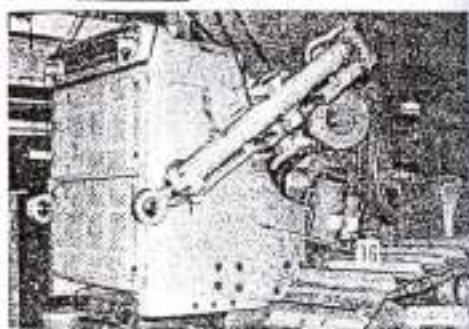
MOUNTING RADIATOR  
GUARD ASSEMBLY

1. Radiator guard assembly  
Lift radiator guard assembly (16) into position on main frame and tighten bolts. While lowering assembly, fit radiator inlet tube into engine hose.

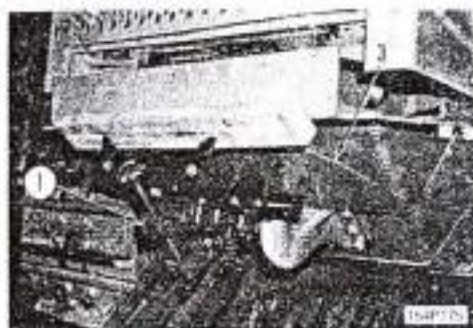
 Mounting bolt: 135±15 kg.m

2. Wiring  
Connect wire (8).
3. Radiator outlet tube  
Fit gasket and connect tube (7).

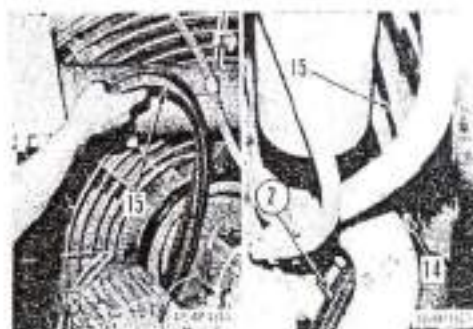
 Gasket: Liquid gasket



4. Underguard (front)  
Support underguard (front) (3) with transmission jack (1) and install.



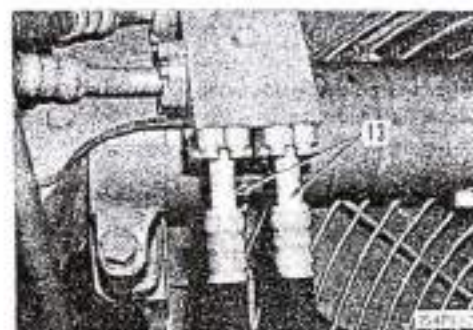
5. Fan belt  
Force tension pulley (14) to inside with bar and attach fan belt (15).



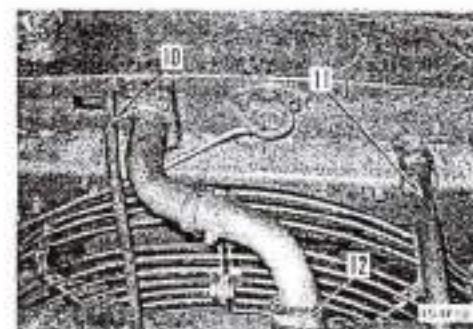
6. Work equipment cylinder hoses  
Fit O-ring and connect hoses (13).



Fit O-rings securely in grooves.



7. Piping  
Tighten clamp of hose (12) and connect hoses (11) and (10).



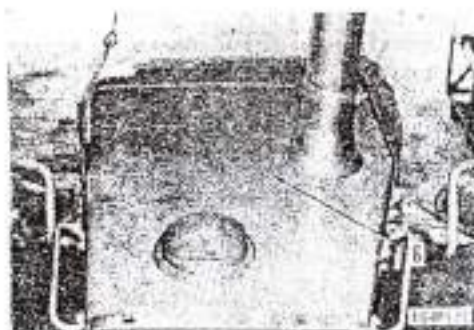


**8. Cover**

Install cover (3).

**9. Hood**

1) Lift hood (6) and install.



2) Install air cleaner cover (5) and cover (4).

**10. Right and left engine side covers**

Install right and left engine side covers.

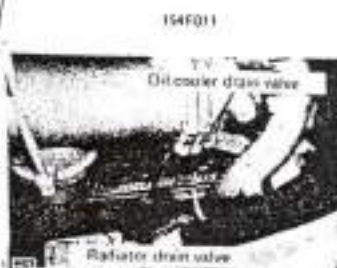
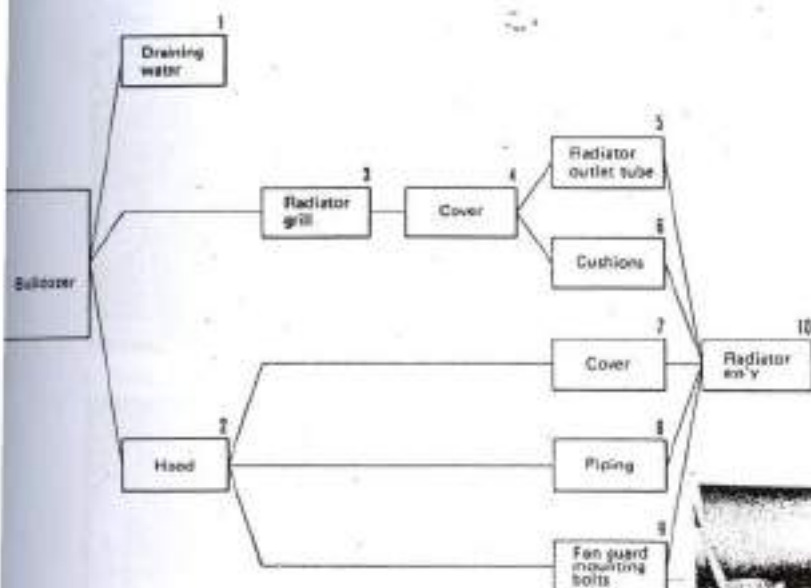
**11. Refilling water**

- 1) Close drain cock securely.
- 2) Refill cooling system by pouring in water through the filler until water reaches the specified level.
  - ★ Start and run engine to let cooling water circulate in cooling system.

Check cooling water level again.



## DISMOUNTING RADIATOR ASSEMBLY



## 1. Draining water

Remove inspection cover (1) and loosen radiator drain cock (2) to drain cooling water.

★ When anti-freeze has been added to the water, dispose of the drained water as a chemical liquid. Do not simply let the water drain away.



## 2. Hood

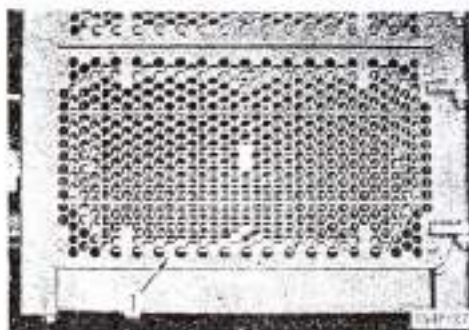
1) Remove cover (4) and air cleaner cover (5).



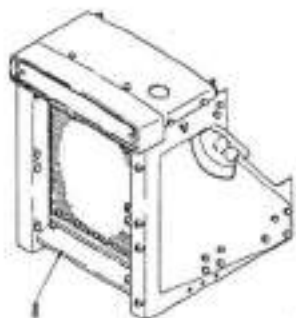
- 2) Lift hood (6) and remove.



3. Radiator grill  
Remove radiator grill (7).

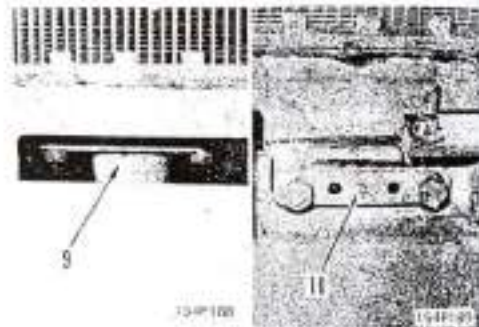


4. Cover  
Remove cover (8).



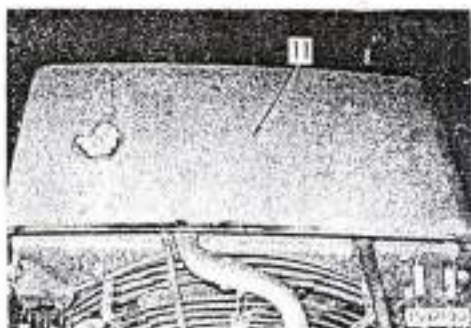
5. Radiator outlet tube  
Disconnect radiator outlet tube (9).

6. Cushions  
Remove right and left cushions (10).  
★ Keep right and left shims separately.



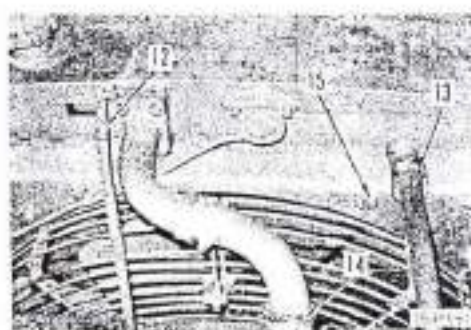
## 7. Cover

Remove cover (11).



## 8. Piping

Disconnect hoses (12) and (13) and leave clamp of hose (14) loose.

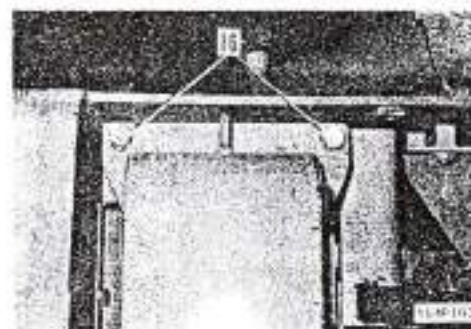


## 9. Fan guard mounting bolts

Remove four fan guard mounting bolts at top.

## 10. Radiator assembly

- 1) Remove right and left radiator mounting bolts (16).

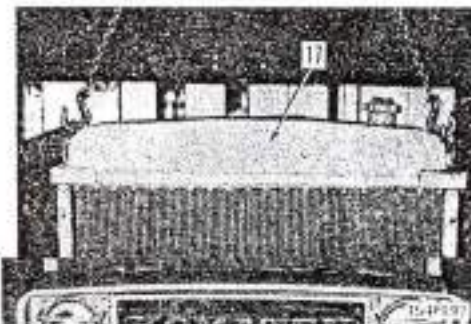


- 2) Lift radiator assembly (17) and remove.

\* Lift while at the same time pulling radiator inlet tube from engine hose.

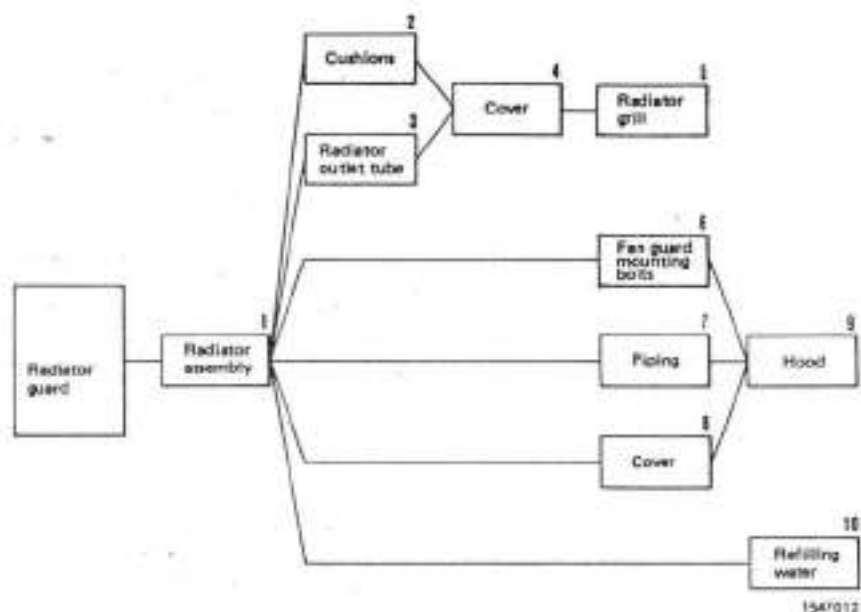


Radiator: 260 kg.



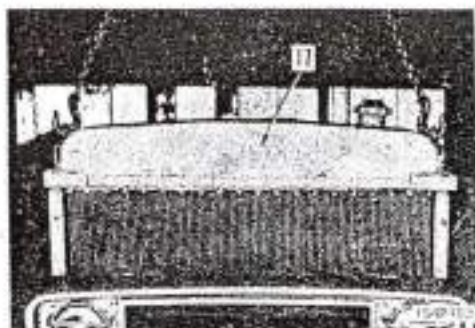


## MOUNTING RADIATOR ASSEMBLY

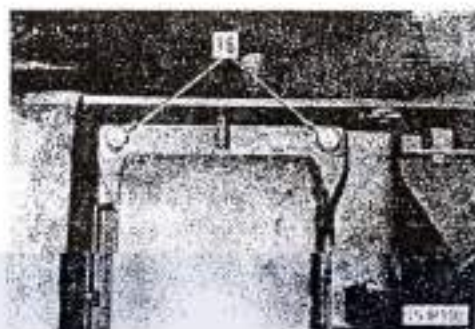


## 1. Radiator assembly

- 1) Lift radiator assembly (17) and mount. While lowering assembly, fit radiator inlet tube into engine hose.

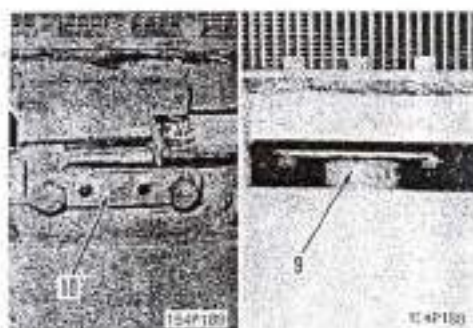


- 2) Tighten right and left radiator mounting bolts (18).



## 2. Cushions

Insert shims which were removed during dismantling, and install right and left cushions (10).



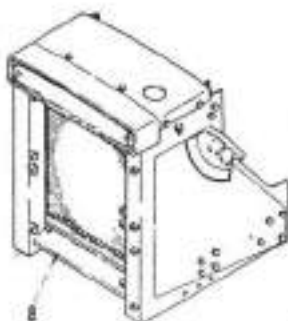
## 3. Radiator outlet tube

Fit gasket and connect radiator outlet tube (9).

 Gasket: Liquid gasket

## 4. Cover

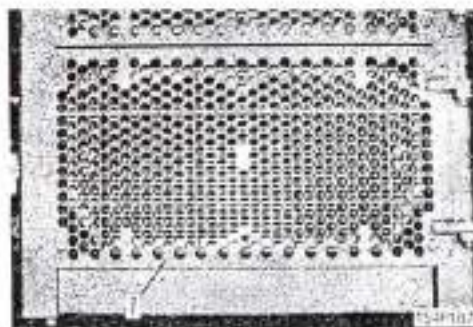
Install cover (8).



154P013

## 5. Radiator grill

Mount radiator grill (7).

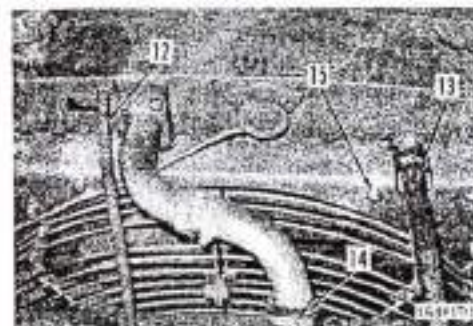


154P107

## 6. Fan guard mounting bolts

Install four fan guard mounting bolts (15):

\* Bend lock plates securely for both end bolts.



154P171

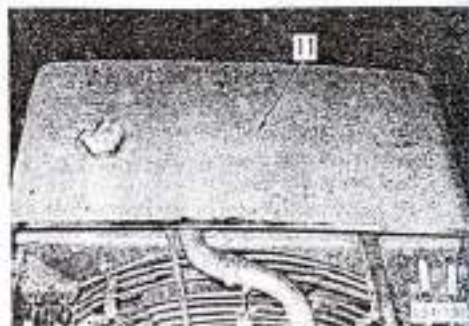
## 7. Piping

Connect hoses (13) and (12), and tighten clamp of hose (14).

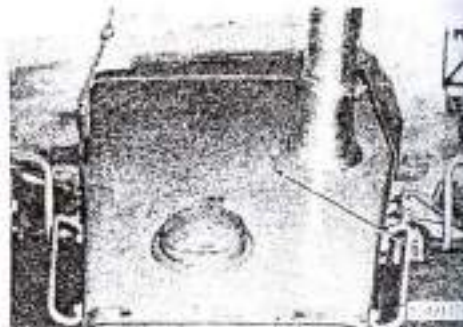


**8. Cover**

Install cover (11).

**9. Hood**

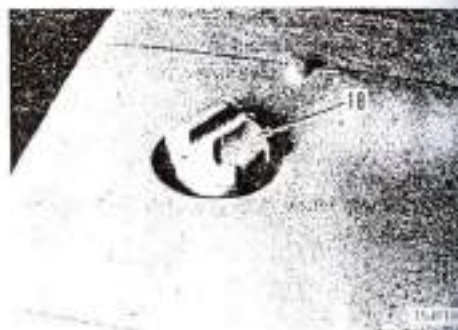
1) Lift hood (6) and install.



2) Install air cleaner cover (5) and cover (4).

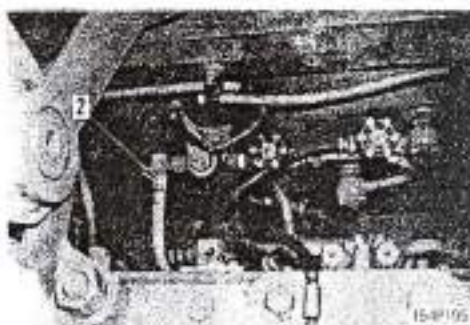
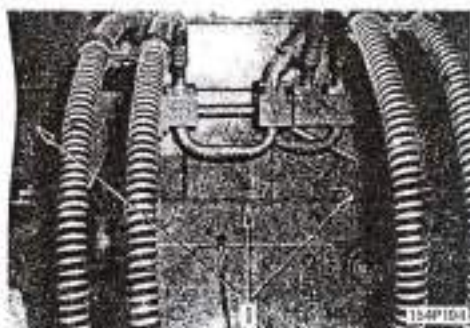
**10. Refilling water**

- 1) Close drain cock.
- 2) Refill cooling system by pouring in water through the filler until water reaches the specified level.
  - \* Start and run engine to let cooling water circulate in cooling system.
  - Check cooling water level again.



## DISMOUNTING FUEL TANK ASSEMBLY

1. Remove three rear covers (1).
2. Remove supply lines and backflow lines of fuel tank.
3. Remove four fuel tank mounting bolts (3).
4. Remove fuel tank assembly (4).



Fuel tank assembly:

## MOUNTING FUEL TANK ASSEMBLY

1. Lift fuel tank assembly (4) and position it on fender.



2. Tighten four fuel tank mounting bolts (3).



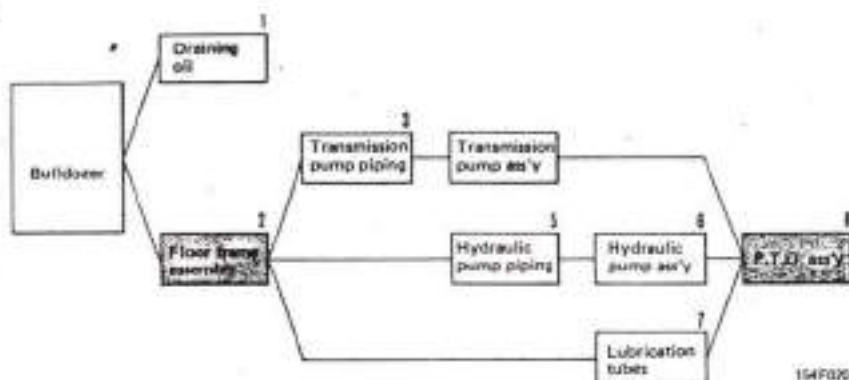
Mounting bolt: Thread tightener

3. Connect supply lines and backflow lines, then opening cock.

4. Install rear covers (1).



## DISMOUNTING P.T.O. ASSEMBLY



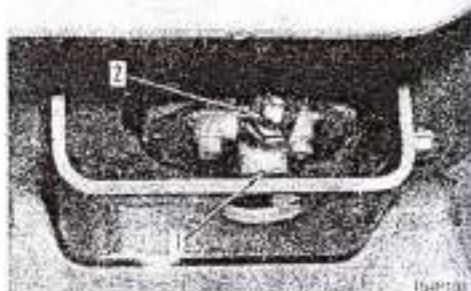
## 1. Draining oil



Loosen oil filler cap to release internal pressure from tank. Remove drain plug (1). Loosen drain cock (2) and drain oil from hydraulic oil tank.



Hydraulic oil tank: Approx. 70 ℓ



## 2. Floor frame assembly

See P. 259 DISMOUNTING FLOOR FRAME for dismounting procedure.

## 3. Transmission pump piping

Disconnect outlet tube (3) and inlet tube (4).



## 4. Transmission pump assembly

Remove transmission pump assembly (5).



## 5. Hydraulic pump piping

Disconnect hydraulic pump outlet hose (8) and inlet tube (7).



## 6. Hydraulic pump assembly

- 1) Remove two mounting bolts under hydraulic pump and use a nylon sling to hold the assembly.
- 2) Remove the two upper mounting bolts and remove hydraulic pump assembly (8).

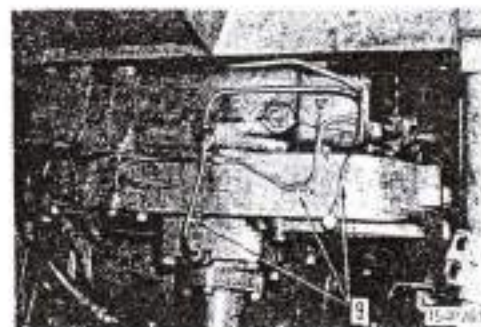


Hydraulic Pump assembly: 40 kg



## 7. Lubrication tubes

Remove P.T.O. lubrication tubes (9).



## 8. P.T.O. assembly

- 1) Attach eyebolt (12 mm, P = 1.75) and hoist P.T.O. assembly (10).

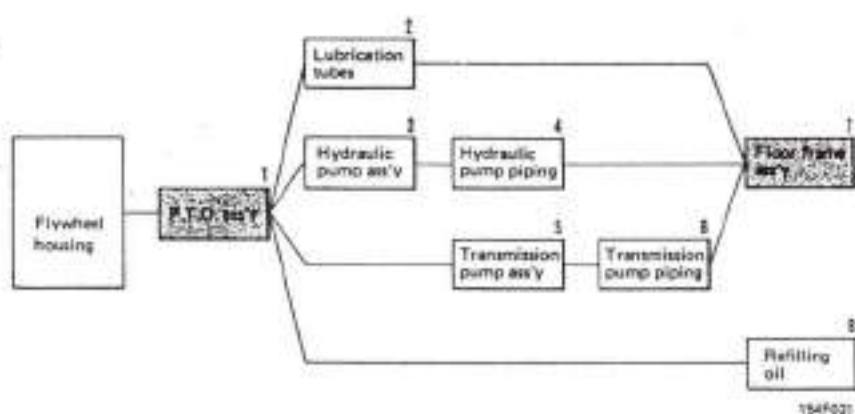


P.T.O. assembly: 80 kg

- 2) Remove 10 mounting bolts and remove P.T.O. assembly.



## MOUNTING P.T.O. ASSEMBLY



154F001

## 1. P.T.O. assembly

- 1) Install ring (11) in flywheel housing.

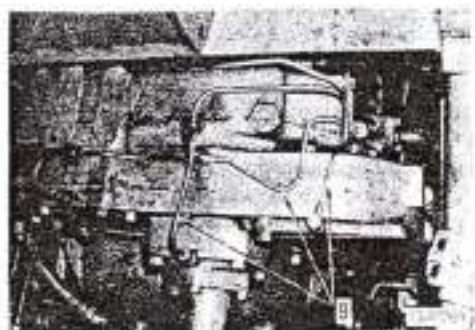


- 2) Fit O-ring on P.T.O. assembly (10) and attach eyebolt (12 mm, P = 1.75). Lift and install P.T.O. assembly.

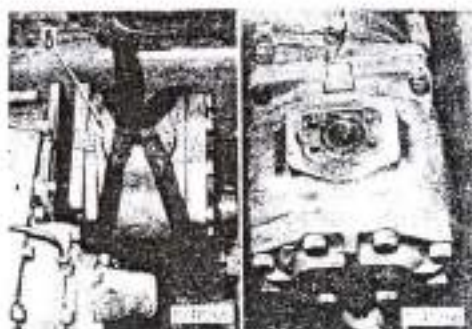


**2. Lubrication tubes**

Install P.T.O. lubrication tubes (9).

**3. Hydraulic pump assembly**

- 1) Fit O-ring on P.T.O. case.
- 2) Use a nylon sling to lift and install work equipment pump assembly (8) on P.T.O. case.

**4. Hydraulic pump piping**

Fit O-ring and connect inlet tube (7) and outlet tube (8) to work equipment.



Fit O-rings securely in grooves.

**5. Transmission pump assembly**

Fit O-ring on P.T.O. case and mount transmission pump assembly (5).





## 6. Transmission pump piping

Fit O-ring and connect outlet tube (3) and inlet tube (4).



Fit O-ring securely in groove.

## 7. Floor frame assembly

See P. 262 MOUNTING FLOOR FRAME ASSEMBLY for mounting procedure.



## 8. Refilling oil

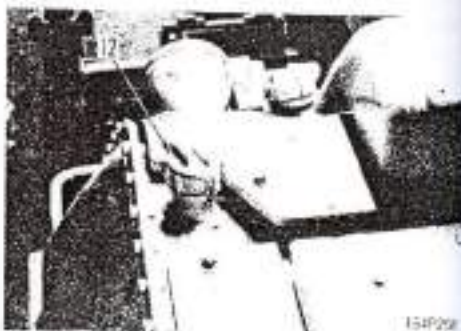
1) Close drain cock.

2) Refill engine oil in through oil filler (12) until it reaches prescribed level.

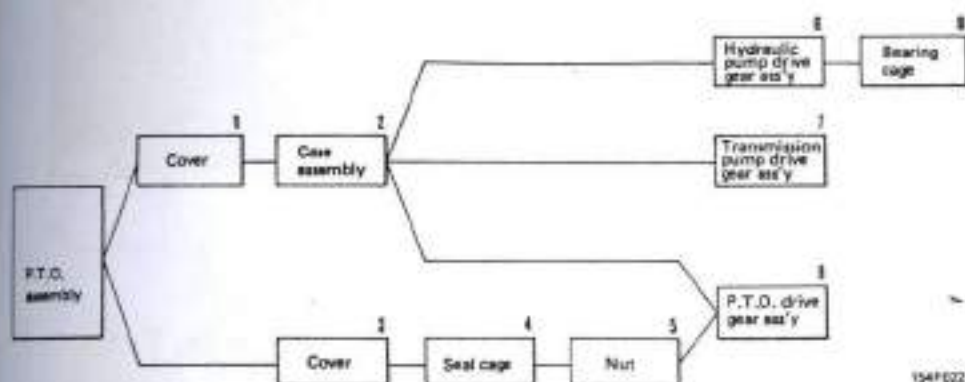


Hydraulic oil tank: approx. 70 l

★ Start engine, and after oil in pipes has circulated, check oil level again.



## DISASSEMBLY OF P.T.O. ASSEMBLY



154FD22

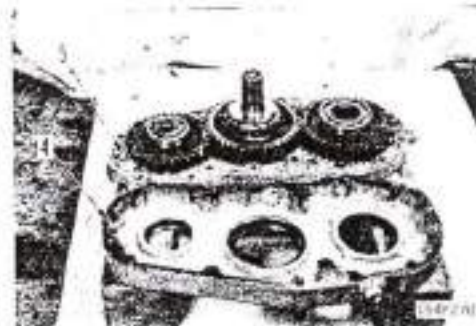
## 1. Cover

- 1) P.T.O. assembly (1) on block (1) (height: approx. 150 mm).
- 2) Remove cover (2).



## 2. Case assembly

- Remove mounting bolts (3) and divide into case (4) and case assembly (5).



**3. Cover**

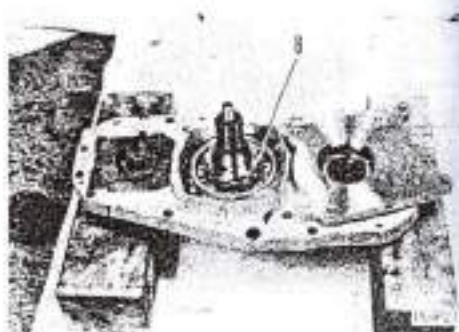
- 1) Turn case assembly (5) upside down and set on block ① (height: Approx. 150 mm).
- 2) Remove cover (5).

**4. Seal cage**

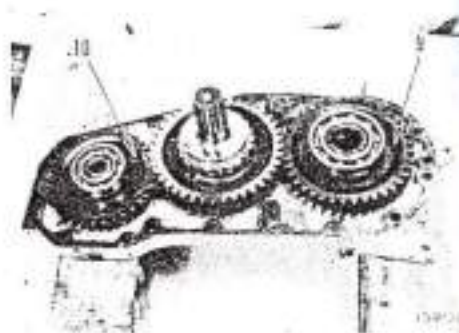
- Remove seal cage (7).

**5. Nut**

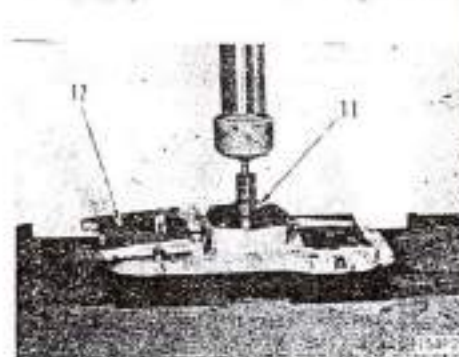
- Using wrench kit remove nut (8).

**6. Hydraulic pump drive gear assembly**

- Remove hydraulic pump drive gear assembly (9) tapping back with copper hammer, etc.

**7. Transmission pump drive gear assembly**

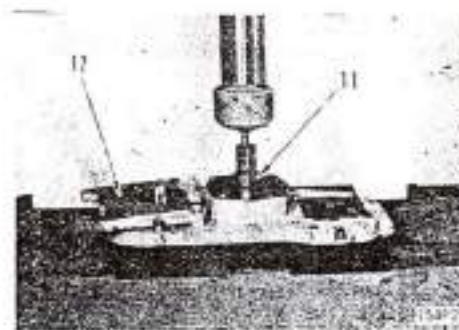
- Remove transmission pump drive gear assembly (10) by tapping back with copper hammer, etc.

**8. P.T.O. drive gear assembly**

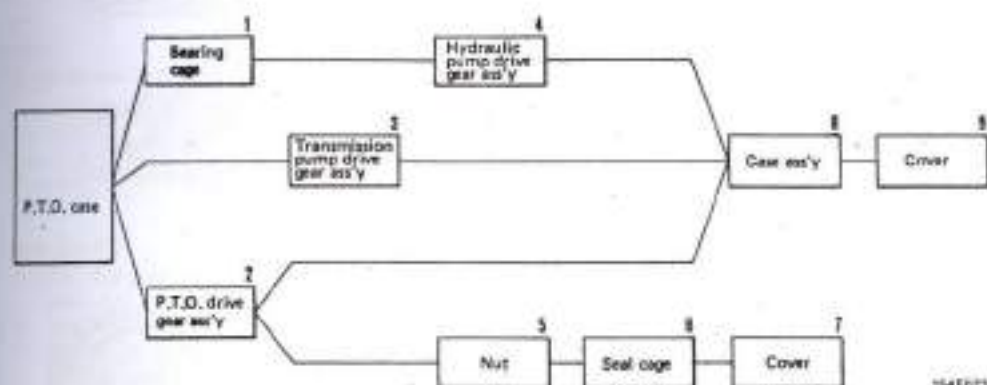
- Remove P.T.O. drive gear assembly (11) using press.

**9. Bearing cage**

- Remove bearing cage (12).



## ASSEMBLY OF P.T.O. ASSEMBLY



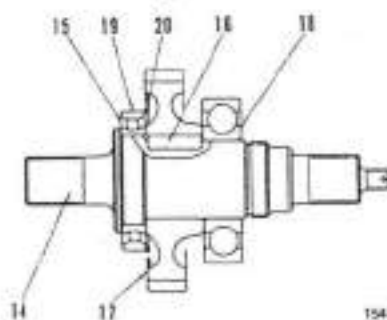
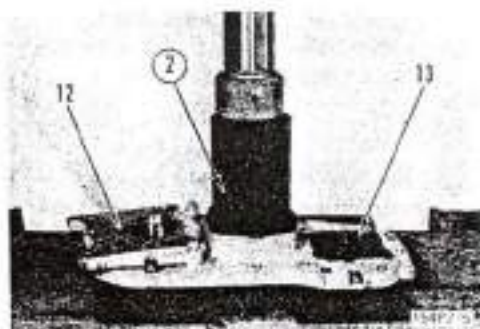
154F023

## 1. Bearing cage

Fit O-ring and install bearing cage (12) on case (13).

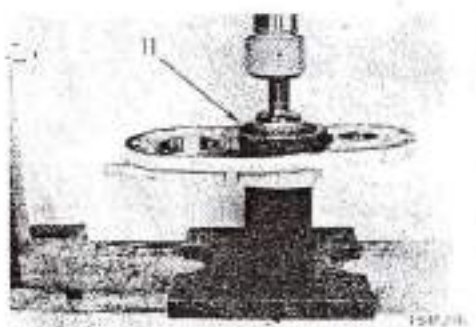
## 2. P.T.O. drive gear assembly

- 1) Using push tool (80 mm inside dia.), pressfit bearing into shaft (14).
- 2) Install key (16) in shaft and using push tool (70 mm inside dia.) pressfit gear (17).
- 3) Using push tool ② (ø150 mm) pressfit bearing (18) into case (13).
- 4) Using push tool (ø125 mm) pressfit outer race (19) into case (4), and install snap ring (20).



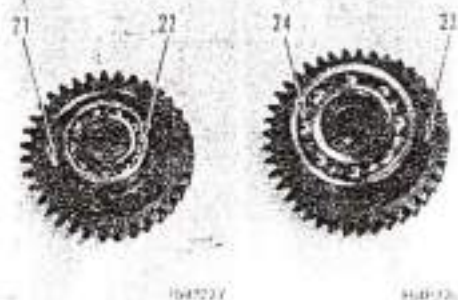
154F024

- 5) Using push tool (2) containing bearing, press-fit P.T.O. drive gear assembly (11).



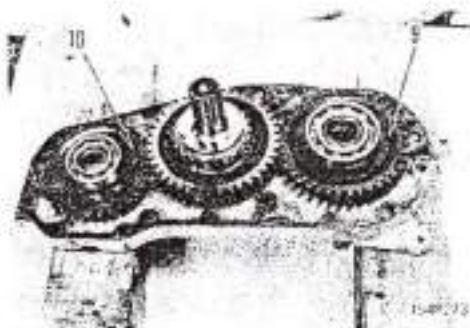
### 3. Transmission pump drive gear assembly

- 1) Using push tool (45 mm inside dia.) pressfit upper and lower bearings (22) into gear (21).
- 2) Install transmission pump drive gear assembly (10) into case with a copper hammer, etc.



### 4. Hydraulic pump drive gear assembly

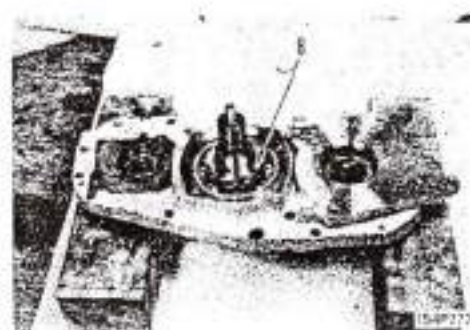
- 1) Using push tool (60 mm inside dia.) pressfit upper and lower bearings (24) into gear (23).
- 2) Install hydraulic pump drive gear assembly (9) into case with a copper hammer, etc.



### 5. Nut

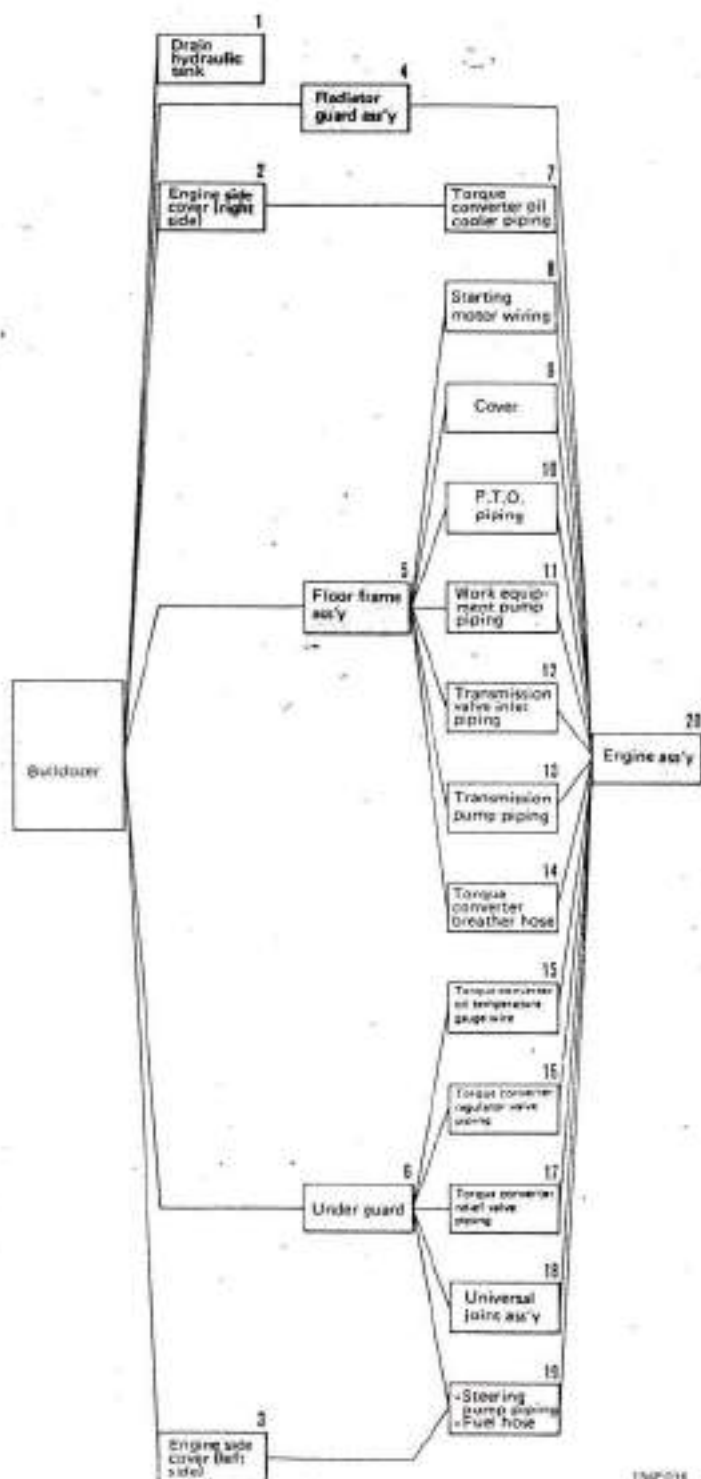
Install spacer and lock plate. Using wrench kit, tighten nut (8).

- ★ Bend lock plate securely.





## DISMOUNTING ENGINE ASSEMBLY



134P018



## 1. Drain hydraulic tank

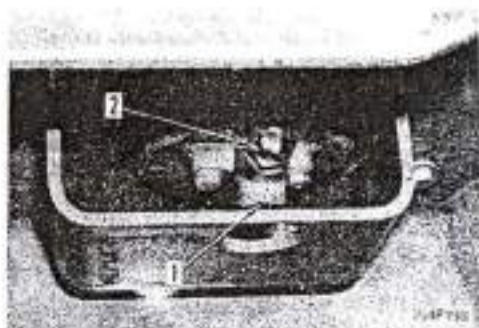


Loosen oil filler cap to release internal pressure from tank.

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



Hydraulic tank: approx. 70 l



## 2. Engine side cover (right side)

Remove right side cover of engine.



## 3. Engine side cover (left side)

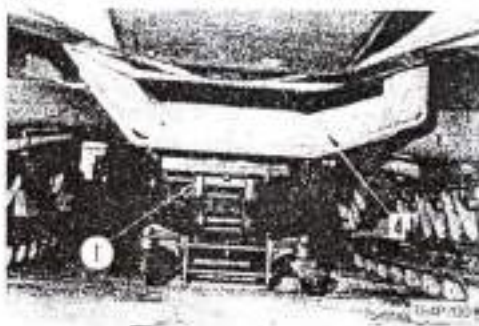
Remove left side cover (3) of engine.

## 4. Radiator guard assembly

See Section DISMOUNTING RADIATOR GUARD for dismantling procedure.

## 5. Floor frame assembly

See Section DISMOUNTING FLOOR ASSY for dismantling procedure.



## 6. Under guard

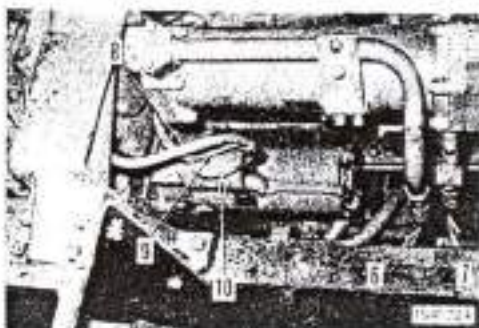
Support under guard (4) with transmission jack (1) and remove.



Under guard: 160 kg.

## 7. Torque converter oil cooler piping

Disconnect inlet and outlet hoses (6) and (7) of torque converter oil cooler.



## 8. Starting motor wiring

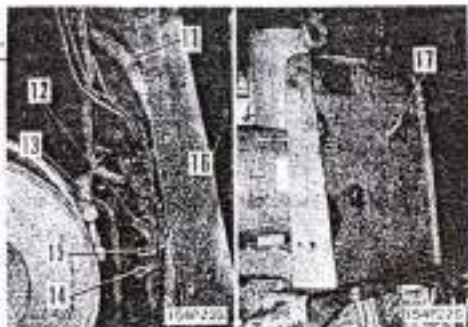
Disconnect wires (8), (9) and (10).

## 9. Cover

- 1) Release clamp and disconnect wires (11), (12) and (13).
- 2) Disconnect priming pump tube (14) at engine end, and tube (15) at body.
- 3) Disconnect oil pressure gauge tube (16) at engine end.
- 4) Install two eyebolts (12 mm, P = 1,75) to cover (17) and lift away.

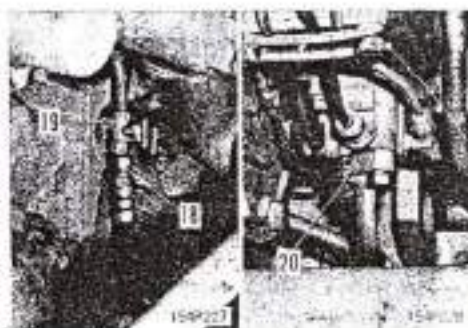


Cover: 50 kg



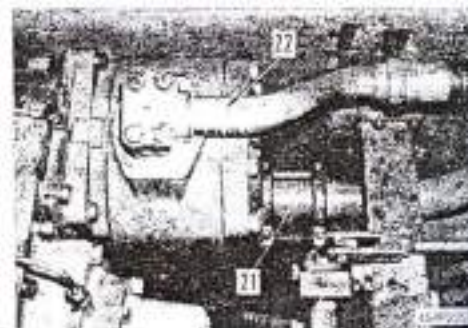
## 10. P.T.O. piping

- 1) Disconnect hose (18).
- 2) Release clamp (19) and remove tube (20).



## 11. Work equipment pump piping

Disconnect pump inlet tube (21) and outlet tube (22).



## 12. Transmission valve inlet piping

Disconnect transmission valve inlet tube (23) at filter.

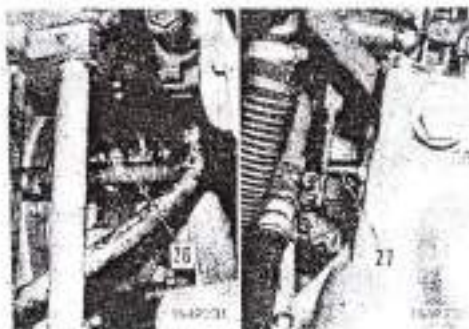
## 13. Transmission pump piping

- 1) Remove pump inlet tube (24).
- 2) Disconnect pump outlet hose (25) at filter.



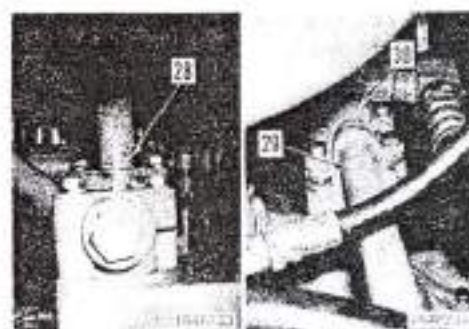
## 14. Torque converter breather hose

Remove torque converter breather hose (26).



## 15. Torque converter oil temperature gauge wire

Disconnect torque converter oil temperature gauge wire (27).



## 16. Torque converter regulator valve piping

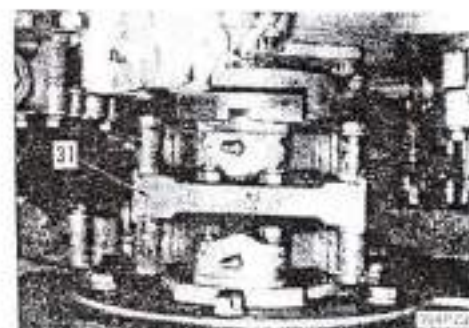
Disconnect torque converter regulator valve outlet tube (28).

## 17. Torque converter relief valve piping

Disconnect torque converter relief valve inlet tube (29) and outlet tube (30).

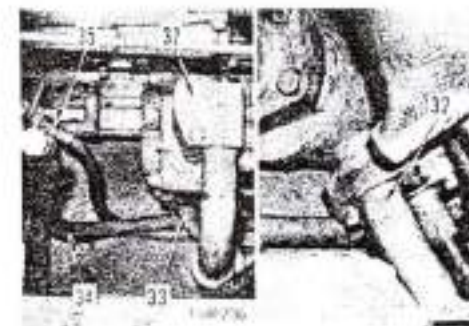
## 18. Universal joint assembly

Remove universal joint assembly (31).



## 19. Steering pump piping and fuel hose

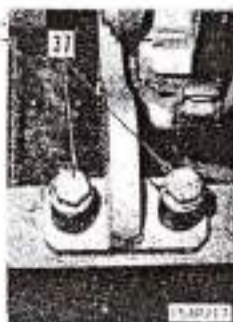
- 1) Remove steering pump inlet tube (32).
- 2) Disconnect steering pump outlet tube (33).
- 3) Disconnect filter inlet hose (34) and injector drain hose (35).





## 20. Engine assembly

- 1) Remove front (37) and rear (38) engine mounting bolts. (right and left sides)



- 2) Attach 3 hooks to lifting bracket of engine assembly (39).

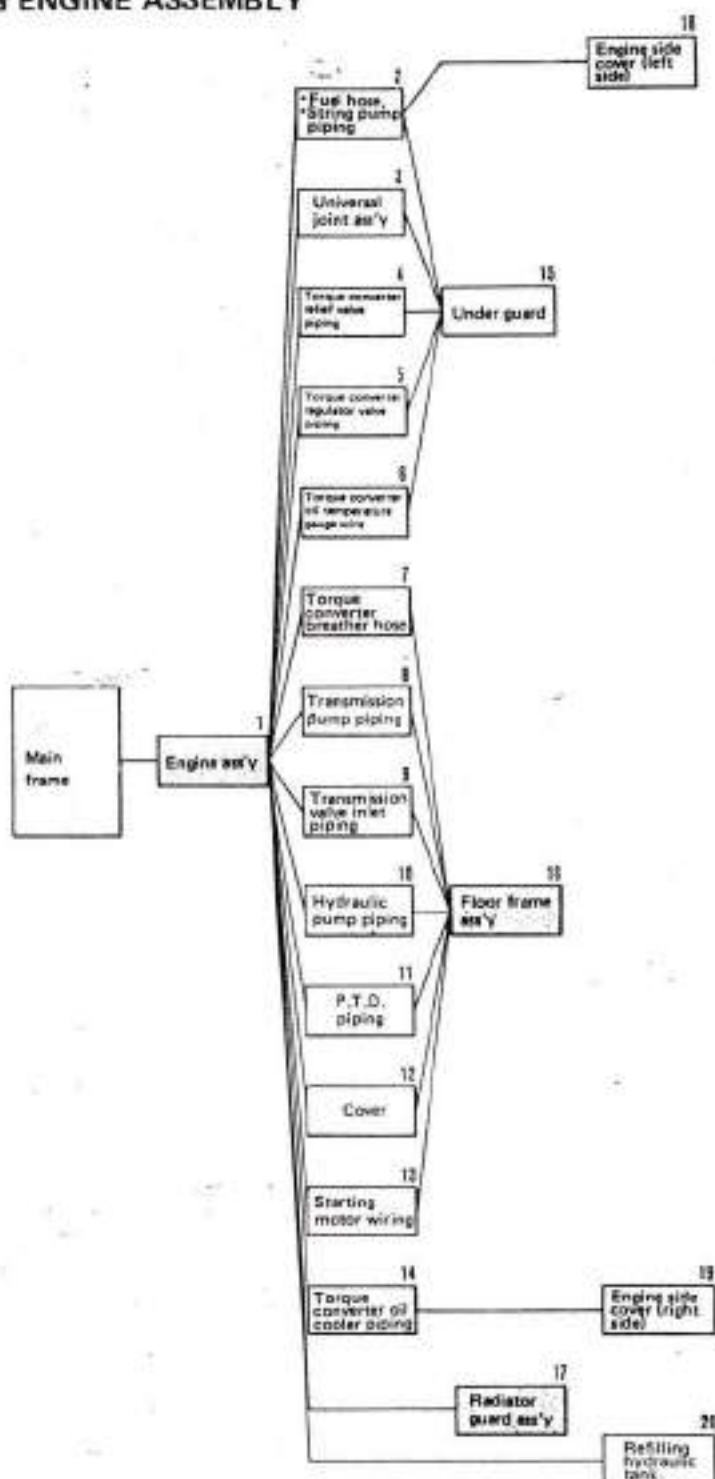


Engine assembly: 2,200 kg

- ★ Keep all mount shims in sets according to position. (front and rear, left and right)



## MOUNTING ENGINE ASSEMBLY

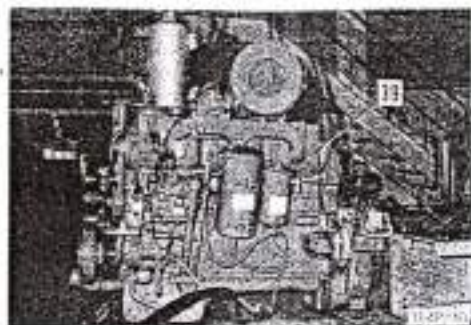


154FD17



## 1. Engine assembly

- 1) Install all mount shims in their correct positions (front and rear, left and right). Lift engine assembly (39), mount on frame, and tighten mounting bolts.

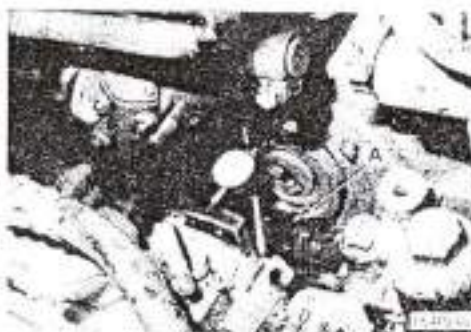
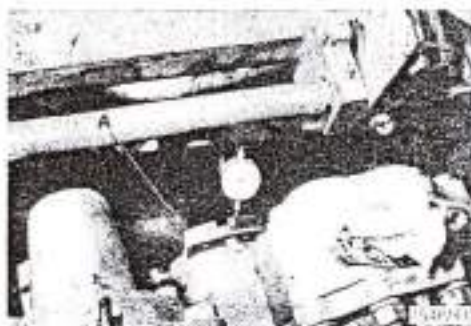


Mounting bolt: 76±8.5 kg.m  
(front and rear)

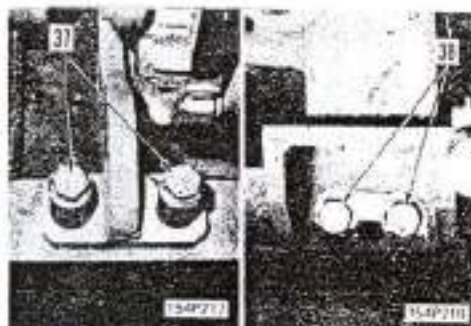
- 2) Mount centering tool A on yoke of torque converter and transmission. Measure radial runout and face runout to confirm that they are within the standard range. If they exceed the standard range, loosen mounting bolts and adjust thickness of shims at each mount.

## ★ Standard value:

- Radial runout: within 0.5 mm
- Face runout : within 0.5 mm  
(dial gauge reading)



- 3) Tighten mounting bolts and lock
  - ★ Lock front mounting bolts (37) securely with wire,
  - ★ Bend lock plate of rear mounting bolts (38) securely.



## 2. Fuel hose, steering pump piping

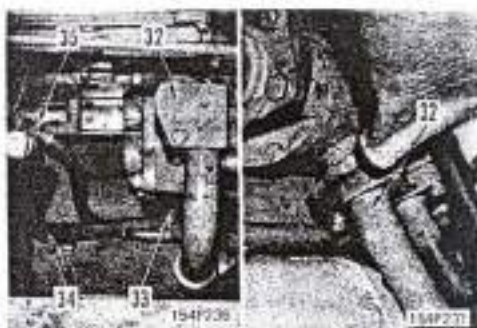
1) Connect injector return hose (35) and fuel filter inlet hose (34).

2) Fit O-ring and connect tube (33) to steering pump.



Fit O-ring securely in groove.

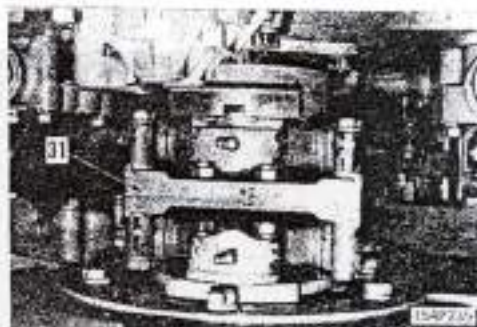
3) Fit O-ring and install tube (32) between steering pump and strainer.



## 3. Universal joint assembly

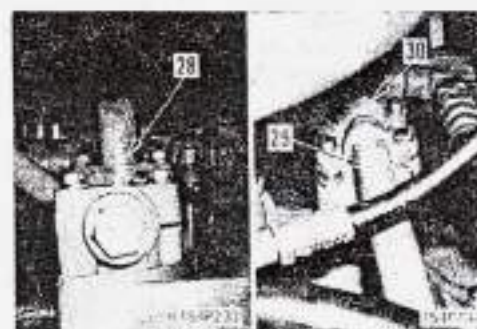
Install universal joint ass'y (31).

\* After completion of installation, apply grease (G2-L1).



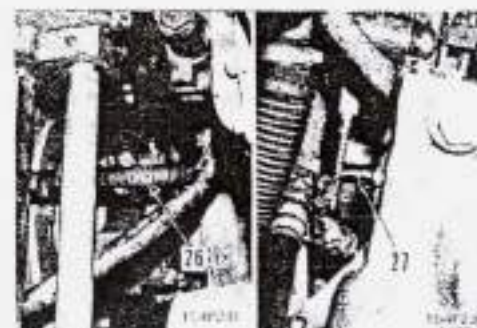
## 4. Torque converter relief valve piping

Fit O-ring and connect outlet tube (30) and inlet tube (29) to torque converter relief valve.



## 5. Torque converter regulator valve piping

Fit O-ring and connect tube (28) to torque converter regulator valve.



## 6. Torque converter oil temperature gauge wire

Connect torque converter oil temperature gauge wire (27).

## 7. Torque converter breather hose

Install torque converter breather hose (26).

## 8. Transmission pump piping

- 1) Fit O-ring and connect transmission pump outlet hose (25) to filter.



Fit O-ring securely in groove.

- 2) Fit O-ring and install pump inlet tube (24) between pump and strainer.



## 9. Transmission valve inlet piping

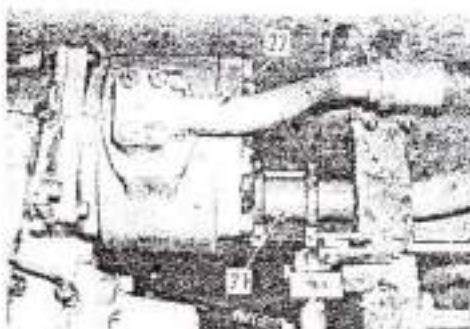
- Fit O-ring and install transmission valve inlet tube (23) to filter.

## 10. Hydraulic pump piping

- Fit O-rings and connect pump outlet hose (22) and inlet tube (21) to pump.

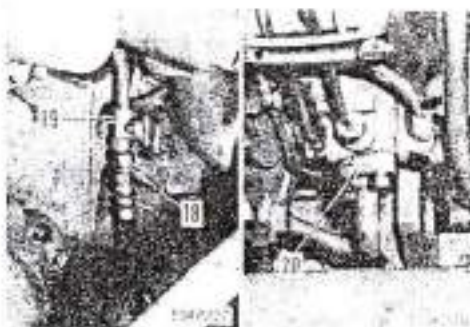


Fit O-rings securely in grooves.



## 11. P.T.O. piping

- 1) Fit O-ring and install tube (20) and clamp (19).
- 2) Connect hose (18).



## 12. Cover

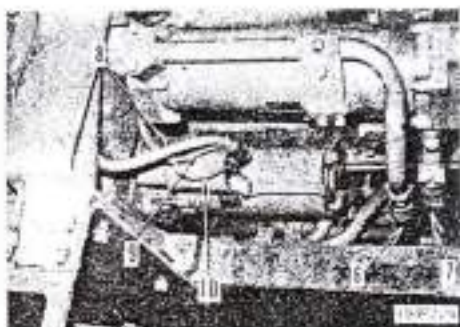
- 1) Attach two eyebolts (12 mm, P = 1.75) to cover (17). Lift and mount.
- 2) Connect oil pressure gauge tube (16) to engine.
- 3) Connect priming pump tube (15) to engine, and tube (14) to body.
- 4) Connect wires (13), (12) and (11) to cover.





## 13. Starting motor wiring

Connect starting motor wires (10), (9) and (8).

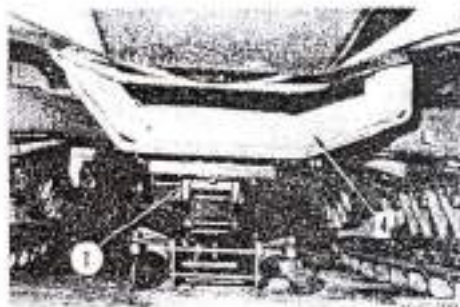


## 14. Torque converter oil cooler piping

Connect torque converter oil cooler inlet and outlet hoses (7) and (6).

## 15. Under guard

Support under guard (4) with mission jack (1) and install.



## 16. Floor frame assembly

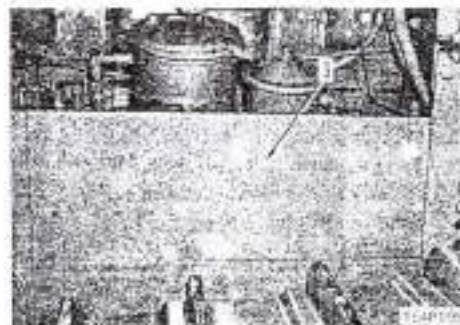
See Section **MOUNTING FLOOR FRAME** for mounting procedure.

## 17. Radiator guard assembly

See Section **MOUNTING RADIATOR GUARD** for mounting procedure.

## 18. Engine side cover (left side)

Install left side cover (3) of engine.



## 19. Engine side cover (right side)

Install right side cover of engine.



## 20. Refilling hydraulic tank

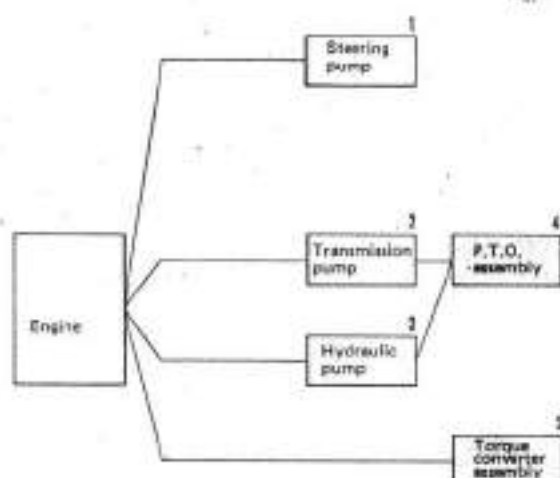
- 1) Close drain cock and drain plug.
- 2) Pour engine oil in through oil filler (40) until it reaches prescribed level.



Hydraulic oil tank: approx. 70 l

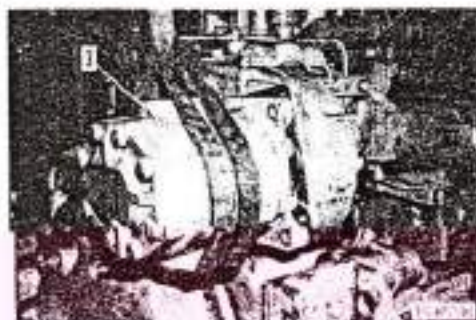
- \* Start engine, and after oil in pipes has circulated, check oil level again.

## DISMOUNTING CHASSIS-RELATED PARTS FROM ENGINE



1547018

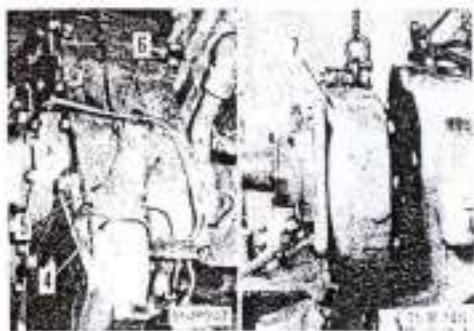
1. Steering pump  
Remove steering pump (1).
2. Transmission pump  
Remove transmission pump from TY 220 or TS 220
3. Hydraulic pump  
Remove hydraulic pump (3).



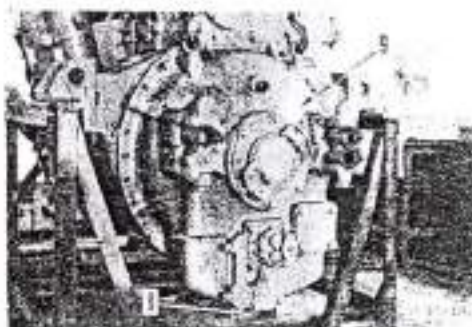


**4. P.T.O assembly**

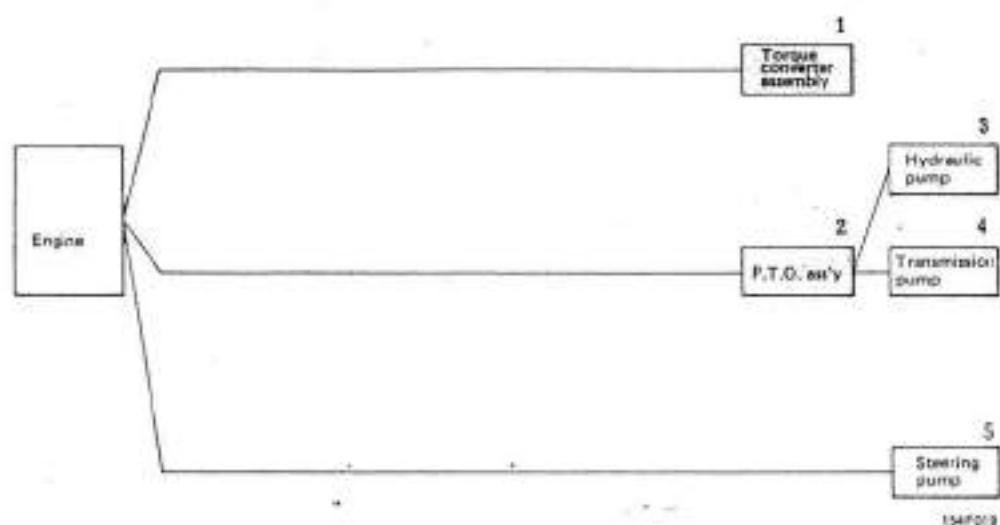
- 1) Remove lubrication tubes (4), (5) and (6).
- 2) Fit two eyebolts (12 mm, P = 1,75) and hoist. Remove mounting bolts and lift away P.T.O. assembly (7).

**5. Torque converter assembly**

- 1) Remove drain plug (8) and drain oil from torque converter.
- 2) Attach hooks to housing and hoist. Remove mounting bolts and screw in jack bolts to remove torque converter assembly (9).



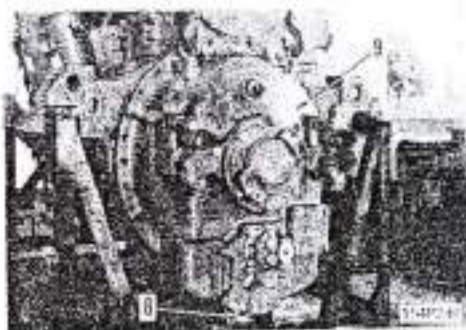
## MOUNTING CHASSIS-RELATED PARTS ON ENGINE



## 1. Torque converter assembly

- 1) Fit gasket on flywheel housing.
- 2) Sling torque converter assembly (9) and, aligning torque converter drive gear with teeth of flywheel, install assembly.
- 3) Tighten bolts.

 Gasket: Liquid gasket



## 2. P.T.O. assembly

- 1) Sling P.T.O. assembly (7). Fit O-ring and install assembly.
- 2) Fit gasket and install lubricator tubes (6), (3) and (4).



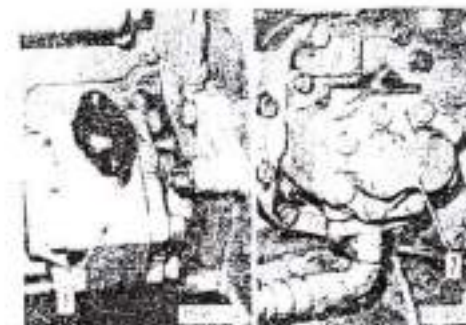
## 3. Hydraulic pump

- Fit O-ring and mount hydraulic pump (3).



## 4. Transmission pump

- Fit O-ring and install transmission pump to TY 220 or TS 220



## 5. Steering pump

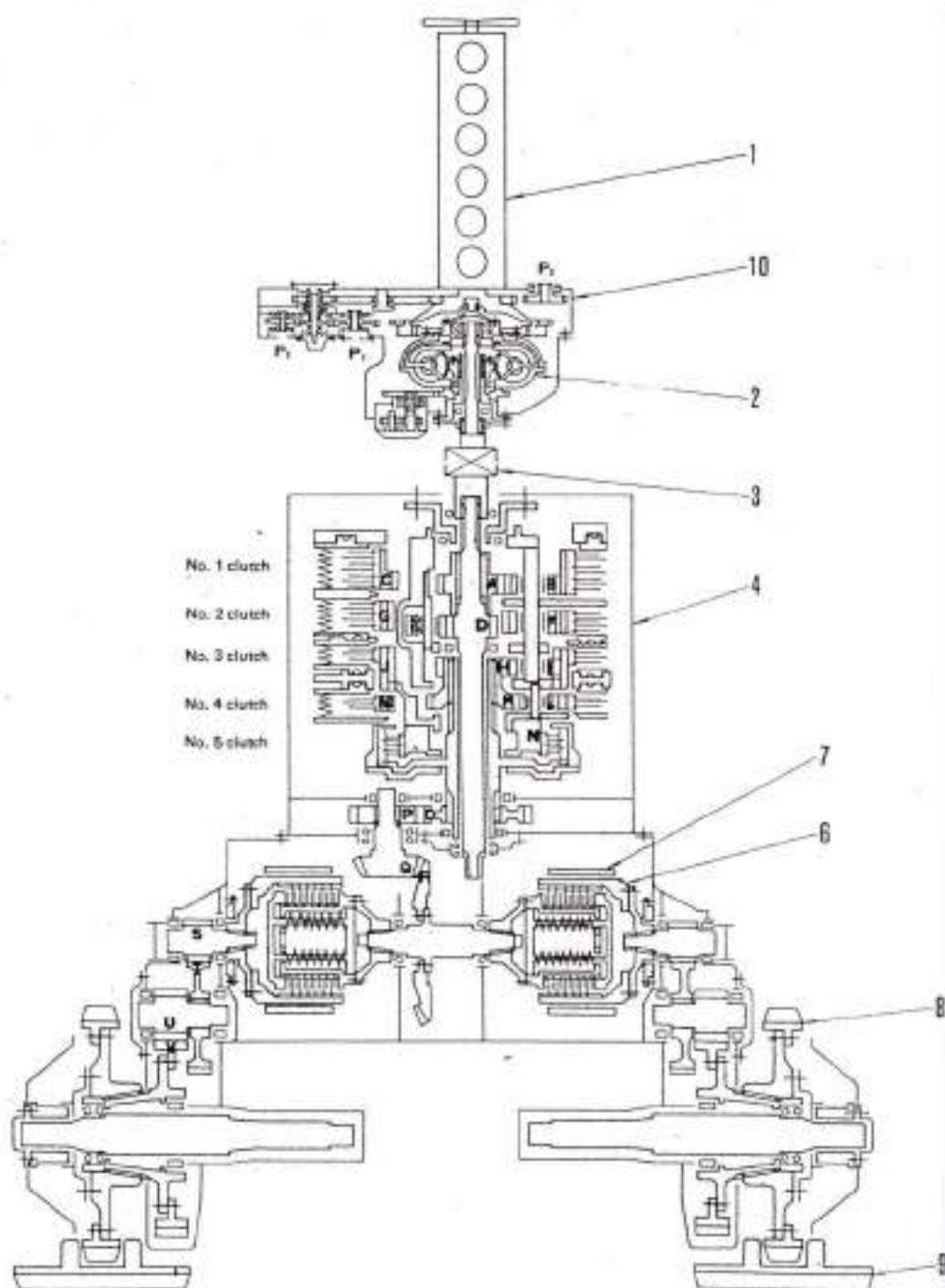
- Fit O-ring and install steering pump (1).



# POWER TRAIN

## STRUCTURE AND FUNCTION

## GENERAL



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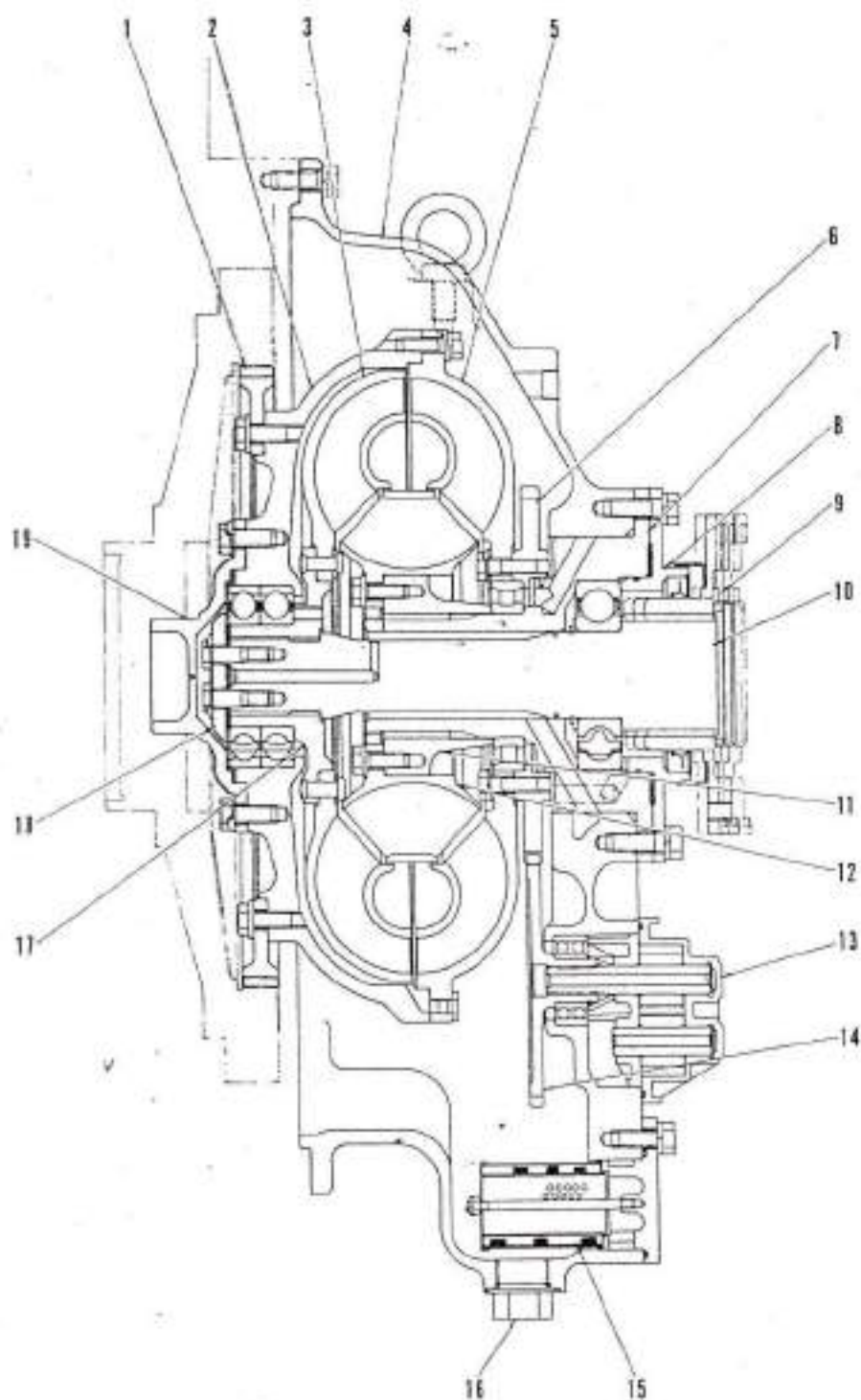
1. Engine
2. Torque converter
3. Universal joint
4. Transmission
5. Control valve
6. Steering clutch
7. Steering brake
8. Sprocket
9. Track
10. P.T.O.
- P1. Work equipment
- P2. TOROFLOW pump
- P3. Steering pump

SPEED STAGE AND POWER TRANSMISSION ROUTE

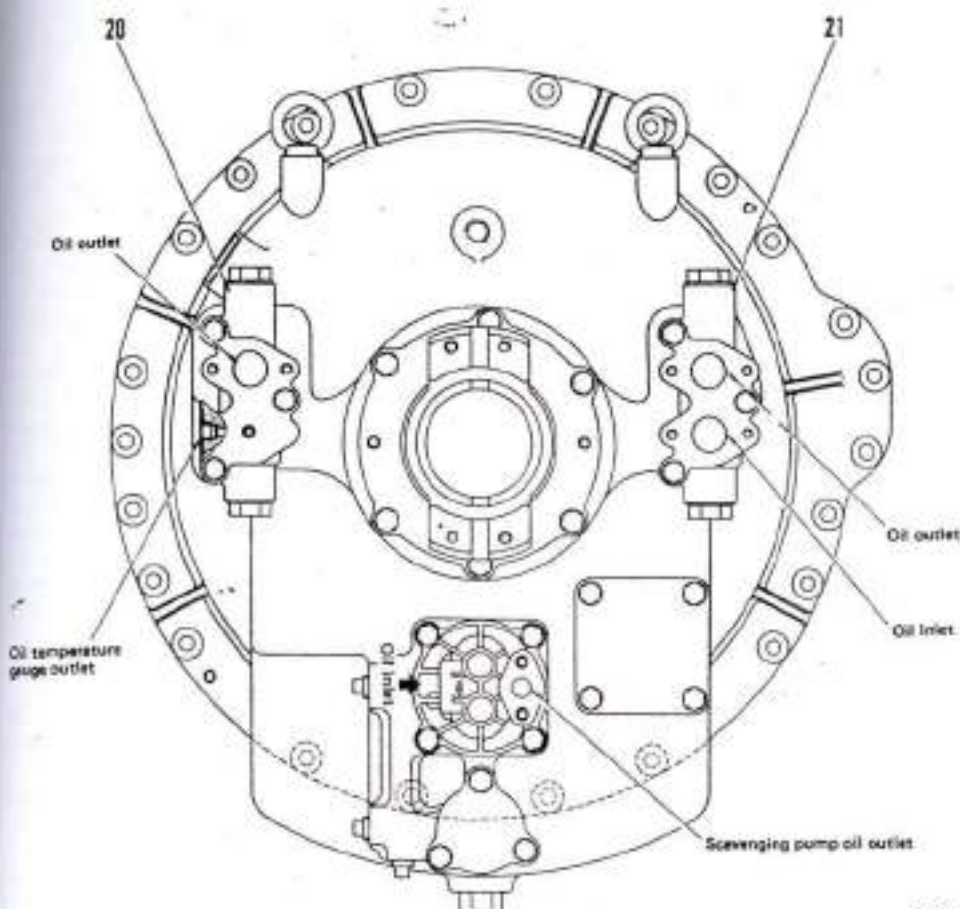
Forward/ Reverse	Speed stage	Gears used (transmission)
Forward	1st speed	No. 1 - No. 5
	2nd speed	No. 1 - No. 4
	3rd speed	No. 1 - No. 3
Reverse	1st speed	No. 2 - No. 5
	2nd speed	No. 2 - No. 4
	3rd speed	No. 2 - No. 3

- |                           |            |                          |
|---------------------------|------------|--------------------------|
| A. No. 1 sun gear         | (33 teeth) | No. 1 clutch (forward)   |
| B. No. 1 planetary pinion | (24 teeth) |                          |
| C. No. 1 ring gear        | (81 teeth) |                          |
| D. No. 2 sun gear         | (21 teeth) | No. 2 clutch (reverse)   |
| E. No. 2 planetary gear   | (23 teeth) |                          |
| F. No. 2 planetary pinion | (24 teeth) |                          |
| G. No. 2 ring gear        | (81 teeth) | No. 3 clutch (3rd speed) |
| H. No. 3 sun gear         | (33 teeth) |                          |
| I. No. 3 planetary pinion | (24 teeth) |                          |
| J. No. 3 ring gear        | (81 teeth) | No. 4 clutch (2nd speed) |
| K. No. 4 sun gear         | (42 teeth) |                          |
| L. No. 4 planetary pinion | (19 teeth) |                          |
| M. No. 4 ring gear        | (81 teeth) | No. 5 clutch (1st speed) |
| N. No. 5 ring gear        |            |                          |
| O. Transfer drive gear    | (34 teeth) |                          |
| P. Transfer driven gear   | (23 teeth) |                          |
| Q. Bevel pinion           | (21 teeth) |                          |
| R. Bevel gear             | (49 teeth) |                          |
| S. Final drive 1st pinion | (12 teeth) |                          |
| T. Final drive 1st gear   | (45 teeth) |                          |
| U. Final drive 2nd pinion | (12 teeth) |                          |
| V. Final drive 2nd gear   | (55 teeth) |                          |

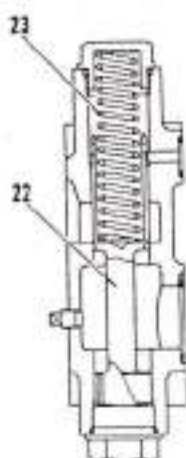
## TORQUE CONVERTER



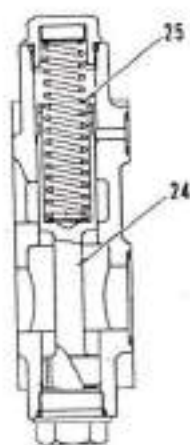
154P310



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15AF118



15AF119

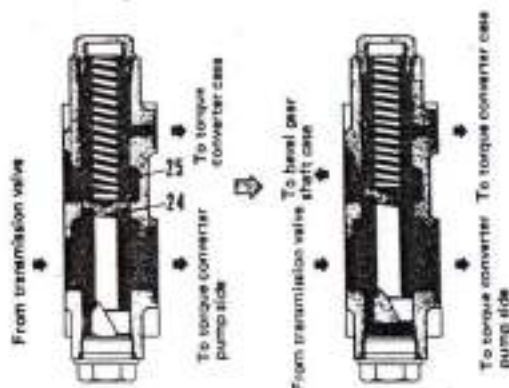


## TORQUE CONVERTER RELIEF VALVE

In order to protect the torque converter from excessively high pressures, a relief valve is installed in the inlet circuit to prevent the pressure inside the torque converter exceeding  $8.7^{+0.3}_0 \text{ kg/cm}^2$ .

Pressurized oil from the transmission and steering pump enters port A, and then passes through the passage A' in the torque converter housing to enter the torque converter.

When the oil reaches port A and the pressure rises above  $8.7^{+0.3}_0 \text{ kg/cm}^2$ , the oil compresses the spring (25), pushing the spool (24) open, and is then relieved through port B into the steering case.



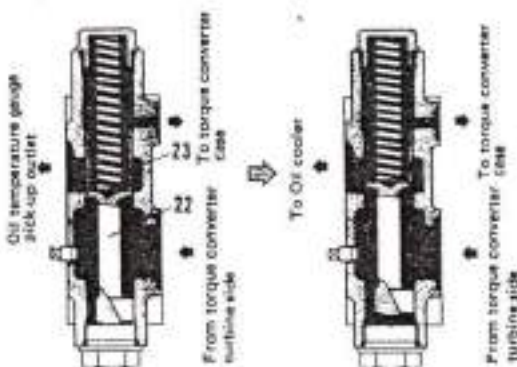
15AF120

## TORQUE CONVERTER REGULATOR VALVE

In order to obtain the maximum performance from the torque converter, a regulator valve is installed in the outlet circuit to maintain the pressure inside the torque converter at  $3 \pm 0.1 \text{ kg/cm}^2$ .

Oil leaving the torque converter passes through passage C into port C.

When the pressure at port C exceeds  $3 \pm 0.1 \text{ kg/cm}^2$ , the oil compresses the spring (23), pushing the spool (22) open, and then flows from port D into the oil cooler.

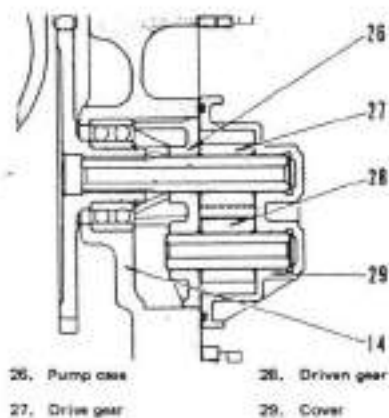


15AF121

## SCAVENGING PUMP

The scavenging pump is driven by the gear (6) mounted on the torque converter pump.

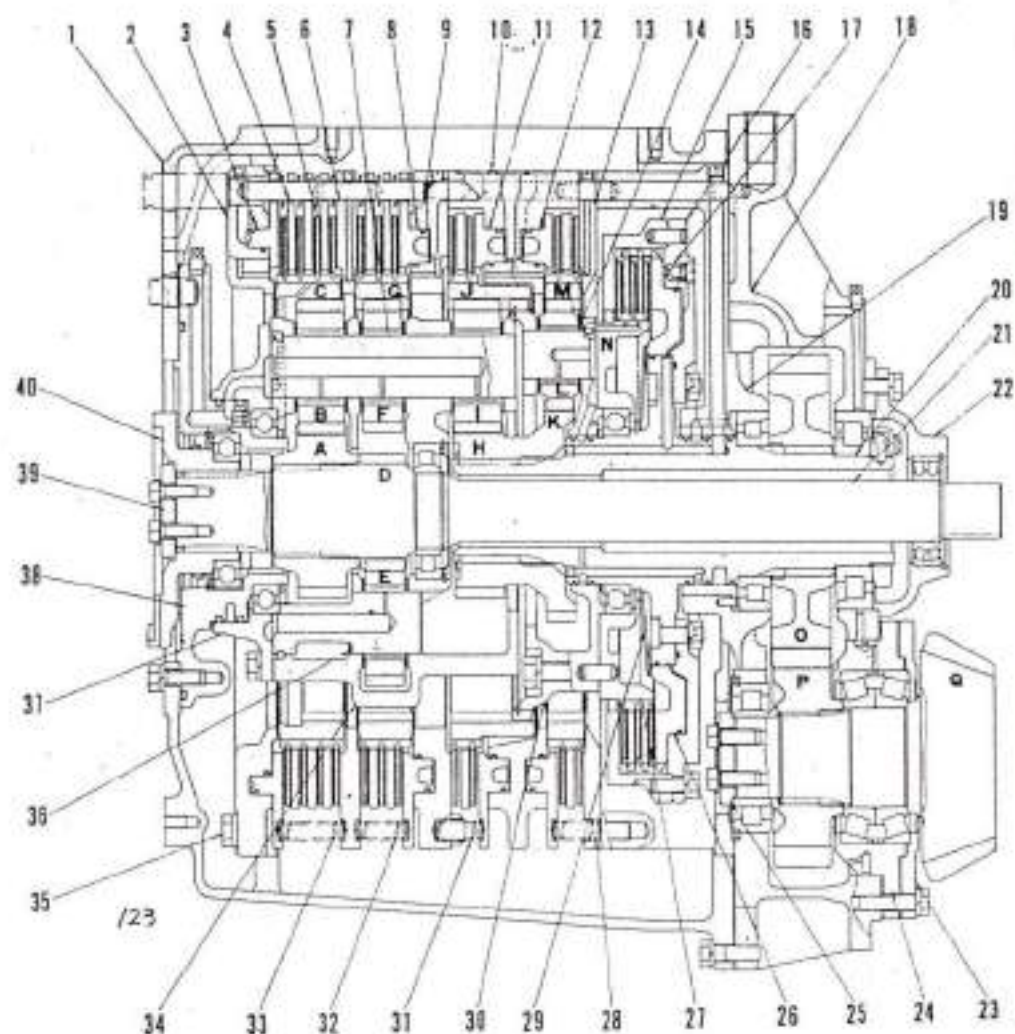
Oil which leaks (internal leakage) from the sealing, etc., of the torque converter and also P.T.O. lubrication oil collects in the torque converter housing. After passing through a strainer, this oil is sucked into the scavenger pump and then transmitted to the steering case.



15AF122



## TORQFLOW TRANSMISSION



154F123

## OUTLINE

TY 220  
The TS 220 is installed with a 3-stage forward/3-stage reverse planetary type transmission constituting a planetary gear unit and disc clutch assembly. Of the five clutches employed in the assembly, two are used to operate and hydraulically fix the control valves, permitting the selection of one rotational direction together with rotational speed.

No. 1 clutch is fixed during forward operation, No. 2 clutch during reverse operation, No. 3 clutch during 3rd speed No. 4 clutch during 2nd speed and No. 5 clutch during 1st speed operation.

1. Transmission case	A. No. 1 sun gear	(33 teeth)	No. 1 clutch (forward)
2. No. 1 clutch housing	B. No. 1 planetary pinion	(24 teeth)	
3. No. 1 clutch piston	C. No. 1 ring gear	(81 teeth)	
4. Clutch plate	D. No. 2 sun gear	(21 teeth)	No. 2 clutch (reverse)
5. Clutch disc	E. No. 2 planetary pinion	(20 teeth)	
6. Plate	F. No. 2 planetary pinion	(24 teeth)	
7. No. 1, 2 and 3 pinion shafts	G. No. 2 ring gear	(81 teeth)	No. 3 clutch (3rd speed)
8. No. 2 clutch piston	H. No. 3 Sun gear	(33 teeth)	
9. No. 2 clutch housing	I. No. 3 planetary pinion	(24 teeth)	
10. No. 3 & 4 clutch housing	J. No. 3 ring gear	(81 teeth)	No. 4 clutch (2nd speed)
11. No. 3 clutch piston	K. No. 4 sun gear	(42 teeth)	
12. No. 4 clutch piston	L. No. 4 planetary pinion	(19 teeth)	
13. Plate	M. No. 4 ring gear	(81 teeth)	No. 5 clutch (1st speed)
14. No. 4 pinion shaft	N. No. 5 ring gear		
15. No. 5 clutch drum	O. Transfer drive gear	(34 teeth)	
16. No. 5 clutch housing	P. Transfer driven gear	(23 teeth)	
17. Ball check valve	Q. Bevel pinion	(21 teeth)	
18. Rear case			
19. No. 5 clutch housing			
20. Output shaft			
21. Input shaft			
22. Bearing cage			
23. Cover			
24. Bearing cage			
25. Holder			
26. No. 5 clutch piston			
27. No. 5 clutch gear			
28. No. 4 clutch spring			
29. No. 5 clutch spring			
30. No. 4 carrier			
31. No. 3 clutch spring			
32. No. 2 clutch spring			
33. No. 1 clutch spring			
34. No. 1, 2 and 3 carrier			
35. Tie bolt			
36. No. 2 pinion shaft			
37. Bearing cage			
38. Bearing cage			
39. Holder			
40. Coupling			

## NUMBER OF PLATES AND DISCS

	Number of plates	Number of discs
No. 1 clutch	3	4
No. 2 clutch	2	3
No. 3 clutch	1	2
No. 4 clutch	1	2
No. 5 clutch	2	3

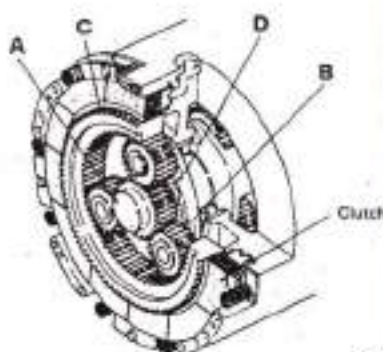
## SPEED STAGE AND POWER TRANSMISSION ROUTE

Forward/ reverse	Speed stage	Clutch to be engaged
Forward	1st speed	No. 1 - No. 5
	2nd speed	No. 1 - No. 4
	3rd speed	No. 1 - No. 3
Reverse	1st speed	No. 2 - No. 5
	2nd speed	No. 2 - No. 4
	3rd speed	No. 2 - No. 3

## STRUCTURE AND FUNCTION

## PLANETARY GEAR SYSTEM (STRUCTURE EXAMPLE)

The planetary gear system consists of sun gear A, planetary pinion B, ring gear C and carrier D. The planetary pinions are supported by the carrier, and mesh with the sun gear and ring gear.



154F124

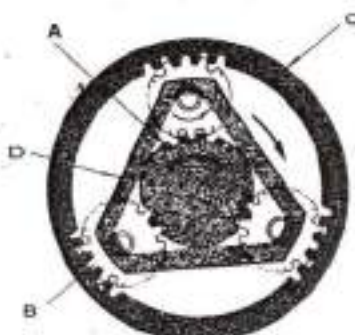
A. Sun gear  
B. Planetary pinion  
C. Ring gear  
D. Planetary carrier

## WHEN THE RING GEAR IS FIXED:

The rotation of sun gear A is transmitted to planetary pinions B.

Because the planetary pinions mesh with sun gear C, and the ring gear is fixed, they cannot rotate at the same position. Consequently, they revolve around the sun gear along the ring gear, while rotating on their own axes.

The torque of the sun gear is transmitted to carrier D which will rotate in the same direction as the sun gear.



154F125

## WHEN THE CARRIER IS FIXED:

The rotation of sun gear A is transmitted to planetary pinions B.

Because the carrier D is fixed, the planetary pinions which mesh with the sun gear rotate at their own axes in the same position.

Ring gear C which meshes with the planetary pinions will rotate in the opposite direction to the sun gear, and the torque of the sun gear is transmitted to the ring gear.

This combination of sun gear + planetary pinions + ring gear or carrier constitutes No. 1, 3 and 4 clutches in the TY 220 TS 220. No. 1 clutch receives its torque from the sun gear and transmits it to the carrier, while No. 3 and 4 clutches receive their torque from the carrier and transmit it to No. 3 and 4 sun gears respectively.



154F126

## WHEN CHANGING DIRECTION OF ROTATION

As shown in the diagram, an extra planetary pinion E is inserted between each planetary pinion B and ring gear C. Sun gear A rotates and the ring gear is fixed. Because the ring gear is fixed, planetary pinions E cannot rotate in the same position, and revolves around the sun gear along the ring gear, while rotating at their own axes.

The torque of the sun gear will be transmitted to the carrier which will rotate in the opposite direction to the sun gear.

This combination of sun gear + planetary pinions + planetary pinions + ring gear or carrier constitutes No. 2 clutch in the T5 220 and is used for reverse operation.

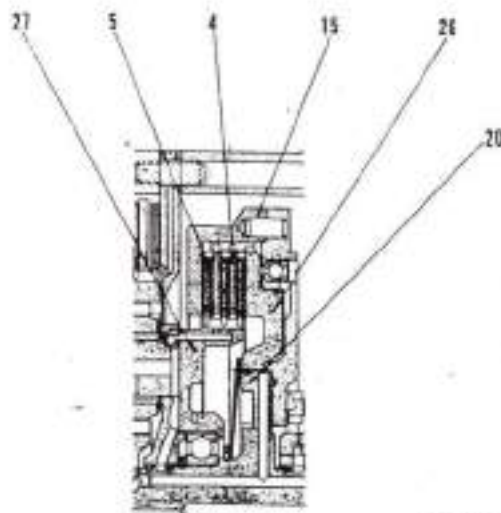


154F127

## ROTARY CLUTCH

The No. 5 clutch used in the T5 220 is a rotary clutch which differs from No. 1 to 4 clutches.

In this clutch, discs (5) are pressed against plates (4) by means of a piston (26) onto the clutch drum (15) which is mounted on the output shaft (20) with bolts. The friction between the discs and plates pressed the gear (27) and clutch drum (15) together, enabling power to be transmitted from the engine. This type of clutch is often used as a 1st speed clutch for transmitting large torque.



154F128

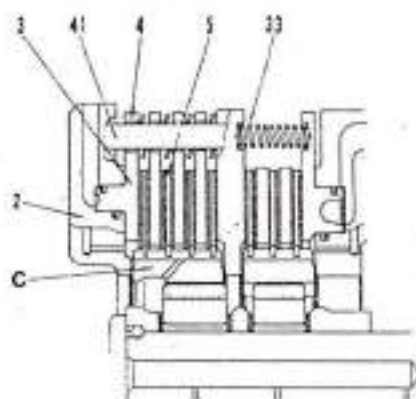


**WHEN FIXING THE RING GEAR (CARRIER)**

In order to fix ring gear C, the disc clutch is incorporated. It consists of a disc clutch consisting of a piston (3), plate (4), disc (5), pins (41) and piston return spring (33).

The internal teeth of the disc mesh with the external teeth of the ring gear.

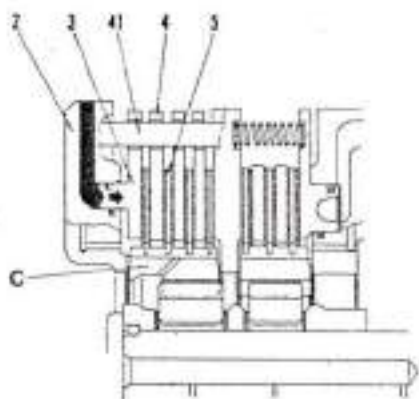
The plate, whose notch on the outside diameter meshes with the pins (41) fixed on the housing, is fixed against the direction of rotation. Similarly, the piston is also fixed against the direction of rotation.



154F129

**ENGAGING (FIXING) CLUTCH**

Pressurized oil from the control valve passed through the port to enter the housing (2), and is then sent to the rear of the piston (3). The piston presses the plates (4) and discs (5) together, and the resulting friction prevents the discs from rotating. In this way, ring gear C which meshes with the internal teeth of the discs is fixed.

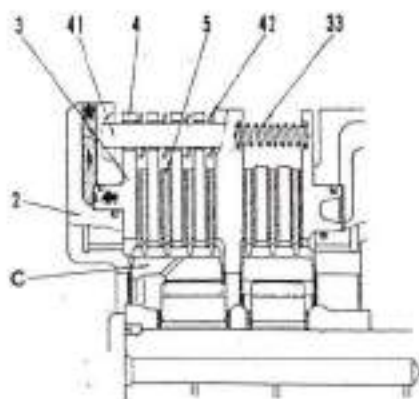


154F130

**DISENGAGING (RELEASING) CLUTCH**

When pressurized oil from the control valve is cut off, the piston (3) is returned to its original position under the action of the return spring (33), thus removing the friction between the plates (4) and discs (5) and putting ring gear C into the neutral condition.

The washer springs (42) mounted between the plates of the pin area are installed to hasten the return of the piston and also to improve the separation of the plates and discs to prevent drag when the clutch is disengaged.



154F131

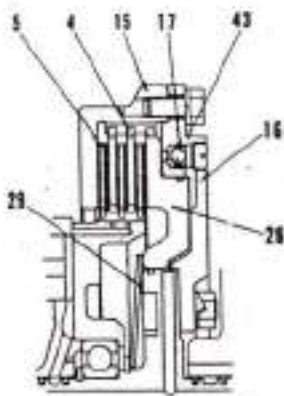


# NO. 5 CLUTCH (BALL CHECK VALVE)

The No. 5 clutch of the TY 220 is a rotary clutch. Because of this, centrifugal force exists due to the rotation of the pressurized oil in the rear of the housing (16) even after the clutch has been disengaged. The force of the disc spring (29) alone is insufficient to return the piston (26) immediately, and the clutch will remain half-engaged.

In other words, even if the gear change lever at the driving seat is put into the neutral position, the clutch remains connected, leading to the problems when changing to the next speed stage.

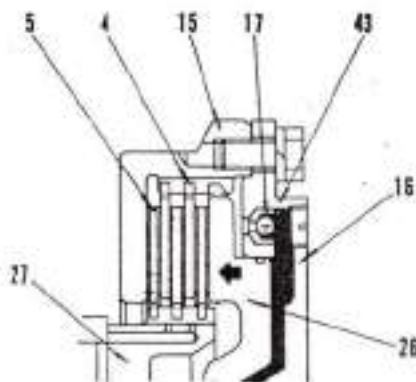
In order to eliminate this condition, a ball check valve (17) is incorporated in the piston of the rotary clutch.



154F132

# ENGAGING (FIXING) CLUTCH

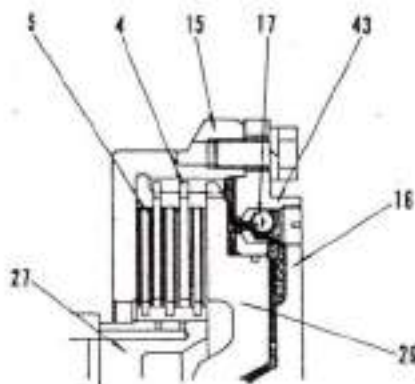
Pressurized oil from the control valve passes through the port to enter the housing (16), and then sent to the rear of the piston (26). The ball check valve (17) clogs the valve seat (43) so that the piston presses the discs (15) and plates (4) together, thus causing the internal teeth of the discs to mesh with the external teeth of the gear (27) and the external teeth of the plate to mesh with the internal teeth of the drum (15). As a result, the clutch engages and rotates as a single unit.



154F133

# DISENGAGING (RELEASING) CLUTCH

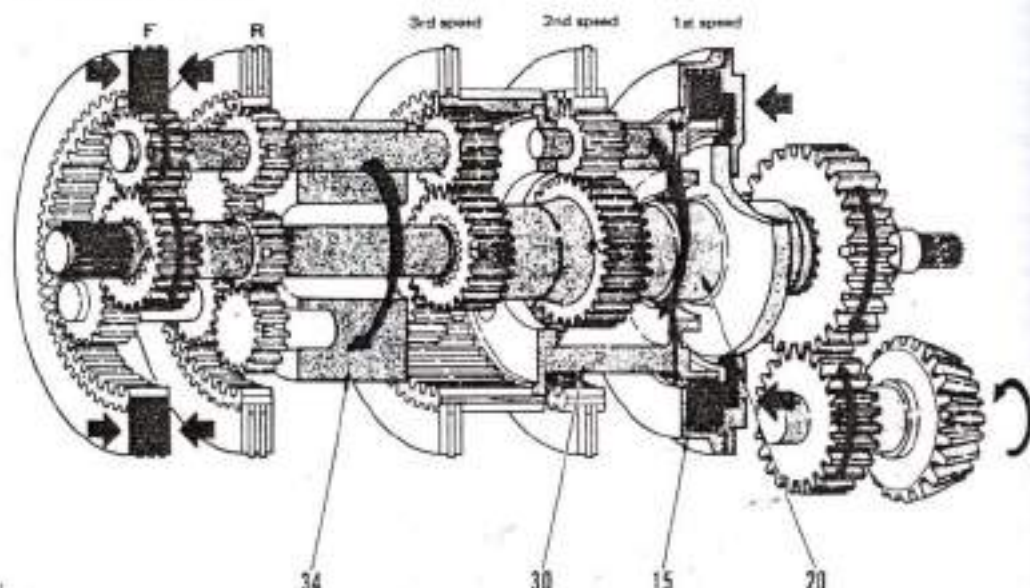
When pressurized oil from the control valve is cut off, the ball check valve (17) shifts outwards due to centrifugal force, and the oil at the rear of the piston (26) is drained off via the clearance in the ball check valve, thus reducing the influence of centrifugal force. As a result, the piston is returned to its original position by the disc spring (29).



154F134

## POWER TRANSMITTING ROUTE

## 1. FORWARD, 1st SPEED



154F135

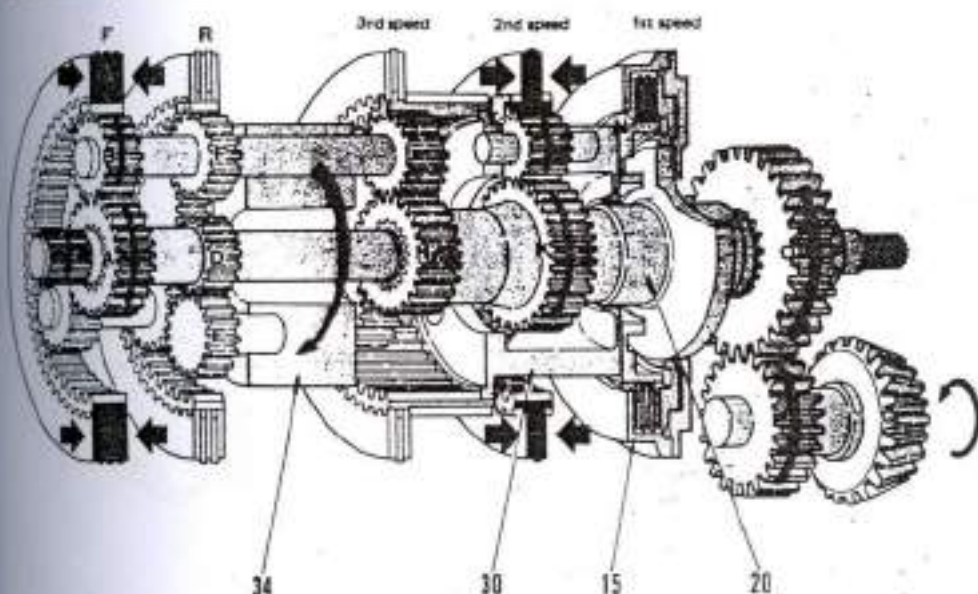
Engage No. 1 clutch and No. 5 clutch. Fix No. 1 ring gear. Connect No. 5 ring gear (integral with No. 4 carrier) directly to output shaft.

By engaging No. 1 clutch (forward) and fixing No. 1 ring gear C, power is transmitted from No. 1 sun gear A to No. 1 planetary pinion.

No. 1 planetary pinion meshes with No. 1 ring gear. Because No. 1 ring gear is fixed however, No. 1 planetary pinion is unable to rotate in its axis in the same position and revolves round No. 1 sun gear along No. 1 ring gear, while rotating on its own axis. No. 1, 2 and 3 carriers (34) rotate in the same direction as No. 1 sun gear to transmit power to the rear speed change clutch.

When No. 5 clutch is engaged, No. 5 clutch drum (15), No. 5 ring gear N, No. 4 carrier (30) No. 3, 4 sun gear H, K and No. 3 ring gear J becomes integral with each other. Because No. 1, 2 and 3 carriers (34) rotate under this condition, No. 4 carrier, No. 3 and 4 sun gear and No. 5 clutch rotate together via No. 3 ring gear J, transmitting power to the output shaft (20).

## 2. FORWARD, 2nd SPEED



154F136

Engage No. 1 clutch and No. 4 clutch. Fix No. 1 ring gear and No. 4 ring gear.

By engaging No. 1 clutch (forward) and fixing No. 1 ring gear C, power is transmitted from No. 1 sun gear A to No. 1 planetary pinion B.

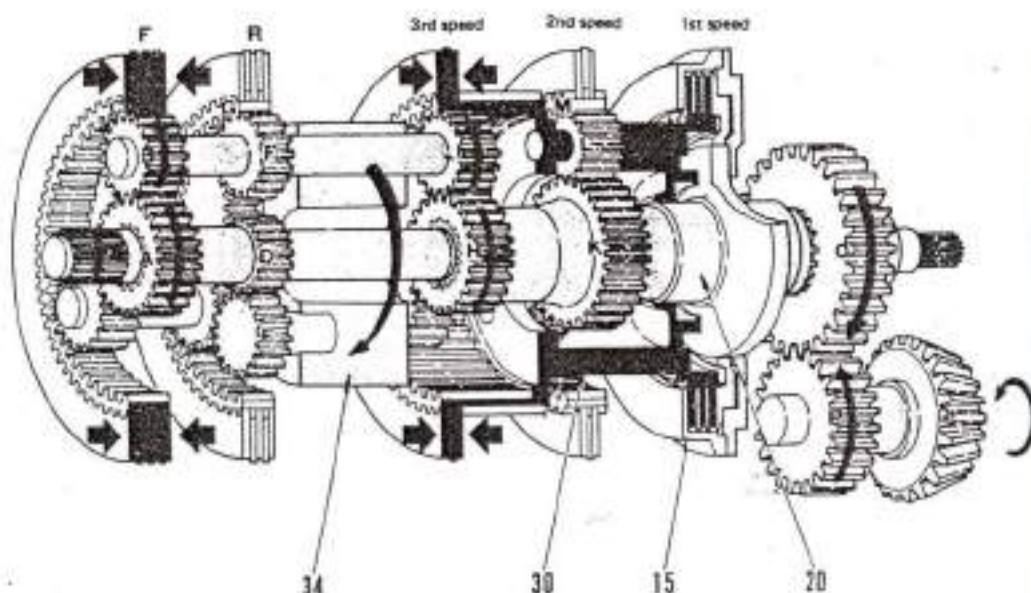
No. 1 planetary pinion meshes with No. 1 ring gear. Because No. 1 ring gear is fixed however, No. 1 planetary pinion is unable to rotate in its axis in the same position and revolves around No. 1 sun gear along No. 1 ring gear, while rotating on its own axis. No. 1, 2 and 3 carriers (34) rotate in the same direction as No. 1 sun gear to transmit power to the rear speed change clutch.

When No. 4 clutch (2nd speed) is engaged and No. 4 ring gear M is fixed, torque from No. 1, 2 and 3 carriers (34) is transmitted from No. 3 sun gear H to No. 4 sun gear K and No. 4 planetary pinion L.

No. 4 planetary pinion meshes with No. 4 ring gear, however because No. 4 ring gear is fixed, No. 4 planetary pinion cannot rotate at the same position and revolves around No. 4 sun gear along No. 4 ring gear, while rotating at its own axis.

No. 1, 2 and 3 carriers transmit torque to No. 3 and 4 sun gears, and thence to the output shaft (20).

## 3. FORWARD, 3rd SPEED



154P137

Engage No. 1 clutch and No. 3 clutch. Fix No. 1 ring gear and No. 3 ring gear.

By engaging No. 1 clutch (forward) and fixing No. 1 ring gear C, power is transmitted from No. 1 sun gear A to No. 1 planetary pinion.

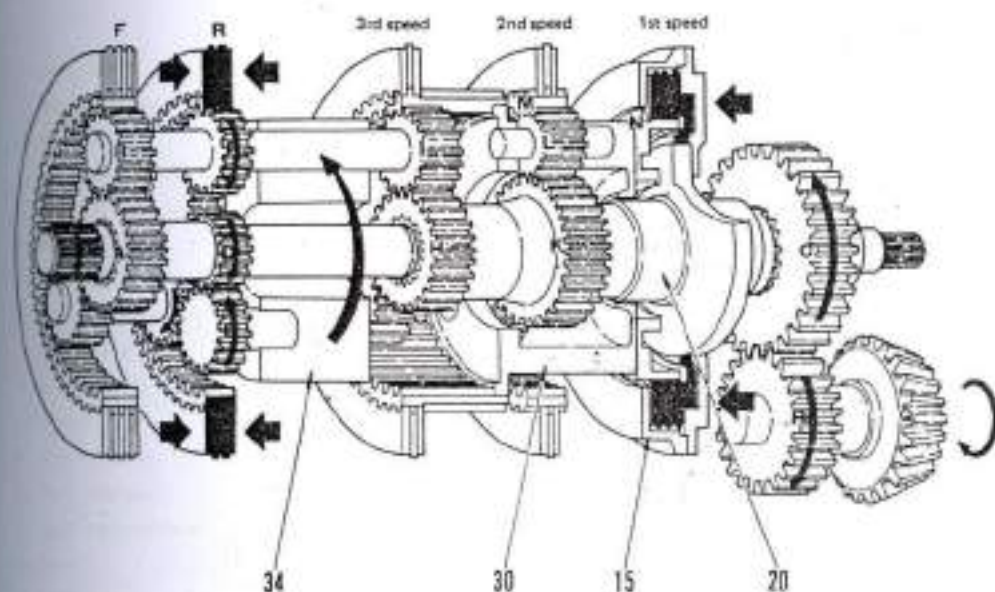
No. 1 planetary pinion meshes with No. 1 ring gear. Because No. 1 ring gear is fixed however, No. 1 planetary pinion is unable to rotate in its axis in the same position and revolves round No. 1 sun gear along No. 1 ring gear, while rotating on its own axis. No. 1, 2 and 3 carriers (34) rotate in the same direction as No. 1 sun gear to transmit power to the rear speed change clutch.

When No. 3 clutch is engaged and No. 3 ring gear J is fixed, torque from No. 1, 2 and 3 carriers (34) is transmitted from No. 3 sun gear H to No. 3 planetary pinion I. No. 3 planetary meshes with No. 3 ring gear, however because No. 3 ring gear is fixed, No. 3 planetary pinion cannot rotate at the same position and revolves around No. 3 sun gear along No. 3 ring gear, while rotating at its own axis.

No. 1, 2 and 3 transmit torque to No. 3 sun gear and thence to the output shaft (20).



## A. REVERSE, 1st SPEED



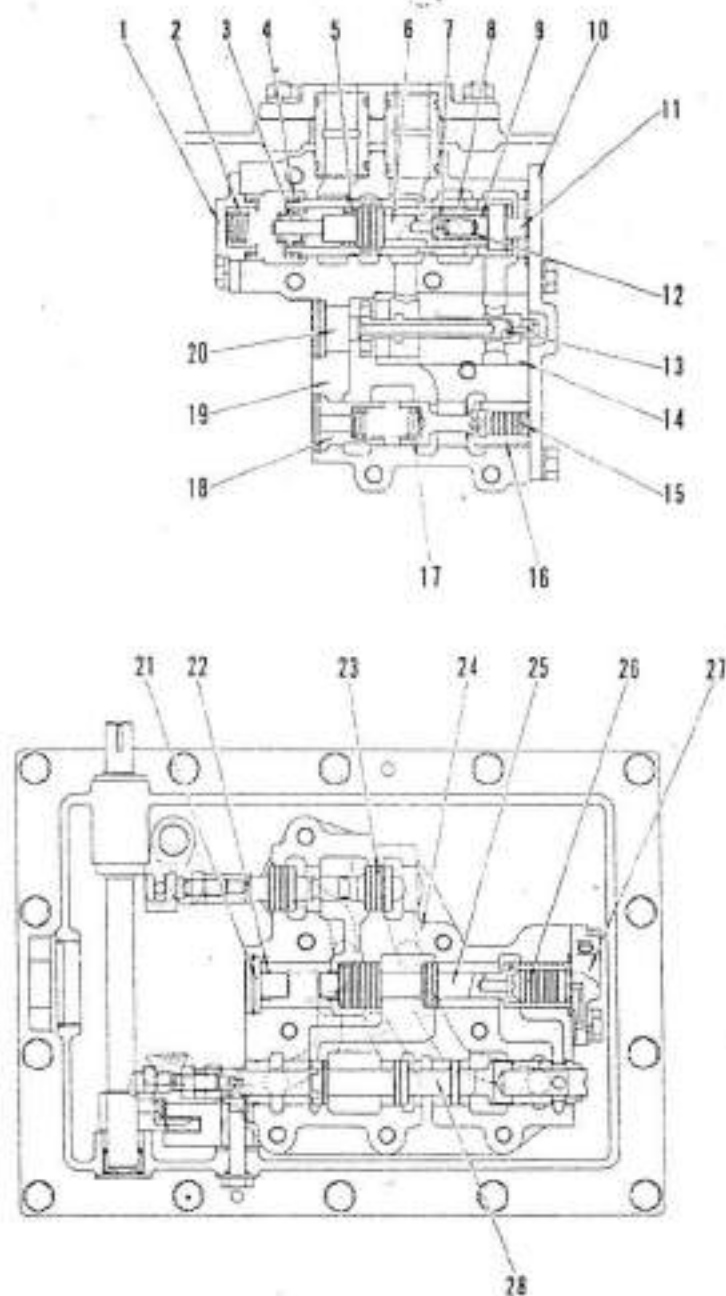
154F138

Engage No. 2 clutch and No. 5 clutch. Fix No. 2 ring gear. Connect No. 5 ring gear (integral with No. 4 carrier) directly to output shaft.

When No. 2 clutch (reverse) is engaged and No. 2 ring gear G is fixed, power will be transmitted from No. 2 sun gear D to No. 2 forward planetary pinion E, and additionally to No. 2 planetary pinion F. No. 2 planetary pinion meshes with No. 2 ring gear, however because No. 2 ring gear is fixed, No. 2 planetary pinion cannot rotate in the same position and revolves around No. 2 sun gear along the ring gear, while rotating at its own axis.

No. 1, 2 and 3 carriers (34) transmit torque to the subsequent speed change clutches. The direction of rotation of the carriers is opposite to that of No. 2 sun gear however, because of the insertion of No. 2 planetary pinion.

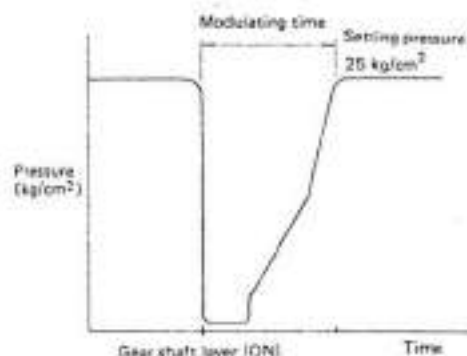


**TRANSMISSION CONTROL VALVE**

154F140

## MODULATING RELIEF VALVE

The modulating relief valve performs a pressure modulating function and a main relief function. It controls the buildup of oil pressure when the gear shift lever is operated and the clutch engaged, so as to avoid shock during startoff and also improve durability of power transmitting system and riding comfort.



154F143

Graph shows pressure rise vs. time lapse at modulating valve.

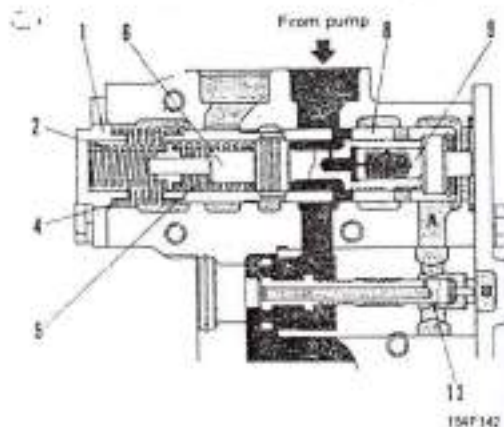
1. Stopper cover
2. Modulating valve spring (small)
3. Spring seat
4. Modulating sleeve spring
5. Modulating valve spring
6. Modulating valve
7. Piston valve (A)
8. Modulating valve sleeve
9. Piston valve (B)
10. Cover
11. Stopper
12. Piston valve spring
13. Quick return valve
14. Quick return valve sleeve
15. Piston
16. Reducing valve
17. Reducing valve spring
18. Stopper
19. Control valve body (A)
20. Stopper
21. Stopper
22. Safety valve spring
23. Directional valve spring
24. Control valve body (B)
25. Safety valve
26. Piston
27. Cover
28. Speed valve spool
1. To 1st speed clutch (No. 6)
2. To 2nd speed clutch (No. 4)
3. To 3rd speed clutch (No. 3)
- F. To forward clutch (No. 1)
- R. To reverse clutch (No. 2)

## FUNCTION

## 1. IMMEDIATELY AFTER SPEED CHANGE

When the gear shift lever is operated and the clutch engaged, the oil passages between the pump and the clutch cylinder opens up, causing oil to flow into the clutch cylinder.

As a result of this flow, the quick return valve (13) moves in the  $\leftarrow$  direction, causing compartment A to be connected to passage B, relieving the back-pressure from modulating valve sleeve (8). Consequently, the modulating valve (5) and the modulating valve sleeve are drawn in the  $\rightarrow$  direction owing to the reaction force of springs (2), (4) and (5), thus shutting off the passage to the torque converter circuit.



154F142

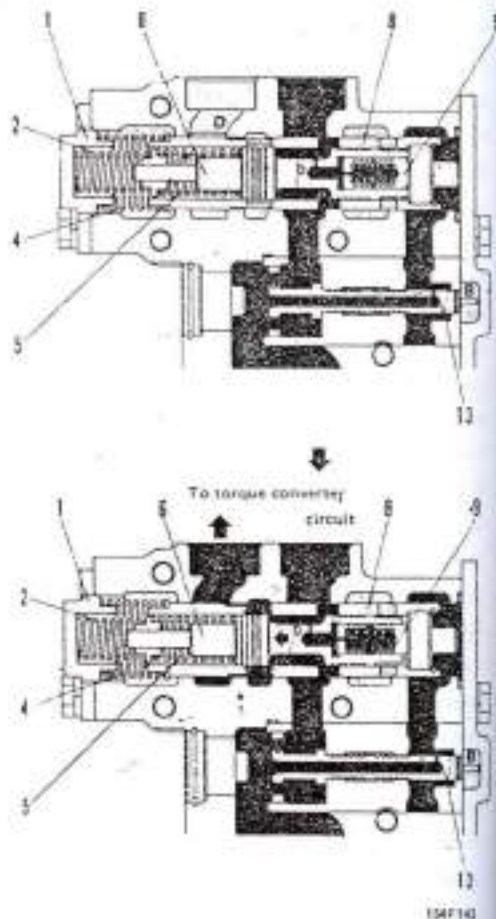
## 2. STARTING OF PRESSURE BUILDING, AND PRESSURE BUILDING UP

When pressurized oil from the pump fills up the circuit as far as the clutch cylinder, the oil pressure starts to rise.

After passing through the orifice a of the quick return valve (13), the oil moves the quick return valve in the  $\rightarrow$  direction, thus closing the passage between compartment A and circuit B. In addition, the oil passes through the modulating valve orifice b and pushes the flow piston (9) against compartment C.

As a result, the modulating valve compresses springs (4) and (5) by its reaction and moves in the  $\leftarrow$  direction, causing port D between the modulating valve and the modulating valve sleeve to open, and thus the high pressure oil will be relieved into the torque converter circuit.

Meanwhile, the oil which passes through the center port of the quick return valve passes through orifice c into compartment A forming the back pressure of the modulating valve sleeve. As a result, the modulating valve sleeve is pushed in the  $\rightarrow$  direction, and compress the spring (2).



154F143

# 1. PRESSURE BUILDING UP, AND FINISHING OF PRESSURE BUILDUP

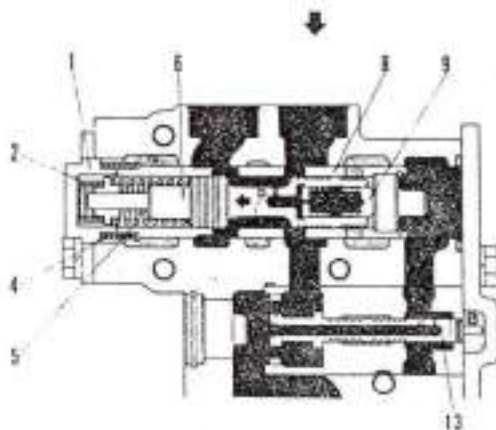
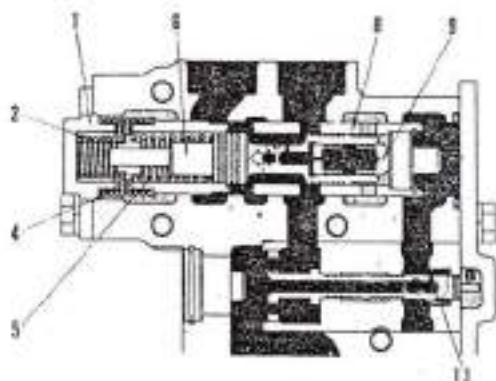
As pressure gradually builds up in the circuit, the back pressure of the modulating valve also increases, and when the modulating valve sleeve moves in the  $\leftarrow$  direction, port D leading to the modulating valve closes up.

Furthermore, the modulating valve moves in the  $\leftarrow$  direction as a reaction to the rise in the pressure of the oil pushing against the piston, causing port D to open up.

The above action is intermittently repeated so that the load on the springs (2), (4) and (5) increase, causing the oil pressure to gradually increase until finally the modulating valve sleeve strikes the stopper (1), preventing it from moving any further. Hence the modulating valve stops with port D remaining open.

Oil from the pump passes through the modulating valve, then through port D, and finally from the modulating valve sleeve to be relieved into the torque converter circuit, thus completing the rise of oil pressure.

The setting pressure is  $25 \text{ kg/cm}^2$ .



## REDUCING VALVE

## FUNCTION

The reducing valve is located in the circuit between the modulating valve and the speed valve. Its function is to reduce the pressure of the oil at the 1st speed clutch to  $12.5 \text{ kg/cm}^2$ .

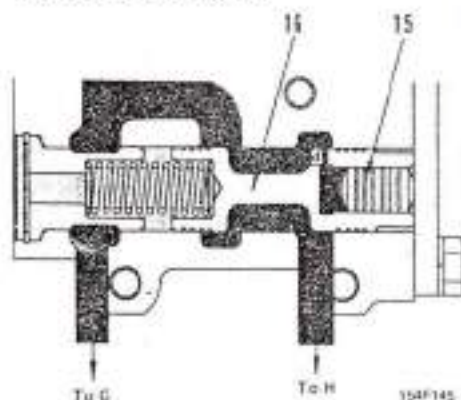
The entire circuit is set at a pressure of  $25 \text{ kg/cm}^2$ , while the 1st speed clutch circuit alone is arranged so that when the internal pressure reaches  $12.5 \text{ kg/cm}^2$ , it will be closed off by the reducing valve.

At the neutral position, when the engine is started the oil from the pump flows from the reducing valve to the 1st speed clutch, filling up the cylinder. This is to reduce the time required to fill up the cylinders (F and R cylinders), so that when the gear shift lever is moved from the neutral position to the forward 1st speed position, the oil from the pump needs only fill up the F cylinder, and when the lever is moved from the forward 1st speed to the forward 2nd speed position, the oil needs only fill up the 2nd speed cylinder because the F cylinder is already filled with oil.

In this way, when the gear shift lever is at the neutral position, the 1st speed cylinder is always full of oil, so as to improve response during speed changing.

## OPERATION

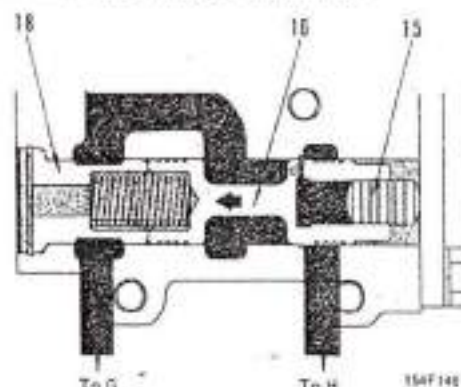
## 1. STARTING OF PRESSURE BUILDUP, AND PRESSURE BUILDING UP



When oil fills the 1st speed cylinder and the ball check valve blocks up the piston hole, the pressure of the oil in the 1st speed clutch circuit starts rising.

After passing through the orifice (14) of the reducing valve (16), the oil pushes the piston (15), the reaction of which causes the reducing valve to move to the left, allowing the oil pressure to rise.

## 2. FINISHING OF PRESSURE BUILDUP



When the oil pressure in the 1st speed circuit builds up, the reducing valve moves all the way to the left, until finally it strikes the stopper (18), preventing it from moving further. As a result, the passage from the pump to the 1st speed cylinder closes up, maintaining the oil pressure in the 1st speed clutch circuit at  $12.5 \text{ kg/cm}^2$ .



## SAFETY VALVE

## FUNCTION

The safety valve functions to prevent the machine from moving if the engine is inadvertently started with the gear shift lever in one of the speed positions. It is located in the circuit between the speed valve and the directional valve.

When starting up the machine, the gear shift lever must be put in the neutral position.

## OPERATION

1. When gear shift lever is in neutral position.

Oil from the reducing valve passed through the speed valve and the orifice *a*, pushing the whole safety valve (25) to the left, thus opening the circuit between the modulating valve and the directional valve.

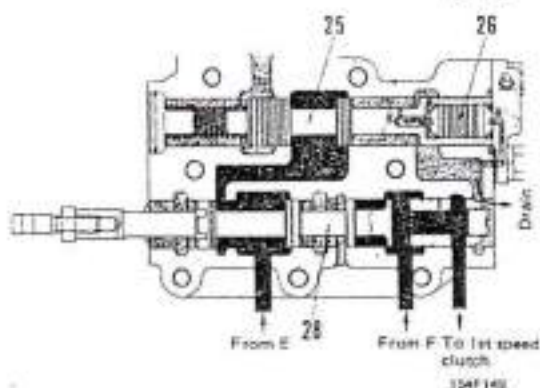
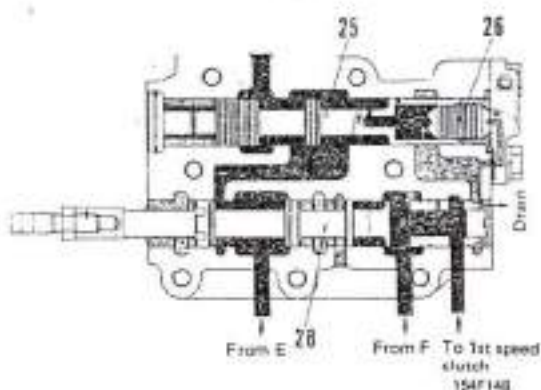
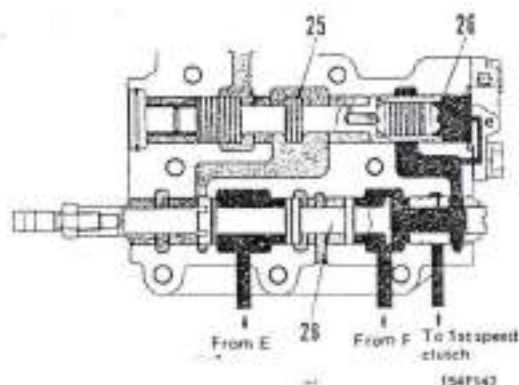
2. When moving the gear shift lever to an arbitrary speed position

When the speed valve (28) moves to any speed position, the oil (back pressure) on the right side of the safety valve (25) passes through the orifice *e* to drain off into the case, and simultaneously oil from modulating valve passes through the orifice *f* in safety valve to push the piston (26) to the right. Consequently, the safety valve remains at the same position, and thus the circuit also remains open.

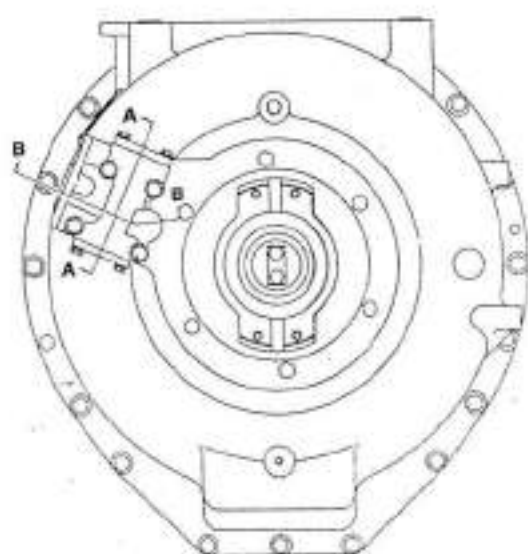
3. When engine is started with gear shift lever engaged. When the engine is started under the conditions of paragraph 2. above, the oil pressure disappears and the safety valve moves to the right under the action of the spring, thus closing up the circuit to the directional valve.

If the engine is restarted under these conditions, the oil from the reducing valve cannot push the safety valve to the left because the circuit to the orifice *a* is closed, hence the circuit to the directional valve does not open, preventing the machine from moving off.

Thus, the gear shift lever must first be put in the neutral position to allow the action described in paragraph 1. above to take place, before starting the machine.



## TRANSMISSION LUBRICATION VALVE

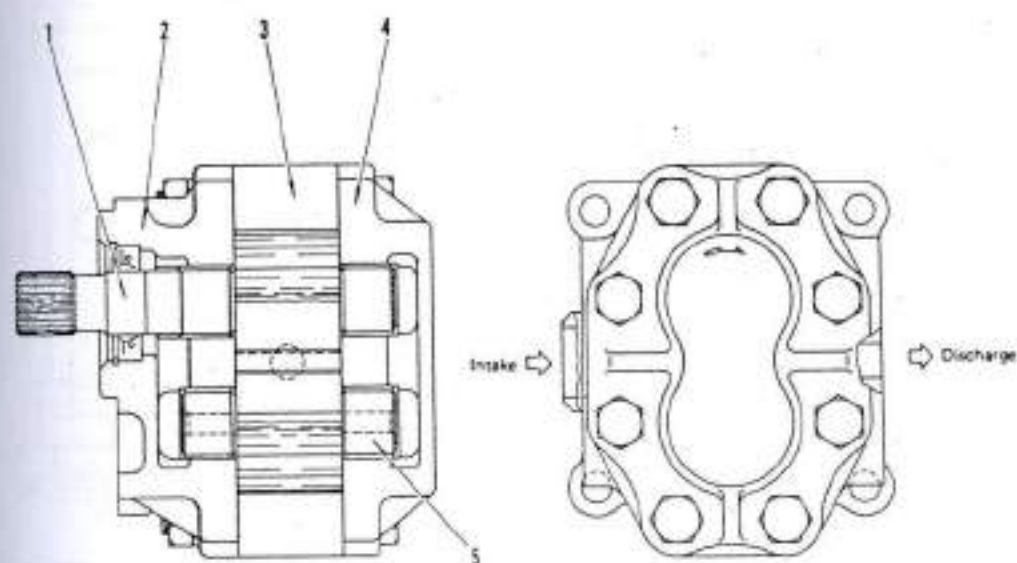


Cracking pressure : 1.24 kg/cm<sup>2</sup>

1. Valve body
2. Cover
3. Valve guide
4. Spring
5. Loop valve
6. Cover
7. Sleeve
8. Sleeve
9. Gasket

154F150

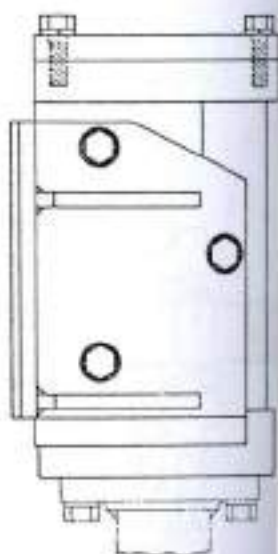
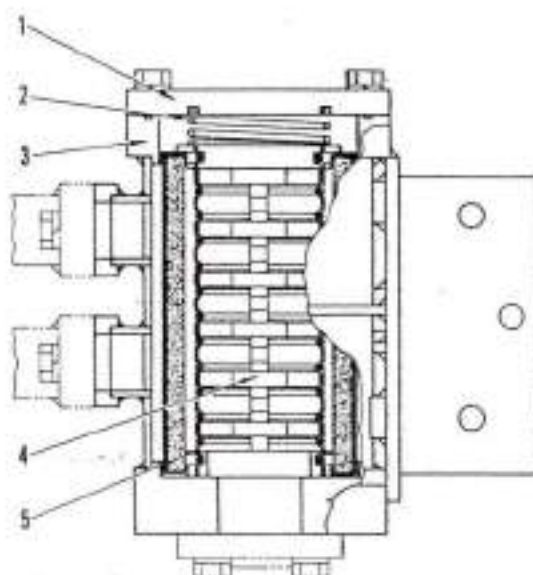
## TRANSMISSION PUMP



1547151

1. Drive gear
2. Bracket
3. Gear case
4. Housing
5. Driven gear

## TRANSMISSION, STEERING OIL STRAINER

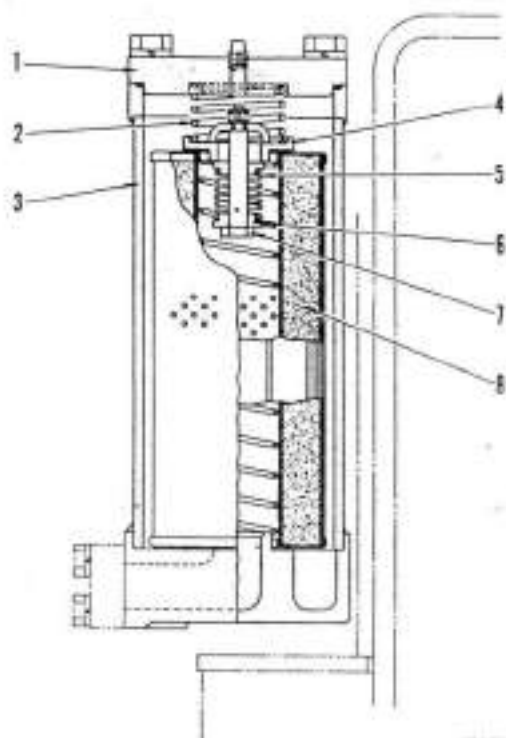
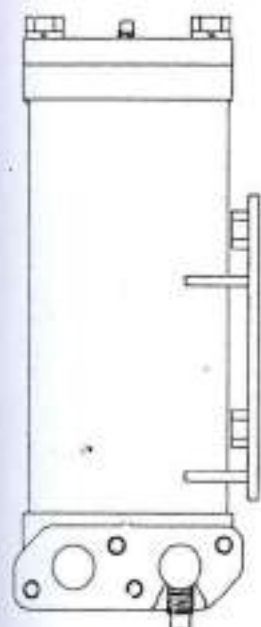


154F281

- 1. Strainer cover
- 2. Spring    Free length    : 23 mm  
                  Installation length : 50 mm  
                  Installation load : 8,8 kg
- 3. Strainer case
- 4. Magnet
- 5. Screen

Flow : 183 l/min.

## TRANSMISSION OIL FILTER



154F 252

1. Filter cover
2. Spring    Installation length : 35.5 mm  
                 Installation load    : 10 kg
3. Filter case
4. Gauge
5. Spring
6. Sieve
7. Bolt
8. Element

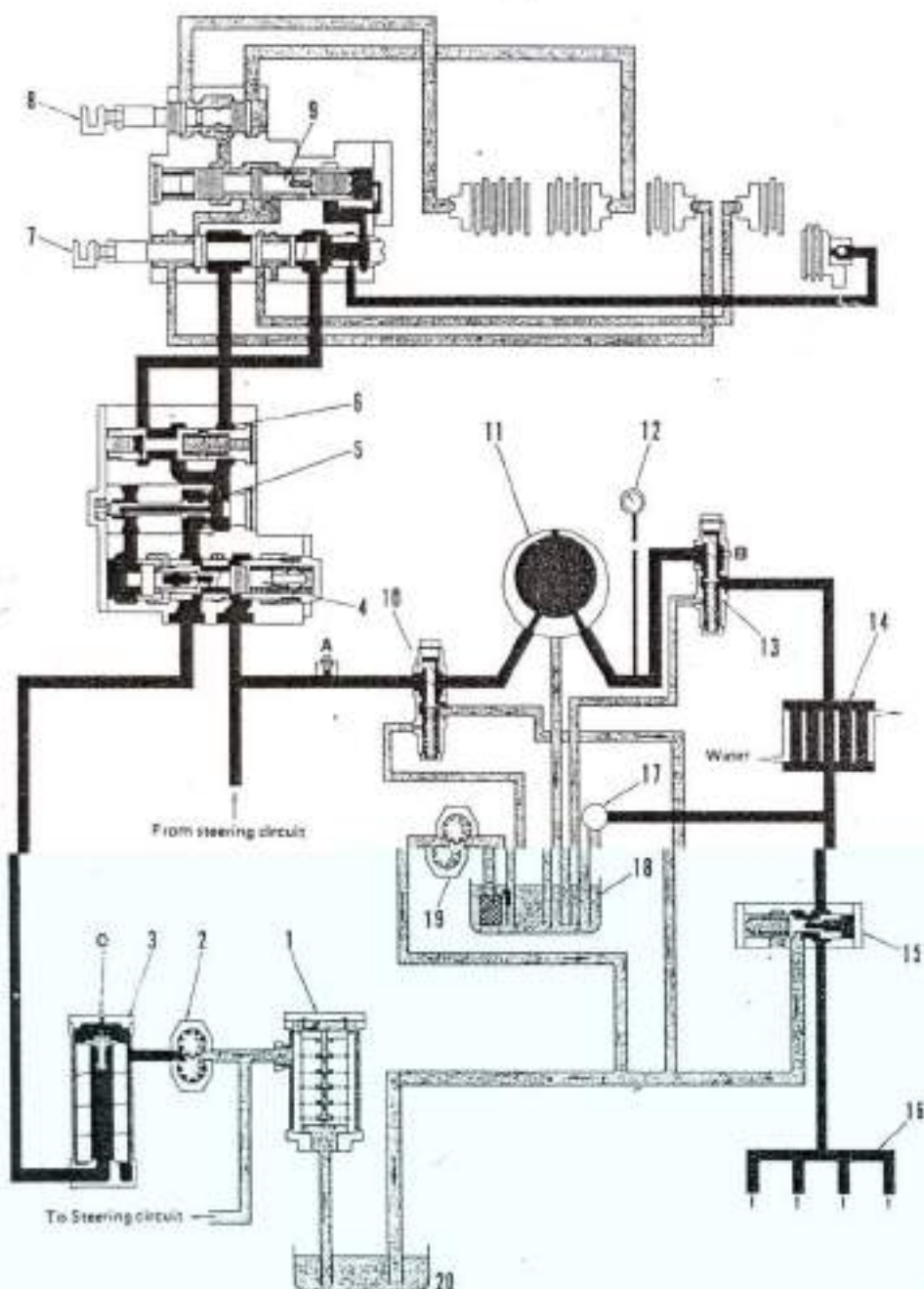
Cracking pressure : 1.21 kg/cm<sup>2</sup>

Flow : 74.1ℓ/min.



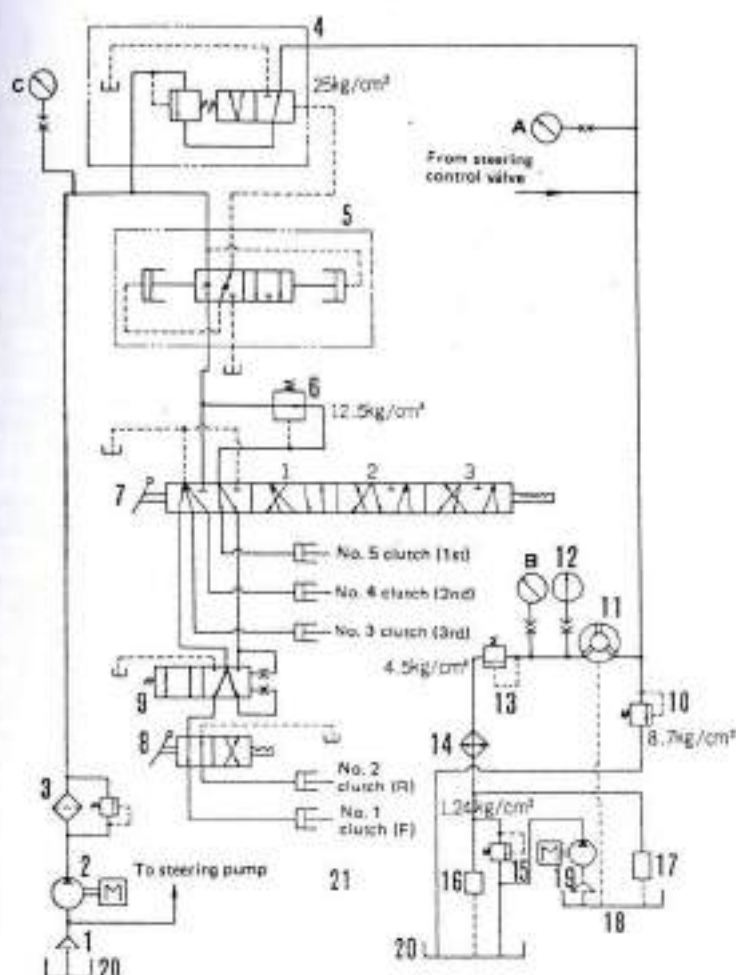
## TORQFLOW HYDRAULIC SYSTEM

## NEUTRAL



1547152

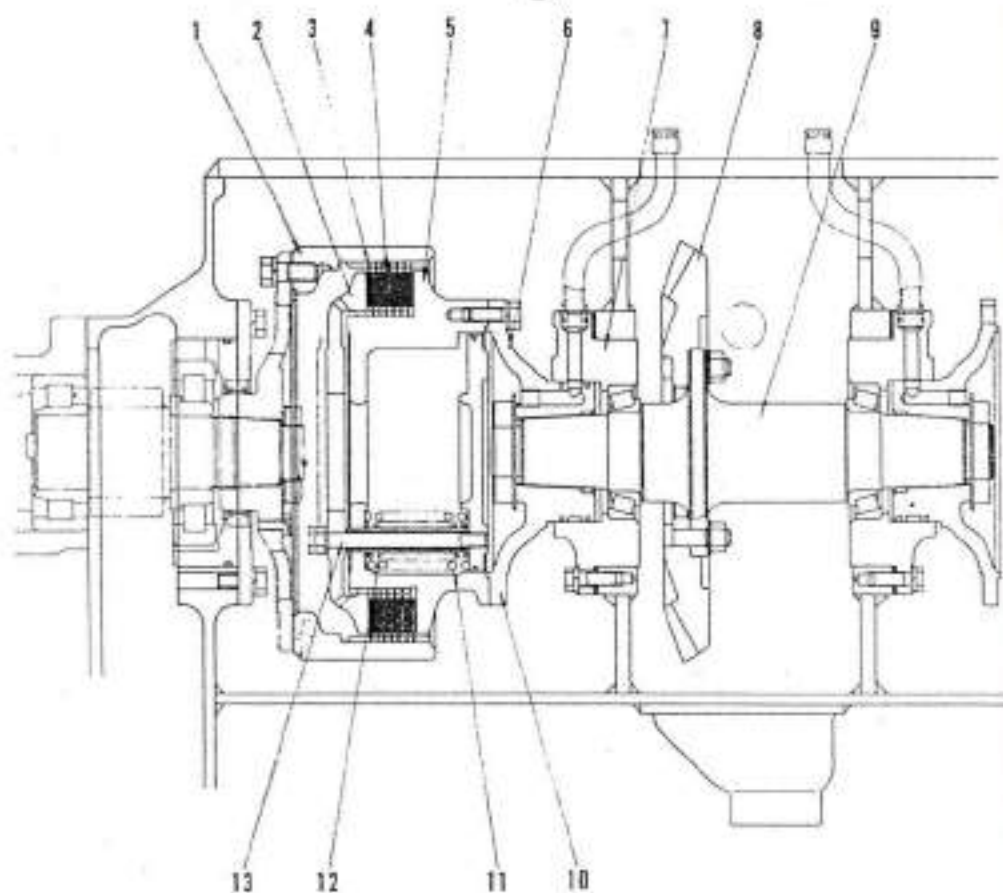
## TORQFLOW HYDRAULIC CIRCUIT



1547153

- |                              |                              |  |
|------------------------------|------------------------------|--|
| 1. Magnet strainer           | 12. Oil temperature gauge    | A. Relief pressure pickup plug (PT 1/8)              |
| 2. Transmission pump (FALOM) | 13. Regulator valve          | B. Regulator pressure pickup plug (PT 1/8)           |
| 3. Oil filter                | 14. Oil cooler               | C. Transmission clutch pressure pickup plug (PT 1/8) |
| 4. Modulating valve          | 15. Lubrication relief valve |  |
| 5. Quick return valve        | 16. Transmission lubrication |  |
| 6. Reducing valve            | 17. P.T.O. lubrication       |  |
| 7. Speed valve               | 18. Torque converter case    |  |
| 8. Directional valve         | 19. Scavenging pump          |  |
| 9. Safety valve              | 20. Steering case            |  |
| 10. Relief valve             |                              |  |
| 11. Torque converter         |                              |  |

## BEVEL GEAR SHAFT · STEERING CLUTCH



1. Outer drum (brake drum)
2. Pressure plate
3. Disc
4. Plate
5. Inner drum (clutch drum)
6. Bevel gear shaft hub
7. Bevel gear

8. Bevel gear
9. Bevel gear shaft
10. Piston
11. Spring
12. Spring
13. Bolt

15AF154

## STRUCTURE

## BEVEL GEAR SHAFT

TY 220, TS 220 are installed with the bevel gear shaft system which converts the power transmitted in the order of engine → torque converter → transmission perpendicularly into the left and right directions by meshing the bevel pinion at the end of the transmission output shaft with the bevel gear on the bevel gear shaft, while reducing the revolution speed.

Helical bevel gears are employed for the bevel pinion and bevel gear. In order to permit adjustment of tooth contact with the bevel pinion as well as the torque of the bevel gear shaft, the bevel gear shaft is installed on the steering case via a taper roller bearing (8) and bearing cage (7), with adjusting shims. Bevel gear shaft hubs (6) for mounting the steering clutch are pressed onto both ends of the bevel gear shaft with taper splines.

Oil ports for operating the steering clutch are provided in the bevel gear shaft hub and bearing cage. The bevel gear shaft is splash-lubricated by the bevel gear which turns in an oil bath.

Adjustment of backlash and tooth contact of the bevel pinion and bevel gear consists of a longitudinal adjustment carried out by increasing or decreasing the shims at the mounting face of the transmission side bevel pinion bearing cage and a lateral adjustment carried out by increasing or decreasing shims at the bevel gear shaft bearing cage and steering case mounting face in order to shift the bevel gear. For details, see 23 POWER TRAIN DISASSEMBLY AND ASSEMBLY manual.

## STEERING CLUTCH

TY 220, TS 220 are installed with the steering clutches on the both ends of bevel gear shaft to cut off or transmit the power transmitted to the bevel gear shaft in order to change the travel direction of the machine; that is, by cutting off or transmitting the power to the final drive.

In these machines, the wet, multidisc spring clutch is employed.

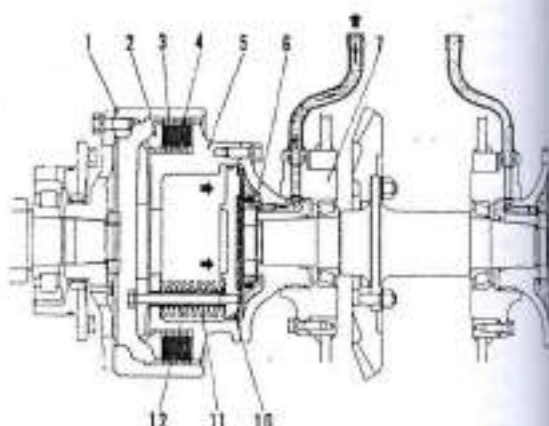
Each steering clutch consists of a clutch inner drum (5) bolted onto the bevel gear hub (6) which is fixed by a taper spline to the bevel gear shaft (9), clutch outer drum (1) bolted onto the final drive flange, plates (4) which mesh with the inner drum, discs (3) which mesh with the outer drum, pressure plate (2) which presses the discs and plates together, piston (10), clutch springs (11) (12) and bolts (13) for mounting the piston and pressure plate.

In the steering clutch, the plates drive and the discs are driven.

## OPERATION

## 1. ENGAGING STEERING CLUTCH

Normally, in the steering clutch, the clutch spring (11) and (12) causes the pressure plate (2) to press the plates (4) and discs (3) against the inner drum (5), so that power is transmitted from the inner drum (5) to the outer drum (1) by friction. As a result, the final drive pinion hub which is integral with the outer drum rotates, transmitting power to the final drive.



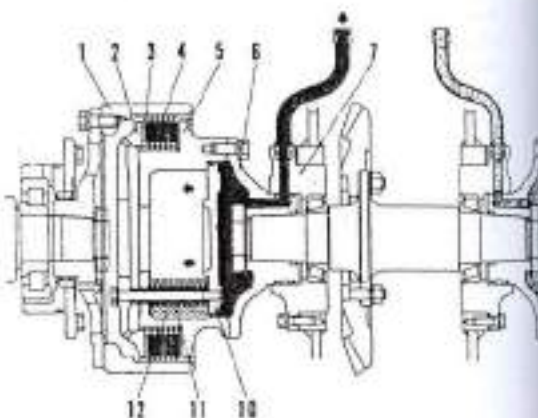
1547-10

## 2. DISENGAGING STEERING CLUTCH

When the steering lever is pulled, oil from the steering control valve flows through the bearing cage (7) and bevel gear hub (6) to enter the right side of the piston (10). As a result, the piston is pushed to the left, compressing clutch springs (11), (12) which in turn pushes the pressure plate (2) to the left. This causes the pressure to be removed from the plates (4) and discs (3), cutting off power to the final drive.

When the steering lever is released, the steering control valve drain circuit opens up, so that the clutch spring forces the piston back to its original position, putting the steering clutch in the engaged condition described above.

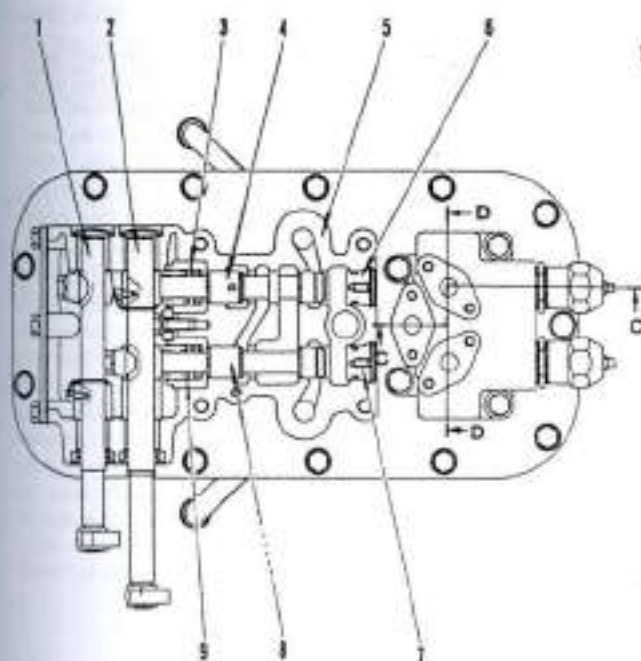
When the left steering clutch is disengaged, power is transmitted only to the right steering clutch, and hence the machine turns to the left.



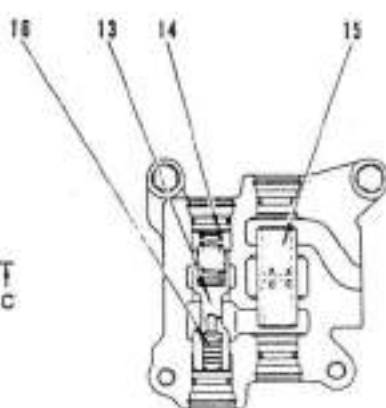
1547-10



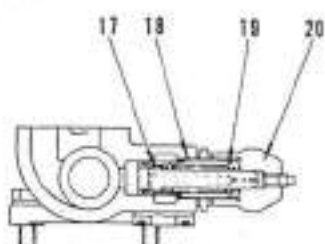
## STEERING CONTROL VALVE



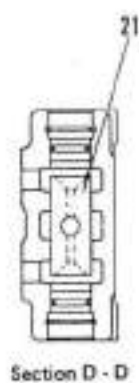
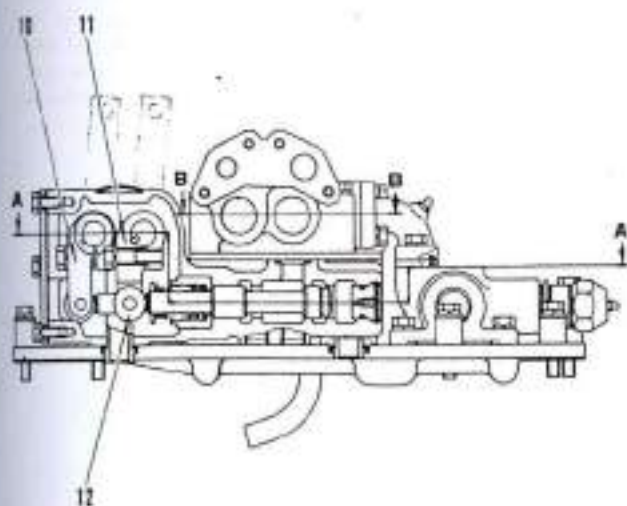
Section A - A



Section B - B



Section C - C



Section D - D

154F157

## STRUCTURE

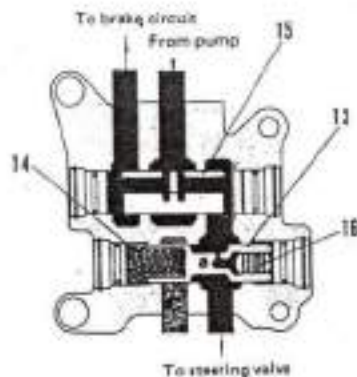
The steering control valve consists of a flow divider valve (15) which distributes the oil from the steering pump into the steering circuit and brake circuit, a main relief valve (13) which maintains the oil pressure in the steering circuit at the specified value of  $12.5 \text{ kg/cm}^2$ , valve spools (4), (8) which adjust the flow of oil into the left and right steering clutches respectively, a flow divider valve (21) which distributes the brake circuit oil to the left and right and a brake relief valve (17) which maintains the brake circuit pressure at the specified value of  $17 \text{ kg/cm}^2$ .

1. Control shaft (Right)
2. Control shaft (Left)
3. Spool return spring
4. Spool (Right)
5. Valve body
6. Stopper
7. Stopper
8. Spool (Left)
9. Spring
10. Lever (Right)
11. Lever (left)
12. Roller
13. Main relief valve
14. Spring
15. Steering brake flow divider valve
16. Piston
17. Brake relief valve
18. Valve sleeve
19. Spring
20. Nut
21. Brake flow divider valve

## OPERATION

## FLOW DIVIDER

Oil from the steering pump enters port A, and is then distributed by the flow divider valve (15) into the steering circuit and brake circuit in the ratio of 3 : 1.



154F158

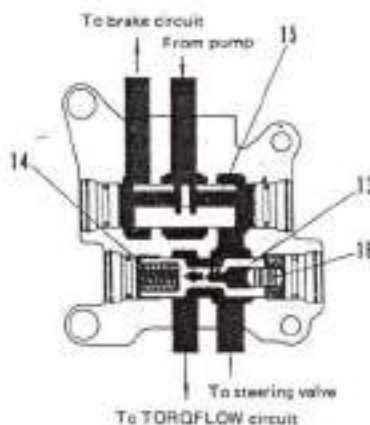
## MAIN RELIEF VALVE

Oil from the pump enters the control valve, and regardless of whether or not the steering lever is operated, once the oil reaches the port of the valve body or the steering clutch piston, the circuit pressure starts to rise.

Oil from port B passes through orifice A of the relief valve (13) to push the piston (16). The resulting reaction causes the relief valve to move in the direction, compressing the spring (14), until it strikes the stopper and comes to rest.

Oil from the flow divider is relieved from port B through port C, and then flows into the torque converter circuit.

The setting pressure is 12.5 kg/cm<sup>2</sup>.



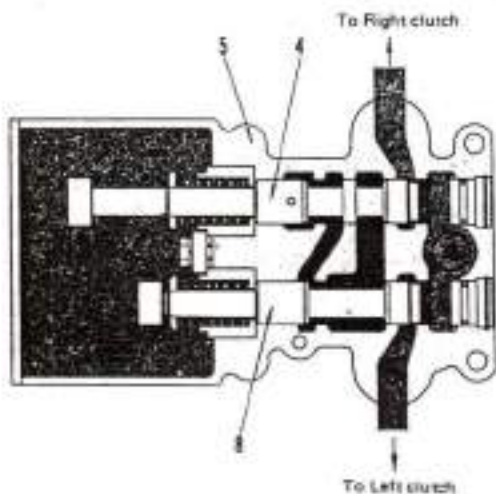
154F159

## ENGAGING LEFT AND RIGHT CLUTCHES (CONTROL VALVE "HOLD")

Oil from the pump passes through the main relief valve to enter port D of the valve body (5).

Because the passage to the clutch piston is closed, only the pressure of the oil in the circuit rises, and the oil at port D is relieved from the main relief valve into the torque converter circuit.

Thus, when the steering lever is not operated, the oil is constantly relieved.

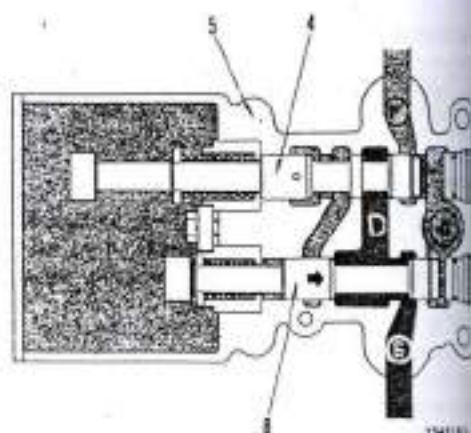


154F160

## 2. DISENGAGING LEFT CLUTCH ENGAGING RIGHT CLUTCH (LEFT LEVER PULLED)

When the left steering lever is pulled, the left spool (8) moves in the  $\Rightarrow$  direction.

Oil from the pump passes through the main relief valve and enters port D of the valve body. It then passes through the passage opened up as a result of the movement of the left spool, and passes through port E into the left clutch piston. In this way, the circuit gradually fills up with oil, causing the pressure to rise, whereupon the left clutch disengages. When the left steering lever is released, the passage through port D and port E closes up, cutting off the flow of oil to the left clutch piston. Meanwhile, the oil which pushed the left clutch piston is returned by the clutch spring, and passes through the clearance between the left spool and the valve body to drain off from port G.

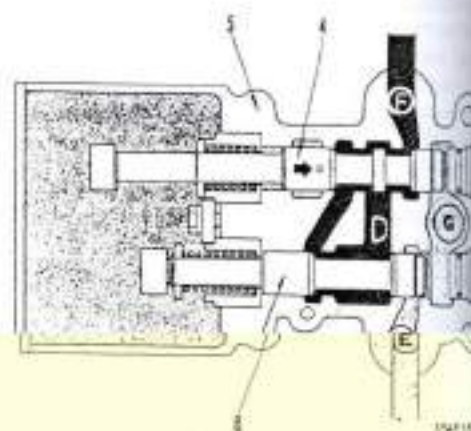


## 3. ENGAGING LEFT CLUTCH, DISENGAGING RIGHT CLUTCH (RIGHT LEVER PULLED)

When the right steering lever is pulled, the right spool (4) moves in the  $\Rightarrow$  direction.

Oil from the pump passes through the main relief valve to enter port D of the valve body. It then passes through the passage opened up as a result of the movement of the left spool, and passes through port F into the right clutch piston. In this way, the circuit gradually fills up with oil, causing the pressure to rise, whereupon the right clutch disengages.

When the right steering lever is released, the passage through port D and port F closes up, cutting off the flow of oil to the right clutch piston. Meanwhile, the oil which pushed the right clutch piston is returned by the clutch spring, and passes through the clearance between the right spool and the valve body to drain off from port G.



#### 4. DISENGAGING LEFT AND RIGHT CLUTCHES (LEFT AND RIGHT LEVERS PULLED)

When the left and right steering levers are pulled, the above-described actions which take place when the left and right levers are pulled, occurs simultaneously. Oil flows from ports E and F into the left and right clutch pistons respectively, so that the oil pressure rises, causing the clutches to disengage. When the left and right steering levers are released, the oil passages from port D are closed off, cutting off the flow of oil to the left and right clutch pistons. Oil is returned by the clutch springs to drain off from port G.

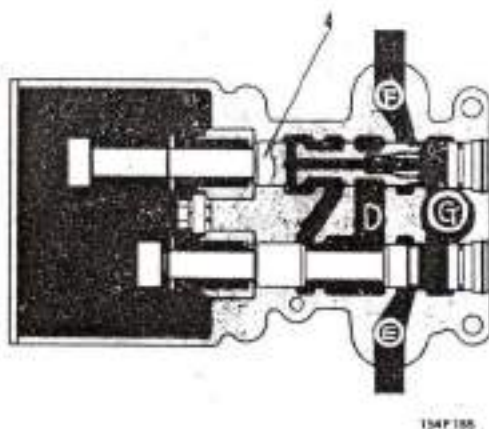
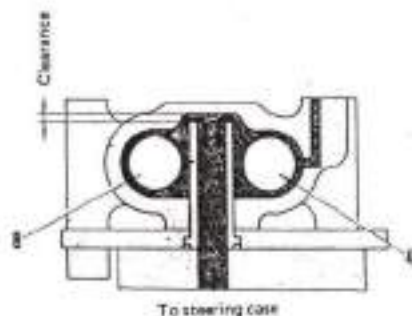
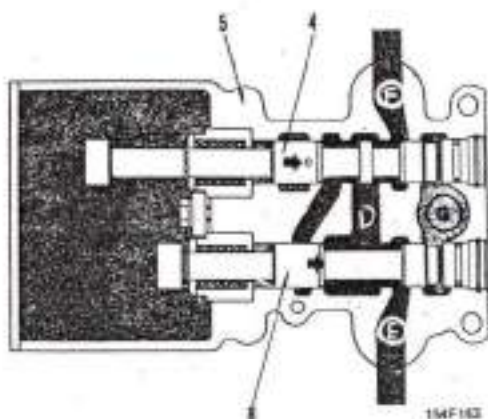
#### DRAIN PORT TUBE

As shown in the diagram, the tube of drain port G is raised up to provide a clearance of 4 mm between it and the control valve housing so that the oil drains off from the top of the tube to the steering case.

Unless the oil returned from the clutch piston fills up the housing, a considerable time will be required for the oil to reach the housing port when the spool is operated, causing the steering disengagement to become sluggish.

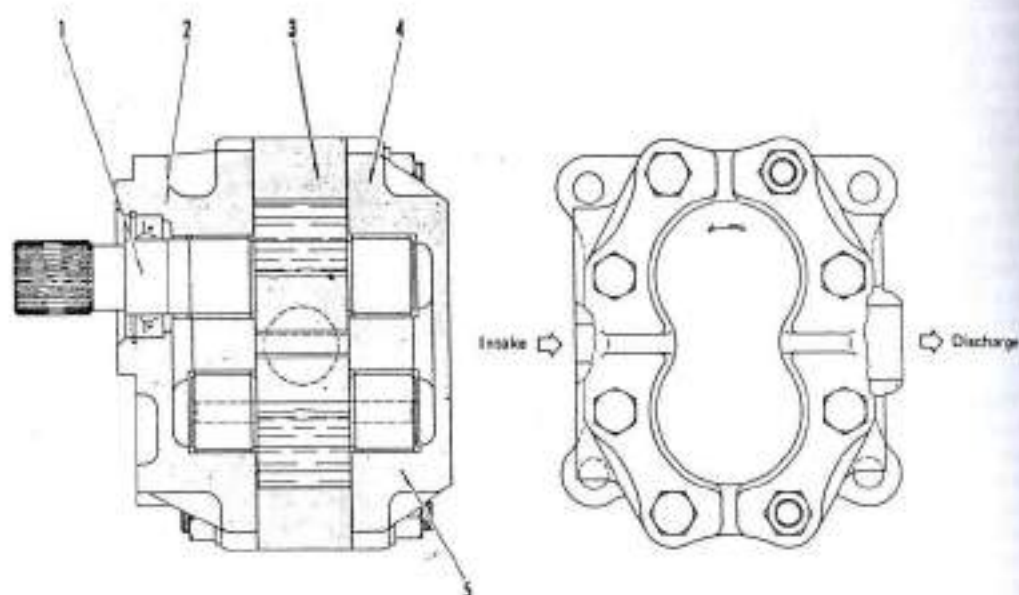
In order to reduce this time lag as far as possible, the tube is installed upright above the mounting face of the housing, so that the port on the housing is always filled with oil.

Also, in order to compensate for oil leakage from the clutch piston sealing, etc., a passage is made in the right spool to pass the oil to the housing port when the steering valve is in the HOLD condition, thus minimizing the time lag.

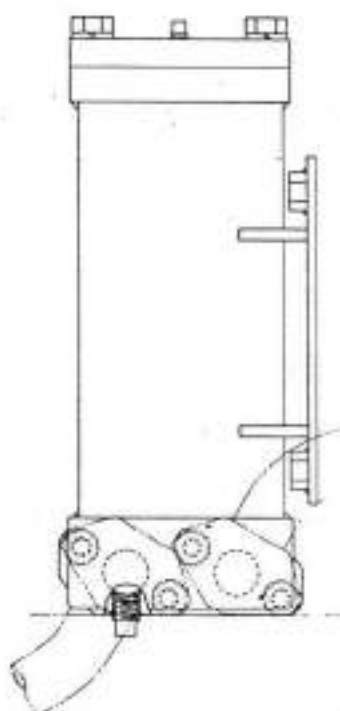
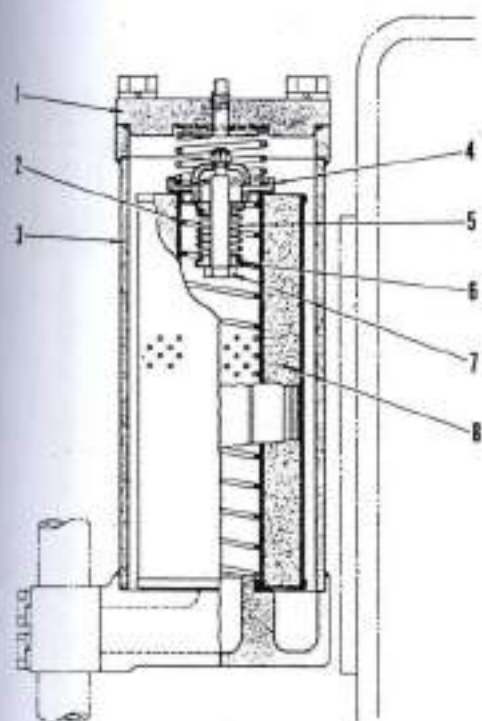




## STEERING PUMP (C BJ-63)



1. Drive gear
2. Bracket
3. Gear case
4. Housing
5. Driven gear

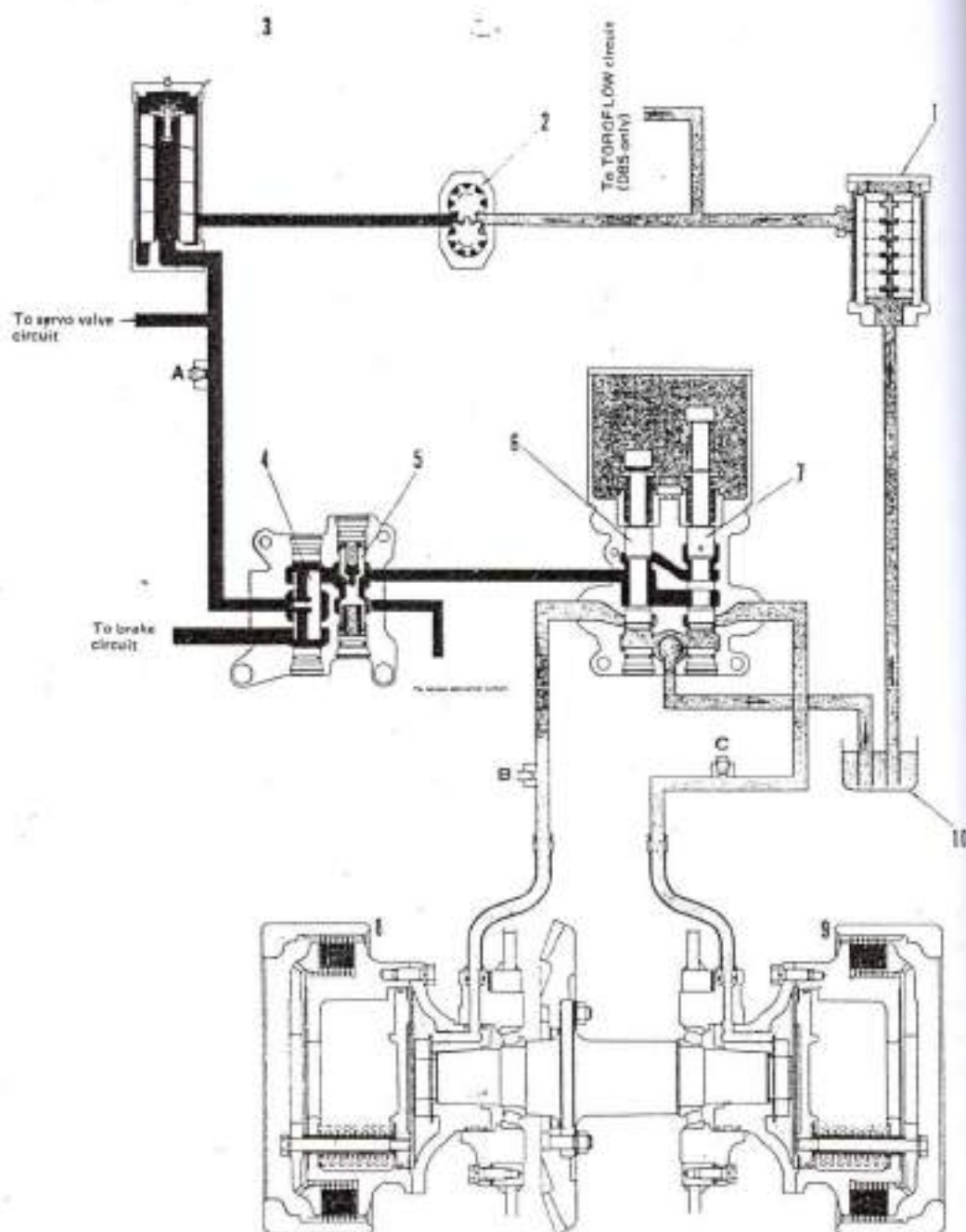
**STEERING OIL FILTER**

- 1. Filter cover
- 2. Spring    Installation length : 35.5 mm  
                 Installation load    : 10 kg
- 3. Filter case
- 4. Gauge
- 5. Spring    Installation length : 26.0 mm  
                 Installation load    : 4.55 kg
- 6. Sleeve
- 7. Bolt
- 8. Element

Cracking pressure : 1.21 kg/cm<sup>2</sup>

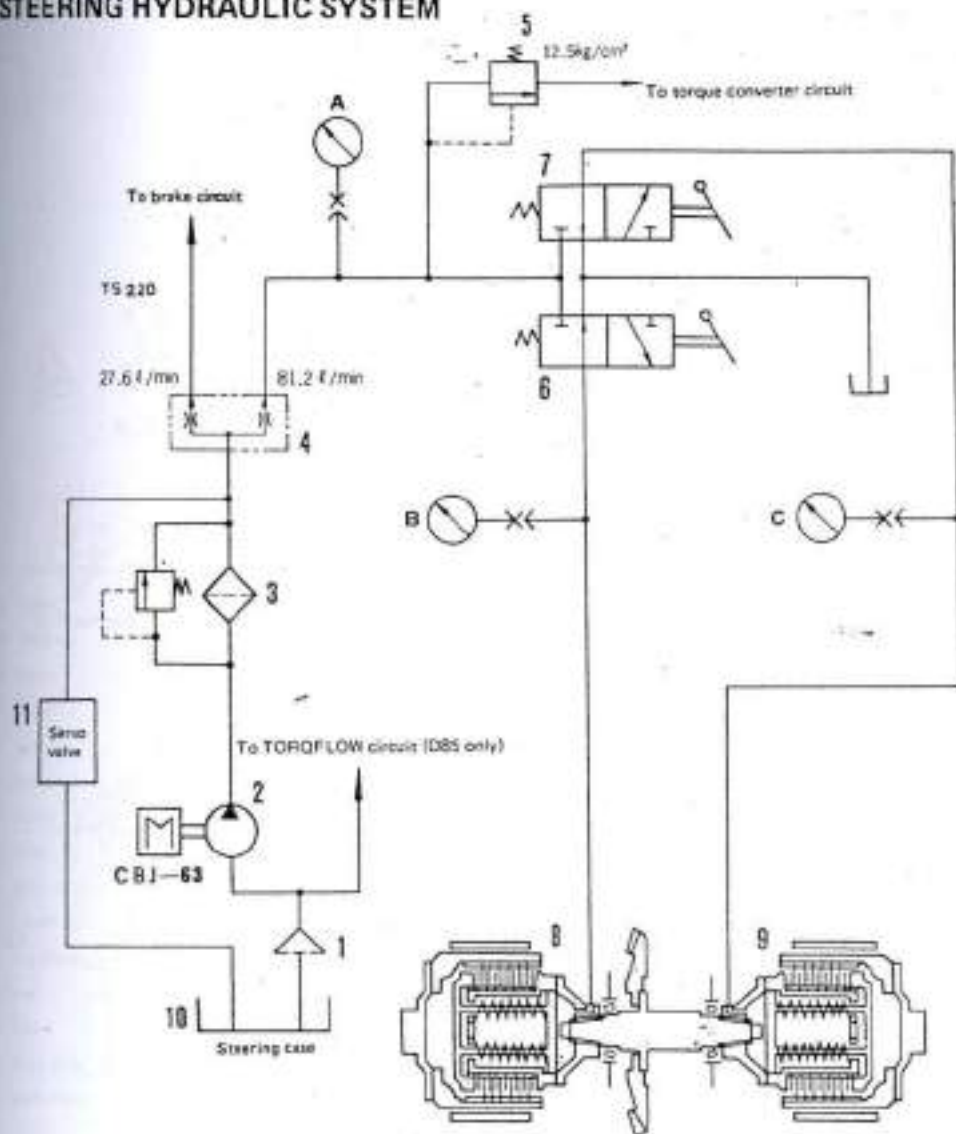
Flow : 109ℓ/min.

## STEERING HYDRAULIC CIRCUIT



154F167

## STEERING HYDRAULIC SYSTEM

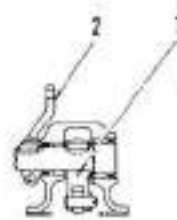
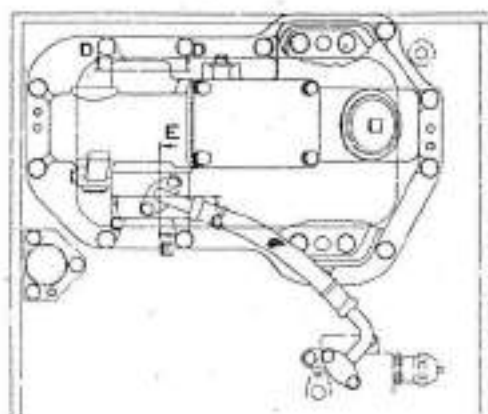


1. Magnet strainer
2. Steering pump
3. Steering filter
4. Flow divider
5. Main relief valve
6. Left clutch spool

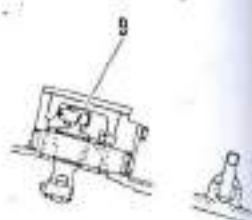
7. Right clutch spool
8. Left clutch
9. Right clutch
10. Steering case
11. Rotary servo booster valve

- A. Clutch main pressure pickup plug (PT 1/B)
- B. Left clutch pressure pickup plug (PT 1/B)
- C. Right clutch pressure pickup plug (PT 1/B)

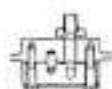
## STEERING BRAKE



Section A - A



Section B - B



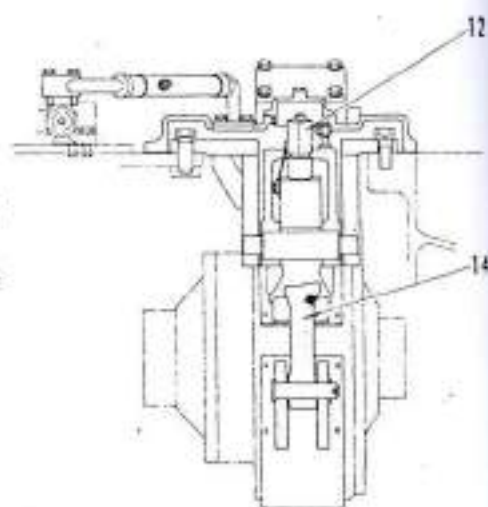
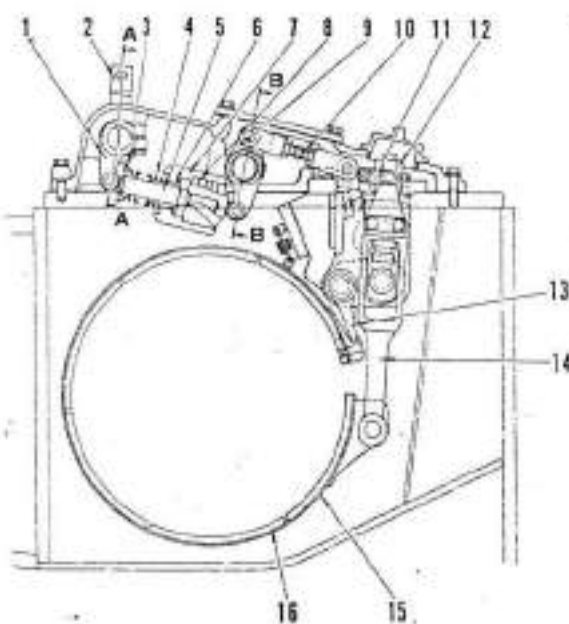
Section C - C



Section D - D



Section E - E



154F108



## STRUCTURE

TY 220J and 220 are installed with an anchor type contacting type band brake in which band clamps the outer periphery of the brake drum. It is a wet type brake using an oil bath.

The steering brake operates as a steering brake which interlocks with the steering lever and also as a stop brake when operated by the brake pedal.

When parking the machine, the center part of the left and right brake pedals are depressed, and the pedals fixed by means of the brake lock.

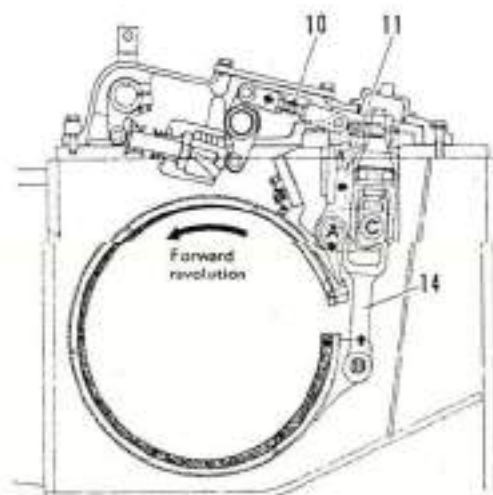
1. Control lever
2. Lever
3. Retainer
4. Spring
5. Spool
6. Retainer
7. Booster valve body
8. Piston
9. Lever
10. Rod
11. Lever
12. Adjustment bolt
13. End
14. Rod
15. Brake band
16. Brake lining

## BRAKE OPERATION

When the steering lever on the side to which the machine is to be turned is pulled, the steering clutch on that side disengages. However, the clutch does not completely disengage, and the resulting drag causes the machine to turn in a large circle.

In order to prevent clutch drag, the lever is pulled further to brake the outer drum (brake drum), thus reducing the radius of the turning circle.

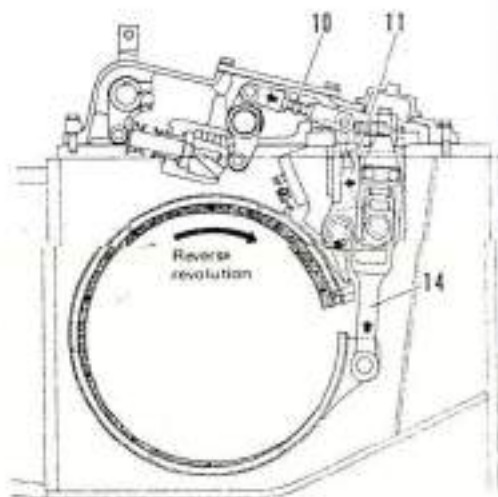
## 1. BRAKE OPERATION DURING FORWARD TURNING



154F170

One end of the brake band (15) is supported at point A of the lever (11), while the other is supported at point B of the rod (14). When the brake pedal is depressed, the rod (10) is drawn in the  $\leftarrow$  direction, and the lever is also pulled in the  $\leftarrow$  direction. As a result, the brake band tends to move about support point C on the lever, so that point A drops and point B rises. Because of forward turning the brake band constrains the brake drum about support point A, causing support point C on the opposite side to be pulled upwards.

## 2. BRAKE OPERATION DURING REVERSE TURNING



154F171

In the same way as for forward turning when the brake pedal is depressed, point A tends to move downwards and point B tends to move upwards. Because of reverse turning the brake band constrains the brake drum about support point B, causing support point A on the opposite side to be pushed downwards.

## BRAKE BOOSTER VALVE

1Y220, T5 220 are installed with a brake booster valve to reduce the force required to operate the brake pedal. Brake booster valve operates by oil from the steering pump and operating the brake pedal.

## OPERATION

Oil from the steering pump is distributed by the flow divider valve of the steering control valve into the steering circuit and brake circuit in the ratio 3 : 1. The oil which enters the brake circuit is further divided by the brake circuit flow divider into the left and right circuits. It then passes through the brake relief valve where its pressure is controlled to  $17 \text{ kg/cm}^2$ , and enters port A of the brake booster valve.

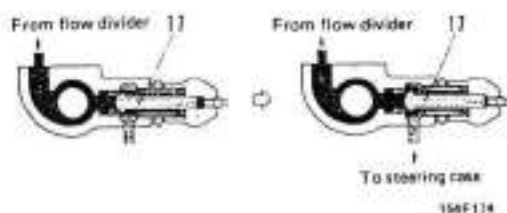
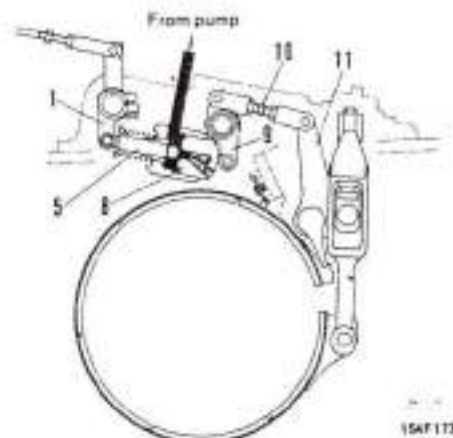
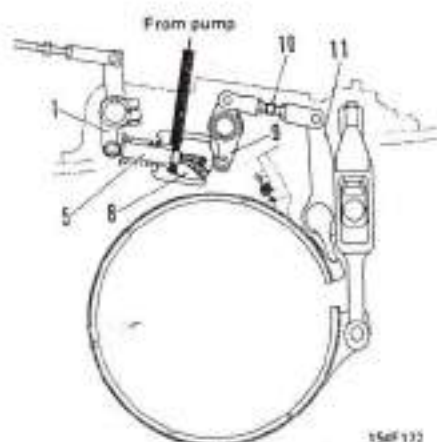
When brake pedal is depressed, the lever (1) pushes the spool (5), shutting off the passage between the spool and the piston. As a result, the pressure of the oil between the flow divider port A starts to rise, causing a pressure differential to occur between the left and right ports of the free piston of the flow divider. The free piston then moves to the circuit corresponding to the brake pedal which is not depressed, increasing the oil flow to the port.

When the pressure of the oil flowing into port A increases, the piston moves in the  $\Rightarrow$  direction, opening up the passage to the drain port. If then, the brake pedal is further depressed by an amount corresponding to the opening of the passage, the spool moves to close the passage.

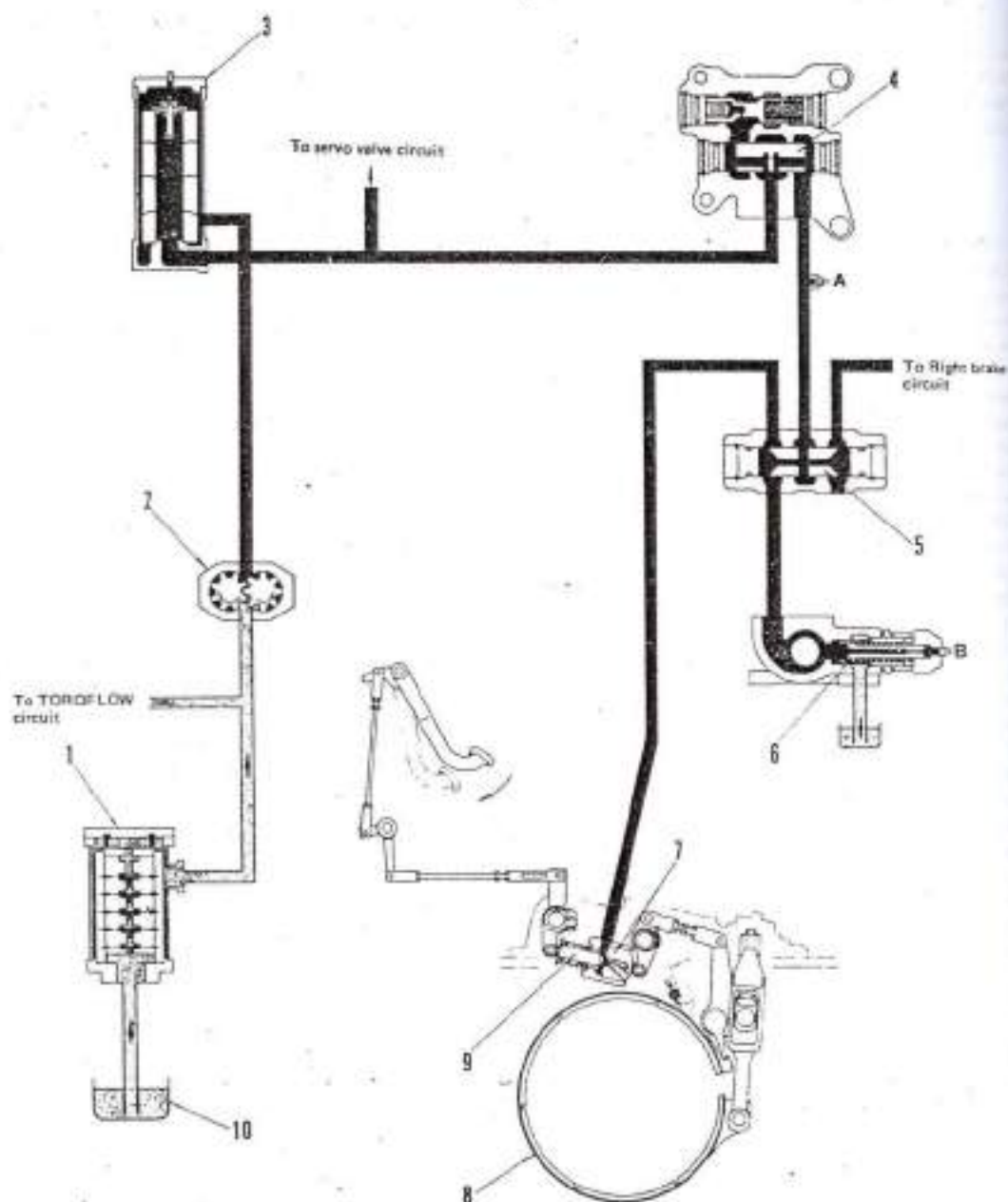
When the above actions are followed through, the end of the piston will push the lever (9), causing the rod to be pulled in the  $\Leftarrow$  direction, so that the brake operates by means of the lever (11).

When the brake fully operates, so that the passage to the drain port remains closed and the oil pressure in the circuit rises, the oil pushes open the plunger valve (17) of the brake relief valve, and then drain off from the port into the steering case.

The relief valve setting pressure is  $17 \text{ kg/cm}^2$ .

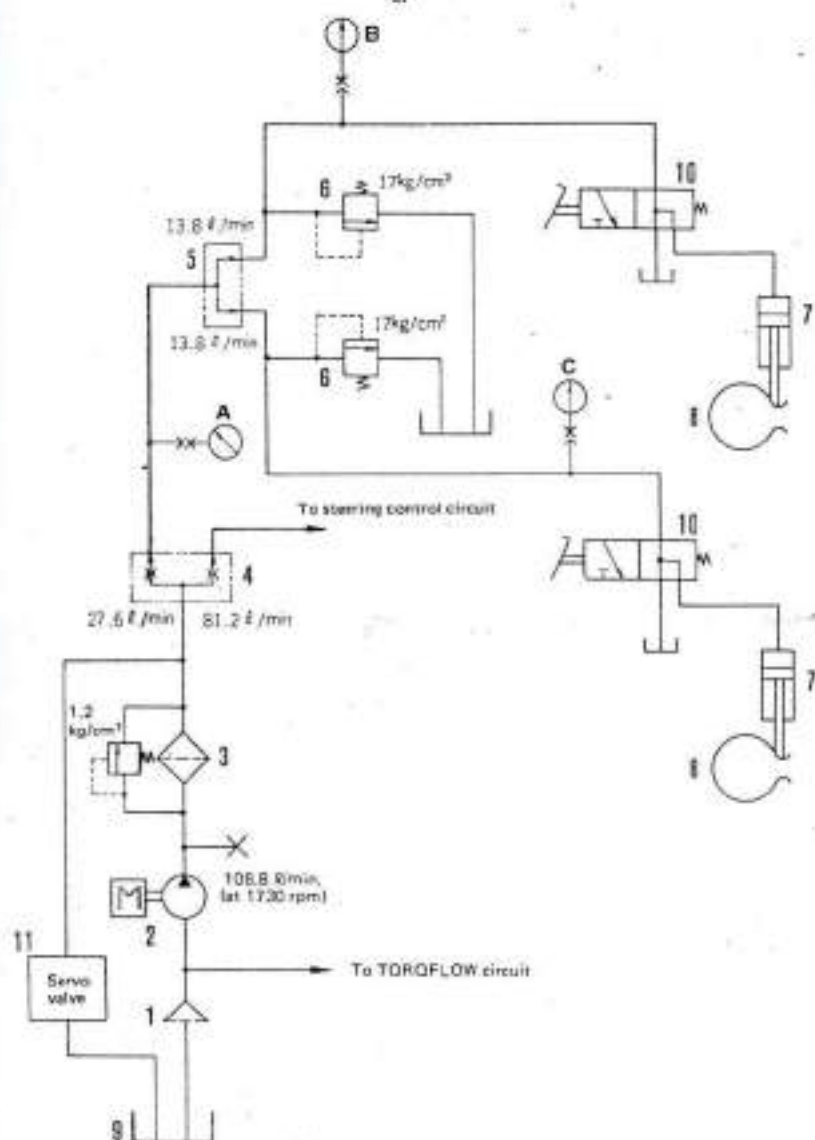


## BRAKE HYDRAULIC SYSTEM



194F115

## STEERING BRAKE HYDRAULIC CIRCUIT



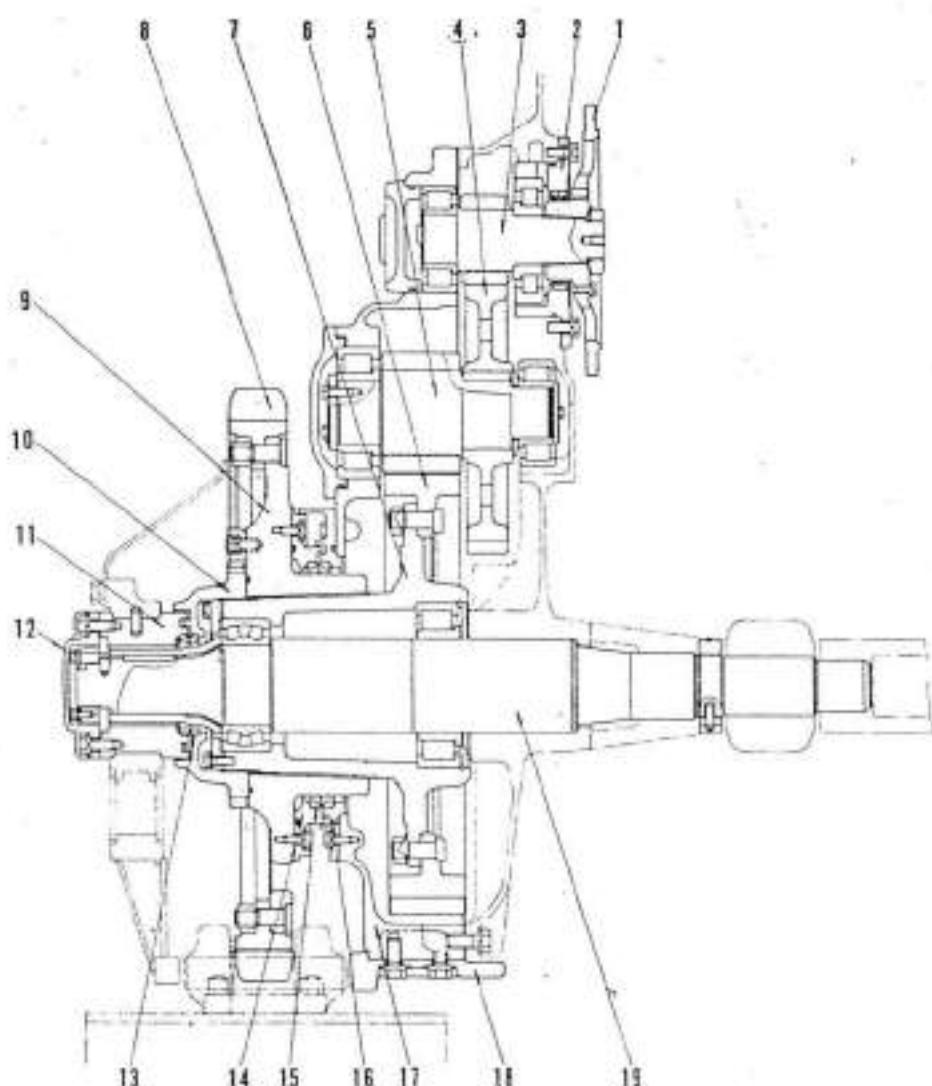
- |                       |                                |
|-----------------------|--------------------------------|
| 1. Magnet strainer    | 7. Brake booster               |
| 2. Steering pump      | 8. Steering brake              |
| 3. Steering filter    | 9. Steering case               |
| 4. Flow divider       | 10. Spool                      |
| 5. Flow divider       | 11. Rotary servo booster valve |
| 6. Brake relief valve |                                |

- |   |
|---|
| A. Brake booster pressure outlet (PT 1/8) |
| B. Right brake pressure outlet (PT 1/8)   |
| C. Left brake pressure outlet (PT 1/8)    |

154F176



## FINAL DRIVE TY 220



1. Final drive flange

2. Bearing cage

3. Final drive 1st pinion (12 teeth)

4. Final drive 1st gear (45 teeth)

5. Final drive 2nd pinion (32 teeth)

6. Final drive 2nd gear (55 teeth)

7. Final drive hub

8. Segment teeth

9. Sprocket boss

10. Sprocket nut

11. Bearing

12. Cover

13. Floating seal

14. Seal guard

15. Floating seal

16. Seal guard

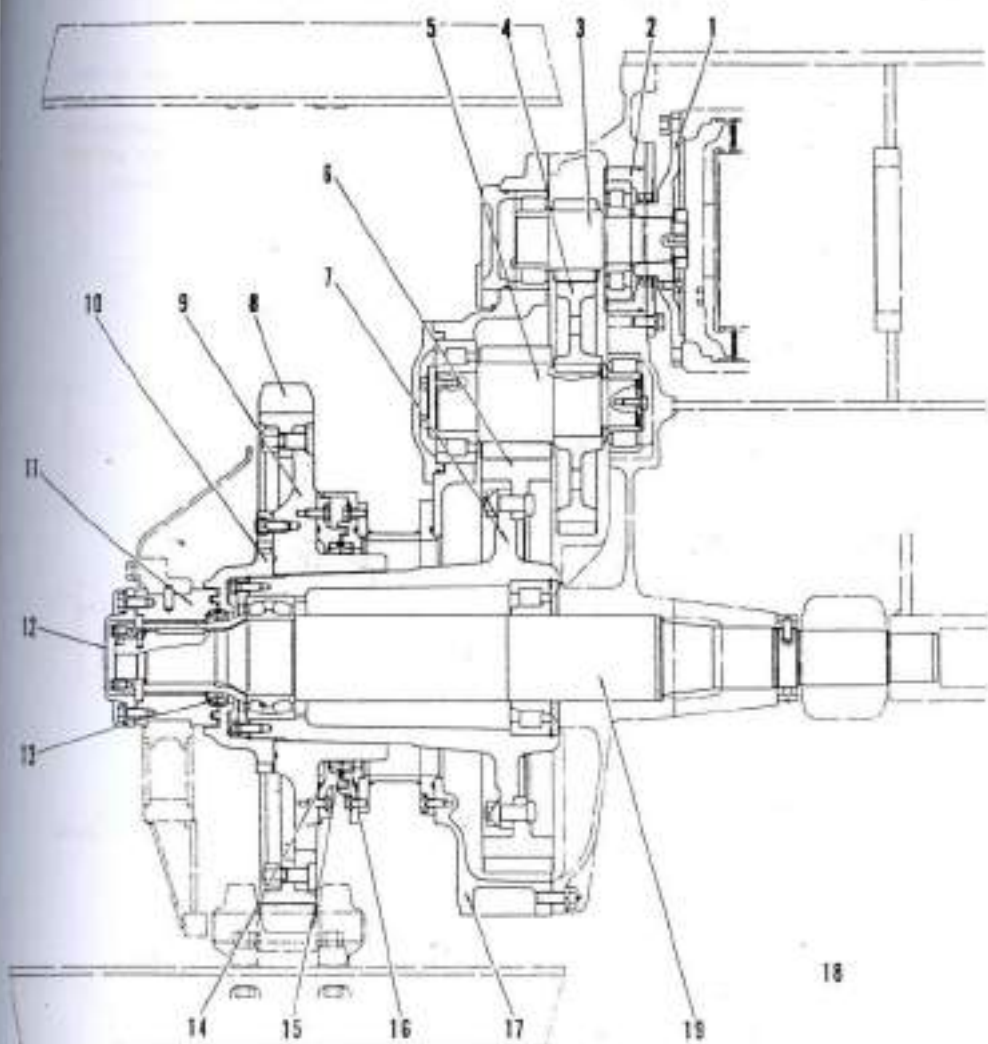
17. Final drive case

18. Guard

19. Sprocket shaft

1547177

## FINAL DRIVE TS 220



- |                                      |                   |                      |
|--------------------------------------|-------------------|----------------------|
| 1. Final drive frame                 | 8. Segment teeth  | 15. Floating seal    |
| 2. Bearing cage                      | 9. Sprocket box   | 16. Seal guard       |
| 3. Final drive 1st pinion (12 teeth) | 10. Sprocket nut  | 17. Final drive case |
| 4. Final drive 1st gear (45 teeth)   | 11. Bearing       | 18. Guard            |
| 5. Final drive 2nd pinion (12 teeth) | 12. Cover         | 19. Sprocket shaft   |
| 6. Final drive 2nd gear (65 teeth)   | 13. Floating seal |                      |
| 7. Final drive hub                   | 14. Seal guard    |                      |

TSAP173

## STRUCTURE AND FUNCTION

TY 220, T5 220 employ the two-step reduction method using spur gears and splash lubrication by gear rotation is used. Power from the bevel gear shaft and steering system is transmitted from the clutch outer drum (brake drum) to the final drive flange (1), causing the 1st pinion (3) on the bevel gear shaft to rotate.

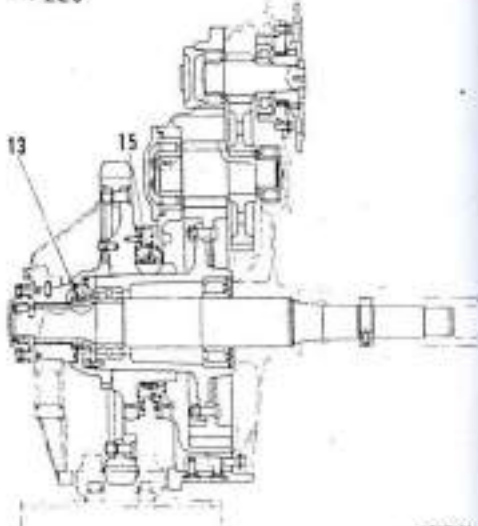
The 1st pinion meshes with the 1st gear (4), causing the 2nd pinion (5) on the bevel gear shaft to rotate. Power is then transmitted to the 2nd gear (6) which meshes with 2nd pinion, with a reduction in speed.

Because the 2nd gear is bolted onto the final drive hub (7), and the sprocket boss (9) is force-fitted onto the final drive hub by means of taper serrations, the rotation of the 2nd gear is transmitted directly to the sprocket boss.

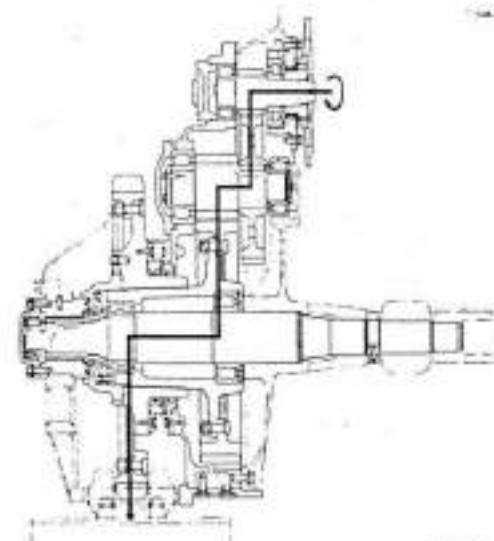
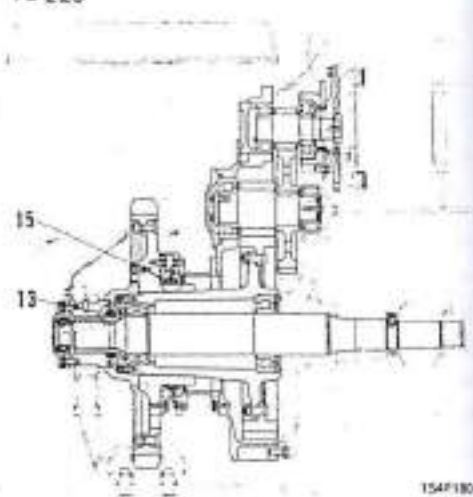
The sprocket teeth (8) are mounted on the sprocket boss with nuts and bolts.

The final drive case (17) acts as an oil bath for lubricating the various gears in the final drive. Floating seals (13), (15) are fitted to the case to protect rotating and sliding parts of the sprocket from dirt and mud and also to prevent oil leakage.

TY 220

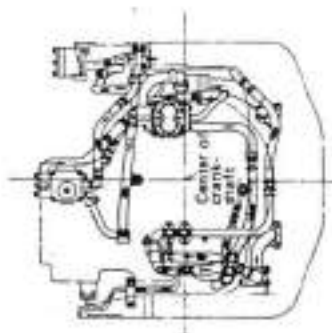
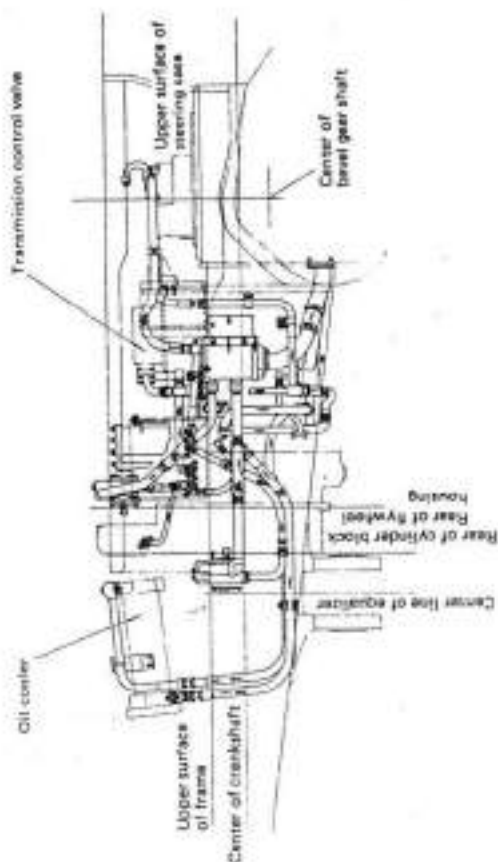
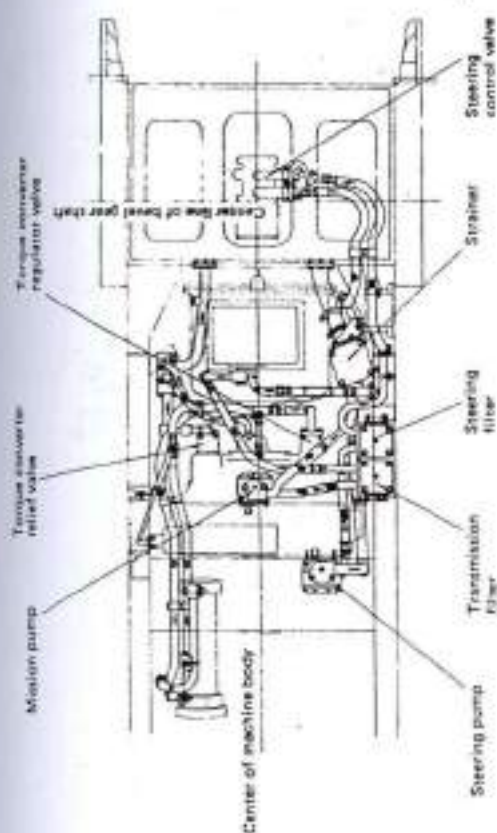


T5 220



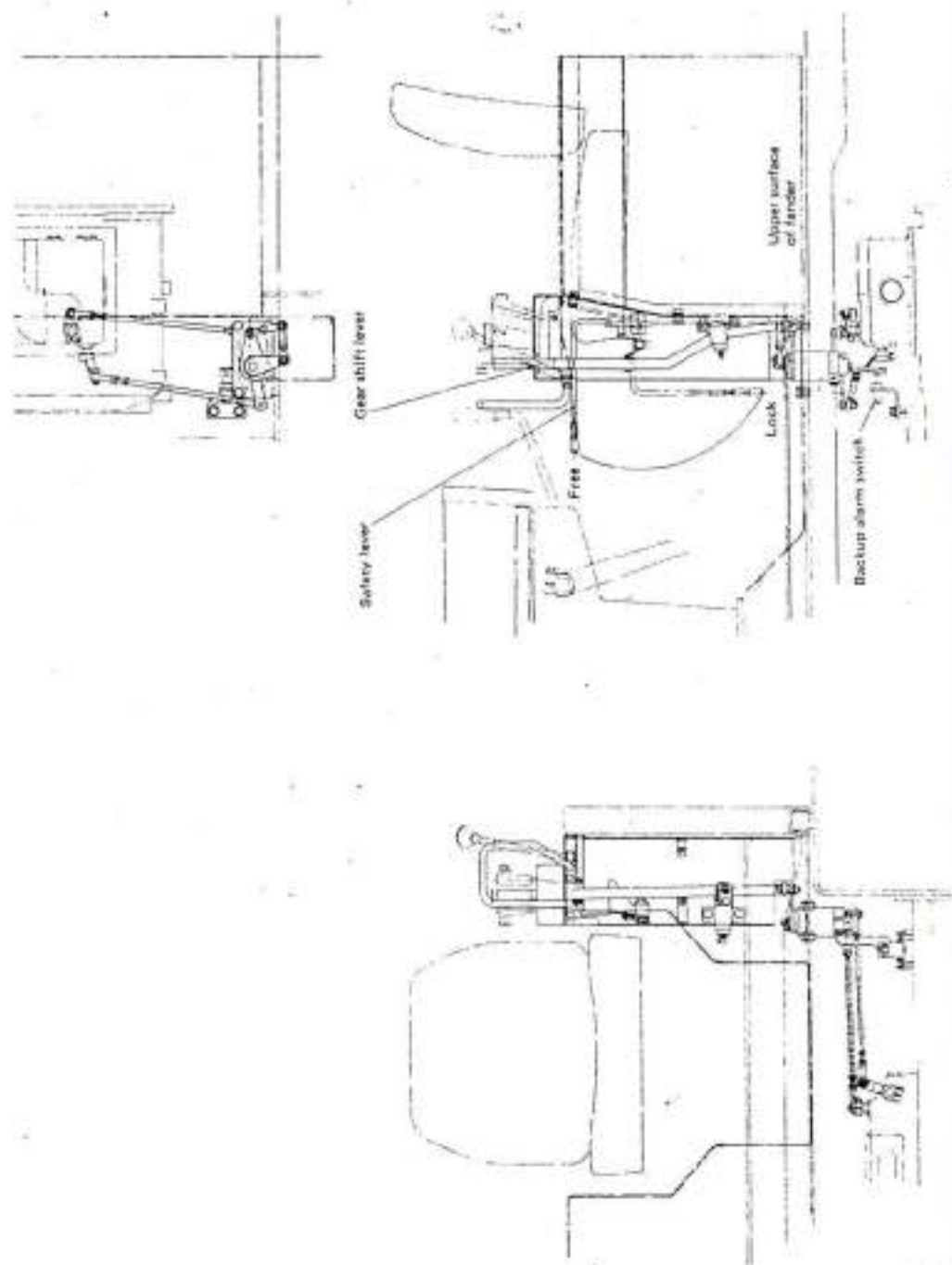
104P176

## STEERING AND TORQFLOW HYDRAULIC PIPING



104F 102

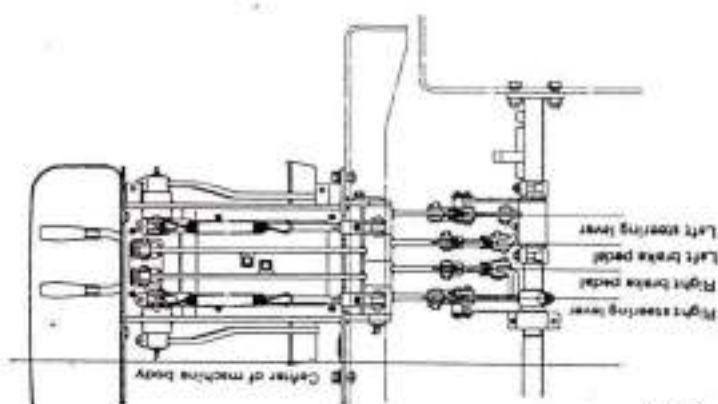
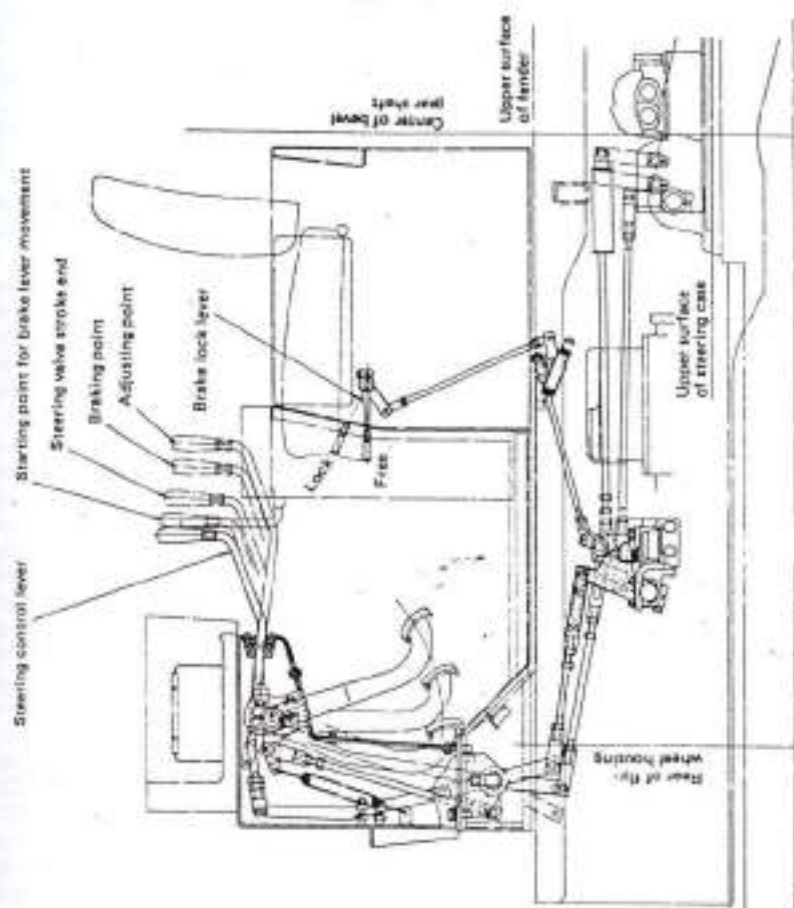
## TORQFLOW TRANSMISSION CONTROL



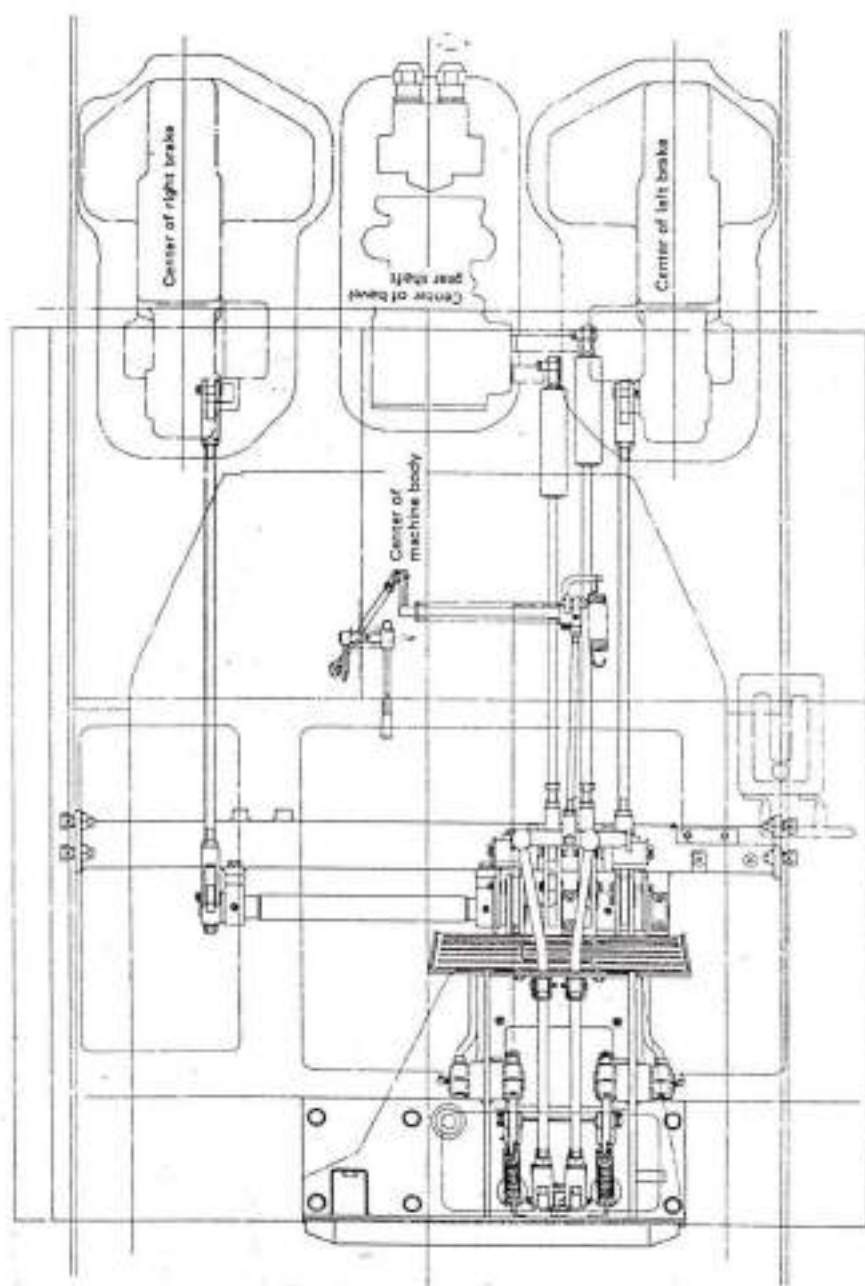
154719



## STEERING CONTROL



5014951



154P185

# INSPECTION AND ADJUSTMENT

## GENERAL

This section describes the method of tracing failures in the power train and also the method of post-repair testing and adjusting.

When it is necessary to perform measurements in the hydraulic circuits, use the appropriate measuring tools.

Always first perform a visual inspection on the machine and then carry out a running test. Perform tests using instruments lat.

### VISUAL INSPECTION

#### 1. Oil quantity and temperature

- (1) Transmission case
- (2) Steering case
- (3) Final drive

#### 2. Oil leakage and damage

Check exposed oil pans, couplings and valves for oil leakage and damage.

#### 3. Adjustment value checks

- (1) Check for losses or misadjustment of transmission, and steering and brake control linkages.
- (2) Check tension of tracks.

#### 4. Oil contamination, filter clogging and foreign particles

Inspect transmission and steering oil filter element and strainer for foreign particles, while paying attention to the following points.

- a. If iron powder or copper slivers are visible, transmission may be faulty.
  - b. If copper colored powder is mixed with oil, clutch may be faulty.
  - c. If shiny metallic slivers are visible on filter element, gear pump may be faulty.
  - d. If aluminium powder is visible on filter element, torque converter may be faulty.
  - e. If rubber particles are detected on filter element, seal or hose may be defective.
- If metallic or rubber fragments are detected, wash all component parts of the hydraulic circuit, and repair defective parts.

### RUNNING TEST

Start up engine and move gear change lever through all positions. Ensure that there is a positive response each time the lever is moved.

Move machine with gear shift lever in all-speed positions, in both forward and reverse, and check performance.



## DANGER PREVENTION

When it is unavoidably necessary to perform testing in a confined location, apply brake and also wedge parking blocks at front and rear of machine to ensure that it does not move during tests. Ensure that unauthorized persons are kept away from the testing area.

## OIL PRESSURE MEASURING POINTS

Item	Measuring point	Measuring plug size	Oil temperature during measurement (°F)	Set oil pressure (kg/cm <sup>2</sup> )		Remarks
				Engine fullspeed	Engine idling	
TORTO FLOW hydraulic transmission	Torque converter relief pressure (inlet)	R 1/4 (PT 1/4) 07042 - 00108	70 ~ 80	7 ~ 9		
	Torque converter regulator pressure (outlet)			3 ~ 5	2 ~ 3	
	Transmission clutch pressure	R 1/4 (PT 1/4) 07042 - 00108	70 ~ 80	23 ~ 27	18 ~ 24	
	Transmission lubricating relief valve			1.5		Normally, measurements are not required, however measuring flange must be inserted in circuit for taking measurements during fault investigation, etc.
Steering hydraulic	Steering clutch pressure	R 1/4 (PT 1/4) 07042 - 00108	70 ~ 80	12 ~ 17	9 ~ 13	It is possible to measure oil pressure at which left or right clutch disengages when left or right steering lever is pulled.
	Brake relief pressure			15 ~ 20	15 ~ 20	

## OIL PRESSURE AND TEMPERATURE MEASURING EQUIPMENT

Part Name	A	B
Hydraulic tester	1	
Thermistor kit		1

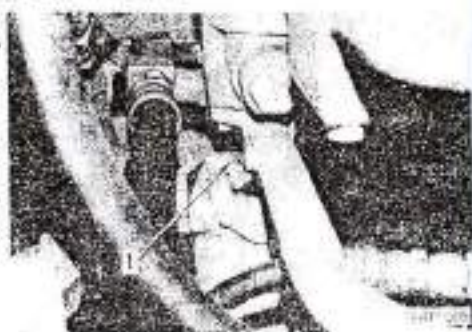




## OUTLINE OF OIL PRESSURE AND TEMPERATURE MEASUREMENTS

### 1. Torque converter relief pressure measurement

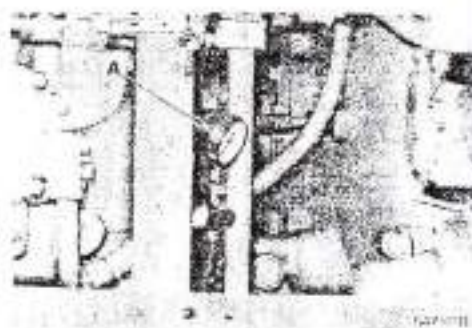
- 1) Installation of oil pressure gauge
  - i) Stop engine. Remove floor plate and then take out torque converter relief valve plug (1).
  - ii) Fit pressure gauge A (25 kg/cm<sup>2</sup>) with adaptor and hose.



### 2) Oil pressure measurement

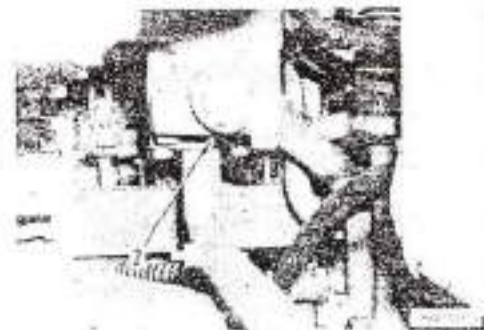
Put gear shift lever in "N" position and start engine. Measure oil pressure at both idle and full speed.

- ★ Oil temperature during measurement: 70 to 80°C
- ★ Be sure to lock parking brake.



### 2. Torque converter regulator pressure measurement

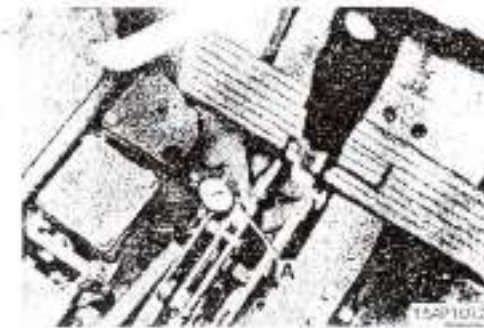
- 1) Installation of oil pressure gauge
  - i) Stop engine. Remove floor plate and then take out torque converter relief valve plug (2).
  - ii) Fit pressure gauge A (25 kg/cm<sup>2</sup>) with 90° adaptor and hose.



### 2) Oil pressure measurement

Put gear shift lever in "N" position and start engine. Measure oil pressure at both idle and full speed.

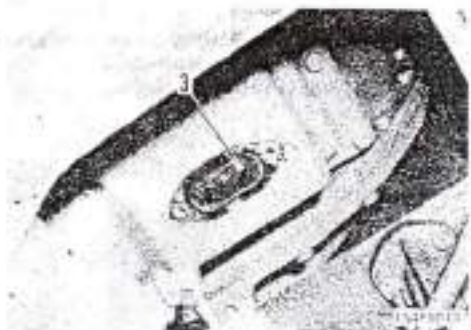
- ★ Oil temperature during measurement: 70 to 80°C
- ★ Be sure to lock parking brake.



## 3. TOROFLOW transmission 1st speed clutch pressure

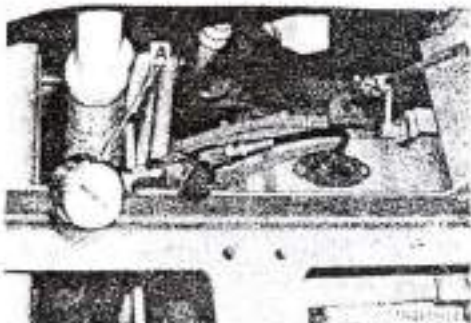
## 1) Installation of oil pressure gauge

- i) Stop engine. Remove servo-valve front cover and transmission valve top cover, and take out plug (3).
- ii) Fit pressure gauge A ( $125 \text{ kg/cm}^2$ ) with adaptor and hose.



## 2) Oil pressure measurement

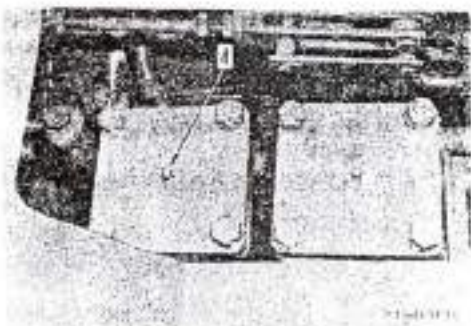
- Put gear shift lever in "N" position and start engine. Put gear shift lever in either forward or reverse position and measure oil pressure.
- Note that machine will start moving when engine is set at full speed.
- Oil temperature during measurement:  $70$  to  $80^\circ\text{C}$



## 4. TOROFLOW transmission modulating pressure

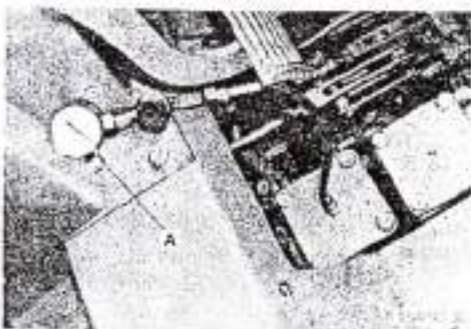
## 1) Installation of oil pressure gauge

- i) Stop engine. Remove floor plate and take out plug (4) at top of filter.
- ii) Fit pressure gauge A ( $70 \text{ kg/cm}^2$ ) with adaptor and hose.



## 2) Oil pressure measurement

- Put gear shift lever in "N" position and start engine. Measure oil pressure at both idle and full speed.
- Oil temperature during measurement:  $70$  to  $80^\circ\text{C}$
  - Be sure to lock parking brake.



**5. Left and right steering clutch pressure measurement**

- 1) Installation of oil pressure gauge
  - i) Stop engine and remove rear cover (5).



- ii) When measuring left steering clutch pressure, remove plug (6), and when measuring right steering pressure, remove plug (7).



- iii) Install pressure gauge A (25 kg/cm<sup>2</sup>) with adaptor and hose.

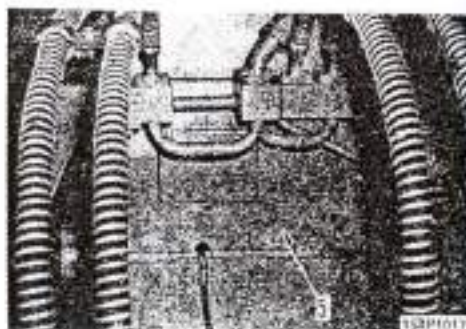
- 2) Oil pressure measurement  
Put gear shift lever in "N" position and start engine. Pull steering lever until clutch disengages, and measure oil pressure at both idle and full speed.

★ Oil temperature during measurement: 70 to 80°C

★ Be sure to lock parking brake.

**6. Left and right brake relief pressure measurement**

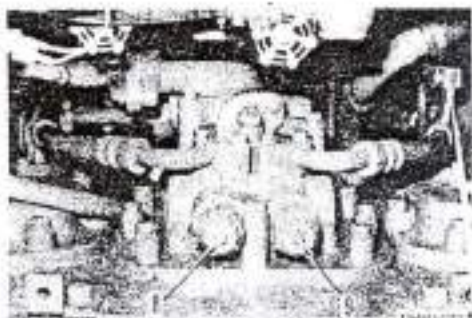
- 1) Installation of oil pressure gauge
  - i) Stop engine and remove rear cover (5).





- ii) When measuring left brake relief pressure, remove plug (8), and when measuring right brake relief pressure, remove plug (9).

- iii) Install oil pressure gauge A (70 kg/cm<sup>2</sup>) with adaptor and hose.

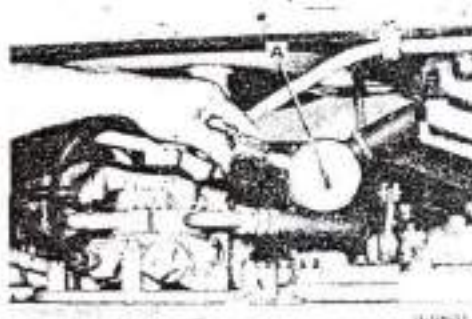


## 2) Oil pressure measurement

Put gear shift lever in "N" position and start engine. Depress brake pedal and measure oil pressure at both idle and full speed.

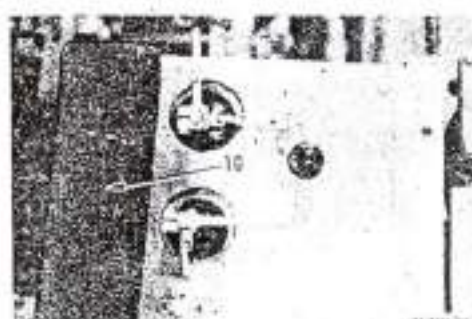
- \* Oil temperature during measurement: 70 to 80°C

- \* Be sure to lock parking brake.



## 7. TORQFLOW and steering brake pressure measurement

- 1) Stop engine and remove right armrest (10).



- 2) Extract level gauge and connect temperature gauge sensor to part B. Insert end of sensor C into level gauge guide (11) and measure oil temperature.



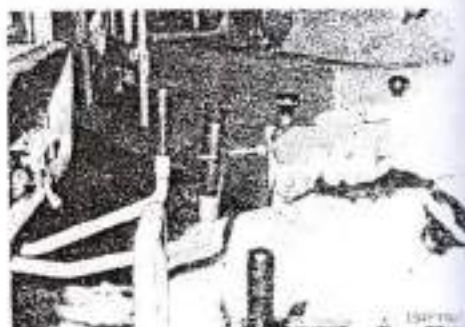
## 8. Gear shift lever

- 1) Stop engine and hook push-pull scale onto lever knob.
- 2) Pull scale and measure force required to move lever through each speed position.



## 9. Steering lever

- 1) Put gear shift lever in "N" position and start engine. Set engine speed at idle and hook push-pull scale onto lever knob.
- 2) Pull scale until clutch disengages, and measure operating force.
- 3) Pull scale further and measure force required to operate brake.



## 10. Brake pedal

- 1) Put gear shift lever in "N" position and start engine. Set engine speed at 1000 rpm.
- 2) Apply push-pull scale to center of brake pedal and put gear shift lever in 1st speed position. Push in pedal and measure force at instant engine stops or torque converter stalls on half brake.

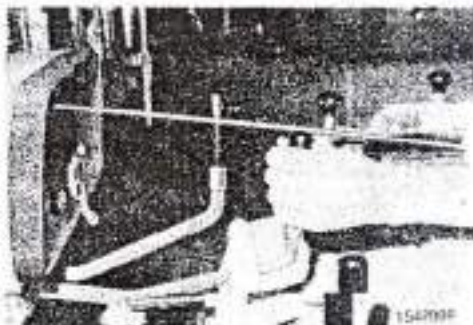




## TRAVEL MEASUREMENTS

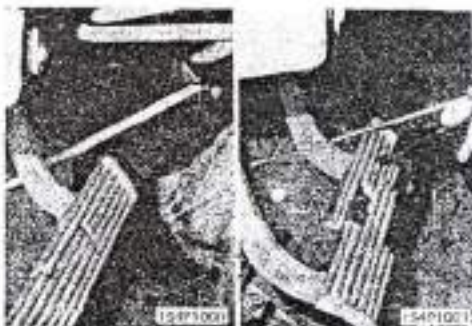
## 1. Steering lever

Put gear shift lever in "N" position and start engine. Set engine speed at idle. Apply scale to steering lever and pull lever until clutch completely disengages. Measure lever travel at this point.



## 2. Brake pedal

Put gear shift lever in "N" position and start engine. Run engine at idle. Apply scale to pedal and measure travel at point corresponding to pedal force of 12 kg.



## OPERATING FORCE MEASUREMENTS

## 1. Fuel control lever

- 1) Put gear shift lever in "N" position and start engine. Hook push-pull scale onto lever knob.



## STANDARD VALUES

Item		Condition	Standard value	Tolerance value
Stroke	Fuel control valve	Center of lever knob Idle ~ Full speed Full speed ~ Idle	110 ~ 150 mm	
	Decelerator pedal	Full speed ~ Idle	30 ~ 40 mm	
	Gear shift lever	Center of lever knob Forward/reverse direction Left/right direction (between F ~ R)	38 ~ 50 mm	
			60 ~ 80 mm	
	Steering lever	Engine idle Until clutch disengages Until brake operates	81 ~ 101 mm 129 ~ 158 mm	
Operating force	Fuel control lever	Idling + Full speed	4 ~ 6 kg	
		Full speed + Idling	8 ~ 12 kg	
	Decelerator pedal	Full speed + Idling	5 ~ 10 kg	
	Gear shift lever	Engine stop	2 ~ 5 kg	
	Steering lever	Engine idle Until clutch disengages Until brake operates and machine turns	7 kg max. 10 kg max.	
Oil pressure	Brake pedal	Until engine stops or torque converter stalls on one brake	15 kg max.	
	Torque converter	Oil temp. 70 ~ 80°C Inlet	Idle	
			Full speed	7 ~ 9 kg/cm <sup>2</sup>
		Outlet	Idle	2 ~ 3 kg/cm <sup>2</sup>
			Full speed	3 ~ 5 kg/cm <sup>2</sup>
	TORQFLOW transmission	Oil temp. 70 ~ 80°C	Idle	18 ~ 24 kg/cm <sup>2</sup>
			Full speed	23 ~ 27 kg/cm <sup>2</sup>
	Steering clutch	Oil temp. 70 ~ 80°C	Idle	9 ~ 13 kg/cm <sup>2</sup>
			Full speed	12 ~ 17 kg/cm <sup>2</sup>
	Steering brake	Oil temp. 70 ~ 80°C Measure when one brake is released and also when both left and right brakes are released.	Idle	15 ~ 20 kg/cm <sup>2</sup>
			Full speed	15 ~ 20 kg/cm <sup>2</sup>

Within 2 kg/cm<sup>2</sup>  
difference left &  
right brakes

Item		Condition	Standard value	Tolerance value
Heat balance	Engine water temperature	<b>TEST CONDITIONS</b> 1. Specified amount of oil and water. 2. Exhaust 30 ~ 40 mm and refill until oil heat balanced. 3. Wind velocity shall be no greater than 5 m/sec. Be careful of wind direction. 4. Stop test during very cloudy or wet weather. 5. Perform test with thermostat fully open. 6. Inspection standards shall be 40°C converted values. 7. Measurements shall be made at least three times every 30 minutes in the vicinity of heat balance.	Radiator inlet 100°C max.	
	Engine oil temperature		Level gauge guide 120°C max.	
	Torque converter oil temperature		Cooler inlet 120°C max.	
	Steering case oil temperature		Level gauge guide 120°C max.	
	Final drive case oil temperature		Level plug -100°C max.	

# POWER TRAIN

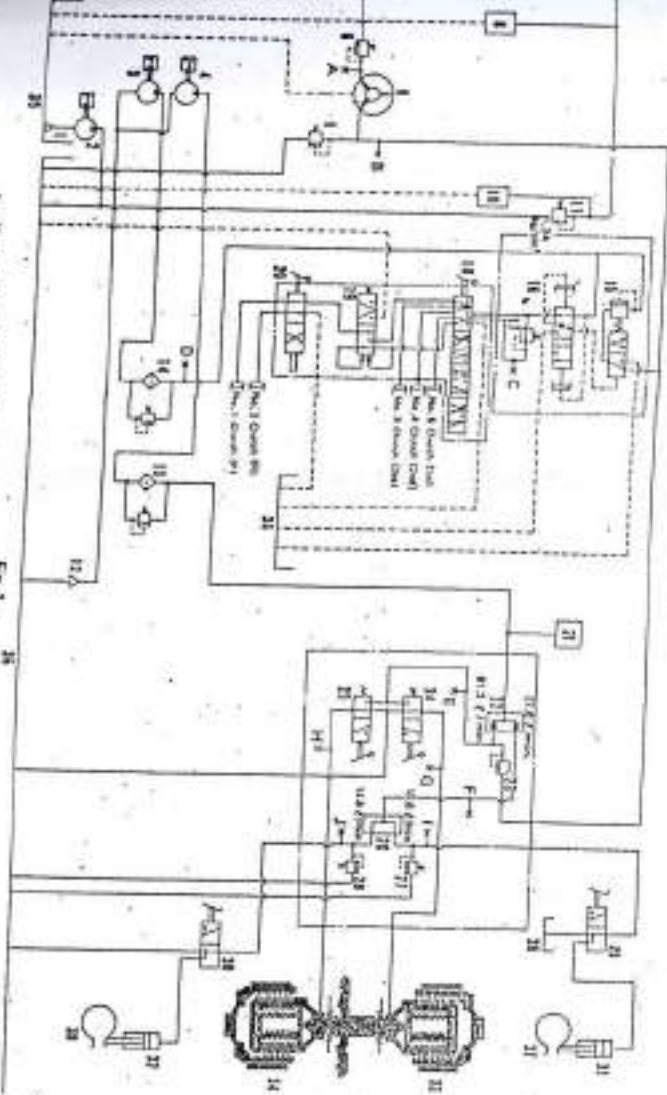
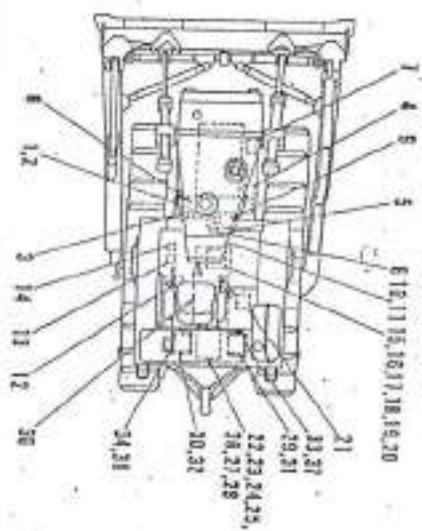


Fig. 1

- A. Torque converter relief pressure pickup plug (PT 1/8)
- B. Torque converter relief pressure pickup plug (PT 1/8)
- C. TORQFLOW transmission reducing pressure pickup plug (PT 1/8)
- D. TORQFLOW transmission modulating pressure pickup plug (PT 1/8)
- E. Steering clutch pressure pickup plug (PT 1/8)
- F. Right steering clutch pressure pickup plug (PT 1/8)
- G. Left steering clutch pressure pickup plug (PT 1/8)
- H. Right steering clutch pressure pickup plug (PT 1/8)
- I. Left steering clutch pressure pickup plug (PT 1/8)
- J. Right steering clutch pressure pickup plug (PT 1/8)
- K. Left steering clutch pressure pickup plug (PT 1/8)
- L. Right steering clutch pressure pickup plug (PT 1/8)
- M. Left steering clutch pressure pickup plug (PT 1/8)
- N. Right steering clutch pressure pickup plug (PT 1/8)
- O. Left steering clutch pressure pickup plug (PT 1/8)
- P. Right steering clutch pressure pickup plug (PT 1/8)
- Q. Left steering clutch pressure pickup plug (PT 1/8)
- R. Right steering clutch pressure pickup plug (PT 1/8)
- S. Left steering clutch pressure pickup plug (PT 1/8)
- T. Right steering clutch pressure pickup plug (PT 1/8)
- U. Left steering clutch pressure pickup plug (PT 1/8)
- V. Right steering clutch pressure pickup plug (PT 1/8)
- W. Left steering clutch pressure pickup plug (PT 1/8)
- X. Right steering clutch pressure pickup plug (PT 1/8)
- Y. Left steering clutch pressure pickup plug (PT 1/8)
- Z. Right steering clutch pressure pickup plug (PT 1/8)

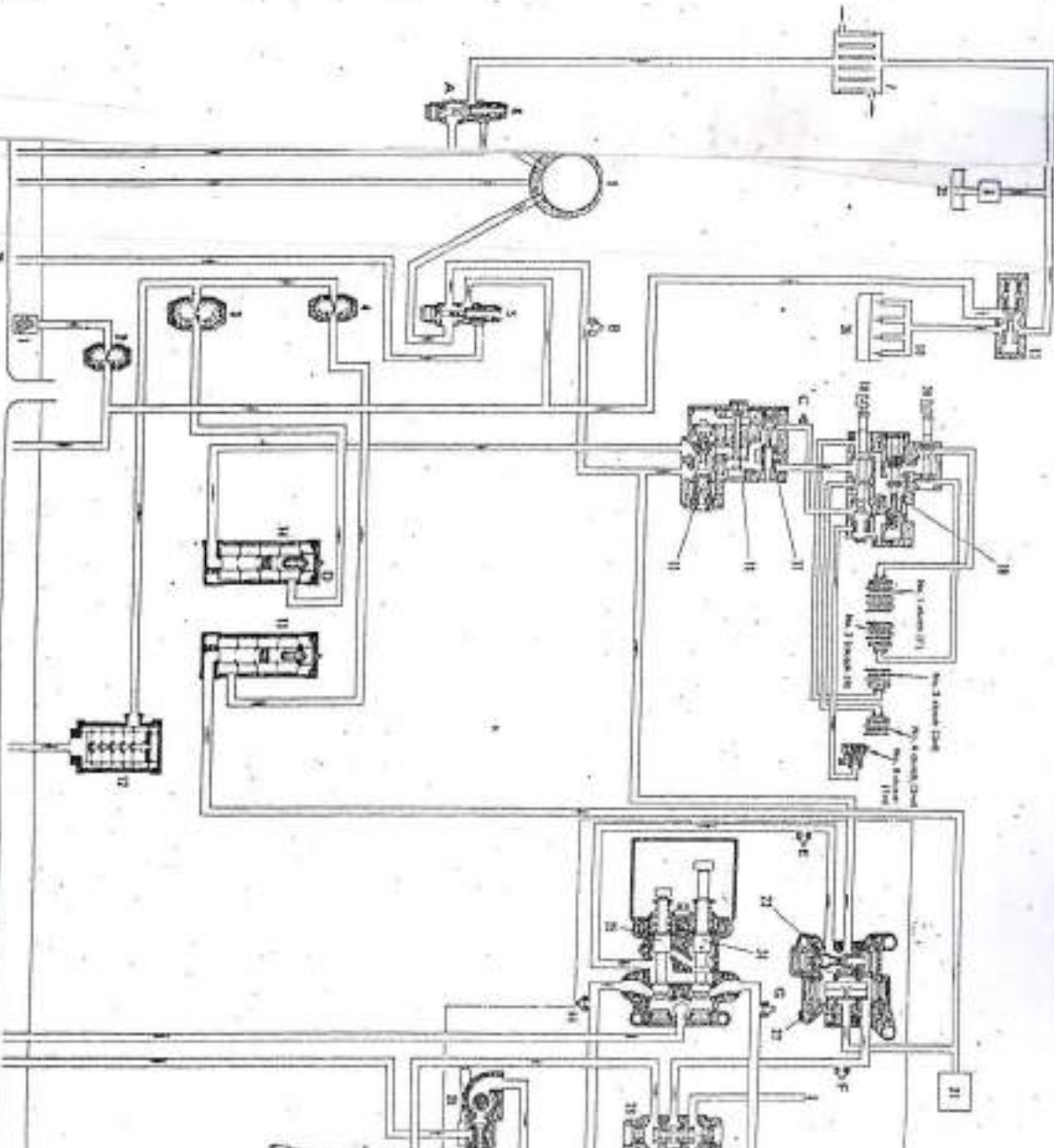


Fig. 2

- 1. Magnet for valve
- 2. Steering clutch
- 3. Steering clutch
- 4. Steering clutch
- 5. Steering clutch
- 6. Steering clutch
- 7. Steering clutch
- 8. Steering clutch
- 9. Steering clutch
- 10. TORQFLOW transmission safety valve
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- 100. TORQFLOW transmission safety valve



## OIL PRESSURE MEASURING POINT

Problem	Mastering		Master method	Set of problems (Duration <sup>1</sup> )	
	Pre-lab exercises	Laboratory		Engine lab course	Engine lab course
Torque converter regulator pressure	PT 1/5	Figs.1.3-6	<p>Fit oil pressure gauge (20 in<sup>2</sup>) with adapter and hose. Put gear shift lever in "N" position and start engine. Measure oil pressure at both idle and 1000 rpm.</p> <ul style="list-style-type: none"> <li>Oil temperature during warm-up: 70 to 90°F</li> <li>Oil level to look green.</li> </ul>	2-6	2-3
Torque converter oil pressure	PT 1/5	Figs.1.2-6	<p>Fit oil pressure gauge (20 in<sup>2</sup>) with adapter and hose. Put gear shift lever in "N" position and start engine. Measure oil pressure at both idle and 1000 rpm.</p> <ul style="list-style-type: none"> <li>Oil temperature during warm-up: 70 to 90°F</li> <li>Be sure to look green.</li> </ul>	2-7	-
TORCON LOW transmission relocking pressure	PT 1/8	Figs.1.2-7	<p>Fit oil pressure gauge (20 in<sup>2</sup>) with adapter and hose. Put gear shift lever in "N" position and start engine. Put gear shift lever in other three reverse positions and measure oil pressure.</p> <ul style="list-style-type: none"> <li>Time that machine will move when engine is set at full speed.</li> <li>Oil temperature during warm-up: 70 to 90°F</li> </ul>	12-8	-
TORCON LOW transmission relocking pressure	PT 1/8	Figs.1.2-7	<p>Fit oil pressure gauge (20 in<sup>2</sup>) with adapter and hose. Put gear shift lever in "N" position and start engine. Measure oil pressure at both idle and 1000 rpm.</p> <ul style="list-style-type: none"> <li>Oil temperature during warm-up: 70 to 90°F</li> <li>Be sure to look green.</li> </ul>	20-21	18-24
Lub and right steering clutch pressure	PT 1/8	Figs.1.3-7	<p>Fit oil pressure gauge (20 in<sup>2</sup>) with adapter and hose. Put gear shift lever in "N" position and start engine. Put steering lever in each of four positions and measure oil pressure at both idle and full speed.</p> <ul style="list-style-type: none"> <li>Oil temperature during warm-up: 70 to 90°F</li> <li>Be sure to look green.</li> </ul>	12-17	8-18
Lub and right steering clutch pressure	PT 1/8	Figs.1.3-7	<p>Fit oil pressure gauge (20 in<sup>2</sup>) with adapter and hose. Put gear shift lever in "N" position and start engine. Measure oil pressure at both idle and 1000 rpm.</p> <ul style="list-style-type: none"> <li>Oil temperature during warm-up: 70 to 90°F</li> <li>Be sure to look green.</li> </ul>	16-20	18-20

## STANDARD VALUES

Item		Description		Standard value
Torque	Full speed value, $T_1$	Size = Full speed	110 ~ 150 mm	
	Decreased value	Full speed = 15%	20 ~ 40 mm	
	Low speed value	Forward/reverse direction Left/right direction (between P and R) Low clutch disengage	20 ~ 40 mm 60 ~ 80 mm 81 ~ 101 mm	
Torque	Opening force	Engage 10%	100 ~ 150 mm	
	Brake action	Low clutch engaging Full pressure 15 kg 100% engine stop to couple reconnect with locking + full speed	110 ~ 150 mm	
	Engage 10%	Full speed + 10% Full speed + 10% Full speed + 10%	4 ~ 8 kg 8 ~ 12 kg 5 ~ 10 kg	
Operating force	Full control lever	Engage 10%	2 ~ 5 kg	
	Directional pedal	Low clutch disengage Low to high over roll and reactive torque	7 kg max. 10 kg max. 15 kg max.	
	Steering lever	Engage 10%	3 kg max. 10 kg max. 15 kg max.	
Horn balance	Brake pedal	TEST CONDITION: 1. Shaded engine oil and water. 2. Engine 20 ~ 40 mm and not over oil heat balance. 3. Wind velocity shall be no greater than 5 m/sec. Be careful of wind direction. 4. Stop test during very cloudy or wet weather. 5. Perform test with standard 10% norm. 6. Inoperative equipment shall be 80°C normal value. 7. Measurement shall be made at least three times every 30 minutes to the history of heat balance.	Medium grade 100°C max. Low grade 100°C max. Low grade 100°C max.	
	Engage water temperature	Engage oil temperature Torque converter oil temperature	Low grade 100°C max. Low grade 100°C max. Low grade 100°C max.	
	Engage oil temperature	Engage oil temperature Torque converter oil temperature	Low grade 100°C max. Low grade 100°C max. Low grade 100°C max.	
Machine speed	Forward 1st speed	Engage speed: Full Reverse 1st speed	Within 20 sec. Within 1.1 sec.	
	Forward 2nd speed	Engage speed: Full Reverse 2nd speed	Within 1.1 sec. Within 0.4 sec.	
	Forward 3rd speed	Engage speed: Full Reverse 3rd speed	Within 1.1 sec. Within 0.4 sec.	
Diameter (mm)	Forward 1st speed	Engage speed: Full Reverse 1st speed	Within 1.1 sec. Within 0.4 sec.	
	Forward 2nd speed	Engage speed: Full Reverse 2nd speed	Within 1.1 sec. Within 0.4 sec.	
	Forward 3rd speed	Engage speed: Full Reverse 3rd speed	Within 1.1 sec. Within 0.4 sec.	
Time lag when gear shifting transmission	Engage speed: Full	Engage speed: Full Reverse 1st speed	Within 1.1 sec. Within 0.4 sec.	
	Engage speed: Full	Engage speed: Full Reverse 1st speed	Within 1.1 sec. Within 0.4 sec.	
	Engage speed: Full	Engage speed: Full Reverse 1st speed	Within 1.1 sec. Within 0.4 sec.	



## 1. Raising machine body

Raise machine body by inserting four blocks (approx. 300 mm high) under tracks.



Insert blocks firmly so that machine does not tilt in any direction.



Apply steering brake firmly.

## 2. Under guard

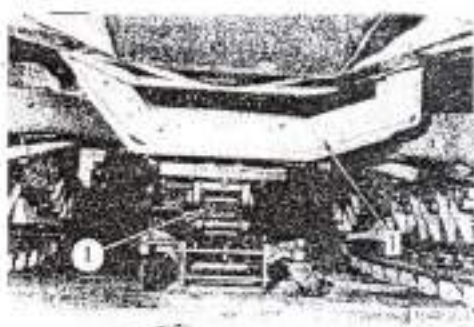
Using mission jack (1), remove under guard (1) from rear of machine body.



To avoid interference between under guard and diagonal brace, remove under guard by pushing it forward while gradually lowering transmission jack.

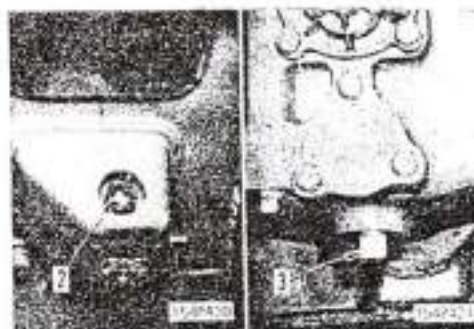


Under guard: 160 kg



## 3. Draining steering and transmission case

Remove drain plug (2) and drain off oil in transmission case.



## 4. Draining torque converter case

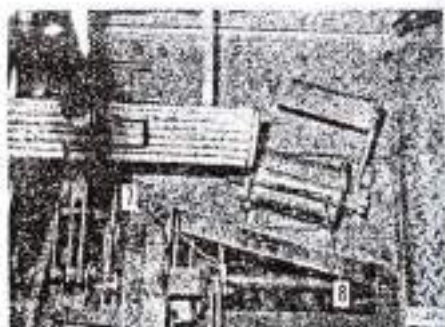
Remove drain plug (3) and drain off oil in torque converter case.



## 5. Floor plate

1) Remove floor plates (4), (5) and (6).

- 2) Disconnect decelerator pedal rod (7) and remove pedal assembly (8).



6. Piping

Disconnect transmission pump inlet tube (9) and outlet tube (10).

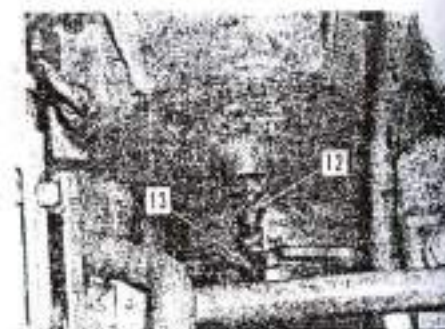


7. Transmission pump assembly

Remove transmission pump assembly (11).

8. Torque converter breather hose

Remove two sleeve nuts (12) and remove breather hose (13).



9. Scavenging pump piping

Disconnect scavenging pump outlet pipe (14).



**10. Relief valve piping**

Disconnect relief valve inlet tube (15) and outlet tube (16).

**11. Regulator valve piping**

Disconnect regulator valve outlet tube (17).

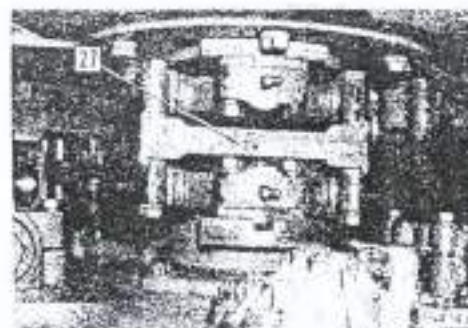
**12. Oil temperature gauge wiring**

Disconnect torque converter oil temperature gauge wiring (26).

**13. Universal joint assembly**

Remove universal joint assembly (27).

- ★ Remove all mounting bolts with joint mounted on machine. Remove all mounting bolts from torque converter side and then remove mounting bolts from transmission side.

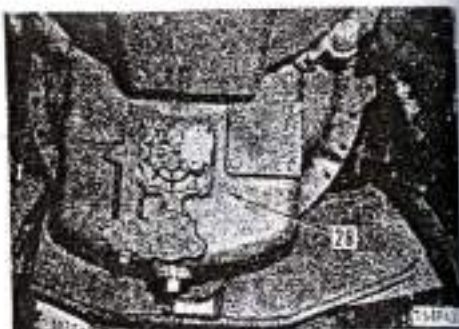


## 14. Torque converter assembly

- 1) Temporarily hoist torque converter assembly [28].
- 2) Remove 22 mounting bolts.
- 3) Separate torque converter assembly from flywheel housing with extraction bolts, and lower it away.

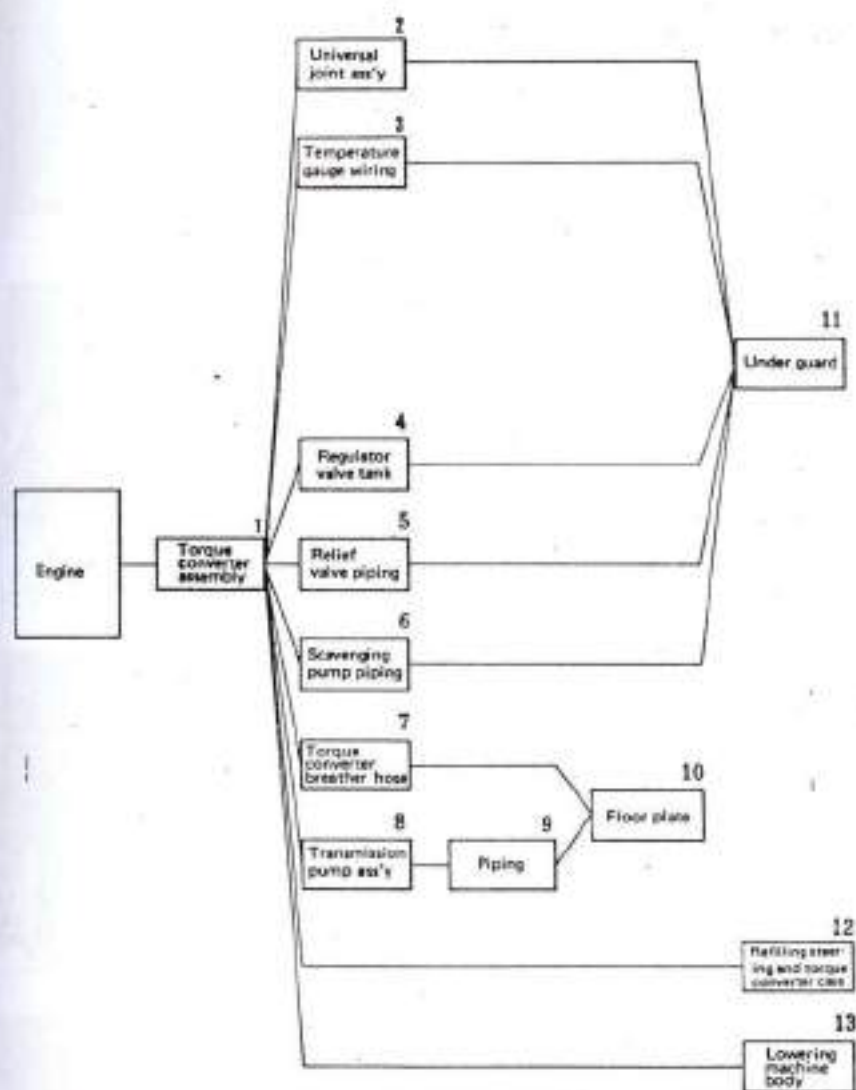


Torque converter assembly: 210 kg





## MOUNTING TORQUE CONVERTER ASSEMBLY



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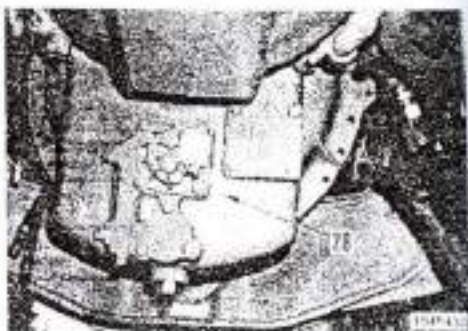
**1. Torque converter assembly**

- 1) Fit gasket to flywheel housing.

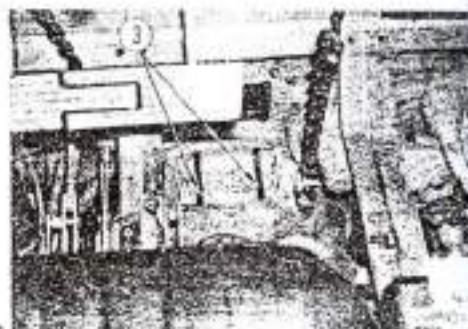


Gasket: Liquid gasket

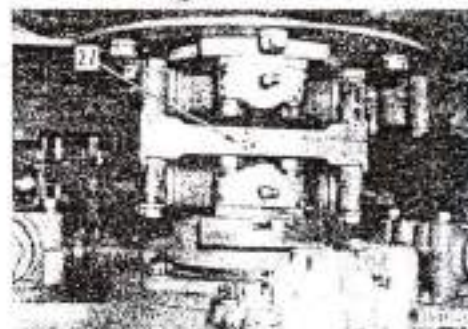
- 2) Place torque converter assembly (28) on wheel stand. Push it into bottom of machine body and raise it with wire.



- 3) Hoist torque converter. Screw guide bolts (3) (12 mm, P = 1.75, length approx. 100 mm) into converter and using them as guides align and push in drive gear and flywheel gear.
- 4) Tighten 22 mounting bolts.

**2. Universal joint assembly**

- 1) Position universal joint assembly (27). Fit transmission side mounting bolts and then fit converter side mounting bolts.
- 2) Additionally tighten all mounting bolts.

**3. Oil temperature gauge wiring**

- Connect oil temperature gauge wiring (26).



## 4. Regulator valve piping

Fit O-ring and connect regulator valve outlet tube (17).



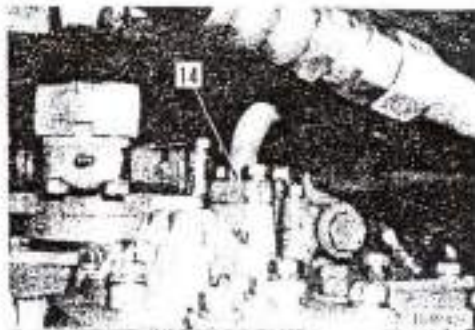
## 5. Relief valve piping

Fit O-ring and connect relief valve outlet tube (16) and inlet tube (15).



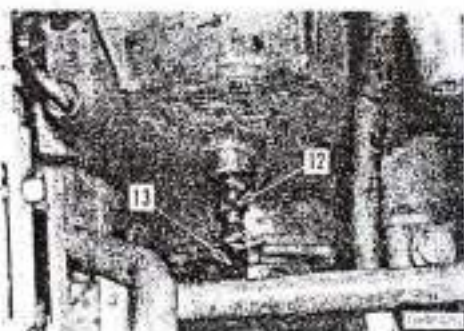
## 6. Scavenging pump piping

Fit O-ring and connect scavenging pump outlet tube (14).

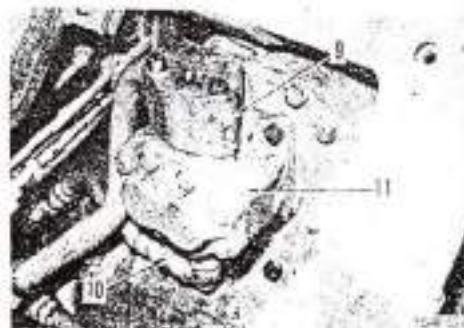


**7. Torque converter breather hose**

Fit breather hose (13) and connect sleeve nut (12).

**8. Transmission pump assembly**

Fit O-ring to P.T.O. case and install transmission pump assembly (11).

**9. Piping**

Fit O-ring and connect transmission pump outlet tube (10) and inlet tube (9).



Fit O-ring securely in groove.

**10. Floor plate**

1) Install floor plate (8) and connect decelerator pedal rod (7).

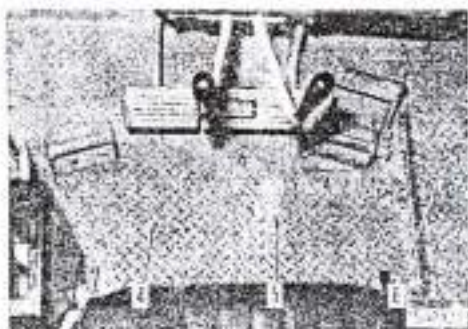


Bend cotter pin securely.





- 2) Install floor plates (6), (5) and (4).

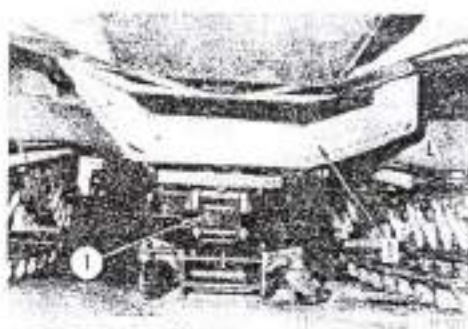


### 11. Under guard

Install under guard (1) at rear of machine body while supporting it with mission jack (1).



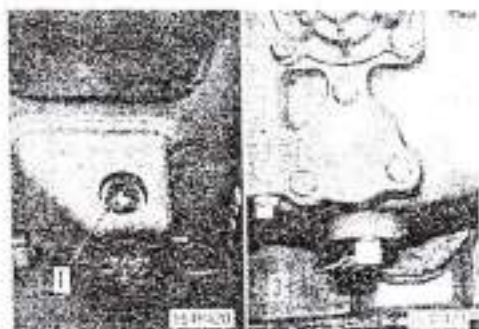
To avoid interference between under guard and diagonal brace, install under guard by shifting it into position while gradually raising mission jack.



### 12. Refilling steering and torque converter case

- 1) Tighten up drain plugs (2) and (3) on steering case and torque converter sides respectively.
- 2) Fill hydraulic tank through oil filler (29) with engine oil until specified level is reached.

\* Run engine to circulate oil through hydraulic system. Check oil level again.

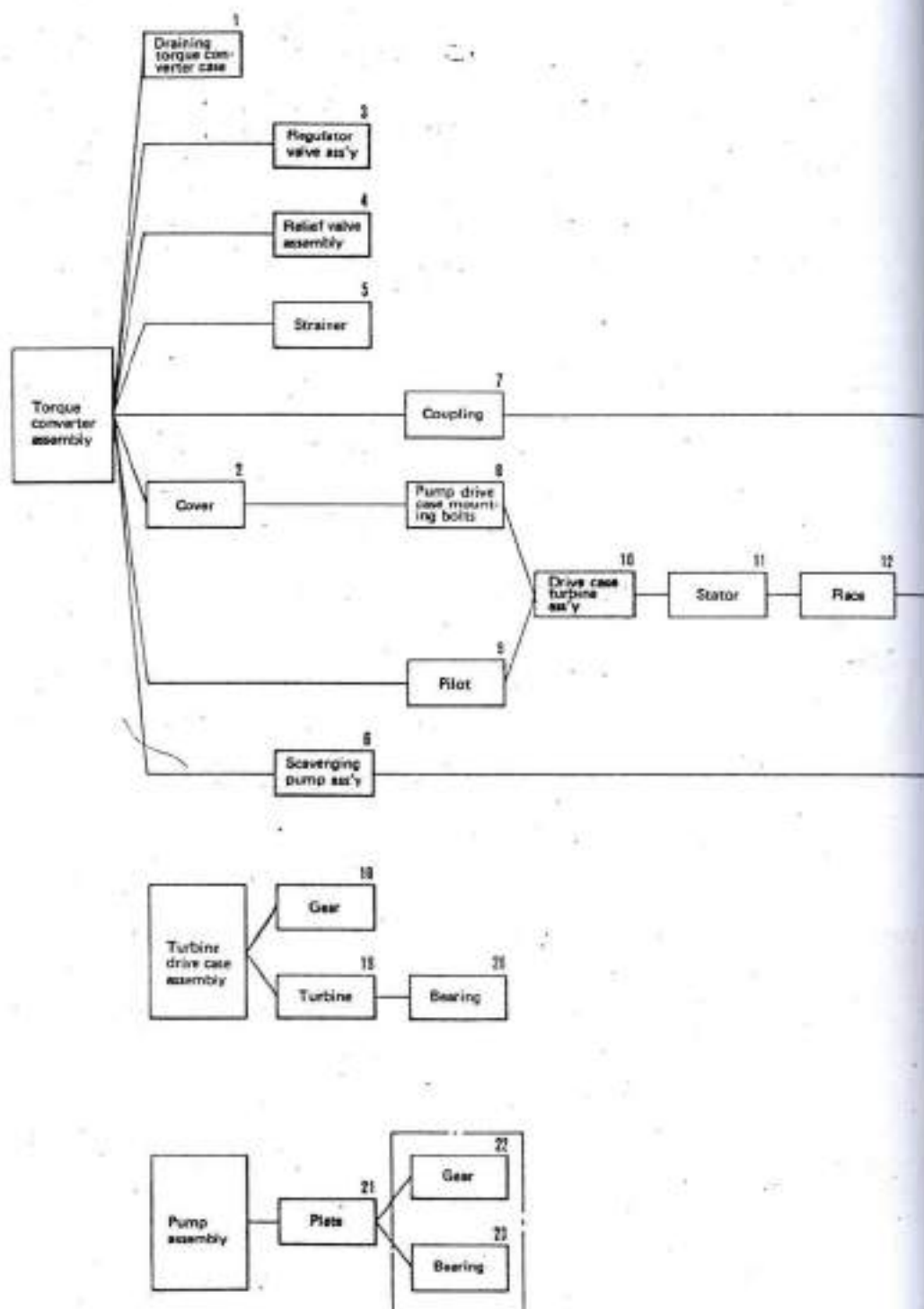


### 13. Lowering machine body

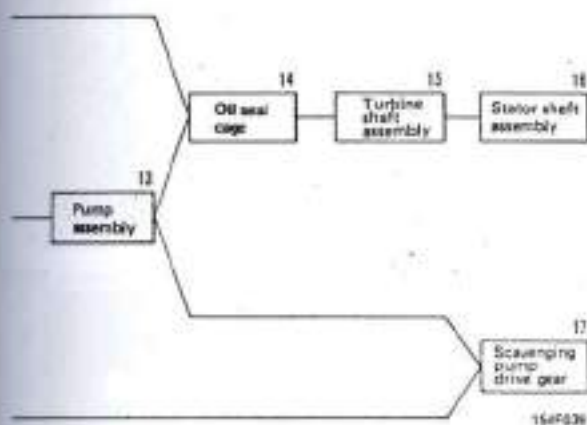
Lower machine body by removing blocks from under tracks.



## DISASSEMBLY OF TORQUE CONVERTER ASSEMBLY







## Special tools

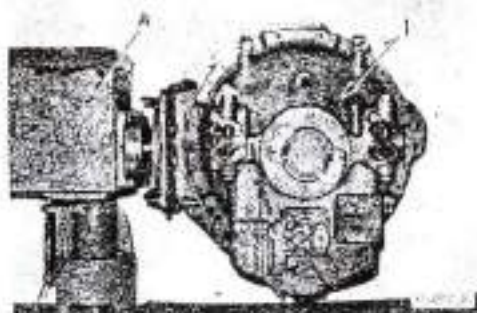
Part Name	A
Unit repair stand	1
Bracket	1

## Preparatory work

- Set torque converter assembly (1) on unit repair stand A.



Torque converter assembly: 210 kg

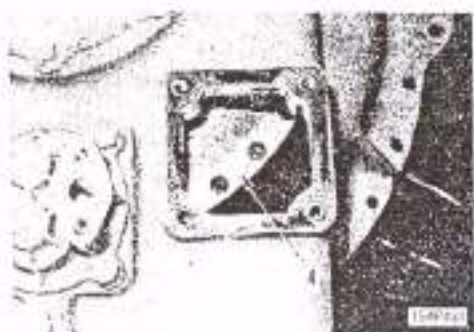


**1. Draining torque converter case**

- 1) Remove drain plug (2).

**2. Cover**

- 1) Remove cover (3).  
2) Remove two drain plugs (4), and drain off oil in drive case.

**3. Regulator valve assembly**

- Remove regulator valve assembly (5).

**4. Relief valve assembly**

- Remove relief valve assembly (6).

**5. Strainer**

- Remove strainer (7).

**6. Scavenging pump assembly**

- Remove scavenging pump assembly (8).

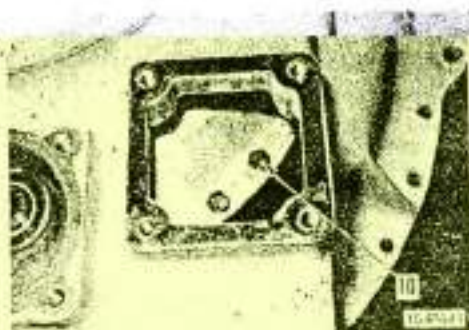
**7. Coupling**

- Remove coupling (9).

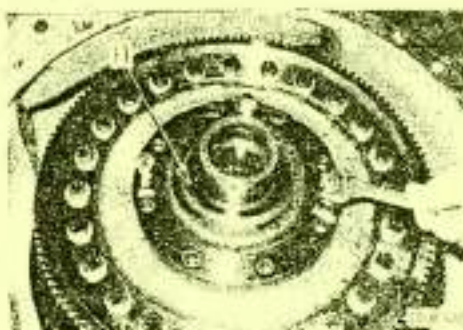


**8. Pump and drive case mounting bolts**

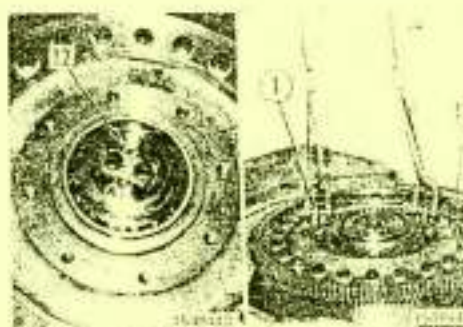
Remove 30 pump and drive case mounting bolts (10).

**9. Pilot**

- 1) Rotate repair stand so that input side of torque converter is facing upwards.
- 2) Remove mounting bolts and remove pilot (11) using extraction bolts.

**10. Drive case and turbine assembly**

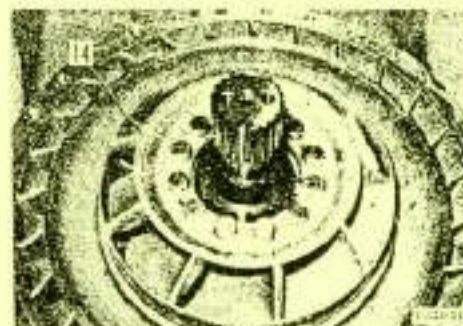
- 1) Remove mounting bolts and remove holder (12).
- 2) Lift out drive case and turbine assembly (13) with hanging bolts ① (12 mm, P = 1.75).



Drive case and turbine assembly: 55 kg

**11. Stator**

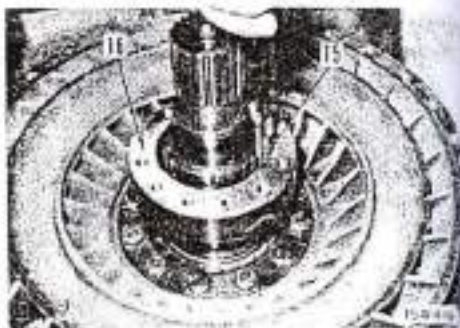
Remove mounting bolts and remove stator (14).





**12. Race**

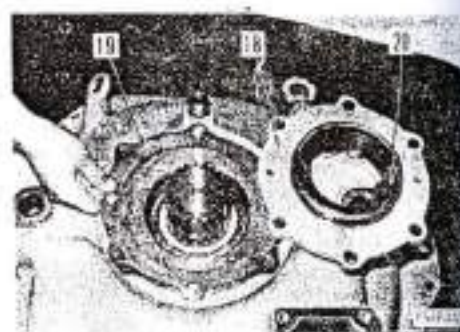
Take off snap ring (15) and remove race (16).

**13. Pump assembly**

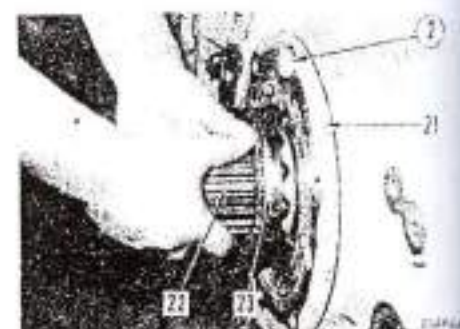
Remove pump assembly (17).

**14. Oil seal cage**

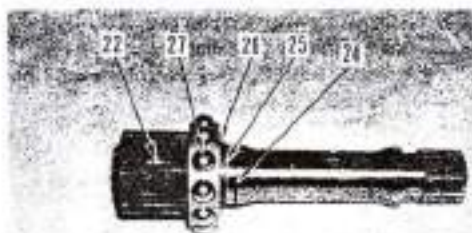
- 1) Rotate repair stand so that output side of torque converter is facing upwards.
- 2) Remove mounting bolts and remove oil seal cage (18) and shim (19) with extraction bolts.  
★ Check number of shims removed and carefully put them aside.
- 3) Remove oil seal (20) from cage.

**15. Turbine shaft assembly**

- 1) Secure stator shaft (21) with bolts (2).
- 2) Rotate repair stand and remove turbine shaft (22) by lightly tapping it with plastic hammer from inside of torque converter.  
★ Outer race (23) will come away together with turbine shaft.



- 3) Remove seal ring (24), snap ring (25) and spacer (26) from turbine shaft assembly (22), and then remove bearing (27).



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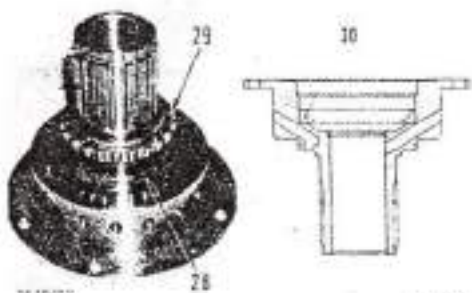
### 16. Stator shaft assembly

- 1) Remove stator shaft assembly (21) by lightly tapping it with plastic hammer from inside of torque converter.



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- 2) Remove seal ring (28), bearing (29) and outer race (30) from stator shaft assembly.

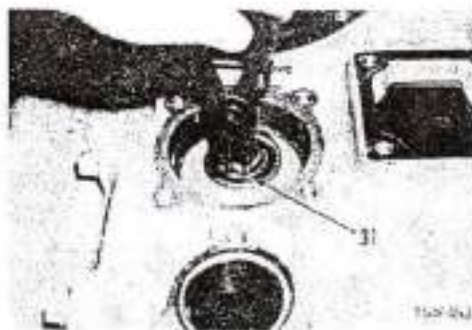


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### 17. Scavenging pump drive gear

- 1) Remove snap ring (31).



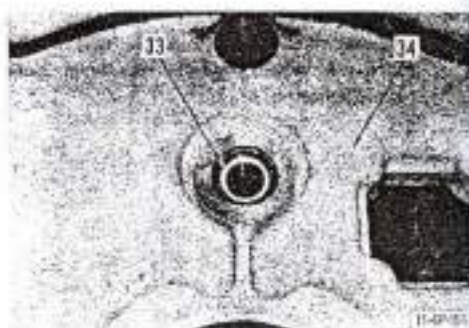
1547510



- 2) Remove scavenging pump gear (32) from inside of case by knocking out shaft.  
 \* When knocking out shaft be careful not to damage gear spline.



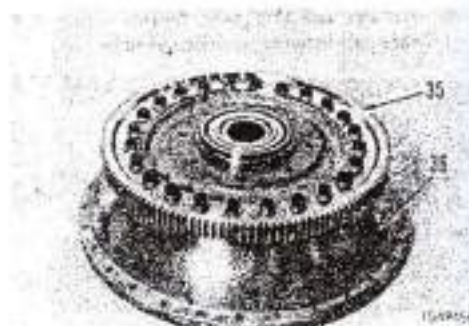
- 3) Remove bearing (33) from case (34).



#### DISASSEMBLY OF DRIVE CASE AND TURBINE ASSEMBLY

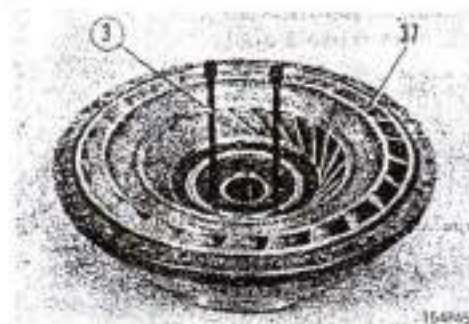
##### 18. Gear

Remove mounting bolts and remove drive gear (35) from drive case (36).



##### 19. Turbine

Remove turbine (37) from drive case with extraction bolts (3) (10 mm,  $P = 1.6$ ,  $\approx 100$  mm).



## 20. Bearing

Remove bearing (38) from drive case.



## DISASSEMBLY OF PUMP

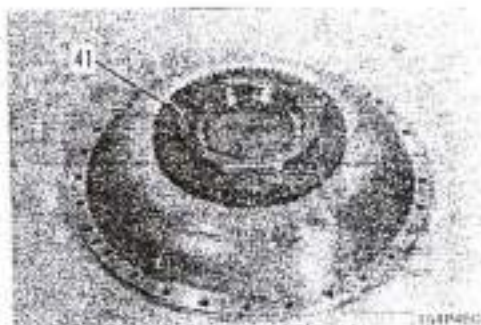
## 21. Plate

Remove mounting bolts and remove plate (39) from pump (40).



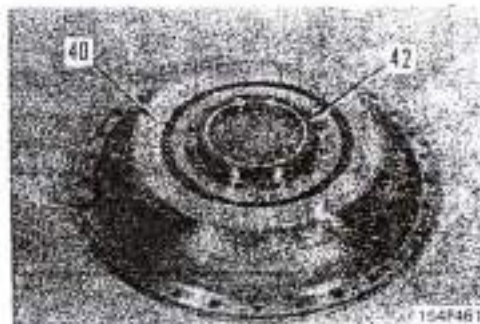
## 22. Gear

Remove gear (41) from bearing.

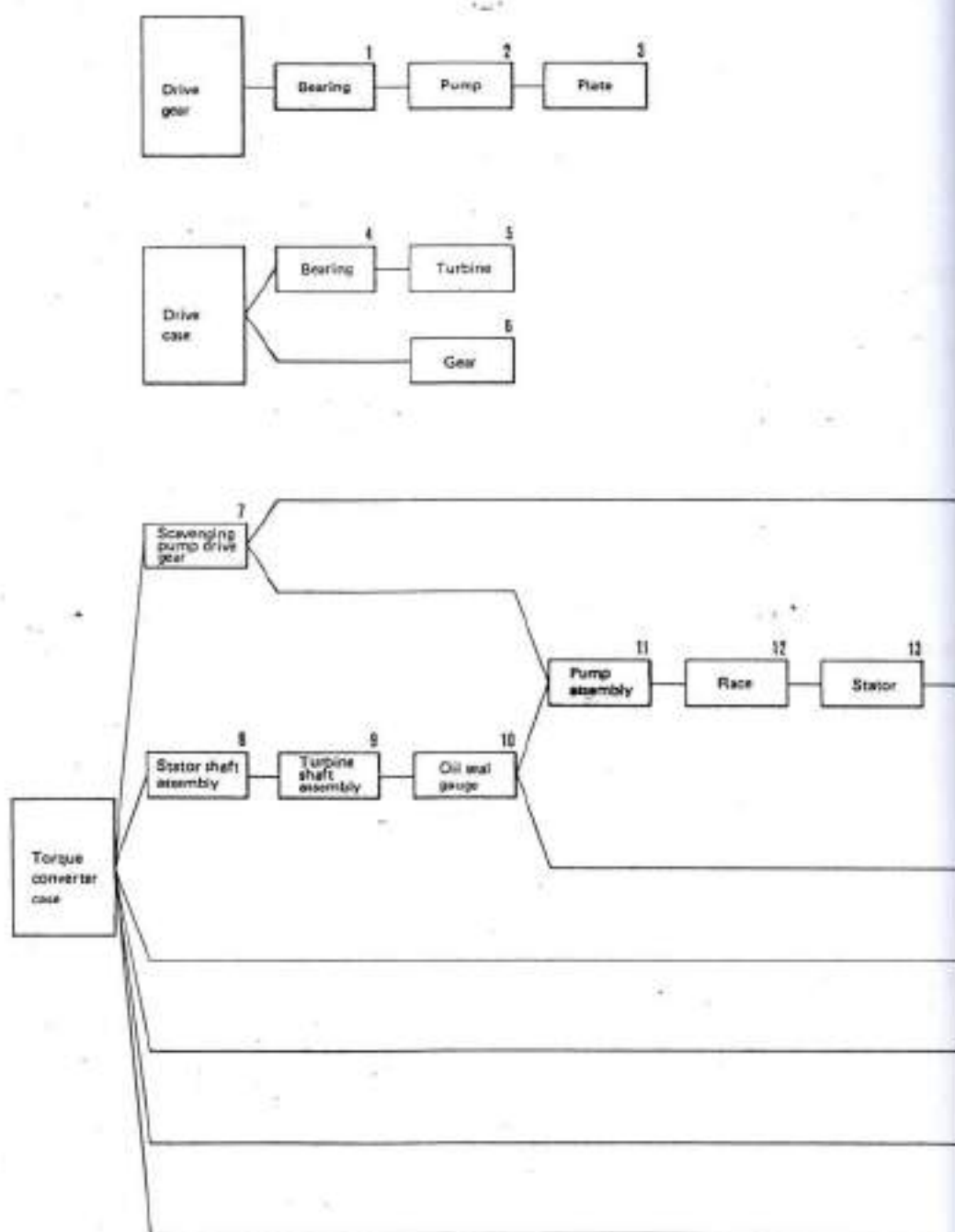


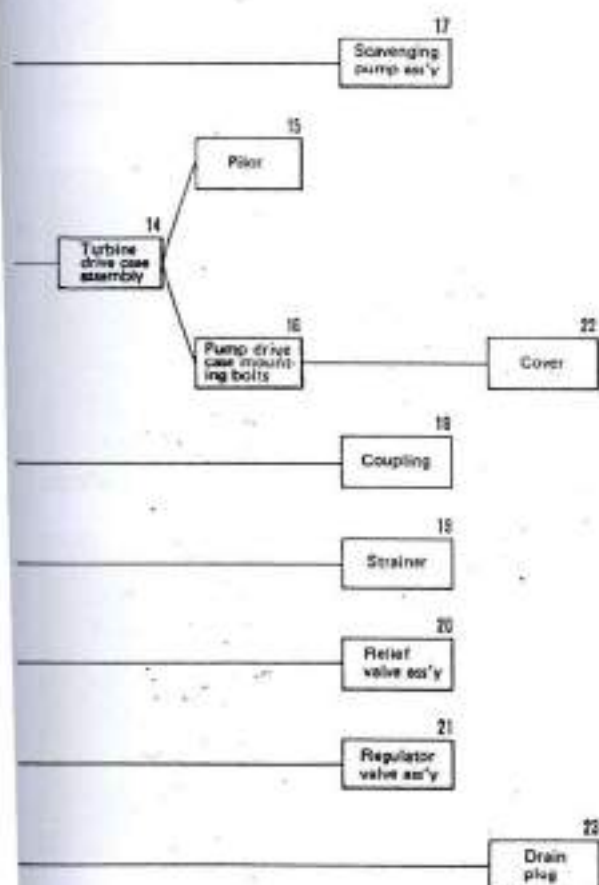
## 23. Bearing

Remove bearing (42) from pump (40).



## ASSEMBLY OF TORQUE CONVERTER ASSEMBLY





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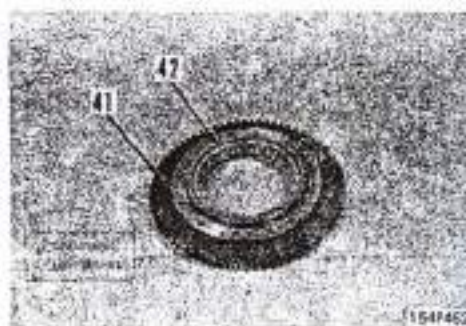
## Special tools

Part Name	A
Unit repair stand	1
Bracket	1

## ASSEMBLY OF PUMP ASSEMBLY

## 1. Bearing

Fit bearing (42) to gear (41).



## 2. Pump

Fit pump (40) to bearing (42).

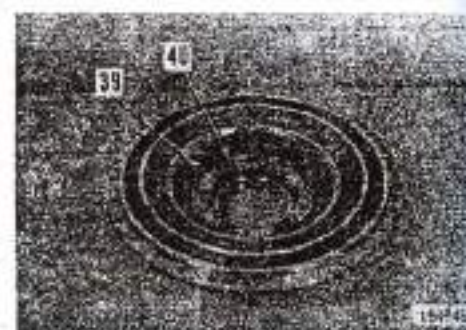
★ Install pump after aligning bolt holes of pump and pump gear.



## 3. Plate

Install plate (39). Fit lock plates and tighten bolts.

★ Bend lock plates securely.





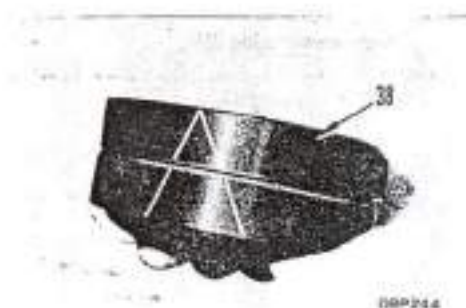
## ASSEMBLY OF DRIVE CASE AND TURBINE ASSEMBLY

## 4. Bearing

Press fit bearing (38) using push tool (internal dia. 70 mm).

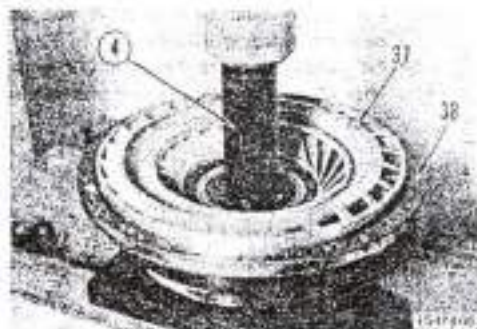


\* The drive case bearing is called ANGULAR BALL BEARING, being so constructed as to display its function in a back-to-back position, and therefore press fit it in by matching the match marks so as to make a mistake in assembling.




## 5. Turbine

Press fit turbine (37) into drive case (36) using push tool (4) ( $\phi 60$  mm).



## 6. Gear

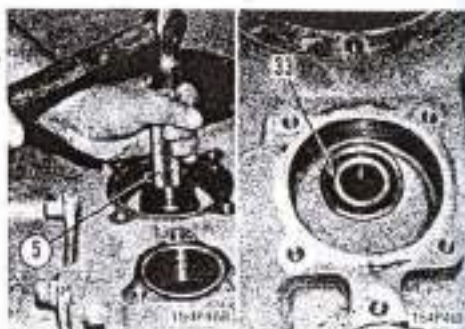
Fit gear (35) into drive case (36) and tighten mounting bolts.

 Mounting bolts:  $11.25 \pm 1.25$  kg.m



**7. Scavenging pump drive gear**

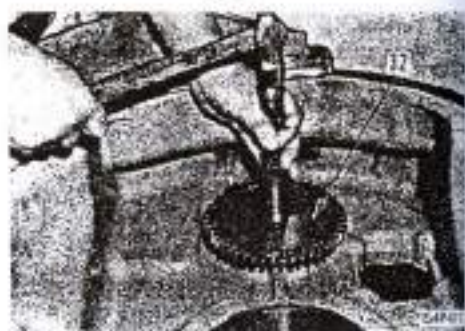
- 1) Set torque converter case on unit repair stand A.
- 2) Rotate repair stand so that output side of torque converter is facing upwards.
- 3) Press fit bearing (33) into case using push tool (5) (462 mm).



- 4) Temporarily fit scavenging pump assembly (8) and secure bearing (33).



- 5) Fix repair stand so that input side of torque converter is facing upwards.
- 6) Fit scavenging pump drive gear (32) onto bearing after aligning splines of pump assembly and drive gear.

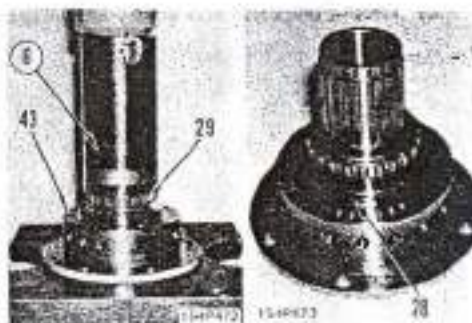


- 7) Fit snap ring (31) and fix scavenging pump drive gear to bearing.

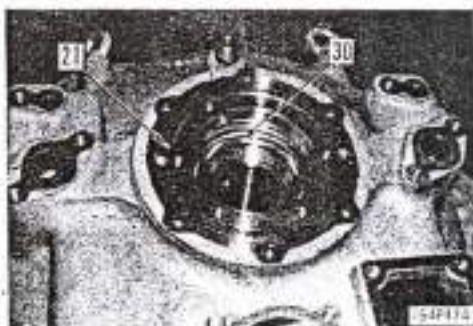


### 6. Stator shaft assembly

- 1) Press fit bearing (29) onto stator shaft (43) using push tool (6) (inside dia. 85 mm).
- 2) Install seal ring (28) on stator shaft.



- 3) Fit O-ring and install stator shaft assembly (21) in torque converter case.
- 4) Fit outer race (30) onto stator shaft.

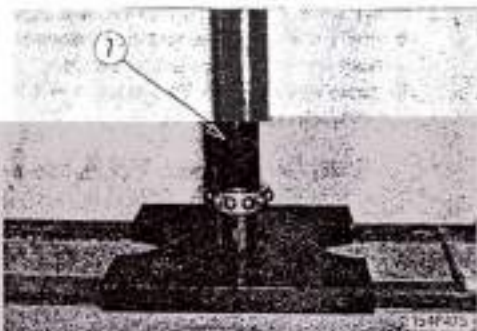


### 7. Turbine shaft assembly

- 1) Force-fit bearing (27) onto turbine shaft (22) using push tool (7) (inside dia. 60 mm).
- 2) Insert spacer (26) and fit snap ring (25).
- 3) Fit seal ring (24) into stator shaft.



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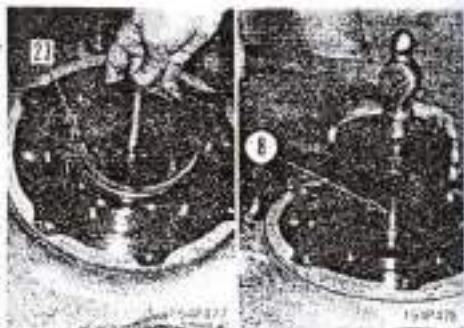


- 4) Install turbine shaft assembly (22) onto stator shaft.
- \* Apply grease to turbine shaft and install it while taking care to avoid damaging it.



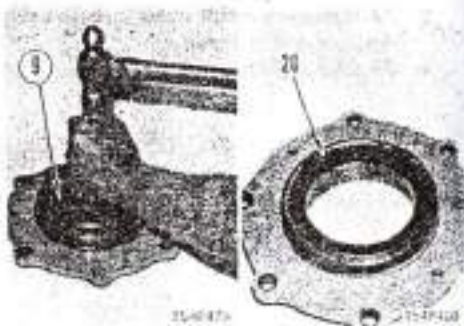


- 5) Press fit outer race (23) using push tool (8) ( $\phi 130$  mm).



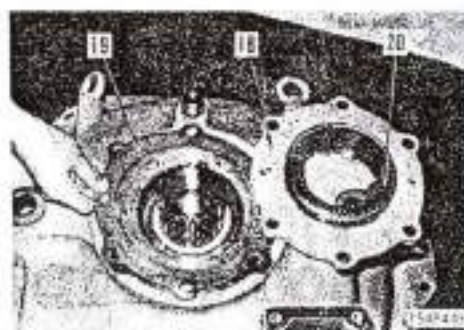
#### 10. Oil seal cage

- 1) Press fit oil seal (20) into cage using push tool (9) ( $\phi 135$  mm).



- 2) Insert shim (19) and install oil seal cage (18).  
 ★ Insert shims so that clearance between stator shaft and oil seal cage is 0 to 0.05 mm.  
 ★ Types of shim:  $t = 0.05$  mm,  $t = 0.1$  mm,  $t = 0.2$  mm.

 Mounting bolts:  $11.25 \pm 1.25$  mm



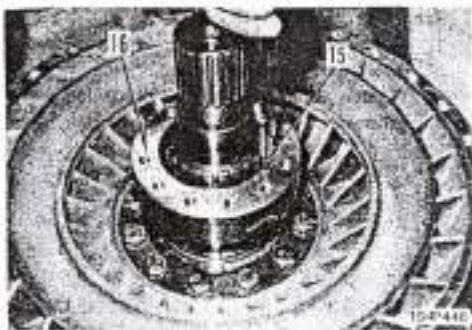
#### 11. Pump assembly

- 1) Rotate repair stand so that input side of torque converter is facing upwards.  
 2) Fit pump assembly (17) onto stator shaft.  
 ★ Fix seal ring on stator shaft with grease to prevent it opening, and securely mount pump assembly.



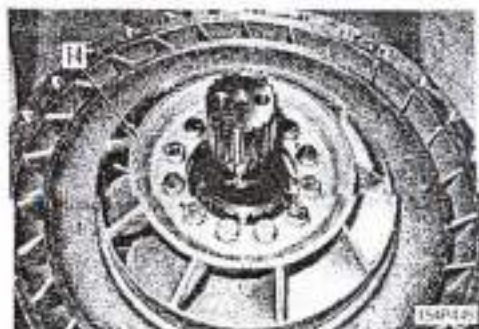
**12. Race**

Fit race (16) to stator shaft, and install snap ring (15).

**13. Stator**

Fit stator (14) onto race, and tighten up mounting bolts.

Mounting bolts:  $6.75 \pm 0.75 \text{ kg.m}$

**14. Turbine drive case assembly**

1) Fit 8 mounting bolts (12 mm, 9 - 1.75) and hoist turbine drive case assembly (13). Fit drive case assembly to turbine shaft after aligning splines.

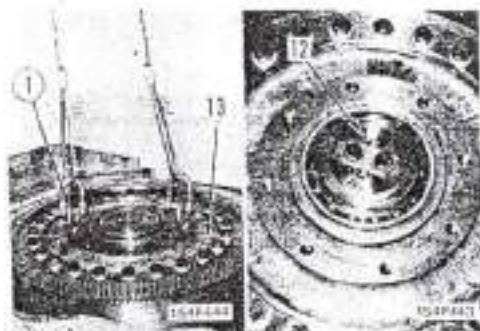
\* Align drain plug position with pump assembly and turbine drive case mounting position.

2) Temporarily fit two or three mounting bolts.

3) Install holder (12). Fit lock plate and tighten up mounting bolts.

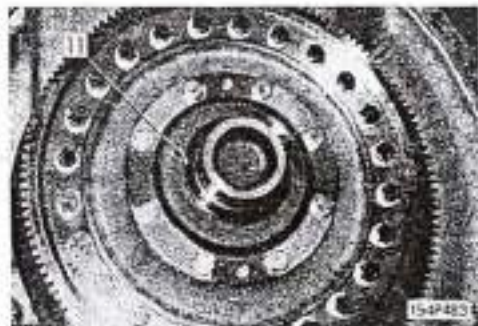
Mounting bolts:  $5.75 \pm 0.25 \text{ kg.m}$

\* Bend lock plate securely.

**15. Pilot**

Install pilot (11). Fit lock plate and tighten mounting bolts.

\* Bend lock plate securely.



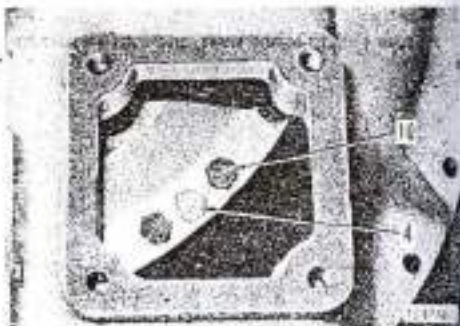


**16. Pump and drive case mounting bolts**

- 1) Rotate repair stand so that output side of torque converter is facing upwards.
- 2) Tighten 30 mounting bolts (10) for pump and drive case, together with two drain plugs (4).

 Mounting bolts: 5.5±0.5 kg.m

 Drain plugs: 1.15±0.15 kg.m

**17. Scavenging pump assembly**

- Fit O-ring and install scavenging pump assembly (8).

**18. Coupling**

- Apply grease to oil seal and install coupling (9).

**19. Strainer**

- Fit O-ring and install strainer (7).

**20. Relief valve assembly**

- Fit O-ring and install relief valve assembly (6).

**21. Regulator valve assembly**

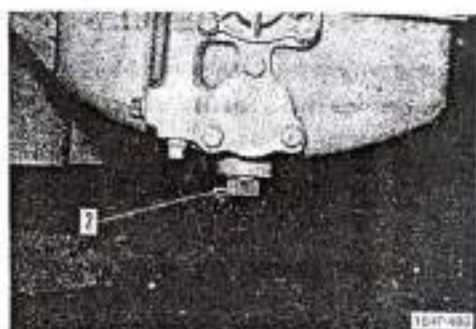
- Fit O-ring and install regulator valve assembly (5).

**22. Cover**

- Fit gasket and install cover (3).

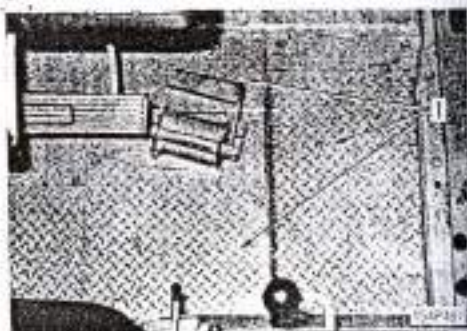
## 23. Drain plug

Fit O-ring and tighten drain plug (2).

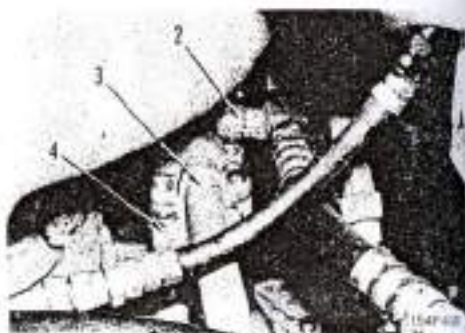


**DISMOUNTING TORQUE CONVERTER  
RELIEF VALVE ASSEMBLY**

1. Remove three floor plates (1).
2. Disconnect relief valve outlet piping (2).
3. Disconnect relief valve inlet piping (3).  
★ When disconnecting outlet valve, lift it with wire prevent it from falling.
4. Remove mounting bolts, and remove relief valve assembly (4).

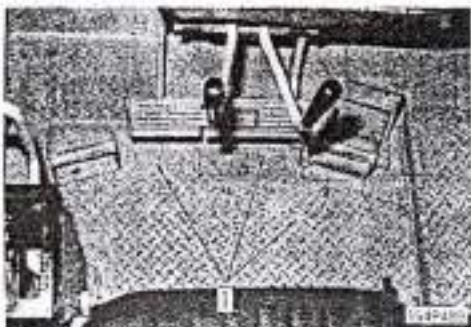
**MOUNTING TORQUE CONVERTER  
RELIEF VALVE ASSEMBLY**

1. Fit O-ring and install relief valve assembly (4).
2. Fit O-ring and connect relief valve inlet pipe (3).
3. Fit O-ring and connect relief valve outlet pipe (2).
4. Install floor plate (1).



**DISMOUNTING TORQUE CONVERTER  
REGULATOR VALVE ASSEMBLY**

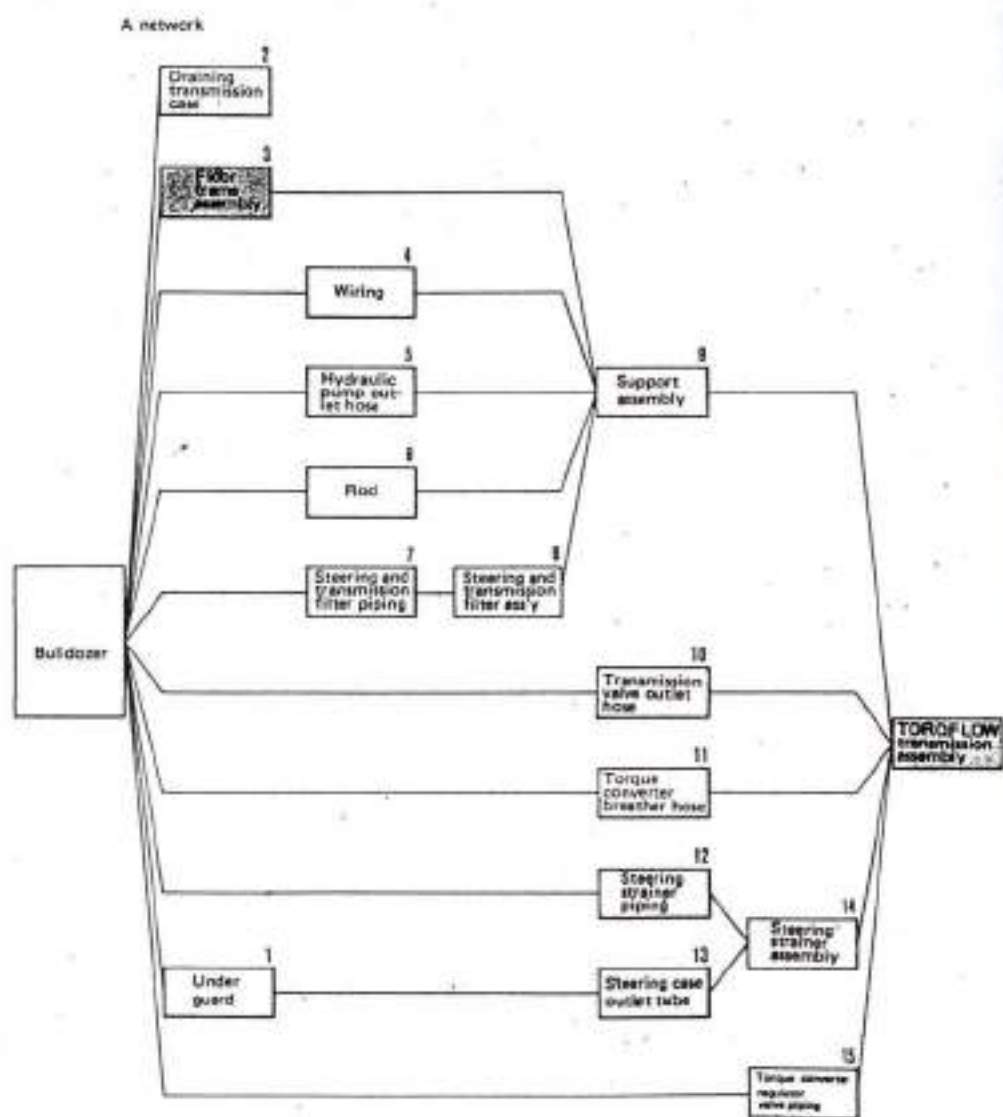
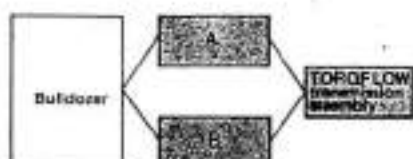
1. Remove three floor plates (1).
2. Disconnect regulator valve outlet pipe (2).
3. Remove mounting bolts and remove regulator valve assembly (3).

**MOUNTING TORQUE CONVERTER  
REGULATOR VALVE ASSEMBLY**

1. Fit O-ring and install regulator valve assembly (1).
2. Fit O-ring and connect regulator valve outlet pipe (2).
3. Install three floor plates (3).

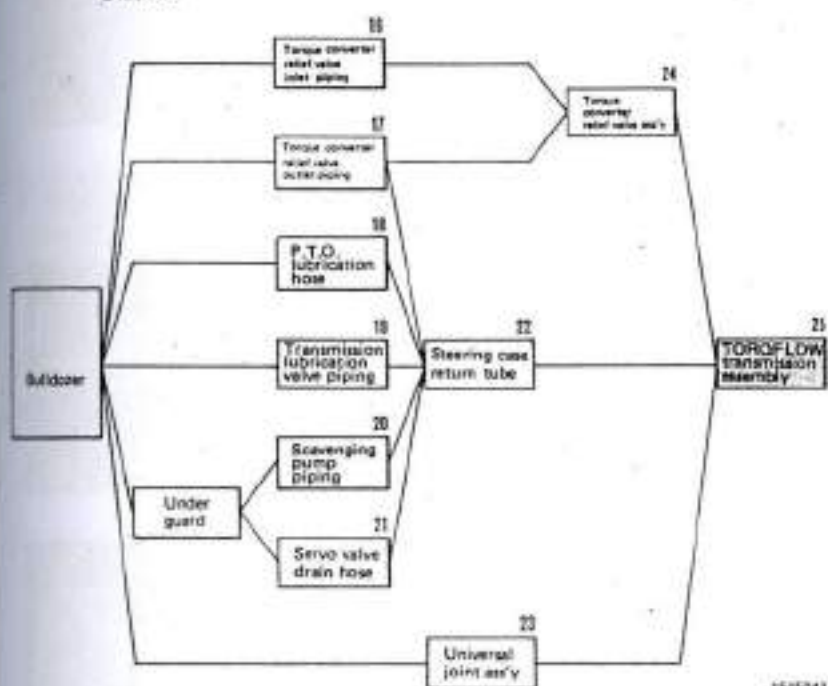


## DISMOUNTING TORQFLOW TRANSMISSION ASSEMBLY





network



154P043

## 1. Under guard

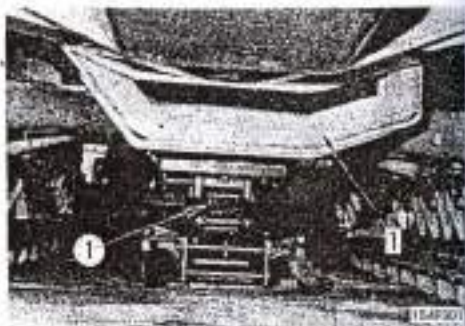
Remove rear under guard (1) and mission jack (1)



To prevent interference between under guard and diagonal brace, remove under guard by pushing it forward while gradually lowering transmission.



Under guard: 160 kg



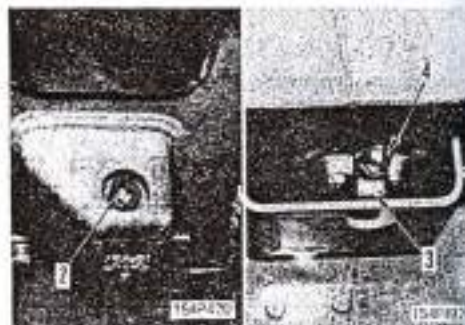
## 2. Draining transmission case, steering case and hydraulic tank

1) Remove drain plug (2) and drain off oil in steering case and transmission case.

2) Loosen lubricating oil cap to relief internal pressure from tank. Remove drain plug (3) and open drain cock (4) to drain off oil.



Hydraulic oil tank: approx. 70 l



## 3. Floor frame assembly

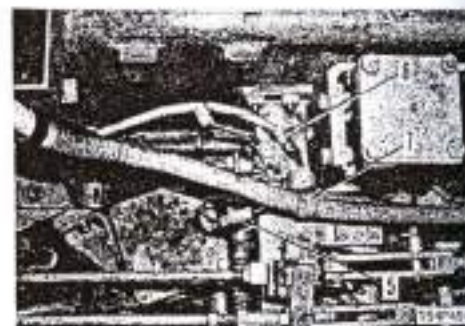
See "DISMOUNTING FLOOR FRAME ASSEMBLY".

## 4. Wiring

1) Disconnect connector (5) from back-up buzzer wiring.

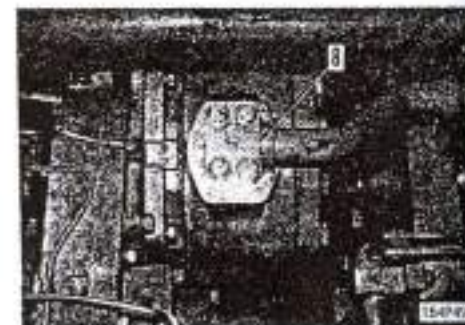
\* Clearly mark disconnected wires to prevent confusion with horn wiring.

2) Remove clamps (6) and (7) and disconnect wiring from support.



## 5. Hydraulic pump outlet hose

Disconnect hydraulic pump outlet hose (8).



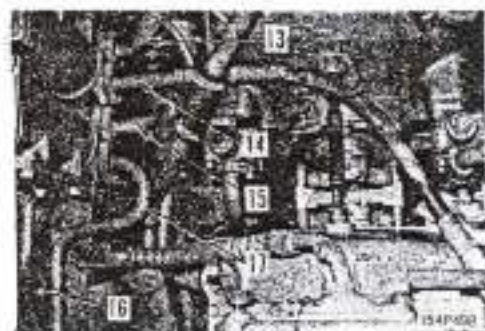
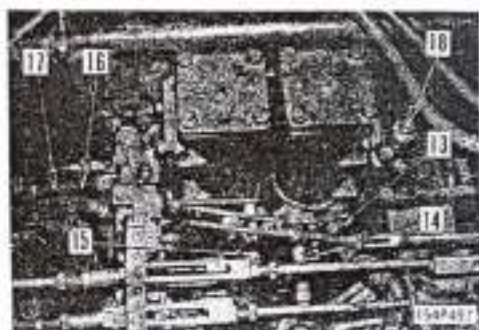
## 6. Rod

- 1) Disconnect left brake rod (9) and right brake rod (10).  
\* Clearly mark disconnected rods as "RIGHT" or "LEFT" and "FRONT" or "REAR".
- 2) Disconnect left steering control rod (11) and right steering control rod (12) at booster side.



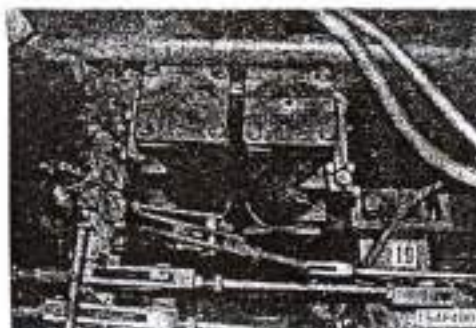
## 7. Steering and transmission oil filter piping

- 1) Disconnect piping (13) between transmission pump and transmission oil filter, at oil filter side.
- 2) Remove pipe (14) between transmission oil filter and transmission valve.
- 3) Disconnect pipe (15) between steering pump and steering oil filter, at filter side.
- 4) Remove clamp (16) and disconnect piping (17) between steering filter and steering control valve.



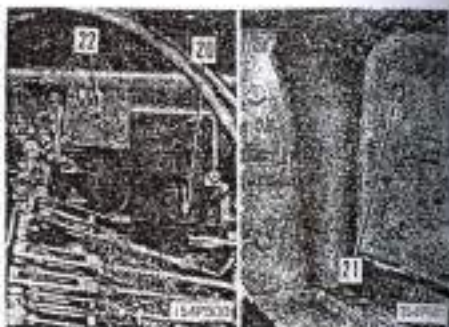
## 8. Steering and transmission oil filter assembly

- 1) Remove steering oil filter (19).





- 2) Remove four mounting bolts (20) and mounting bolts (21), and remove transmission oil filter (22) together with bracket.



9. Support assembly

Remove eight left and right mounting bolts and remove support assembly (23).



Support assembly: 45 kg



10. Transmission outlet hose

Remove transmission control valve outlet hose (24).



11. Torque converter breather hose

Remove torque converter breather hose (25).



12. Steering strainer piping

- 1) Remove steering piping (26) between steering strainer and transmission pump.
- 2) Disconnect piping (27) between steering strainer and steering pump.

## 13. Steering case outlet tube

Remove tube (28) between steering case and steering strainer.



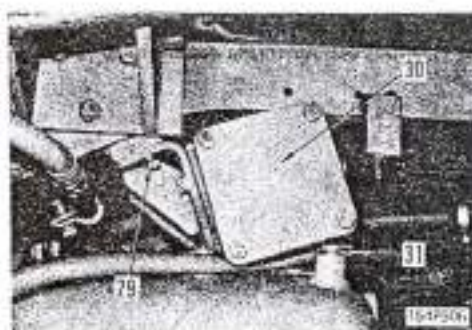
## 14. Steering strainer assembly

- 1) Remove three mounting bolts (29) and remove steering strainer assembly (30) together with bracket.



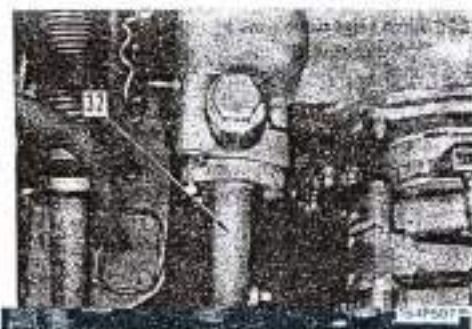
Steering strainer assembly: 35 kg

- 2) Remove clamp (31) and remove fuel supply hose from transmission.



## 15. Torque converter regulator valve piping

Disconnect regulator valve tube (32).

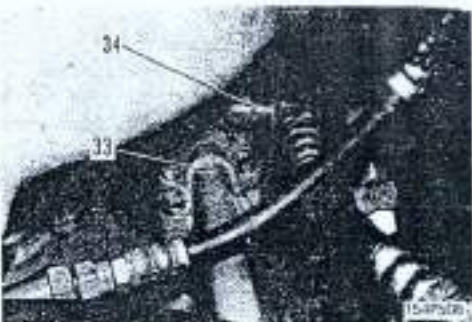


## 16. Torque converter relief valve inlet piping

Disconnect relief valve inlet piping (33) from valve.

## 17. Torque converter relief valve outlet piping

Disconnect relief valve outlet piping (34) from valve.





**18. P.T.O lubrication hose**

Disconnect P.T.O lubrication hose (35) from transmission lubrication valve inlet tube.

**19. Transmission lubrication valve piping**

Disconnect transmission lubrication valve inlet and outlet piping (36) from valve.

**20. Scavenging pump outlet piping**

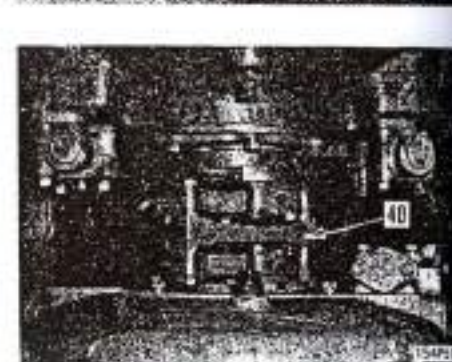
Disconnect scavenging outlet piping (37) from pump.

**21. Servo valve drain hose**

Disconnect servo valve drain hose (38).

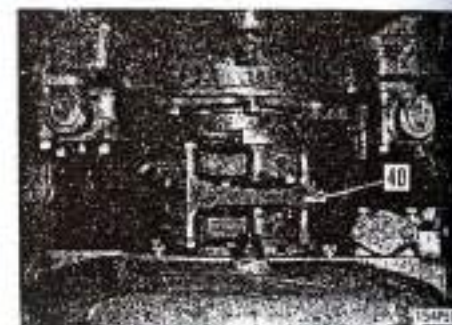
**22. Steering case return tube**

Disconnect steering case return tube (39) together with related piping from steering case.

**23. Universal joint assembly**

Remove universal joint assembly (40).

★ Loosen all bolts with joint installed. Remove mounting bolts from torque converter side and then remove mounting bolts from transmission side.

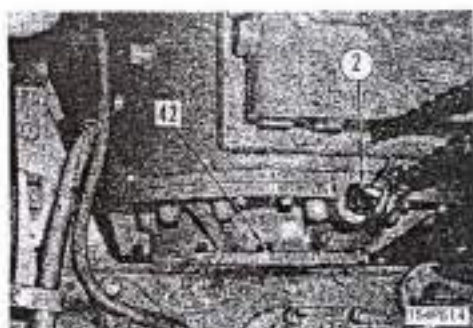


24. Torque converter relief valve assembly  
Remove relief valve assembly (41).



25. Torqflow transmission assembly

- 1) Lift transmission with three eye bolts (2) (24 mm,  $F = 3.0$ ), and remove 10 mounting nuts (42).



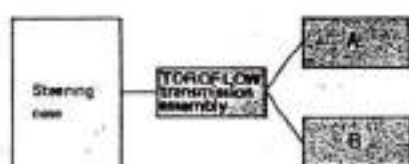
- 2) Disconnect transmission assembly (43) from steering case. Lift out transmission assembly taking care to prevent interference with other components.



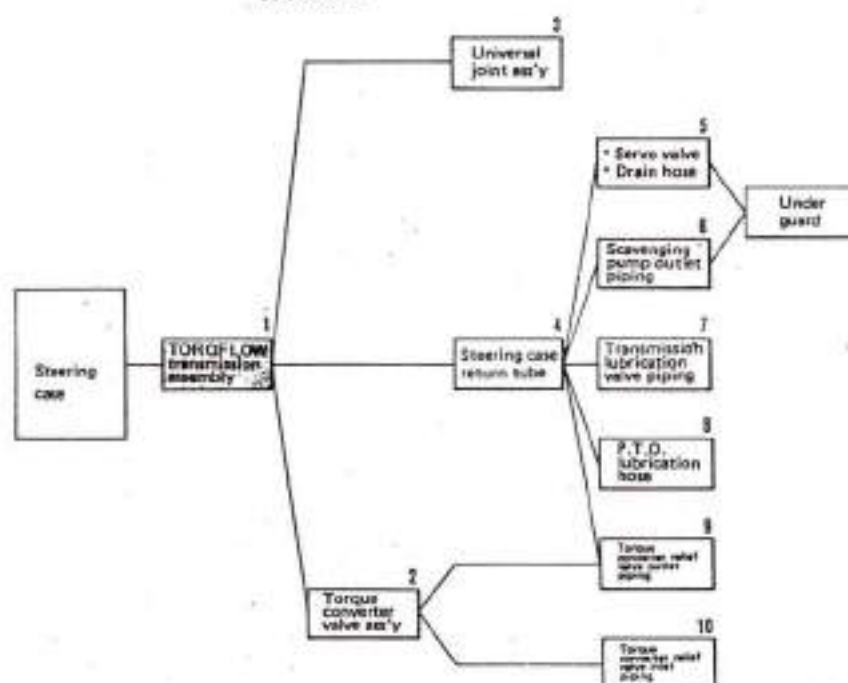
Transmission assembly: 800 kg



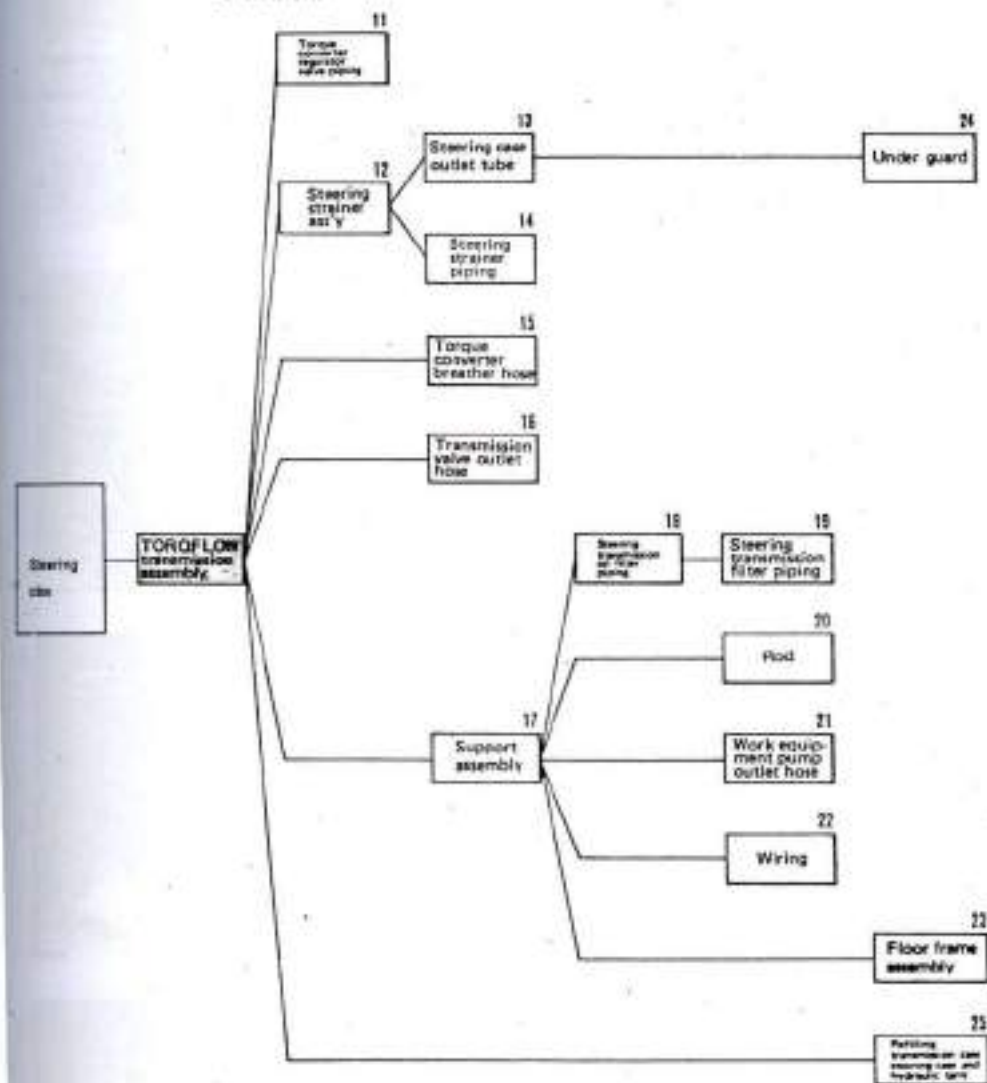
## MOUNTING TORQFLOW TRANSMISSION ASSEMBLY



A Network



## B Network



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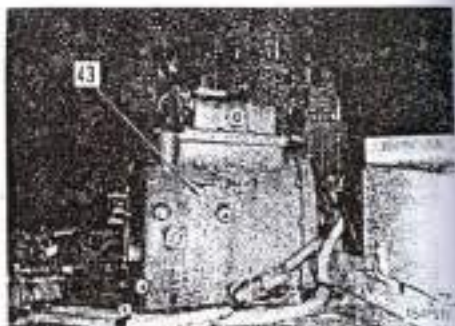
**1. Torqflow transmission assembly**

- 1) Fit gasket to steering case.

 Gasket: Liquid gasket

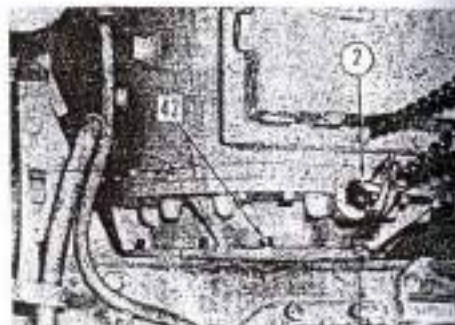
- 2) Fit eye bolts (2) (24 mm, P = 3.0) and lower transmission assembly (43) into position on case.

★ Gradually lower transmission into position so as to prevent interference with other components.

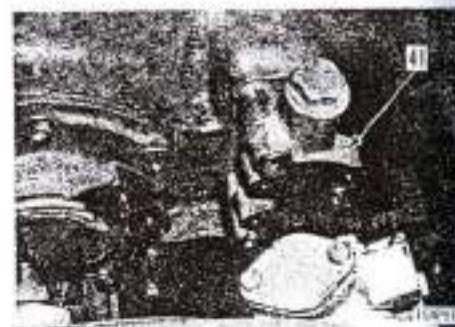


- 3) Tighten 10 mounting nuts (42).

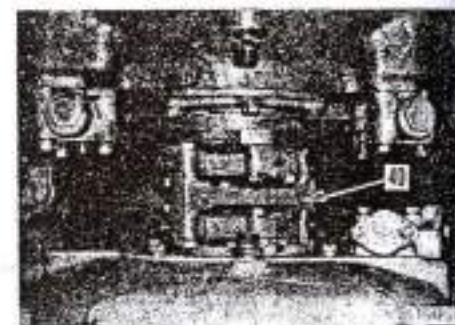
 Mounting nuts: 38±5.5 kg.m

**2. Torque converter return valve assembly**

- Fit O-ring and install relief valve assembly (41).

**3. Universal joint assembly**

- 1) Position universal joint assembly (40). Tighten mounting bolts on transmission side and then tighten mounting bolts on torque converter side.
- 2) Tighten up all mounting bolts.





**4. Steering case return tube**

Fit O-ring and connect steering case return tube (39) together with related piping to case.

**5. Servo valve drain hose**

Connect servo valve drain hose (38).

⊕ Install hose without twist or interference.

**6. Scavenging pump outlet piping**

Fit O-ring and connect scavenging pump outlet tube (37).

**7. Transmission lubrication valve piping**

Fit O-ring and connect transmission lubrication valve inlet and outlet pipes (36).

**8. P.T.O lubrication hose**

Connect up P.T.O lubrication hose (35) to transmission lubrication valve inlet tube.

⊕ Install hose without twist or interference.

**9. Torque converter relief valve outlet piping**

Fit O-ring and connect torque converter outlet pipe (34) to valve.

**10. Torque converter relief valve inlet piping**

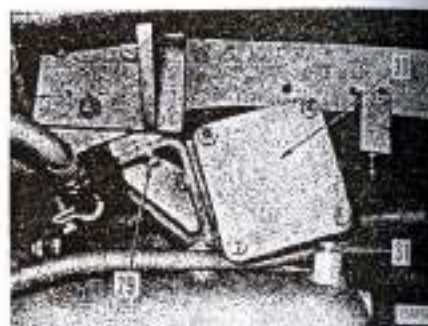
Fit O-ring and connect torque converter inlet pipe (33) to valve.

**11. Torque converter regulator valve piping**

Fit O-ring and connect regulator valve tube (32).

**12. Steering strainer assembly**

- 1) Fit clamp (31) to fuel supply hose and install hose on transmission.
- 2) Position steering strainer assembly (30) together with bracket on main frame, and tighten three mounting bolts (29).

**13. Steering case outlet tube**

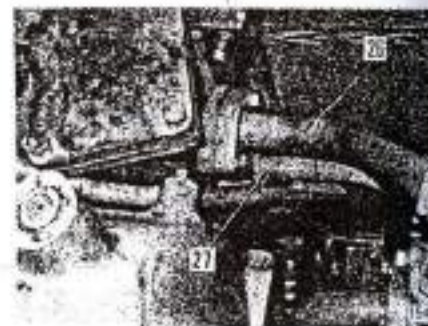
- 1) Fit O-ring and install tube (28) between steering case and steering strainer tube.

**14. Steering strainer piping**

- 1) Fit O-ring and connect piping (27) between steering strainer and steering pump.
- 2) Fit O-ring and connect piping (26) between steering strainer and transmission pump.



Fit O-ring securely in groove.



## 15. Torque converter breather hose

Connect torque converter breather hose (25), and tighten sleeve nut.



## 16. Transmission valve outlet hose

Fit O-ring and connect transmission outlet side tube (24). Tighten sleeve nut on tube side.



Install hose twist or interference.

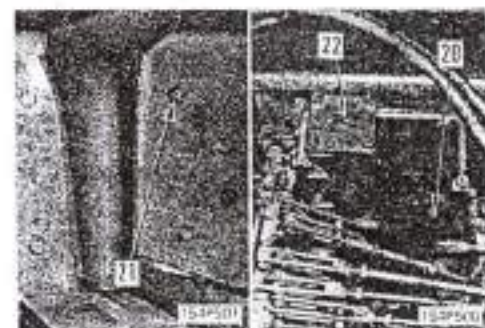
## 17. Support assembly

Position support assembly (23) between left and right fenders, and tighten eight left and right mounting bolts.

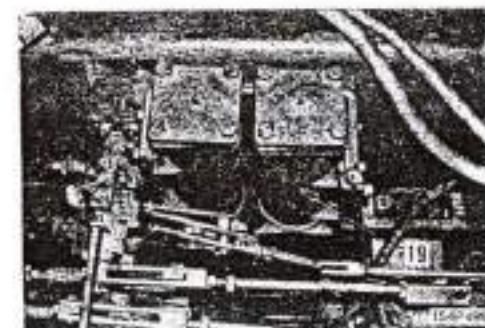


## 18. Steering and transmission oil filter assembly

1) Position transmission filter (22) together with bracket on main frame, and tighten four mounting bolts (20) and mounting bolts (21).



2) Install steering oil filter (19).





## 19. Steering and transmission oil filter piping



Fit O-ring securely in groove of each pipe.

- 1) Fit O-ring and connect piping (17) between steering oil filter and steering control valve. Install clamp (16).
- 2) Fit O-ring and connect piping (15) between steering pump and steering oil filter.
- 3) Fit O-ring and install piping (14) between transmission oil filter and transmission valve.
- 4) Connect piping (13) between transmission pump and transmission oil filter.



## 20. Rod



Bend cotter pin securely at each rod linkage.

- 1) Install left brake rod (9) and right brake rod (10).  
\* When installing rods do not confuse left and right or front and rear.
- 2) Connect left steering control rod (11) and right steering control rod (12).

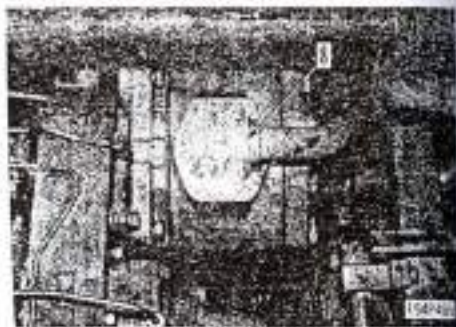


## 21. Hydraulic pump outlet hose

Fit O-ring and connect hydraulic pump outlet hose (8).

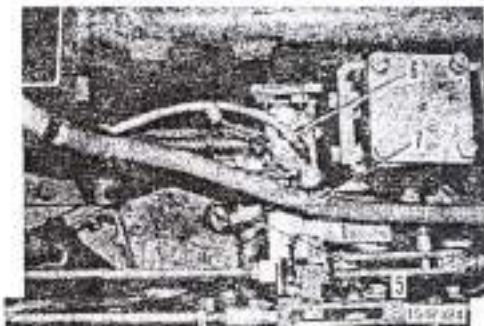


Fit O-ring securely in groove.



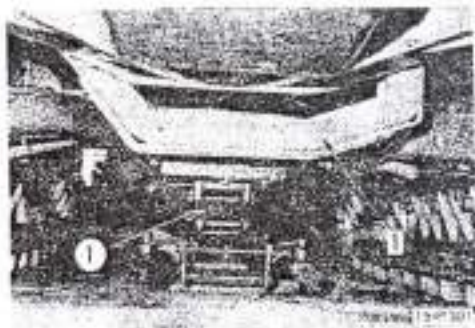
## 22. Wiring

- 1) Position wiring on support and fix it with clamps (6) and (7).
- 2) Connect back-up buzzer wiring connector (5).
- \* Do not confuse back-up buzzer wiring connector with horn wiring connector.



## 23. Floor frame assembly

See "MOUNTING FLOOR FRAME ASSEMBLY".



## 24. Under guard

Install machine body rear under guard (1) using mission jack (1).



To prevent interference between under guard and diagonal brace, install under guard by shifting it into position while gradually raising mission jack.



## Refilling transmission case, steering case and hydraulic tank

## 1) Steering and transmission cases.

- i) Tighten drain plug (2).
- ii) Refill steering and transmission cases through oil filler (44) with engine oil until specified oil level is reached.

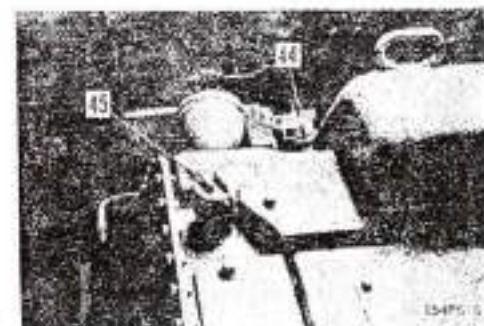
## 2) Hydraulic tank

- i) Close drain cock (4) and tighten drain plug (3).
- ii) Refill hydraulic tank through oil filler (45) with engine oil until specified oil level is reached.



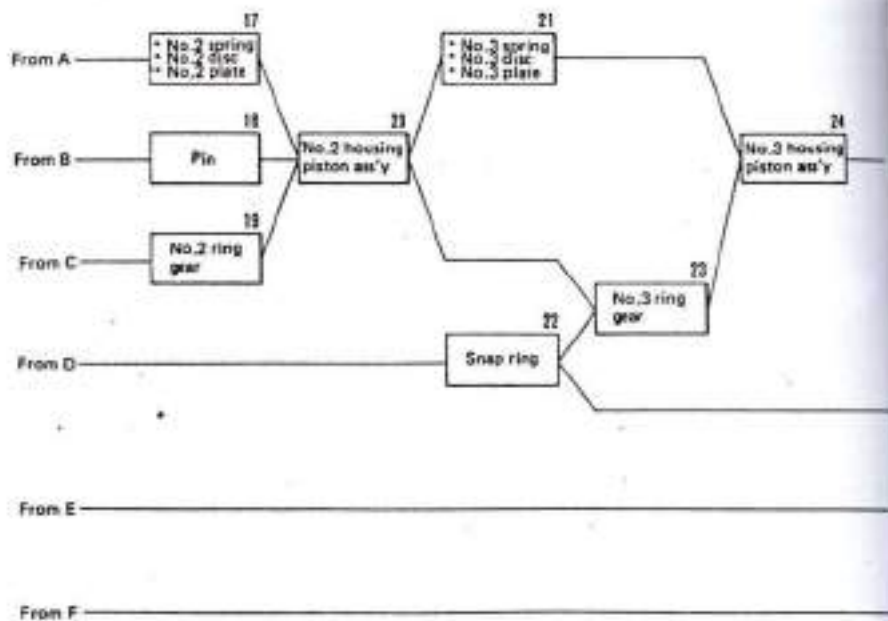
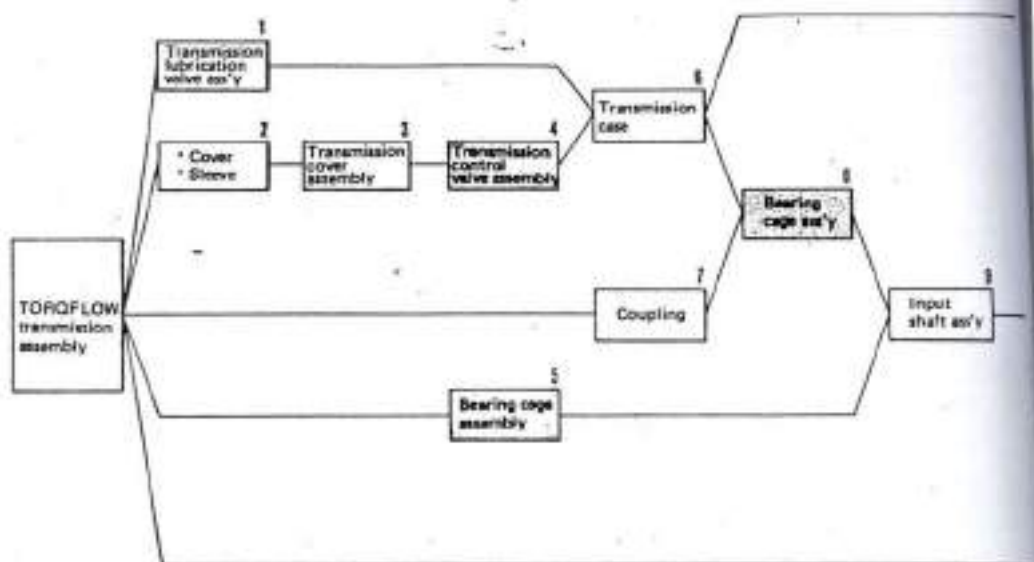
Hydraulic tank: approx. 70 l

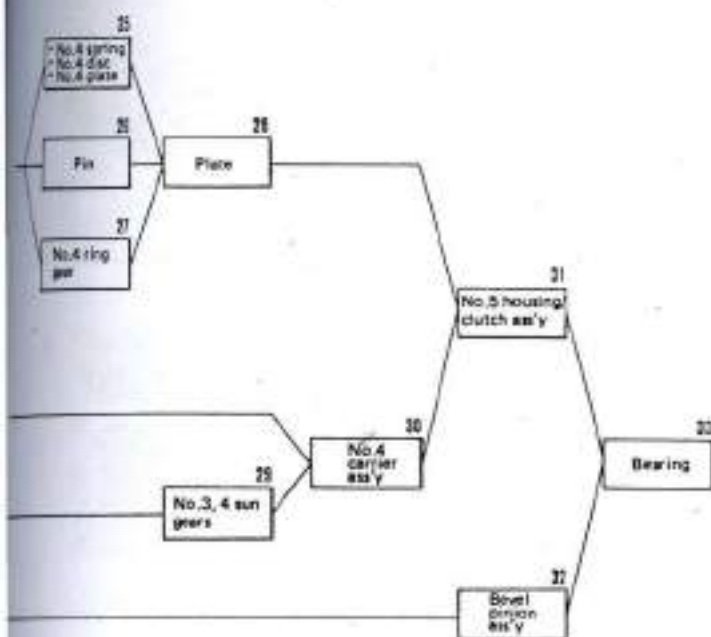
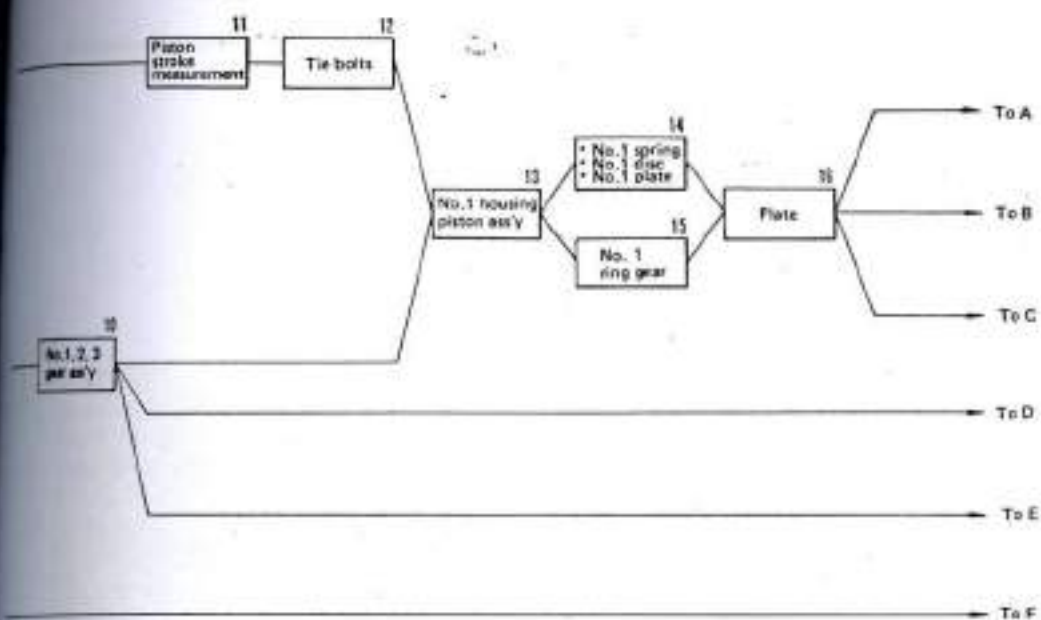
Run engine to circulate oil through hydraulic system. Check oil level again.





# DISASSEMBLY OF TORQFLOW TRANSMISSION ASSEMBLY (1/2)





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**Special tools**

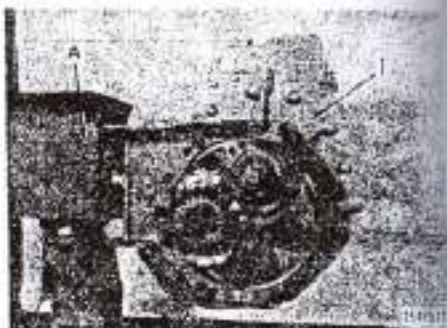
Part Name	A
Unit repair stand	1
Bracket	1

**Preparatory work**

Set TORQFLOW transmission assembly (1) on unit repair stand A.



Transmission assembly: 750 kg



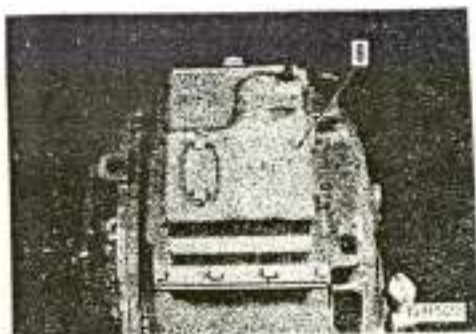
1. Transmission lubrication valve assembly  
Disconnect transmission lubrication valve assembly (2) and remove sleeves (3) and (4).



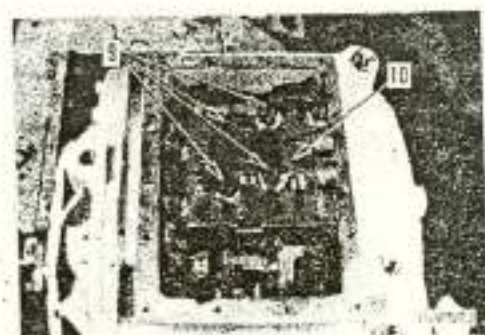
2. Cover and sleeve  
Remove cover (5) and remove sleeves (6) and (7).




3. Transmission cover assembly  
Remove transmission cover assembly (8).

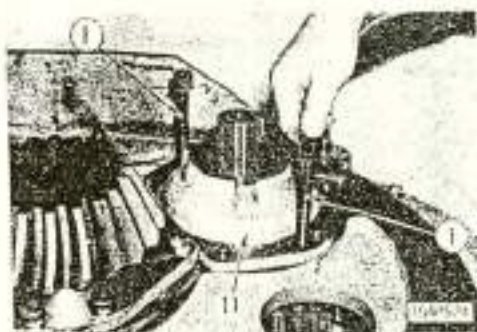


4. Transmission control valve assembly  
Remove four mounting bolts (9) and remove transmission control valve assembly (10) together with seal.



 Transmission control valve assembly: 30 kg

5. Bearing cage assembly  
Remove bearing cage (11) using extraction bolts (1) (12 mm, P = 1.75, L = 100 mm).



6. Transmission case
  - 1) Rotate transmission assembly in opposite direction.
  - 2) Remove bearing cage and transmission case mounting bolts (12).
  - 3) Remove transmission case and rear case mounting bolts (13).

\* Four mounting bolts are tightened from rear case side.

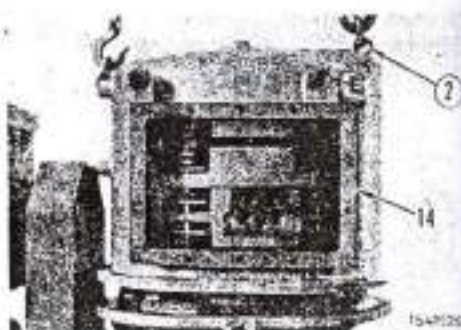




- 4) Gradually lift out transmission case (14) using eye bolts (2) (10 mm, P = 1.5).

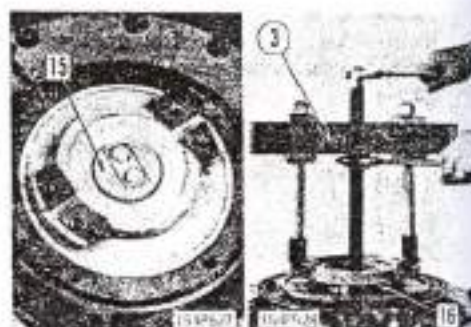


Transmission case: 95 kg



7. Coupling

- 1) Remove holder (15).
- 2) Remove coupling (16) using puller (3).



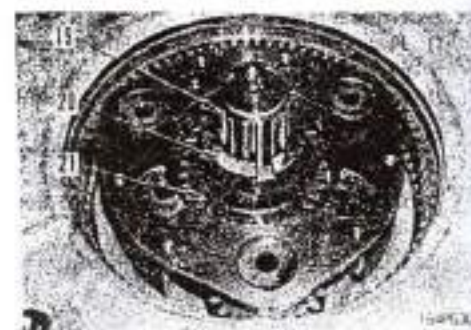
8. Bearing cage assembly

Remove six mounting bolts (17) and remove bearing cage assembly (18).



9. Input shaft assembly

Remove input shaft assembly (19) together with spacer (20) and gear (21).

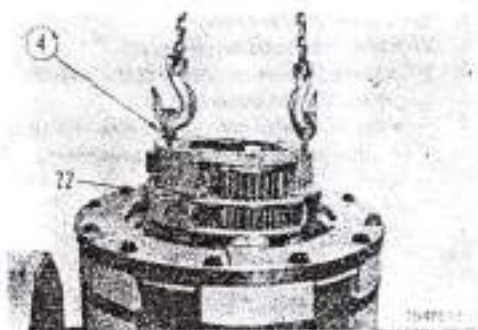




## 10. No. 1, 2 and 3 carrier assembly

Fit eye bolts (4) (12 mm, P = 1.75) and remove carrier assembly (22).

- \* If gears do not disengage easily, remove carrier while rotating entire carrier assembly.

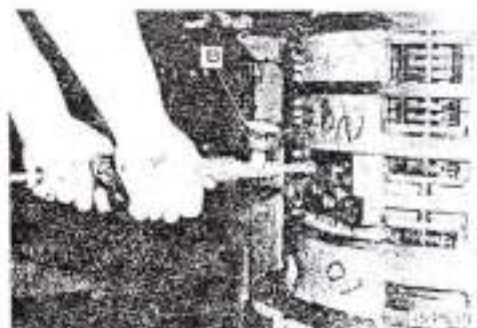


## 11. Piston stroke measurement

Using air checker B, check operation and stroke of each piston.

- \* Air pressure: 6 to 7 kg/cm<sup>2</sup>
- \* Stroke

Clutch Number	Stroke
No.1 clutch	5 mm
No.2 clutch	4 mm
No.3 clutch	4 mm
No.4 clutch	4 mm




## 12. Tie bolts

Remove tie bolts (23).



## 13. No.1 housing and piston assembly

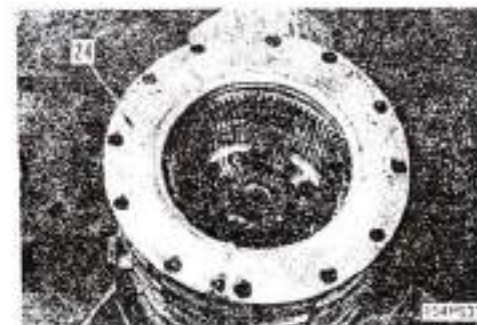
Remove No.1 housing and piston assembly (24).

 No.1 housing and piston assembly: 45 kg

- \* Support assembly during removal to prevent it from falling.



Because assembly is heavy, remove it using two people.



**14. No.1 springs, discs and plates**

- 1) Remove No.1 piston springs (25).
- 2) Alternately remove discs (26), washer return springs (27) and plates (28).

★ After dismounting, place discs and plates on a flat surface to prevent them warping.

**15. No.1 ring gear**

Remove No. 1 ring gear (29).

**16. Plate**

Remove plate (30).

**17. No.2 springs, discs and plates**

- 1) Remove No.2 piston springs (31).
- 2) Alternately remove discs (32), washer return springs (33) and plates (34).

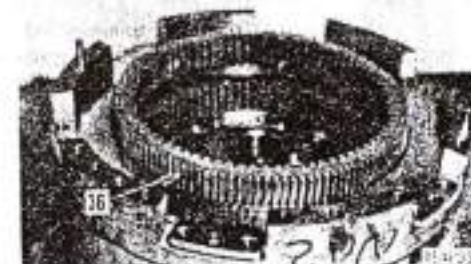
★ After dismounting, place discs and plates on a flat surface to prevent them warping.

**18. Pins**

Remove six guide pins (35).

**19. No.2 ring gear**

Remove No.2 ring gear (36).



**25. No.4 springs, discs and plates**

- 1) Remove No.4 piston spring (45).
  - 2) Alternately remove discs (46), washer return spring (47) and plates (48).
- ★ After dismantling, place discs and plates on a flat surface to prevent them warping.

**26. Pins**

Remove six guide pins (49).

**27. No.4 ring gear**

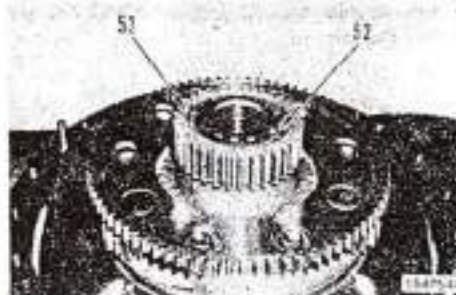
Remove No.4 ring gear (50).

**28. Plate**

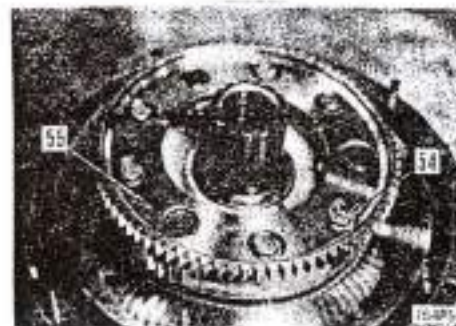
Remove plate (51).

**29. No.3 and No.4 sun gears**

Remove snap ring (52) and remove No.3 and No.4 sun gears (53).

**30. No. 4 carrier assembly**

Remove mounting bolts (54) and remove No.4 carrier assembly (55).



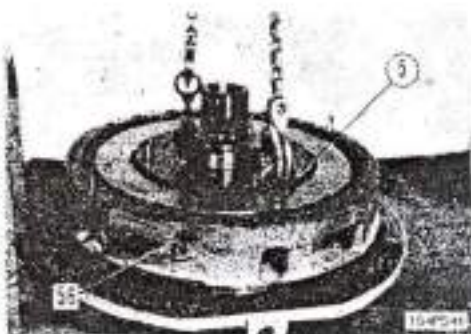


## 10. No.5 housing and clutch assembly

Fit eye bolts (5) (14 mm, P = 2.0) and remove No.5 housing and clutch assembly (56).



No.5 housing and clutch assembly: 145 kg



## 11. Bevel pinion assembly

1) Rotate repair stand in opposite direction so that bevel pinion side is uppermost.

2) Remove mounting bolts and remove bevel pinion assembly (57).



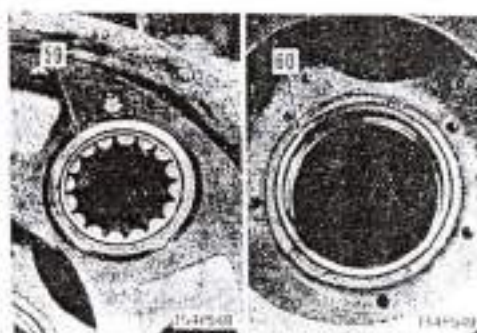
Bevel pinion assembly: 35 kg

3) Remove left and right shims (58).



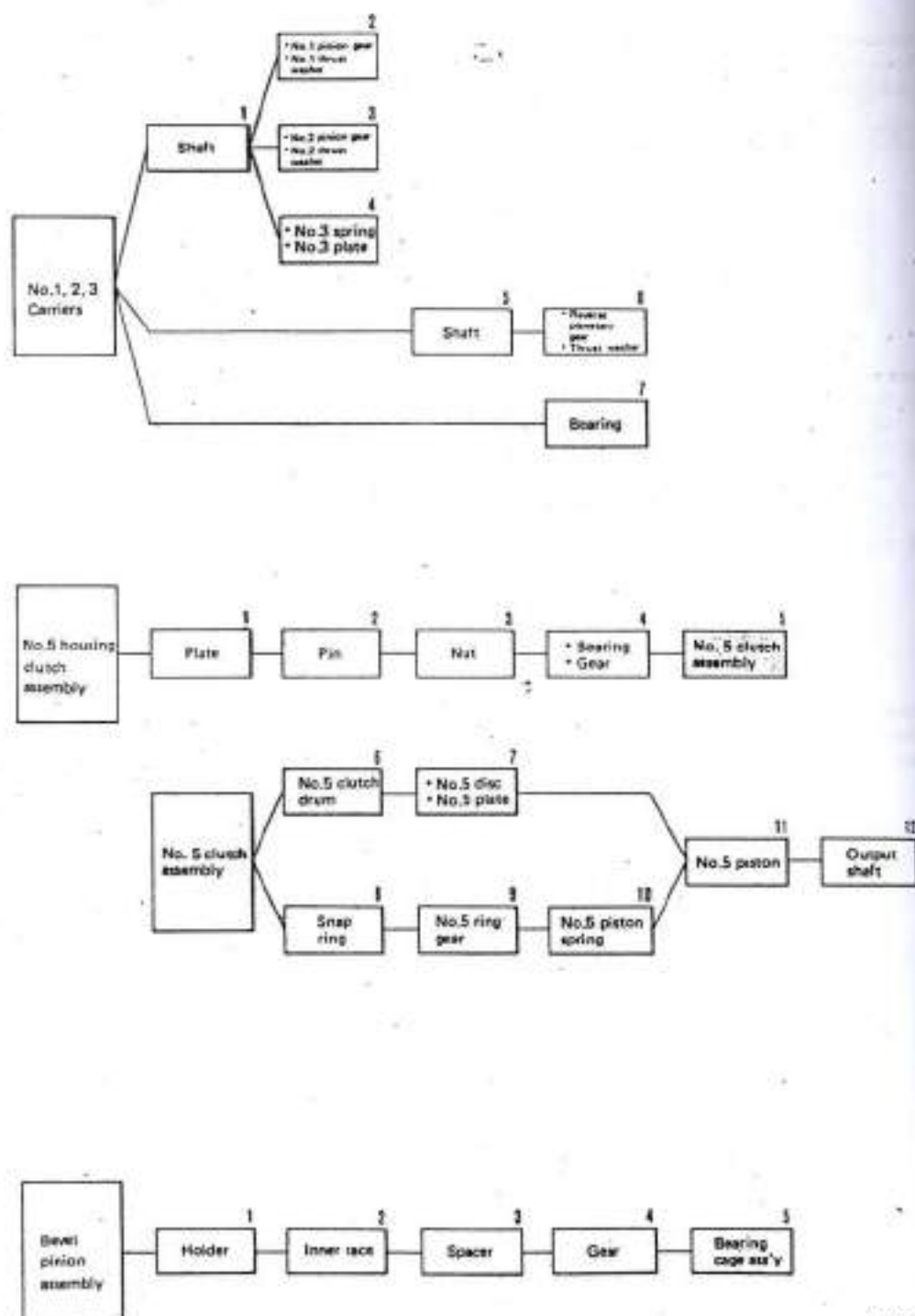
## 12. Bearing

Remove bearing (59) and outer race (60) from rear case.





## DISASSEMBLY OF TORQFLOW TRANSMISSION ASSEMBLY (2/2)



## DISASSEMBLY OF NO.1, 2 and 3 CARRIER ASSEMBLY

## 1. Shaft

Place copper rod against shaft (1) and knock it out.  
 \* Be careful not to lose shaft stopper ball (2).

## 2. No.1 pinion gear and thrust washer

## 3. No.2 pinion gear and thrust washer

## 4. No.3 pinion gear and thrust washer

Dismount No. 1 pinion gear (3), No. 2 pinion gear (4), No. 3 pinion gear (5) and also thrust washer (6) and needle bearings (7) of each gear.

## 5. Shaft

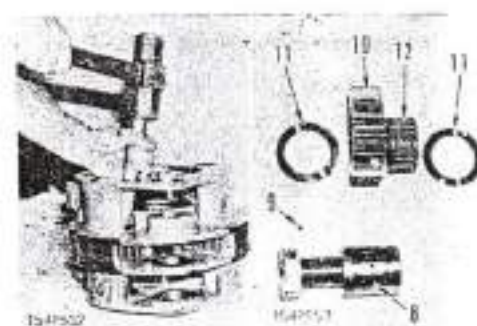
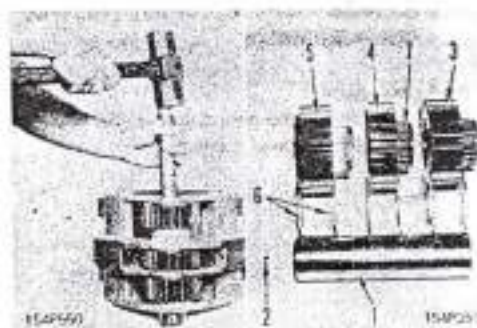
Place copper rod against shaft (8) and knock it out.  
 \* Be careful not to lose shaft stopper ball (9).

## 6. Reverse planetary gear and thrust washer

Remove planetary gear (10), thrust washer (11) and needle bearing (12).

## 7. Bearing

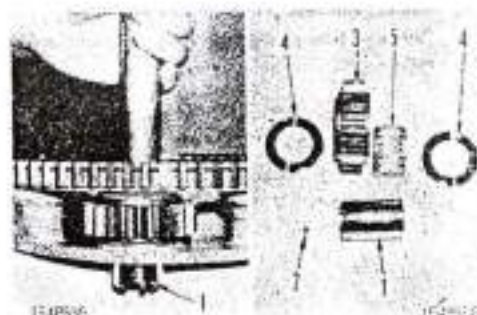
Remove snap ring (13) and remove bearing (14) from carrier (15).



## DISASSEMBLY OF NO.4 CARRIER ASSEMBLY

1. Place copper rod against shaft (1) and knock it out.  
 \* Be careful not to lose shaft stopper ball (2).

2. Remove gear (3), thrust washer (4) and needle bearing (5).



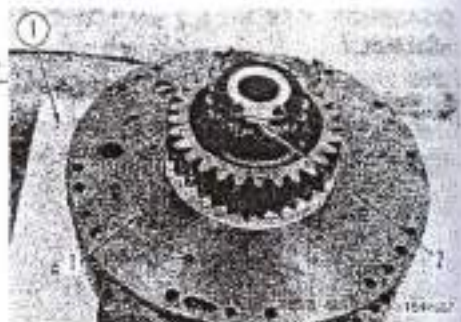
# DISASSEMBLY OF NO. 5 HOUSING AND CLUTCH ASSEMBLY

## Preparatory work

- Set No. 5 housing and clutch assembly (1) on block (1) (height: approx. 250 mm).

## 1. Plate

Remove plate (2).



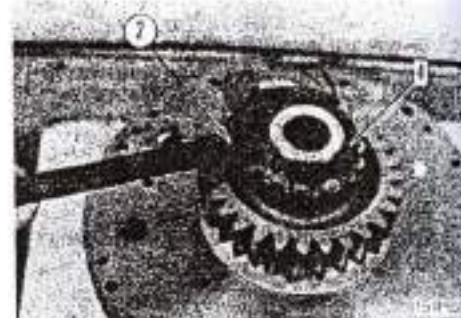
## 2. Pin

Remove nut retaining pin (3).



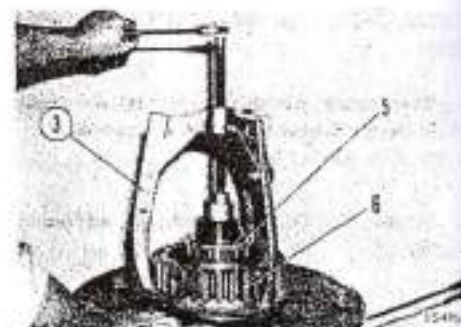
## 3. Nut

Remove nut (4) using nut wrench (2).



## 4. Bearing and gear

Remove bearing (5) and gear (6) together using gear puller (3).



## 1. No. 5 clutch assembly

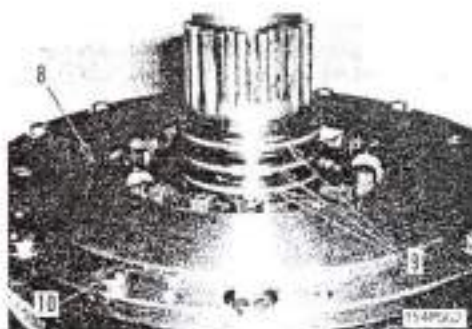
Remove No. 5 housing (7) and disassemble clutch assembly (8).



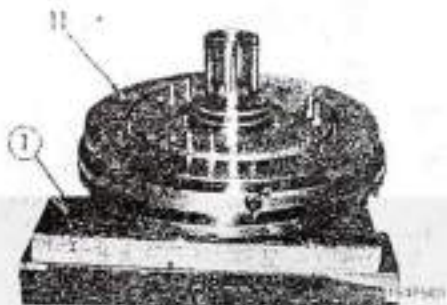
## 2. No. 5 clutch drum

1) Remove seal ring (9).

2) Remove all drum mounting bolts (10) except for two diagonally opposed bolts. Rotate No. 5 clutch assembly (8) in opposite direction and set it on block (1).



3) Remove No. 5 clutch drum (11).

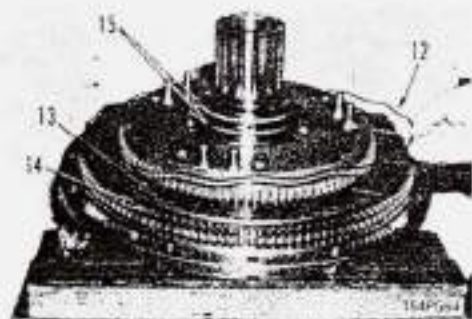


## 3. No. 5 discs and plates

1) Alternately remove wave springs (12), discs (13) and plates (14).

\* After dismounting, place discs and plates on a flat surface to prevent them warping.

2) Remove seal rings (15).



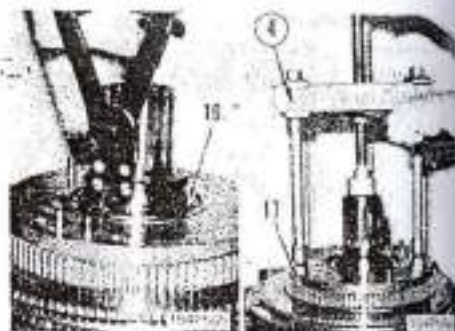


**8. Snap ring**

Remove snap ring (16).

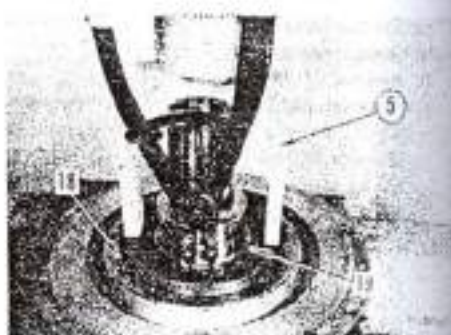
**9. No. 5 ring gear**

Remove No. 5 ring gear (17) using puller (4).

**10. No. 5 piston spring**

1) Set pusher (5) to return spring (18). Using a press, compress spring slightly, and remove snap ring (19).

2) Remove No. 5 piston spring.

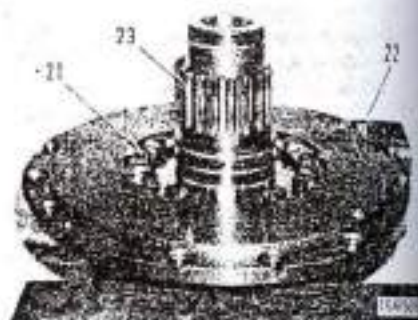
**11. No. 5 piston**

Remove No. 5 piston (20).

**12. Output shaft**

1) Remove mounting nut (21).

2) Remove output shaft (23) from clutch housing (22).



## DISASSEMBLY OF BEVEL PINION ASSEMBLY

## 1. Holder

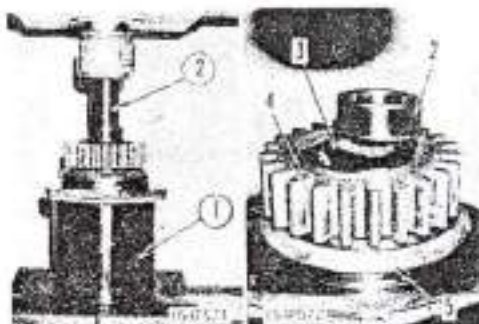
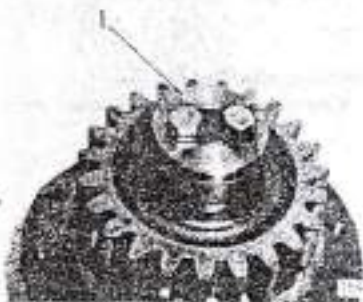
Remove holder (1).

## 2. Inner race

## 3. Spacer

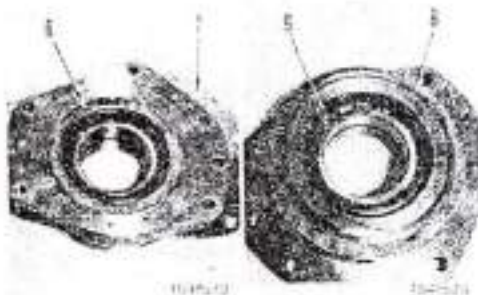
## 4. Gear

- 1) Set bevel pinion assembly on push tool ① ( $\phi 220$  mm, height: approx. 200 mm).
- 2) Using push tool ② ( $\phi 50$  mm), push pinion shaft to separate inner race (2), spacer (3), gear (4) and bearing assembly (5).



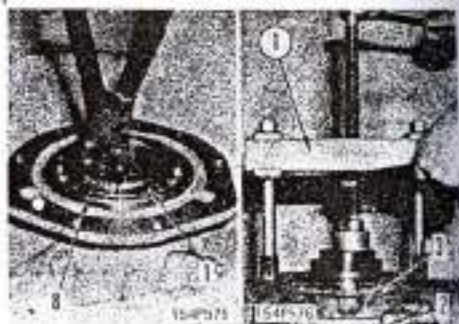
## 5. Bearing cage assembly

- 1) Remove cover (6) and shim (7) from bearing cage assembly.
- 2) Remove bearing (9) from bearing cage (8).

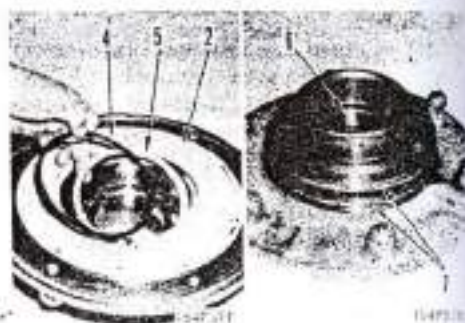


## DISASSEMBLY OF BEARING CAGE ASSEMBLY

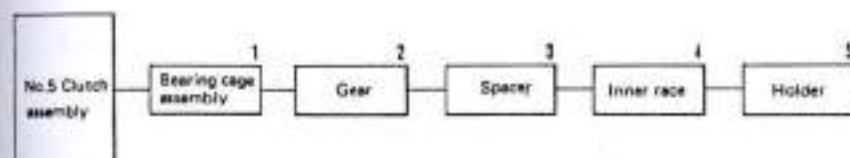
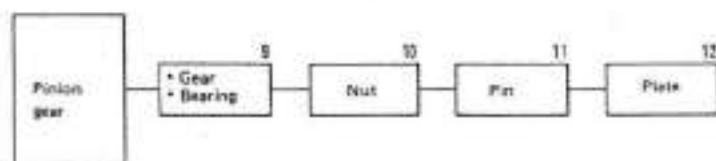
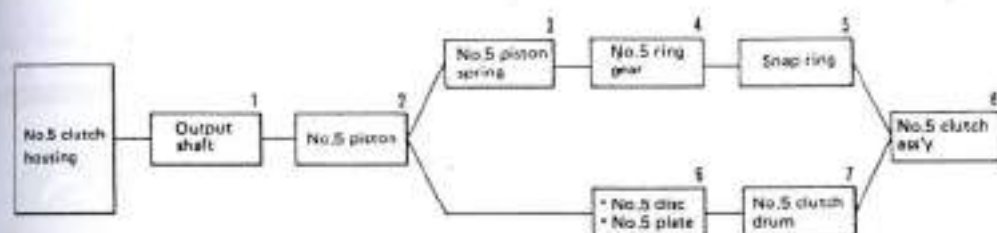
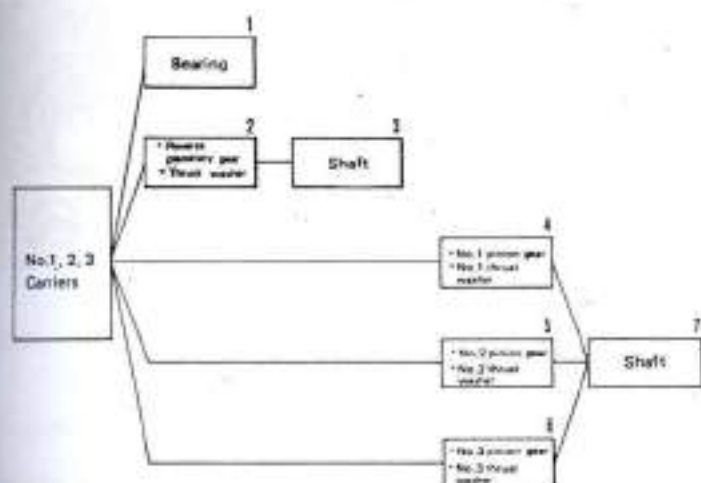
1. Remove snap ring (1).
2. Using pulley (1), separate cages (2) and (3).



3. Remove oil seal from cage (2) and remove snap ring (4) and spacer (5).
4. Remove bearing (6).
5. Remove seal ring (7).
6. Remove bearing (8) from cage (3).



## ASSEMBLY OF TORQFLOW TRANSMISSION ASSEMBLY (1/2)



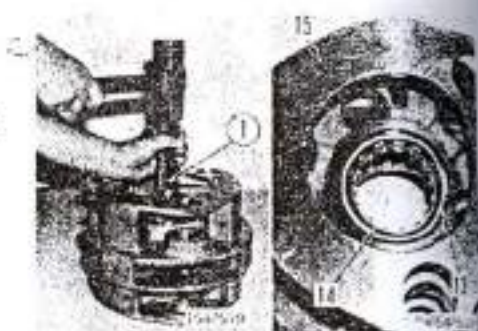
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## ASSEMBLY OF NO. 1, 2 AND 3 CARRIER

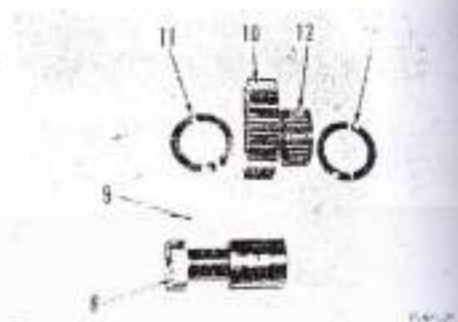
## 1. Bearing

- 1) Using push tool ① ( $\phi 110$  mm), press-fit bearing (14) onto carrier (15).
- 2) Install snap ring (13).



## 2. Reverse planetary gear and thrust washer

- 1) Fit needle bearing (12) onto planetary gear (10).
  - 2) Assemble planetary gear, needle bearing assembly and left and right thrust washers (11), and position resulting assembly on carrier.
- ★ Apply engine oil (EO30-CD) to bearing and washer before assembly.



## 3. Shaft

Align shaft side and carrier side stopper ball mounting holes. Drive in shaft (8) with plastic hammer and fit stopper balls (9).

★ When driving in shaft, rotate planetary gear.

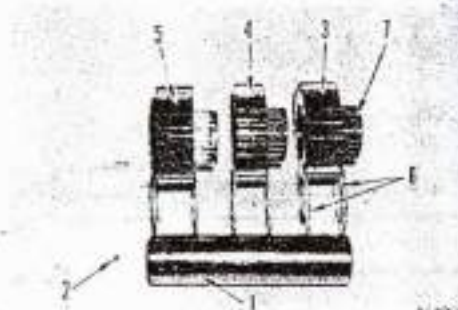


## 4. No. 1 pinion gear and thrust washer

## 5. No. 2 pinion gear and thrust washer

## 6. No. 3 pinion gear and thrust washer

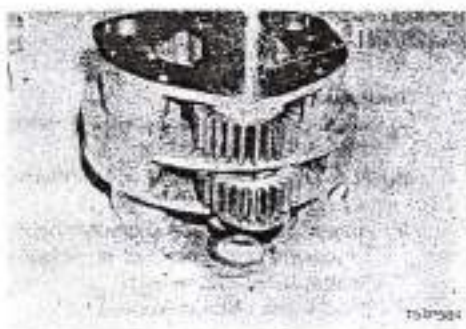
- 1) Assemble No. 1 pinion gear (3), No. 2 pinion gear (4), No. 3 pinion gear (5) and needle bearing (7).
  - 2) Assemble No. 1, 2 and pinion gears, needle bearings and left and right thrust washers (6). Align assembly on carrier.
- ★ Apply engine oil (EO30-CD) to bearing and washer before assembly.



## 7. Shaft

Align shaft side and carrier side stopper ball mounting holes. Drive in shaft (1) with plastic hammer and fit stopper balls (2).

- \* When driving in shaft, rotate pinion gear.



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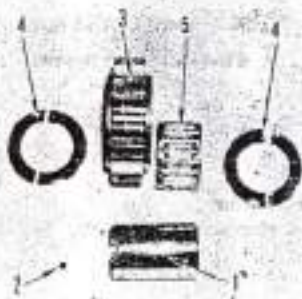
## ASSEMBLY OF NO. 4 CARRIER ASSEMBLY

1. Fit needle bearing (5) onto pinion gear (3).

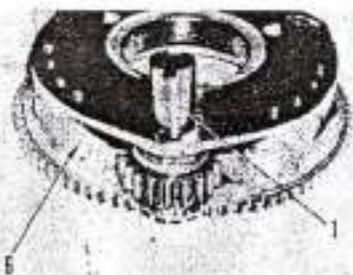
2. Assemble pinion gear, needle bearing assembly and left and right thrust washers (4), and position resulting assembly on carrier (6).

- \* Apply engine oil to bearing and washer before assembly.

3. Align shaft side and carrier side stopper ball mounting holes. Drive shaft (1) with plastic hammer and fit stopper balls (2).



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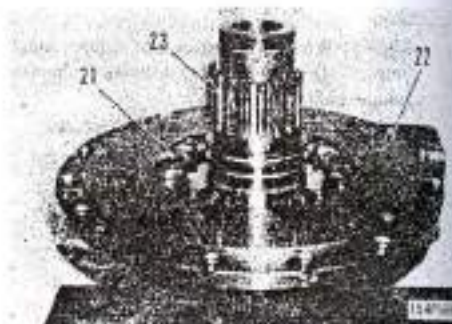
**ASSEMBLY OF NO. 5 HOUSING AND CLUTCH ASSEMBLY****1. Output shaft**

- 1) Fit O-rings to mounting face of clutch housing (22) and output shaft (23).
- 2) Position output shaft on clutch housing, and fit mounting bolts.
- 3) Rotate clutch housing and output shaft assembly in opposite direction, and set it on block (1) (height: approx. 250 mm).
- 4) Fit lock plates and tighten nuts (21).

 Nut: Adhesive

 Nut:  $11 \pm 1.5$  kg.m

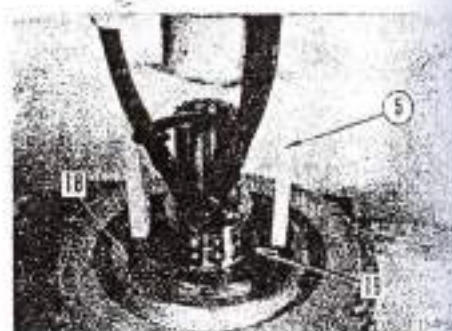
★ Bend lock plates securely.

**2. No. 5 piston**

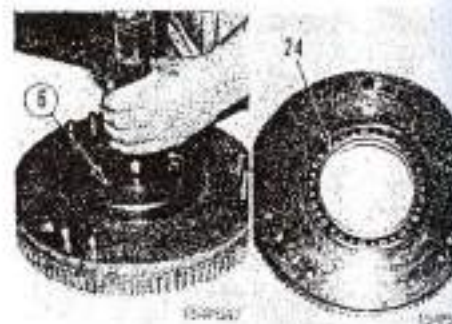
- Fit piston rings on piston (20), and install housing.

**3. No. 5 piston spring**

- 1) Install No. 5 piston spring (18).
- 2) Set pusher (5) to spring. Compress spring using press, and install snap ring (19).

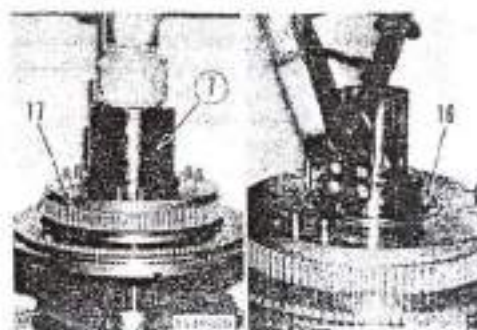
**4. No. 5 ring gear**

- 1) Using push tool (6) (φ165 mm), press-fit bearing (24) onto ring gear.





- 2) Using push tool (7) (internal  $\phi 120$  mm), press-fit No. 5 ring gear (17).

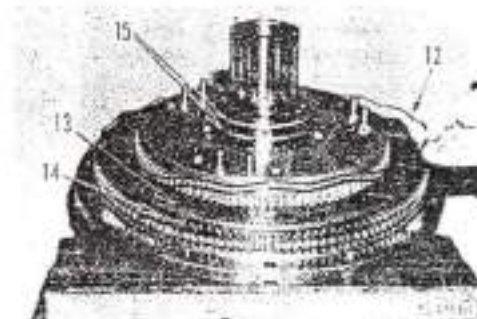


#### 5. Snap ring

- Install snap ring (16).

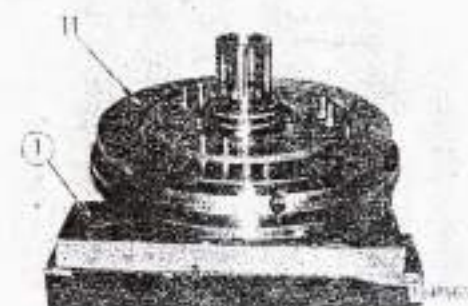
#### 6. No. 5 discs and plates

- 1) Alternately install discs (13), wave springs (12) and plates (14).
  - \* Before assembly, apply engine oil to both faces of discs and plates. During assembly, take care to avoid adhesion of dust and dirt.
  - \* Assemble discs so that notches on inner teeth are in line with each other.
- 2) Install seal ring (15).



#### 7. No. 5 clutch drum

- 1) Align outer teeth of plate with inner teeth of No. 5 clutch drum (11). Align knock pin positions and fit plate to drum.
- 2) Tighten two diagonally opposite mounting bolts (10). Rotate clutch assembly (8) in opposite direction and set it on block (1).



- 3) Tighten mounting bolts (10).

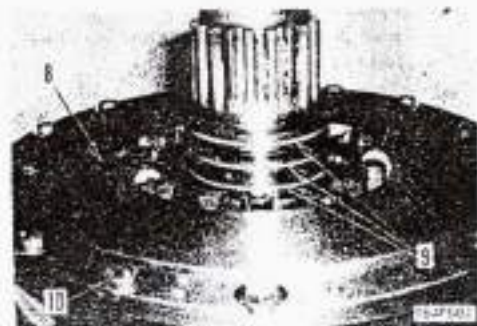


Mounting bolts: Adhesive



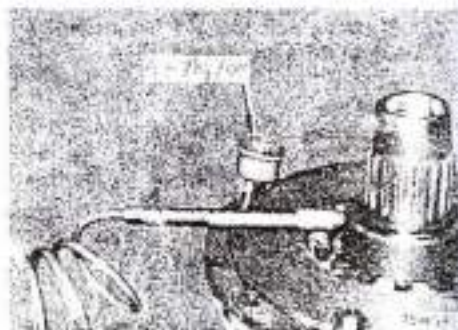
Mounting bolts:  $11 \pm 1.5$  kg m

- 4) Install seal ring (9).



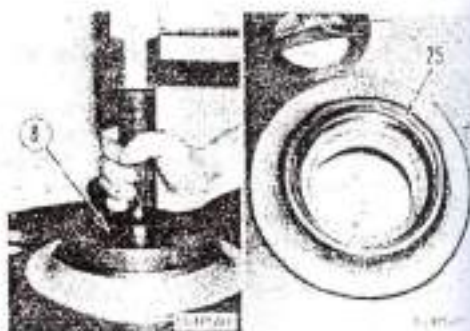


- 5) Using air checker apply 6 to 7 kg/cm<sup>2</sup> air pressure and check operation of No. 5 clutch piston.  
 ★ If air pressure does not rise or cannot be maintained, seal ring is faulty.  
 ★ No. 5 clutch stroke: 3 mm

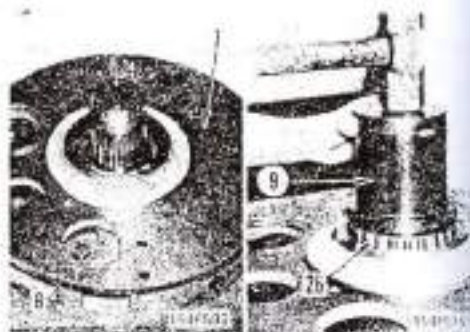


#### 8. No. 5 clutch assembly

- 1) Using push tool (8) (ø160 mm), press-fit outer race (25) into No. 5 housing.

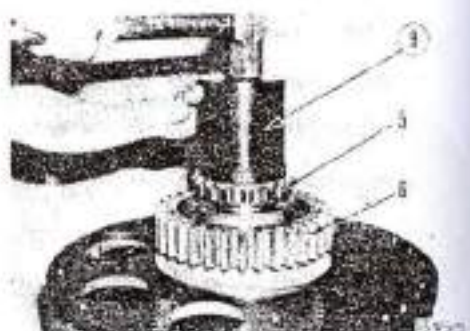


- 2) Align No. 5 housing on clutch assembly (8).  
 3) Using push tool (9) (inside ø105 mm), press-fit bearing (28).



#### 9. - Bearing and gear

- Install gear (6). Using push tool (9) (inside ø90 mm), press-fit bearing (5).



## 10. Nut

Tighten nut (4) using nut wrench (2).

- When tightening nut, locate nut retaining pin in one of three positions.



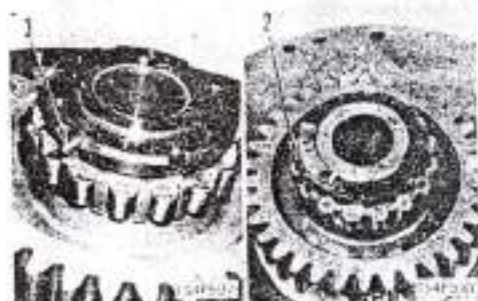
## 11. Pin

Install pin (3).

## 12. Plate

Install plate (2) and lock plate. Tighten nut.

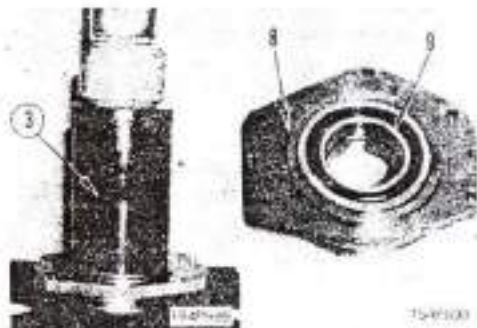
- Bend lock plate securely.



## ASSEMBLY OF BEVEL PINION ASSEMBLY

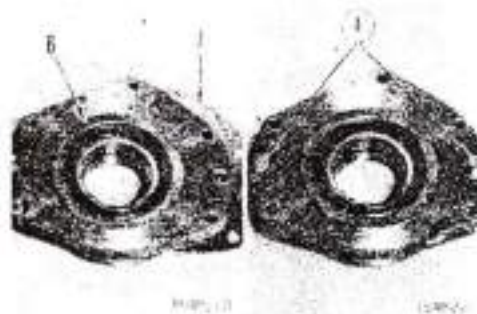
## 1. Bearing cage assembly

- 1) Using push tool (3) ( $\phi 140$  mm), press-fit bearing (9) onto bearing cage (8).

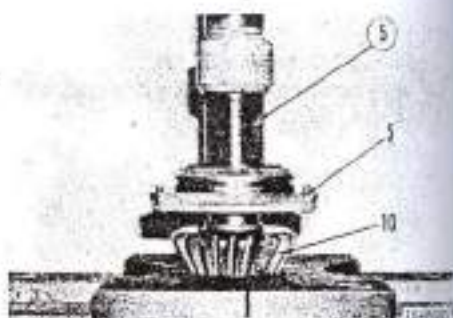


- 2) Insert shim (7) and install cover (6). Insert temporary mounting bolts (4) (12 mm,  $P = 1.75$ ) into extraction bolt holes to secure bearing cage assembly.

- Standard shim thickness: 0.4E mm



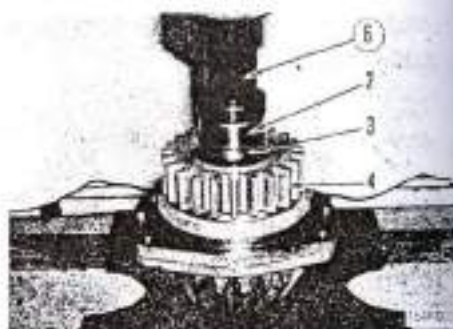
- 3) Using push tool (5) (inside dia. 60 mm), press bearing cage assembly (5) into bevel pinion (10).



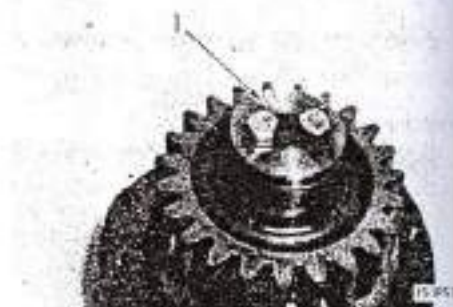
2. Gear  
Install gear (4).

3. Spacer  
Install spacer (3).

4. Inner race  
Press-fit inner race (2) using push tool (6) (inside dia. 60 mm).

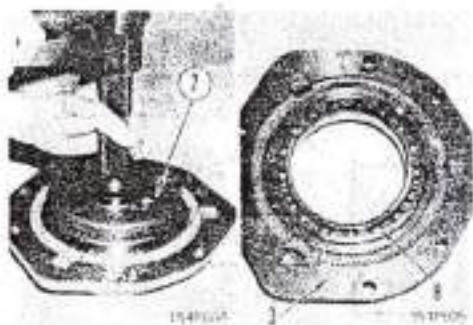


5. Holder  
Fit holder (1) and lock plate, and tighten bolts.  
★ Bend lock plate securely.

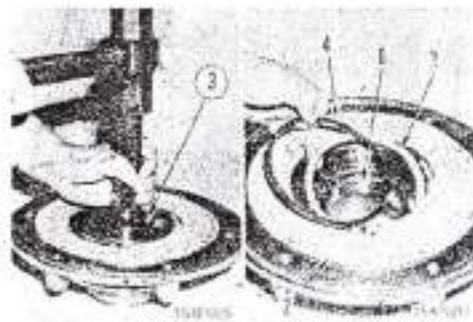


## ASSEMBLY OF BEARING CAGE ASSEMBLY

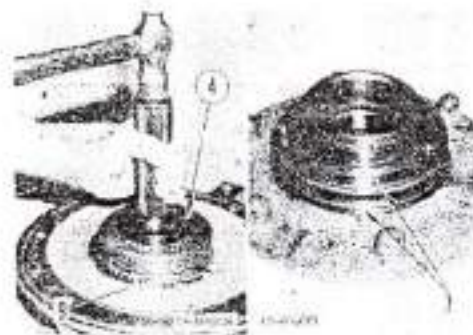
1. Using push tool ② ( $\phi 165$  mm), press-fit bearing (8) into cage (3).



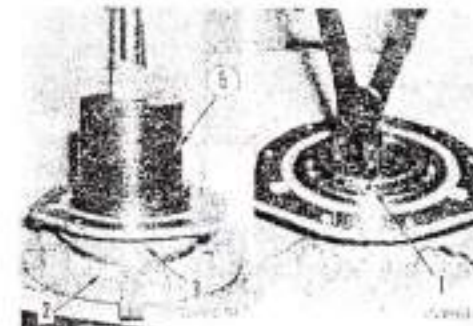
2. Using push tool ③ ( $\phi 125$  mm), press-fit bearing (6) into cage (2).



3. Using push tool ④ ( $\phi 125$  mm), press-fit oil seal (9).  
4. Install seal ring (7).

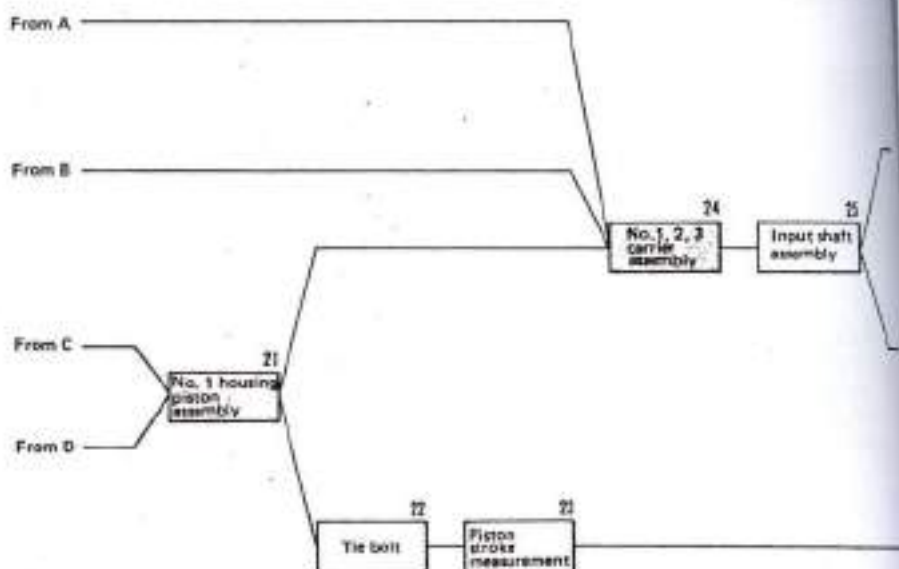
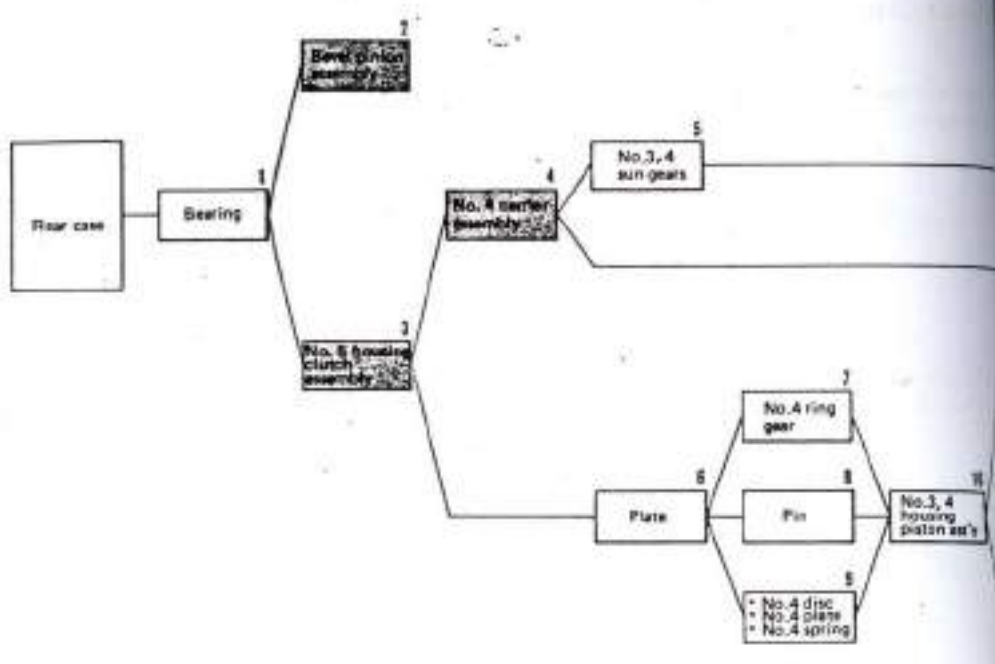


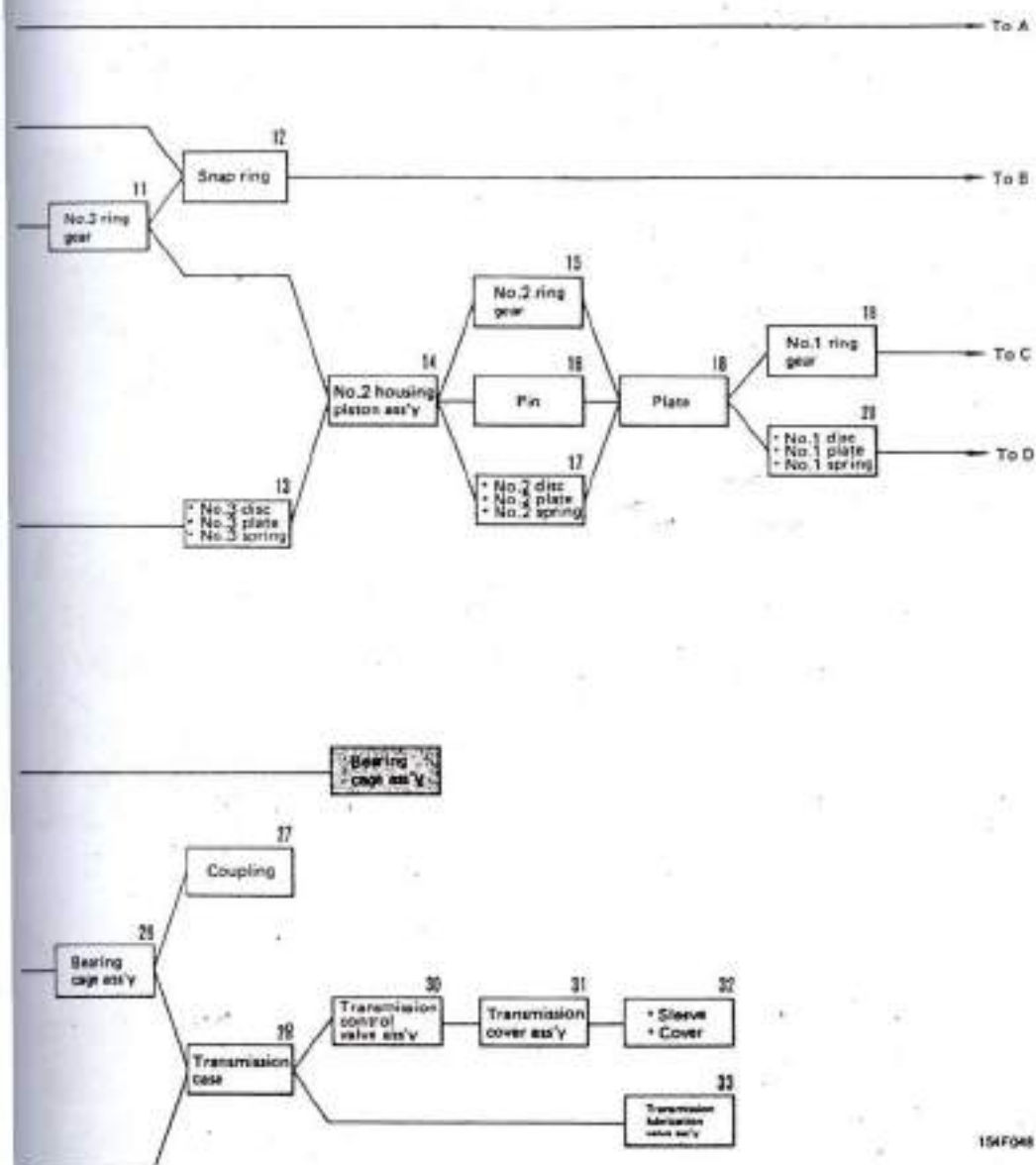
5. Using push tool ⑤ (inside dia. 120 mm), press cage (2) into cage (3).  
\* Before assembly, apply engine oil to sliding face of seal ring.



6. Install snap ring (1).



**ASSEMBLY OF TORQFLOW TRANSMISSION ASSEMBLY (2/2)**



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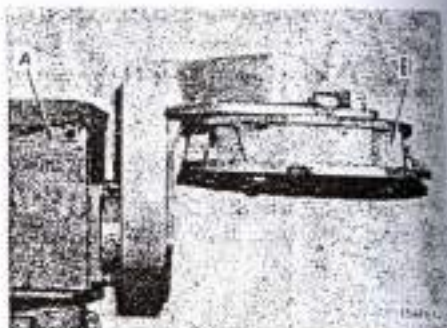
## Special tools required

Part Name	A	B
Unit repair stand	1	
Bracket	1	
Air checker		1

- \* Before assembly, apply engine oil to sliding surfaces of each bearing, seal ring, plate and disc, etc., and also apply grease to lip surface of oil seal.

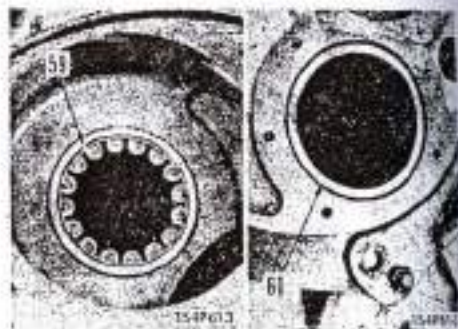
## Preparatory work

- \* Set rear case (61) on unit repair stand A.



## 1. Bearing

Press-fit bearing (59) and outer race (60) into rear case.

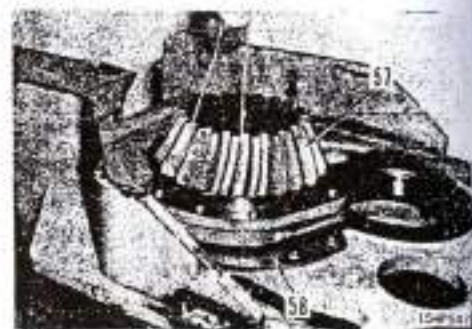


## 2. Bevel pinion assembly

Insert tooth contact adjusting shim (58), and install bevel pinion assembly (57).

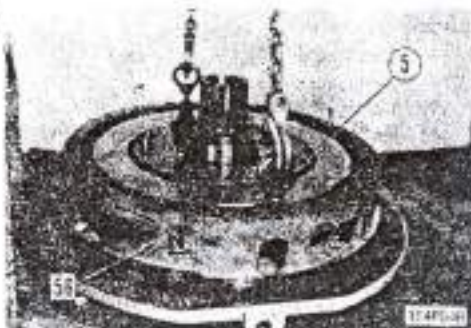
- \* Standard shim thickness: 2.0 mm

- \* Types of shims:  $t=1.0$  mm,  $t=0.2$  mm,  $t=0.3$  mm



## 1. No. 5 housing and clutch assembly

- 1) Rotate repair stand in opposite direction and set assembly so that bevel pinion is facing downwards and rear case side is horizontal.
- 2) Raise assembly using eye bolts (5) (14 mm, P = 2.0). Align dowel pin positions and install No. 5 housing and clutch assembly (56).

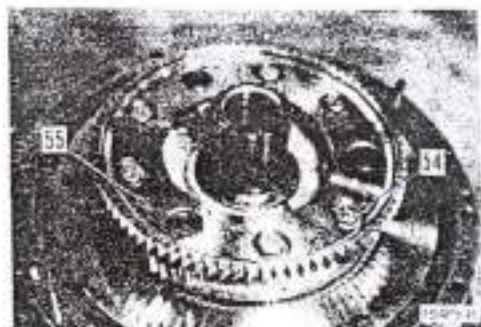


## 2. No. 4 carrier assembly

- Install No. 4 carrier assembly (55), and tighten mounting bolts (54).

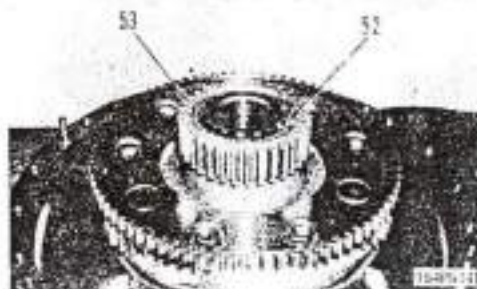
 Mounting bolts: Adhesive

 Mounting bolts:  $17.5 \pm 2.5$  kg.m



## 3. No. 3 and 4 sun gears

- Install No. 3 and 4 sun gears (53), and fit spring (52).

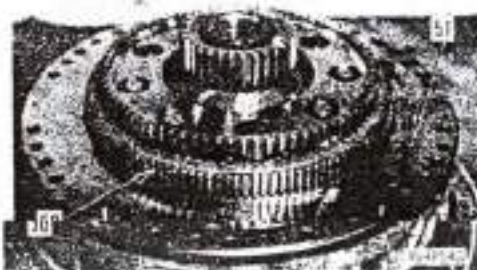


## 4. Plate

- Align dowel pin positions and install plate (51).

## 5. No. 4 ring gear

- Install No. 4 ring gear (50).





## 8. Pins

Install guide pins (49).

## 9. No. 4 discs, plates and springs

- 1) Mount discs (46), washer return springs (47) and plates (48) in that order.

★ Assemble discs so that notches on inner teeth are in line with each other.

- 2) Install No. 4 piston spring (45).

★ Free height of spring: 45,7 mm



## 10. No. 3 and 4 housing and piston assembly

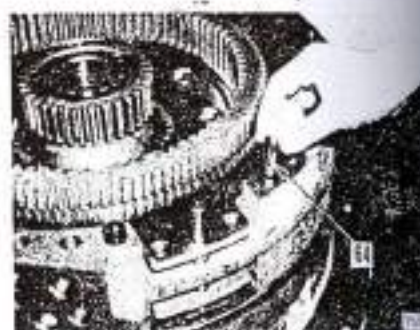
- 1) Fit piston rings to No. 3 piston (62) and No. 4 piston (63). Install pistons in housing.

- 2) Raise assembly with eye bolts (5) (14 mm, P = 2.0). Align dowel pin positions and install No. 3 and 4 housing and piston assembly (44).

★ During installation, support No. 4 piston with hand to prevent it falling.



- 3) Install sleeve (64) to housing.



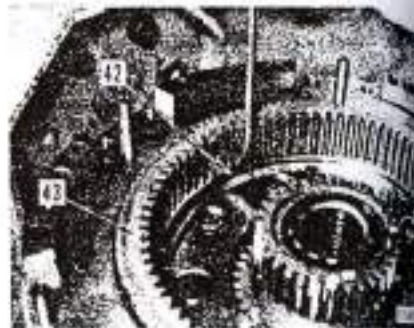
## 11. No. 3 ring gear

Install No. 3 ring gear

## 12. Snap ring

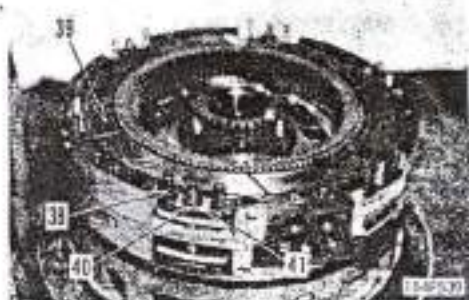
Align connecting grooves of No. 3 ring gear and No. 4 ring gear, and fit snap ring (42).

★ Check that No. 3 ring gear does not rise up after snap ring is fitted.



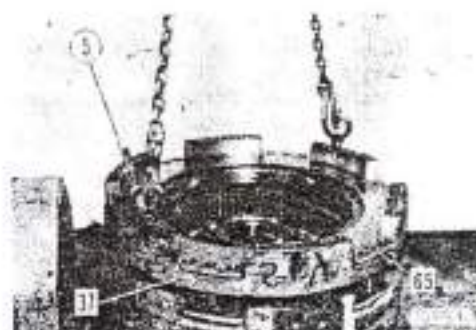
1. No. 3 discs, plates and springs

- 1) Mount discs (39), washer return springs (40) and plates (41) in that order.
  - \* Assemble discs so that notches on inner teeth are in line with each other.
- 2) Install No. 3 piston spring (38).
  - \* Free height of spring: 45,7 mm



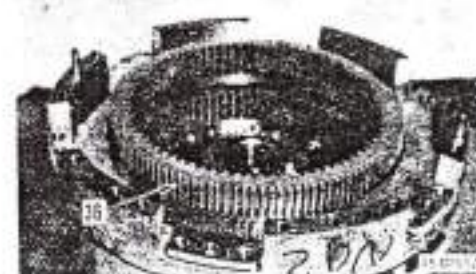
2. No. 2 housing and piston assembly

- 1) Fit piston ring on No. 2 piston (65), and install piston in housing.
- 2) Raise assembly with eye bolts (5) (14 mm, P = 20). Align dowel pin positions and install No. 2 housing and piston assembly (37).



3. No. 2 ring gear

- 1) Install No. 2 ring gear (36).



4. Pin

- 1) Install guide pins (35).

5. No. 2 discs, plates and springs

- 1) Mount discs (32), washer return springs (33) and plates (34) in that order.
  - \* Assemble discs so that notches on inner teeth are in line with each other.
- 2) Install No. 2 piston spring (31).
  - \* Free height of spring: 45,7 mm



## 18. Plate

Install plate (30).

## 19. No. 1 ring gear

Install No. 1 ring gear (29).

★ Install ring gear so that notch on inner teeth is up-  
permost (input side).



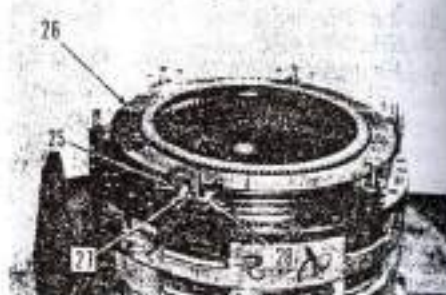
## 20. No. 1 discs, plates and springs

1) Mount discs (26), washer return springs (29) and  
plate (28) in that order.

★ Assemble discs so that notches on inner teeth  
are in line with each other.

2) Install No. 1 piston spring (25).

★ Free height of spring: 66 mm



## 21. No. 1 housing and piston assembly

1) Fit piston ring to No. 1 piston and install piston  
in housing.

2) Align dowel pin positions and install No. 1 hous-  
ing and piston assembly (24).



Because assembly is heavy, lift it using two  
people and install it carefully.

★ During installation, support No. 1 piston with  
hand so that it does not fall down.



## 22. Tie bolts

Tighten tie bolts (23).



Tie bolts:  $17 \pm 1.0$  kg.m





## 23. Piston stroke measurement

Using air checker B, check operating condition and stroke of each piston.

- Air pressure: 6 to 7 kg/cm<sup>2</sup>
- Stroke

Clutch No.	Stroke
No. 1 clutch	6 mm
No. 2 clutch	4 mm
No. 3 clutch	4 mm
No. 4 clutch	4 mm



## 24. No. 1, 2 and 3 carrier assembly

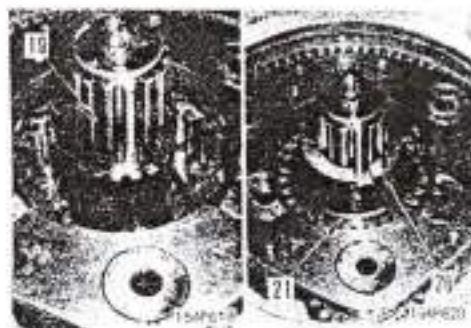
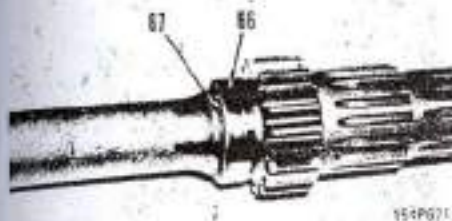
Lift assembly with eye bolts (4) (12 mm, P = 1.75), and install No. 1, 2 and 3 carrier assembly (22).

- If gears do not mesh satisfactorily, rotate complete carrier during installation.



## 25. Input shaft assembly

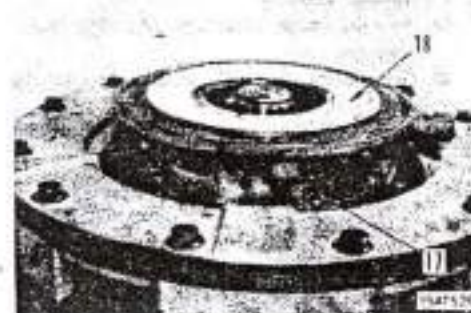
- 1) Press-fit inner race (66) onto input shaft, and fit snap ring (67).



- 2) Install input shaft (19) and install gear (21) and spacer (20).

## 26. Bearing cage assembly

Position bearing cage assembly (18) and tighten mounting bolts (17).



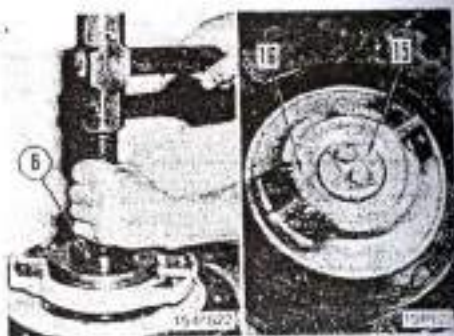


## 27. Coupling

- 1) Press-fit coupling (16) using push tool (6).
- 2) Fit O-ring. Install holder (15) and lock plate and tighten mounting bolts.

 Mounting bolts:  $4.5 \pm 1.0$  kg.m

\* Bend lock plate securely.

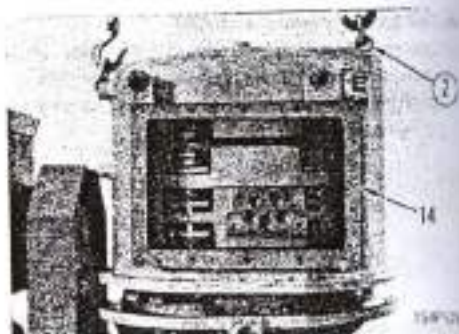


## 28. Transmission case

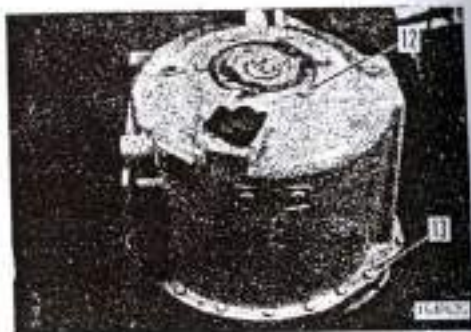
- 1) Fit gasket to rear case and fit O-ring to bearing cage.

 Gasket: Liquid gasket

- 2) Lift transmission case (14) with eye bolts (2) (10 mm, P = 1.5) and install it.

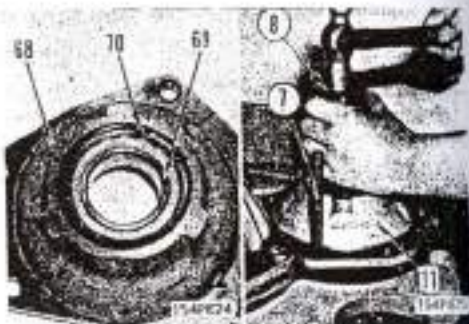


- 3) Tighten transmission case and rear case mounting bolts (13).
- \* Insert four mounting bolts from rear case side.
- 4) Tighten transmission case and bearing cage mounting bolts (12).



## 29. Bearing cage assembly

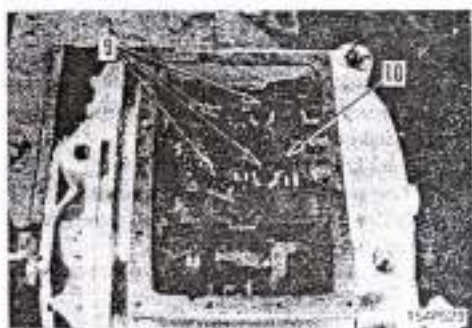
- 1) Press-fit bearing (69) into cage (68), and install snap ring (70).
- 2) Using guide bolts (7), position bearing cage assembly (11).
- 3) Using push tool (8) (internal dia. 60 mm), press-fit bearing cage assembly.



## 30. Transmission control valve assembly

- 1) Fit O-ring to clutch housing side, and install transmission control valve assembly (10) together with seat.
- 2) Tighten mounting bolts (9).

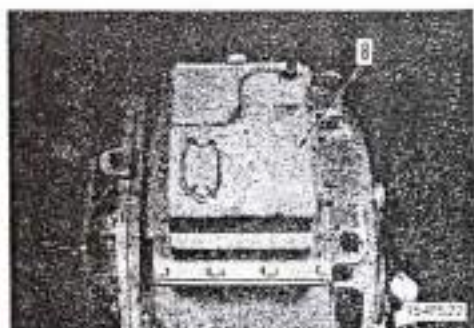
 Mounting bolts:  $4.25 \pm 1.25 \text{ kg.m}$



## 31. Transmission cover assembly

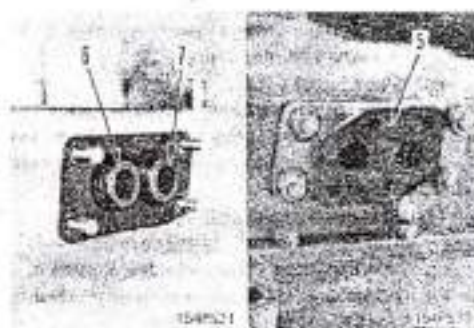
- Fit gasket to transmission case. Align connecting parts of spool and yoke and install transmission cover assembly (8).

 Gasket: Liquid gasket



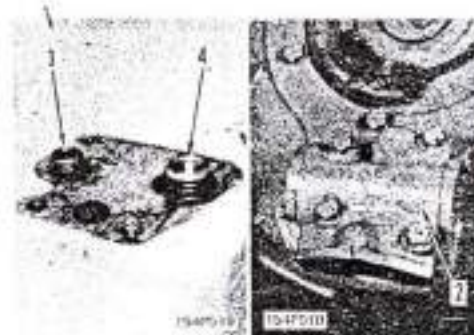
## 32. Sleeves and cover

- 1) Fit O-ring and install sleeves (6) and (7).
- 2) Fit gasket and install cover (5).



## 33. Transmission lubrication valve assembly

- 1) Fit O-ring and install sleeves (3) and (4).
- 2) Fit gasket and install cover (2).

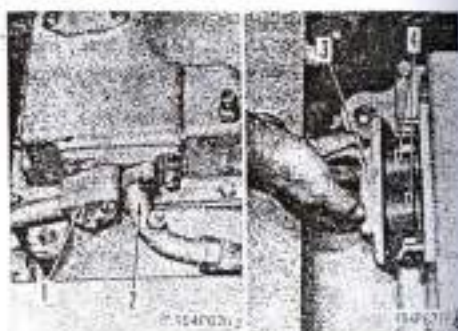


## DISMOUNTING TRANSMISSION CONTROL VALVE ASSEMBLY

1. Remove floor frame assembly while referring to "DISMOUNTING FLOOR FRAME ASSEMBLY".
2. Disconnect transmission control valve inlet tube (1) and outlet tube (2).
3. Remove cover (3) and sleeve (4).
4. Remove transmission control valve cover (5).  
★ Before removing cover, loose inspection plug (6) facilitate removal.
5. Remove four mounting bolts (7) and remove transmission control valve assembly (8).



Transmission control valve assembly: 30 kg



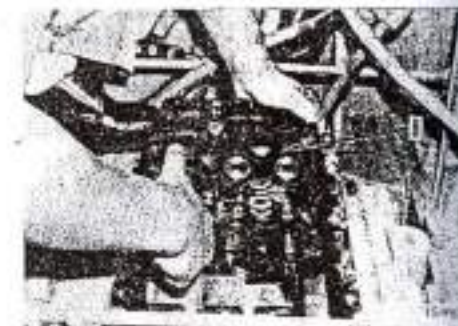
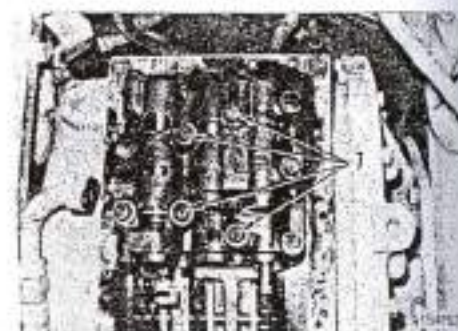
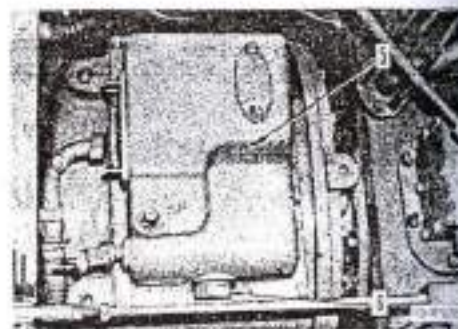
## MOUNTING TRANSMISSION CONTROL VALVE ASSEMBLY

1. Fit O-ring to transmission housing side.
2. Install transmission control valve assembly (8).  
★ When installing valve assembly, align bolt holes to prevent damaging O-ring.



Mounting bolts:  $4.25 \pm 1.25$  kg.m

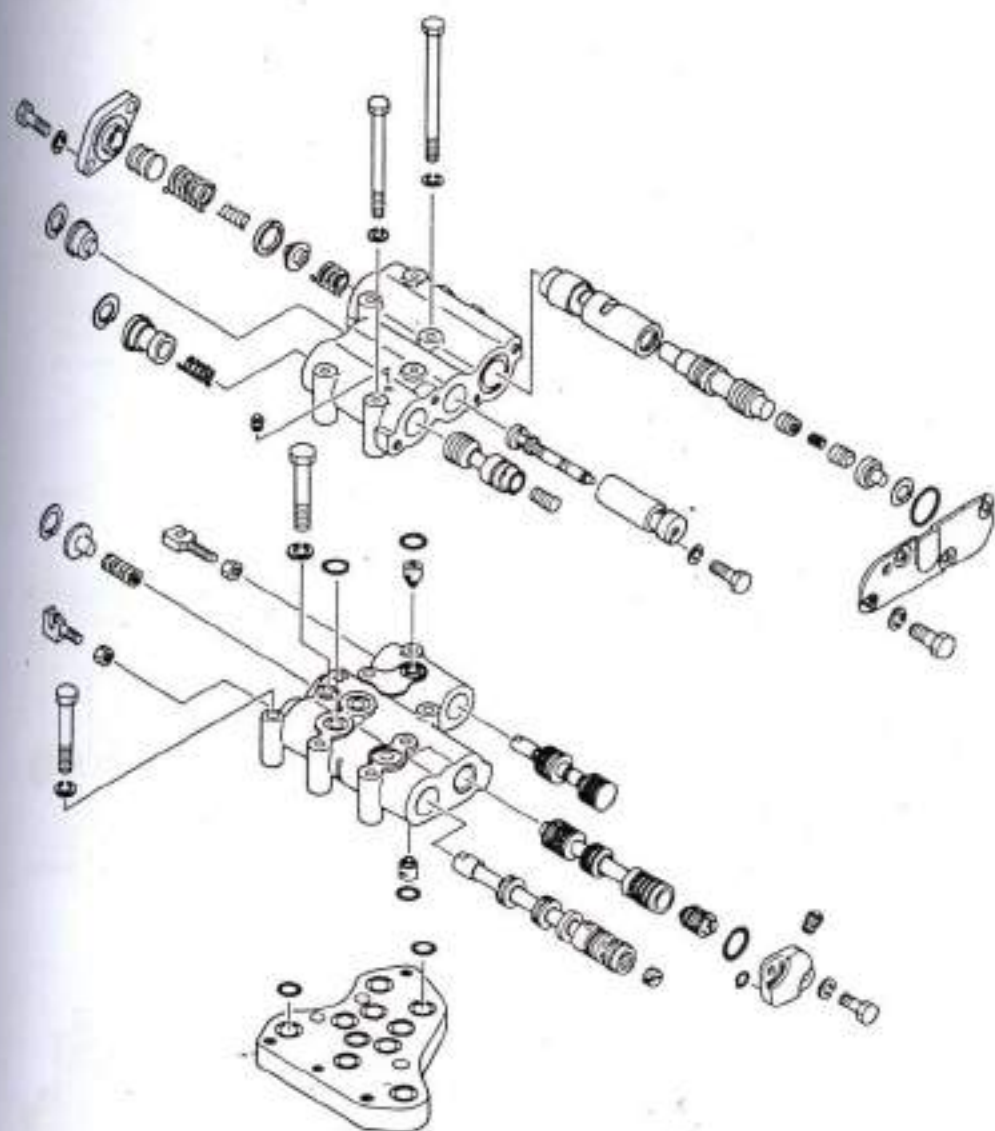
3. Fit gasket. Align spool yoke and lever mounting positions while observing inspection plug hole, and install cover (5).
4. Tighten inspection plug (6).
5. Fit sleeve (4) and O-ring. Install cover (3).
6. Fit gasket and install cover and sleeve together.
7. Fit O-rings and connect transmission control valve inlet tube (1) and outlet tube (2).
8. Install floor frame assembly while referring to "MOUNTING FLOOR FRAME ASSEMBLY".





# DISASSEMBLY OF TRANSMISSION CONTROL VALVE ASSEMBLY

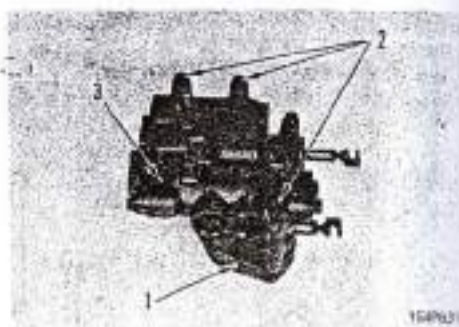
Fig. 1



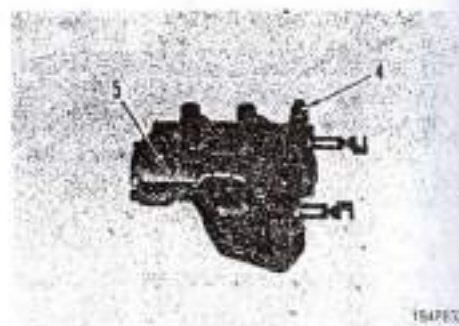


**1. Disassembly of control valve assembly**

- 1) Remove valve seat (1) and through-bolts (2).
- 2) Remove modulating, reducing and quick return valve assembly (3).
- 3) Remove valve seat and coupling bolts (4). Dis-mount speed, directional and safety valve assembly (5).



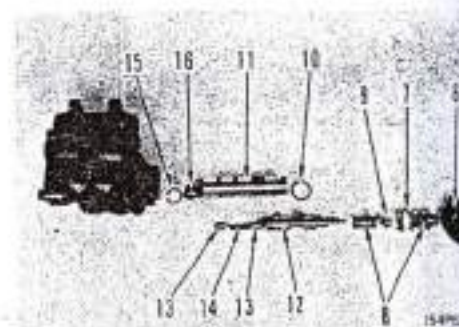
154P631



154P632

**2. Disassembly of modulating, reducing and quick return valve assembly****1) Disassembly of modulating valve**

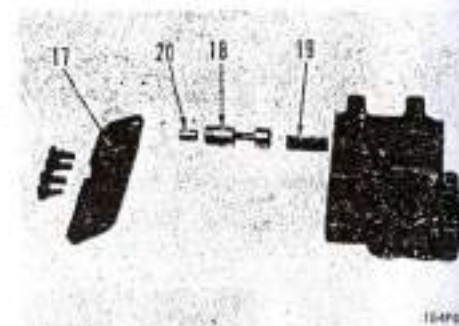
- i) Remove cover (6). Remove sleeve spring (7), valve spring (8), seat (9) and washer (10).
- ii) Extract sleeve (11) and valve (12) together and then separate them.
- iii) Remove piston (13) and spring (14) from valve (12).
- iv) Remove snap ring (15) from sleeve (11) and then remove stopper (16).



154P633

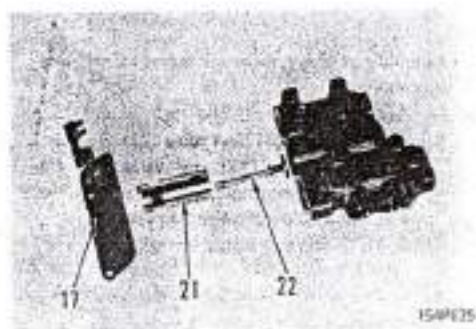
**2) Disassembly of reducing valve**

- i) Remove cover (17).
- ii) Extract valve (18) and spring (19).
- iii) Extract sleeve (20) and valve (22).



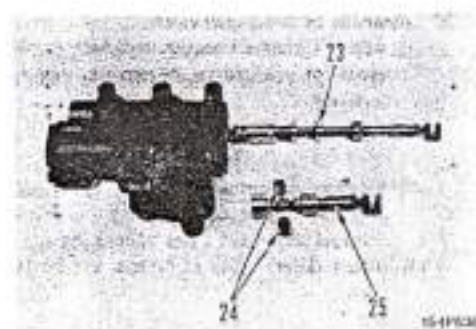
154P634

- 3) Disassembly of quick return valve  
 i) Remove cover (17).  
 ii) Extract sleeve (21) and valve (22).

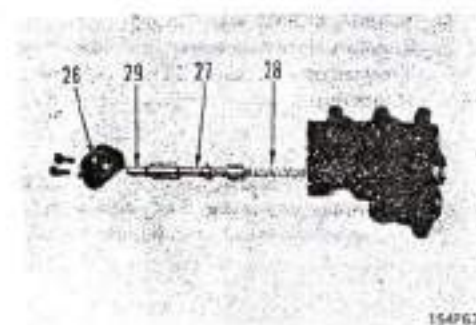


1. Disassembly of speed, directional and safety valve assembly

- 1) Disassembly of speed valve  
 Extract spool (23).  
 2) Disassembly of directional valve  
 Remove detent (24) and extract spool (25).



- 3) Disassembly of safety valve  
 i) Remove cover (26) and extract valve (27) and spring (28).  
 ii) Remove piston (29) from valve.

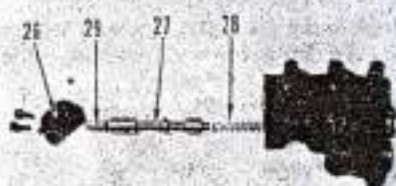


## ASSEMBLY OF TRANSMISSION CONTROL VALVE ASSEMBLY

## 1. Assembly of speed, directional and safety valve assembly

## 1) Assembly of safety valve

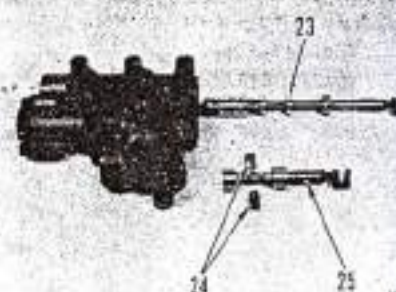
- i) Fit piston (26) into valve (27).
- ii) Insert spring (28) and valve (27) into body.  
★ Before assembly apply engine oil SAE 30 to outside of valve and piston.
- iii) Fit O-ring and install cover (26).



154F02

## 2) Assembly of directional valve

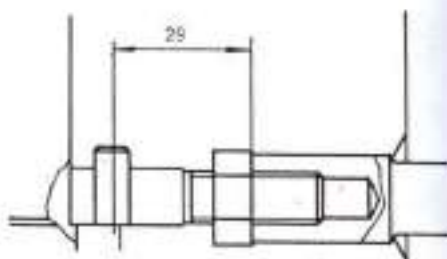
- i) Adjust distance between end face of nut and center of yoke to be 29 mm and then tighten lock nut.
- ii) Fit spool (25) into body.  
★ Apply engine oil SAE 30 to outside of spool and install spool by rotating it.
- iii) Install detent (24) from top and bottom of body.



154F03

## 3) Assembly of speed valve

- i) Adjust distance between end face of nut and center of yoke to be 29 mm and then tighten lock nut.
- ii) Install spool (23) into body.  
★ Apply engine oil SAE 30 to outside of spool and install spool by rotating it.

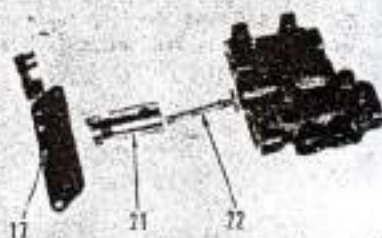


154F03

## 2. Assembly of modulating, quick return and reducing valve assembly

## 1) Assembly of quick return valve

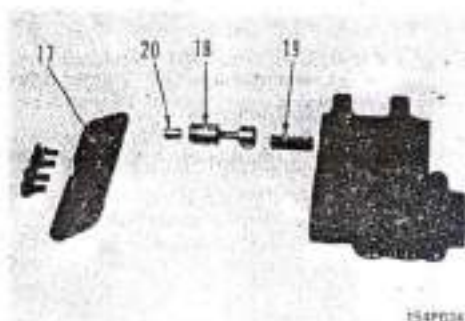
- i) Fit valve (22) onto sleeve (21), and install assembly onto body.  
★ Before assembly, apply engine oil SAE 30 to outside of sleeve.
- ii) Install cover (17).



154F05

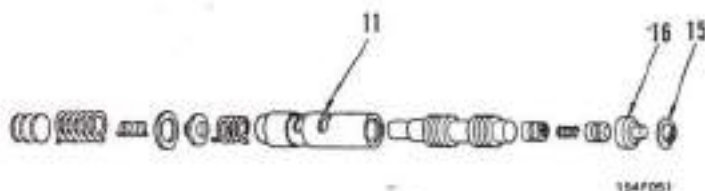
2) Assembly of reducing valve

- i) Fit piston (20) onto valve (18).
- ii) Install sleeve (19) and valve (18) onto body.  
\* Before assembly, apply engine oil SAE 30 to outside of valve.
- iii) Install cover (17).

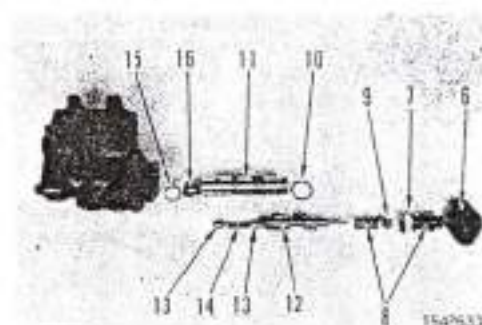


3) Assembly of modulating valve

- i) Install stopper (16) on sleeve (11) and install snap ring (15).
- \* Take care not to install stopper reverse way round.



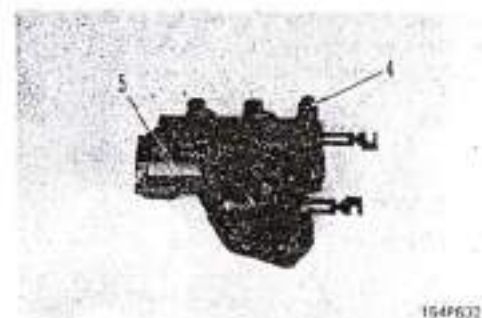
- ii) Install piston (13) and spring (14) onto washer (12).
- iii) Install valve (12) onto sleeve (11) and install assembly onto body.  
\* Before assembly, apply engine oil SAE 30 to outside of sleeve and valve.
- iv) Assemble washer (10), valve spring (8), seat (9) and sleeve spring (7). Install cover (6).



3. Assembly of control valve assembly

- i) Fit O-ring to valve seat (1). Install speed, directional and safety valve assembly (5) and tighten coupling bolt (4).

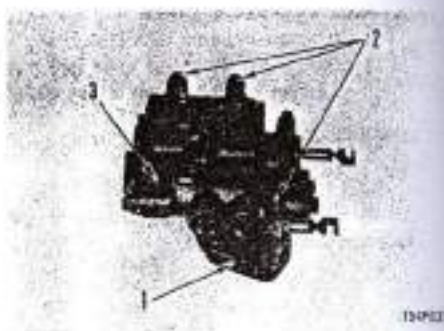
Through bolt:  $4.25 \pm 1.25$  kg.m





- 2) Fit O-ring to speed, directional and safety valve assembly. Install modulating, reducing and quick-return valve assembly (3). Tighten valve seat (1) and through-bolts (2).

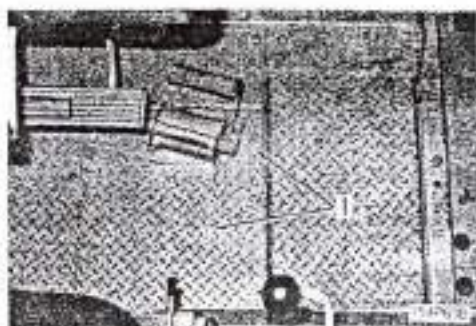
 Through bolts:  $4.25 \pm 1.25 \text{ kg.m}$



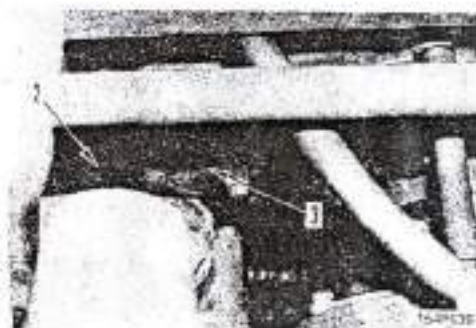
1349531

**DISMOUNTING TRANSMISSION LUBRICATION VALVE ASSEMBLY**

1. Remove two floor plates (1).
2. Disconnect lubricating valve outlet pipe (2).
3. Remove mounting bolts and remove transmission lubrication valve assembly (3).

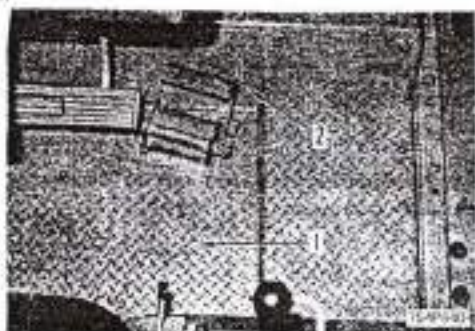
**MOUNTING TRANSMISSION LUBRICATION VALVE ASSEMBLY**

1. Fit gasket and mount transmission lubrication valve assembly (3).
2. Fit O-ring and connect up lubrication valve inlet and outlet pipes (2).
3. Install two floor plates (1).



## DISMOUNTING TRANSMISSION PUMP ASSEMBLY

1. Remove floor plate (1).
2. Disconnect decelerator pedal rod and remove floor plate (2).
3. Disconnect pump outlet tube (3) and inlet tube (4).
4. Remove pump assembly (5).



## MOUNTING TRANSMISSION PUMP ASSEMBLY

1. Fit O-ring to P.T.O case and install pump assembly (5).



2. Fit O-rings and connect pump outlet tube (3) and inlet tube (4).



Fit O-ring securely in groove.

3. Install floor plate (2) and connect decelerator pedal rod.



Bend cotter pin securely.

4. Install floor plate (1).



## DISMOUNTING STEERING PUMP ASSEMBLY

1. Remove engine left side cover (1).
2. Disconnect pump outlet tube (2) and inlet tube (3).
  - \* Sling inlet tube.
3. Remove pump assembly (4).



## MOUNTING STEERING PUMP ASSEMBLY

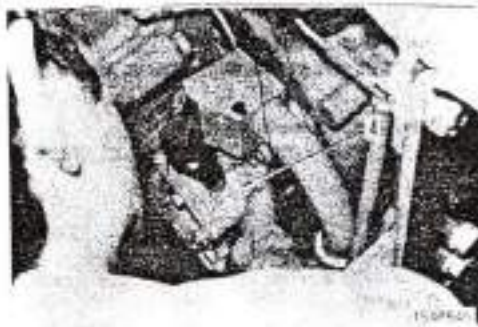
1. Fit O-ring to clutch housing side and install pump assembly (4).
2. Fit O-rings and connect pump outlet tube (3) and inlet tube (2).



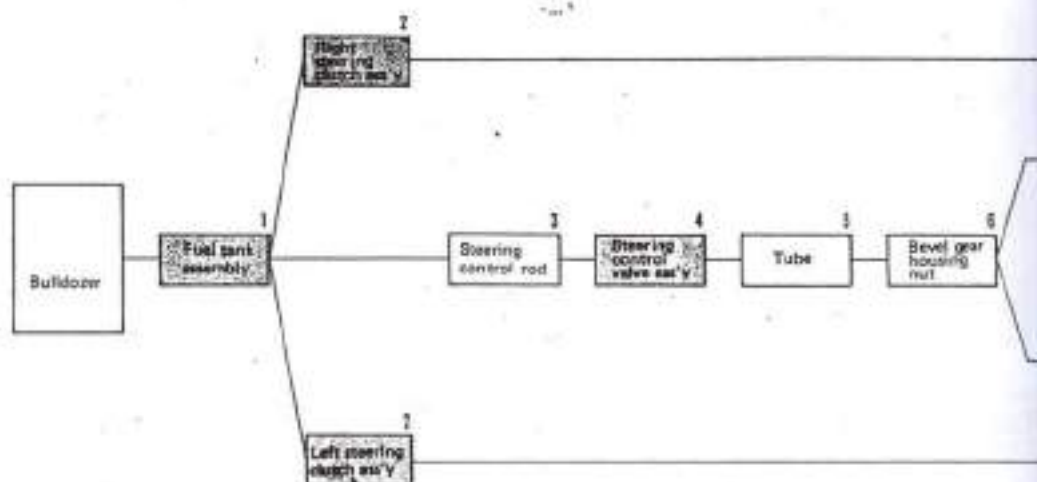
Fit O-ring securely in groove.



3. Install engine side cover (1).





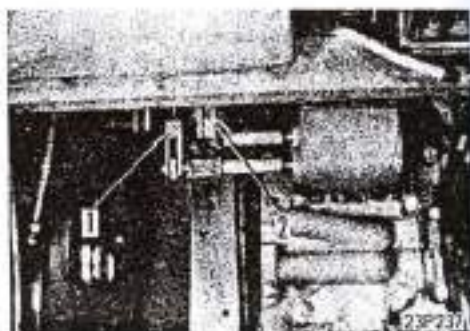
**DISMOUNTING BEVEL GEAR SHAFT AND BEVEL GEAR****Special tools**

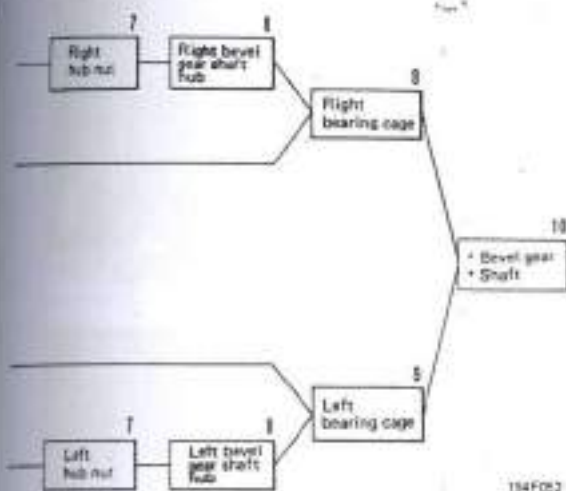
Part Name	A	B
Remover & installer	1	
Remover		1
Pump		1
Puller (50 ton)		1

- 1. Fuel tank assembly**  
See "DISMOUNTING FUEL TANK ASSEMBLY".
- 2. Steering clutch assembly**  
See "DISMOUNTING STEERING CLUTCH ASSEMBLY".
- 3. Steering control rod**  
Disconnect steering control rod valve operating rods (1) and (2).
- 4. Steering control valve assembly**  
Remove valve seat (3) mounting bolts and remove valve seat together with steering control valve assembly (4).



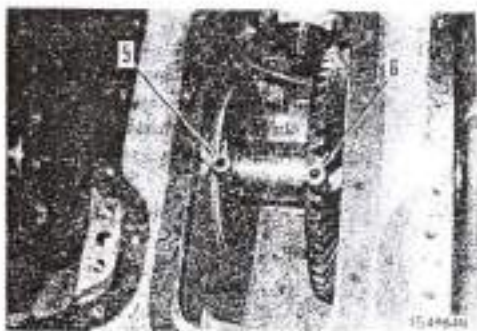
Steering control valve assembly: 65 kg





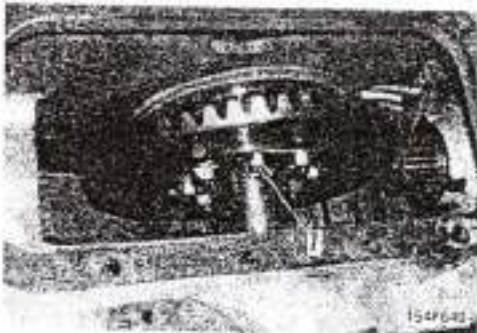
#### 5. Tube

Remove left clutch tube (5) and right clutch tube (6).



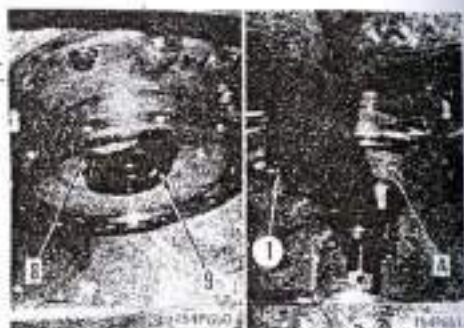
#### 6. Bevel gear mounting nuts

Lock bevel gear shaft using shaft hub bolt holes.  
Remove bevel gear mounting nuts (7).



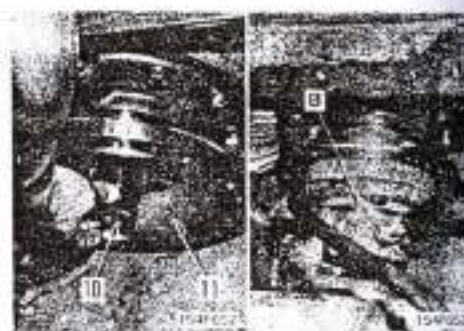
## 7. Hub nuts

- 1) Lift up lock plates (8) of left and right hub nuts.
- 2) Insert lock pin (1) in bevel gear shaft hub bolts hole. Using tool A, remove left and right hub nuts (9).



## 8. Bevel gear shaft hub

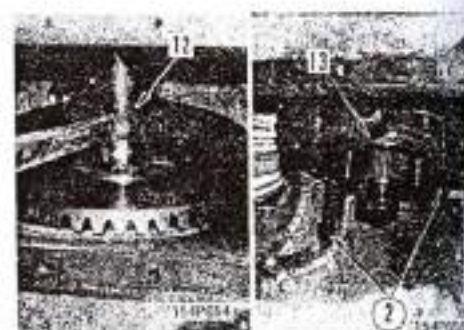
- 1) Remove left and right hubs and shaft gasket (10).
- 2) Set tool B and remove left and right bevel gear shaft hub (11).



## 9. Bearing cage

- 1) Sling bevel gear shaft (12).
- 2) Remove mounting bolts. Using extraction bolts (2) (14 mm, P = 2.0), length approx. 100 mm), remove left and right bearing cages (13).

\* Check number and thickness of left and right tooth contact adjusting shims. Store them in safe place.



## 10. Bevel gear and shaft

- 1) Lightly strike bevel gear to separate pilot bore part of shaft (12). Remove shaft from right clutch housing.



Shaft assembly: 35 kg

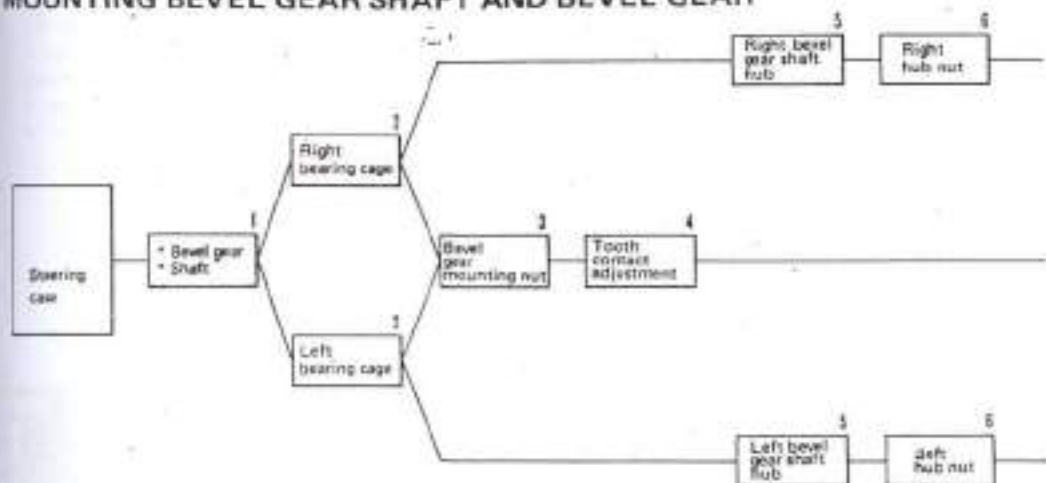
- 2) Remove bevel gear (13).



Bevel gear: 30 kg



## MOUNTING BEVEL GEAR SHAFT AND BEVEL GEAR

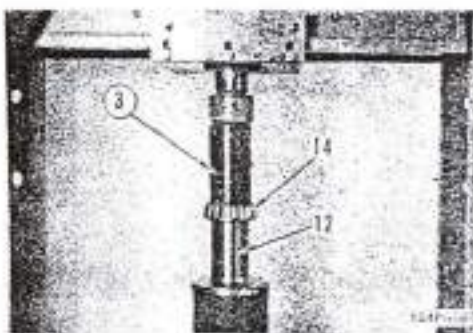


## Special tools

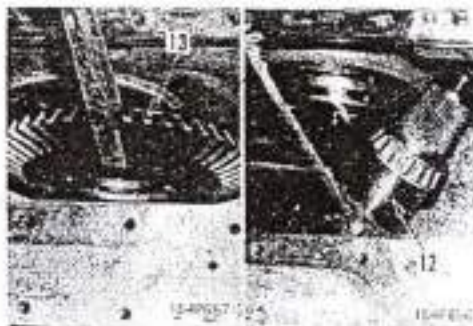
Part Name	A	C
Remover/installer	1	
Installer		1
Pump		1
Puller (50 ton)		1

## 1. Bevel gear and shaft

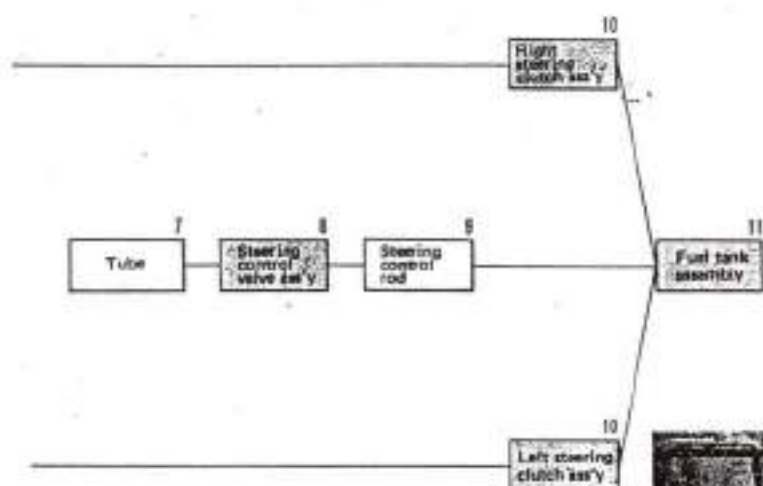
- 1) Press fit shaft (12) into left and right bearings (14) using push tool (3) (inside dia. 80 mm)



- 2) Set bevel gear (13) in bevel gear housing.
- 3) Insert shaft (12) from clutch housing and install it on bevel gear.

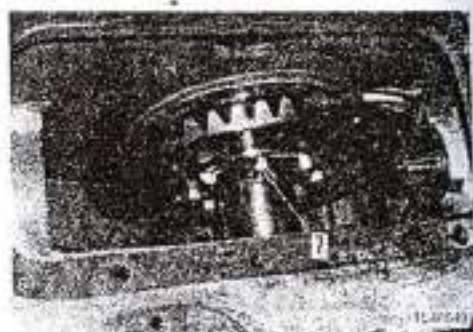






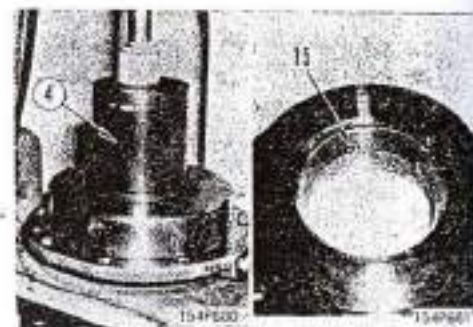
1547053

- 4) Fit hub nuts on both ends of shaft and raise shaft. Align bevel gear with pilot bore part of shaft.
- 5) Fit mounting bolts. Install lock plates and temporarily tighten nuts (7).
- \* When tightening bolts, check that chamfered part of bolt head is in firm contact with shaft.



## 2. Bearing cage

- 1) Press fit outer race (15) onto cage using push tool (4) ( $\phi 140$  mm).



- 2) Lift bevel gear shaft. Fit same shims as those removed during disassembly and install left and right bearing cages (13).

\* Standard shim thickness: 2.5 mm

\* Types of shims:  $t = 0.5$  mm,  $t = 0.25$  mm,  $t = 0.1$  mm



#### 1. Bevel gear mounting nut

Temporary fit bevel gear shaft hub. Insert retaining pin in hub bolt hole and tighten up bevel gear mounting nut (7).

 Mounting nut:  $39.25 \pm 4.25$  kg.m

\* Bend lock plates securely.



#### 4. Tooth contact adjustment

##### 1) Preload adjustment

Apply push-pull scale (5) square on to addendum of bevel gear and measure turning force of bevel gear.

\* Standard value: 2 to 3 kg (bevel gear mounted on bevel gear shaft)

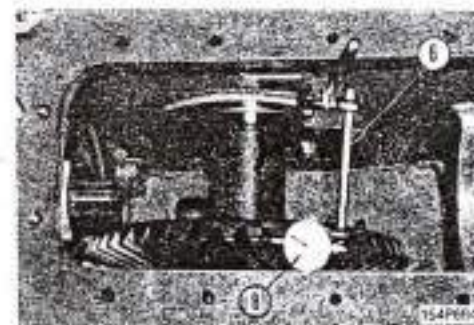
\* If turning force is greater than standard value, increase number of shims and vice-versa.



##### 2) Measurement and adjustment of backlash

###### 1) Dial gauge measurement

Fix stand (6) on steering case. Apply tip of dial gauge (8) square on to tooth face of bevel gear. Fix bevel pinion. Rotate bevel gear and measure backlash at a minimum of three diagonally opposite points.

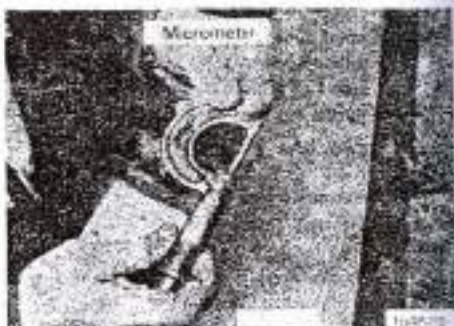


## ii) Fuse measurement

Insert fuse wire (41.5 mm) between bevel pinion and bevel gear forward side tooth face. Rotate bevel gear and measure thickness of fuse wire using micrometer (7).

★ Insert fuse in center part of bevel pinion tooth contact pattern (30% of distance from small end). Perform measurements at a minimum of three equidistant points around the pinion.

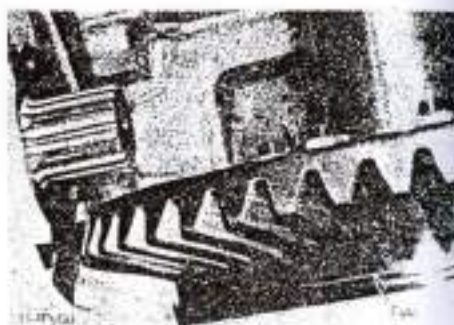
★ Standard value: 0.25 to 0.33 mm



## iii) Move shims on left and right steering case and bevel gear shaft bearing cage mounting face and also increase or decrease thickness of shims on bevel pinion cage mounting face to obtain specified backlash of 0.25 to 0.33 mm.

★ Make sure that shims corresponding in number and thickness to those removed are inserted in opposite bearing cage. If this is not done, rotational force will not remain constant.

★ When adjusting shims on piston side, first remove transmission assembly.



## 3) Tooth contact adjustment

Apply thin coating of red lead to tooth face of bevel pinion. Rotate bevel gear back and forth and inspect tooth contact pattern.

★ Ideally, tooth contact pattern should start from vicinity of small end and extend over about 30% of tooth length. It should be located in center of tooth face width. If adjustment is carried out in this manner, correct tooth contact will be obtained when load is applied.



If correct tooth contact pattern is not obtained, carry out adjustment once again according to directions given on following page.



- i) If bevel pinion is too far away from bevel gear center line, tooth contact pattern will appear on small end tooth face of convex face and large end tooth face of concave face of bevel gear.

To adjust tooth contact pattern, shift pinion shaft in a direction towards bevel gear by reducing thickness of shims in bevel pinion assembly cage and transmission case assembly, and then shift bevel gear by an equal amount in B direction using adjusting shims. Check tooth contact pattern and backlash.



- ii) If bevel pinion is too near bevel gear center line, tooth contact pattern will appear on large end tooth face of concave face and large end tooth face of convex face of bevel gear.

To adjust tooth contact pattern, shift pinion shaft in a direction away from bevel gear by increasing thickness of shims in bevel pinion assembly cage and transmission case assembly, and then shift bevel gear by an equal amount in B direction using adjusting shims. Check tooth contact pattern and backlash.




- ★ To increase or decrease adjusting shims on bevel pinion side, remove transmission assembly, remove bevel pinion assembly mounting bolts and pull out assembly with extraction bolts by an amount sufficient to permit adjustment of shims.
- ★ When moving bevel gear to adjust, transfer adjusting shims on both sides by equal amounts (i.e. by amount removed) to opposite side so as to maintain constant preload on bearing.

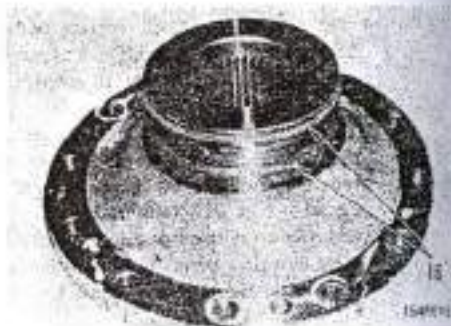
- ★ If transmission is replaced as a complete unit, readjust backlash and tooth contact according to above procedure.



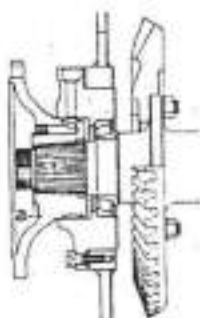
## 5. Bevel gear shaft hub

- 1) Fit seal ring (16) to bevel gear shaft.
- 2) Fit left and right bevel gear shaft hubs (11) together with taper separation parts to bevel gear shaft.

 Taper separation part: Anti-friction compound

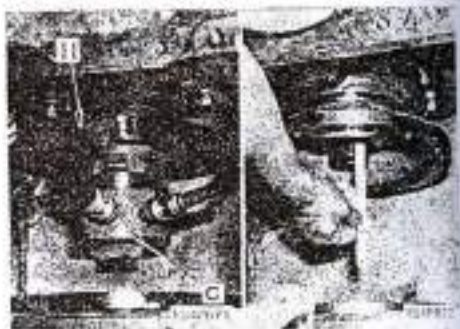


- 3) Set tool C and press fit left and right bevel gear shaft hubs.
  - \* Pressure: 30 to 40 ton
- 4) After press fitting hubs, measure dimension "A" between bevel gear shaft stepped part and bevel gear shaft hub end face.
  - \* Standard dimension: 5 to 6.5 mm
  - \* Be sure to check that bevel gear shaft hub is not inserted any further than stepped part of bevel gear shaft.



154F001

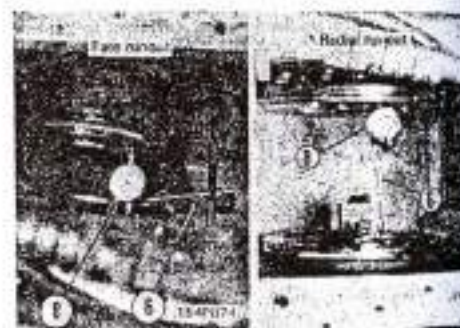
- 5) Fit gasket on bevel gear shaft hub and bevel gear shaft (10).



## 6. Hub nut

- 1) Fix stand (8) to steering case and measure face runout and radial runout of hub with dial gauge (8).

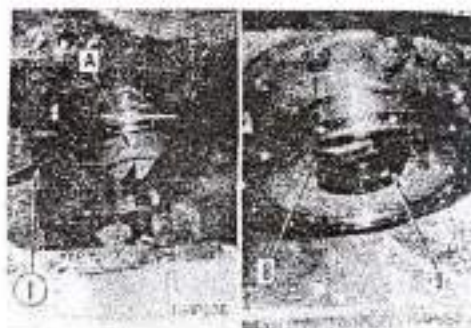
\* Standard values: face runout 0.15 mm  
radial runout 0.15 mm



- 2) Fit retaining pin (1) in bevel gear shaft hub bolt hole. Install lock plate (8), and tighten hub nut (9) using tool A.

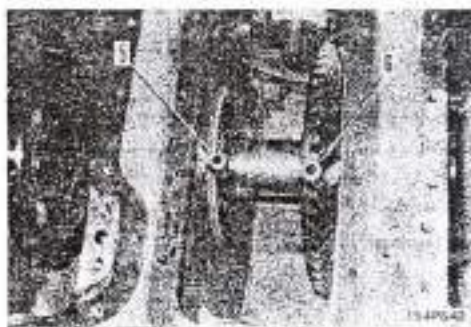
 Hub nut: 70±5 kg.m

• Bend lock plate securely.



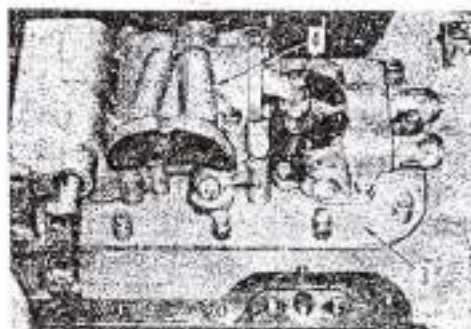
#### 7. Tube

- Fit O-ring and install left clutch tube (5) and right clutch tube (6).



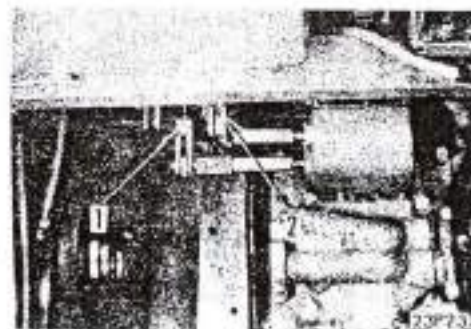
#### 8. Steering control valve assembly


- 1) Fit gasket to steering case.  
2) Raise valve seat (3) together with steering control valve assembly (4). Align it on mounting part and tighten mounting bolts.



#### 9. Steering control rod

- Connect steering control valve operating rods (1) and (2).



-  Bend cotter pin securely.

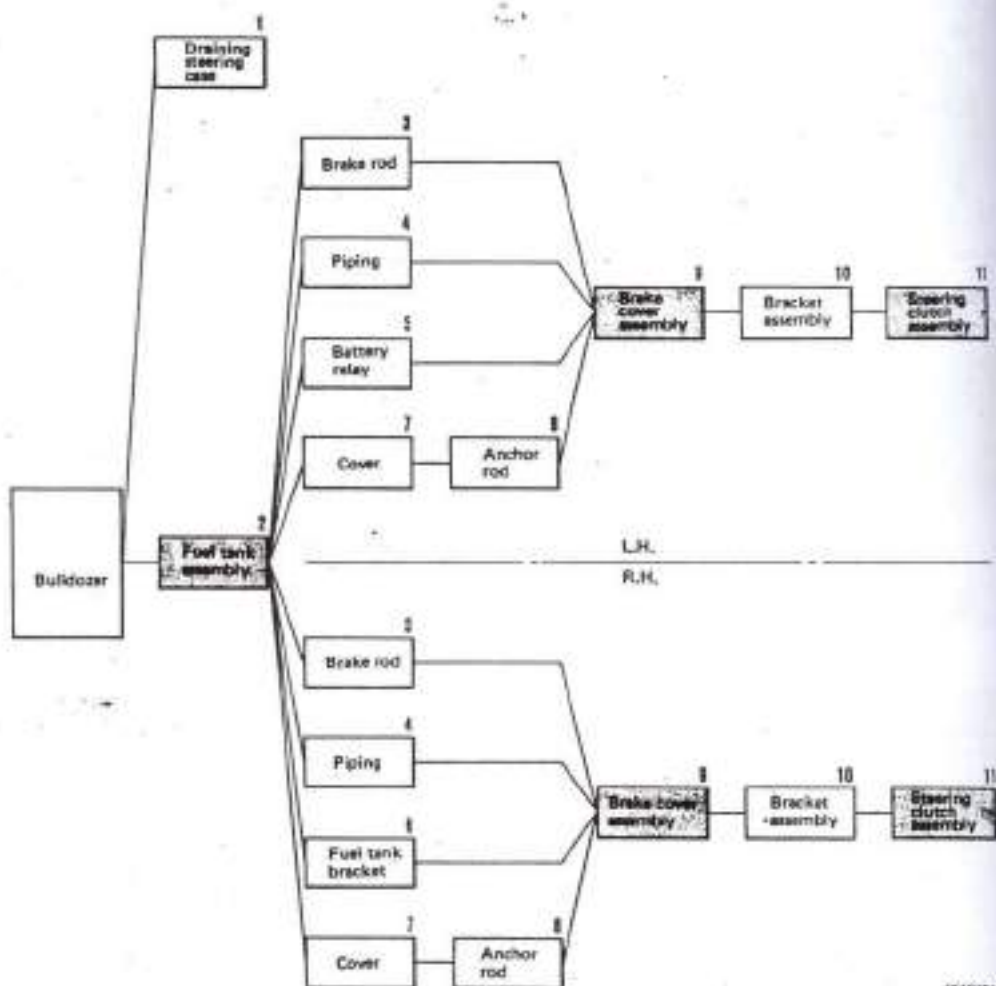
#### 10. Steering clutch assembly

See "MOUNTING STEERING CLUTCH ASSEMBLY".

#### 11. Fuel tank assembly

See "MOUNTING FUEL TANK ASSEMBLY".

## DISMOUNTING STEERING CLUTCH ASSEMBLY



154F054

1. Draining steering case  
Remove drain plug (1) and drain off oil in steering case.



Steering case:

TY 220 902

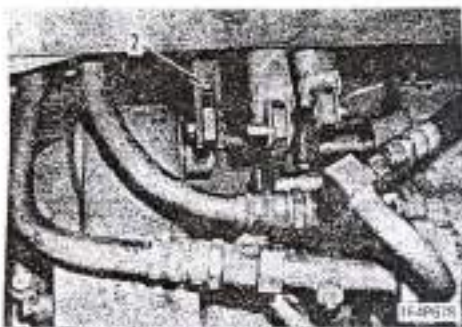
2. Fuel tank assembly  
See "DISMOUNTING FUEL TANK ASSEMBLY".





**3. Brake rod**

Disconnect left and right brake rods (2).

**4. Piping**

(When dismantling left steering clutch)

1) Disconnect hose (3) between servo valve and steering valve inlet tube.

2) Disconnect steering control valve inlet tube (4) and outlet tube (5).

3) Disconnect hose (6) between brake valve and brake cover, at cover side.

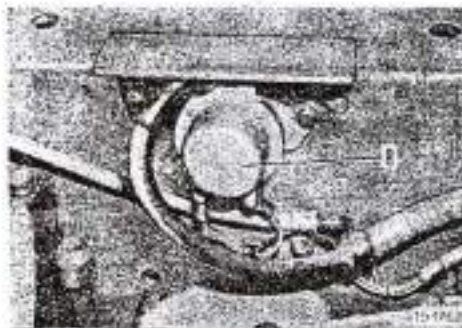
(When dismantling right steering clutch)

4) Disconnect hose (7) between brake valve and brake cover, at cover side.

**5. Battery relay**

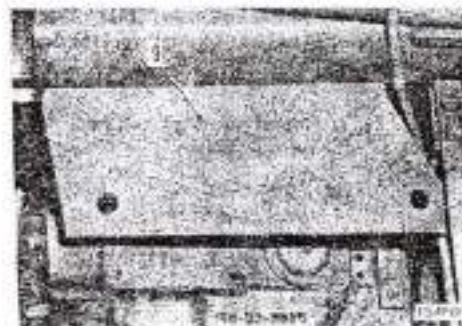
(When dismantling left steering clutch)

Remove battery relay (8) together with bracket.

**6. Fuel tank bracket**

(When disconnecting right steering clutch)

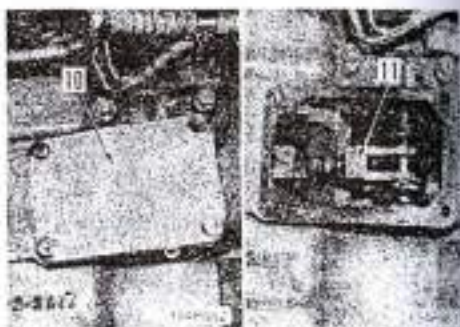
Remove fuel tank bracket (9).





**7. Cover**

Remove cover (10).

**8. Anchor rod**

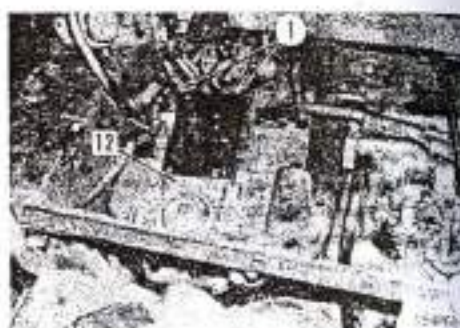
Disconnect anchor rod (11).

**9. Brake cover assembly**

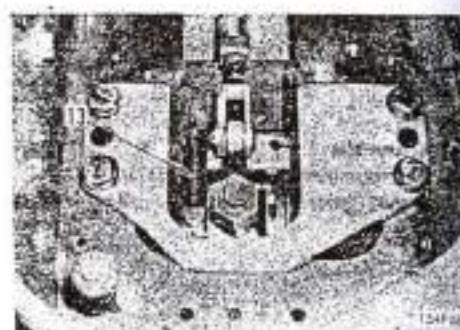
Temporary lift brake cover assembly (12) with eye bolts ① (12 mm, P = 1.75). Separate it from steering case using extraction bolts and remove it.



Brake cover assembly: 45 kg

**10. Bracket assembly**

- 1) Remove brake lever return spring (13).
- 2) Remove mounting bolts.



- 3) Lift up bracket assembly (14). Extract brake band and rod connecting pin (15) and remove assembly.

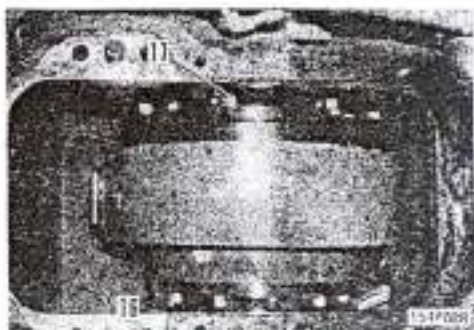


Bracket assembly: 35 kg



## 11. Steering clutch assembly

- 1) Remove inner drum mounting bolts (16) and outer drum mounting bolts (17).



- \* Apply jack (2) to grouser part of track. Gradually turn track and remove bolts.



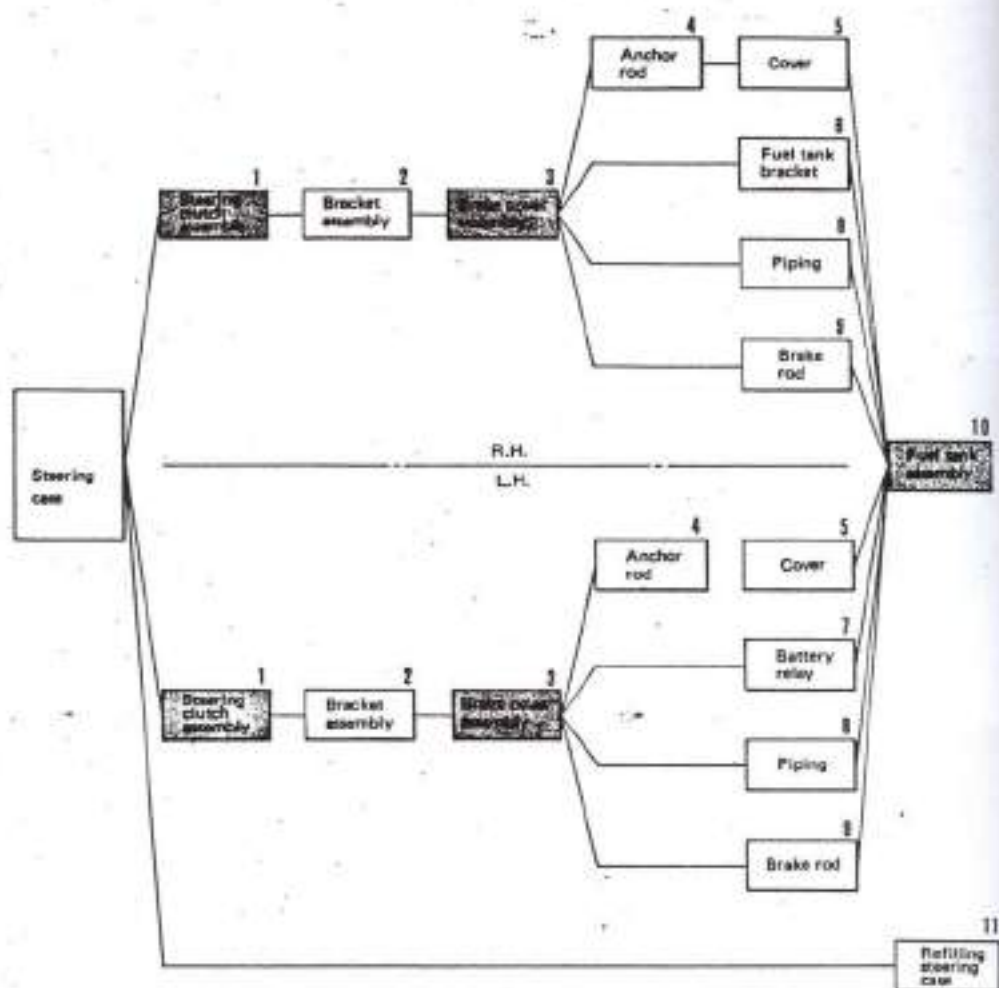
- 2) Install pin on brake band. Lift steering clutch assembly with wire. Shift inner drum to inner side of steering case, remove pilot bore part and dismount assembly.



Steering clutch assembly: 125 kg



## MOUNTING STEERING CLUTCH ASSEMBLY



194705

## 1. Steering clutch assembly

- 1) Install pin on brake band. Lift steering clutch assembly (18) with wire and align it on steering case.

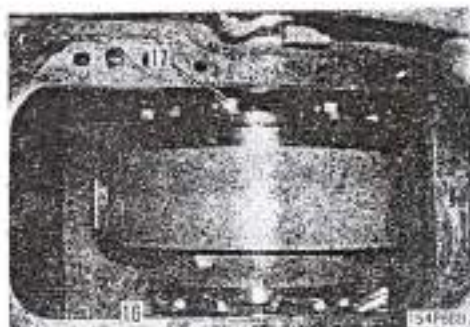
\* Install brake band so that pin is at rear of steering clutch assembly.







- 2) Align final drive flange with brake drum and bevel gear hub with pilot bore part of clutch drum. Tighten outer drum mounting bolts (17) and inner drum mounting bolts (16).

\* Apply jack ② to grouser part of track. Gradually turn track and remove bolts.




 Outer drum mounting bolts:  
39.25±4.25 kg.m

 Inner drum mounting bolts:  
28.25±3.25 kg.m




#### 1. Bracket assembly

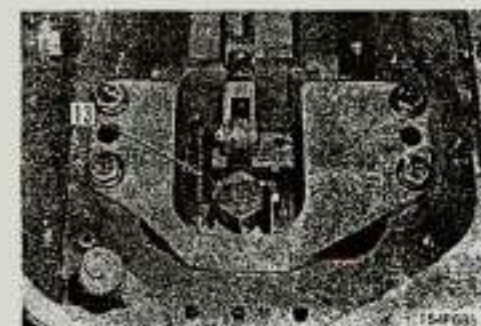
- 1) Lift bracket assembly (14) and install brake band and rod connecting pin (15).

 Bend cotter pin securely.



- 2) Tighten mounting bolts and install brake band return spring (13).

 Mounting bolts: 39.25±4.25 kg.m





## 3. Brake cover assembly


- 1) Fit gasket to steering case.
- 2) Lift assembly with eye bolts ① (12 mm, P = 1.75).  
Align brake cover assembly (12) on case.
- 3) Tighten cover mounting bolts uniformly.

 Mounting bolts:  $11.25 \pm 1.25$  kg.m



## 4. Anchor rod

- 1) Connect up anchor rod (11).

 Bend cotter pin securely.

- 2) Brake adjustments

- i) Tighten brake adjusting bolt (19).

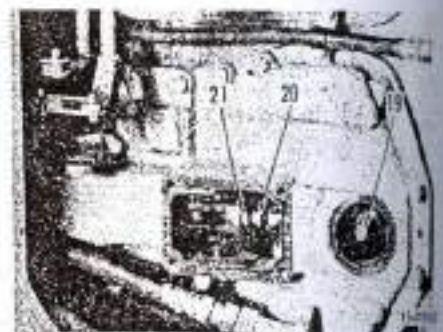
 Adjusting bolt: 5 kg.m

- ii) Tighten adjusting turnbuckle bolt (20) to a torque of approx. 2 kg.m. Eliminate clearance between piston and roller and tighten up lock nut (21).

- iii) Slacken off brake adjusting bolt by 1-1/8 turn.

\* This will result in clearance between brake lining and drum of about 0.3 mm.

\* Check that adjusting bolt is securely locked with lock plate.



## 5. Cover

- 1) Fit O-ring and tighten adjusting bolt cover (22).

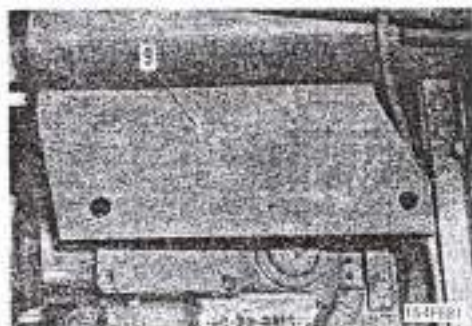
 Cover:  $3 \pm 0.5$  kg.m

- 2) Fit gasket and install cover (10).



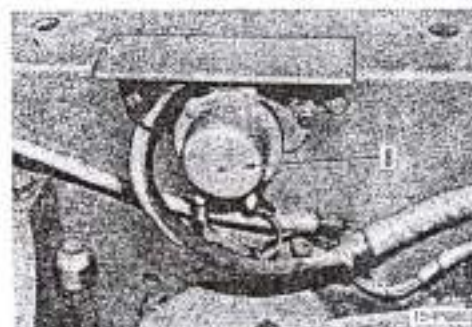
## 6. Fuel tank bracket

(When mounting right steering bracket)  
Install fuel tank bracket (9).



## 7. Battery relay

(When left mounting left steering clutch)  
Install battery relay (8).



## E. Piping

⊕ Fit O-ring properly in groove and install hose without twist or interference.

(When mounting right steering clutch)

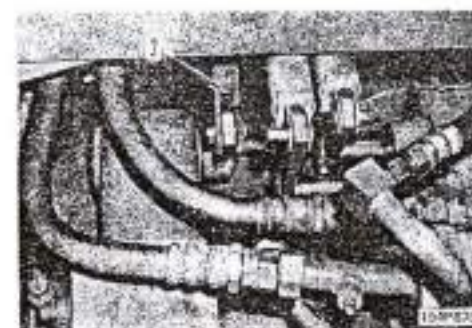
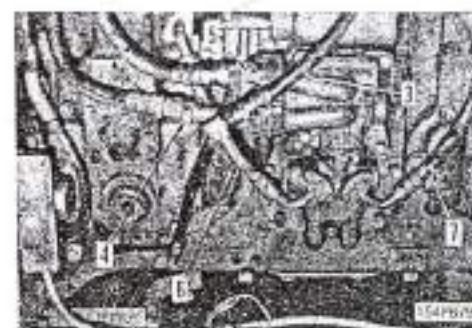
1) Fit O-ring and connect hose (7) between brake valve and brake cover.

(When mounting left steering clutch)

2) Fit O-ring and connect hose (6) between brake valve and brake cover.

3) Fit O-ring and connect steering control valve inlet tube (4) and outlet tube (5).

4) Connect hose (3) between servo valve and steering valve inlet tube.



## 8. Brake rods

Connect left and right brake rods (2).

⊕ Bend cotter pin securely.

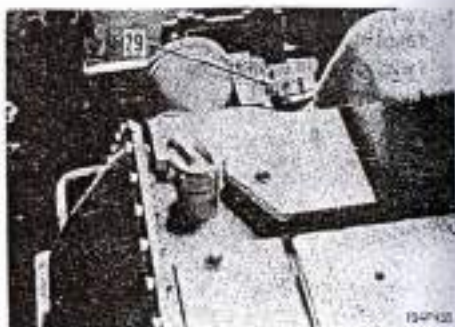
## 10. Fuel tank assembly

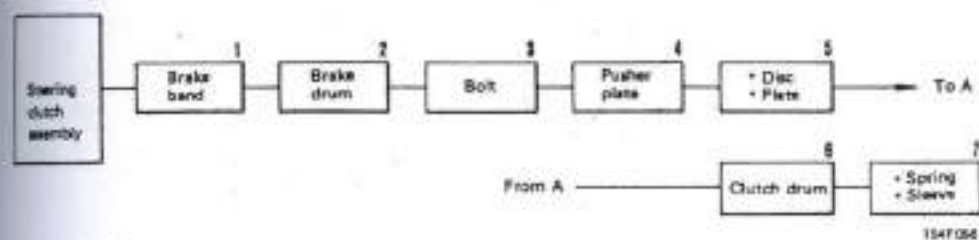
See "MOUNTING FUEL TANK ASSEMBLY".

## 11. Refilling steering case

- 1) Fit O-ring and tighten drain plug.
- 2) Refill steering case through oil filler (29) until specified oil level is reached.

★ Run engine to circulate oil through steering system. Check oil level again.



**DISASSEMBLY OF STEERING CLUTCH ASSEMBLY****Special tools**

Part Name	A
Compressor	1
Pin	1
Puller (30 ton)	1

**1. Brake band**

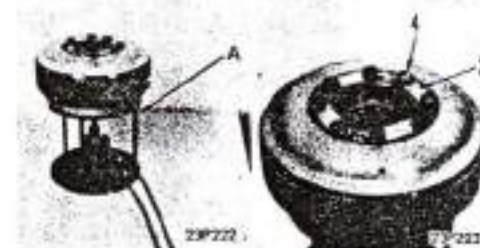
Remove brake band (1).

**2. Brake drum**

Fit eye bolts (1) (18 mm, P = 2.5) and lift out brake drum (2).

**3. Bolt**

- 1) Install clutch assembly on tool A (compressor).
- 2) Flatten out lugs on lock plates (3). Extend tool A (puller) and remove bolts (4).





**4. Pressure plate**

Retract tool A and remove push plate (5).

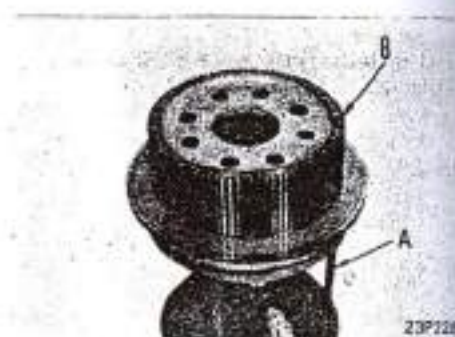
**5. Discs and plates**

Remove discs (6) and plates (7).

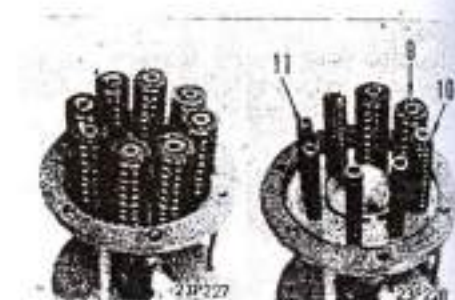
\* After removal, place discs and plates on a flat surface to prevent them warping.

**6. Clutch drum**

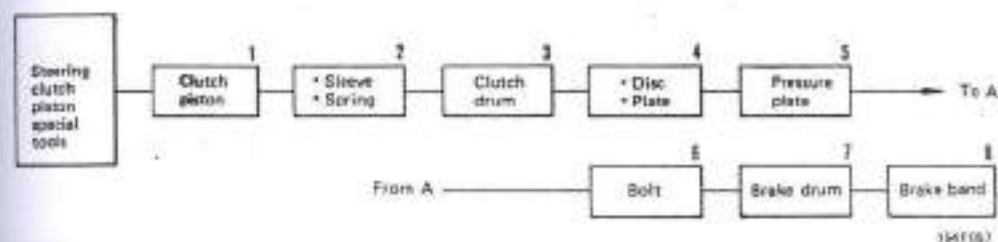
Remove clutch drum (8) by removing connecting bolts from tool A (compressor).

**7. Springs and sleeves**

Remove large springs (9), small springs (10) and sleeves (11).



## ASSEMBLY OF STEERING CLUTCH ASSEMBLY

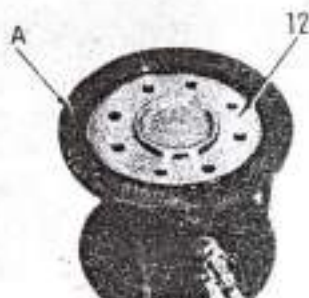


## Special tools

Part Name	A
Compressor	1
Pump	1
Puller (30 ton)	1

## 1. Clutch piston

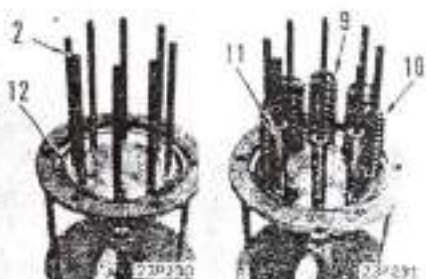
Install seal ring to clutch piston (12). Set piston on tool A (puller) after aligning center of piston with center of tool.



23P229

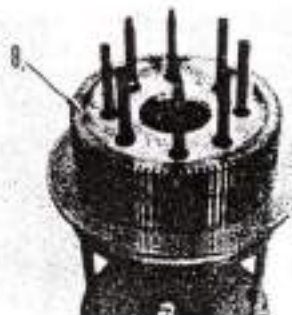
## 2. Sleeves and springs

Insert guide bolts (2). Install sleeves (1,1), small spring (10) and large spring (9).



## 3. Clutch drum

Align clutch drum (8) and temporary insert bolts into tool A (compressor).

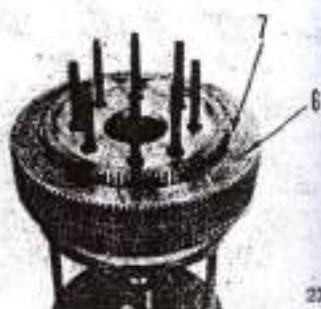


23P232

## 4. Plates and discs

Install discs (6) and plates (7).

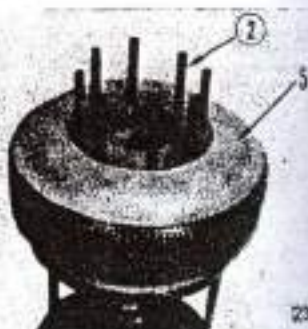
\* Before assembly, apply engine oil SAE 30 to sliding faces of discs and plates.



23P231

## 5. Pressure plate

Install pressure plate (5).



23P234

## 6. Bolts

Extend puller and remove guide bolts. Fit lock plates (3) and tighten bolts (4).

\* Bend lock plates securely.



23P235

## 7. Brake drum

- 1) Extend puller and free plates and discs. Lift brake drum with eye bolts (1) (18 mm, P = 2.5). Align teeth of discs and gradually assembly them.
- 2) Remove clutch assembly from tool A.



23P236

8. Brake band  
Install brake band (1).



154P665

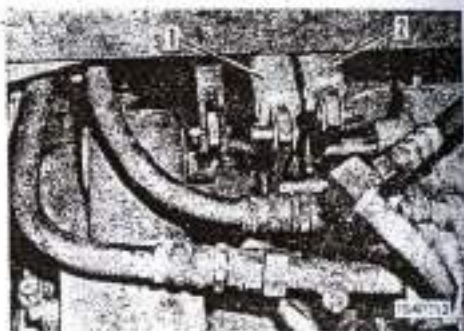


## DISMOUNTING STEERING CONTROL VALVE ASSEMBLY

1. Remove fuel tank assembly while referring to "DISMOUNTING FUEL TANK ASSEMBLY".
2. Disconnect steering control rods (1) and (2).
3. Disconnect hose (3) between steering control valve inlet tube and servo valve.
4. Disconnect steering control valve inlet tube (4) and outlet tube (5).
5. Remove tube (6) between steering control valve and brake valve.
6. Remove four mounting bolts (7) and remove steering control valve assembly (8).



Steering control valve assembly: 40 kg



## MOUNTING STEERING CONTROL VALVE ASSEMBLY

1. Install two drain tubes on seat (9).
2. Fit O-ring and locate steering control valve assembly (8) on seat.
3. Tighten mounting bolts (7).
4. Fit O-ring and connect tube (6) between steering control valve and brake valve.
5. Fit O-ring and connect steering control valve inlet tube (4) and outlet tube (5).
6. Connect hose (3) between steering control inlet valve inlet tube and servo valve.
7. Connect steering control rods (1) and (2).



Bend cotter pin securely.

8. Install fuel tank assembly while referring to "MOUNTING FUEL TANK ASSEMBLY".

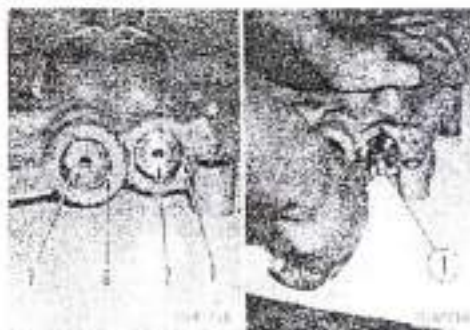


## DISASSEMBLY OF STEERING CONTROL VALVE

## DISASSEMBLY OF MAIN RELIEF VALVE

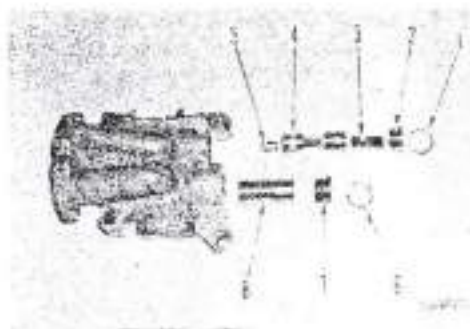
## 1. Relief valve

- 1) Remove snap ring (1).
- 2) Extract stopper (2). Tighten extraction bolt (1) (8 mm, P = 1.25). Remove relief valve by pulling extraction bolt and pliers, etc.
- 3) Remove spring (3), valve (4) and piston (5) from housing.



## 2. Piston

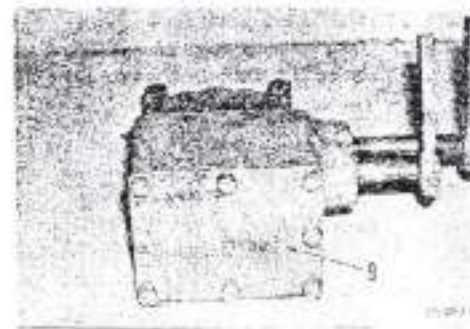
- 1) Remove snap ring (6).
- 2) Insert extraction bolts (1) (8 mm, P = 1.25) into stopper. Remove piston by pulling extraction bolt and pliers, etc.
- 3) Remove piston (8) from housing.



## DISASSEMBLY OF STEERING CONTROL VALVE

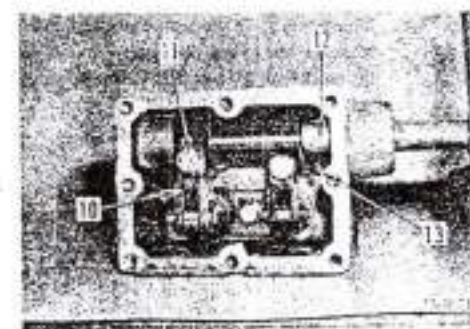
## 3. Cover

- Remove cover (9).



## 4. Right lever shaft

- 1) Loosen mounting bolt (11) of lever (10).
- 2) Remove wire and remove lock bolts (13) of bush (12).

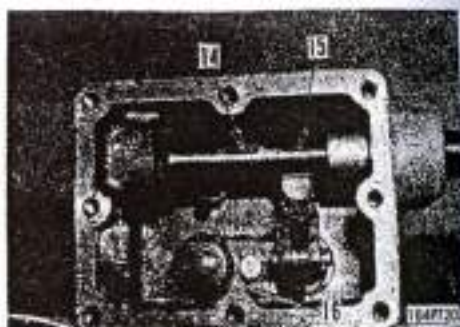


- 3) Remove key (14) and extract lever shaft (15).

★ When extracting lever shaft, be careful not to damage oil seal lip surface at shaft side key groove edges.

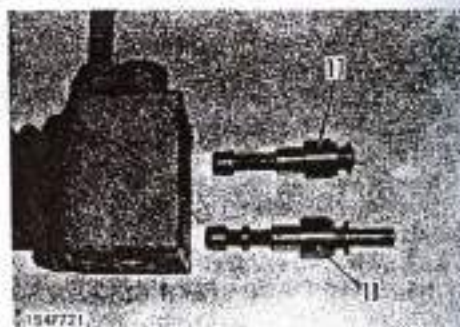
5. Plate

Remove plate (16).



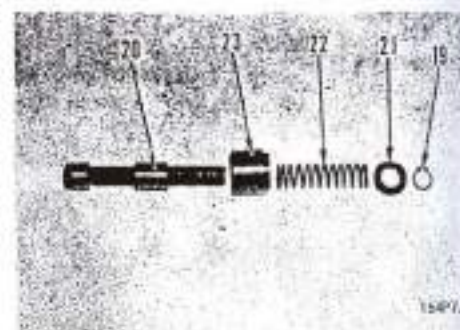
6. Left and right steering clutch spools

- 1) Extract left spool assembly (17) and right spool assembly (18) from housing.



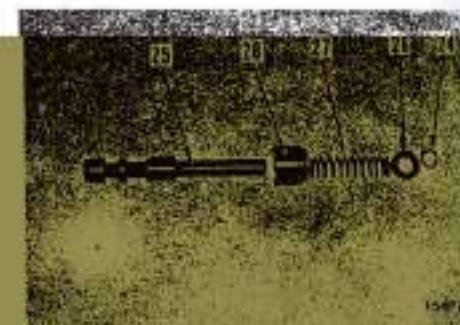
2) Disassembly of left spool assembly

Take off snap ring (19) and remove washer (21), spring (22) and bush (23) from spool (20).



3) Disassembly of right spool assembly

Remove snap ring (24) and remove washer (26), spring (27) and bush (28) from spool (25).





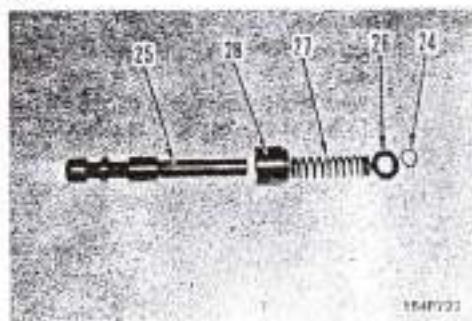
## DISASSEMBLY OF MAIN RELIEF VALVE

## ASSEMBLY OF STEERING CONTROL VALVE

## 1. Left and right steering clutch spool

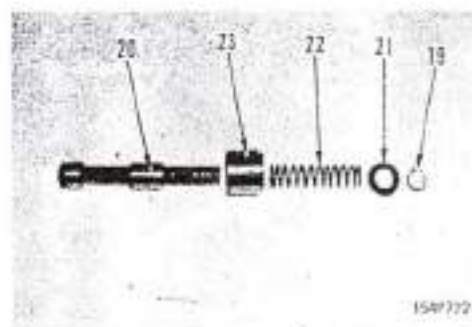
## 1) Assembly of right spool assembly

Assemble bush (28), spring (27) and washer (26) on spool (25). Install snap ring (24).



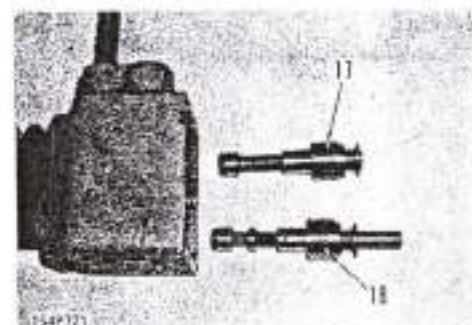
## 2) Assembly of left spool assembly

Assemble bush (23), spring (22) and washer (21) on spool (20). Fit snap ring (19).



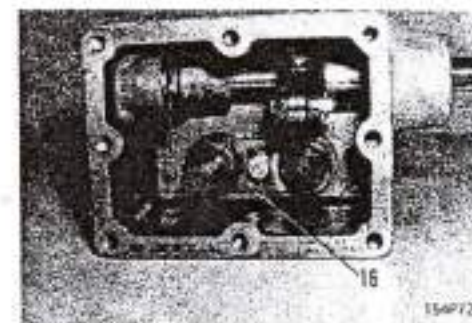
## 3) Fit right spool assembly (16) and left spool assembly (17) into housing.

\* Apply engine oil to outer surface of spools.  
Fit spools while rotating them.



## 2. Plate

Install plate (15).



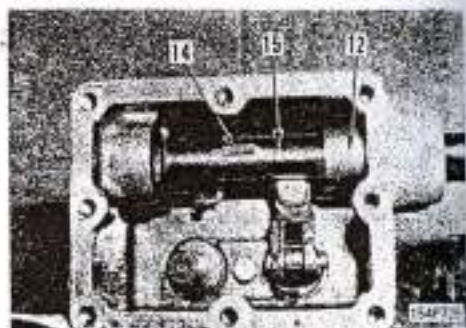


## 3. Right lever shaft

- 1) Push lever shaft (15) into housing. Fit bush (12) on shaft.

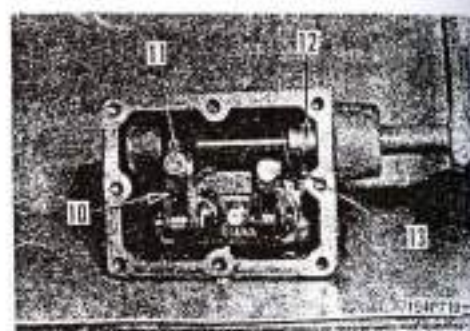
★ When pushing on shaft, take care not to damage lip face of oil seal.

- 2) Drive in key (14) into shaft.



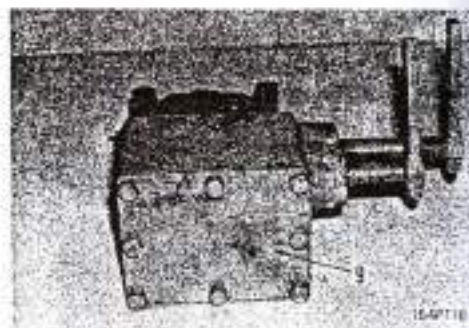
- 3) Fit lever (10) on shaft and tighten bolt (11).

- 4) Align bush and shaft locating bolt hole. Tighten lock bolt (13), and lock it securely with wire.



## 4. Cover

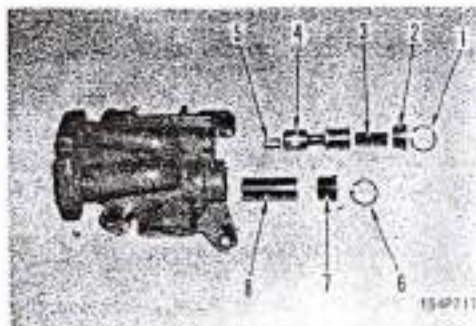
- Fit gasket and install cover (9).



## ASSEMBLY OF MAIN RELIEF VALVE

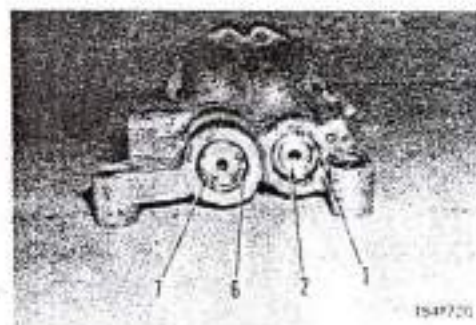
## 5. Piston

- 1) Install piston (8) into housing.
  - \* Apply engine oil SAE 30 to outside of piston before installing it.
- 2) Fit O-ring and install stopper (7). Install snap ring (6).



## 6. Relief valve

- 1) Install piston (5) onto valve (4).
- 2) Install piston, valve assembly and spring (3) in housing.
  - \* Apply engine oil SAE 30 to outside of piston before installing it.
- 3) Fit O-ring and install stopper (2). Install snap ring (1).



**DISMOUNTING BRAKE SAFETY VALVE ASSEMBLY**

1. Remove three rear covers (1).
2. Disconnect brake safety valve outlet hoses (2) and (3).
3. Remove tube (4) between steering control valve and brake safety valve.
4. Remove brake safety valve (5).

**MOUNTING BRAKE SAFETY VALVE ASSEMBLY**

1. Fit O-ring and mount brake safety valve assembly (5) on seat (6).
2. Fit O-ring and install tube (4) between steering control valve and brake safety valve.
3. Fit O-ring and connect brake safety valve outlet hoses (2) and (3).
4. Install three rear covers (1).



**DISASSEMBLY OF BRAKE SAFETY VALVE****1. Safety valve**

- 1) Remove cap nut (1) and remove spring (2) and plunger (3).
- 2) Loosen lock nut (4) and remove seat (5).

**2. Piston**

- Remove snap ring (6) and stopper (7) and remove piston (8).

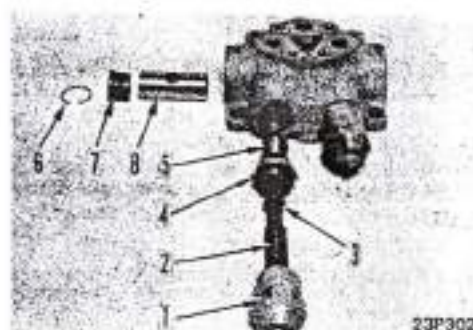
**ASSEMBLY OF BRAKE SAFETY VALVE****1. Piston**

- Install piston (8) into valve body, insert stopper (7) and install snap ring (6).

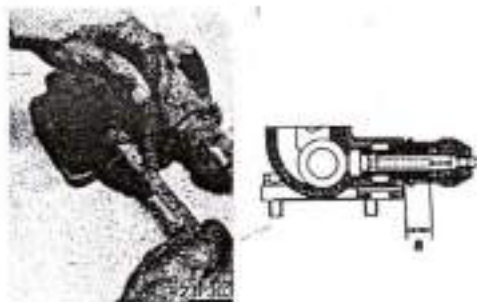
\* Apply engine oil SAE 30 to piston before installing it.

**2. Safety valve**

- 1) Fit seat (5) into body and tighten lock nut (4).
- 2) Install plunger (3) and spring (2). Tighten cap nut (1).



- \* Adjust pressure so that standard dimension "A" between end face of valve body and end face of plunger seat assembly is 27 mm (17 kg/cm<sup>2</sup>).





## DISASSEMBLY OF BRAKE BOOSTER

## 1. Brake booster assembly

Flatten out lugs on lock plate (1) and remove mounting bolts (2). Remove brake booster assembly (3) from housing (4).

## 2. Spring

Remove snap ring (5). Remove retainer (6) and spring (7) from spool (8).



Remove snap ring while firmly holding retainer. If this is not done, retainer and spring will fly out due to spring compression force when snap ring is removed.

\* Spring mounting load: 10 kg

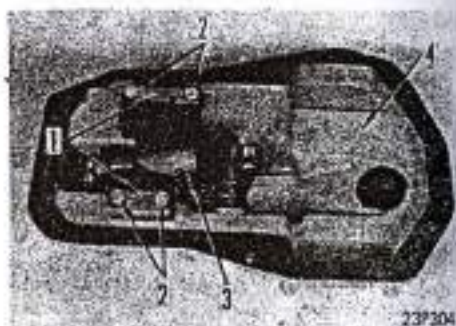
## 3. Piston

Extract piston (9) from valve body (10).

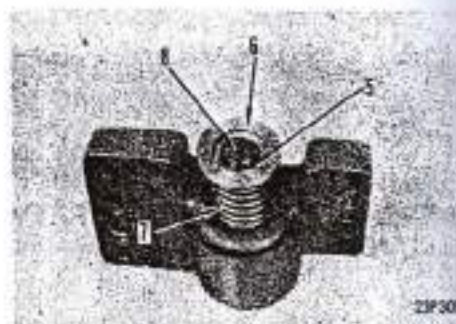
\* When extracting piston, be careful not to damage sliding parts of piston or valve body.

## 4. Spool

Remove spool (8) from valve body (10).



23P204



23P308

## ASSEMBLY OF BRAKE BOOSTER

\* Before assembly, thoroughly clean various constituent parts and apply engine oil SAE 30 thereto.

## 1. Spool

Install valve body (10) and spool (8).

\* Install spool so that taper seal face is on piston side.

## 2. Piston

Install piston (9) on valve body (10).

## 3. Spring

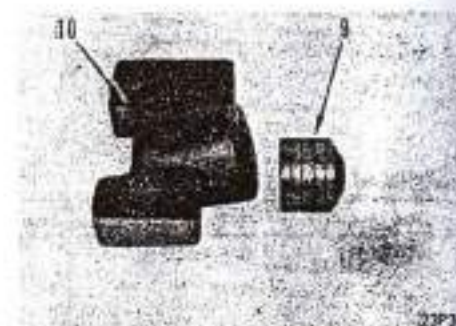
Fix valve body. Install spring (7) and retainer (6) on spool and secure assembly with snap ring (5).

## 4. Brake booster assembly

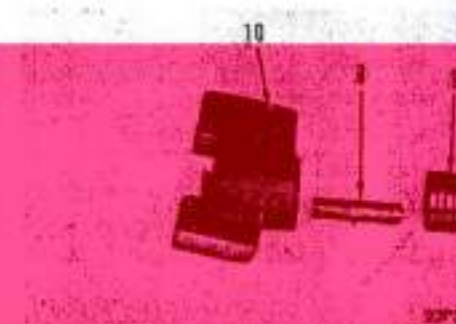
1) Fit O-ring to booster mounting face and fix booster assembly (3) to housing (4).

2) Fit lock plate (1) and tighten up mounting bolts (2).

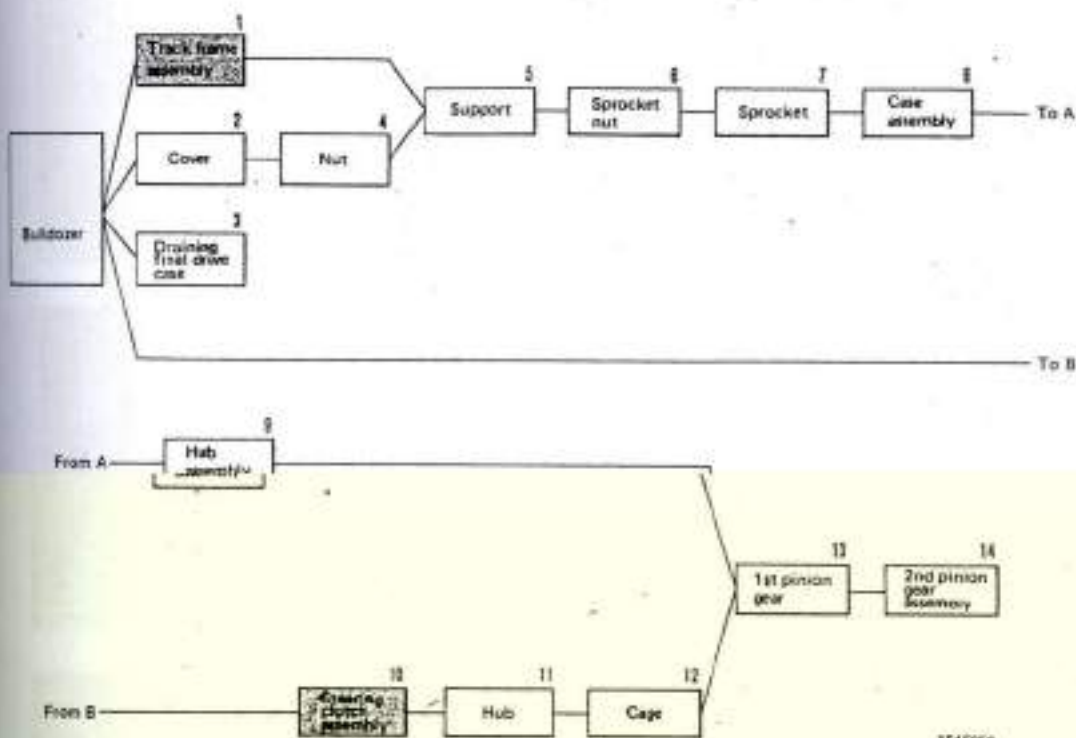
\* Bend lock plate securely.



23P306



23P309

**DISASSEMBLY OF FINAL DRIVE ASSEMBLY**

154F050

**Special tools**

Part Name	A	B	C	D	E	F	G	H
Remover, D KIT	1							
Pump	1				1	1		
Puller (50 ton)	1							
Remover & installer		1						
Wrench			1					
Remover & installer				1				
Remover A					1			
Cylinder (70 ton)					1	1		
Remover						1		
Lifting tool							1	
Scrap								1

## 1. Track frame assembly

See "MOUNTING TRACK FRAME ASSEMBLY".

## 2. Cover

Remove cover (1).



## 3. Draining final drive case

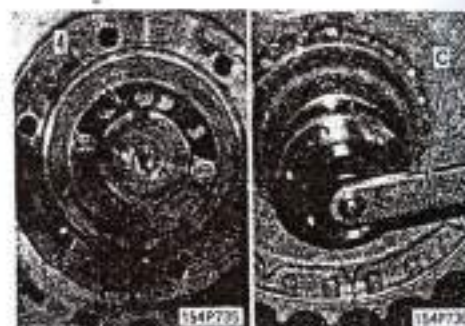
Remove drain plug (2) and drain off oil in final drive case. If oil does not drain off easily, remove oil filler plug (3).

Final drive case: 36ℓ (TY 220)  
51ℓ (TS 220)

## 4. Nut

1) Remove lock plate (4).

2) Using tool C, remove nut.



## 5. Support

Remove support (5).



Support: 28 kg





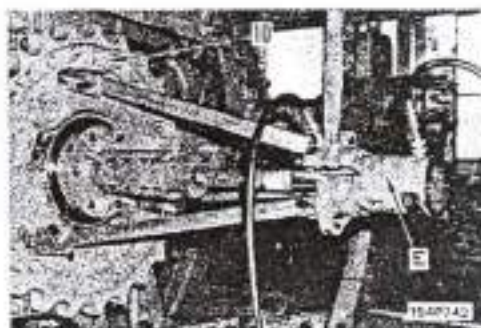
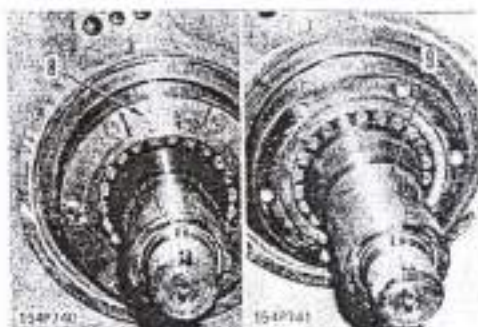
## 6. Sprocket nut

- 1) Remove lock (6).
- 2) Using tool D, remove sprocket nut (7).



## 7. Sprocket

- 1) Remove retainer (8).
- 2) Remove collar (9).
- 3) Using tool E, extract sprocket nut (10).



- 4) Lift out sprocket (10).
- ★ When removing sprocket, be careful not to damage thread at end of shaft.



• Sprocket: 245 kg





## 8. Case assembly

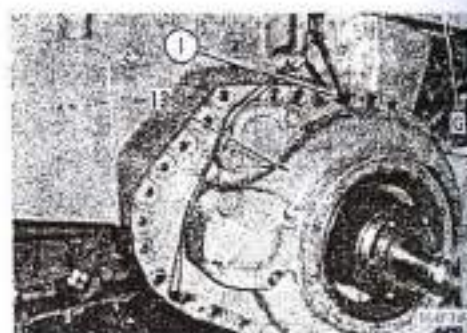
- 1) Remove case mounting bolts (12).



- 2) Using tool G, temporary sling case assembly (13). Remove assembly with extracting bolts (1) (d20 mm, P = 2.5).
- 3) Remove assembly while slinging case.



Case assembly: 210 kg

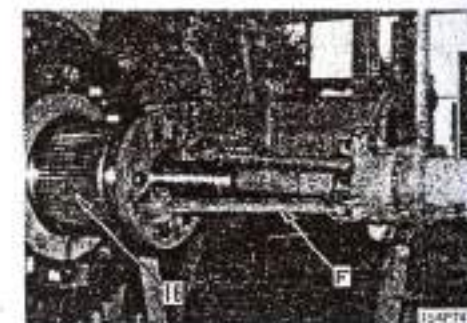


- 4) Remove bearings (14) and (15) from case.



## 9. Hub assembly

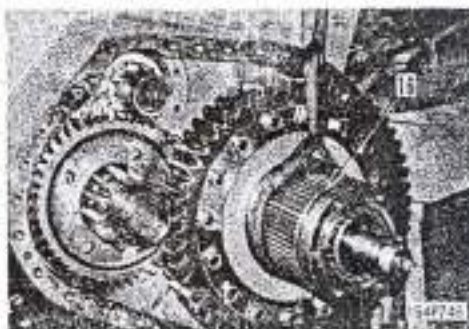
- Using tool F, extract hub assembly (16).



- 2) Lift out hub assembly (16).



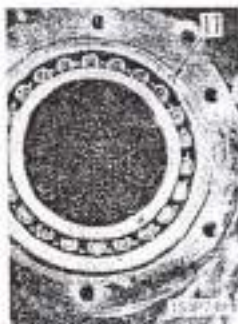
Hub assembly: 250 kg



- 3) Remove bearings (17) and (18).

### 13. Steering-clutch assembly

See "DISMOUNTING STEERING CLUTCH ASSEMBLY".

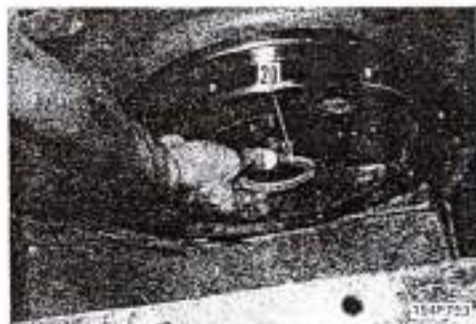


### 11. Hub

- 1) Remove hub nut (19) using wrench B.



- 2) Remove collar (20).

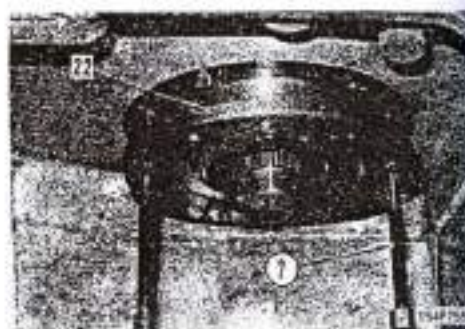


- 3) Extract hub (21) using tool A.



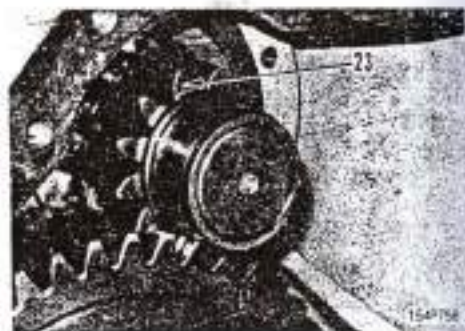
#### 12. Cage

- 1) Remove cage mounting bolts. Using extracting bolts ② (616mm, P = 2.0) extract cage (22).
- 2) Extract seal using tool
- 3) Extract bearing using tool



#### 13. 1st pinion gear

- Remove 1st pinion gear (23).



#### 14. 2nd pinion gear assembly

- 1) When removing 2nd pinion gear assembly (24) before 1st pinion gear, use tool H to remove bearing inner race (25) to prevent inner race striking 2nd pinion gear.

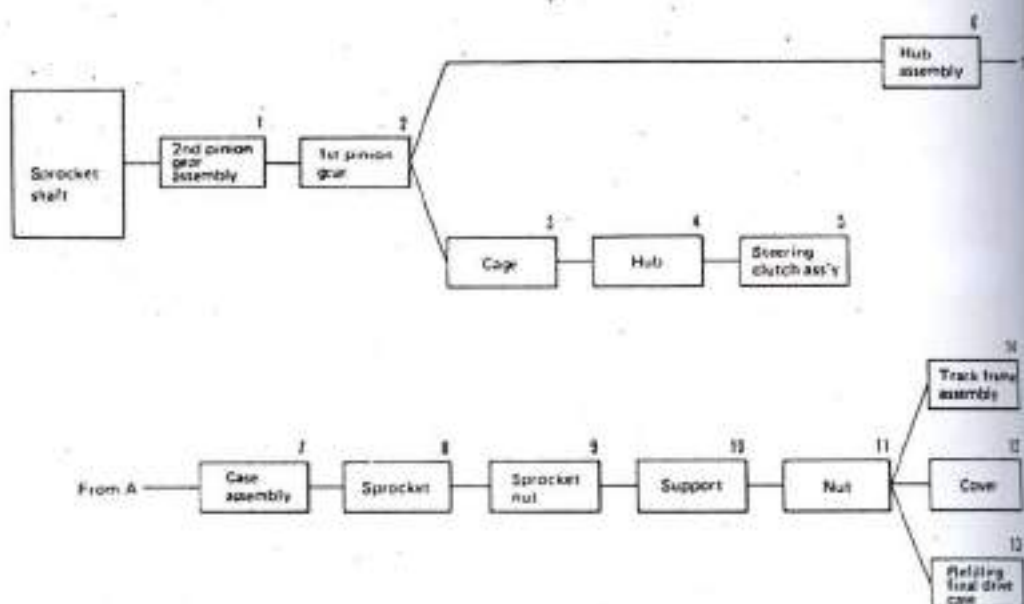


- 2) Lift out 2nd pinion gear assembly (24).
- 3) Separate 2nd pinion gear and 1st driven gear.





## ASSEMBLY OF FINAL DRIVE ASSEMBLY



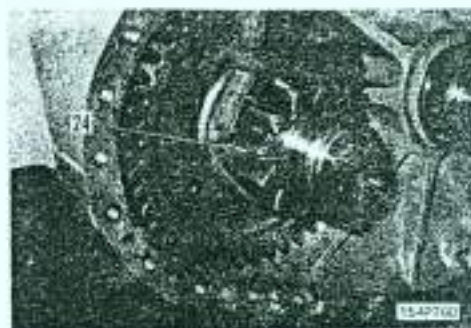
150/90

## Special tools

Part Name	A	B	C	D	E	F	G	H
Installer	1							
Pump	1				1	1		
Puller (50 ton)	1							
Remover & installer		1						
Wrench			1					
Remover & installer				1				
Installer A					1			
Cylinder (70 ton)					1			
Installer A						1		
Puller (30 ton)						1		
Installer							1	
Installer							1	
Lifting tool								1

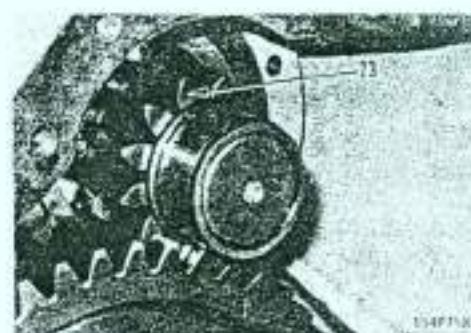
## 1. 2nd pinion gear assembly

- 1) Assemble 2nd pinion gear and 1st driven gear.
- 2) Lift 2nd pinion gear assembly (24) into position and install it.



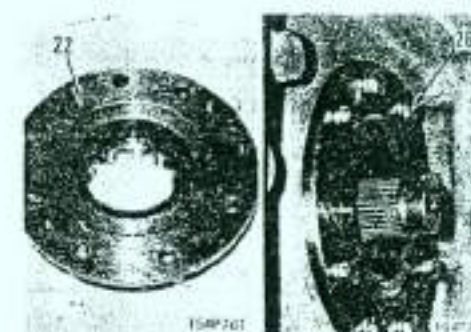
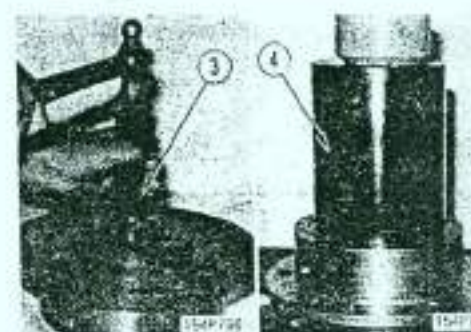
## 2. 1st pinion gear

- 1) Press fit bearing inner race (25).
- 2) Install 1st pinion gear (23).



## 3. Cage

- 1) Press fit bearing using press tool (4) ( $\phi 190$  mm).
- 2) Press fit seal using push tool (3) ( $\phi 150$  mm).
- 3) Push in cage (22) and fix it with cage mounting bolts (26).



## 4. Flange

- 1) Using tool A, install flange (21).



Flange mounting part:

Anti-friction compound M&S<sub>2</sub>NO.1

★ Press fit force 30 ~ 40 ton



- 2) Install collar (20)



- 3) Using tool B, install flange nut (19).



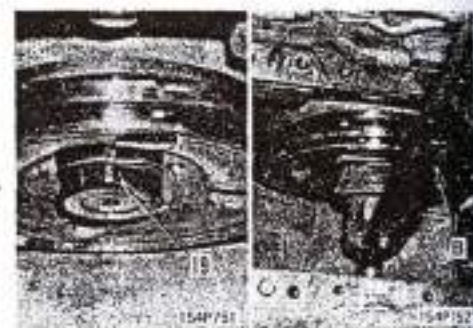
Bend washer properly.



Flange nut: 70 ± 5 kg.m

## 5. Steering clutch assembly

See "MOUNTING STEERING CLUTCH ASSEMBLY".

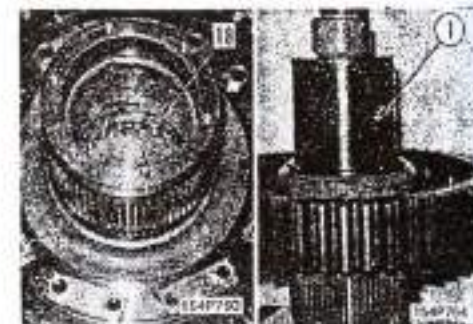


## 6. Hub assembly

- 1) Press fit bearing (18) with press tool ① (φ200 mm).
- 2) Install hub and gear.



Gear: 70 ± 5 kg.m





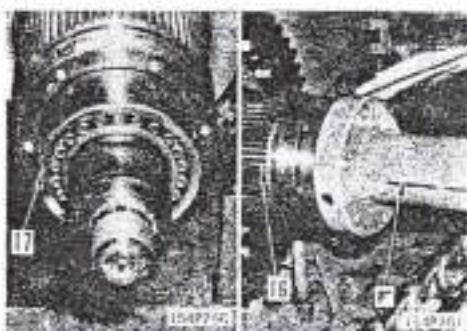
- 3) Temporary sling hub assembly (16).



Hub assembly: 250 kg



- 4) Align bearing (17) and press fit it using tool F.



7. Case assembly

- 1) Press fit bearings (14) and (15) into case.

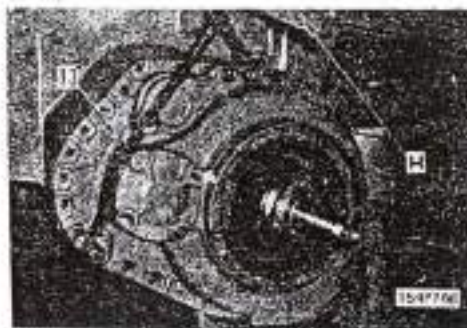


- 2) Mount gasket on case (13).



Gasket: Liquid gasket

- 3) Using tool H, lift case assembly and align dowel pin holes.





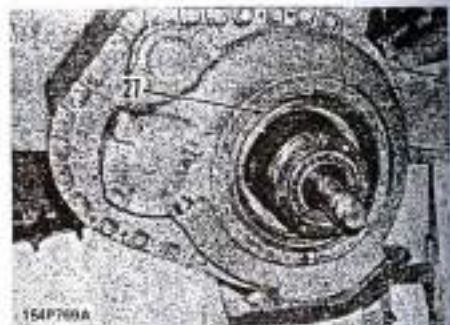
- 4) Drive in dowel pin and fit case mounting bolts (12).

 Case: 56±6 kg.m




8. Sprocket

- 1) Install floating seals (27) on FINAL drive case and sprocket.



- 2) Temporarily sling sprocket (10), then press fit it using tool E.

 Apply anti-friction agent to part of sprocket to be press fit.

★ Sprocket press fit force: 50 to 60 t



- 3) Fit retainer (8).

★ Bend lock washer securely.

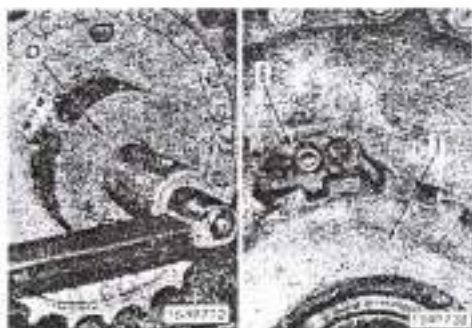
- 4) Install collar (9).



## 8. Sprocket nut

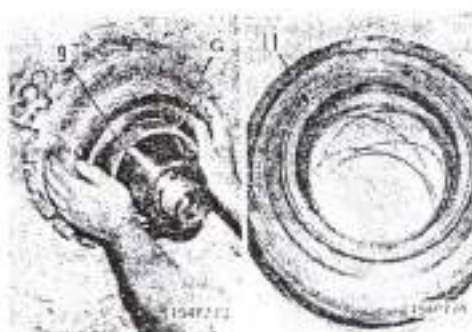
- 1) Using tool D, tighten sprocket nut (7).

- 2) Install lock (6).



## 9. Support

- 1) Using tool G, install floating seal (11) on sprocket nut and support.



- 2) Install support (5).

- 3) Install collar (28).

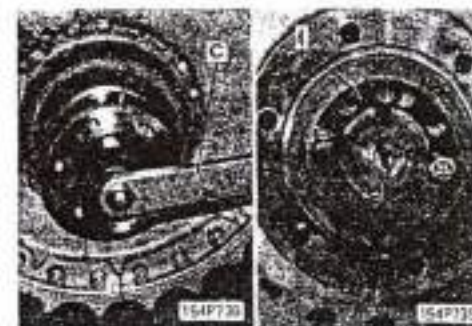


## 10. Nut

- 1) Tighten nuts using wrench C.

 Nut: 105±15 kg.m

- 2) Install lock plate (4).



**12. Cover**

Install cover (1).

**13. Refilling final drive case**

1) Fit drain plug (2).

2) Refill final drive case through oil filler (3) with engine oil until oil level reaches the specified level.



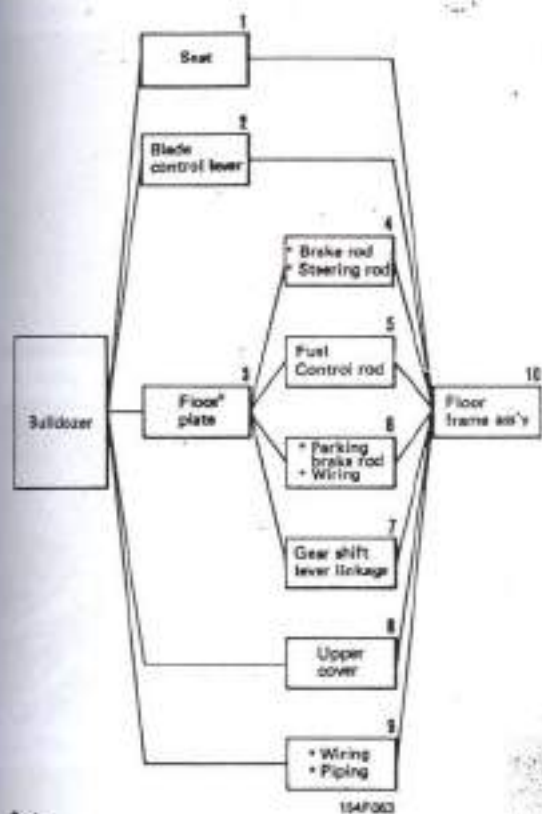
Final drive case: approx. 36 ℓ (TY 220)  
51 ℓ (TS 220)

**14. Track frame assembly**

See "MOUNTING TRACK FRAME ASSEMBLY".



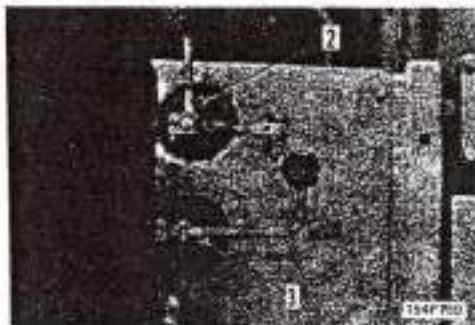
## DISMOUNTING FLOOR FRAME ASSEMBLY



1. Seat  
Remove seat (1).



2. Blade and ripper control levers  
Remove blade control lever (2) and ripper control lever (3).





**3. Floor plates**

Remove floor plates (4) and (5).

**4. Brake rod and steering rod**

Disconnect brake rod (6) and steering rod (7).

**5. Fuel control rod**

Disconnect fuel control rod (8).

**6. Parking brake rod and wiring**

Disconnect parking brake rod (9) and horn wiring (10).

**7. Gear shift lever linkage**

Disconnect speed valve lever (11) and directional lever (12).



### 8. Upper cover

Remove upper cover (13).



### 9. Wiring and piping

- 1) Disconnect wiring (14) at socket. Disconnect dust indicator hose (15).
- 2) Disconnect engine oil pressure gauge tube (16) and priming pump tube (17).
- 3) Remove bolts and disconnect plate (18) from cover.



### 10. Floor frame assembly

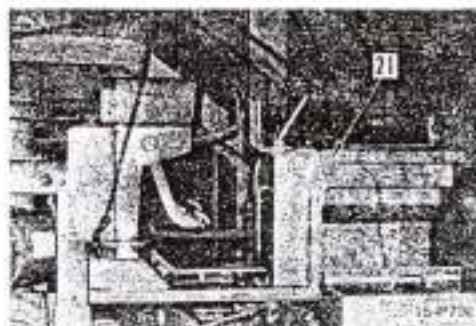
- 1) Remove frame left and right mounting bolts (19) and seat mounting bolts (20).



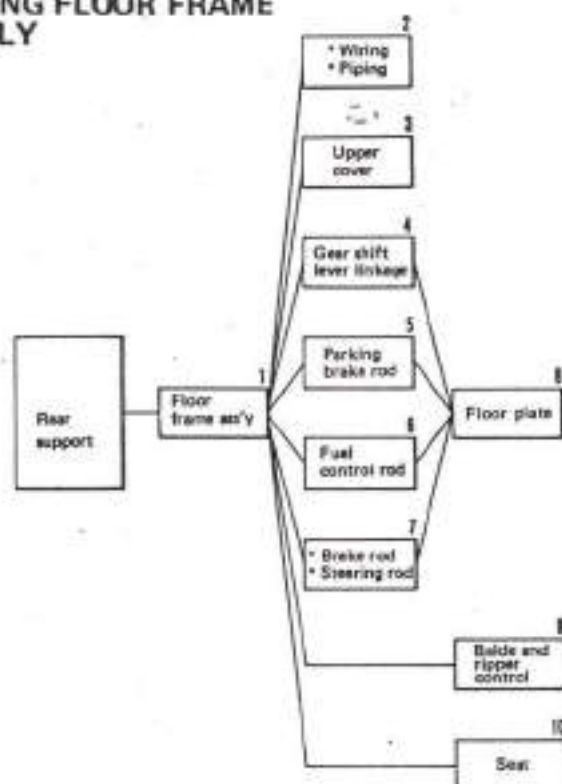
- 2) Lift out floor frame assembly (21) with four eye bolts (14 mm, P = 2.0).



Floor frame assembly: 300 kg

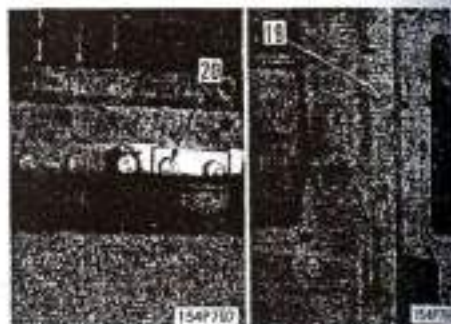


# MOUNTING FLOOR FRAME ASSEMBLY



## 1. Floor frame assembly

- 1) Place plates on frame mounting parts of left and right fenders.
- 2) Lift floor frame assembly (21) and position it on top of fender.
- 3) Tighten mounting bolts (20) and (19).





## 2. Wiring and piping

- 1) Connect plate (18) to cover.
- 2) Connect priming pump tube (17) and engine oil pressure gauge tube (16).
- 3) Connect dust indicator hose (15) and wiring (14).



## 3. Upper cover

- Install cover (13).



## 4. Gear shift lever linkage

- Connect directional lever (12) and speed valve lever (11).

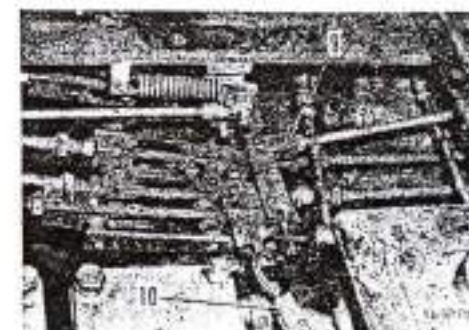
⊕ Bend cotter pin securely.



## 5. Parking brake rod and wiring

- Connect wiring (10) to parking brake rod (9).

⊕ Bend cotter pin securely.





**6. Fuel control rod**

Connect fuel control rod (8).



Bend cotter pin securely.

**7. Brake rod and steering rod**

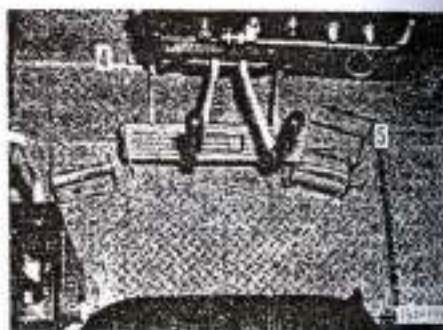
Connect steering rod (7) and brake rod (6).



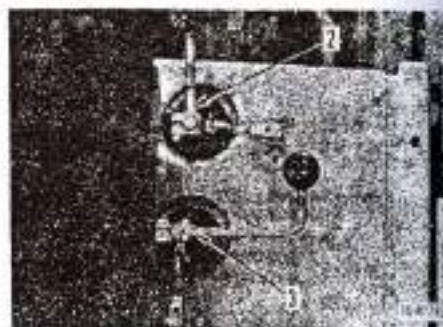
Bend cotter pin securely.

**8. Floor plates**

Install floor plates (5) and (4).

**9. Blade and ripper control levers**

Install blade control lever (2) and ripper control lever (3).

**10. Seat**

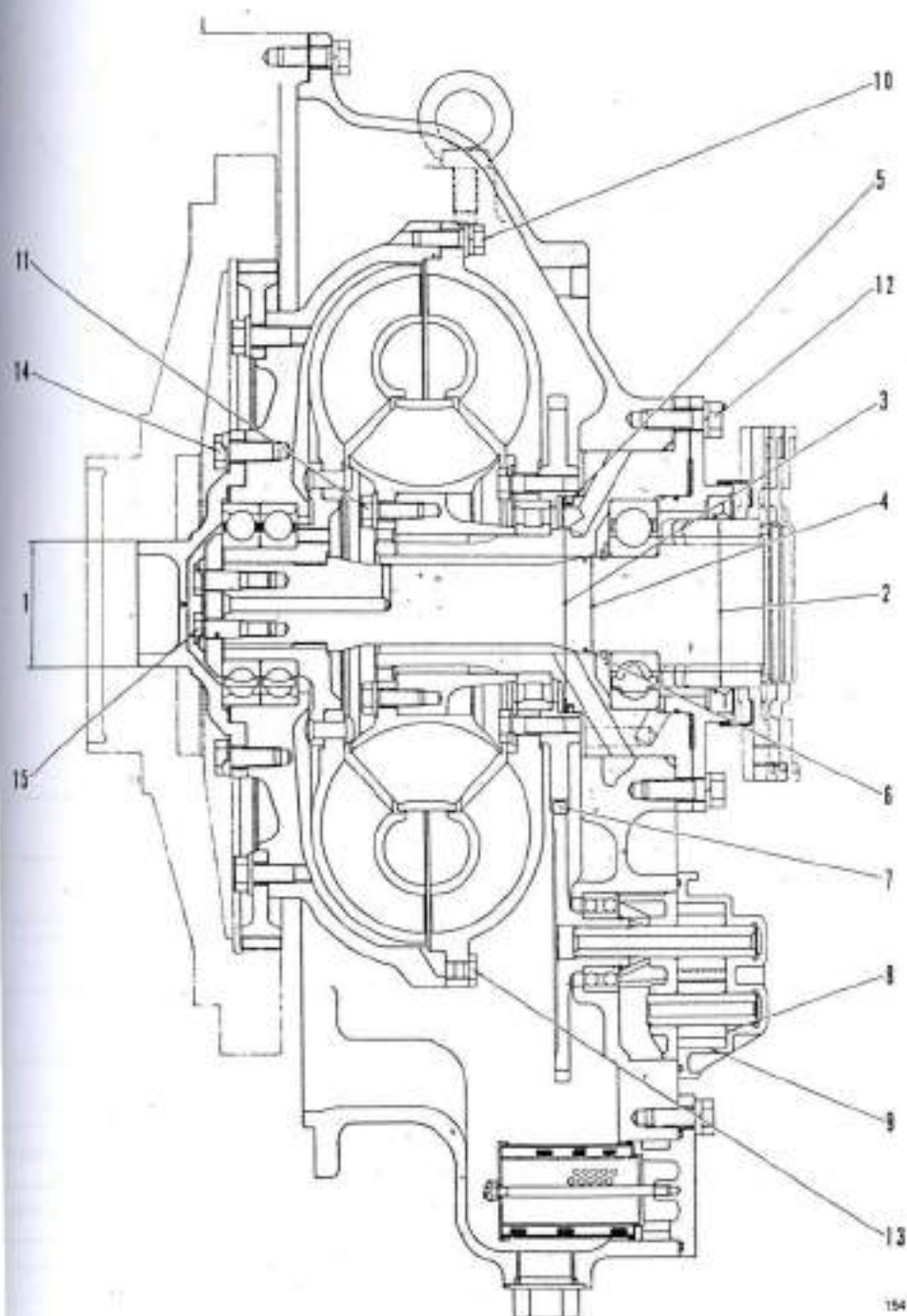
Install seat (1).



## MAINTENANCE STANDARD

## TORQUE CONVERTER

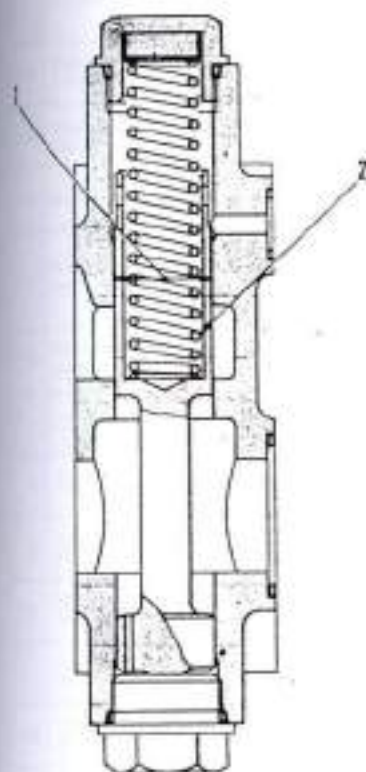
## (1) TORQUE CONVERTER



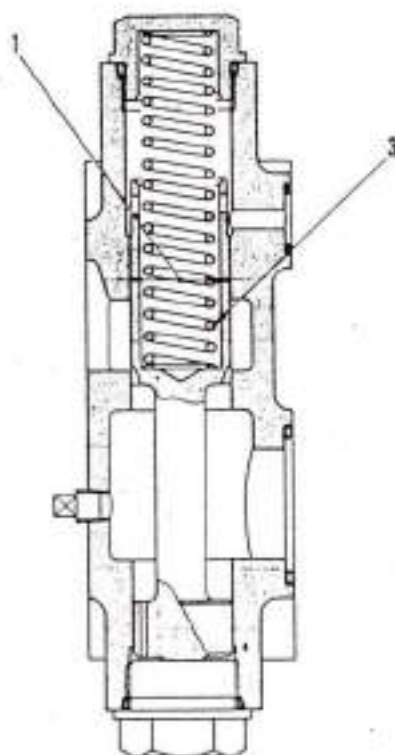
154F193



## RELIEF VALVE AND REGULATOR VALVE



104F194



104F195

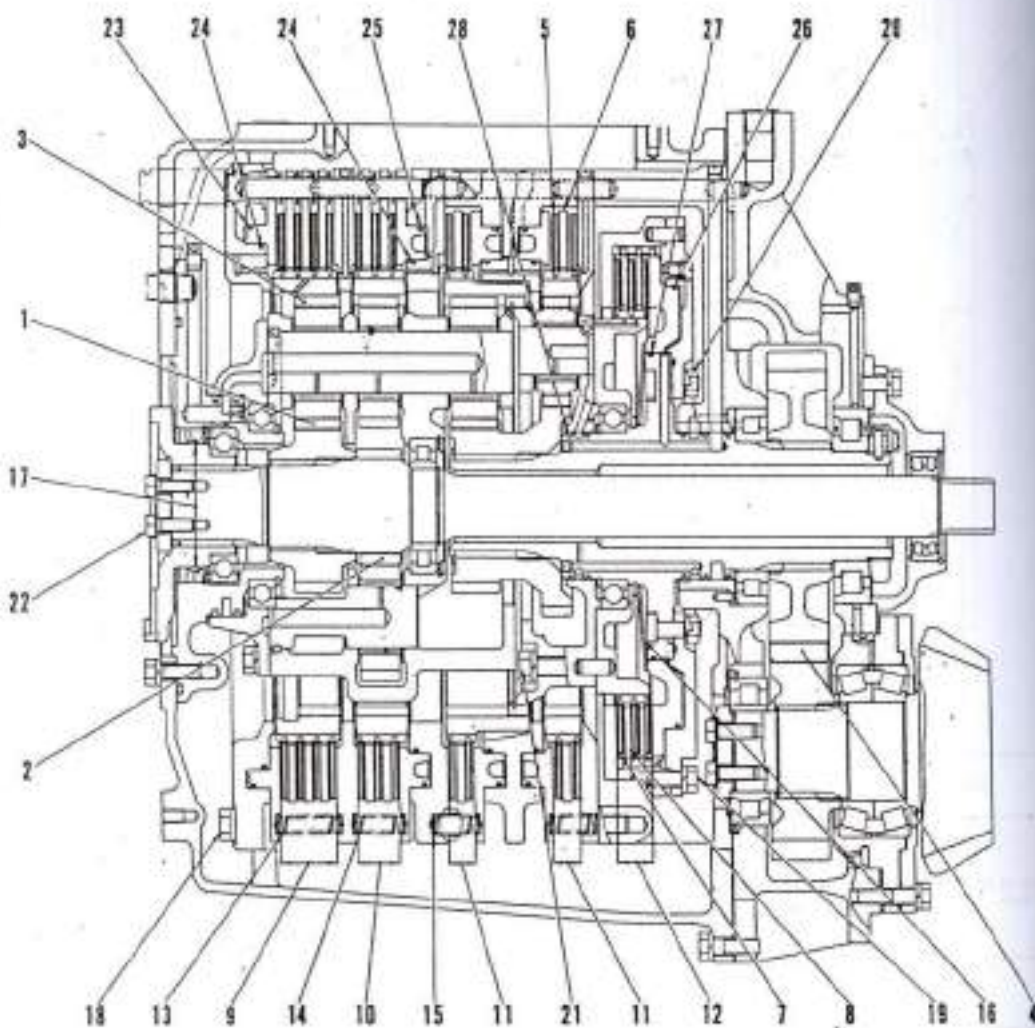
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
	Clearance between valve body and spool	32	Shaft -0.050 -0.066	Hole +0.025 0	0.050 ~ 0.081	0.2	
		Standard size		Repair limit			Replace
		Free length x O.D.	Installation length	Installation load	Free length	Installation load	
1	Relief valve spring	137.7x14	98.0	63.5 kg	134.2	57.9 kg	
2	Regulator valve spring	126.6x23.5	106.5	20.9 kg	120	14.0 kg	
3	Relief valve set pressure	8.7 <sup>+0.3</sup> <sub>0</sub> kg/cm <sup>2</sup> Oil temperature 70 ~ 80°C					
4	Regulator valve set pressure	2.5 + 1.0 kg/cm <sup>2</sup> at 50 /min. 3.5 + 0.5 kg/cm <sup>2</sup> at 100 /min. 4.5 + 0.5 kg/cm <sup>2</sup> at 200 /min. Oil temperature 70 ~ 80°C					



## TORQFLOW TRANSMISSION

## (1) TRANSMISSION



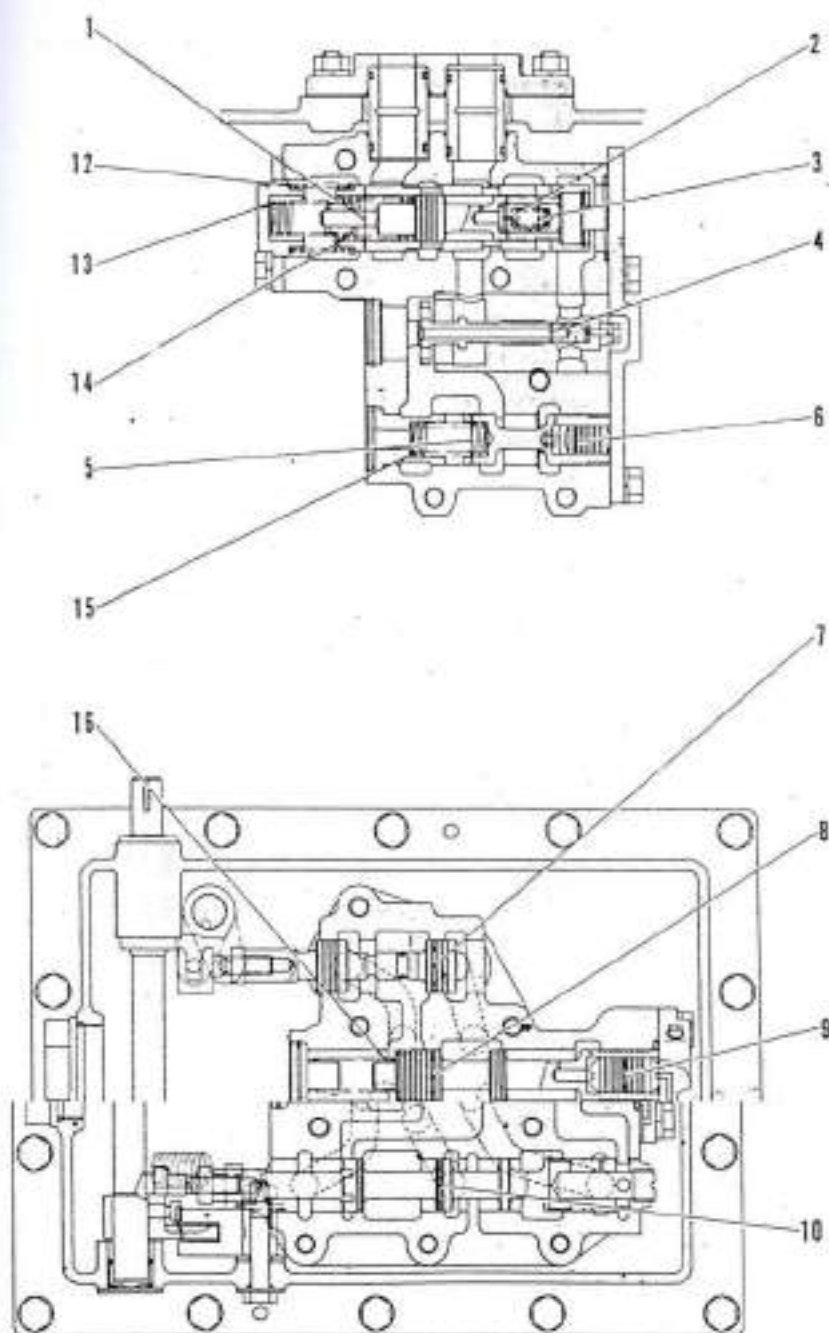
104F196

Unit: mm

No.	Check item	Criteria				Remedy	
1	Backlash between No. 1, 2, 4 sun gear and planetary pinion	Standard clearance			Clearance limit		
		0.14 ~ 0.37			—		
2	Backlash between No. 2 sun gear and planetary pinion	0.13 ~ 0.43			—		
3	Backlash between ring gear and planetary gear	0.16 ~ 0.48			—		
4	Backlash of transfer gear	0.20 ~ 0.51			—		
5	Thickness of No. 1 ~ 4 clutch disc	Standard size			Repair limit		
		5.4			4.6		
6	Thickness of No. 1 ~ 4 clutch plate	7.0			6.2		
7	Thickness of No. 5 clutch disc	5.4			4.6		
8	Thickness of No. 5 clutch plate	5.0			4.2		
9	Total assembly thickness of No. 1 clutch disc, plate	47.6					
10	Total assembly thickness of No. 2 clutch disc, plate	34.2					
11	Total assembly thickness of No. 3, 4 clutch disc, plate	21.8					
12	Total assembly thickness of No. 5 clutch disc, plate	29.2					
13	No. 1 clutch spring	Standard size			Repair limit		
		Free length X O, D	Installation length	Installation load	Free length	Installation load	
		66.7 ± 15.3	66.6	13.3 kg	64.1	10.6 kg	
14	No. 2 clutch spring	45.7 ± 15.3	41.2	9.6 kg	44.8	7.7 kg	
15	No. 3, 4 clutch spring	45.7 ± 15.3	39.8	12.6 kg	44.5	10.1 kg	
16	No. 5 clutch spring		14				
17	Outside dia of the seal contacting of input side coupling	Standard size			Repair limit		
18	Tie bolt tightening torque	17 ± 1 kgm					
19	Tightening torque of housing mounting bolt	11 ± 1.5 kgm					

Unit: mm			
No	Check item	Criteria	Remedy
20	Tightening torque of shaft mounting bolt	$11 \pm 1.5 \text{ kgm}$	Adjust
21	Tightening torque of carrier mounting bolt	$18 \pm 2 \text{ kgm}$	
22	Tightening torque of shaft mounting holder	$4 \pm 1.5 \text{ kgm}$	

(2) CONTROL VALVE



154F107

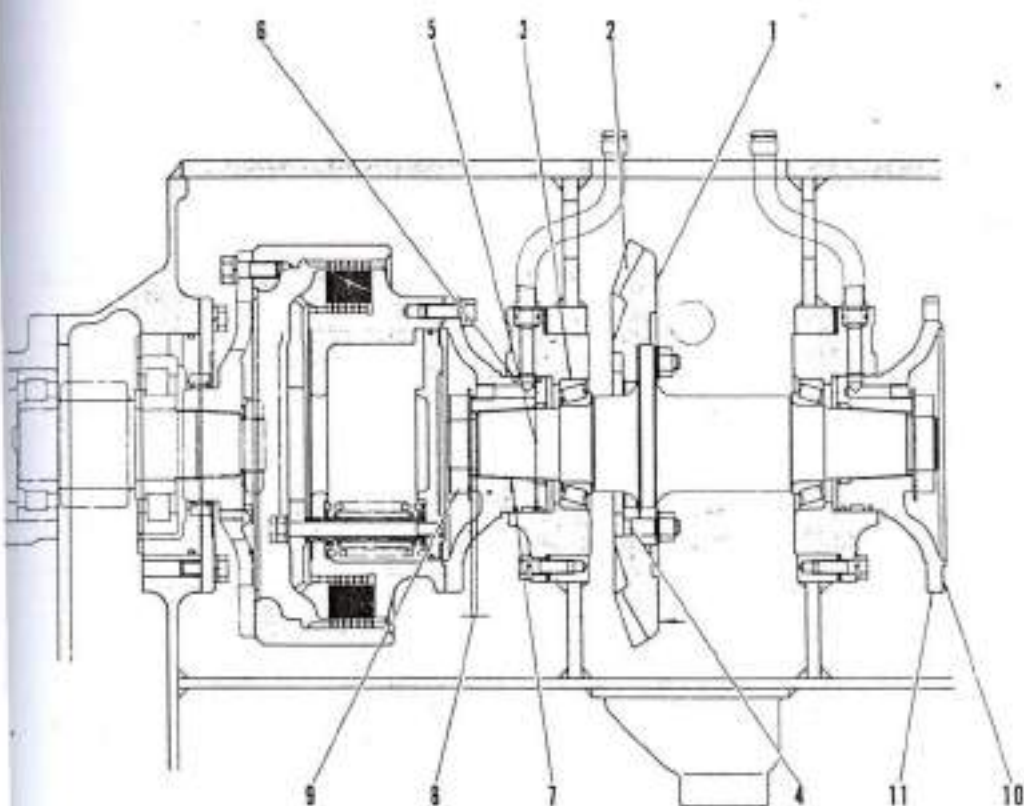


Unit: mm

No.	Check item	Criteria					Remedy	
1	Clearance between modulating valve and valve body	Standard size	Tolerance		Standard clearance	Clearance limit		
			Shaft	Hole				
2	Clearance between relief valve and modulating valve	25	-0.035 -0.045	+0.013 0	0.035 ~ 0.058	0.064		
3	Clearance between relief valve and piston	15	-0.02 -0.03	+0.018 0	0.020 ~ 0.048	0.054		
4	Clearance between quick return valve and valve body	12	-0.035 -0.045	+0.011 0	0.035 ~ 0.056	0.062		
5	Clearance between reducing valve and valve body	28	-0.035 -0.045	+0.013 0	0.035 ~ 0.058	0.064		
6	Clearance between reducing valve and piston	15	-0.02 -0.03	+0.018 0	0.020 ~ 0.048	0.054		
7	Clearance between directional valve and valve body	28	-0.035 -0.045	+0.013 0	0.035 ~ 0.058	0.064		
8	Clearance between safety valve and valve body	25	-0.035 -0.045	+0.013 0	0.035 ~ 0.058	0.064		
9	Clearance between safety valve and piston	20	-0.02 -0.03	+0.018 0	0.020 ~ 0.048	0.054		Replace
10	Clearance between speed valve and valve body	28	-0.035 -0.045	+0.013 0	0.035 ~ 0.058	0.064		"
11	Clearance between lubrication valve and valve body	28	-0.035 -0.045	+0.013 0	0.035 ~ 0.058	0.1		
12	Modulating valve spring	Standard size			Repair limit			
		Free length ± 0.5	Installation length	Installation load	Free length	Installation load		
		53±37.9	35.0	8.65 kg	51.2	7.79 kg		
13	Relief valve spring (Large)	38.5±22.8	26.5	21.7 kg	37.3	19.5 kg		
14	Relief valve spring (Small)	43.8±22.5	32.1	40.3 kg	42.6	36.3 kg		
15	Reducing valve spring	52±18.2	38.2	21.9 kg	50.7	19.7 kg		
16	Safety valve spring	79±17.2	47	1.41 kg	75.8	1.34 kg		
17	Lubrication valve spring	87±18	61	7.5 kg	84.1			
18	Clutch pressure	Engine slow Engine full	18 ~ 24 kg/cm <sup>2</sup> 23 ~ 27 kg/cm <sup>2</sup>	Oil temperature 70 ~ 80°C				Adjust

## BEVEL GEAR SHAFT AND STEERING CLUTCH

## (1) BEVEL GEAR SHAFT

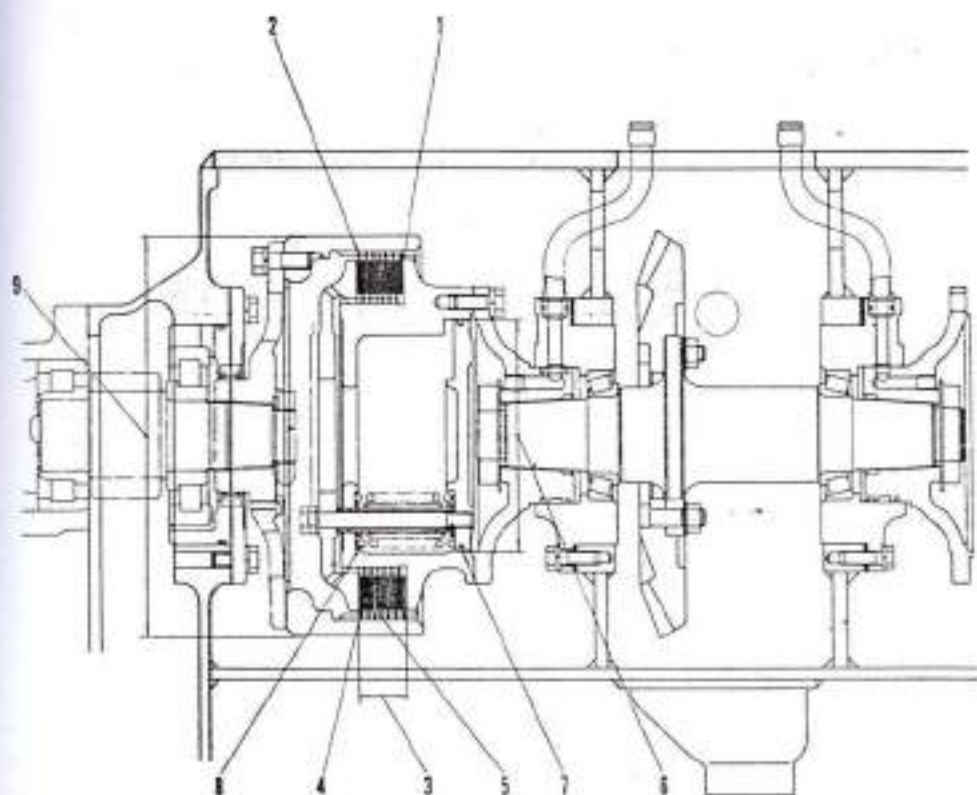


1547196

Unit: mm

No.	Check item	Criteria				Remedy
1	Deflection of bevel gear back surface	Repair limit: 0.1 (Measure after mounting on bevel gear shaft)				Repair or replace as assembly
2	Backlash between bevel gear and pinion	Standard clearance		Clearance limit		
		0.25 ~ 0.32		0.75		
3	Pre-load of bevel gear shaft taper roller bearing	Standard rotating torque: 2 ~ 3 kg.m (Measure at tip of bevel gear pinion at bevel pinion engaging condition)				Adjust
4	Fitting of bevel gear pinion belt	Standard size	Tolerance		Standard clearance	Clearance limit
			Shaft	Hole		
		18	0 -0.015	+0.027 0	0 ~ 0.042	0.1
5	Contact surface of bearing cage seal ring	Standard size		Repair limit		Replace
		145		145.3		
6	Width of seal ring	4.5		4.0		
	Width of seal ring groove	4.5		5.0		
7	Force-fitting force of bevel gear shaft hub	30 ~ 40 ton				Adjust
8	Dimension after force-fitting of bevel gear shaft hub	6 ± 0.5				
9	Tightening torque of bevel gear shaft nut	70 ± 5 kg.m				
10	Face run-out of bevel gear shaft hub	Repair limit: 0.08				
11	Radial run-out of bevel gear shaft hub	Repair limit: 0.08				

(2) STEERING CLUTCH



1547 100

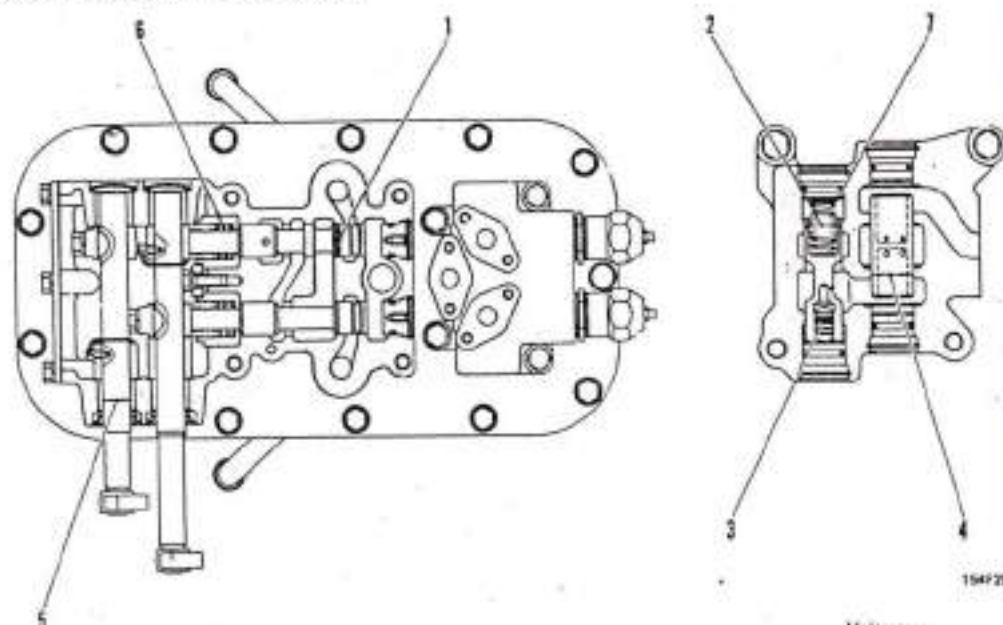


Unit: mm

No.	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Thickness of drive plate	2.9	2.0	Replace
	Strain of drive plate	Tolerance Within 0.2	Repair limit 0.3	Repair or replace
2	Thickness of driven plate	Standard size 4.7	Repair limit 3.7	Replace
	Strain of driven plate	Tolerance Within 0.2	Repair limit 0.3	Repair or replace
3	Total assembly thickness of drive plate and driven plate	Standard size 50.3	Repair limit 46	
4	Backlash between drive plate and clutch drum (inner drum)	Standard clearance 0.3 ~ 0.4	Repair limit 1.0	
5	Backlash between driven plate and brake drum (outer drum)	0.3 ~ 0.4	1.0	
6	Contact surface inside dia. of clutch drum (inner drum) seal ring	Standard size 245	Repair limit 245.3 <sup>f</sup>	Replace
7	Width of piston seal ring	4.9		
	Width of seal ring grooves	5		
8	Clutch spring	Standard size		Repair limit
		Free length ± O.D.	Installation length	Free length Installation load
		(Large) 145.15×59 (Small) 137.83×39	106.1 106.1	242 kg 138 kg
9	Outside dia. of brake drum (outer drum)	Standard size 425	Repair limit 420	
10	Face run-out of brake drum (outer drum)	Tolerance Within 0.2	Repair limit 0.5	Repair or replace
11	Eccentricity of brake drum (outer drum)	Within 0.2	0.3	

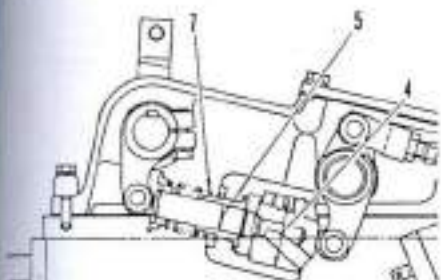


# (4) STEERING CONTROL VALVE

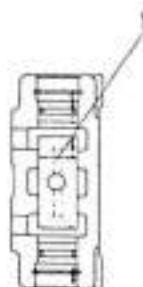


Unit: mm

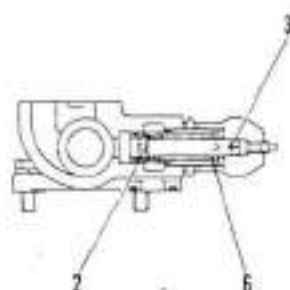
No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
1	Clearance between spool and valve	30	-0.020 -0.041	+0.013 0	0.020 ~ 0.054	0.1	Repair or replace
2	Clearance between relief valve and valve body	26	-0.014 -0.023	+0.013 0	0.014 ~ 0.026	0.08	
3	Clearance between relief valve and piston	16	-0.020 -0.030	+0.018 0	0.020 ~ 0.048	0.08	
4	Clearance between free piston and body	31	-0.020 -0.041	+0.016 0	0.020 ~ 0.057	0.1	
5	Clearance between shaft and bushing	25	-0.020 -0.041	+0.033 0	0.020 ~ 0.074	0.12	Replace bushing
6	Valve spring	Standard size		Repair limit			Replace
		Free length x O. D.	Installation length	Installation load	Free length	Installation load	
		104.5x26.3	50	10 kg	99	9 kg	
7	Relief valve spring	45x19.5	40	22.1 kg	45.7	11 kg	
8	Main relief pressure	9 ~ 13 kg/cm <sup>2</sup> (Engine slow) 12 ~ 17 kg/cm <sup>2</sup> (Engine full)					Adjust

**5 STEERING BRAKE VALVE AND BOOSTER**

154F202



154F204



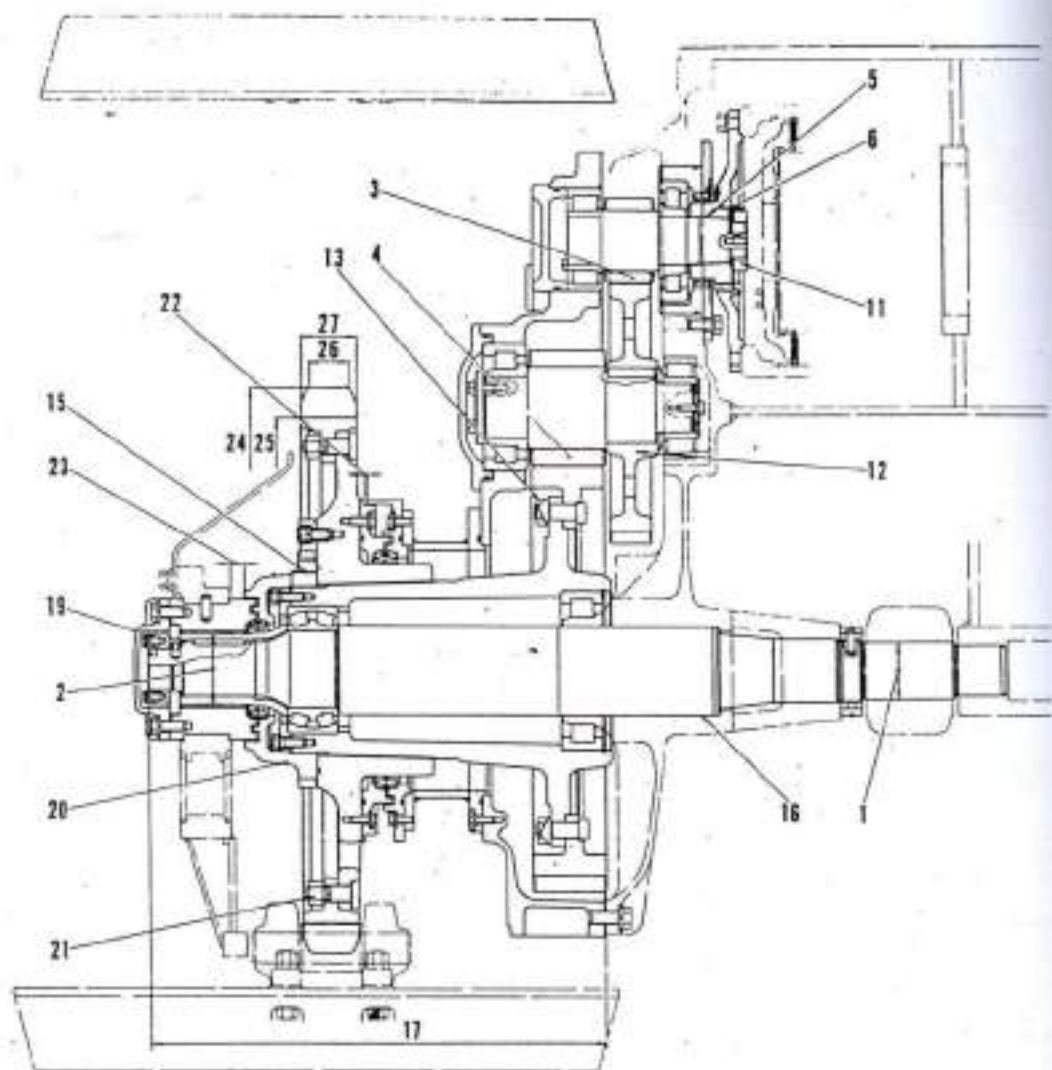
154F203

Unit: mm

No.	Check item	Criteria						Remedy
1	Clearance between free piston and body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace	
			Shaft	Hole				
2	Clearance between valve seat and plunger	21	-0.065 -0.098	+0.021 0	0.055 ~ 0.115	0.15		
3	Clearance between nut and plunger	14	-0.016 -0.034	+0.027 0	0.016 ~ 0.061	0.1		
4	Clearance between booster housing and piston	70	-0.030 -0.049	+0.030 0	0.030 ~ 0.079	0.1		
5	Clearance between booster valve and valve seat	26	-0.005 -0.010	+0.064 +0.043	0.048 ~ 0.074	0.1		
6	Relief valve spring	Standard size			Repair limit			
		Free length x O.D.	Installation length	Installation load	Free length	Installation load		
		76.4x19.6	63	8 kg				
7	Booster valve return spring	80x45.5	58	10 kg	85.8	9 kg		
8	Brake relief pressure	15 ~ 20 kg/cm <sup>2</sup> (Engine slow) 15 ~ 20 kg/cm <sup>2</sup> (Engine full)		Difference between right and left: within 2 kg/cm <sup>2</sup>				



## FINAL DRIVE



154F205

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between sprocket shaft and diagonal brace bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole			
		90	-0.035 -0.071	+0.035 0	0.035 ~ 0.106	0.5	
2	Clearance between support shaft collar and bushing	110	-0.035 -0.071	+0.198 +0.084	0.120 ~ 0.270	0.5	
3	Backlash between No. 1 pinion and No. 1 gear	Standard clearance			Clearance limit		Replace
		0.400- 0.523			1.5		
4	Backlash between No. 2 pinion and No. 2 gear	0.475- 0.847			1.5		
5	Force-fitting force final drive flange and No. 1 pinion	30 ~ 40 ton					Adjust
6	Dimension after force-fitting final drive flange	2 ~ 3.5					
7	Radial run-out of final drive case	0.6 (Dial gauge reading)					
8	Clearance between final drive pinion shaft and side clearance	0.82 ~ 1.58 (Dial gauge reading)					
9	Face run-out of final drive flange	0.08					
10	Radial run-out of final drive flange	0.08					
11	Tightening torque of final drive flange mounting nut	70 ± 5 kg.m					
12	No. 1 gear force-fitting force	5 ~ 16 ton					
13	Tightening torque of No. 2 gear mounting nut	70 ± 5 kg.m					
14	Force-fitting force of sprocket	50 ~ 60 ton					
15	Dimension between end surfaces of sprocket hub and sprocket bore	39 ~ 41					
16	Force-fitting force of sprocket shaft	12 ~ 45 ton					
17	Dimension between end surface of sprocket shaft and steering case	TY 220 599.5 T.S 220 724.5					
18	Sprocket shaft bending	Repair limit: Less than 1.0					
19	Tightening torque of nut at sprocket shaft end	105 ± 15 kg.m					
20	Tightening torque of sprocket nut	85 ± 15 kg.m					
21	Tightening torque of sprocket tooth nut	105 ± 10 kg.m					

POWER TRAIN **MAINTENANCE STANDARD**

Unit : mm

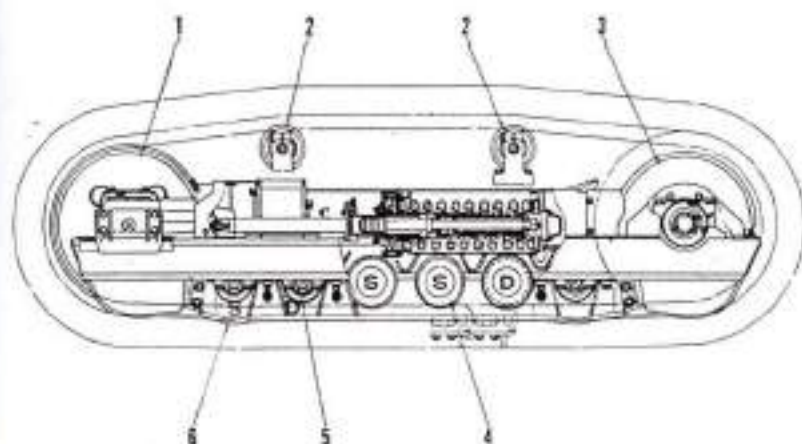
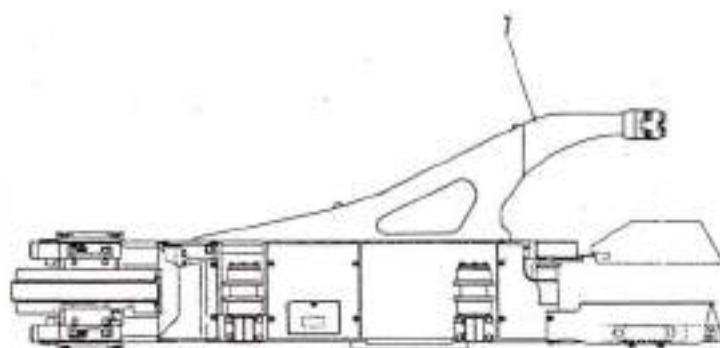
No.	Check item	Criteria				Remedy
22	Clearance of floating seal guide	4.3 ± 1.0				
23	Dimension from sprocket hub end to sprocket bore end	22.8 ± 1.2				
24	Wear on sprocket tooth top surface		Standard size	Tolerance	Clearance limit	
25	Wear on sprocket tooth bottom surface					
26	Wear on sprocket tooth top surface width	Standard size			Clearance limit	
27	Wear on sprocket tooth bottom surface width	90				

# UNDERCARRIAGE



## STRUCTURE AND FUNCTION

TRACK GROUP TY 220

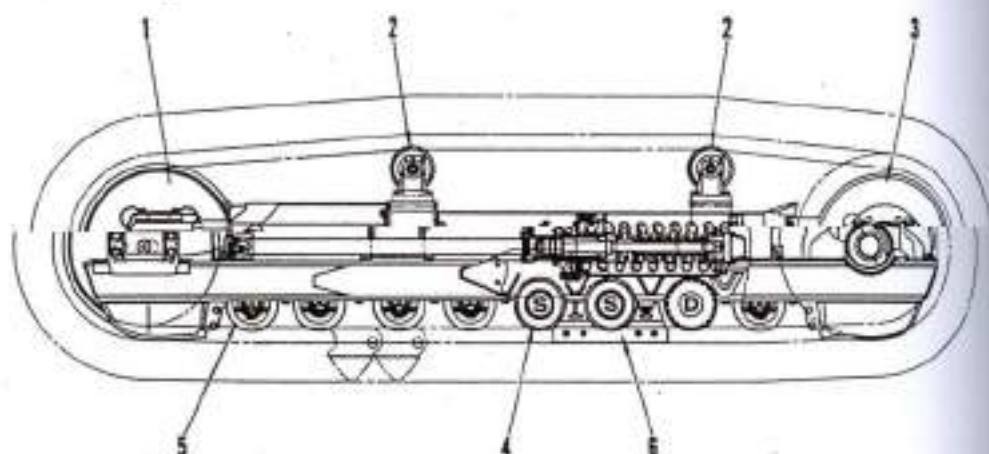
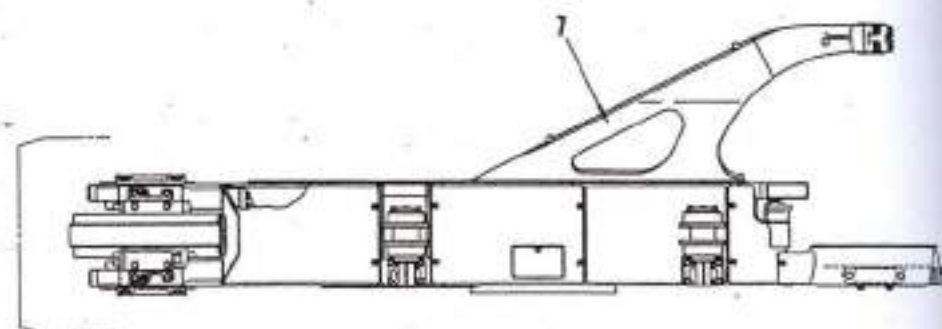


1547306

1. Idler
2. Carrier roller
3. Sprocket cover
4. Track roller (Single)

5. Track roller (Double)
6. Track roller guard
7. Diagonal brace

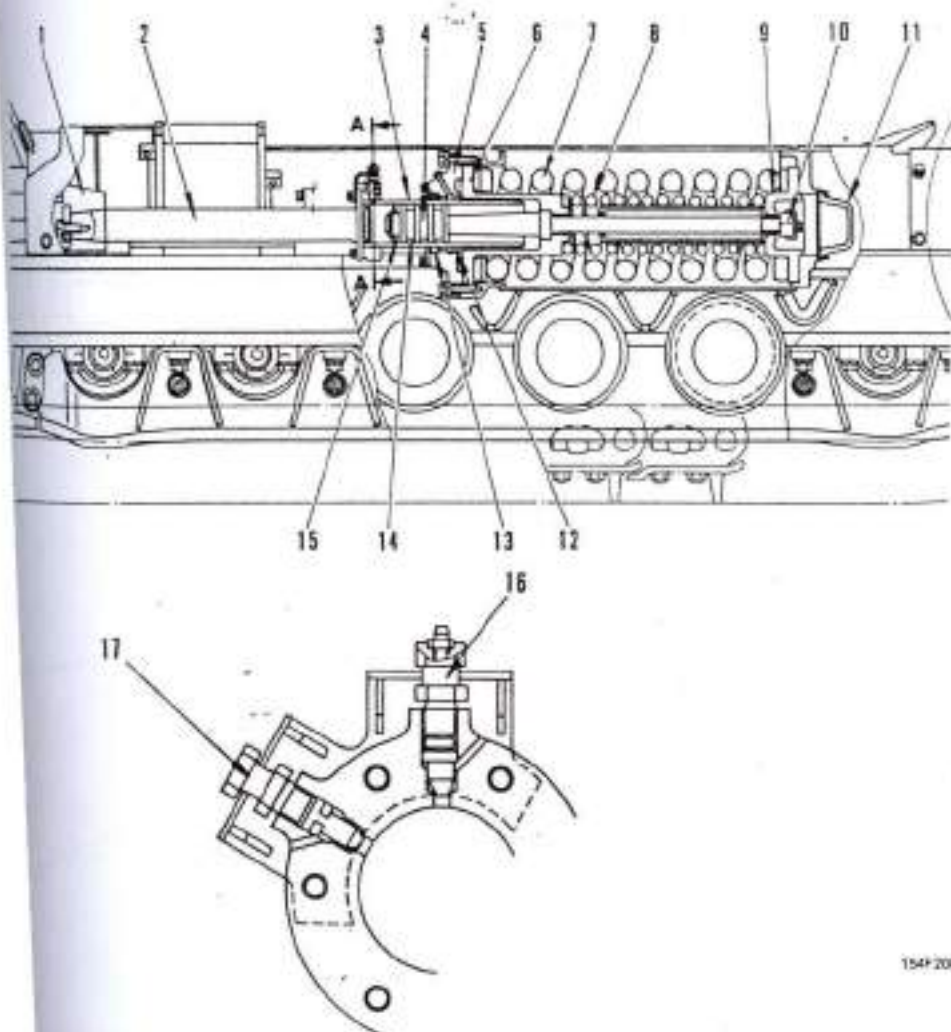
## TRACK GROUP TS 220



1M720

- |                          |                          |
|--------------------------|--------------------------|
| 1. Idler                 | 5. Track roller (Double) |
| 2. Carrier roller        | 6. Track roller guard    |
| 3. Sprocket cover        | 7. Diagonal brace        |
| 4. Track roller (Single) |                          |

## RECOIL SPRING

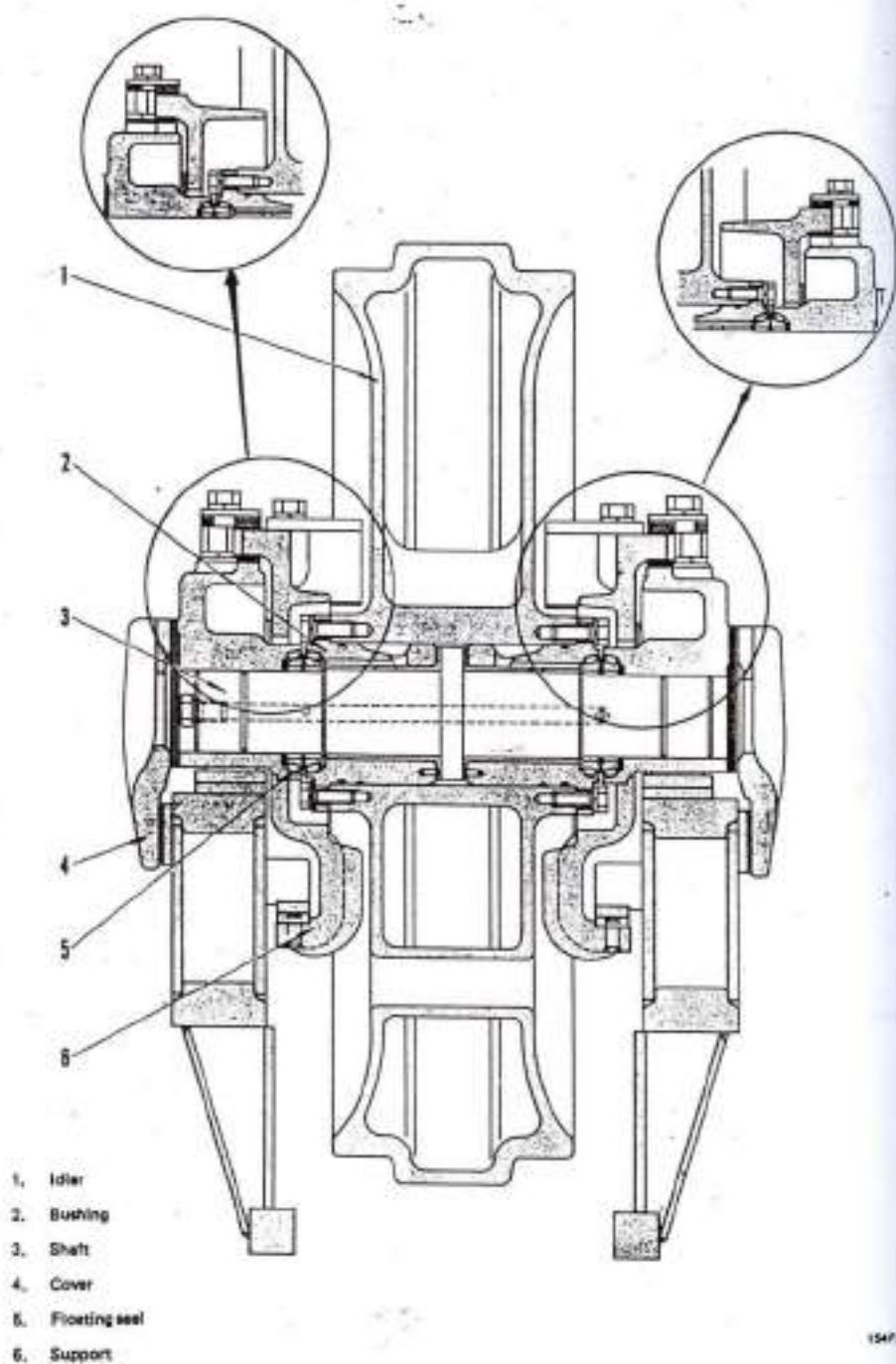


1. Yoke
2. Rod
3. Cylinder
4. Piston
5. Cover
6. Front pilot
7. Recoil spring (Large)
8. Recoil spring (Small)

9. Rear pilot
10. Nut
11. Cover
12. Bushing
13. Oil seal
14. Wear ring
15. Packing
16. Lubricator
17. Plug

154P/208

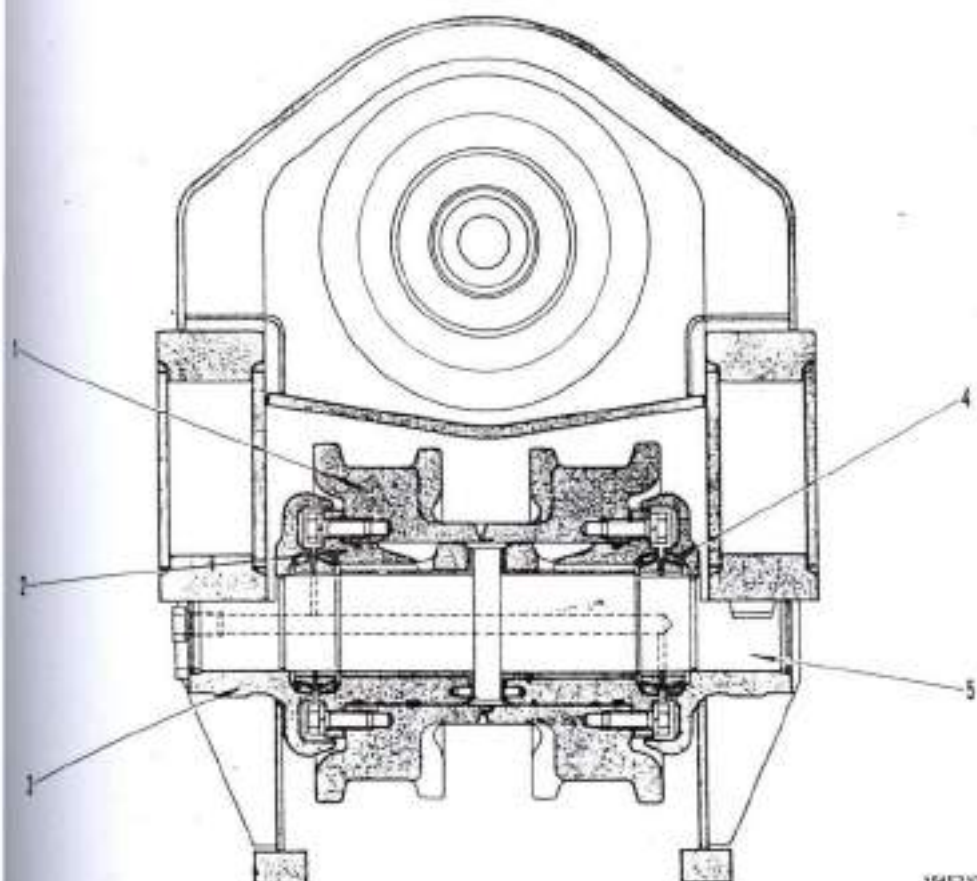
## IDLER



154/209



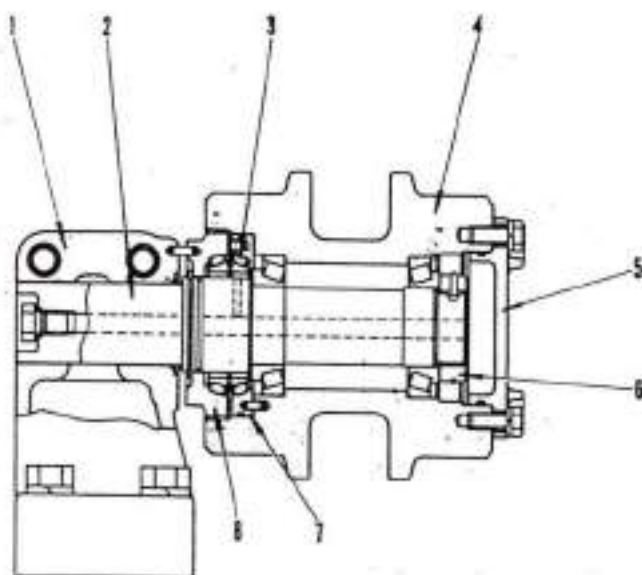
# TRACK ROLLER



154F210

- 1. Track roller
- 2. Bushing
- 3. Collar
- 4. Floating seal
- 5. Shaft

## CARRIER ROLLER

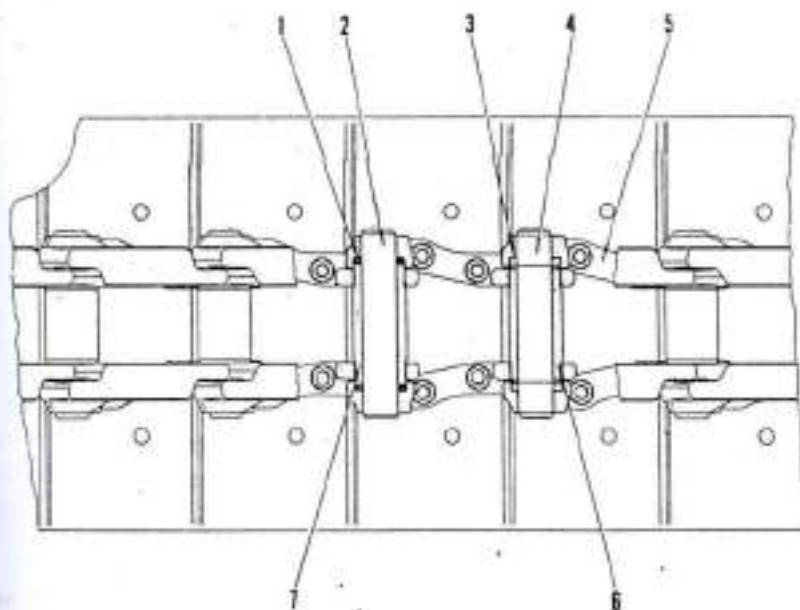
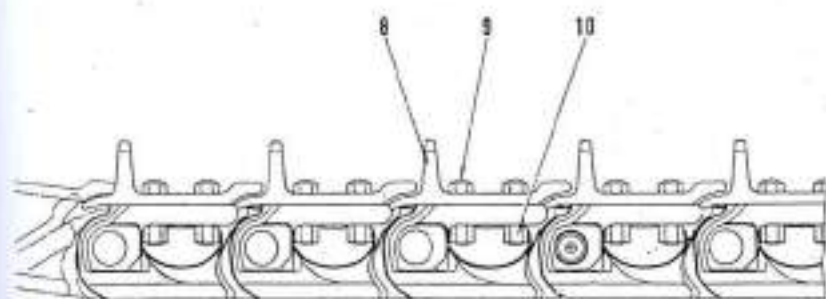


164F211

1. Support
2. Shaft
3. Floating seal
4. Carrier roller

5. Cover
6. Nut
7. Seal
8. Collar

## TRACK (SHOE) TY 220

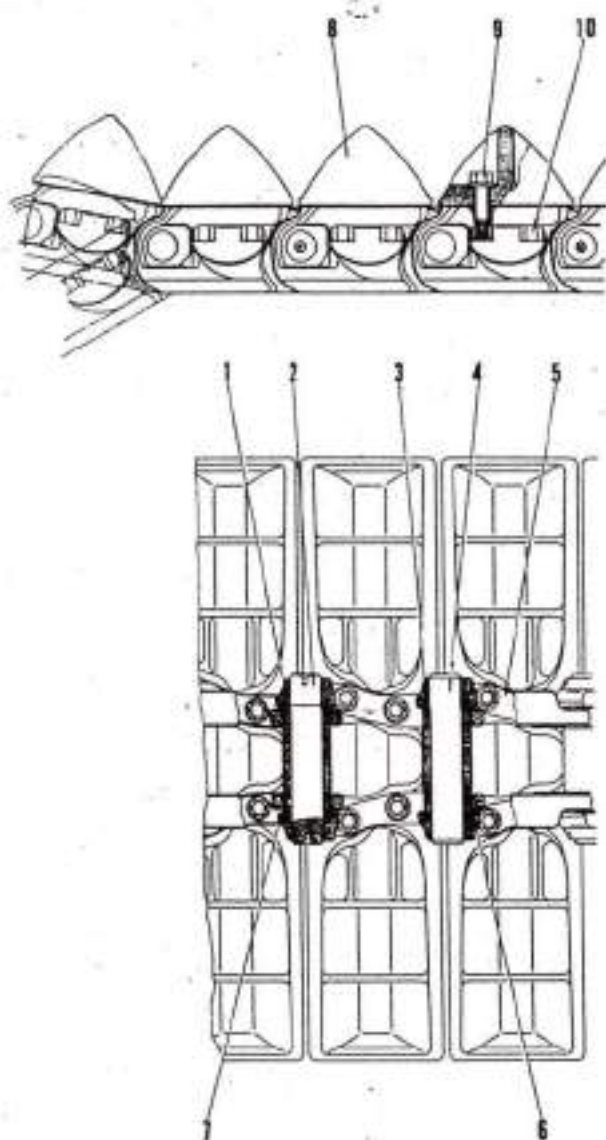


1. Regular dust seal
2. Regular pin
3. Meter dust seal
4. Meter pin
5. Link

6. Master bushing
7. Regular bushing
8. Single shoe
9. Shoe bolt
10. Shoe nut

154P212

## TRACK (SHOE) TS 220



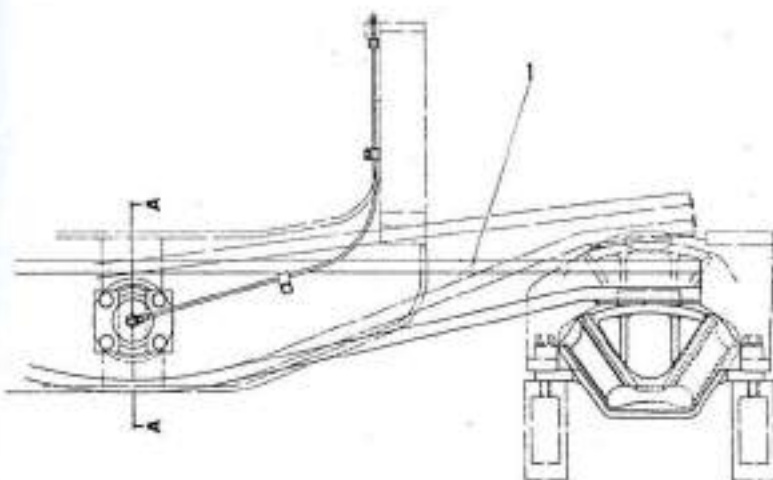
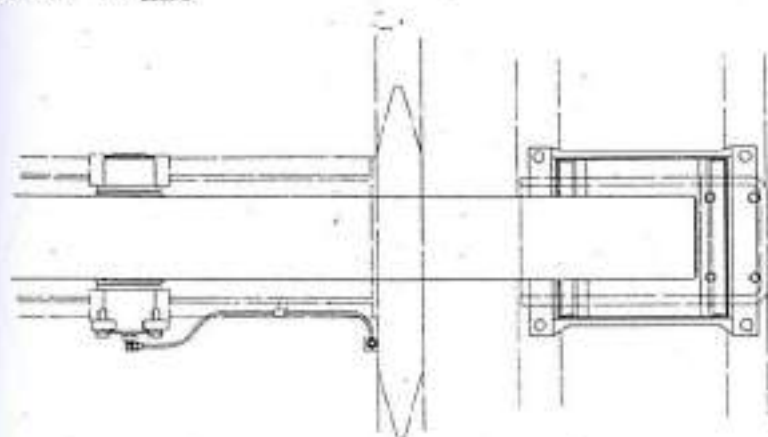
1. Regular dust seal
2. Regular pin
3. Master dust seal
4. Master pin
5. Link

6. Master bushing
7. Regular bushing
8. Swamp shoe
9. Shoe bolt
10. Shoe nut

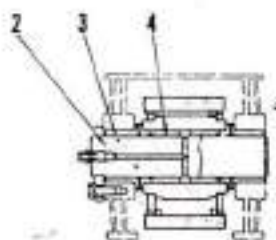
1547213



# SUSPENSION TY 220



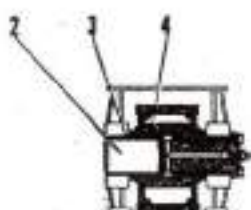
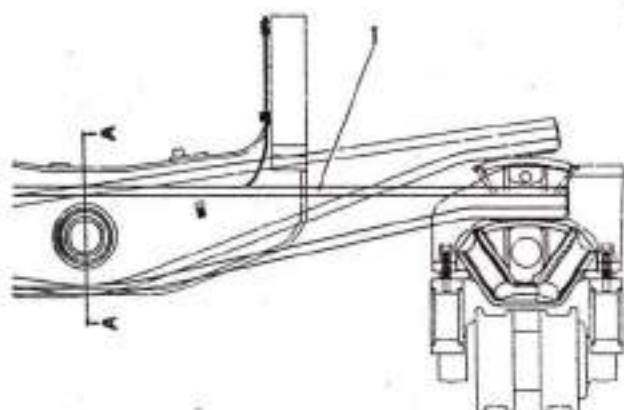
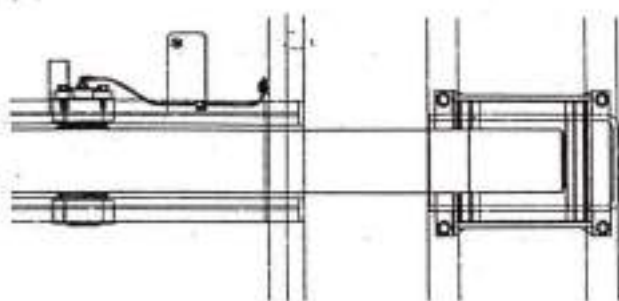
- 1. Equalizer bar
- 2. Pin
- 3. Bushing
- 4. Bushing



Section A - A

154F214

## SUSPENSION TS 220

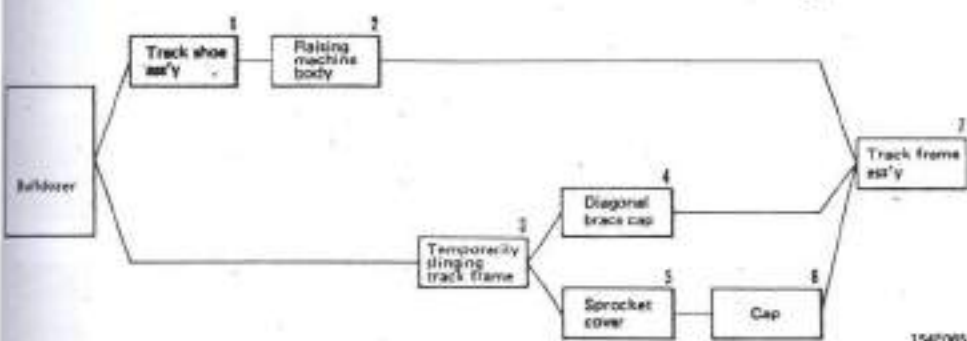


1. Equalizer bar
2. Pin
3. Support
4. Bushing

1547218

## DISASSEMBLY AND ASSEMBLY

## DISMOUNTING TRACK FRAME ASSEMBLY

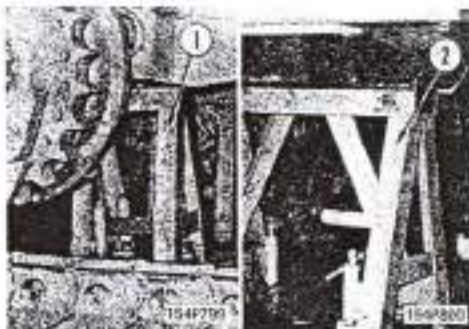


## Track shoe assembly

See Section SEPARATION OF TRACK FOR dismounting procedure.

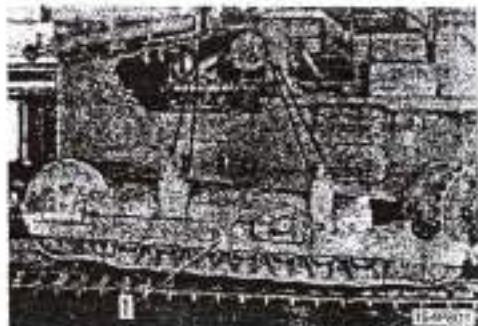
## Raising machine body

Raise machine body and place blocks .1 (height: approx. 500 mm) under both sides of steering case, and block 2 (height: approx. 850 mm) under center of radiator guard.



## Track frame assembly

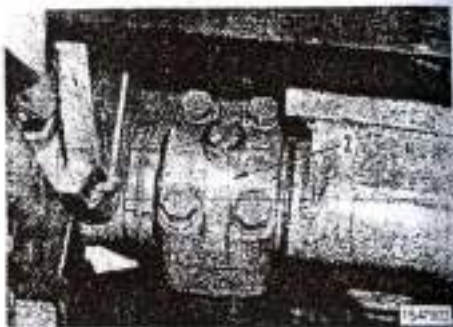
Temporarily sling track frame assembly (1).



**4. Diagonal brace cap**

Remove diagonal brace cap (2).

- ★ Before removing cap, make match marks on cap and diagonal brace.

**5. Sprocket cover**

Remove sprocket cover (3).

**6. Cap**

Remove cap (4).

**7. Track frame assembly**

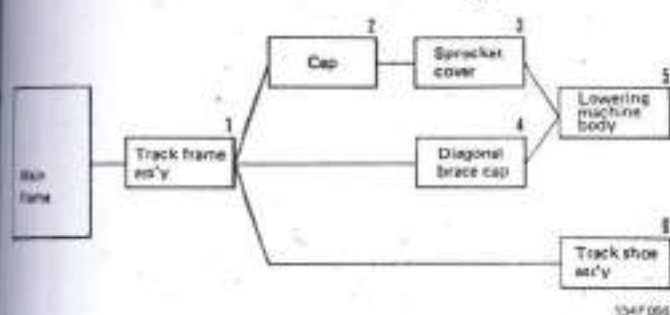
Sling the track frame assembly (1) and disconnect it from the diagonal brace and sprocket shaft.

- ★ Keep rear part of track frame assembly slightly lower when removing.

Track frame assembly: 2,300 kg (TY 220)  
2,560 kg (TS 220)

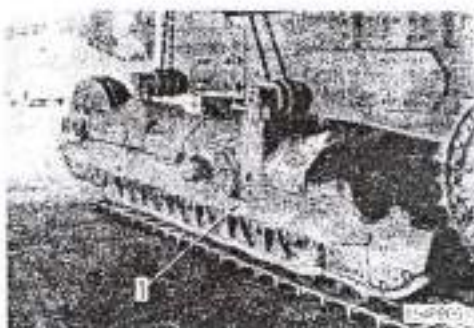


## MOUNTING TRACK FRAME ASSEMBLY



## Track frame assembly

Sling track frame assembly (1) and position it on diagonal frame and sprocket shaft.



## Cap

Install cap (4).

Cap:  $94 \pm 10$  kg.m



## Sprocket cover

Install sprocket cover (3).


\* Mounting bolt: Thread tightener

Bolt: (16 mm)  $25 \pm 5$  kg.m  
(14 mm)  $11 \pm 2$  kg.m



**4. Diagonal brace cap**

Align match marks on the cap and diagonal brace, and install cap (2).

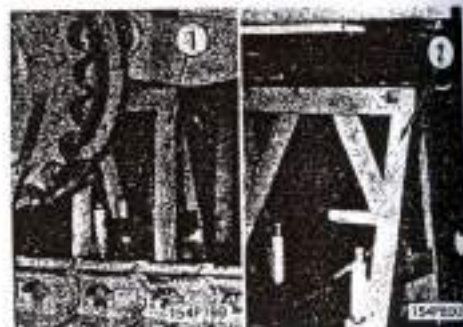
 Cap:  $94 \pm 10$  kg.m

**5. Lowering machine body**

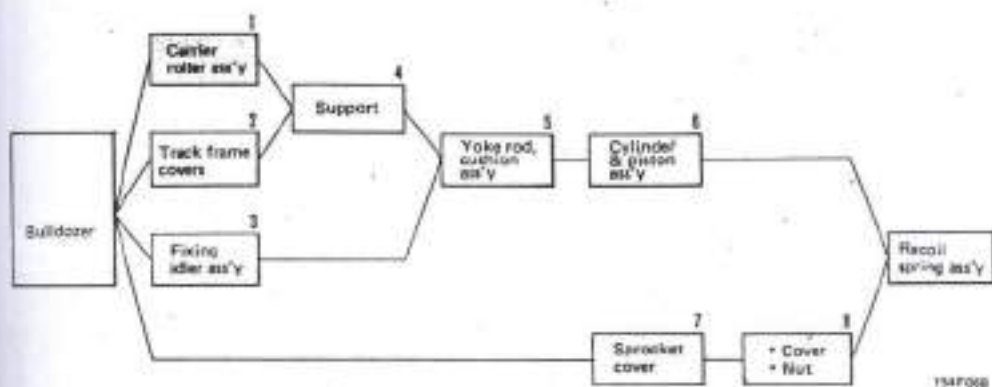
Raise machine body and remove blocks 1 (height: approx. 500 mm) from under both sides of steering case, and block 2 (height: approx. 850 mm) from under center of radiator guard. Lower machine body.

**6. Track assembly**

See Section CONNECTION OF TRACK for mounting procedure.

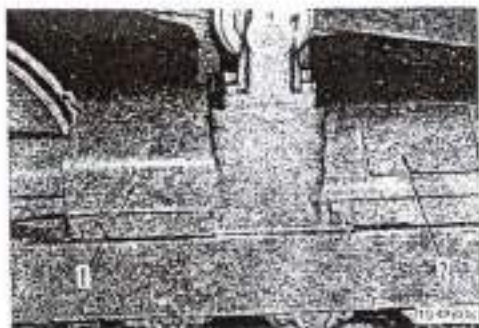


### DISMOUNTING RECOIL SPRING ASSEMBLY

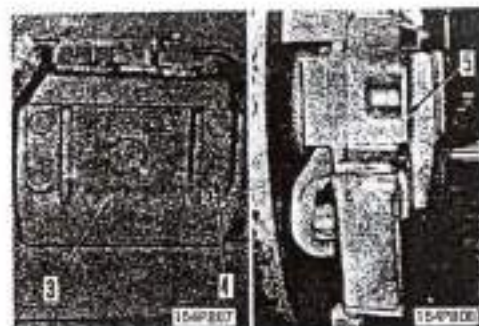


- See Section **DISMOUNTING CARRIER ROLLER**  
for dismounting procedure.

2. Track frame covers  
Remove covers (1) and (2)



3. Fixing idler assembly  
Loosen mounting bolts (4) of inner and outer guide plates (3). Take out adjustment shims (5) and retighten mounting bolt to fix idler assembly.



## 4. Support

- 1) Jack up equalizer bar to raise it from support (6).

- 2) Hoist support to remove.

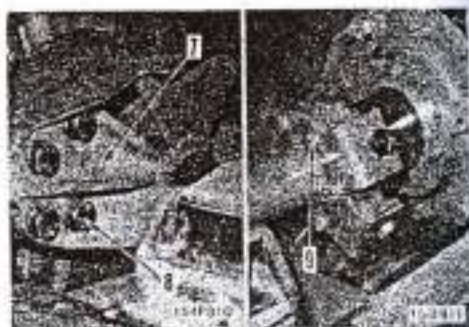


Support: 75 kg

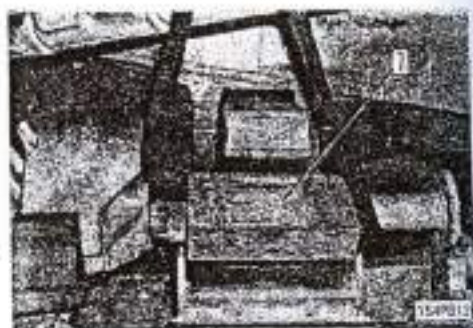


## 5. Yoke rod, cushion assembly

- 1) Remove mounting bolts (8) and (9) from yoke rod and cushion assembly (7).

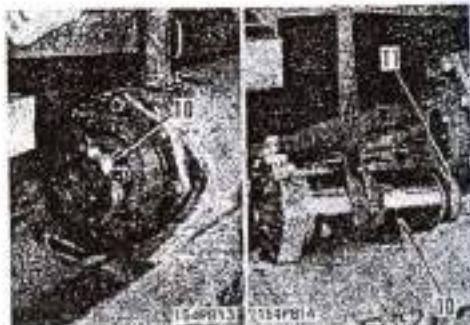


- 2) Disconnect yoke rod pilot by pushing in cylinder. Lift out yoke rod and cushion assembly (7) as one unit.



## 6. Cylinder and piston assembly

Pull out cylinder (10) slightly. Attach lifting tool and remove cylinder and piston (11) as an assembly.





## 7. Sprocket cover

Remove cover (12).



## 8. Cover, nut

1) Remove cover (14).

2) Remove lock plate (15) and tighten nut (16).

\* Before tightening the nut, check the nut's mounting position, so that it can be returned to the same position when mounting.



Do not fail to tighten the nut at this stage. It is very dangerous if the mounting bolt of the front cover is loosened while the nut is still loose because the recoil spring load is under tension.



## 9. Recoil spring assembly

1) Loosen bolts (18) in turn and remove cover (17).



2) Pull recoil spring assembly (19) out from sprocket side, and sling at center to remove.

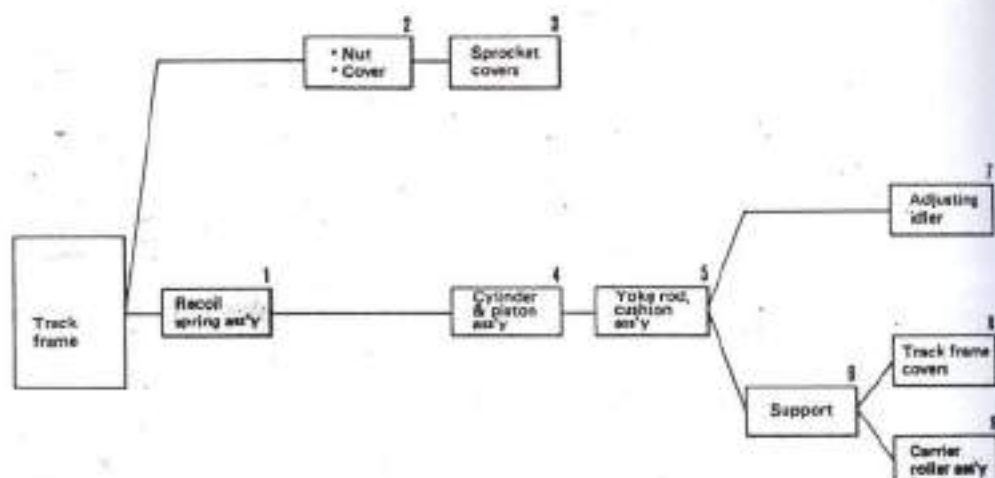


Recoil spring: 165 kg



D147006

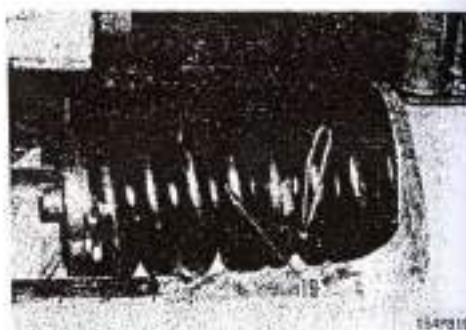
## MOUNTING RECOIL SPRING ASSEMBLY



1547907

## 1. Recoil spring assembly

- 1) Hoist recoil spring assembly (19) at its center, set it on track frame and insert it into case.  
 ★ Assembly must be guided in from sprocket side for final 10 mm.



1547919

- 2) Fit gasket on mounting face and mount cover (17). Tighten mounting bolts (18) in turn.



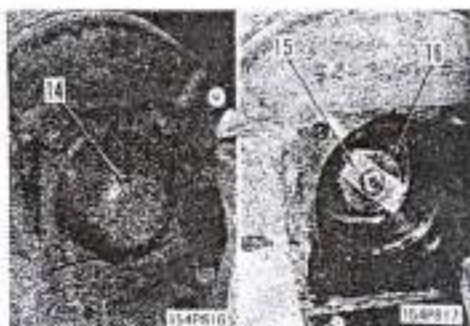
1547920

## 2. Nut, cover

- 1) Confirm assembly position of nut (16), then secure in place with lock plate (15).

★ Tighten nut until it reaches position it was in at time of disassembly.

- 2) Fit gasket and mount cover (14).



## 3. Sprocket covers

- Install sprocket covers (12) and (13).

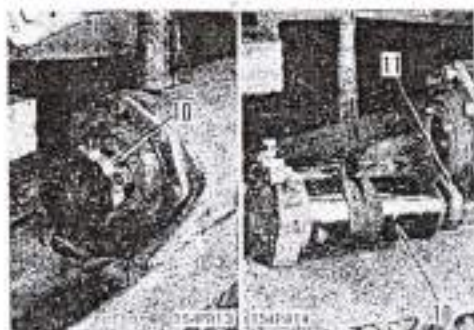
★ Coat mounting bolts with thread tightener



## 4. Cylinder and piston assembly

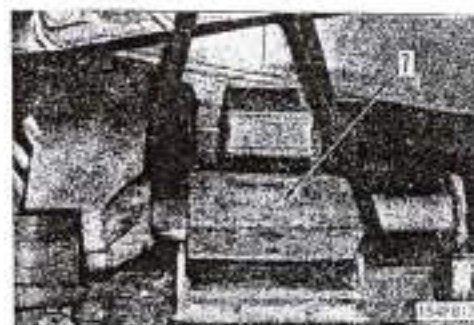
- Hoist cylinder (10) and piston (11) as one unit.

★ Take care not to damage the seal ring.



## 5. Yoke rod and cushion assembly

- 1) Hoist yoke rod and cushion assembly (7) as one unit and align yoke rod pilot and pilot bore.





- 2) Fasten yoke rod and cushion assembly (7) with mounting bolts (8) and (9).



6. Support

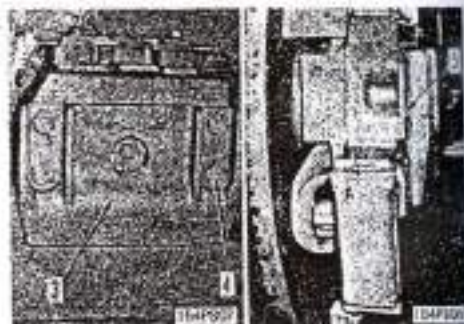
- 1) Hoist support (6) and install.
- 2) Release jack position of equalizer bar.



7. Adjusting idler assembly

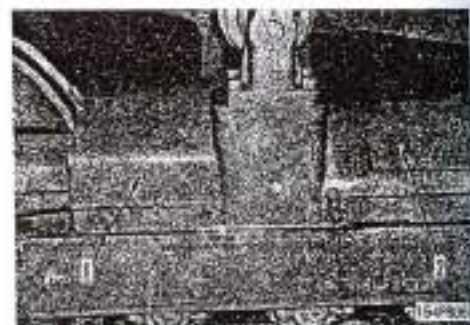
Loosen mounting bolts (4) of inner and outer guide plates (3), insert shims (5), and retighten bolts.

- \* Thickness of shims between guide plates and track frame: 0,5 to 1,0 mm



8. Track frame covers

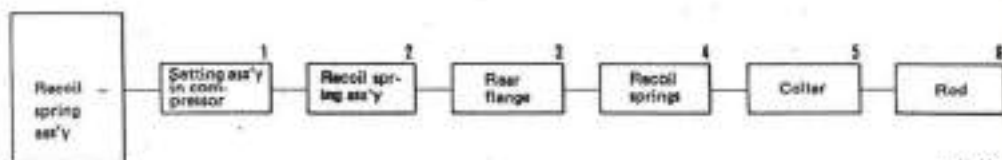
Mount track frame covers (1) and (2).





9. Mounting carrier roller assembly  
See Section MOUNTING CARRIER ROLLER ASSEMBLY for mounting procedure.

## DISASSEMBLY OF RECOIL SPRING ASSEMBLY



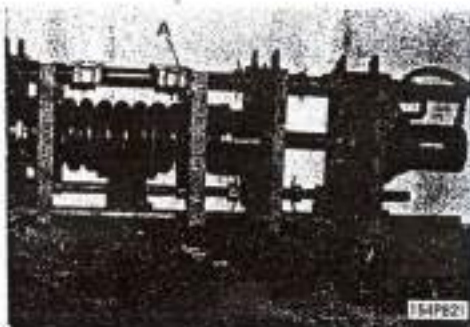
154P060

## Special tools required

Part Name	A
Compressor	1
Cylinder (70 ton)	1
Pump	1

## 1. Setting assembly in compressor

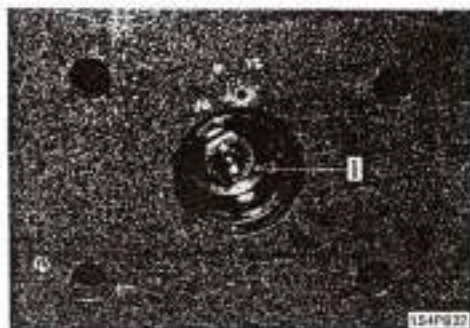
- 1) Set recoil spring assembly in compressor A.  
 \* Set with nut on opposite side from cylinder.



- 2) Apply hydraulic pressure to compress spring, and remove nut (1) from end of rod.

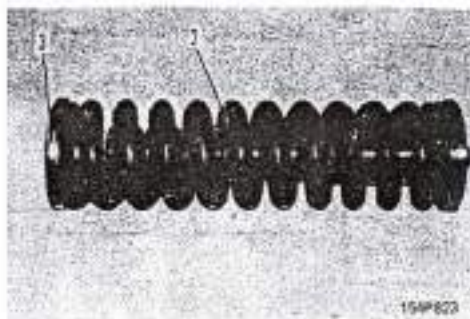


Recoil spring assembly: 165 kg



**2. Recoil spring assembly**

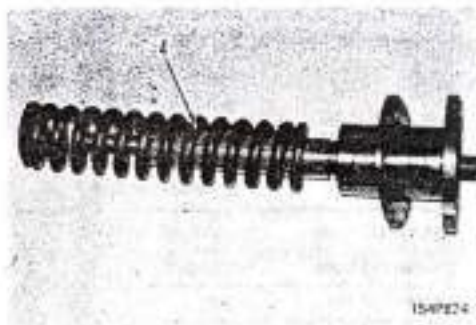
Release hydraulic pressure, and relieve spring tension.  
Remove recoil spring assembly (2) from compressor.

**3. Rear flange**

Remove rear flange (3).

**4. Recoil springs**

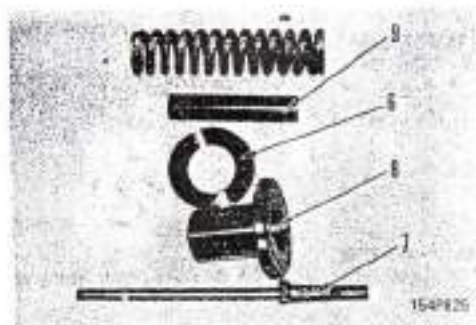
Remove recoil springs.

**5. Collar**

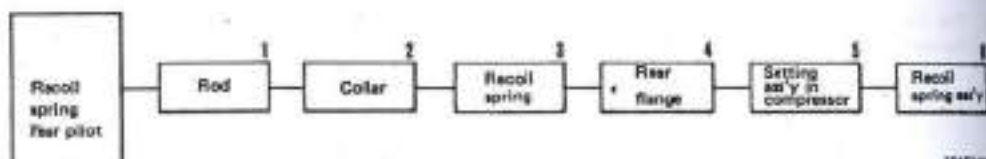
Remove collar (6), flange (8) and guide (9).

**6. Rod**

Remove rod (7).



## ASSEMBLY OF RECOIL SPRING ASSEMBLY

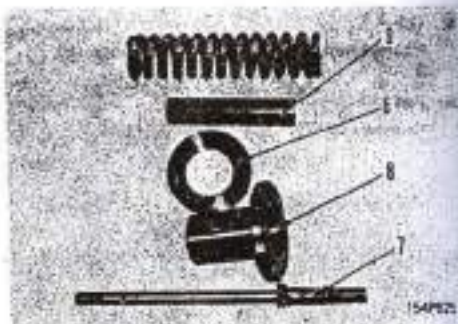


154702

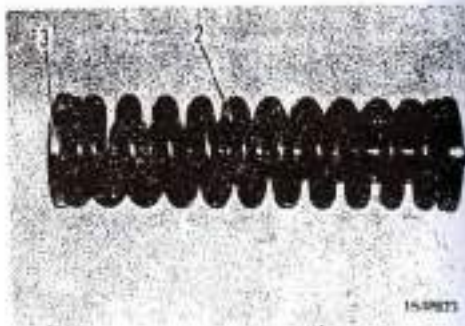
## Special tools required

Part Name	A
Compressor	1
Cylinder (70 ton)	1
Pump	1

1. Rod  
Insert rod (7) into flange (8).
2. Collar  
Fit collar (6) over rod.
3. Recoil springs  
Install recoil springs.
4. Rear flange  
Attach rear flange (3) to make recoil spring assembly (2).



154702



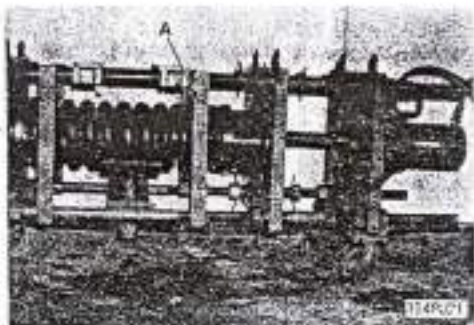
154702



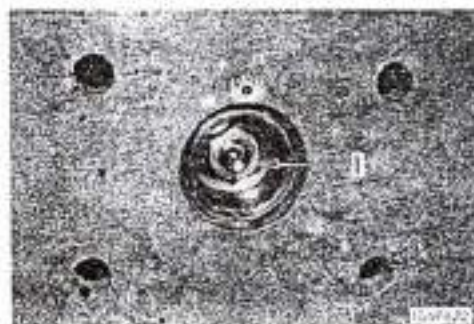
## 5. Setting assembly in compressor

- 1) Set recoil spring assembly into compressor and attach cylinder pump.

★ Set with nut on opposite side from cylinder A.

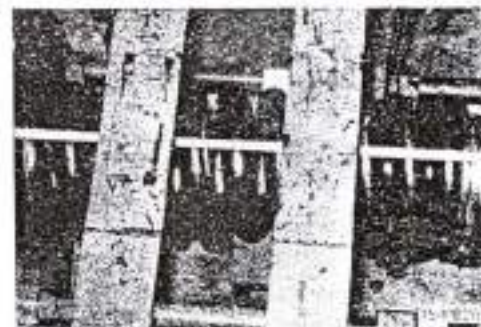


- 2) Apply hydraulic pressure to cylinder and attach nut (1).



- ★ Install recoil spring assembly so that distance between front and rear flanges is 668 mm (665 + 3 mm).

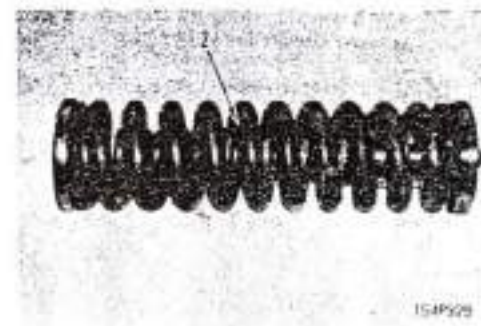
Use nut to reduce length to 665 mm.



## 6. Recoil spring assembly

Slowly release hydraulic pressure in cylinder, then remove recoil spring assembly (2) from compressor

A



114P04

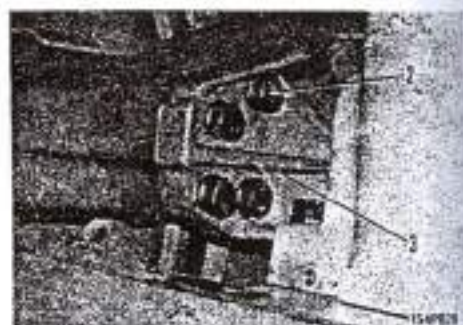
## DISMOUNTING IDLER ASSEMBLY

1. See Section WORK EQUIPMENT DISASSEMBLY AND ASSEMBLY for dismantling procedure.
2. See Section TRACK for separation procedure.
3. Remove cover (1) from front of track frame.



4. Remove yoke mounting bolts (2) and disconnect yoke (3).

 Bolt:  $55 \pm 6,5 \text{ kg.m}$



5. Loosen mounting bolts of guide plate (4).


6. Loosen spring seat keep bolts (5).

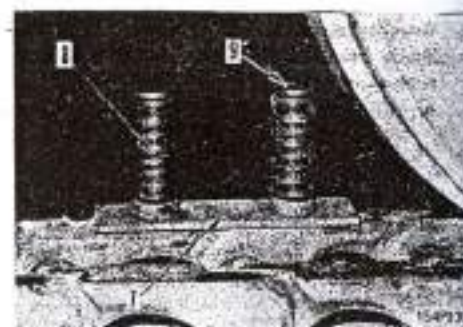
 Bolt:  $55 \pm 6,5 \text{ kg.m}$

7. Hoist idler assembly (6) with a wire inserted through its lifting hole, and sliding it along top of track frame, pull it forwards to remove.



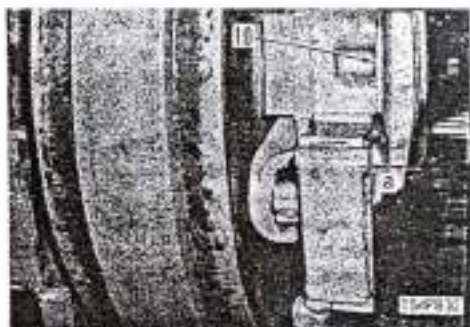
\* Spring seat (7), spring (8) and seat (9) are installed between support and track frame.

 Idler assembly: 350 kg



## MOUNTING IDLER ASSEMBLY

1. Sliding idler assembly with a wire inserted through its lifting hole, install spring seat (7), spring (8), and seat (9). Slide idler assembly (6) along top of track frame to its correct position.
2. Install mounting bolt (4) and connect yoke (3).
3. Spring seat keep bolts (5) of spring seat.
4. Install mounting bolts of guide plate (4).
  - \* Use shims (10) to adjust clearance between guide plate and track frame so that it is 0.5 to 1.0 mm.
5. See Section TRACK for connecting procedures.
6. See Section WORK EQUIPMENT DISASSEMBLY AND ASSEMBLY for mounting procedure.
7. Mount track frame front cover (1).





## DISMOUNTING TRACK ROLLER ASSEMBLY

1. Open inspection cover (1) and loosen plug (2) to relieve track tension.



Do not loosen plug (2) more than one turn. Do not loosen any part except plug (2).

★ If loosening plug does not relieve tension, move machine backwards and forwards.

2. Remove retainers (3), guard tension bolts (4), and guard mounting bolts (5). Then detach inner track roller guard (6) and outer track roller guard.



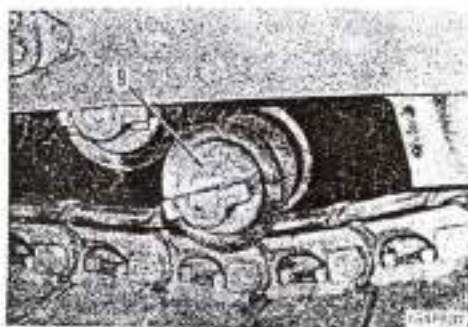
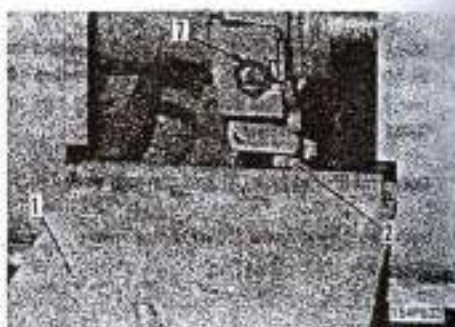
Track roller guard: 47 kg

3. Remove mounting bolts (8) from the track roller assemblies to be dismantled.
4. Raise the machine by backing it onto an approximately 300 mm high block 1. This will leave the track roller assemblies resting on the links.



Be sure to lock brake after raising rear of machine.

5. Remove track roller assemblies (9).





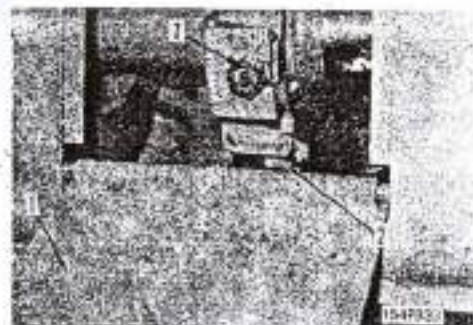
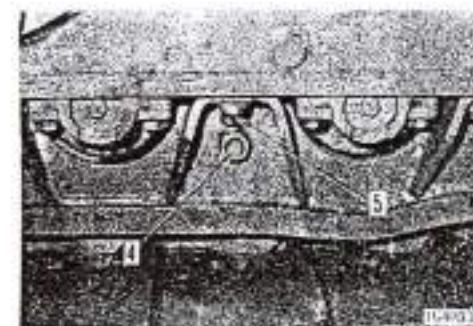
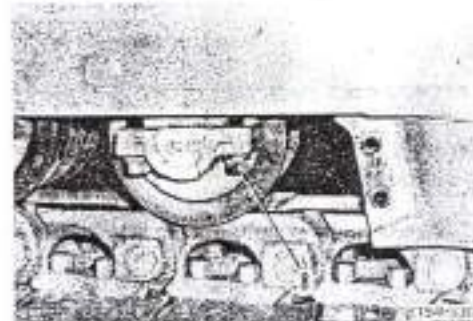
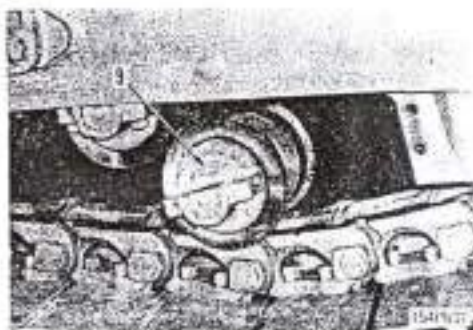
## MOUNTING TRACK ROLLER ASSEMBLY

1. With lubrication plug facing out, set track roller assemblies on track links.
2. Drive machine slowly forward and off blocks. When machine reaches position where mounting bolts have effect, tighten bolts loosely.
3. Drive machine forward until it is on the ground and tighten mounting bolts (8) securely to hold track roller assembly (9).

\* Coat bolts with thread tightener

 Track roller:  $80 \pm 4.5 \text{ kg/m}$

4. Install inner track roller guard (6) and outer track roller guard.
- \* Insert guard tension bolts (4) from inside machine and tighten with nuts on outside.
5. Install retainers (3).
- \* Coat mounting bolts with thread tightener
6. Open inspection cover (1) and pump grease through grease fitting of lubricator (7) to adjust track tension.
- \* Place a straightedge on idler and front carrier roller. Adjust tension so that there is a clearance of 30 to 40 mm between tip of grouser and middle of straightedge.
- \* When adjusting track tension, if it is difficult to pump in grease, move machine backwards and forwards.
- \* Before pumping in grease, make sure plug (2) is tightened.



## DISMOUNTING CARRIER ROLLER ASSEMBLY

1. Open inspection cover (1) and loosen plug (2) to relieve track tension.



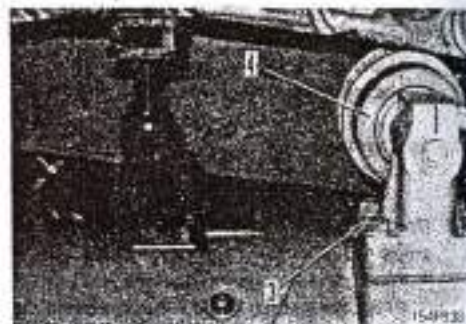
Do not loosen plug (2) more than one turn.  
Do not loosen any part except plug (2).

- \* If loosening plug (2) does not relieve tension, move machine backwards and forwards.
2. Jack up track until there is a gap between track link and carrier roller assembly (4).
  3. Sling carrier roller assembly and loosen support mounting bolts (3). Turn roller to front and remove.



## MOUNTING CARRIER ROLLER ASSEMBLY

1. Jack up track so there is a gap between carrier roller and track link.
2. Sling carrier roller assembly and loosely tighten support mounting bolts (3). Turn carrier roller assembly and position it. Tighten mounting bolts.
  - \* Coat mounting bolts with thread tightener (LT-2).



3. Open inspection cover (1) and pump grease through grease fitting of lubricator (7) to adjust track tension.
  - \* Place straightedge on idler and front carrier roller. Adjust tension so that there is a clearance of 30 to 40 mm between tip of grouser and middle of straightedge. After adjustment, close inspection cover.
  - \* When adjusting track tension, if it is difficult to pump in grease, move machine backwards and forwards.
  - \* Before pumping in grease, make sure plug (2) is tightened.





## SEPARATION OF TRACK

## Special tools required

Part Name	A
Remover & Installer	1
Pump	1
Cylinder (100 ton)	1

1. See Section WORK EQUIPMENT DISASSEMBLY AND ASSEMBLY for dismounting procedure.

2. Open inspection cover (1) and loosen plug (2) to relieve track (3) tension.



Do not loosen plug (2) more than one turn.  
Do not loosen any part except plug (2).

- \* If loosening plug does not relieve tension, move machine backwards and forwards.

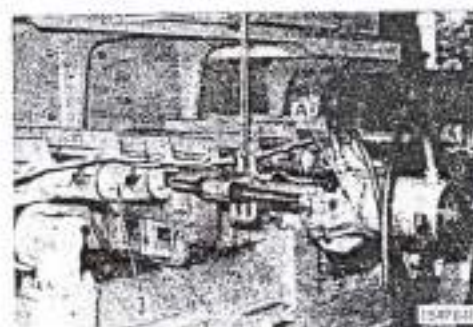
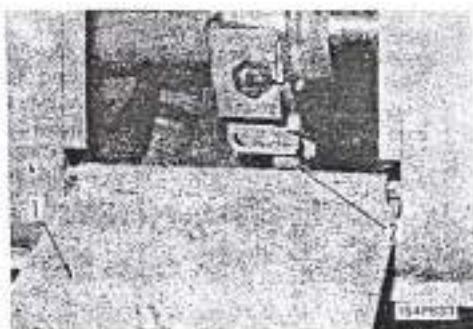
3. Start engine and position master pin between carrier rollers. Use special tool (A) to remove master pin.  
\* Sling tool with crane.

4. With temporary pin inserted, move machine forward. Insert block 1 (height: approx. 14 mm) and remove temporary pin (4).

5. Insert bar 2 in last link of track and support with crane.



Observe agreed signals when working with one or more persons.



## CONNECTION OF TRACK

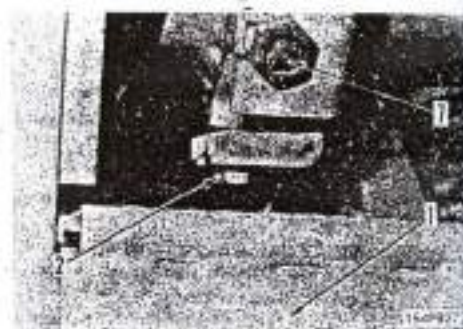
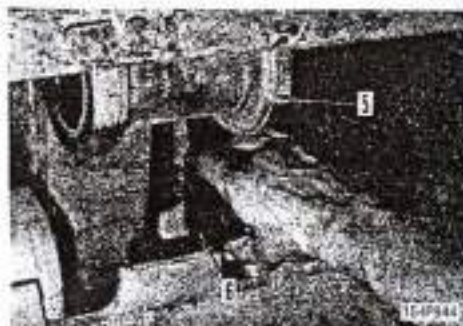
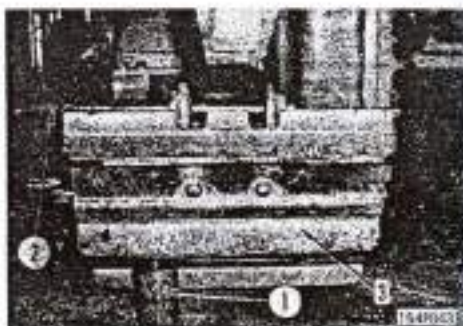
1. Insert bar 2 into last link of track. Move machine slowly forward until track winds round sprocket. Hoist bar with crane and move machine slowly forward until track is fully installed along track frame.



Observe agreed signals when working with one or more persons.

2. Insert dust seals (6) on inside of link assembly (5). Align holes of two links so that the links overlap and insert temporary pin (4).
3. Back up machine until temporary pin is positioned between carrier rollers. Using special tool A, force-fit master pin.
  - \* Hoist tool with crane.
  - \* Fit master pin so that ends protrude equal distance from both sides of links.

4. Open inspection cover (1) and tighten plug (2). Pump grease through lubricator (7) to adjust track tension.
  - \* Place straightedge on idler and front carrier roller. Adjust tension so that there is a clearance of 30 to 40 mm between grouser and middle of straightedge.
5. Close and lock inspection cover (1).
6. See WORK EQUIPMENT DISASSEMBLY AND ASSEMBLY for mounting procedure.

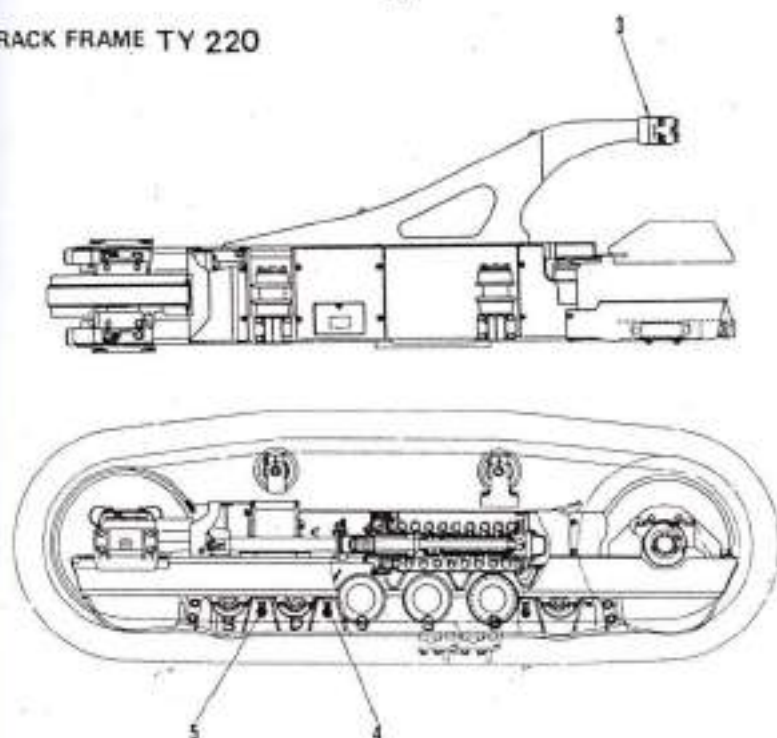




## MAINTENANCE STANDARD

## UNDERCARRIAGE

## (1) TRACK FRAME TY 220

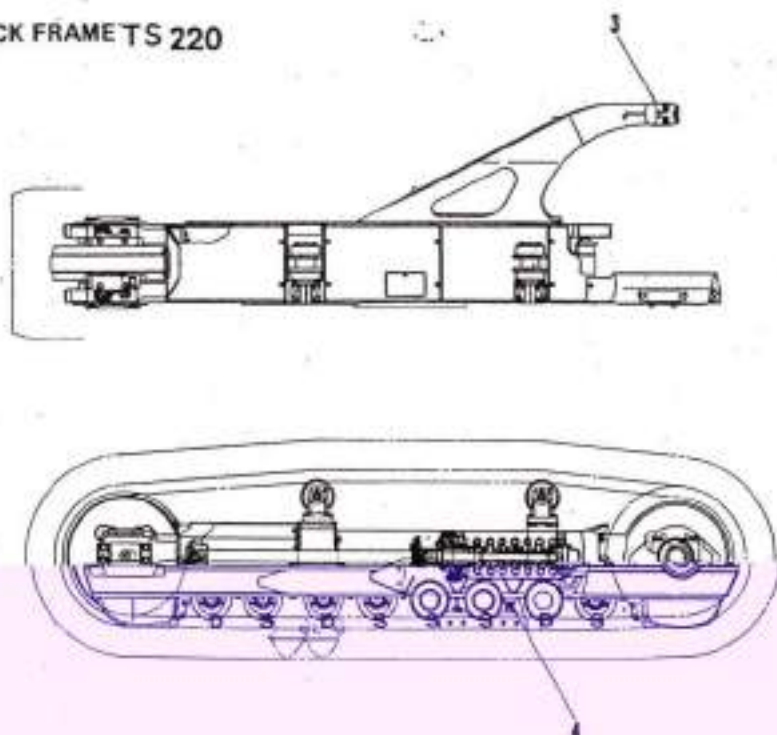


154F216

Unit: mm

No	Check item	Criteria				Remedy	
1	Track frame deformation	Item		Repair limit		Repair or replace	
		Bent		7 (at a length of 100)			
		Torsion		3 (at a length of 300)			
		Opening at idler		5			
2	Center distance between right and left track frame	Standard size		Repair limit			
		2000		Front and rear difference: within 15			
3	Clearance between sprocket shaft and diagonal brace bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		90	-0.036 -0.071	+0.035 0	0.036 ~ 0.106	0.5	
4	Tightening torque of track roller guard mounting bolt	16 ± 8.5 kg.m				Adjust	
5	Tightening torque of spacer bolt mounting nut	82.5 ± 22.5 kg.m					

## (1) TRACK FRAME TS 220

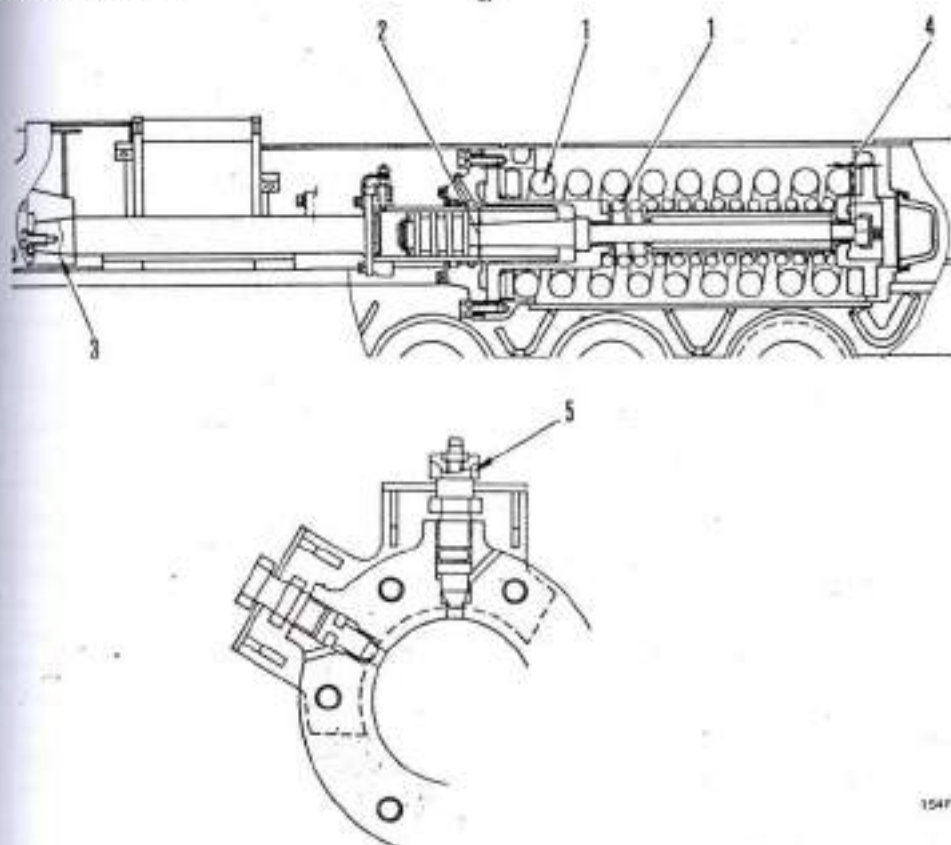


154P217

Unit: mm

No.	Check item	Criteria				Remedy	
1	Deformation of track frame	Item		Repair limit		Repair or replace	
		Bent		7 (at length of 100)			
		Torsion		3 (at length of 300)			
		Opening at idler		5			
2	Center distance between right and left track frames	Standard size		Repair limit			
		2250		Front and rear difference within 15			
3	Clearance between sprocket shaft and diagonal brace bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		90	-0.036 -0.071	+0.035 0	0.036 ~ 0.106	0.5	
4	Tightening torque of track roller guard mounting bolt	76 ± 8.5 kg.m				Adjust	
5	Tightening torque of spacer bolt mounting nut	82.5 ± 22.5 kg.m					

## ② RECOIL SPRING

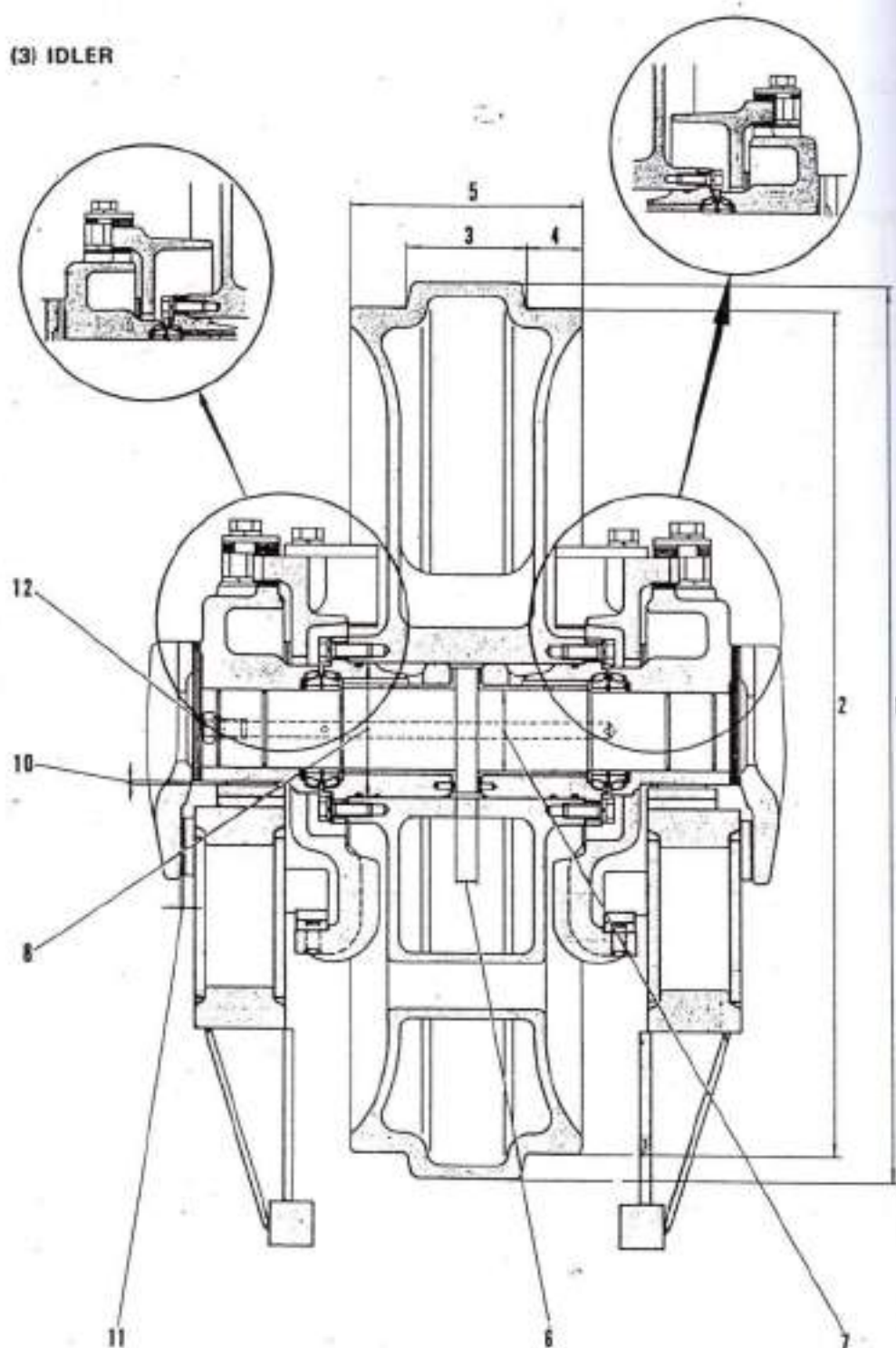


154F218

Unit: mm

No.	Check item	Criteria					Remedy
1	Recoil spring	Standard size			Repair limit		Replace
		Free length x O.D.	Install length	Install load	Free length	Repair limit	
		(large) 817x237 (small) 630x128	665 436	17,130 kg 3,250 kg		15,400 kg 2,900 kg	
2	Clearance between adjust cylinder and bushing	standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		100	-0.036 -0.090	+0.136 +0.065	0.101 ~ 0.226	0.5 - +	
3	Force fitting force of idler yoke	15 ton					Adjust
4	Clearance between rear pilot and nut	10					
5	Lubricator tightening torque						

(3) IDLER



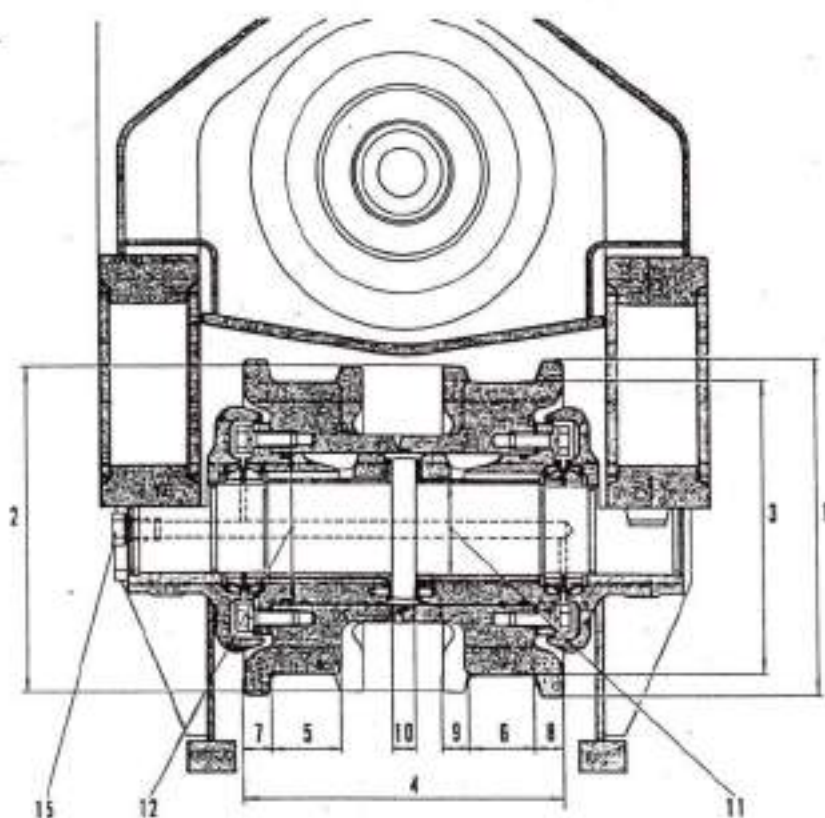
194F234



Unit: mm

No.	Check item	Criteria				Remedy	
		Standard size		Repair limit			
1	Outer dia. of protrusion	774		760		Build-up welding or replace	
2	Outer dia. of tread	730		715			
3	Width of protrusion	105		89			
4	Width of tread	49.5		51.5			
5	Total width	204		194			
6	Shaft flange width	20		19.5		Replace	
7	Clearance between shaft and bushing	Standard size 70	Tolerance		Standard clearance 0.270 ~ 0.390		Clearance Limit 1.5
			Shaft -0.210 -0.260	Hole +0.130 +0.060			
8	Interference of outer bushing and idler	Standard size 115	Tolerance		Standard interference -0.03 ~ 0.144		Allowable interference -0.35
			Shaft +0.094 +0.040	Hole +0.07 -0.05			
9	Play at axial direction of shaft	Standard clearance			Clearance limit		
		0.27 ~ 0.39			1.5		
10	Clearance between guide plate and support	2.0				Build-up welding or replace	
11	Clearance between guide plate and side plate	0.5 ~ 1.0		3		Shim adjust or plate replacement	
12	Tightening torque of oil filling plug	21 ± 5 kg.m				Adjust	
13	Quantity of filling oil	280 ~ 320 cc SAE 140/ GL-4 (ISO 140)				Filling oil	

(4) TRACK ROLLER

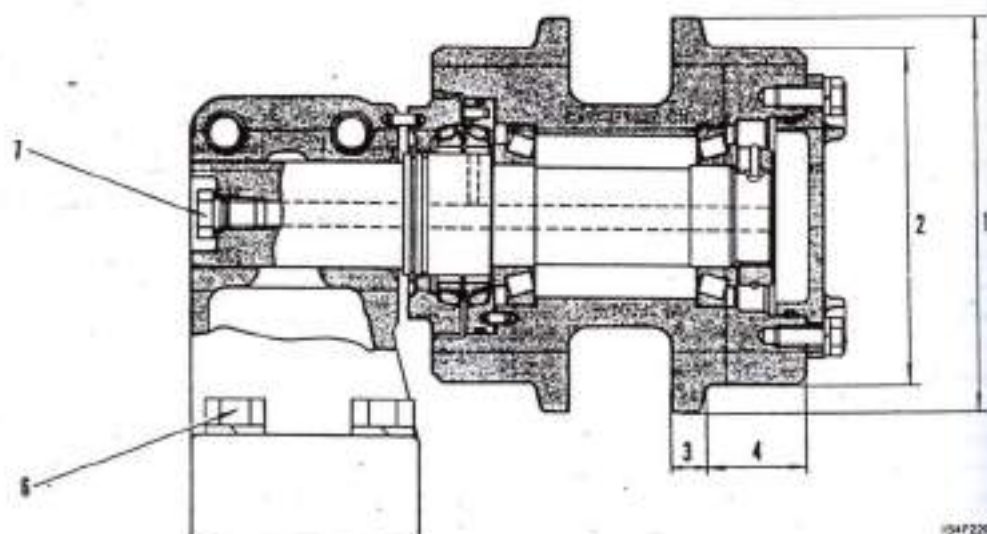


154F218

Unit: mm

No.	Check item	Criteria		Remedy	
1	Flange (outside) outer dia.	Standard size	Repair limit		
		257	247		
2	Flange (inside) outer dia.	249	239	Build-up, welding or replace	
3	Tread outside dia.	222	198		
4	Tread width	251.2	—		
5	Tread width (single flange)	55.6	66.6		
6	Tread width (double flange)	51.6	68.6		
7	Flange width (single flange)	21	6		
8	Flange width (double flange, outside)	21	6		
9	Flange width (double flange, inside)	21	6		
10	Shaft flange width	20	18.5		
11	Clearance between shaft and bushing	Standard size	Tolerance		Standard clearance
		70	Shaft -0.210 -0.260	Hole +0.130 +0.100	0.31-0.39
12	Interference between outer bushing and roller	Standard size	Tolerance	Standard interference	Allowable interference
		115	Shaft +0.004 +0.040	Hole +0.027 -0.027	0.013 ~ 0.121
13	Play at axial direction of shaft	Standard clearance		Clearance limit	
		0.40 ~ 0.80		1.5	
14	Tightening torque of track roller mounting bolt	76 ± 8.5 kg.m		Adjust	
15	Tightening torque of filling oil plug	21 ± 5 kg.m			
16	Quantity of filling oil	280 ~ 320 cc. SAE 140/ GL-4		Filling oil	

(5) CARRIER ROLLER



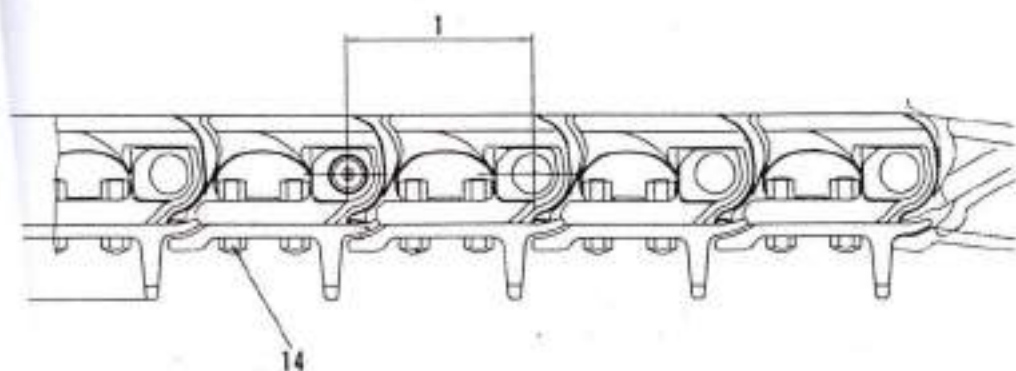
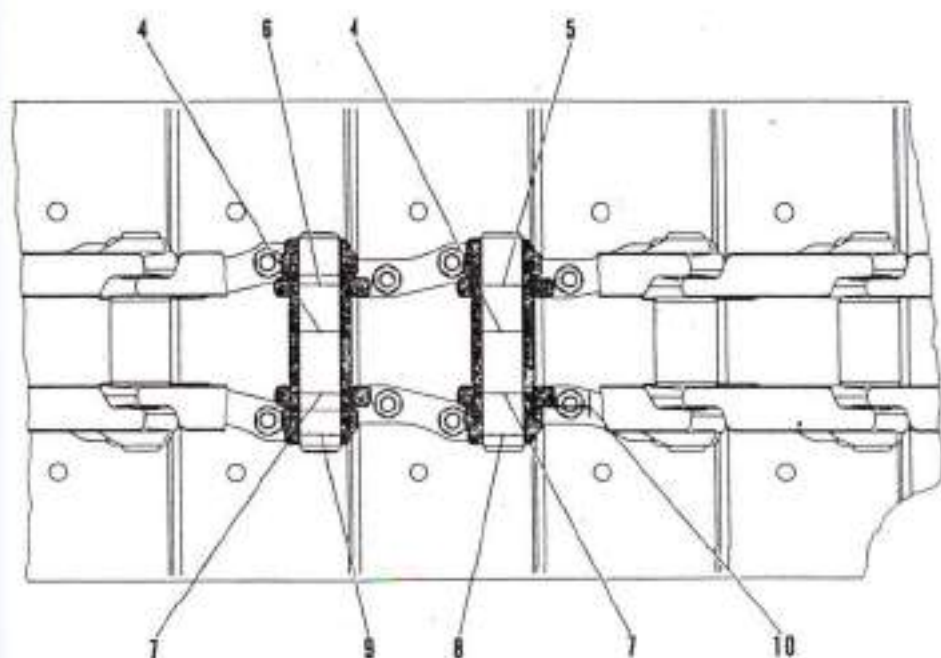
ISAF226

Unit: mm

No.	Check item	Criteria		Remedy
1	Flange outside dia.	Standard size	Repair limit	Build-up welding or replace
		217	207	
		185	165	
		13	10	
2	Tread outside dia.	185	165	Build-up welding or replace
3	Flange width	13	10	
4	Tread width	57	55	
5	Play at axial direction of shaft	Standard clearance	Clearance limit	Not adjust or bearing replace
		0.10 ~ 0.13	0.2	
6	Tightening torque of support mounting bolt	55 ± 5 kg.m		Adjust
7	Tightening torque filling oil plug	21 ± 5 kg.m		
8	Quantity of filling oil	470 ~ 530 cc SAE 140/ GL-4		Filling oil



(6) TRACK (SHOE) TY 220



15AF221

Unit: mm

No.	Check item	Criteria				Remedy
1	Link pitch	Standard size		Repair limit		Reverse or replace
		216.25		219.25 (Impact loading) 221.25 (Normal loading)		
2	Grouser height	72		25		Lug welding, build-up welding or replace
3	Link height	129		117		Build-up welding or replace
4	Bushing outside dia.	74.3		70.8 (Impact loading) 69.3 (Normal loading)		Reverse or replace
5	Clearance between regular pin and bushing	Standard size	Tolerance		Standard clearance	Clearance limit
			Shaft	Hole		
		47	+0.185 +0.085	+0.915 +0.415	0.230 ~ 0.830	
6	Clearance between master pin and bushing	47	-0.200 -0.400	+0.630 +0.230	0.430 ~ 1.030	
7	Interference between bushing and link	Standard size	Tolerance		Standard interference	Allowable interference
			Shaft	Hole		
		71	+0.344 +0.304	+0.074 0	0.230 ~ 0.344	0.22
8	Interference between regular pin and link	Shaft 47 Hole 46.8	+0.185 +0.085	+0.062 0	0.223 ~ 0.385	0.203
9	Interference between master pin and link	46.8	+0.230 +0.200	+0.062 0	0.138 ~ 0.230	0.138
10	Clearance between link joint surface	Standard clearance			Clearance limit	
		(one side) 0 ~ 1.1 (each side) 0 ~ 2.2			8	
11	Force-fitting force of bushing	12.3 ~ 18.3 ton				Adjust
12	Force-fitting force of regular pin	21.4 ~ 37.0 ton				
13	Force-fitting force of master pin	12.3 ~ 22.1 ton				
14	Tightening torque of shoe bolt	76 ± 6 kg.m				



Unit: mm

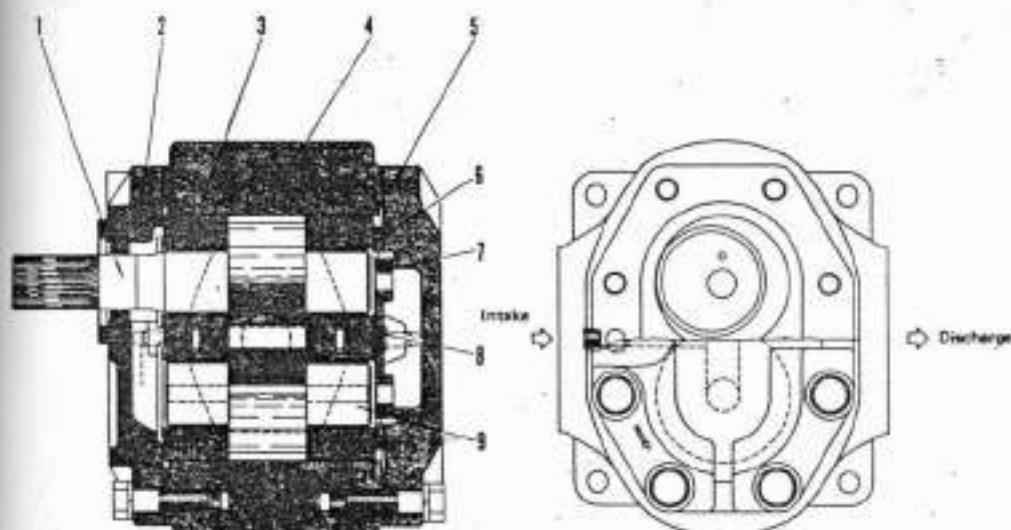
No.	Check item	Criteria				Remedy
1	Link pitch	Standard size		Repair limit		Reverse or replace
		216.25		219.25		
2	Grouser height	123		101		Lug welding, build-up welding or replace
3	Link height	129		117		Build-up welding or replace
4	Bushing outside dia.	74.3		70.8		Reverse or replace
5	Clearance between regular pin and bushing	Standard size	Tolerance		Standard clearance	Clearance limit
			Shaft	Hole		
		47	+0.185 +0.085	+0.915 +0.415	0.230 ~ 0.830	
6	Clearance between master pin and bushing	47	-0.200 -0.400	+0.630 +0.230	0.430 ~ 1.030	
7	Interference of bushing and link	Standard size	Tolerance		Standard interference	Allowable interference
			Shaft	Hole		
		71	+0.344 +0.304	+0.074 0	0.230 ~ 0.344	0.22
8	Interference of regular pin and link	Shaft 47 Hole 46.8	+0.185 +0.085	+0.062 0	0.223 ~ 0.385	0.203
9	Interference of master pin and link	46.8	+0.330 +0.200	+0.062 0	0.138 ~ 0.230	0.138
10	Clearance between link joint surface	Standard clearance			Clearance limit	
		(one side) 0 ~ 1.1 (each side) 0 ~ 2.2			8	
11	Force-fitting force of bushing	12.3 ~ 18.3 ton				Adjust
12	Force-fitting force of regular pin	21.4 ~ 37.5 ton				
13	Force-fitting force of master pin	13.3 ~ 22.1 ton				
14	Tightening torque of shoe bolt	76 ± 6 kg·m				



# HYDRAULIC CONTROL

# STRUCTURE AND FUNCTION

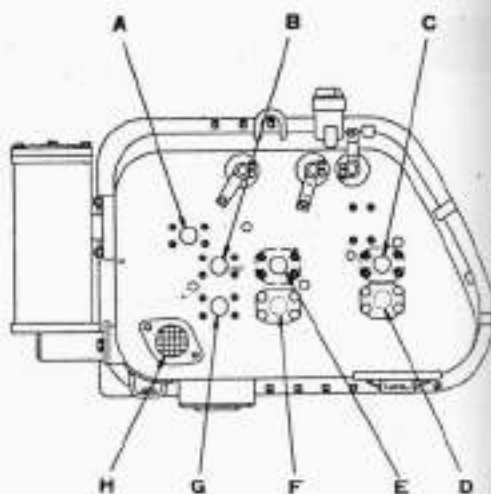
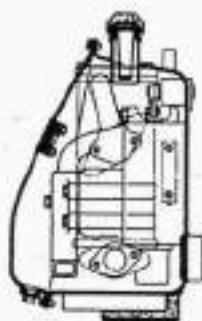
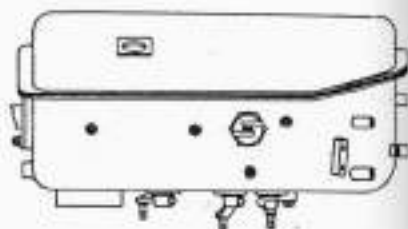
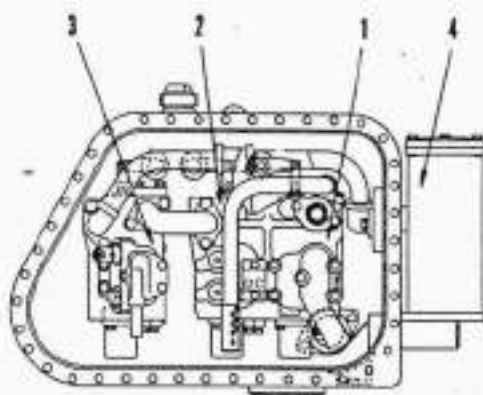
## HYDRAULIC PUMP



15MF223

1. Drive gear
2. Bracket
3. Bushing
4. Gear case
5. Cover
6. Seal plate
7. Collar
8. Backup ring
9. Driven gear

## HYDRAULIC TANK



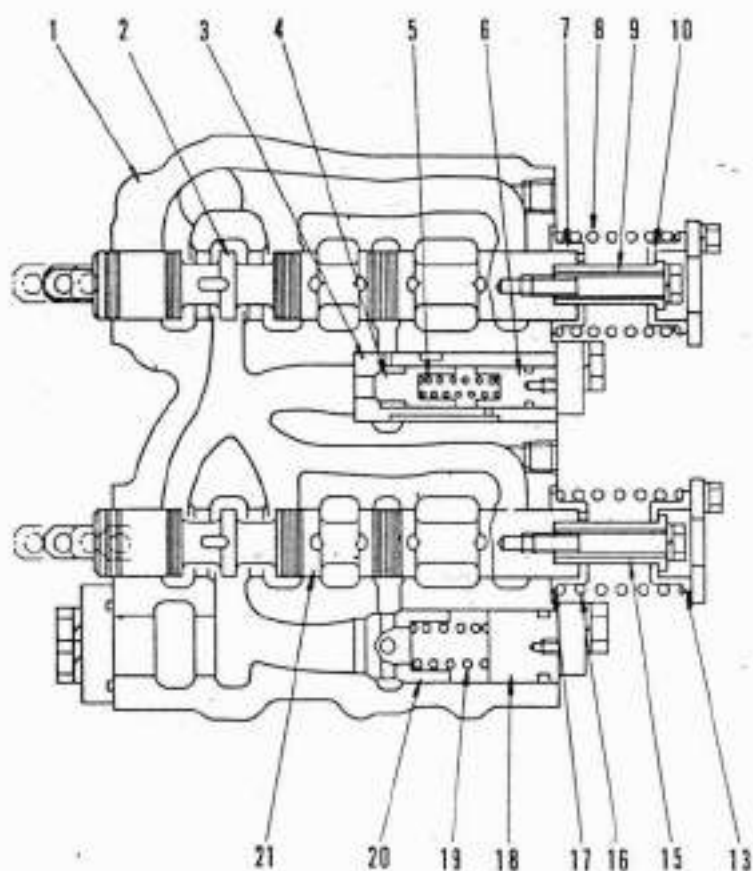
1. Brake lift control valve
2. Brake tilt control valve
3. Ripper control valve
4. Hydraulic filter

- A. From pump
- B. To Brake cylinder bottom side (lower)
- C. To ripper cylinder bottom side (lower)
- D. To ripper cylinder head side (raise)
- E. Tilt cylinder head side (left tilt)
- F. Tilt cylinder bottom side (right tilt)
- G. Brake cylinder head side (raise)
- H. To pump

154724

## HYDRAULIC CONTROL VALVE

## (1) BLADE LIFT AND TILT CONTROL VALVE



1. Valve body

2. Tilt spool

3. Collar

4. Tilt check valve

5. Spring

6. Seat

7. Retainer

8. Spring

9. Collar

10. Retainer

13. Retainer

15. Collar

16. Spring

17. Retainer

18. Seat

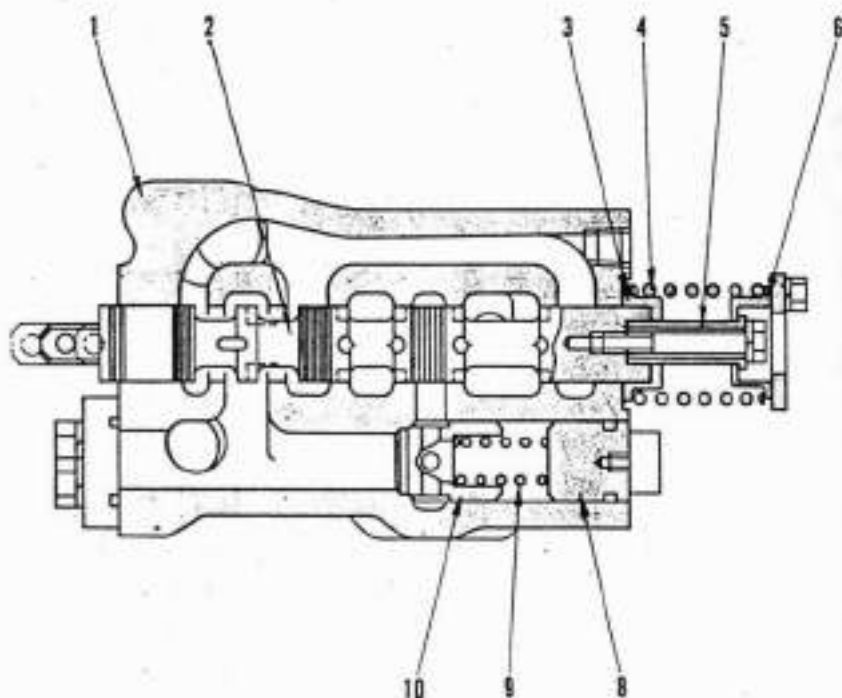
19. Spring

20. Lift check valve

21. Lift spool

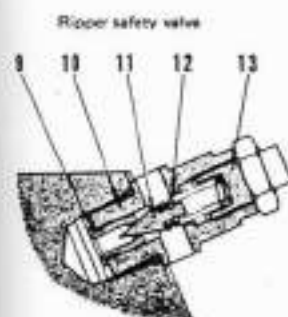
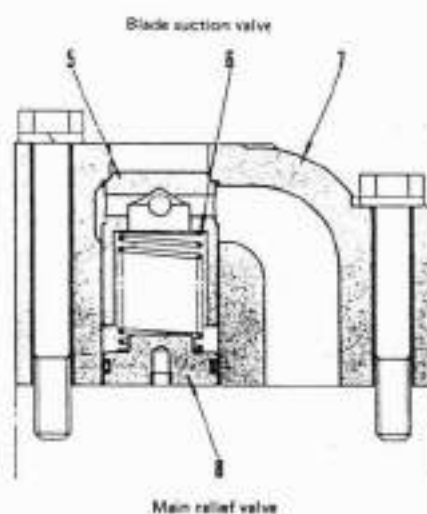
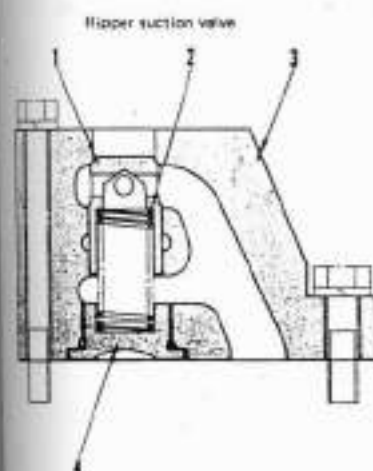


(2) RIPPER CONTROL VALVE TY 220



- 1. Valve body
- 2. Spool
- 3. Retainer
- 4. Spring
- 5. Collar
- 6. Retainer
- 8. Seat
- 9. Spring
- 10. Check valve

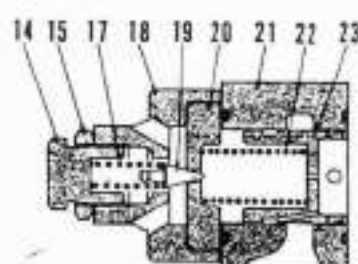
### 3 MAIN RELIEF, SUCTION, SAFETY VALVE



1. Ripper suction valve
2. Spring
3. Valve body
4. Plug seat
5. Blade suction valve
6. Spring
7. Valve body
8. Poppet

9. Seat
10. Valve body
11. Poppet
12. Spring
13. Plug seat
14. Adjust screw
15. Holder

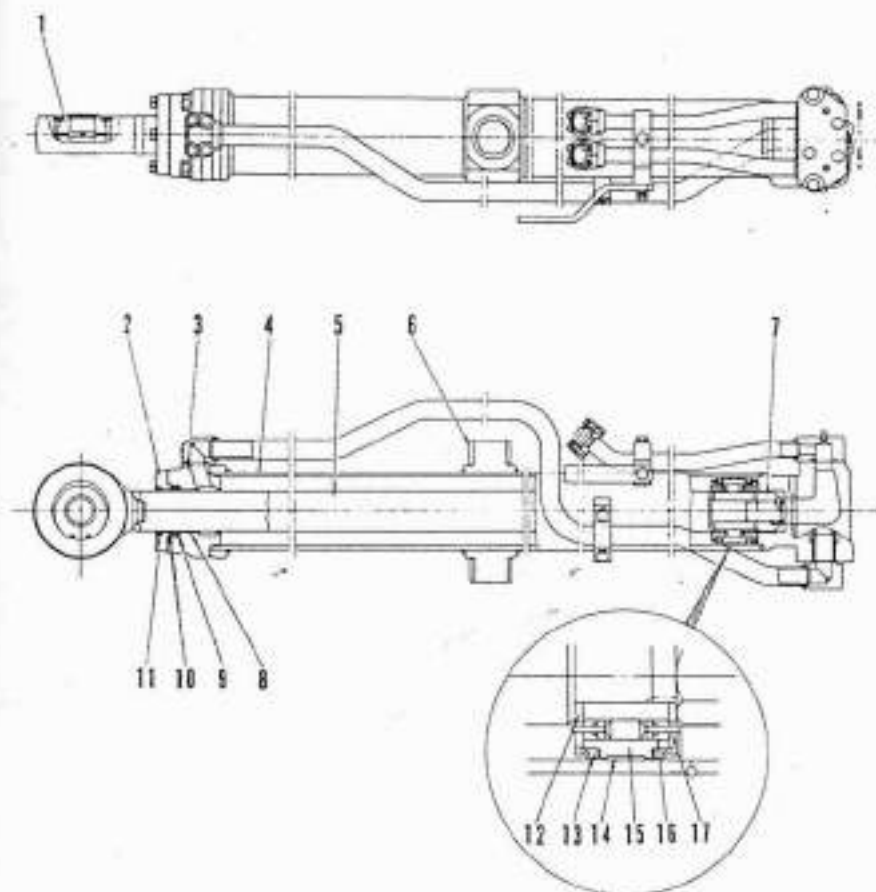
17. Spring
18. Valve body
19. Poppet
20. Seat
21. Sleeve
22. Spring
23. Sleeve



15AF227



## 1) BLADE LIFT CYLINDER TS 220

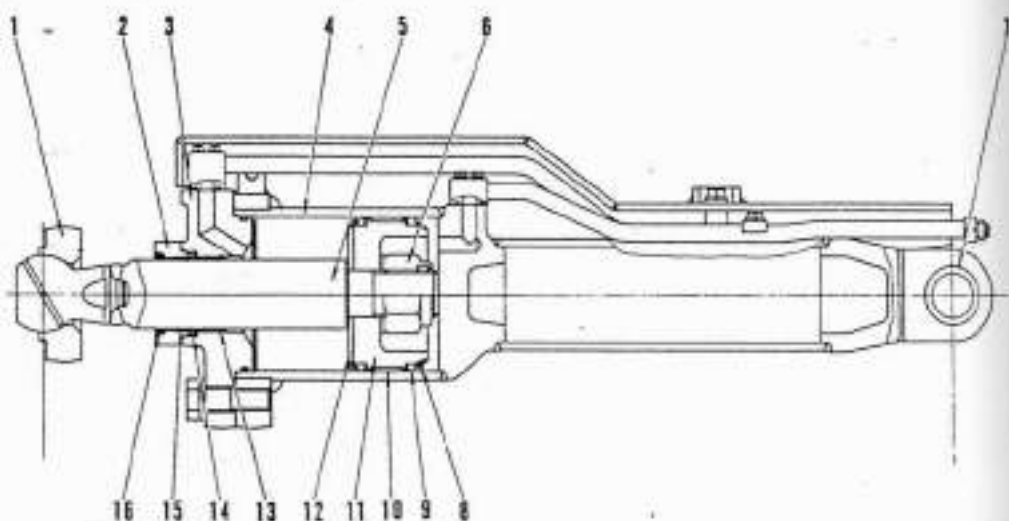


- |                  |                  |
|------------------|------------------|
| 1. Bushing       | 10. Bushing      |
| 2. Gland         | 11. Dust seal    |
| 3. Cylinder head | 12. Retainer     |
| 4. Cylinder      | 13. Packing      |
| 5. Piston rod    | 14. Wear ring    |
| 6. Bushing       | 15. Piston       |
| 7. Nut           | 16. Valve seat   |
| 8. Bushing       | 17. Piston valve |
| 9. Packing       |                  |

154F220



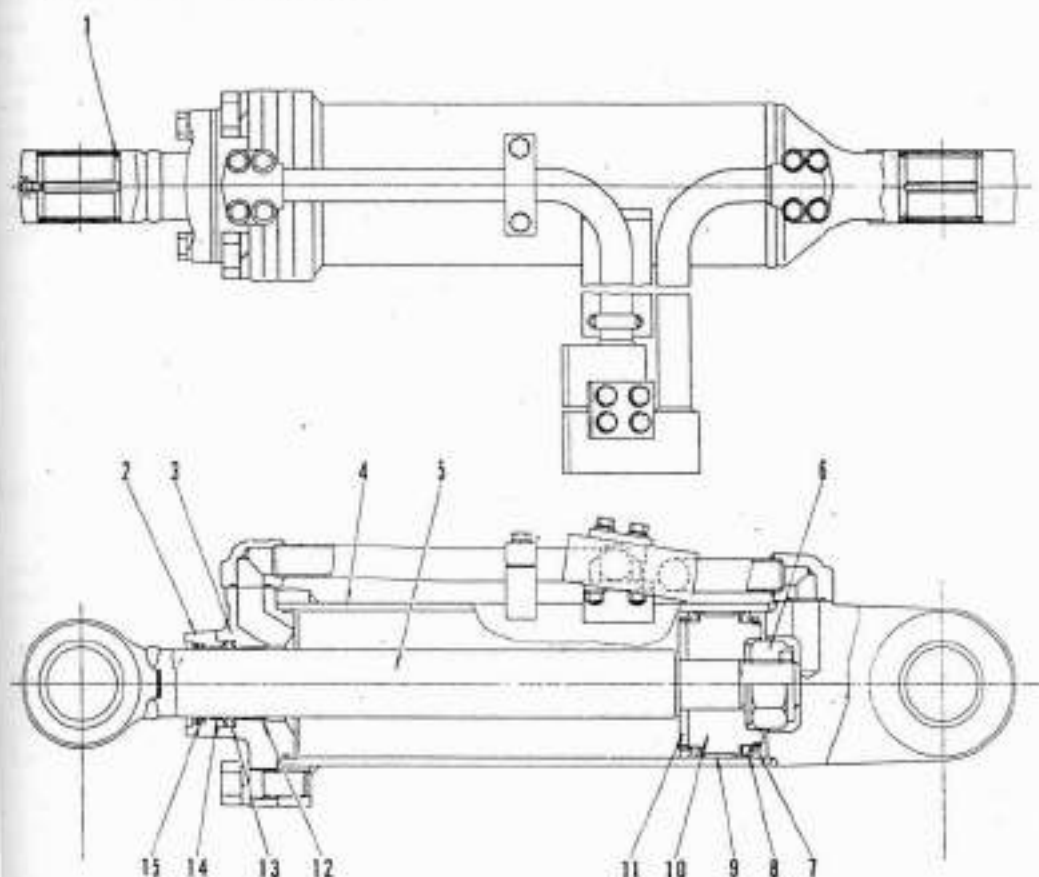
## (2) BLADE TILT CYLINDER



154F220

- |                  |               |
|------------------|---------------|
| 1. Cap           | 9. Packing    |
| 2. Gland         | 10. Wear ring |
| 3. Cylinder head | 11. Piston    |
| 4. Cylinder      | 12. Retainer  |
| 5. Piston rod    | 13. Bushing   |
| 6. Nut           | 14. Packing   |
| 7. Bushing       | 15. Bushing   |
| 8. Retainer      | 16. Dust seal |

## (3) RIPPER CYLINDER TY 220



1. Bushing
2. Gland
3. Cylinder head
4. Cylinder
5. Piston rod
6. Nut
7. Retainer
8. Packing

9. Wear ring
10. Piston
11. Retainer
12. Bushing
13. Packing
14. Bushing
15. Dust seal

1547225

## PISTON VALVE

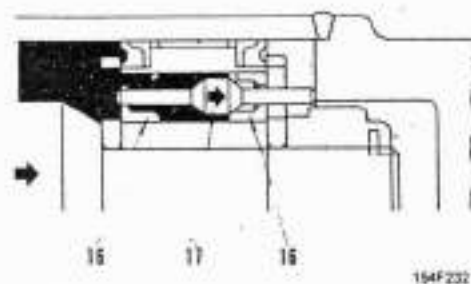
## CONSTRUCTION

The piston valve is installed on the piston of the blade lift cylinder. It is designed to relieve oil pressure from the hydraulic pump at the end of the piston rod stroke. Because the piston moves with considerable velocity, a surge pressure will be developed in the circuit when the piston is abruptly stopped at the end of its stroke. Further, when high pressure oil is sent to the cylinder, the circuit pressure will rise excessively, causing the main relief valve of the control valve to open and relieve the circuit pressure.

This surge and relief which takes place continuously at the end of the piston stroke places undue stress on the hydraulic circuit. In order to prevent this, the piston valve is arranged so that it strikes the cylinder bottom or head just before the piston reaches the end of its stroke, thus allowing the high pressure oil to flow out from the periphery of the piston valve.

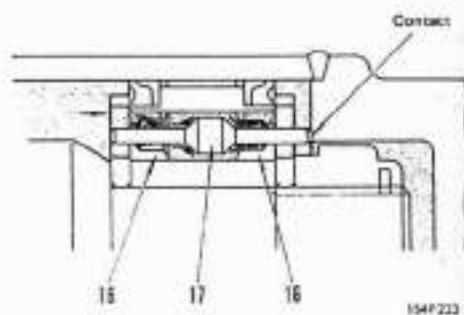
## OPERATION

## 1. During piston valve operation



High pressure oil from the hydraulic pump pushes against the piston (15) and piston valve (17). Because the piston valve is pushed in the  $\Rightarrow$  direction, thus sealing the taper part of the piston valve seat (16), the pressure in the cylinder will rise, causing the piston rod (15) to move the  $\Rightarrow$  direction.

## 2. During piston valve operation



Just before the piston rod (15) reaches the end of its stroke, the end of the piston valve (17) strikes the bottom (or head) of the cylinder, causing the piston valve to stop in that position, so that only the piston rod continues to move.

As a result, the high pressure oil which was sealed in the piston valve flows out from the piston valve seat (16), preventing the pressure in the cylinder from rising.

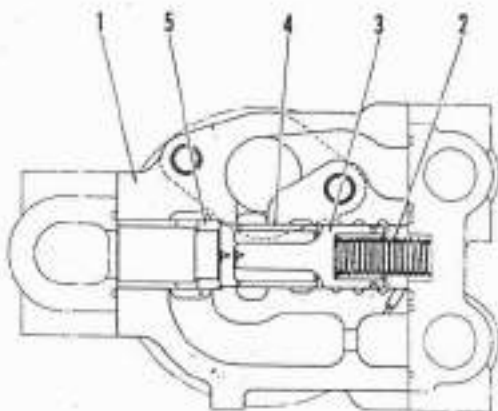
In this way, the oil simply passes through the piston valve to be recirculated, without the generation of surge pressure in the hydraulic circuit or relief from the main relief valve of the control valve.

## QUICK DROP VALVE

## STRUCTURE

Quick drop valve is composed of the valve body (1), spring (2), spool (3), check valve (4) and collar (5). The function of the quick drop valve is to reduce the vacuum produced inside the cylinder, resulting in an increase in the blade lowering speed, and reducing the shock until the digging operation starts. The blade lowering speed is decided by pump discharge rate, thus greater lowering speed can be obtained by installation of the quick drop valve.

- |               |                |
|---------------|----------------|
| 1. Valve body | 4. Check valve |
| 2. Spring     | 5. Collar      |
| 3. Spool      |                |



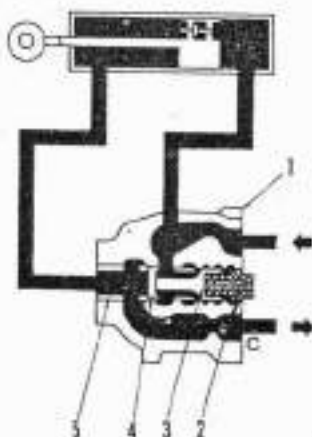
154F234

## OPERATION

## 1. When starting blade lowering:

When putting the work equipment control lever in the "L" position, oil from the control valve flows into the cylinder bottom side through port A and pushes the piston.

At the same time, oil in the cylinder head side is pushed out by the piston, enters the valve port B and flows into the tank.



154F232

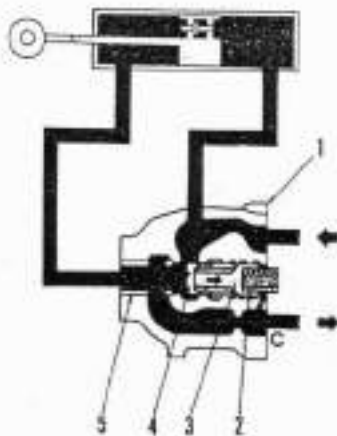
## 2. When blade is lowering:

Oil pushed out from the head side flows into port C through port B.

At this time there is a pressure difference produced between the before and after sides of the orifice because of a throttle in the oil passage. When this pressure difference is larger than the force of the spring (2), the spring is shortened and the spool (3) and the valve (4) are moved to the right.

Part of the oil which flows into the tank from the cylinder head side, flows into the passage connected to the cylinder bottom side. As a result this oil flows into the cylinder bottom side together with oil flowing from the control valve.

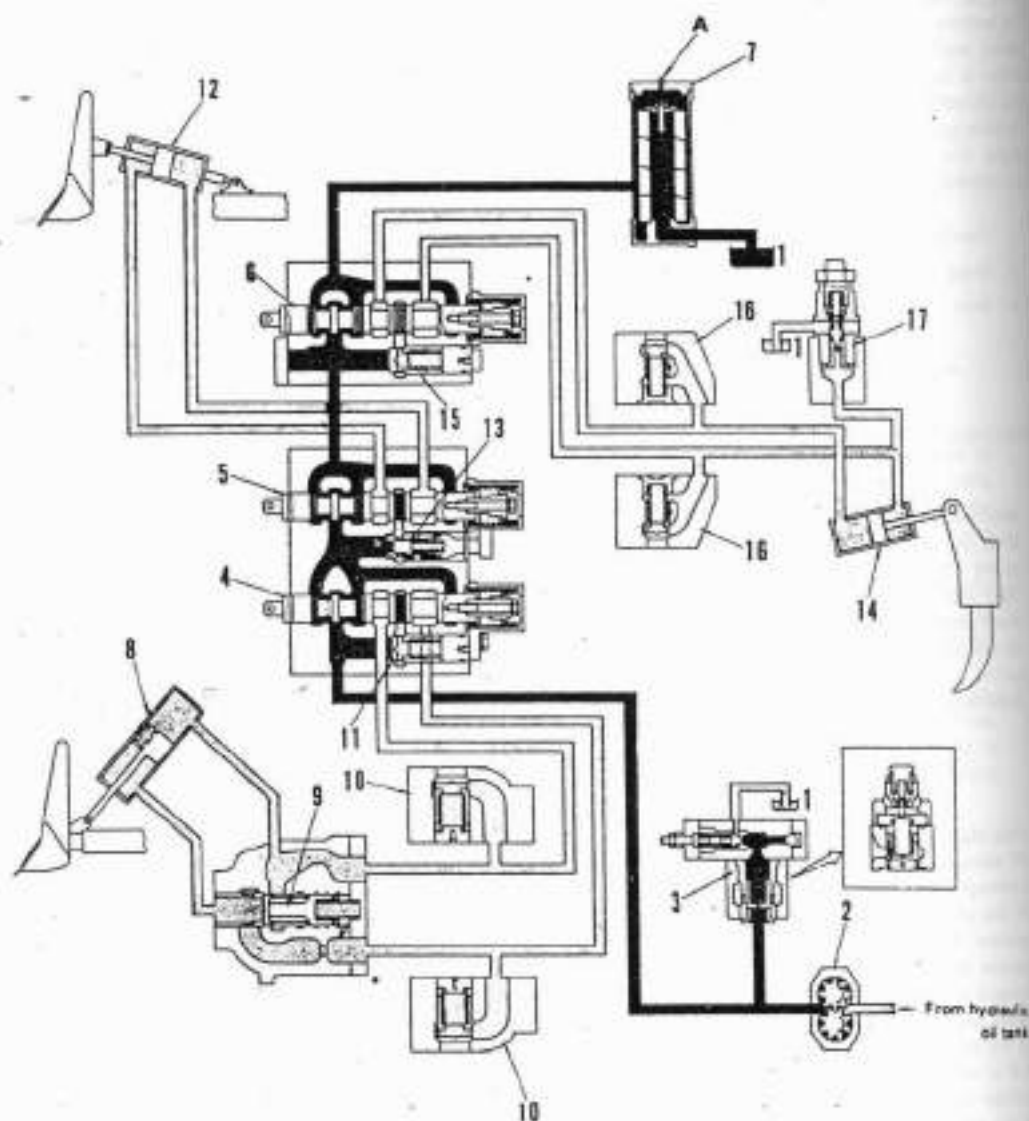
As seen from the above explanation the blade lowering speed is increased, with installation of the quick drop valve, because oil flows into the cylinder side, resulting in reducing the vacuum produced inside the cylinder bottom.



154F273

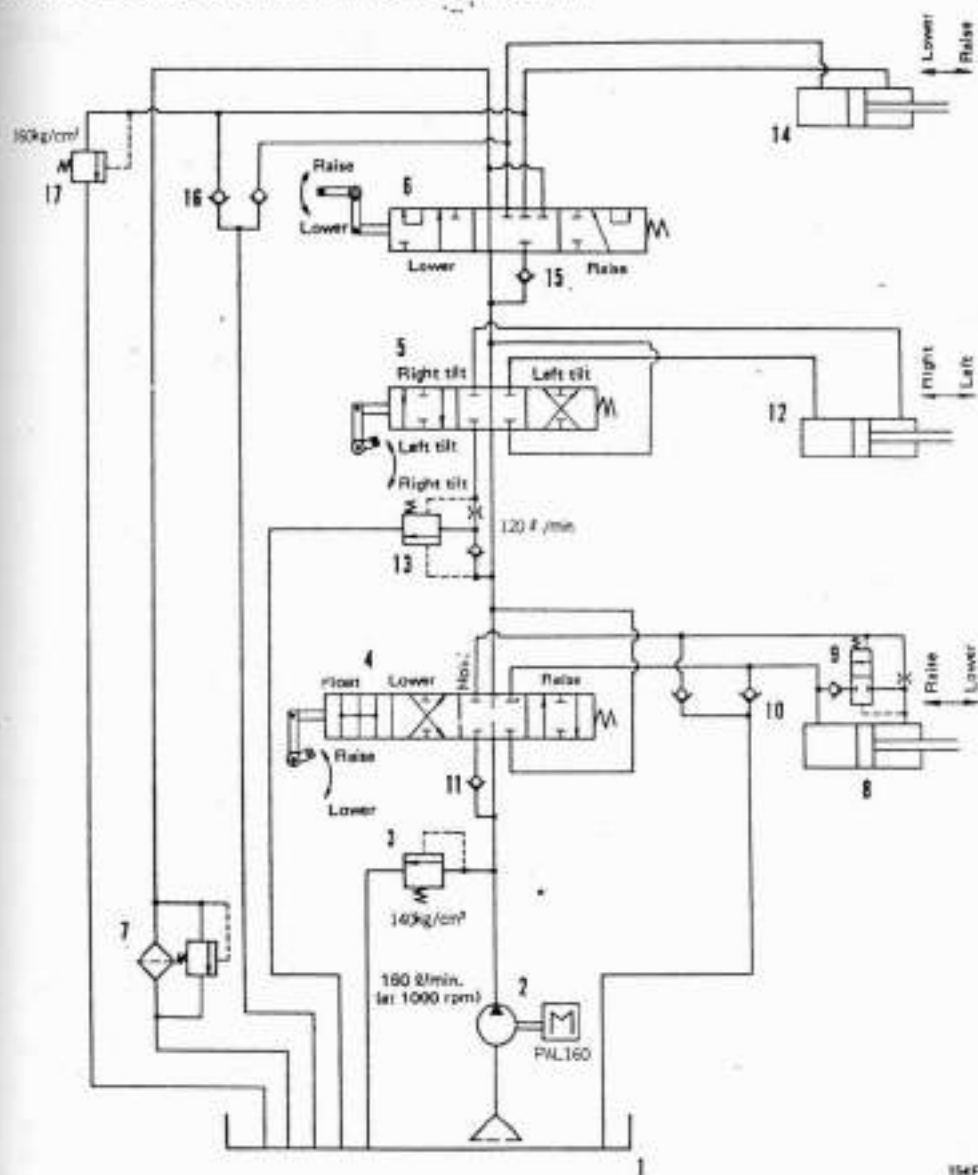


## WORK EQUIPMENT HYDRAULIC SYSTEM



154F23b

## WORK EQUIPMENT HYDRAULIC CIRCUIT

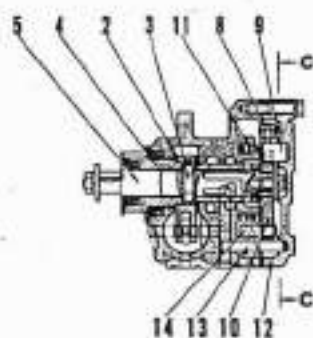
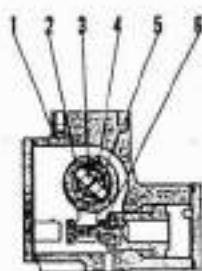
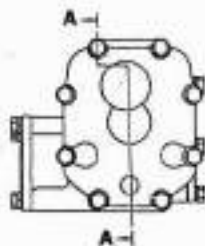
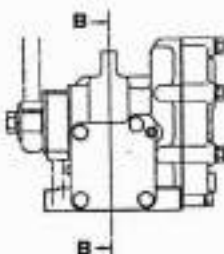
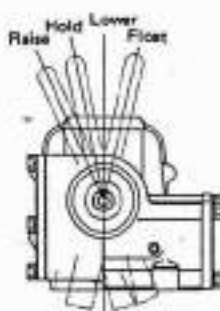


154F238

- |                            |                              |                                     |
|----------------------------|------------------------------|-------------------------------------|
| 1. Hydraulic oil tank      | 8. Blade lift cylinder       | 15. Check valve                     |
| 2. Hydraulic pump (PAL160) | 9. Quick drop valve          | 16. Suction valve                   |
| 3. Main relief valve       | 10. Suction valve            | 17. Ripper safety valve             |
| 4. Blade lift valve        | 11. Check valve              | A. Main relief pressure output plug |
| 5. Blade tilt valve        | 12. Blade tilt cylinder      |                                     |
| 6. Ripper valve            | 13. Flow check valve         |                                     |
| 7. Oil filter              | 14. Ripper cylinder (only A) |                                     |

# ROTARY SERVO VALVE

## (1) BLADE LIFT

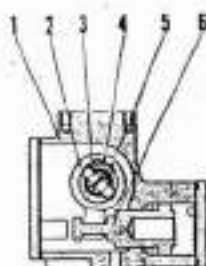
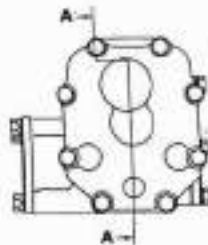
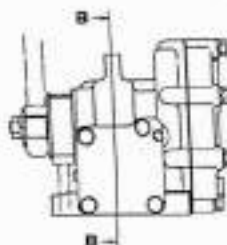
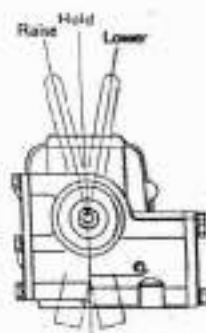


1. Valve body
2. Lever
3. Pin
4. Sleeve (Output shaft)
5. Rotor (Input shaft)
6. Piston
7. Lever

8. Detent spring
9. Pin
10. Detent
11. Spring
12. Cover
13. Pin
14. Pin

154F238

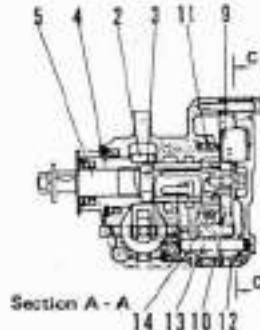
## (2) BLADE TILT &amp; RIPPER ( TY 220 )



Section B - B



Section C - C



Section A - A

1M2202

## STRUCTURE

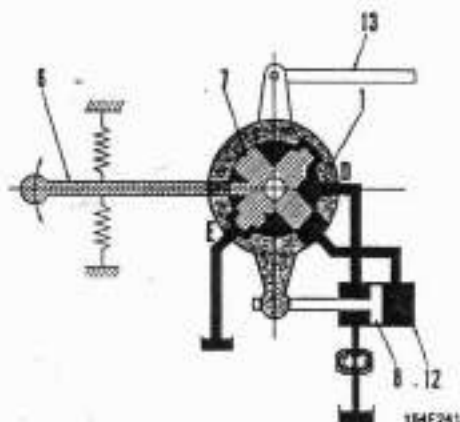
Rotary servo valves are installed on TY 220 to reduce the operating force of the work equipment control lever and also to shorten its stroke. The rotary valve consists of a rotor (5) which is coupled to the work equipment control lever by the operator's seat, sleeve (4) which is coupled to the work equipment control valve spool, lever (2) which is fixed to the sleeve with a key, piston (6) which slides inside the valve body (1) by oil pressure, and pin (3) which permits manual instead of hydraulic operation when the engine is stationary.

The rotary servo valve for the blade lift control incorporates a detent mechanism for FLOAT operation.



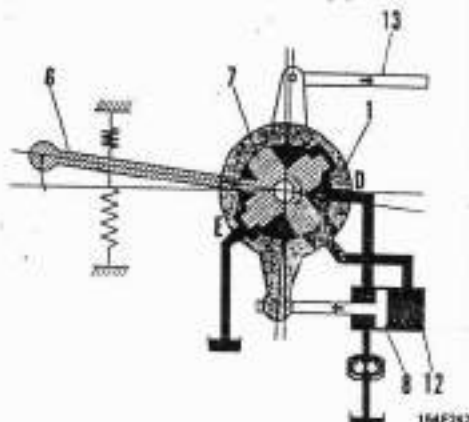
## OPERATION

## NEUTRAL



When the input lever (6) is put in the HOLD position, this rotor (7) which is direct-coupled to the input lever will close up the passages between port A and port C or between port B and port C. As a result, the cylinder (12) will be sealed up, the piston (8) will return to the neutral position and stop there and the sleeve (1) and the output shaft (13) coupled to the sleeve will stop in the neutral position.

## RIGHT TURN



When the input lever (6) is moved in the  $\Rightarrow$  direction, the rotor (7) which is direct-coupled to the input lever will rotate in the  $\Rightarrow$  direction, causing the passage between port A and port C to open up. As a result, high pressure oil from the pump will flow from port D into port A, and then into port C to enter the bottom of the cylinder (12).

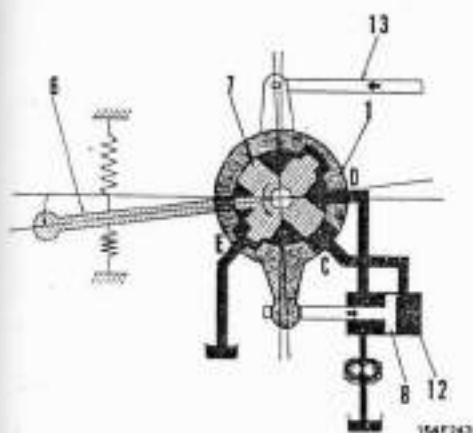
Because of the difference in area between the bottom and head of the piston, the oil which enters the bottom of the cylinder will push the piston (8) in the  $\Rightarrow$  direction.

The piston will in turn push the lever of the sleeve (1), causing the sleeve to rotate, and thus the output shaft (13) which is coupled to the sleeve will move in the  $\Rightarrow$  direction.

When the rotor (7) rotates in the  $\Rightarrow$  direction and the sleeve which is pushed by the piston rotates until the passage between port A and port C closes, the oil flow to the cylinder bottom will be cut off and the sleeve will stop in that position.

The above sequence of actions will be repeated intermittently until the control valve spool which is coupled to the output shaft reaches the specified position.

## LEFT TURN



When the input lever (6) is moved in the  $\Rightarrow$  direction, the rotor (7) which is direct-coupled to the input lever will rotate in the  $\Rightarrow$  direction, causing the passage between port B and port C to open up. The oil at the bottom of the cylinder (12) will then flow from port C to port B, and then drain off through port E.

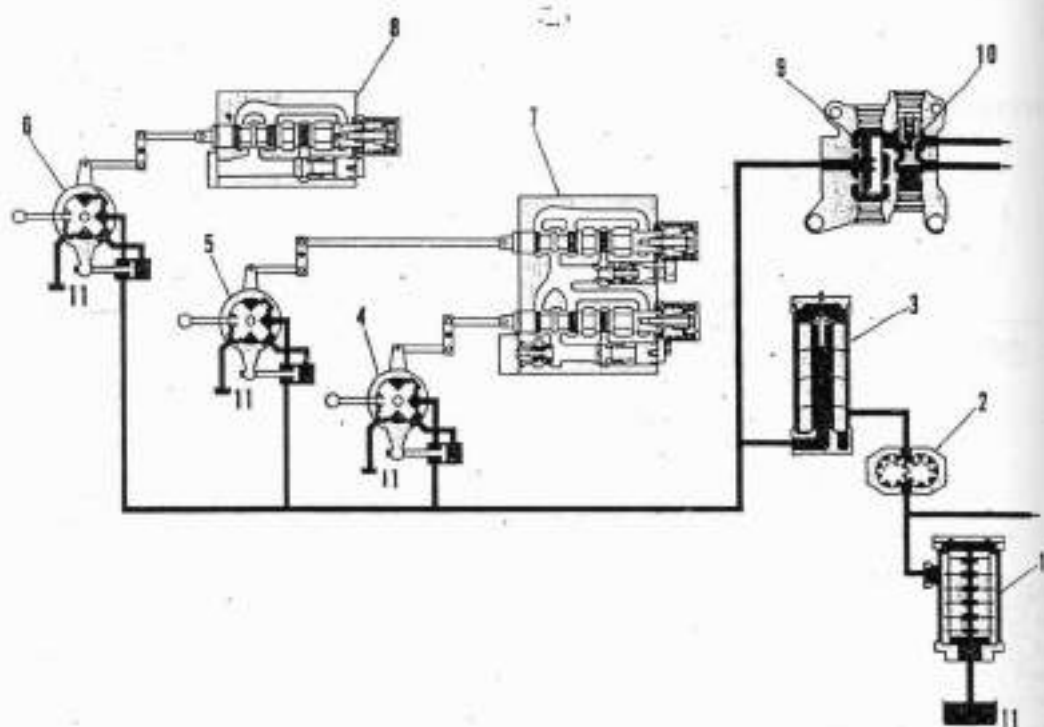
In this way, the oil pressure at the bottom of the cylinder drops, and hence the oil from the pump pushes the piston in the  $\Rightarrow$  direction from the head of the cylinder.

As the piston moves, it pulls the lever of the sleeve, causing the sleeve to rotate. As a result, the output shaft (13) which is coupled to the sleeve will move in the  $\Rightarrow$  direction.

When the rotor (7) rotates in the  $\Rightarrow$  direction and the sleeve which is pulled by the piston rotates until the passage between port B and port C closes, the oil at the bottom of the cylinder will be unable to drain off and the sleeve will remain in that position.

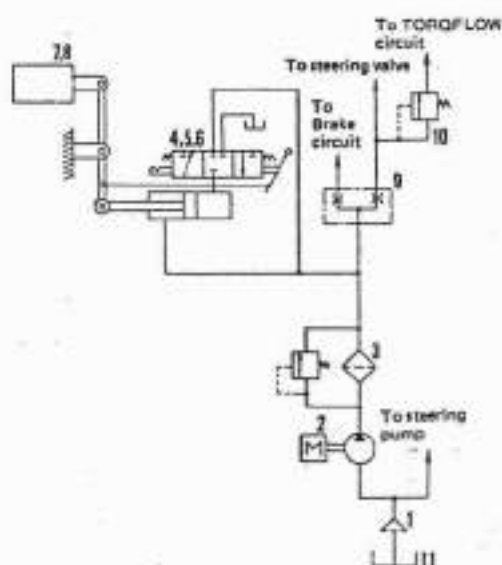
The above sequence of actions will be repeated intermittently until the control valve spool which is coupled to the output shaft reaches the specified position.

## SERVO VALVE HYDRAULIC SYSTEM



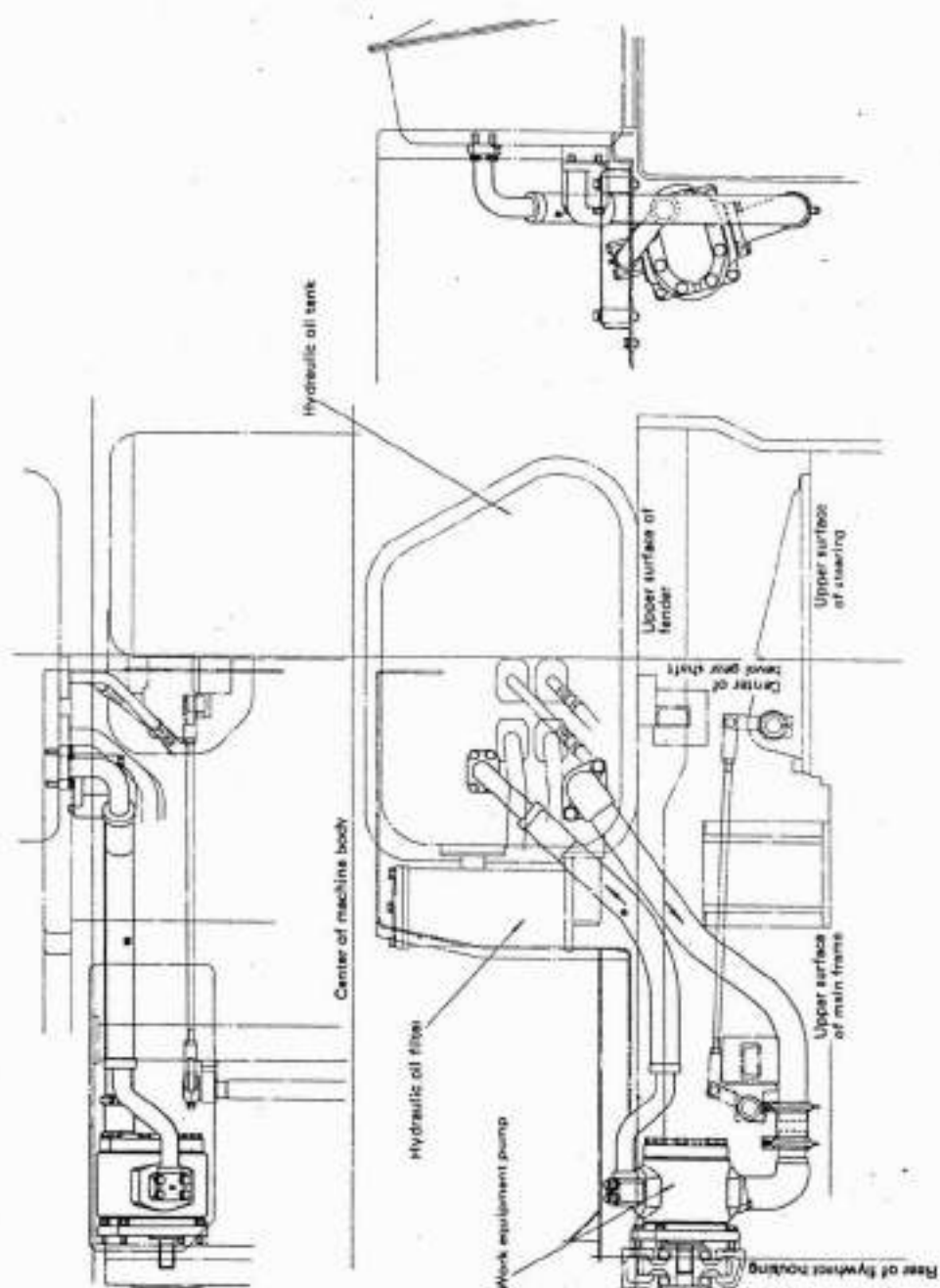
1547246

## SERVO VALVE HYDRAULIC CIRCUIT



1547245

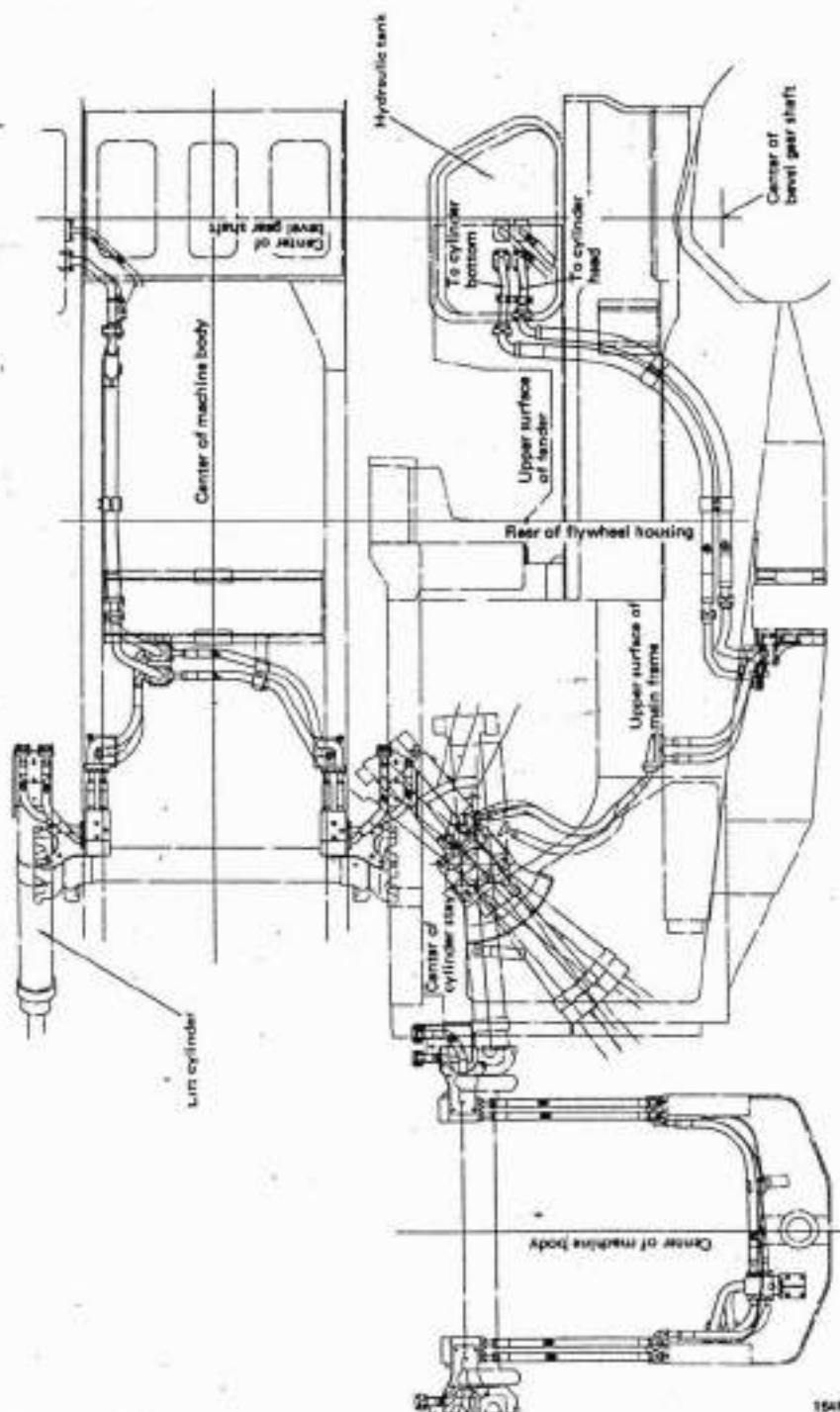
1. Strainer
2. Steering pump
3. Steering filter
4. Rotary servo valve (For blade lift operation)
5. Rotary servo valve (For blade tilt operation)
6. Rotary servo valve (For ripper operation)
7. Blade control valve
8. Ripper control valve
9. Float divider
10. Steering main relief valve
11. Steering case

WORK EQUIPMENT HYDRAULIC PIPING (PUMP  $\longleftrightarrow$  TANK)

304751

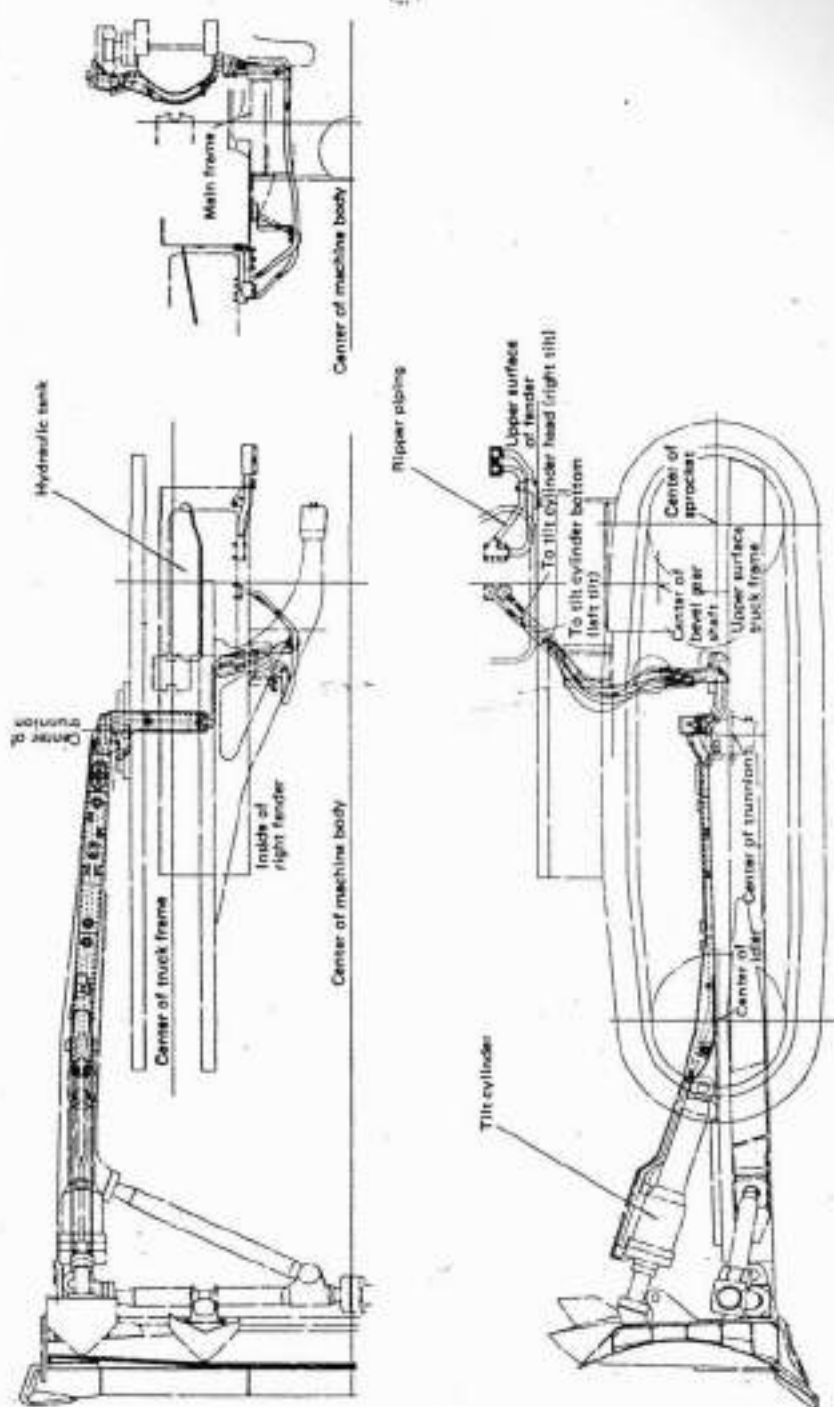


## WORK EQUIPMENT HYDRAULIC PIPING (BLADE LIFT)



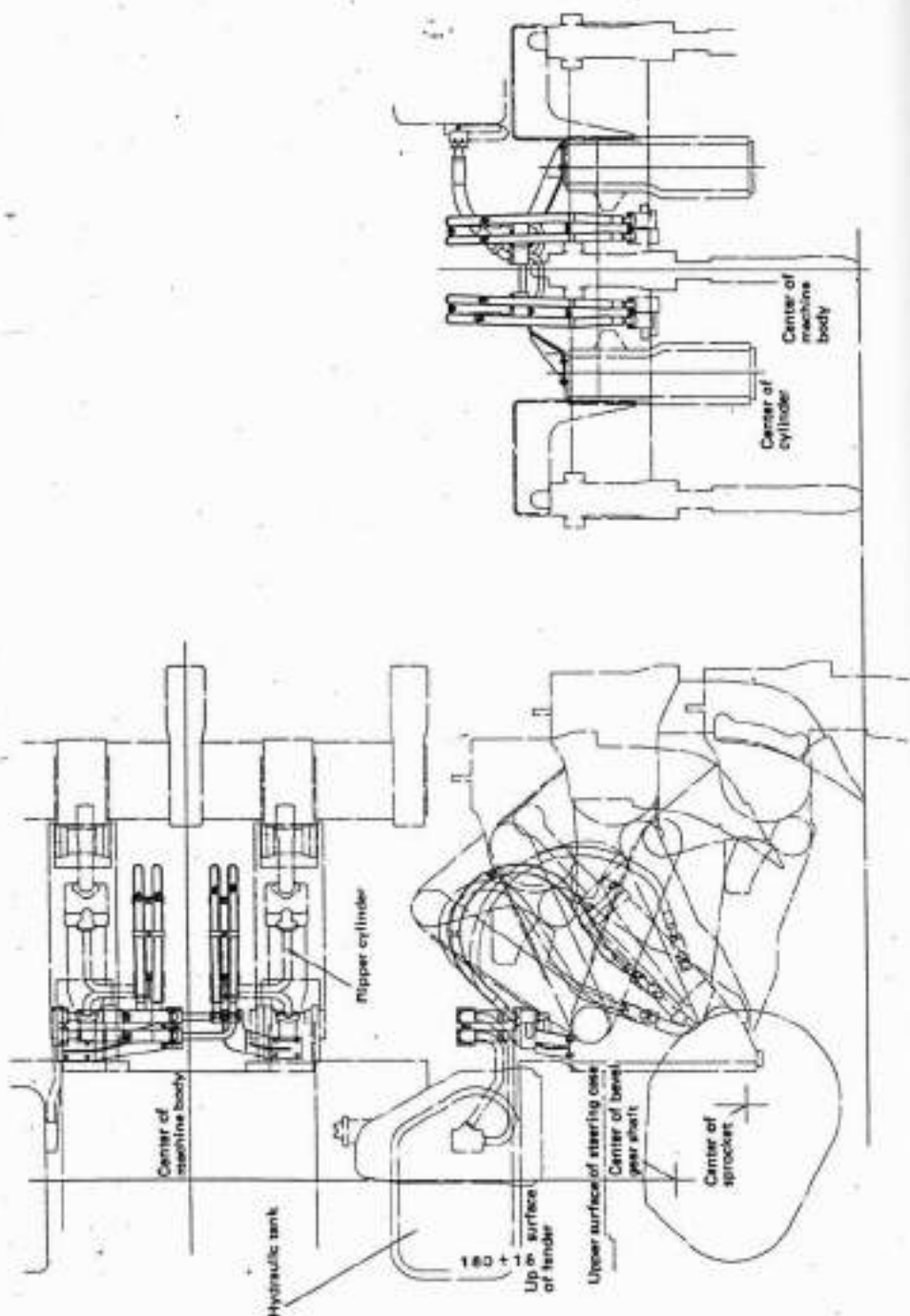
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### WORK EQUIPMENT HYDRAULIC PIPING (BLADE TILT)

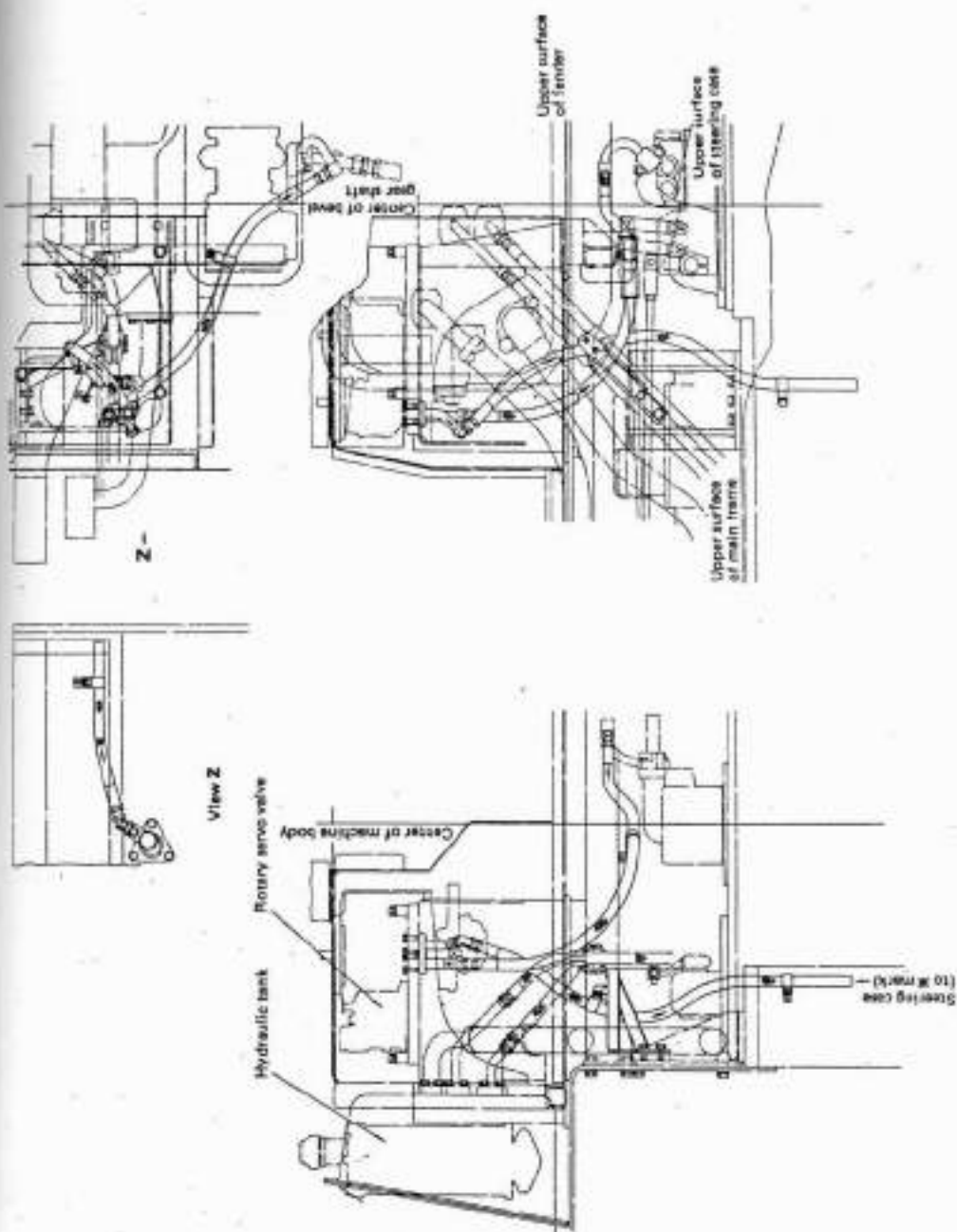


15F248

**WORK EQUIPMENT HYDRAULIC PIPING (RIPPER) TY 220**



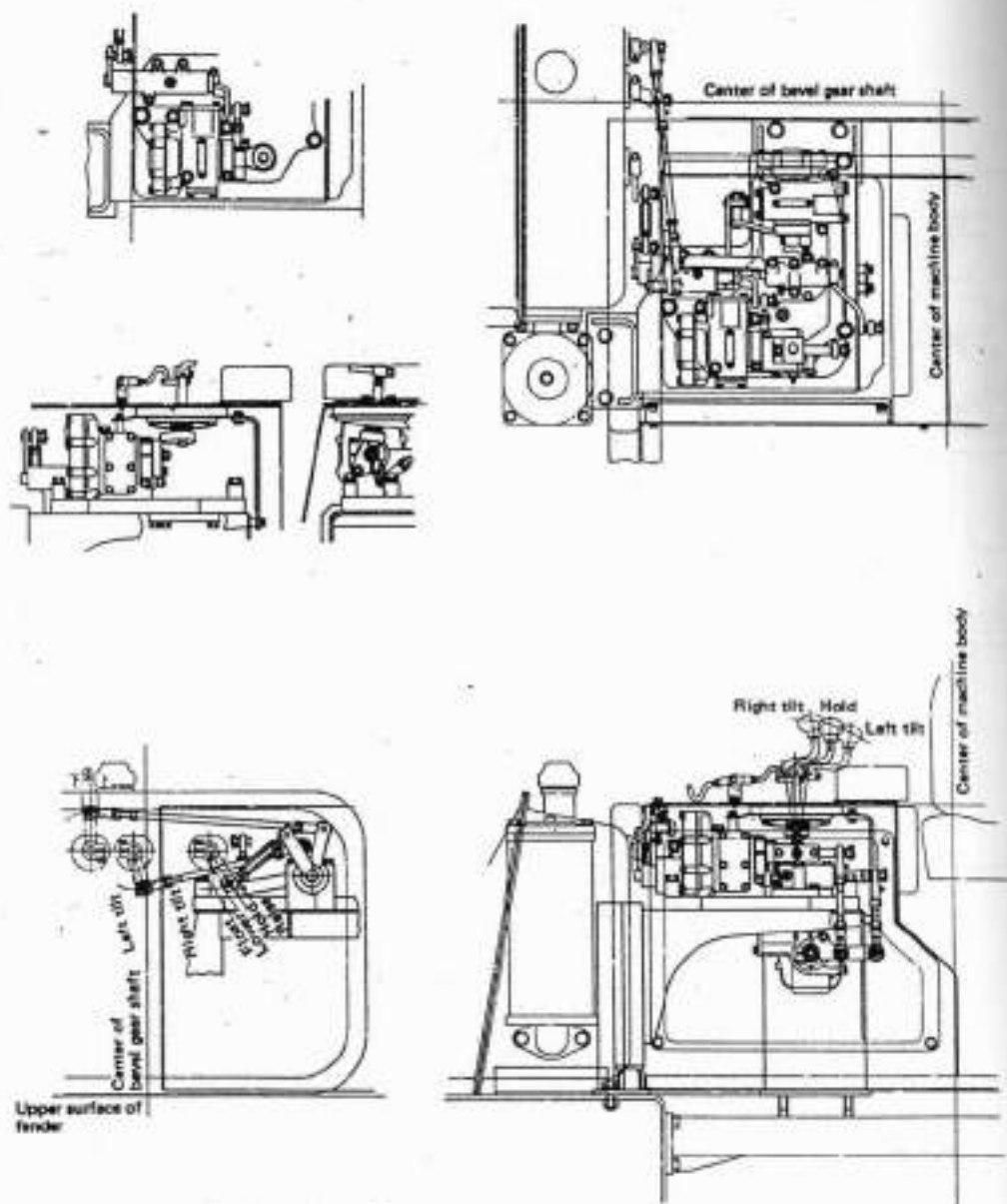
## SERVO VALVE HYDRAULIC PIPING



1947250

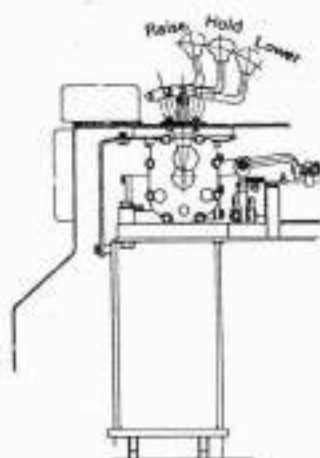
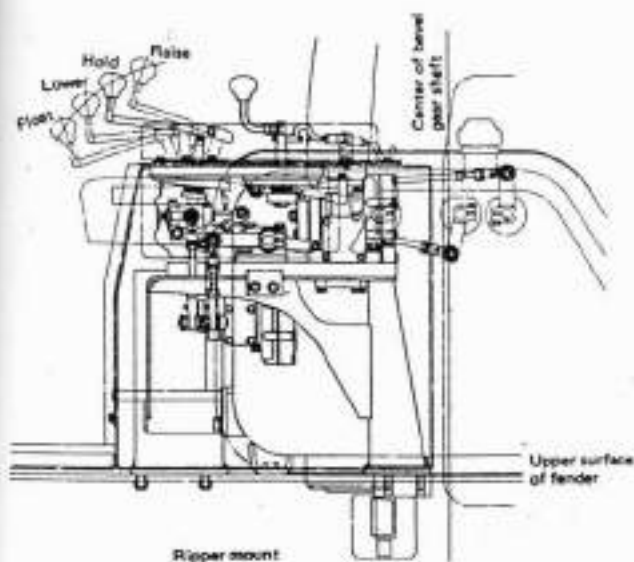
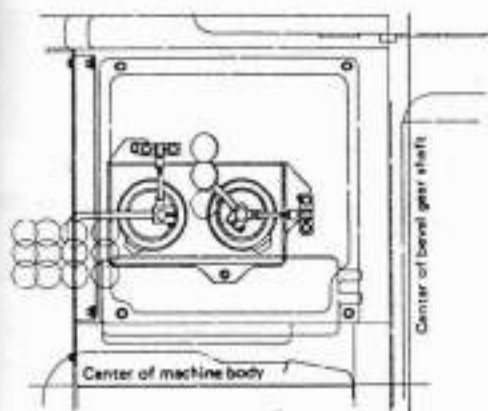


# WORK EQUIPMENT CONTROL

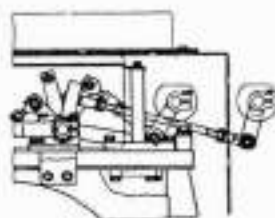


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Page 7



Ripper mount



Ripper dismount

154F262

# INSPECTION AND ADJUSTMENT

## GENERAL

When performing an analysis of the hydraulic system always bear in mind the necessity of maintaining NORMAL OIL FLOW and SPECIFIED PRESSURE in order to ensure suitable hydraulic system operation.

The oil flow is provided by a pump operating at a rate proportional to the engine speed. Oil pressure is built up by restricting the flow.

A systematic inspection of the hydraulic system consists of the following three stages:

1. Visual inspection
2. Running test
3. Pressure check

Tests on the hydraulic system can be performed using a hydraulic measuring tool

Always first perform a visual inspection and then carry out a running test. Perform tests using instruments last.

Thus, if the various items given below are borne in mind, fault location will become an easy matter and accurate diagnosis will be possible.



## DANGER PREVENTION

When performing tests or adjustments on the hydraulic system, move the machine out of the path of other vehicles and also keep unauthorized personnel away from it. Only one person must sit on the machine, while other people must keep to one side within the operator's field of vision.

### 1. Visual inspection

When finding failure, first of all carry out a visual inspection.

1. Oil quantity
2. Remove filter element and check for foreign particles.  
Ferrous metal particles can be separated from non-ferrous metal particles and non-metallic seal material (piston ring, O-rings, etc.) by means of a magnet.
3. Check all piping and cylinders for damage or external leakage.
4. Check pipe joints for damage or leakage.
5. Check to see if control linkage is bent or has damaged or broken parts.

### 2. Running test

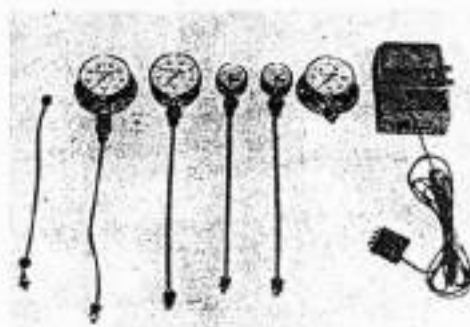
By carrying out a running test it is possible to detect internal leakage or damage to valves or pumps in the operating control system.

## OIL PRESSURE MEASURING POINTS

Item	Measuring point	Measuring plug size	Oil temperature during measurement (°C)	Set oil pressure (kg/cm <sup>2</sup> )		Remarks
				Engine full speed 2000 rpm	Engine idling 600 rpm	
Work equipment hydraulic	Main relief pressure	PT 1/8 07042-00100	45 ~ 55	135 ~ 150	130 ~ 140	

## OIL PRESSURE AND TEMPERATURE MEASURING EQUIPMENT

Part Name	A	B
Hydraulic tester	1	
Thermistor kit		1





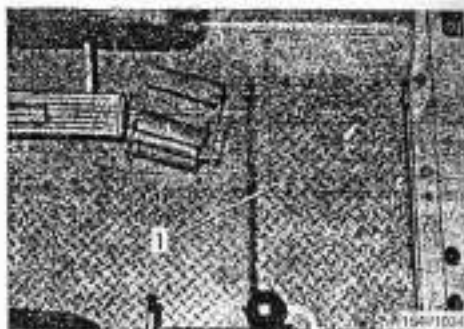
## OUTLINE OF OIL PRESSURE AND TEMPERATURE MEASUREMENTS

## 1. Main relief pressure measurement

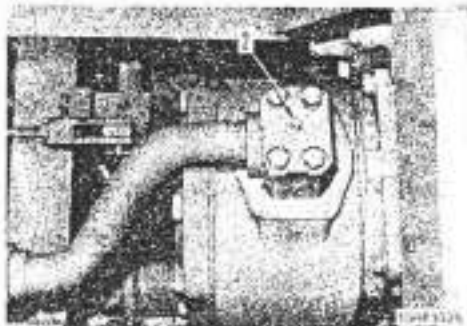
- 1) Ground machine and turn off engine. Operate control lever two or three times to remove residual pressure from hydraulic circuit. Lock lever in operating condition (position other than FLOAT) and close off circuit between hydraulic oil tank (control valve) and hydraulic pump.

## 2) Installation of oil pressure gauge

- i) Remove floor plate (1).



- ii) Remove inspection plug (2) from hydraulic pump outlet tube.

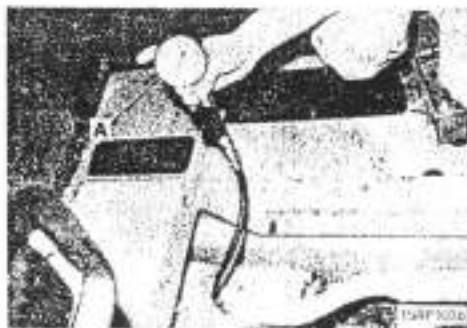


- iii) Install pressure gauge A ( $350 \text{ kg/cm}^2$ ) with hose and adaptor.

## 3) Oil pressure measurement

Put control lever in neutral position and start engine. Operate control lever and move cylinder to be measured to end of stroke. Measure oil pressure at both idle and full speed.

- \* Oil temperature during measurement: 45 to 55°C
- \* Be sure to lock parking brake.



**2. Oil pressure adjustment**

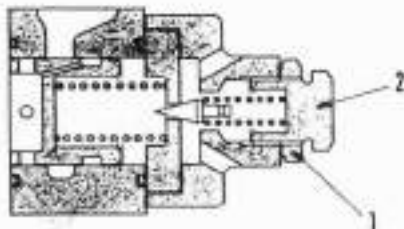
When necessary, adjust oil pressure as shown below.

- 1) Drain off oil from hydraulic oil tank and remove tank cover.
- 2) Loosen lock nut (1) of main relief valve adjusting screw. Rotate adjusting screw (2) and adjust oil pressure.

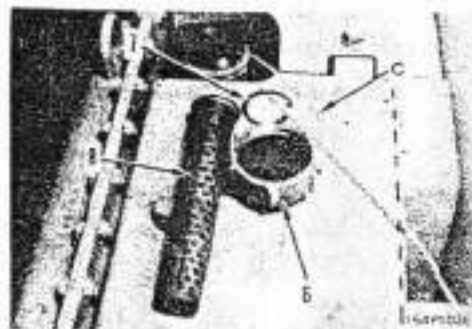
When screw is turned clockwise, pressure will increase, and vice-versa.

Pressure adjustment range per turn of screw:

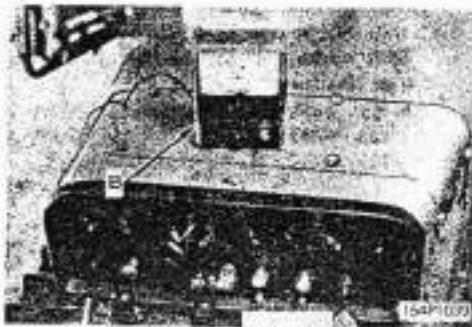
29.2 kg/cm<sup>2</sup>

**3. Oil temperature measurement**

- 1) Remove cap (6) from hydraulic oil tank. Take off snap ring (7) and remove strainer (8). Insert measuring sensor.



- 2) Connect sensor to thermistor and measure oil temperature.

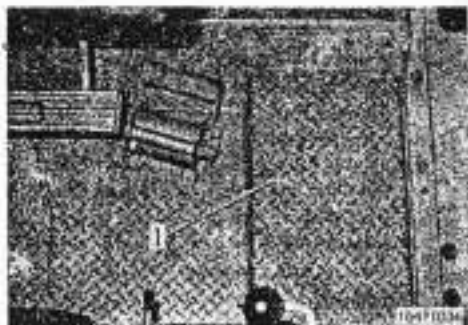


## OIL FLOW MEASUREMENTS

## FLOW MEASUREMENTS

## 1. Installation of flowmeter

- 1) Ground work equipment and turn off engine. Operate control lever two or three times to remove residual pressure. Lock lever in operating position (position other than FLOAT).



- 2) Loosen oil feeder cap and bleed off air from hydraulic oil tank.

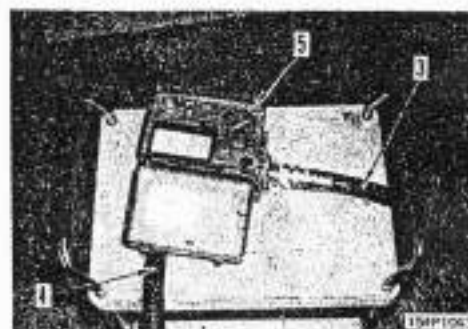
- 3) Remove floor plate (1).

- 4) Remove pump outlet tube (2).



- 5) Connect flowmeter input hose (3) to pump side.

- 6) Connect flow meter output hose (4) to hose side.



- 7) Connect hoses (3) and (4) to flowmeter (5) and put control valve in neutral position. Start engine and perform flow measurement after bleeding off air.

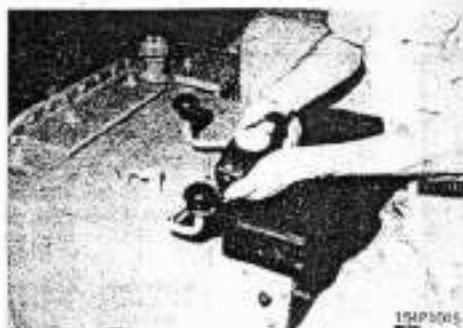
\* For outline of measuring procedure see OIL PRESSURE TESTER INSTRUCTION MANUAL.



**MEASUREMENT OF OPERATING FORCE****1. Blade control lever**

- 1) Start engine and run it at full speed. Hook push-pull scale onto lever knob.
- 2) Measure operating force when scale is moved forward and backwards (lift) and left and right (tilt).

Push-pull scale is not Kotatsu's special tool, local purchasing item.

**2. Ripper control lever**

- 1) Start engine and run it at full speed. Hook push-pull scale onto lever knob.
- 2) Measure operating force when scale is moved forward and backwards (lift) and left and right (tilt).

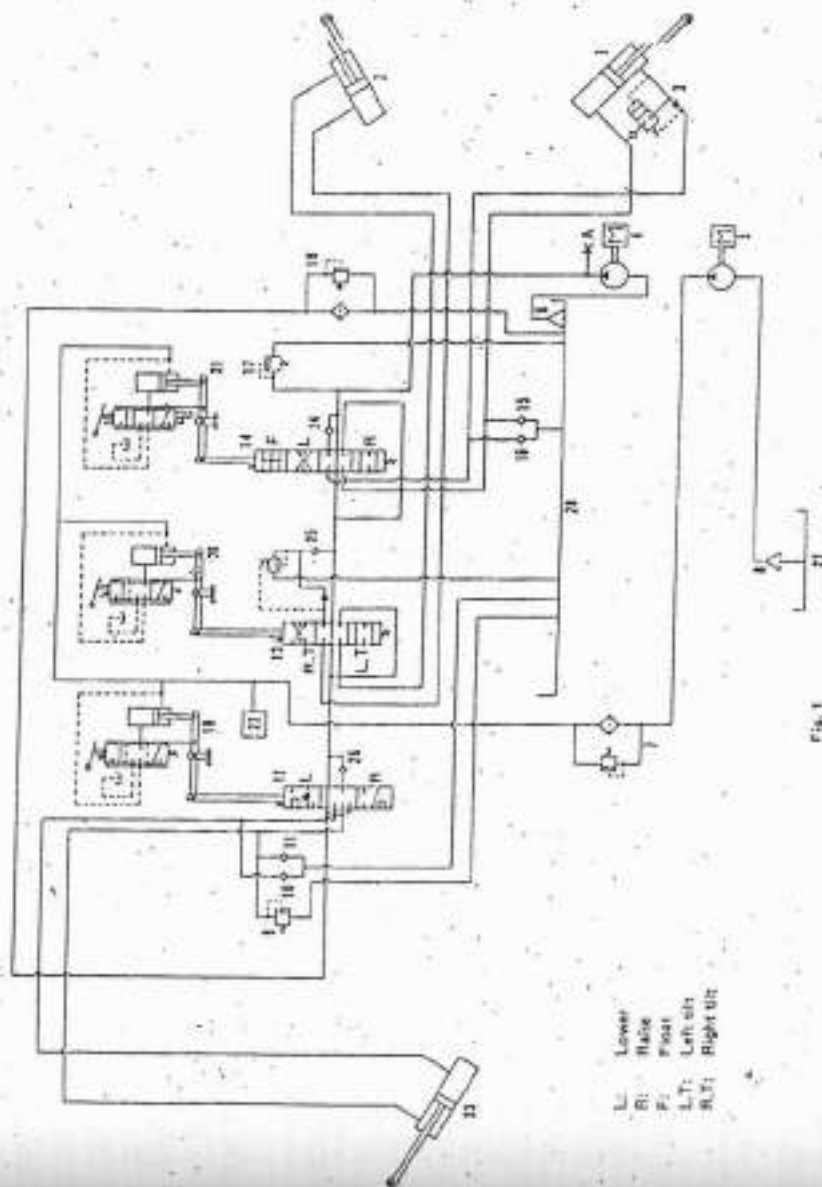
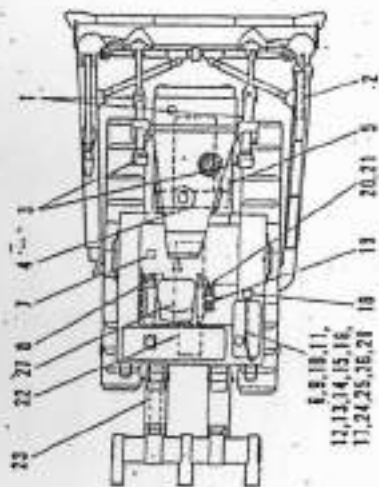




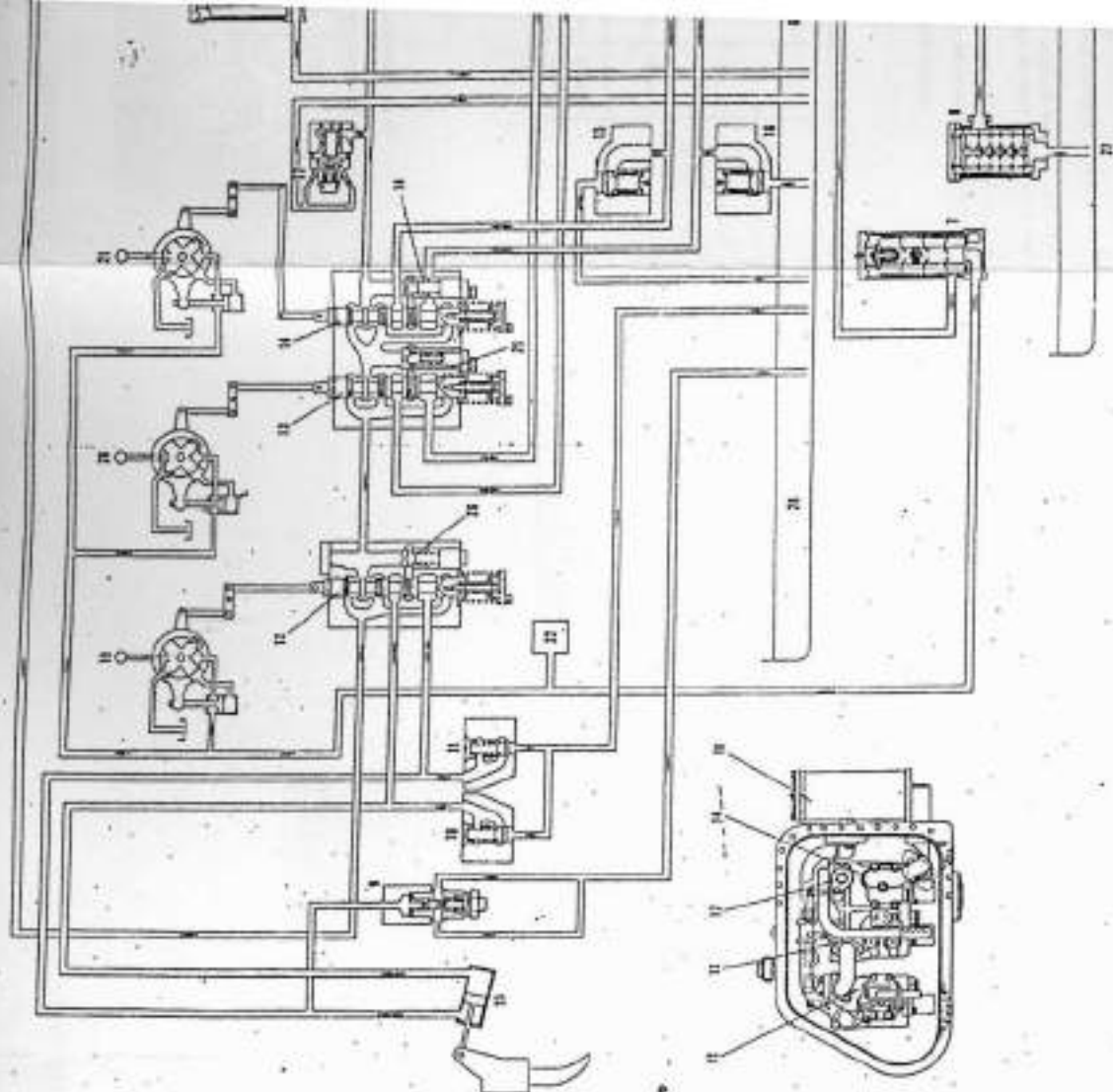
## STANDARD VALUES

Item		Condition		Standard value	Tolerance value
Stroke	Blade lever	Center of lever knob	Blade raise/float C	47 ~ 57 mm	
			Neutral + lower/float T	52 ~ 72 mm	
			Neutral + Left tilt/Right tilt	33 ~ 45 mm	
	Ripper lever	Center of lever knob	Neutral + Ripper raise/lower	45 ~ 63 mm	
Operating power	Blade lever	Stroke and position at full engine speed	Neutral + Blade raise/lower	1 ~ 2 kg	
			Blade lower + Float	5.5 ~ 7.5 kg	
			Neutral + Left tilt/Right tilt	2 ~ 3 kg	
	Ripper lever	Stroke and position at full engine speed	Neutral + Ripper raise/lower	1 ~ 2 kg	
Oil pressure	Main relief	Oil temp. 45 ~ 55°C	Idling	130 ~ 140 kg/cm <sup>2</sup>	
			Full speed	135 ~ 150 kg/cm <sup>2</sup>	
Performance	Blade	* Oil temp. 45 ~ 55°C	Raise Idling	TY 220 8 ~ 13 sec. TS 220 9 ~ 14 sec.	
			Full speed	TY 220 1 ~ 3.1 sec. TS 220 1.5 ~ 3.5	
			Lower Idling, Full speed	TY 270 1 ~ 1.5 sec. TS 220 1.4 ~ 1.9	
		* Blade unloaded	Float Idling, Full speed	1 ~ 1.5 sec.	
		* Ground level + Upper limit			
		Natural drop	Oil temp. 40 ~ 50°C engine stopped. Drop from height of 800 mm above ground at center of blade.	120 mm/15 sec. max.	
	Machine body drop		Amount by which center of idler drops when blade only	100 mm/15 sec. max.	
	Blade tilt	* Oil temp. 45 ~ 55°C	Left tilt Idling	4 ~ 5.5 sec.	
			Full speed	TY 220 2.5 ~ 3.5 sec. TS 220 1.5 ~ 2.5 sec.	
			Right tilt Idling	TY 220 3.5 ~ 5 sec. TS 220 2.0 ~ 3.5	
		* Blade unloaded	Full speed	TY 220 2 ~ 3 sec. TS 220 1.5 ~ 2.5 sec.	
		* Oil temp. 40 ~ 50°C, blade tilted to push down blade and engine stopped. Measure time until machine fully grounded.			
		Tilt return (Tilt natural drop)	Left tilt Right tilt	10 min. min. 8 min. min.	
	Ripper	* Oil temp. 45 ~ 55°C	Raise Idling	4 ~ 7 sec.	
			Full speed	1.5 ~ 2.5 sec.	
			Shank high position Idling	1 ~ 2 sec.	
		* Ground level + Upper limit	Lower Full speed	1 ~ 1.5 sec.	
		Natural drop	Oil temp. 40 ~ 50°C engine stopped. Drop from height of 500 mm above ground at bottom of point.	80 mm/15 min. max.	
		Machine body drop	Oil temp. 40 ~ 50°C, ripper pushed down and engine stopped. Drop at center of sprocket.		
Heat balance	Operating oil temp.			100°C max.	

## HYDRAULIC SYSTEM



1



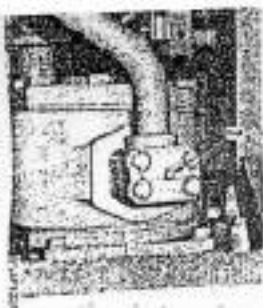
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1. Blade lift cylinder
2. Blade tilt cylinder
3. Blade quick drop valve
4. Hydraulic pump (LAL 160)
5. Steering pump (FAR 063)
6. Strainer
7. Steering oil filter
8. Magnet strainer
9. Upper safety valve
10. Upper suction valve

15. Ripper suction valve
16. Ripper valve
17. Blade lift valve
18. Blade lift valve
19. Blade lift suction valve
20. Blade lift suction valve
21. Hydraulic main relief valve
22. Hydraulic oil filter
23. Rotary servo valve (for ripper)
24. Rotary servo valve (for blade)

21. Rotary servo valve 19
22. To steering and trans-
23. Rapper cylinder
24. Flow check valve
25. Check valve
26. Check valve
27. Steering case
28. Hydraulic tank,

# TION OF THE PRESSURE PLUG



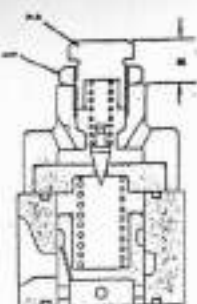
Set oil pressure (Fig. 1.3A)

Method

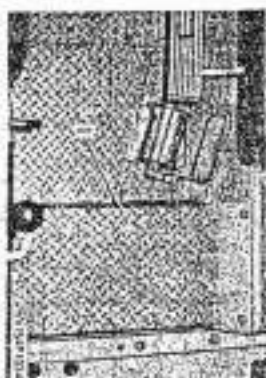
Measuring	Measuring method	Standard value pressure
Fig. 1.3A	Put engine lower in neutral position and stop engine. Open oil drain and screw cap to be measured to end of screw. Measure oil pressure at both top and full speed. • Oil temperature during measurement: 45 to 55°C • Be sure to lock parking brake.	120-150 120-140

## Pressure adjustment

1) Adjust oil pressure as shown below.  
2) Put term hydraulic tank and remove tank.  
3) Look out (1) of main relief valve adjust.  
4) Rotate adjusting screw (2) and adjust oil.  
5) The main relief valve, pressure will be adjusted.  
6) Increase of decrease per turn of screw:  
20.2 kg/cm<sup>2</sup>



# OIL FLOW MEASUREMENTS



## 1. Installation of flowmeter

- 1) Ground work equipment and turn off engine. Operate control lever two or three times to remove residual pressure. Look lower in operating condition position other than FLOATT. Loosen oil feeder cap and bleed off air from hydraulic oil tank.
- 2) Remove floor plate (1).

- 3) Remove pump outlet tube (2).
- 4) Connect flowmeter input hose (3) to pump add.
- 5) Connect flow meter output hose (4) to hose add.

- 6) Connect hoses (3) and (4) to flowmeter (5) and put control valve in neutral position. Start engine and perform flow measurement after bleeding off air.
- 7) For outline of measuring procedure see D.C. PRESSURE TESTER INSTRUCTION MANUAL.
- 8) Run the engine at 1500 rpm.
- 9) For any pump test, the pump flow, measured in liter/min at 7 kg/cm<sup>2</sup> will be larger than the pump flow at 70 kg/cm<sup>2</sup> at the same rpm.

- 10) The difference between the pump flow of two operating pressures is the flow loss.
- 11) Use these values in the following Formula 1.

$$\text{Formula 1: } \left( \frac{\text{Flow at 7 kg/cm}^2}{\text{Flow at 70 kg/cm}^2} \right) \times 100 = \text{Percent of flow loss}$$

- 12) If the percent of flow loss is more than 10%, pump performance is not high enough for use.

# STANDARD VALUES

Item	Condition	Value
Stroke	Stroke lever	Neutral + Stroke lever / C
	Center of lever knob	Neutral + Stroke lever / C
Engine lever	Engine lever	Neutral + Stroke lever / C
	Center of lever knob	Neutral + Stroke lever / C
Operating power	Engine lever	Neutral + Stroke lever / C
	Stroke lever	Neutral + Stroke lever / C
Oil pressure	Main relief	Oil temp. 45 ~ 55°C / Full speed / 12
	Stroke lever	Oil temp. 45 ~ 55°C / Full speed / 12
Performance	Stroke lever	Oil temp. 45 ~ 55°C / Full speed / 12
	Stroke lever	Oil temp. 45 ~ 55°C / Full speed / 12

## DISASSEMBLY AND ASSEMBLY

## DISMOUNTING HYDRAULIC PUMP ASSEMBLY

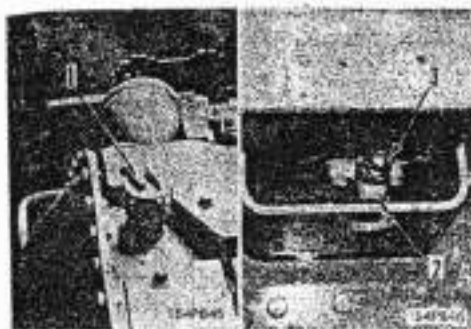
⚠ Completely lower work equipment to ground.

1. Loosen oil filler cap (1) to release internal pressure in tank.  
Remove drain plug (2), then open cock (3) to drain oil in hydraulic tank.

 Hydraulic tank: Approx. 70 ℓ

2. Remove floor plate.
3. Disconnect hydraulic pump outlet tube (4) and inlet tube (5) from pump.
4. Remove hydraulic pump assembly (6).

 Hydraulic pump assembly: 40 kg



## MOUNTING HYDRAULIC PUMP ASSEMBLY

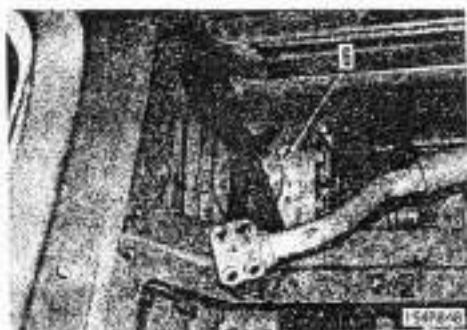
1. Fit O-ring on PTO case, then mount hydraulic pump assembly (6).
2. Fit O-rings and connect inlet tube (5) and outlet tube (4).

 Fit O-ring securely in groove.

3. Attach floor plate.
4. Tighten drain plug (2) and close drain valve (3).
5. Pour engine oil in through oil filter (1) until it reaches specified level.

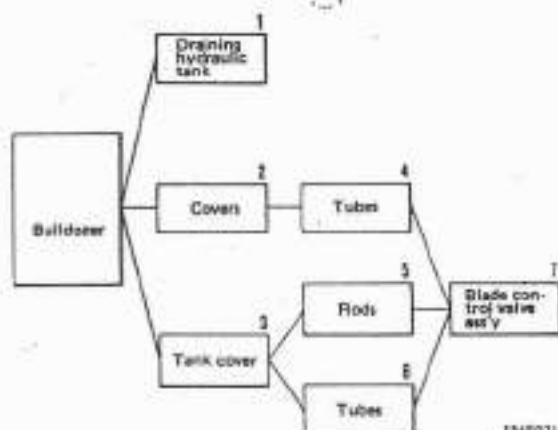
 Hydraulic tank: Approx. 70 ℓ

- \* Start and run engine to let oil circulate in hydraulic system. Check oil level again.





## DISMOUNTING BLADE CONTROL VALVE ASSEMBLY



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## 1. Draining hydraulic tank



Loosen oil filler cap to release internal pressure in tank.

Remove drain plug (1), then open valve (2) to drain oil.



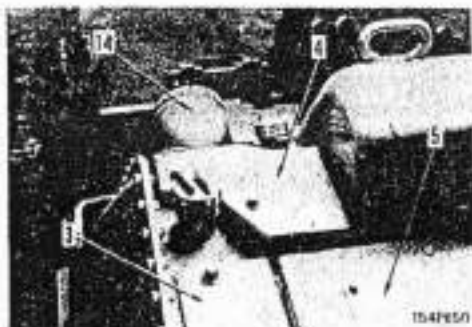
Hydraulic tank: Approx. 70 l



## 2. Covers

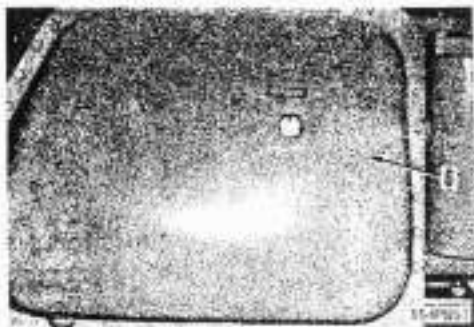
1) Remove lamp (14).

2) Remove covers (3), (4) and (5).



## 1. Tank cover

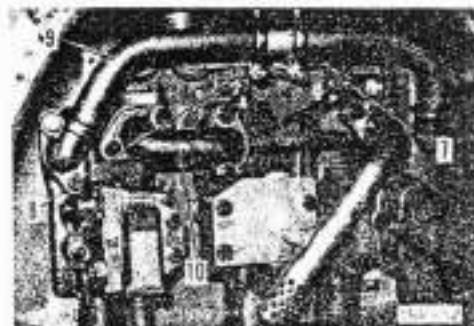
Remove tank cover (6).



## 4. Tube

1) Remove tube (9) between hydraulic filter and ripper control valve.

2) Remove tube (10) between blade control valve and ripper control valve.



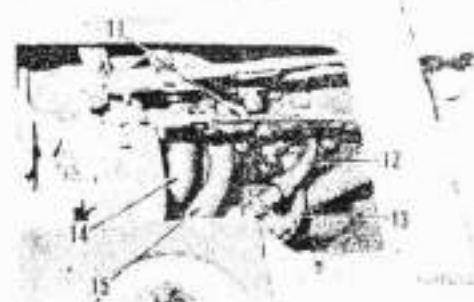
## 5. Rods

Disconnect rods (7) and (8) inside tank.

## 6. Tubes

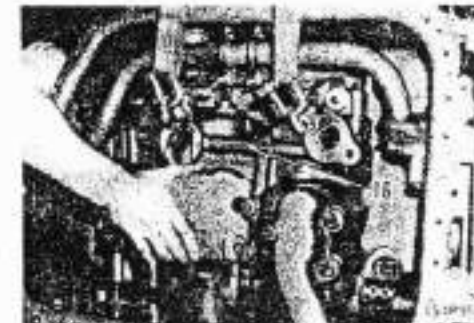
1) Disconnect servo valve rod (11).

2) Remove tilt tubes (12) and (13), and lift tubes (14) and (15).

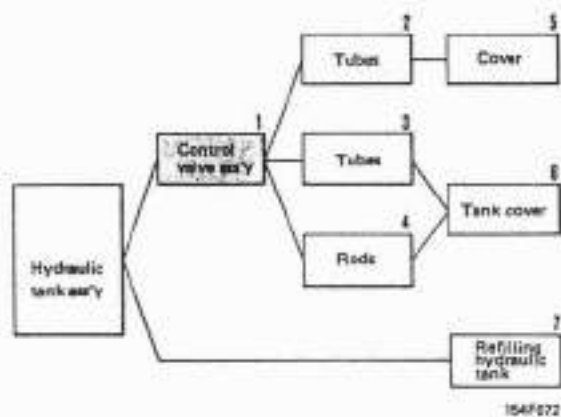


## 7. Blade control valve assembly

Hoist control valve assembly (16) and remove.

 Blade control valve assembly: 78 kg


## MOUNTING BLADE CONTROL VALVE ASSEMBLY

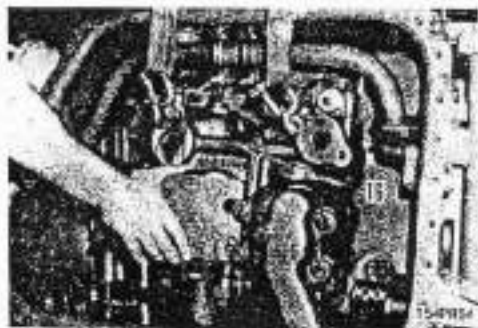


## 1. Blade control valve assembly

Fit O-ring and sling control valve assembly (16) to install.



Fit O-ring securely in groove.



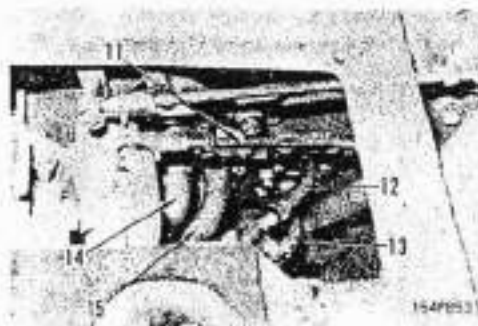
## 2. Tubes

1) Fit O-rings. Connect lift tubes (14) and (15), and tilt tubes (13) and (12).



Fit O-rings securely in grooves.

2) Install servo valve rod (11).



## 3. Tubes

- 1) Fit O-ring and install tube (10) between blade control valve and ripper control valve.

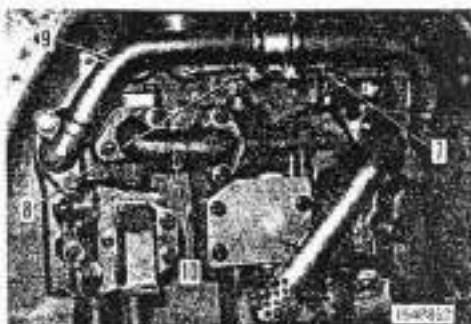


Fit O-ring securely in groove.

- 2) Fit O-ring and install tube (9) between hydraulic filter and ripper control valve.



Fit O-ring securely in groove.



## 4. Rods

- Install rods (7) and (8) inside tank.



Band cotter pin securely.

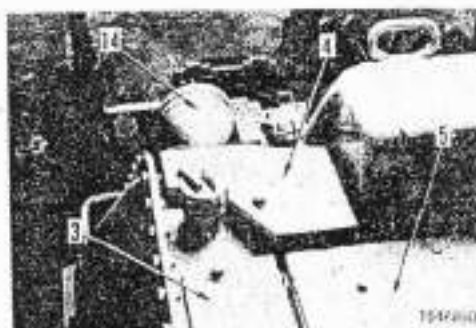


## 5. Tank cover

- Fit gasket and install cover (6).

## 6. Covers

- 1) Install covers (3), (4) and (5).
- 2) Install lamp (14).



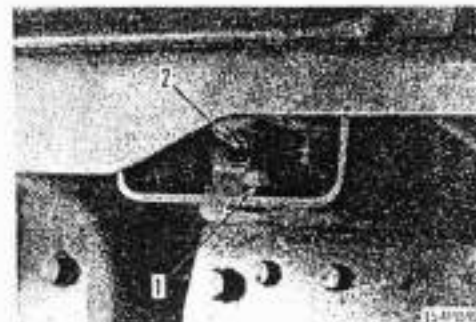
## 7. Refilling hydraulic tank

- 1) Tighten drain plug (1) and close drain valve (2).
- 2) Pour engine oil in through oil filler until it reaches specified level.



Hydraulic tank: Approx. 70 l

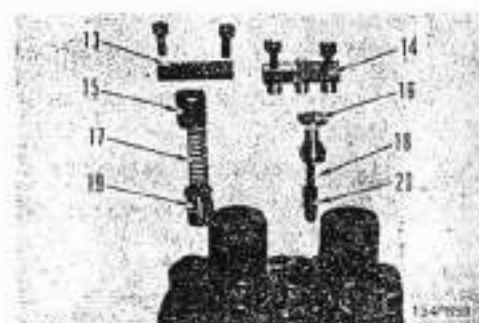
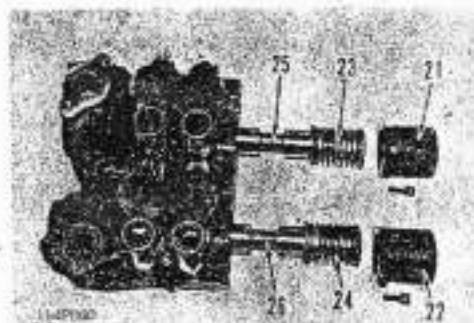
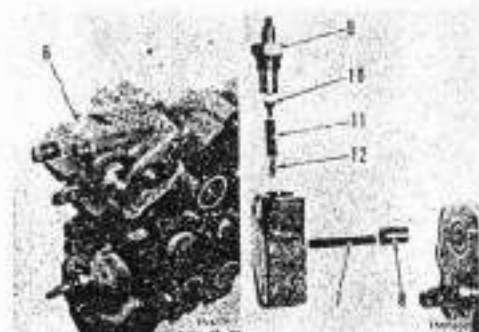
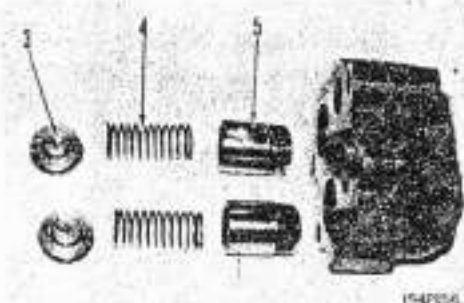
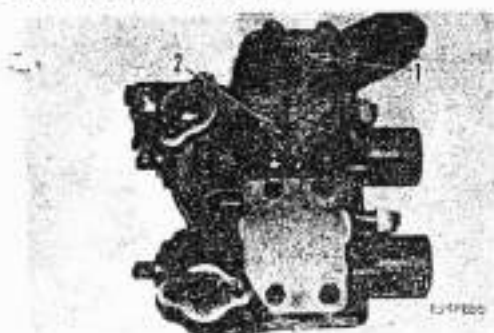
- ★ Start and run engine to let oil circulate in hydraulic system.
- Check oil level again.









## DISASSEMBLY OF BLADE CONTROL VALVE ASSEMBLY

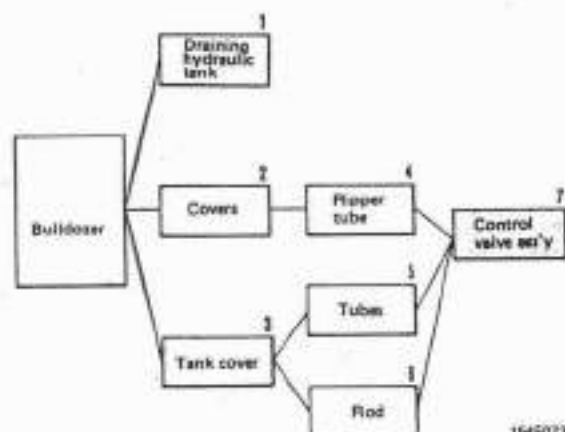
1. Remove suction valve tube (1).
2. Remove suction valve assembly (2).
3. Loosen plugs (3) and remove springs (4) and suction valves (5).
4. Remove main relief valve assembly (6). Then remove spring (7) and main relief valve (8).
5. Remove holder (9). Then remove retainer (10), spring (11) and poppet (12).
6. Remove plates (13) and (14). Then remove spring seats (15) and (16), spring (17) and (18), and valves (19) and (20).
7. Remove covers (21) and (22). Then remove springs (23) and (24), and spools (25) and (26).



## ASSEMBLY OF BLADE CONTROL VALVE ASSEMBLY

1. Install springs (23) and (24) in spools (25) and (26), and install covers (21) and (22).
2. Install valves (19) and (20), and springs (17) and (18).
3. Fit O-rings on spring seats (15) and (16), and install plates (13) and (14).  
 Fit O-rings securely in groove.
4. Assemble poppet (12), spring (11) and retainer (10). Fit O-ring on holder (9) and install.  
 Fit O-ring securely in groove.
5. Assemble main relief valve (8) and spring (7). Fit O-ring and install main relief valve assembly (6).  
 Fit O-ring securely in groove.
7. Install suction valve assembly (2).  
 Suction valve: 10 kg.m
8. Install suction valve tube (1).

## DISMOUNTING RIPPER CONTROL VALVE ASSEMBLY



154F073

## 1. Draining hydraulic tank

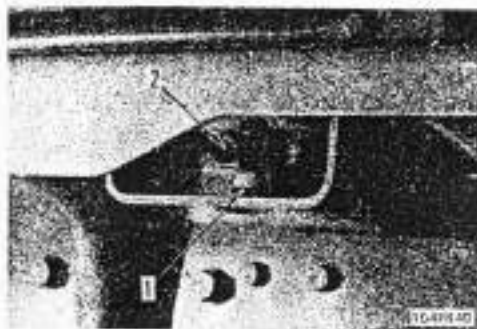


Loosen oil filler cap to release internal pressure in tank.

Remove drain plug (1), then open valve (2) to drain oil.

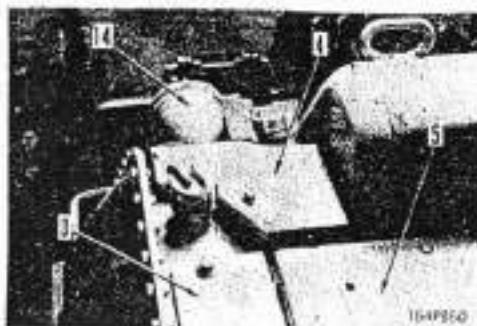


Hydraulic tank: Approx. 70ℓ



## 2. Covers

Remove lamp (14) and covers (3), (4) and (5).



## 3. Tank cover

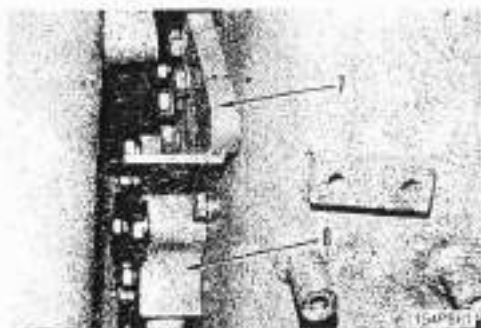
Remove tank cover (6).



## 4. Ripper tube

1) Remove oil filler mounting bracket (7) from steering case.

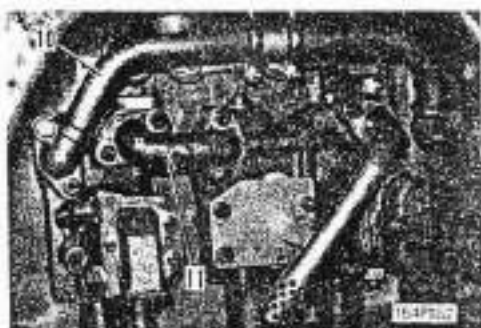
2) Remove tube (8) between ripper control valve and ripper cylinder at control valve end.



## 5. Tubes

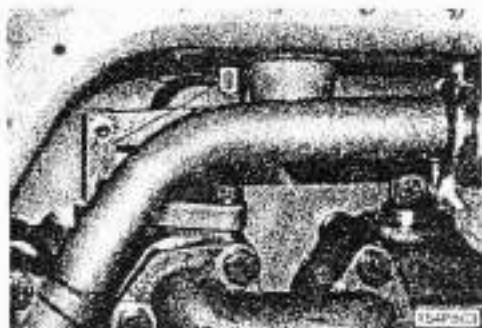
1) Remove tube (10) between ripper control valve and hydraulic filter at control valve end.

2) Remove tube (11) between ripper control valve and lift and tilt control valves.



## 6. Rod

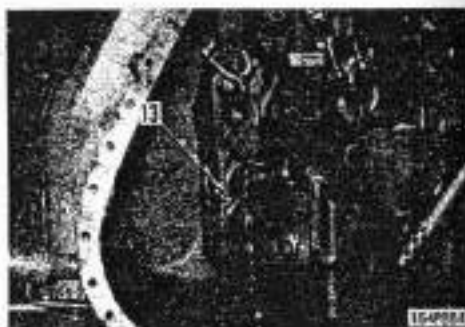
Disconnect rod (9).



7. Ripper control valve assembly  
Hoist ripper control valve assembly (13) and remove.

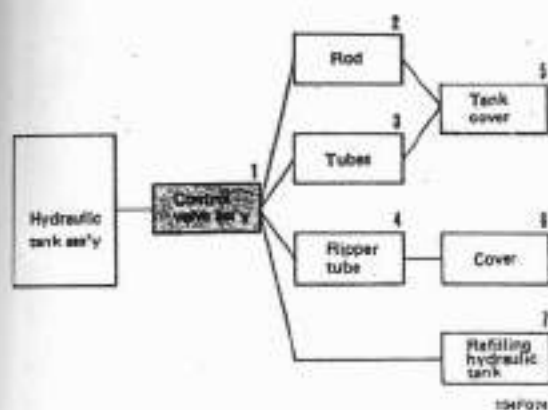


Control valve assembly: 45 kg





## MOUNTING RIPPER CONTROL VALVE ASSEMBLY



## 1. Ripper control valve assembly

Fit O-ring. Hoist ripper control valve assembly (13) to install.



Fit O-ring securely in groove.

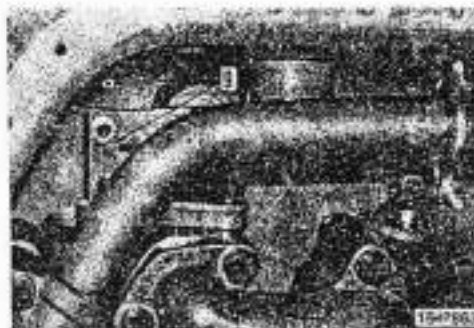


## 2. Rod

Install rod (9).



Bend cotter pin securely.



## 3. Tubes

- 1) Install tube (11) between ripper control valve and lift and tilt control valves.
- 2) Install tube (10) between ripper control valve and hydraulic filter.



Fit O-ring securely in groove.



## 4. Ripper tube

- 1) Fit O-ring and install tube (8) between ripper control valve and ripper cylinder.



Fit O-ring securely in groove.

- 2) Install oil filler bracket (7) to steering case.



## 5. Tank cover

Attach gasket, then install tank cover (6).

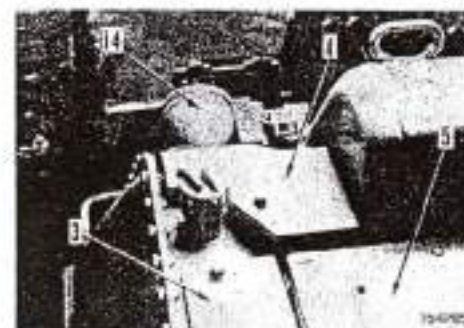


Stick gasket to cover.



## 6. Cover

- 1) Install lamp (14).
- 2) Install specs, and cover (3).
- 3) Install covers (4) and (5).



## 7. Refilling hydraulic tank

- 1) Tighten drain plug (1) and close drain valve (2).
- 2) Pour engine oil in through oil filler until it reaches specified level.



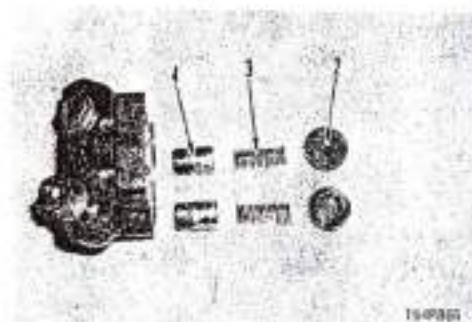
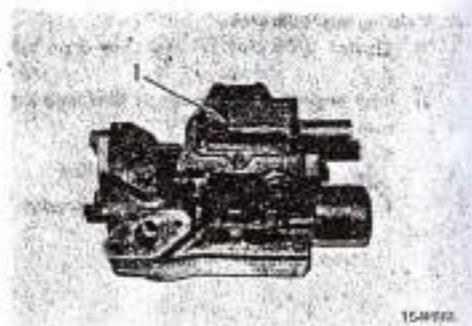
Hydraulic tank: approx. 70 l

- ★ Start and run engine to let oil circulate in hydraulic system.
- Check oil level again.

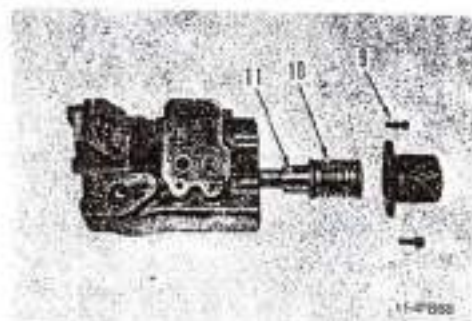
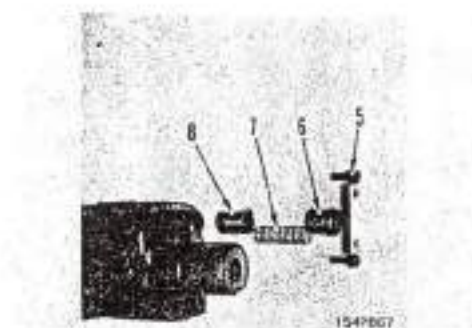


**DISASSEMBLY OF RIPPER CONTROL VALVE ASSEMBLY**

1. Remove suction valve assembly (1).
2. Loosen plugs (2) and remove springs (3) and valves (4).
3. Loosen bolts (5) and remove plug (6), spring (7) and check valve (8).
4. Remove bolts (9). Then remove spool (11) and spring (10).

**ASSEMBLY OF RIPPER CONTROL VALVE ASSEMBLY**

1. Install spring (10) on spool (11) and mount with cap bolts (9).
2. Install check valve (8) and spring (7).
3. Fit O-ring on plug (6) and install with bolts (5).  
 Fit O-ring securely in groove.
4. Install valves (4) and springs (3). Fit O-ring on plugs (2) and tighten.  
 Fit O-rings securely in grooves.
5. Fit O-ring and install suction valve assembly (1).  
 Fit O-ring securely in groove.  
 Suction valve mounting bolt: 10 kg.m





## DISMOUNTING BLADE LIFT SERVO VALVE ASSEMBLY

1. Disconnect blade control lever (1) and ripper control lever (2).
2. Remove upper cover (3) of servo valve.
3. Remove front cover (4) of servo valve.
4. Remove servo valve cover (5) and spring.
5. Disconnect rod (6) between servo valve and blade control lever at servo valve end.
6. Remove servo valve assembly (7).



Fig. 1-10-1 Disconnection of blade control lever and ripper control lever at servo valve end.



Fig. 1-10-2 Removal of servo valve assembly.

## MOUNTING BLADE LIFT SERVO VALVE ASSEMBLY

1. Fit O-ring and install servo valve assembly (7).
2. Connect rod (6) between blade control lever and servo valve.
- ⊕ Bend cotter pin securely.
3. Install spring and attach servo valve cover (5).
4. Install front cover (4) of servo valve.
5. Install upper cover (3) of servo valve.
6. Connect ripper control lever (2) and blade control lever (1).



Fig. 1-10-3 Installation of servo valve assembly.



Fig. 1-10-4 Connection of rod between blade control lever and servo valve.

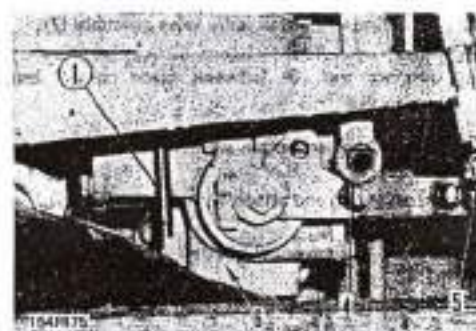


**DISMOUNTING BLADE TILT SERVO VALVE ASSEMBLY**

1. Remove front cover (1) of servo valve.
2. Disconnect hose (2) between steering valve and servo valve inlet, and hose (3) between steering case and servo valve outlet.
3. Remove rods (4) and (5) from servo valve.
4. Support servo valve assembly (6) with a bar, etc. Slide out guide bolt 1 (10 mm, P 1.5,  $l = 60$ ).

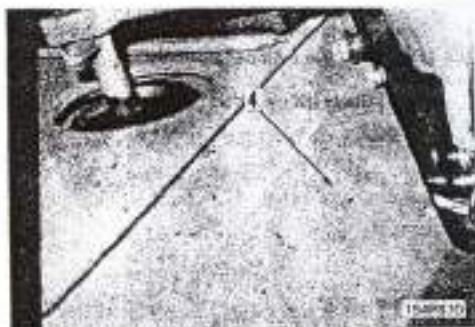
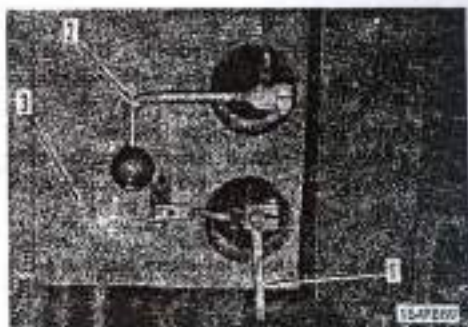
**MOUNTING BLADE TILT SERVO VALVE ASSEMBLY**

1. Install guide bolt 1 (10 mm, P 1.5,  $l = 60$ ).
2. Fit O-ring, and using a bar, etc. align servo valve assembly (6) with guide bolt to install.  
 ⊕ Fit O-ring securely in groove.
3. Install rods (4) and (5).
4. Install hose (3) between steering case and servo valve outlet, and hose (2) between steering valve and servo valve inlet.
5. Install front cover (1) of servo valve.




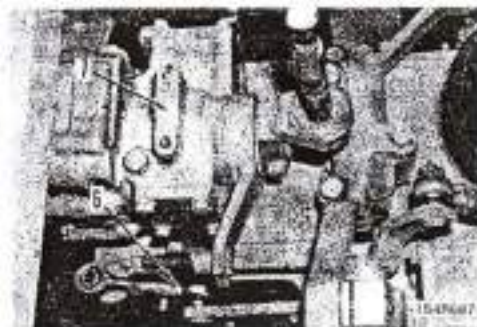
### DISMOUNTING RIPPER SERVO VALVE ASSEMBLY

1. Disconnect blade control lever (1) and ripper control lever (2).
2. Remove upper cover (3) of servo valve.
3. Remove front cover (4) of servo valve.
4. Remove servo valve cover (5) and spring.
5. Disconnect rod (6) between servo valve and ripper control lever at servo valve end.
6. Remove servo valve-assembly (7).



### MOUNTING RIPPER SERVO VALVE ASSEMBLY

1. Fit O-ring and install servo valve assembly (7).  
 Fit O-ring securely in groove.
2. Connect rod (6) between ripper control lever and servo valve.
3. Install spring and attach servo valve cover (5).
4. Install front cover (4) of servo valve.
5. Install upper cover (3) of servo valve.
6. Connect ripper control lever (2) and blade control lever (1).

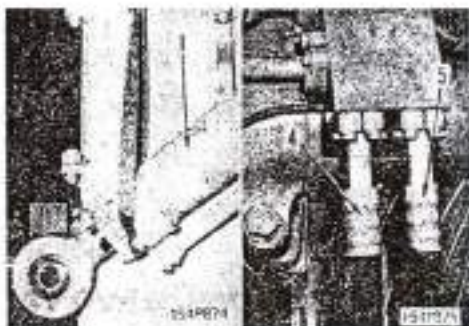


## DISMOUNTING BLADE LIFT CYLINDER ASSEMBLY


1. Hoist blade lift cylinder assembly (1), then remove lock pin (2) and pull out piston rod mounting pin (3).
2. Start engine and retract piston rod fully.  
★ When piston rod is retracted, center of gravity shifts toward cylinder bottom, causing cylinder to drop.
3. Operate control lever to release internal pressure in cylinder. Rehoist cylinder assembly, then disconnect hoses (4) and (5) between cylinder and control valve cylinder end.
4. Remove cylinder mounting cap (6), take out bearings (7) and remove cylinder assembly.

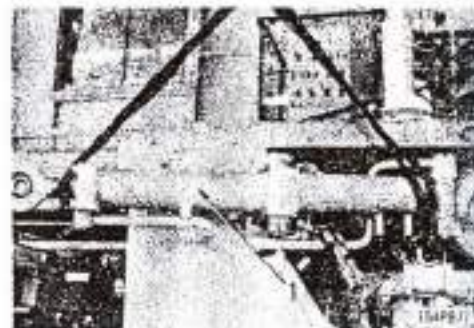
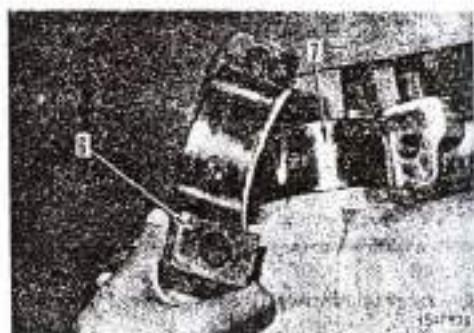


Blade lift cylinder: 150 kg (TY 220)  
160 kg (TS 220)



## MOUNTING BLADE LIFT CYLINDER ASSEMBLY

1. Hoist cylinder assembly (1) and position it at cylinder stay mount. Install bearings (7) and cylinder mounting cap (6).
2. Fit O-rings and install hoses (4) and (5) between control valve and cylinder.  
 Fit O-rings securely in grooves.
3. Rehoist cylinder assembly. Start engine, and extend piston rod. Align holes in blade and cylinder, and insert piston rod mounting pin (3) and lock pin (2).





## DISMOUNTING BLADE TILT CYLINDER ASSEMBLY

1. Remove tilt cylinder tube covers (1) and (2).
2. Hoist tilt cylinder assembly (3) and remove piston rod mounting flange (4).  
Start engine and retract cylinder rod fully.
3. Disconnecting hoses  
Stop engine and operate blade tilt control lever to release internal pressure in cylinder. Then disconnect hoses (5) and (6) between cylinder and control valve at cylinder end.
4. Remove lock plate (7) and pin (8).
5. Hoist tilt cylinder assembly (3) and remove.

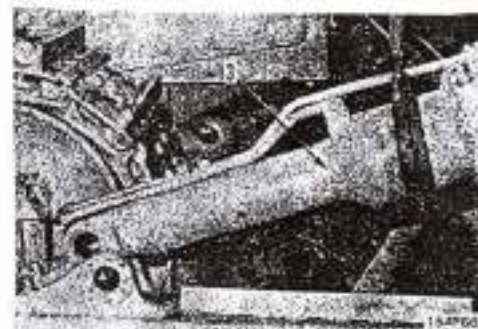
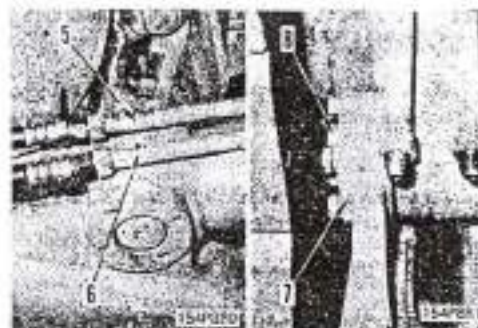


Tilt cylinder: 165 kg



## MOUNTING BLADE TILT CYLINDER ASSEMBLY

1. Hoist tilt cylinder assembly (3), install pin (8) and lock plate (7).
2. Connect hoses (5) and (6) between cylinder and control valve.
3. Start engine and extend cylinder rod. Install flange (4).
4. Attach covers (1) and (2) over tilt cylinder tube.




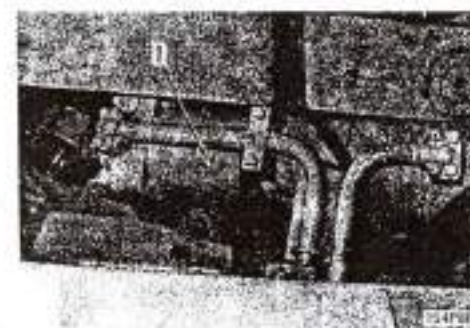
## DISMOUNTING RIPPER CYLINDER ASSEMBLY

1. Hoist cylinder assembly (1), and pull out pin (2) holding rod end. Start engine and retract piston rod fully.
2. Operate control lever to release internal pressure. Disconnect hoses (3) and (4) between cylinder and ripper control valve at cylinder end.
3. Raise ripper frame with Jack 1 (10 ton). Use Jack bolt 2 (#16 mm) to pull out pin (5) at bottom of cylinder.
4. Hoist cylinder assembly (1) and remove.



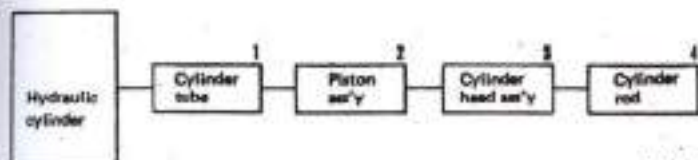
## MOUNTING RIPPER CYLINDER ASSEMBLY

1. Hoist cylinder assembly (1), and align with holes in bracket and beam. Install pin (5) at bottom of cylinder.
  2. Fit O-ring and install hoses (4) and (3) between ripper control valve and cylinder.
-  Fit O-ring securely in groove.
3. Hoist cylinder assembly. Start engine and extend cylinder rod. Align holes in rod and beam, and insert pin (2) in end of rod.





## DISASSEMBLY OF CYLINDER ASSEMBLY



154F075

## Special tools required

Part Name	A
Cylinder overhaul stand	1
Pump	1

## 1. Cylinder tube

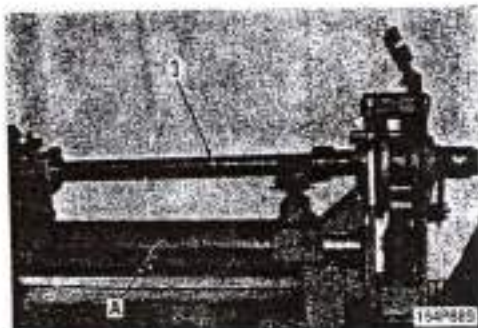
- 1) Remove cylinder tube (1).
- 2) Remove cylinder head bolt (2).
- 3) Pull out piston rod assembly.



154P582

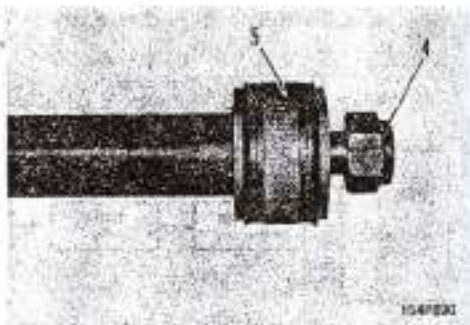
## 2. Piston assembly

- 1) Set piston rod assembly (3) in cylinder overhaul stand A.

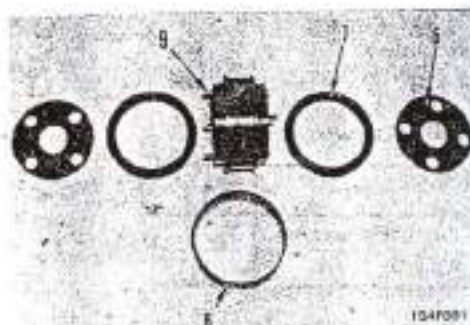


154P625

- 2) Remove nut (4) with wrench.  
★ Width of piston mounting nut face: 60 mm
- 3) Remove piston assembly (5).

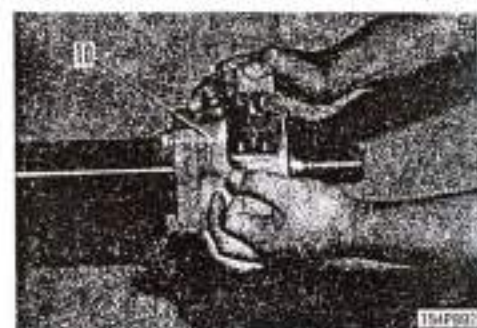


- 4) Remove retainer (6), U-packing (7), wear ring (8) and piston valve (9).



### 3. Cylinder head assembly

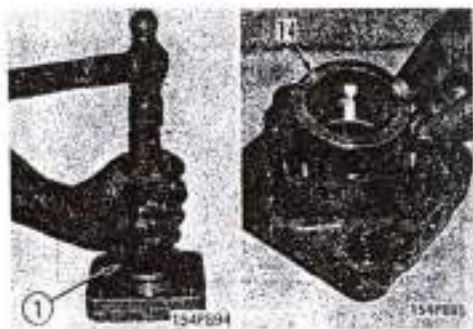
- 1) Remove cylinder head assembly (10).



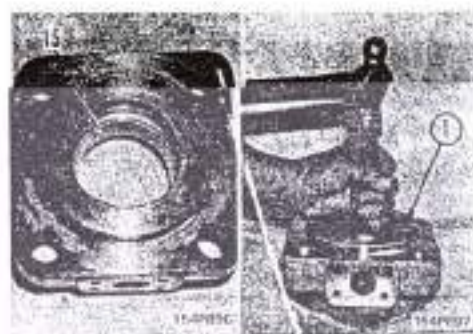
- 2) Remove gland (11) and dust seal (12).



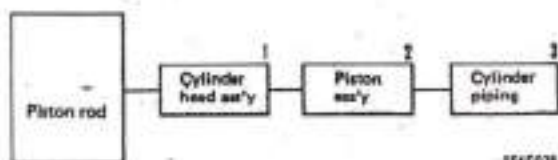
- 2) Using pushing tool 1 ( $\phi 70$  mm), remove bushing (13).
- 4) Remove U-ring (14).



- 5) Using pushing tool 1 ( $\phi 70$  mm), remove bushing (15).



## ASSEMBLY OF CYLINDER ASSEMBLY



## Special tools required

Part Name	A
Cylinder overhaul stand	1
Pump	1

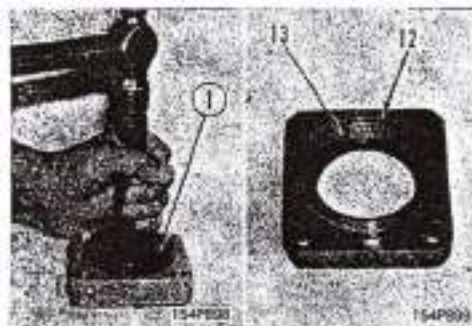
## 1. Cylinder head assembly

- 1) Using pushing tool 1 ( $\phi 70$  mm), press-fit bushing (15).



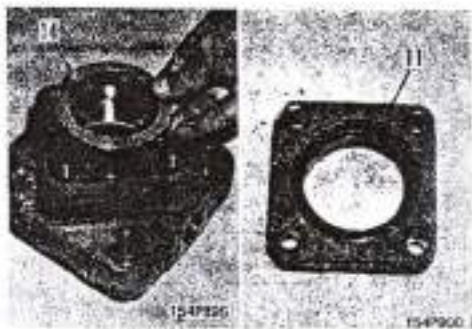
- 2) Using pushing tool 1 ( $\phi 70$  mm), press-fit bushing (13).

- 3) Using pushing tool 1 ( $\phi 70$  mm), press-fit oil seal (12).





- 4) Install U-ring (14) and attach gland (11).



- 5) Fit O-ring and install cylinder head assembly (10).

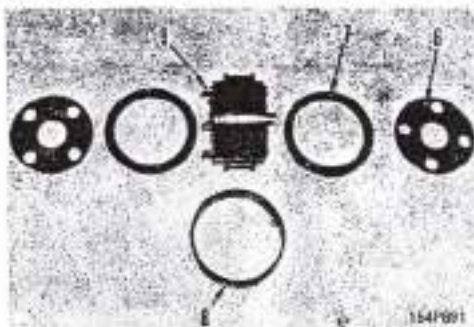


Fit O-ring securely in groove.



## 2. Piston assembly

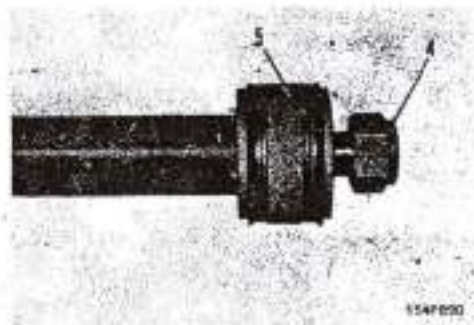
- 1) Install piston valve (9), wear ring (8), U-pecking (7) and retainer (6).



- 2) Install piston assembly (5).


- 3) Temporarily tighten nut (4).

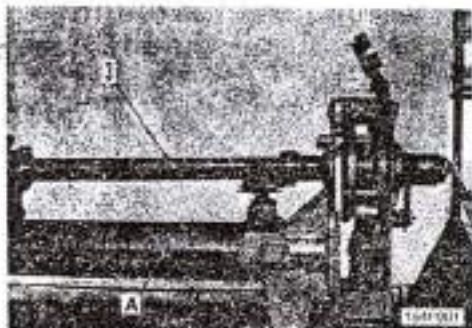
★ Width across flats: 60 mm



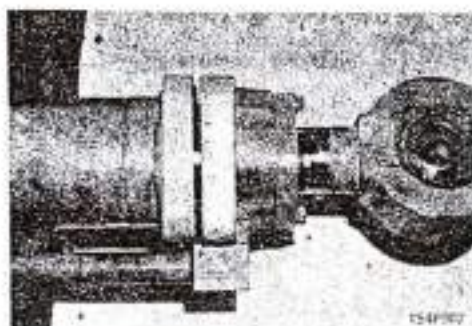


- 4) Set piston rod assembly (3) in cylinder overhaul stand A and tighten with wrench.

 Nut:  $160 \pm 15$  kg.m



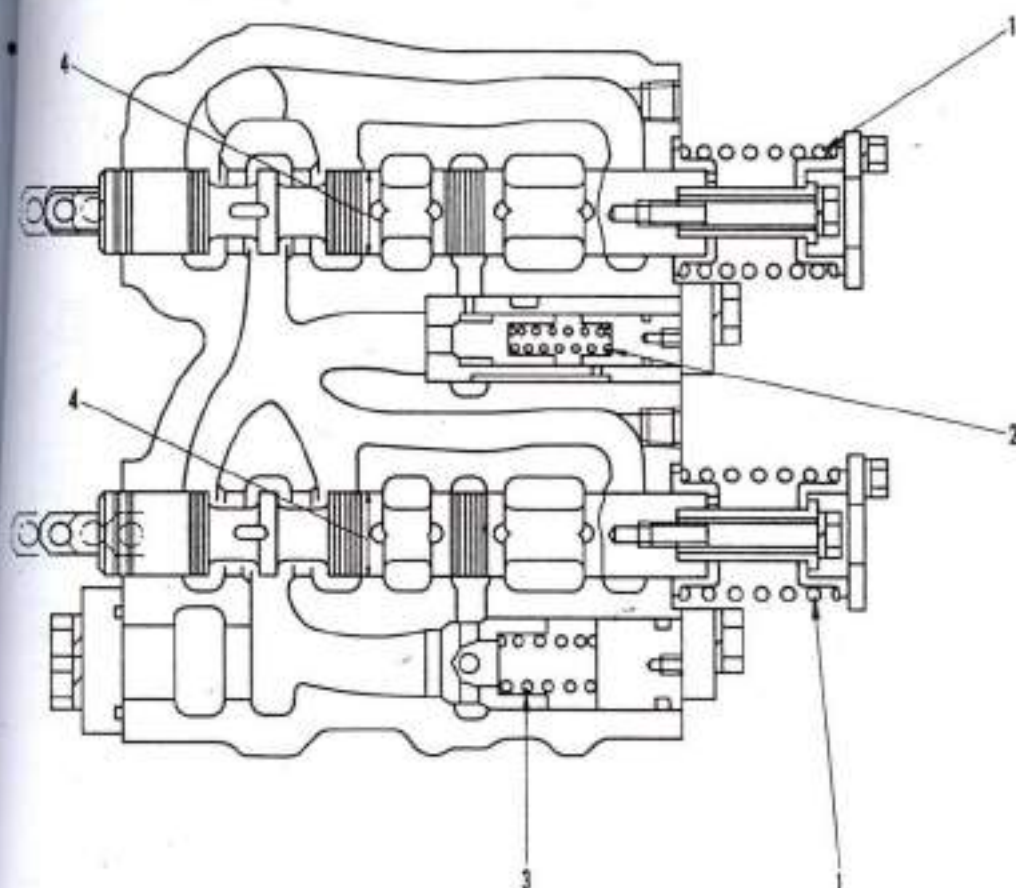
3. Lift cylinder piping
- 1) Connect piston rod assembly to cylinder tube.
  - 2) Tighten cylinder head assembly mounting bolt (2).
  - 3) Connect tube (1) from control valve.



# MAINTENANCE STANDARD

## WORK EQUIPMENT CONTROL VALVE

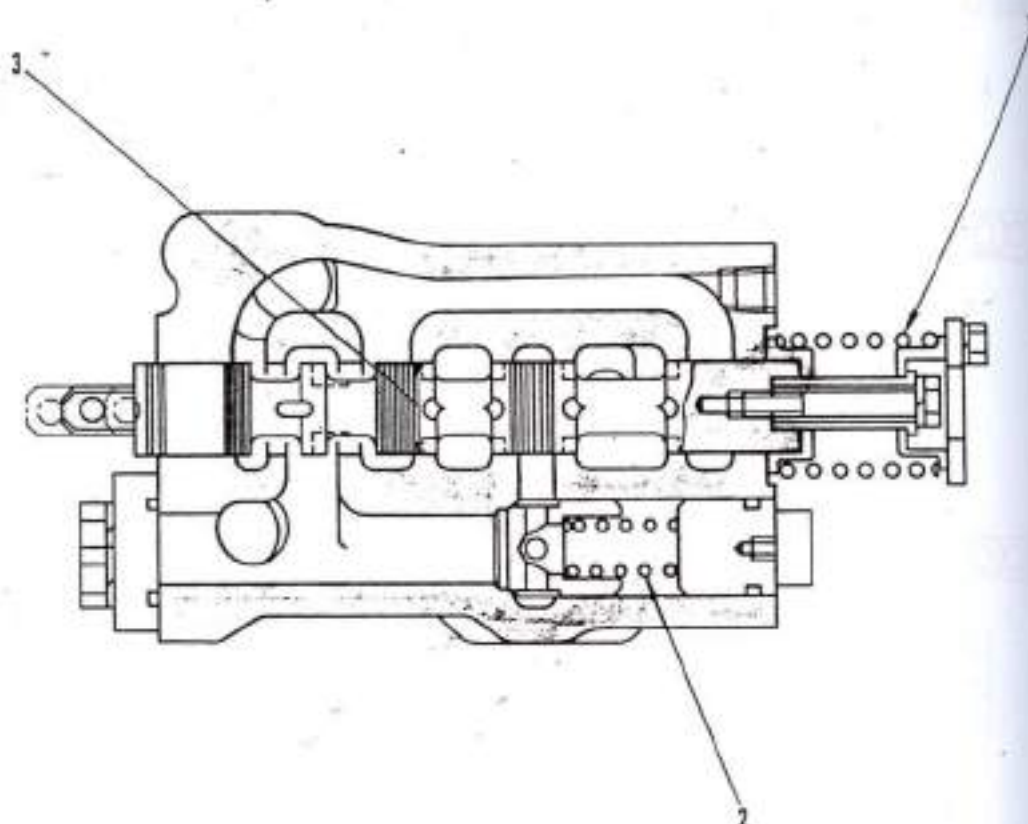
### BLADE LIFT AND TILT VALVE



Unit : mm

No.	Check item	Criteria						Remedy
1	Spool spring		Standard size			Repair limit		Replace
			Free length X O D	Installation length	Installation load	Free length	Installation load	
			120 x 56	72	12 kg	110	9.6 kg	
2	Lift check valve spring		57 x 14	51	3.6 kg	55	2.9 kg	
3	Tilt check valve spring		84.7 x 26.6	47.5	1.3 kg	79	1.1 kg	
4	Clearance between spool and valve body			Standard size		Standard clearance		
				40		0.018 ~ 0.023		

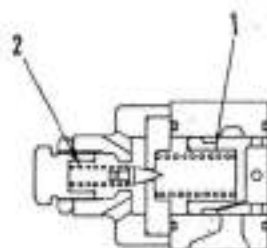
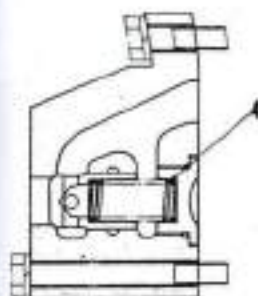
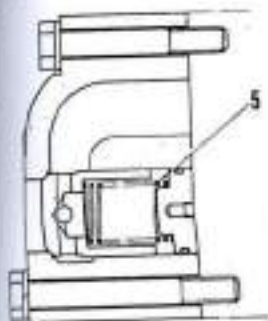
## (2) RIPPER VALVE TY 220



Unit : mm

No	Check item	Criteria						Remedy
1	Spool spring		Standard size			Repair limit		Replace
			Free length X O. D	Installation length	Installation load	Free length	Installation load	
			120 × 56	72	1.2 kg	110	9.6 kg	
2	Check valve spring		84.7 × 26.6	47.5	1.3 kg	79	1.1 kg	
3	Clearance between spool and valve body			Standard size	Standard clearance			
				40	0.018 ~ 0.023			

## MAIN RELIEF, SUCTION AND SAFETY VALVE



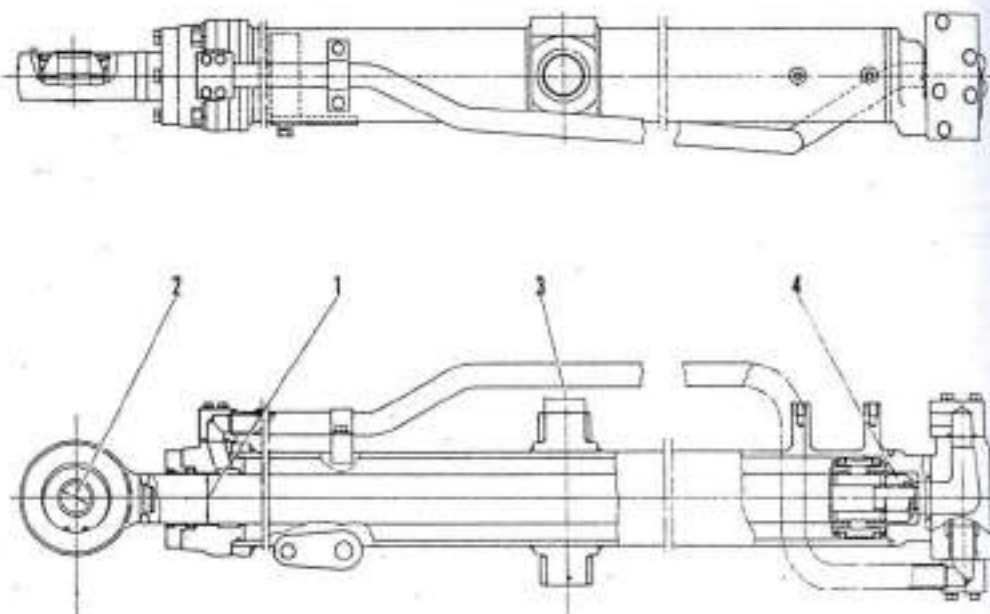
154F255

Unit: mm

No	Check Item	Criteria					Remedy
1	Main relief valve spring (Large)	Standard size			Repair limit		Replace
		Free length x O.D.	Installation length	Installation load	Free length	Installation load	
	60 x 22, 6	43	10 kg		9N g		
2	Main relief valve spring (Small)						
		37.1 x 11.3	30	27.3 kg		22k g	
3	Safety valve spring	37x	28.9	31.5 kg		25.2 kg	
4	Ripper suction valve spring	56x	47	0.5 kg		0.4 kg	
5	Blade lift suction valve spring	73x	52	0.84 kg		0.7 kg	
6	Main relief pressure	140 kg/cm <sup>2</sup>					Adjust
7	Safety valve set pressure	160 kg/cm <sup>2</sup>					

## WORK EQUIPMENT CYLINDER

## (1) BLADE LIFT CYLINDER



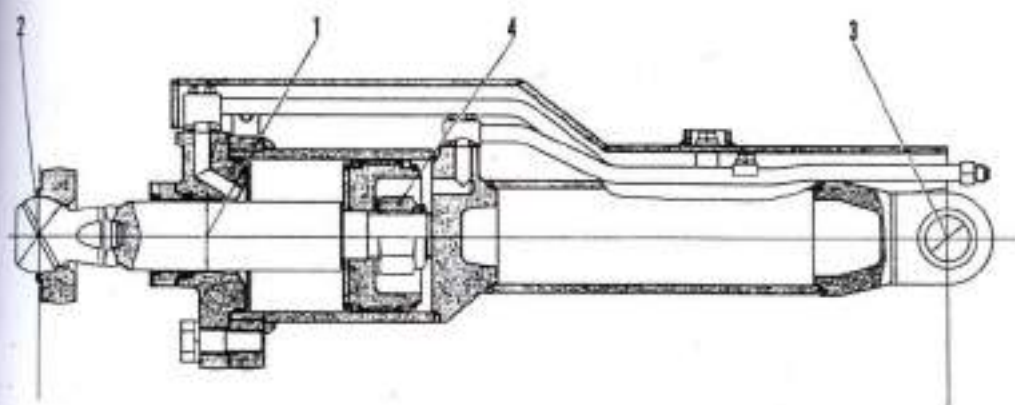
164715

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
1	Clearance between piston rod and bushing	70	-0.100 -0.174	+0.271 +0.075	0.175 ~ 0.445	0.745	Replace
2	Clearance between piston rod and pin	45	-0.2 -0.3	+0.039 0	0.200 ~ 0.339	1	
3	Clearance between cylinder support shaft bushing and yoke bushing	75	-0.100 -0.174	+0.074 0	0.100 ~ 0.244	0.5	
4	Tightening torque of piston nut	180 ± 18 kg·m					Adjust



## (2) BLADE TILT CYLINDER

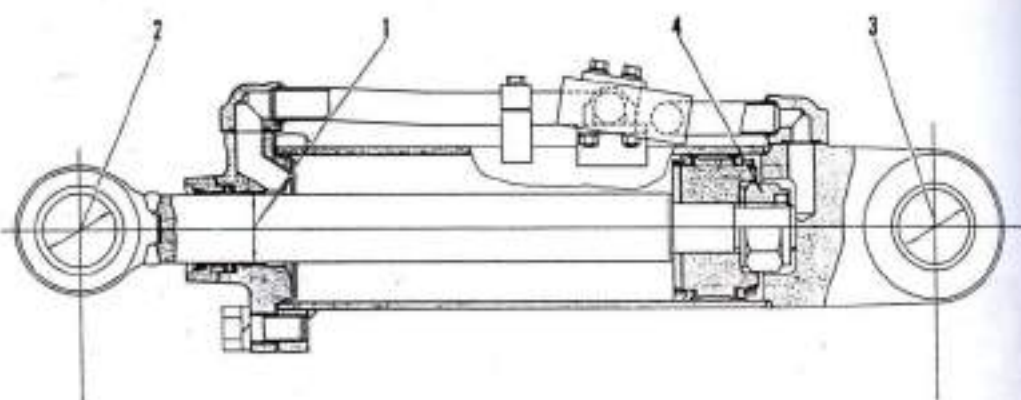


154F267

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limits	
1	Clearance between piston rod and bushing	90	-0.120 -0.207	+0.270 +0.061	0.181 ~ 0.477	0.777	Replace
2	Spherical clearance between piston rod head and cap	100	0 -0.1	+0.5 +0.2	0.300 ~ 0.600	1	
3	Clearance between cylinder bottom bushing and pin	60	-0.3 -0.5	+0.174 +0.100	0.400 ~ 0.674	1	
4	Tightening torque of piston nut	690 ± 69 kg·m					Adjust

### (3) RIPPER CYLINDER TY 220



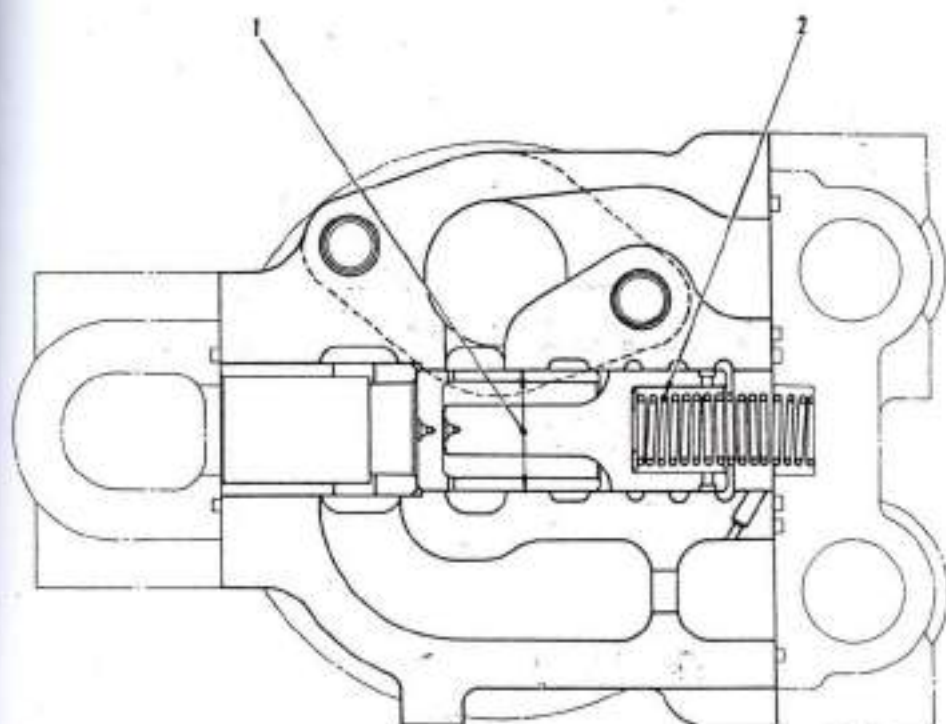
154F258

Unit: mm

No.	Check item	Clearance					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
1	Clearance between piston rod and bushing	70	-0.100 -0.174	+0.271 +0.075	0.175 ~ 0.445	0.745	Replace
2	Clearance between piston rod bushing and pin	75	-0.030 -0.076	+0.296 +0.184	0.214 ~ 0.364	1	
3	Clearance between cylinder bottom bushing and pin	75	-0.030 -0.076	+0.296 +0.184	0.214 ~ 0.362	1	
4	Tightening torque of piston nut	405 ± 40.5					Adjust

## QUICK DROP VALVE

TS220

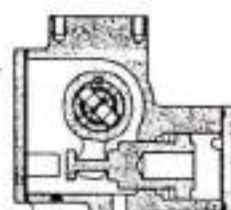
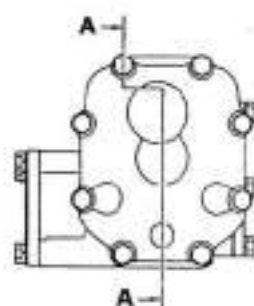
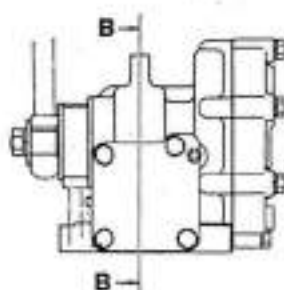
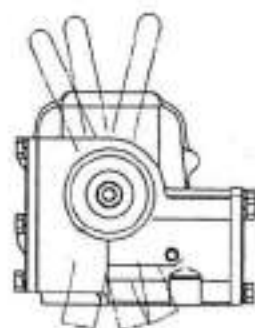


ISAF125

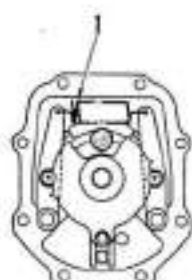
Unit: mm

No.	Check item	Criteria					Remedy	
1	Clearance between plunger and valve body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace	
			Shaft	Hole				
		38	-0.011 -0.016	+0.010 0	0.013 ~ 0.018	0.024		
2	Valve spring	Standard size			Repair limit			
		Free length x O.D.	Installation length	Installation load	Free length	Installation load		
			55.9	13.9				

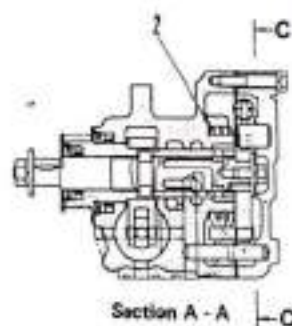
## ROTARY SERVO VALVE



Section B - B



Section C - C



Section A - A L-C

154F269

Unit: 1000

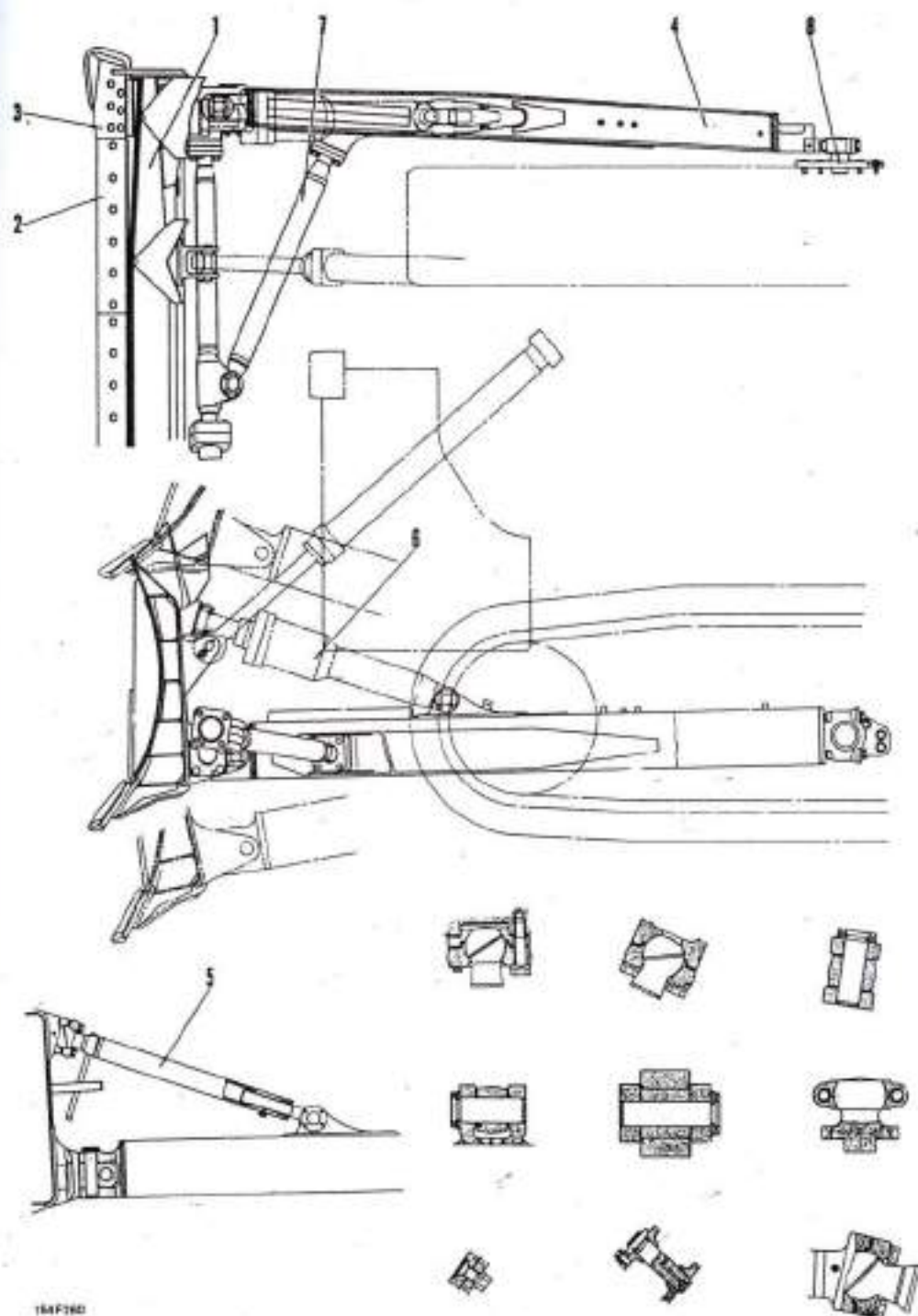
No.	Check item	Criteria					Remedy
1	Input lever spring	Standard size			Repair limit		Replace
		Free length x O.D.	Installation length	Installation load	Free length	Installation load	
2	Detent spring						

# WORK EQUIPMENT



# STRUCTURE AND FUNCTION

## STRAIGHT TILTDZER TY 220



164F280

## STRUCTURE

The work equipment system is divided into the work equipment and the hydraulic control device which controls hydraulic equipment.

In TY 220 machines, straightdozer and straight-tiltdozer are two representative hydraulic equipments. Straight tiltdozer is explained in this section.

### STRAIGHT-TILTDOZER

High tensile strength steel plate is used for the front side plate of blade (1) to give enough strength for severe work.

The cutting edge (2) is made of cutting blade carbon steel and is divided into three parts to make turning operations easy.

The end bit (3) is made of low alloy, cast steel which has high resistance to wear and high strength.

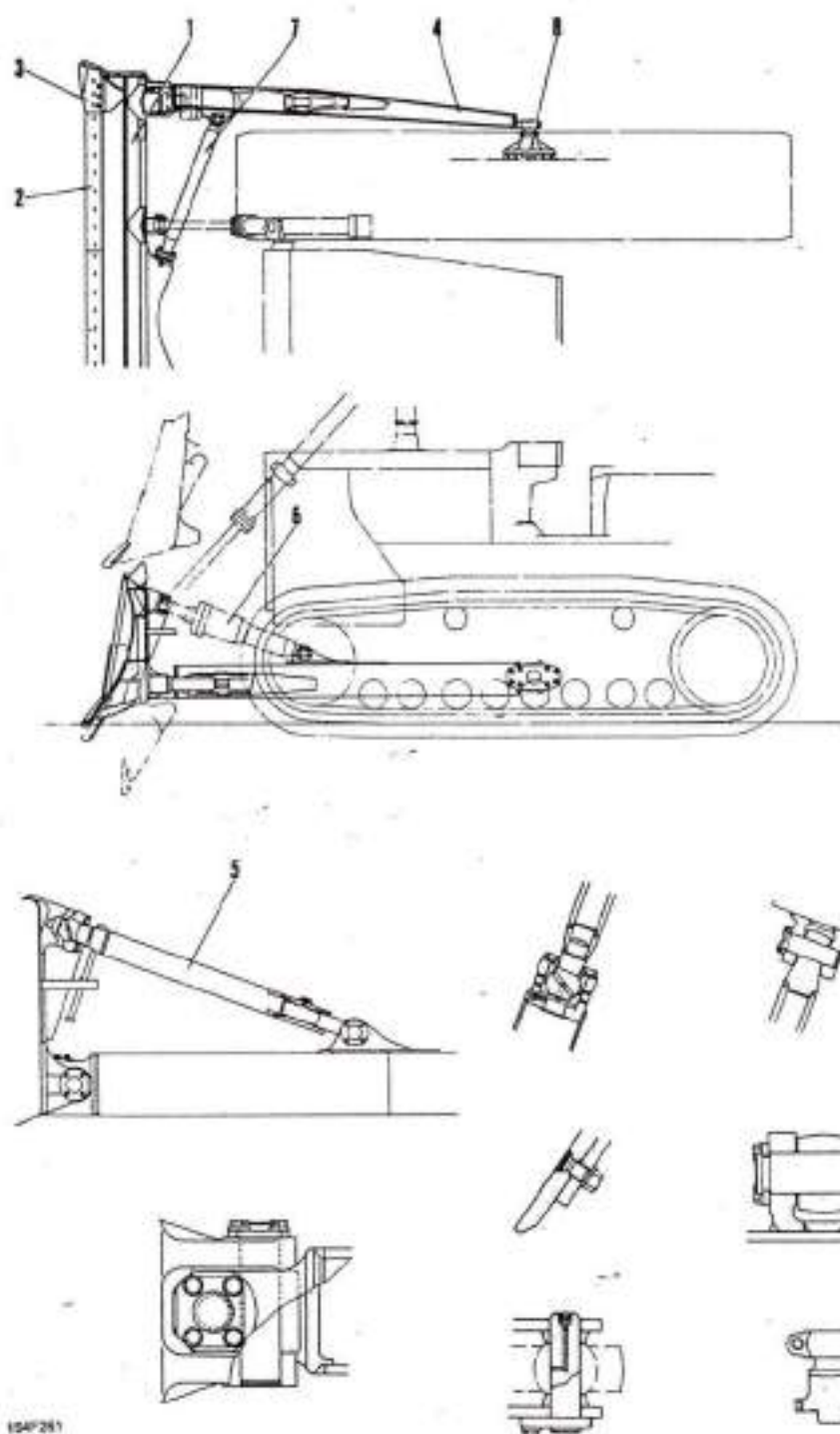
The straight frame (4) is made of high tensile strength steel plate and is of box type.

The straight frame is fixed to the blade at its front by the joint block and to the track frame at its rear by the trunnion (8) and can be moved up and down by the blade lift cylinder.

The blade and straight frame are supported by a tilt cylinder at their right side and by a brace (6) at their left side.

1. Blade
2. Cutting edge
3. End bit
4. Straight frame
5. Brace
6. Tilt cylinder
7. Arm
8. Trunnion

# STRAIGHT TILDOZER TS 220



154P/281

## STRUCTURE

The work equipment system is divided into the work equipment and the hydraulic control device which controls the work equipment.

In TS 220 machines, angledozer, straightdozer and straight-tiltdozer are three representative hydraulic equipments. Straight-tiltdozer is explained in this section.

## STRAIGHT-TILTDOZER

1. Blade
2. Cutting edge
3. End bit
4. Straight frame
5. Brace
6. Tilt-cylinder
7. Arm
8. Trunnion

High tensile strength steel plate is used for the front side plate of blade (1) to give enough strength for severe work.

The cutting edge (2) is made of cutting blade carbon steel and is divided into three parts, to make turning operations easy.

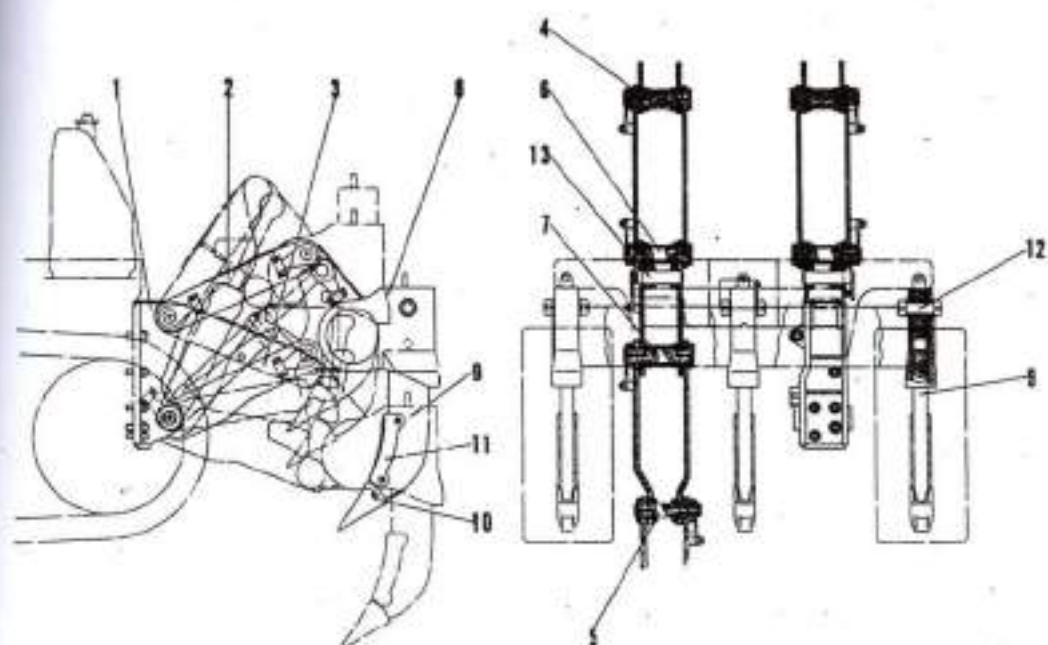
The end bit (3) is made of low alloy cast steel which has high resistance to wear and high strength.

The straight frame (4) is made of high tensile strength steel plate and is of box type, with high strength. The straight frame is fixed to the blade at its front by the joint block and to the track frame at its rear by the trunnion (8), respectively, and can be moved up and down by the blade lift cylinder.

The blade and straight frame are supported by a tilt cylinder at their right side and by a brace (5) at their left side.

In addition, a relief mechanism for tilting is applied at the center of back side of blade.

## FIXED MULTI-SHANK RIPPER TY 220



154F281



## STRUCTURE

Following are the four representative, hydraulic rippers.

1. Fixed, multi-shank ripper
2. Variable ripper
3. Fixed, giant ripper
4. Variable, giant ripper

Fixed multi-shank ripper is explained in this section.

## FIXED MULTI-SHANK RIPPER

The upper and lower links (2), (3) are fastened by pins (4), (5) to the ripper bracket (1) which is mounted on the rear surface of the steering case by nuts. The beam (6) is attached to the tip of upper and lower links by pins (7), (8).

The shank (9) is mounted on the beam (6) by pin (12). Point (10) and protector (11) are mounted on shank by pin.


In the ripper cylinder used for raising and lowering (digging) the shank, its bottom is fixed by same pin as link mounting pin (5) and the ripper cylinder is fixed to the beam at its rod side by pin (13). Point digging depth is obtained by converting ripper cylinder expansion and contraction operation into ripper point raising and lowering operation by using a four joints link mechanism (parallelogram which consists of pin (4), (5), (6) and (7)).

1. Ripper bracket
2. Link (upper)
3. Link (lower)
4. Pin (upper)
5. Pin (lower)
6. Pin (upper)
7. Pin (lower)
8. Beam
9. Shank
10. Point
11. Protector
12. Pin
13. Pin

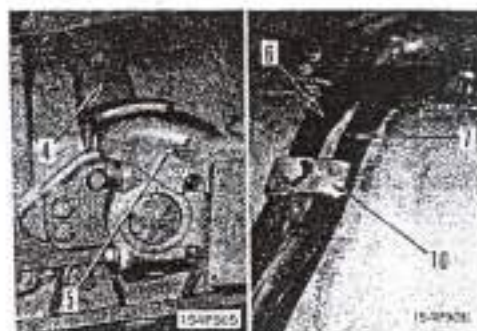
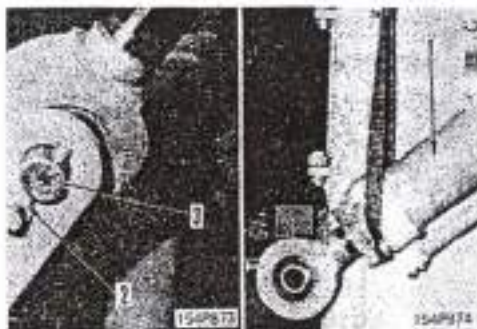
## DISASSEMBLY AND ASSEMBLY

## DISMOUNTING BLADE ASSEMBLY

 Place blocks (height: 370 mm) under I-frames.

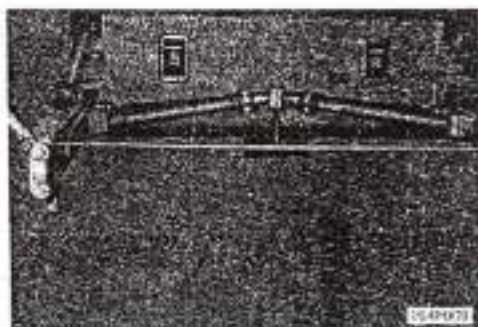
 Stop engine, then operate tilt control lever two or three times to release internal pressure in piping.

1. Remove lock pin (3) of cylinder assembly (1) and pull out pin (2).
2. Sling cylinder, start engine and retract cylinder rod.
3. Remove covers (4) and (5) from blade tilt cylinder hoses.
4. Release clamp (10) and disconnect hoses (6) and (7) between tilt control valve and tilt cylinder.
5. Remove trunnion caps (8). Start engine and disconnect blade assembly and trunnion (9).

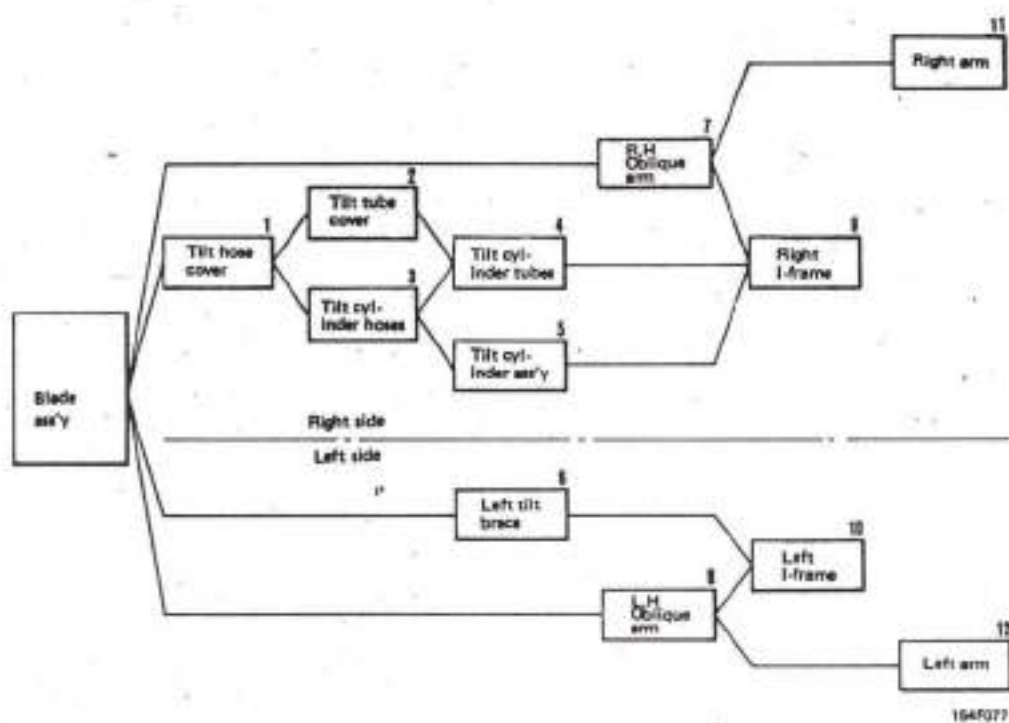


## MOUNTING BLADE ASSEMBLY

1. Set blocks under left and right I-frames so that trunnion mounts are 445 mm from the ground, and I-frames are 2762 mm apart at center.
2. Start engine, move machine forward and position blade and trunnions (5).
3. Install left and right trunnion caps (8).
4. Connect hoses (6) and (7) between tilt control valve and tilt cylinder assembly (1).
5. Install covers (4) and (5) over tilt cylinder hoses.
6. Sling cylinder assembly. Start engine, extend rod and insert mounting pin (2) and lock pin (3).



## DISASSEMBLY OF BLADE ASSEMBLY



1. Tilt hose cover  
Remove hose cover (1).
2. Tilt tube cover  
Remove tube cover (2).

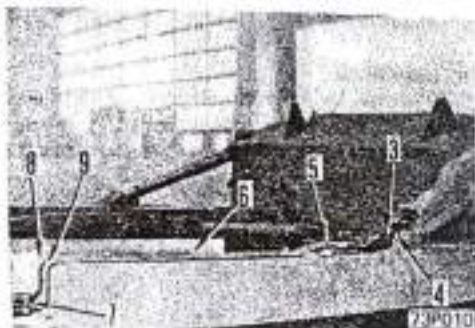


## 2. Tilt cylinder hoses

Disconnect hoses (3) and (4).

## 4. Tilt cylinder tubes

Release clamps (5), (6) and (7) and remove tubes (8) and (9).



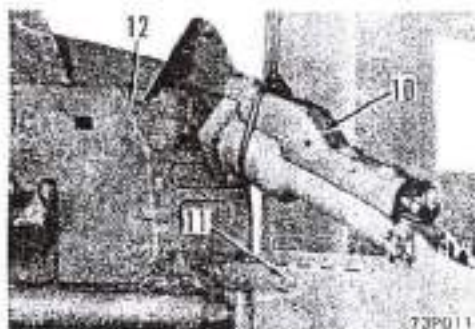
## 5. Tilt cylinder assembly

Sling tilt cylinder assembly (10) with crane, disconnect it from I-frame (11) and blade (12), and lift away.

\* Note number and thickness of shims at blade ball joint for later reference.



Tilt cylinder assembly: 165 kg



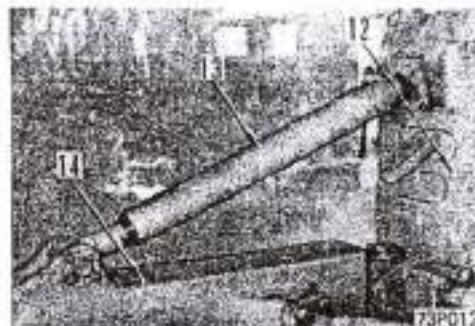
## 6. Left tilt brace

Sling left tilt brace (13) with crane, then disconnect it from I-frame (14) and blade (12) and lift away.

\* Note number and thickness of shims at blade ball joint for later reference.



Tilt brace: 65 kg



## 7. R.H Oblique arm

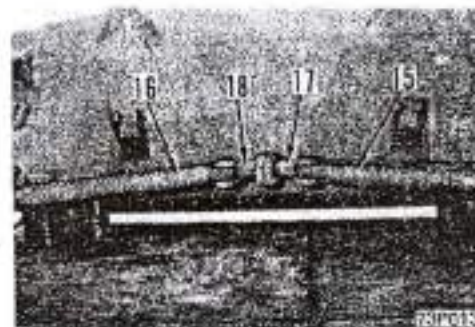
## 8. L.H Oblique arm

Sling R.H oblique arm (15) and L.H oblique arm (16), disconnect them from arms (17) and (18) and I-frame, and lift away.

\* Note number and thickness of shims at I-frame ball joint for later reference.



Oblique arm: 60 kg




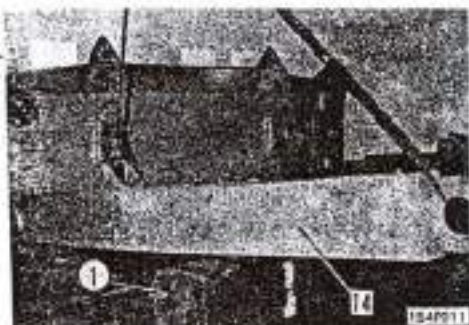


9. Right i-frame

10. Left i-frame

Insert blocks 1 under left and right arm mounts to prevent blade from falling over. Sling i-frame (14) with crane, disconnect joint (19) and blade (12) and lift i-frame away.


 i-frame: 350 kg




11. Right arm

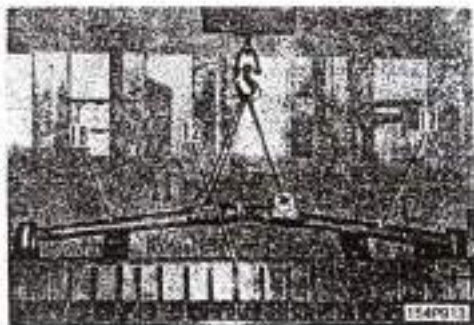
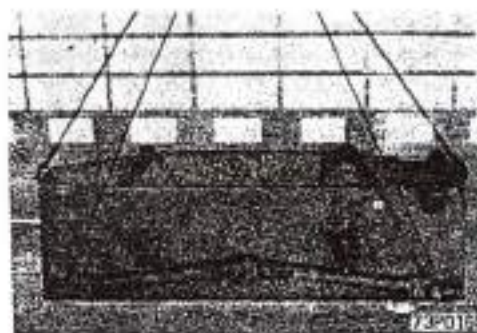
12. Left arm

- 1) Lower blade and lay it flat on ground.
- 2) Sling right arm (17) and left arm (18) with crane, disconnect from blade (12) and lift away.

 Arms: 90kg

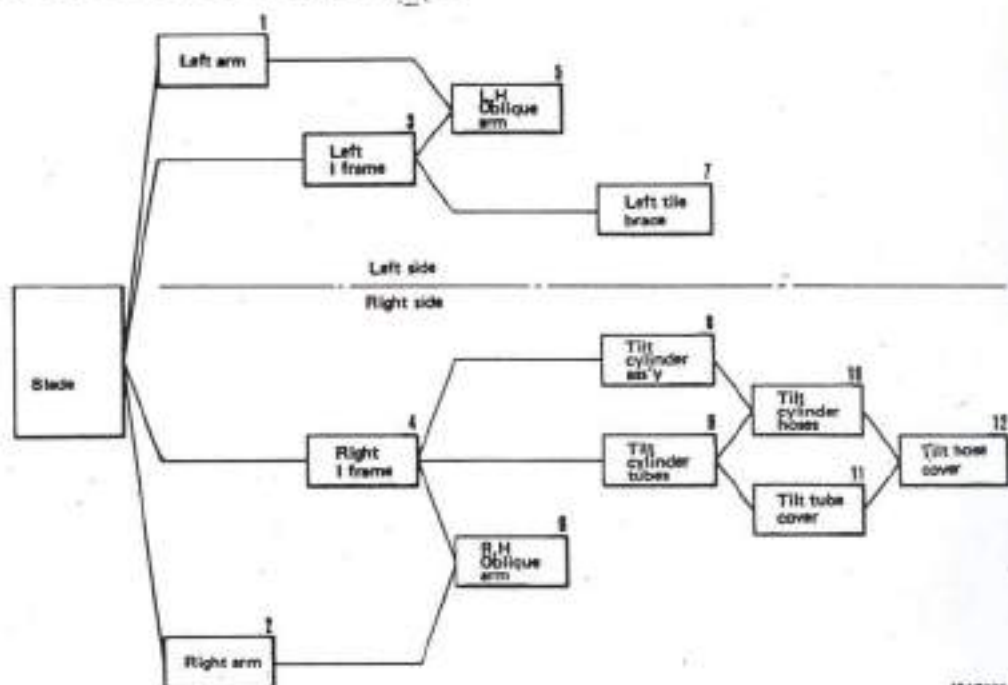
★ Note number and thickness of shims at ball joint at both ends for later reference.

 Blade assembly: 1,600 kg





# ASSEMBLY OF BLADE ASSEMBLY



154F978

## 1. Left arm

## 2. Right arm

Attach left arm (18) and right arm (17) to blade (12), and join together.

★ For each joint insert the same number and thickness of shims that were removed during disassembly. Check and adjust as follows:

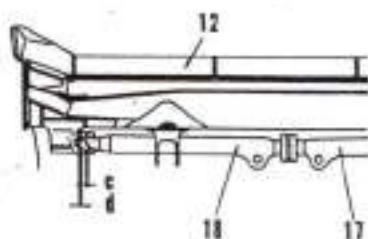
### • Adjustment of dimension c

Adjust shims at ball joint so that axial play is less than 1 mm, but ball can still turn smoothly.

★ Thickness of shims should not be less than 3 mm.

### • Adjustment of dimension d

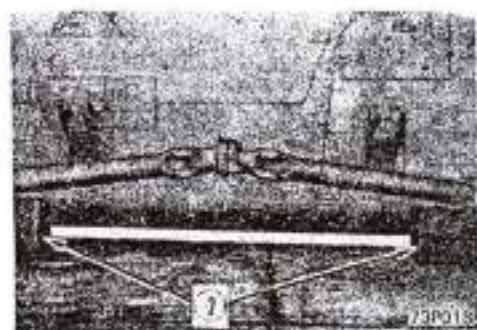
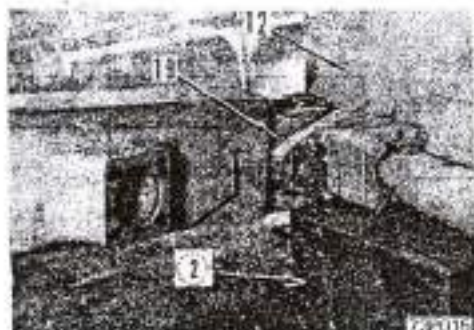
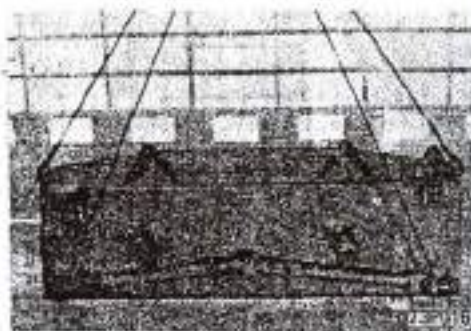
○ Insert shims of a standard thickness of 5 mm at (d) as adjustment will be made when mounting blade assembly on machine.



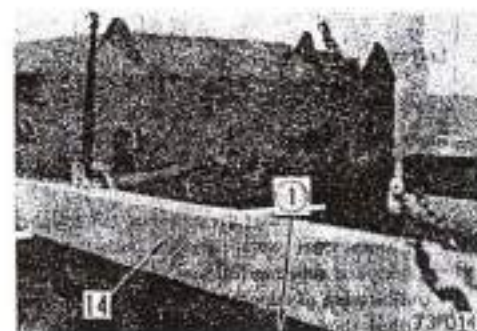
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**3. Left I-frame**

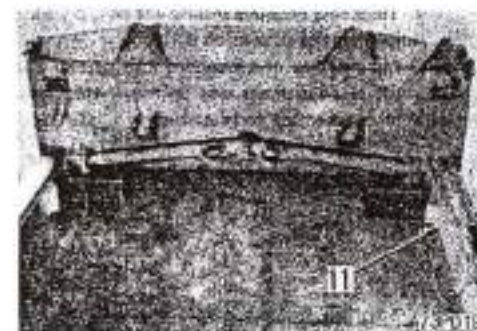
- 1) Sling blade with crane, insert blocks 2 under arm mounts to keep blade in standing position.
- 2) Attach joint (19) to I-frame (14), lift with crane and connect to blade (12).



- 3) Insert block 1 under I-frame so that center of I-frame trunnion mount is 442.5 mm from ground.

**4. Right I-frame**

Mounting procedure for right I-frame (11) is same as for left I-frame.

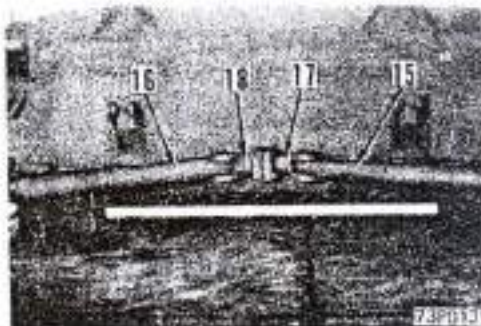


5. L.H Oblique arm

6. R.H Oblique arm

Sling L.H oblique arm (16) and R.H oblique arm (15) with crane, and connect to arms (18) and (17), and I-frame (14) and (11).

- ★ Adjust shims at ball joint so that axial play is less than 1 mm, but ball can still turn smoothly.
- ★ Thickness of shims should not be less than 3 mm. (standard: 5 mm)
- ★ If at time of connection, pin holes are not aligned, move I-frame to right or left.

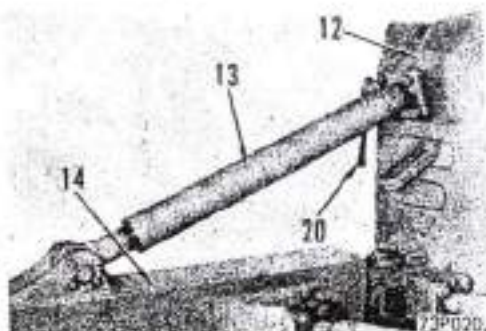


7. Left tilt brace

- 1) Sling left tilt brace (13) with crane and connect to blade (12).

★ Adjust shims at joint face so that axial play of ball is less than 1 mm, but ball can still turn smoothly.

- 2) Turn handle (20) to align pin hole for connection to I-frame (14), then connect.



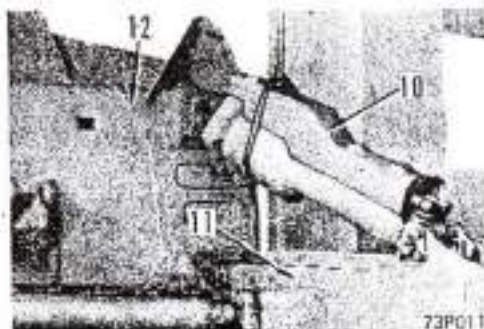
8. Tilt cylinder assembly

- 1) Sling tilt cylinder assembly (10) with crane and connect to blade (12).

★ Adjust shims at joint face so that axial play of ball is less than 1 mm, but ball can still turn smoothly.

- 2) Extend cylinder with a bar to align pin hole for connection to I-frame (11), then connect.

★ NOTE: Oil comes out when extending cylinder, so prepare a container.

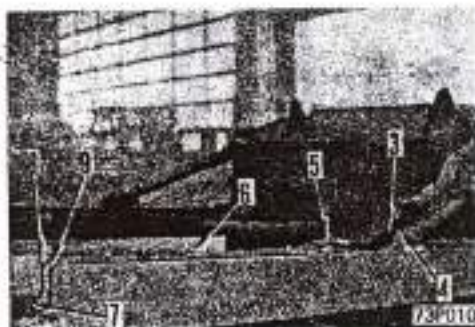


**9. Tilt cylinder tubes**

Secure tubes (8) and (9) with clamps (5), (6) and (7).

**10. Tilt cylinder hose**

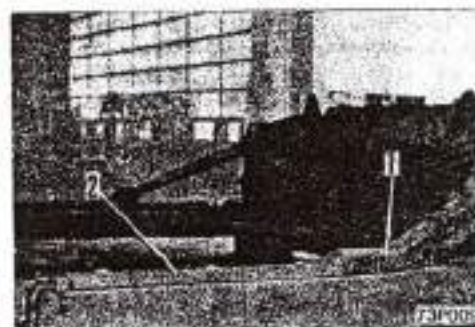
Install hoses (3) and (4).

**11. Tube cover**

Install tube cover (2).

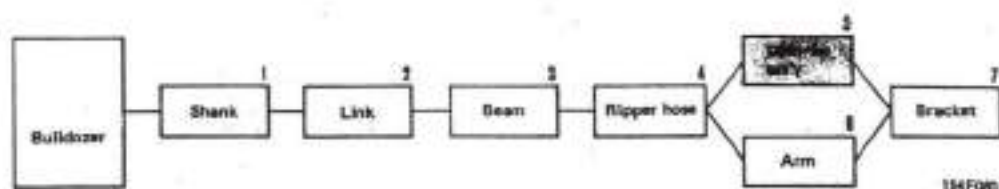
**12. Hose cover**

Install hose cover (1).





## DISASSEMBLY OF RIPPER ASSEMBLY



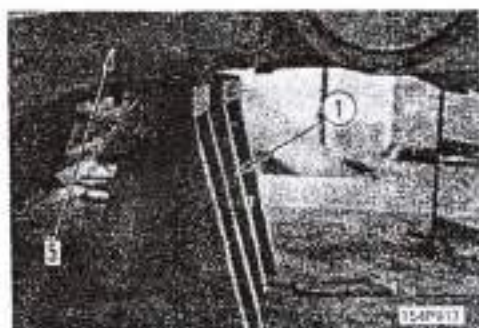
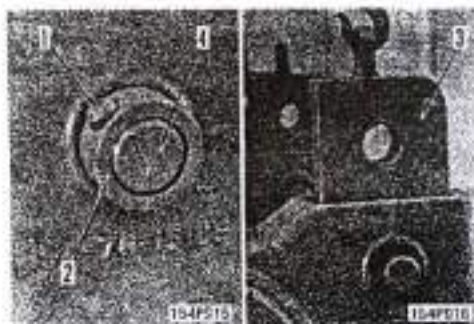
## 1. Shank

- 1) Remove shank pin (1) and collar (2).
- 2) Sling shank (3) by its top and remove shank mounting pin (4).
- 3) Start engine and raise ripper assembly fully. Lower shank.



Shank: 200 kg

- 4) Insert block 1 (height: approx. 700-mm) under arm to keep ripper assembly (5) in position.



## 2. Link

- Hoist link (7) and remove mounting pin of bracket (6) and beam (8).



Link: 93 kg





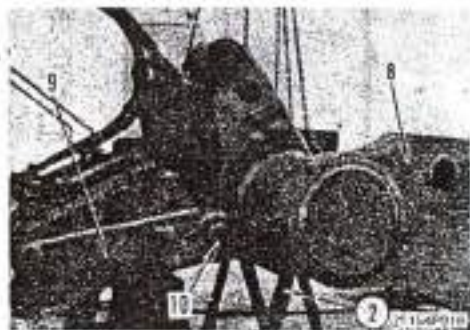
**3. Beam**

- 1) Sling beam (8) and pull out mounting pin at cylinder head. Start engine and fully retract cylinder rod.
- 2) Raise beam (8) and after inserting block 2 (height: approx. 1000 mm) under beam, lower it again.
- 3) Remove mounting pin (10) connecting beam and arm (9). Lift beam and remove.

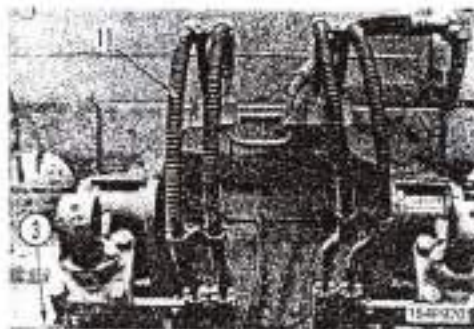


Beam: 1150 kg

★ Insert block 3 under cylinder.

**4. Ripper hose**

Remove hose (11) between ripper control valve and cylinder assembly.

**5. Cylinder assembly**

Using jack bolt (4) ( $\phi 16$  mm, P = 1.8), pull out pin (13) connecting arm and cylinder assembly (12). Lift cylinder assembly and remove.



Cylinder assembly: 115 kg

★ Leave mounting pin in arm.



6. Arm

Hoist arm (14), pull out mounting pin and remove arm.



Arm: 380 kg



7. Bracket

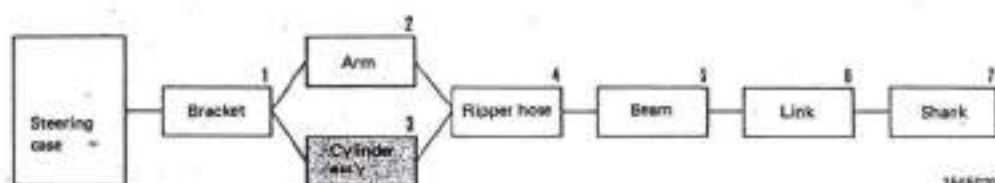
Hoist bracket (6), remove mounting nut (15) and lift away bracket.



Bracket: 125 kg



## ASSEMBLY OF RIPPER ASSEMBLY



## 1. Bracket

Lift bracket (6) and insert mounting bolt (15).

 Bracket: 225 ± 25 kg.m



## 2. Arm

Sling arm (14), align with bracket holes and temporarily insert mounting pin (13).

\* Insert mounting pin so that bottom of cylinder can enter.



## 3. Cylinder assembly

- 1) Lift cylinder assembly (12) and aligning it with holes in bracket and arm, insert and lock mounting pin (13).
- 2) Insert block 1 (height: approx. 700 mm) under arm to keep it in position.
- 3) Insert block 3 under head of cylinder assembly.

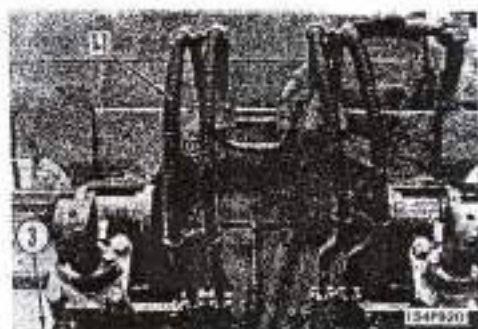


## 4. Ripper hose

Fit O-ring and install hose (11) between ripper control valve and cylinder assembly.



Fit O-ring securely in groove.



## 5. Beam

- 1) Lift beam (8) and aligning it with holes in arm (9), insert and lock mounting pin (10).
- 2) Lift beam and insert block 2 (height: approx. 1000 mm) under beam to keep it in position.





- 3) Start engine and extend cylinder rod (10). Align with hole in beam and insert mounting pin (10).

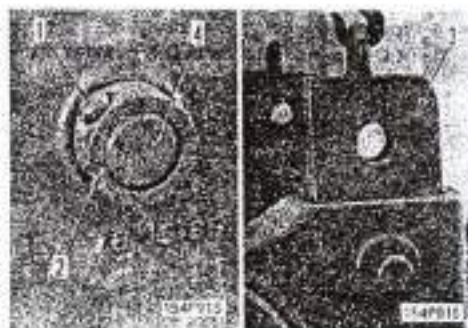


6. Link  
Lift link (7) and aligning it with holes on both sides of bracket (6) and beam (8) Insert and lock mounting pin.



7. Shank

- 1) Start engine and fully raise ripper assembly. Lift shank (3) by its top and insert shank mounting pin (4).
- 2) Install collar (2) and shank pin (1).

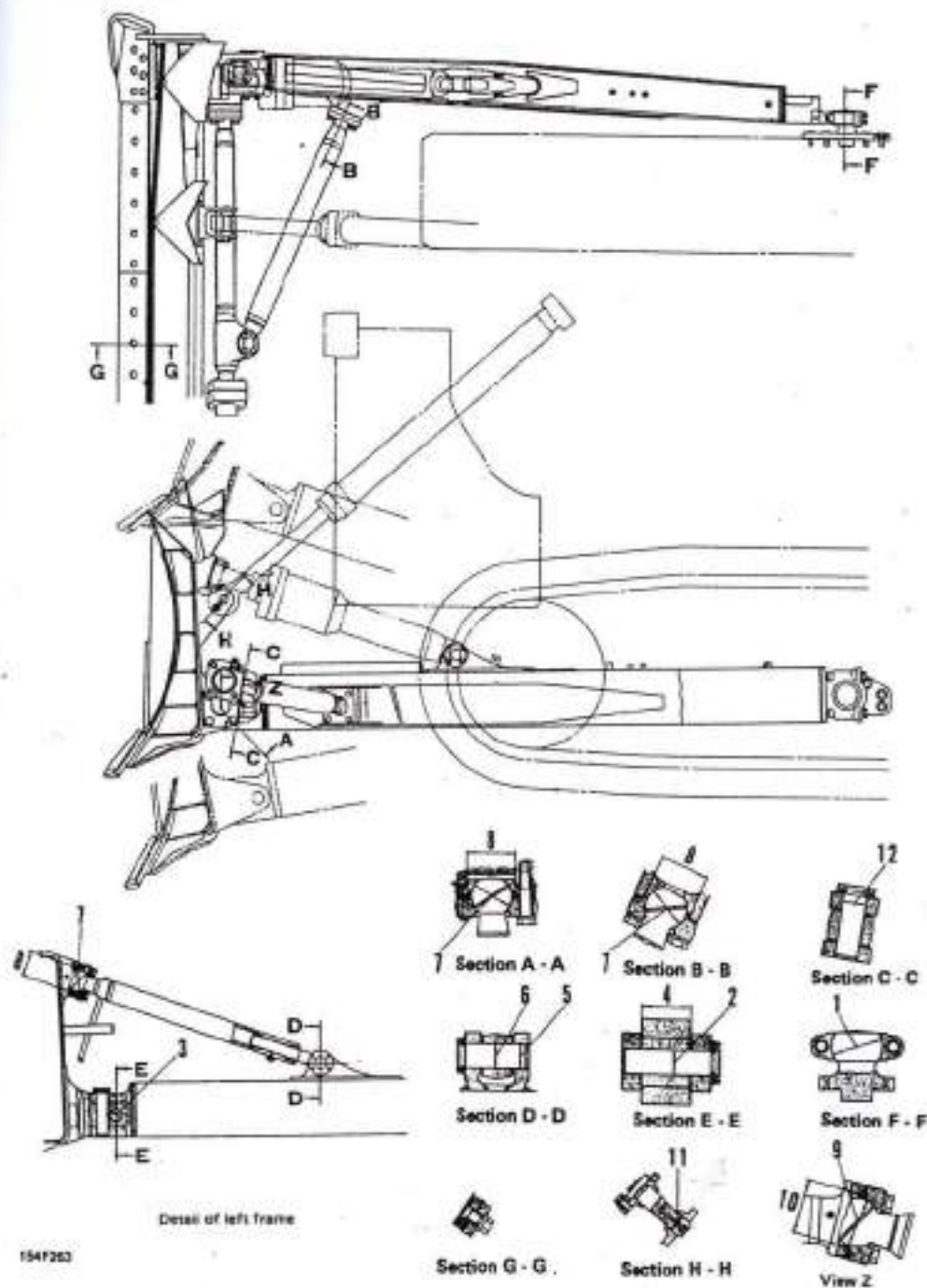




## MAINTENANCE STANDARD

## STRAIGHT TILDOZER TY 220

## (1) BLADE, FRAME



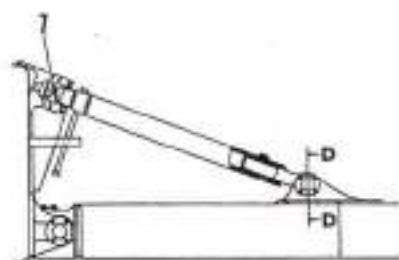
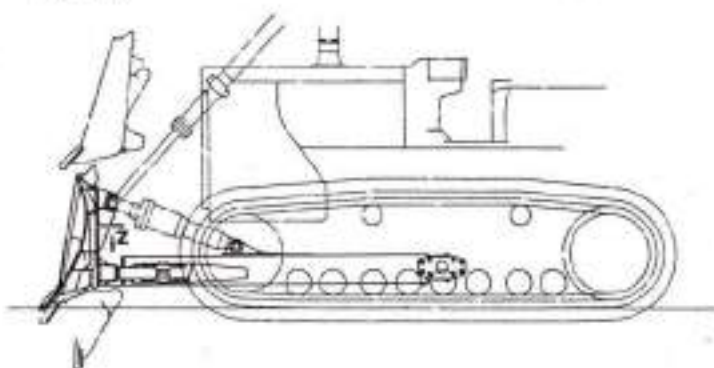
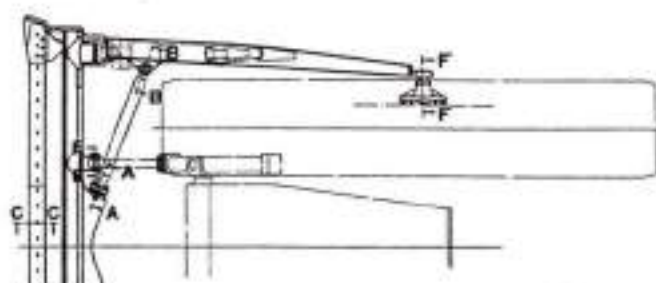
1547263

Unit: mm

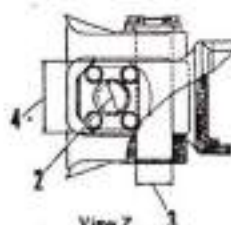
No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
1	Spherical clearance between trunnion cap and trunnion	130 ball	-0.5 -1.0	+0.5 0	0.5 ~ 1.5	10	Replace
2	Clearance between frame pin and joint	60	-0.3 -0.5	+0.3 0	0.3 ~ 0.8	3	
3	Clearance between blade pin and joint	60	-0.3 -0.5	+0.3 0	0.3 ~ 0.8	3	
4	Clearance between joint, bracket and frame	120	-0.2 -0.7	+0.4 +0.1	0.3 ~ 1.1	6	
5	Clearance between brace pin and bracket	60	-0.3 -0.5	+0.5 +0.2	0.5 ~ 1.0	2	
6	Clearance between brace pin and frame	60	-0.3 -0.5	+0.5 +0.3	0.6 ~ 1.0	2	
7	Clearance between sphericity of brace, arm and cap	100 ball	0 -0.1	+0.5 +0.2	0.2 ~ 0.6	1	Shim adjust or replace
8	Clearance between cap of arm and frame	120	-0.1 -0.2	+0.2 0	0.1 ~ 0.4		
9	Clearance between sphericity and cap	115 ball	-0.2 -0.3	+0.3 0	0.2 ~ 0.6	1	
10	Clearance between arm and arm	135	-0.046 -0.106	+0.100 0	0.046 ~ 0.206		
11	Clearance between cylinder piston rod pin and bracket	45	-0.2 -0.3	+0.5 +0.2	0.4 ~ 0.8	2	Replace
12	Clearance between arm and mounting pin	55	-0.3 -0.5	+0.3 0	0.3 ~ 0.7		

# STRAIGHT TILTDOZER TS 220

## (1) BLADE AND FRAME



Detail of left frame



View Z



Section A - A



Section C - C



Section E - E



Section B - B



Section D - D

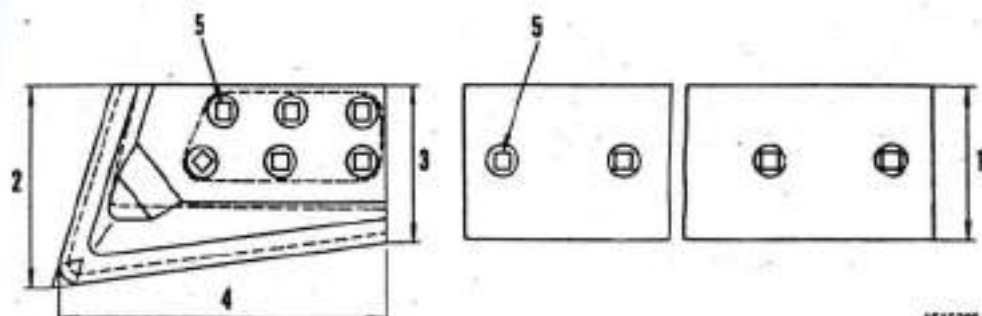


Section F - F

1947264

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Spherical clearance between trunnion cap and trunnion	130 ball	-0.5 -1.0	+0.5 0	0.5 ~ 1.5	10	
2	Clearance between frame pin and joint	60	-0.3 -0.5	+0.3 0	0.3 ~ 0.8	3	Replace
3	Clearance between blade pin and joint	60	-0.3 -0.5	+0.3 0	0.3 ~ 0.8	3	
4	Clearance between joint bracket and frame	120	-0.2 -0.7	+0.4 +0.1	0.3 ~ 1.1	6	
5	Clearance between brace pin and bracket	60	-0.3 -0.5	+0.5 +0.2	0.6 ~ 1.0	2	
6	Clearance between brace pin and frame	60	-0.3 -0.5	+0.5 +0.3	0.6 ~ 1.0	2	
7	Clearance between sphericity of brace, arm and cap	100 ball	0 -0.1	+0.5 +0.2	0.2 ~ 0.6	1	Shim adjust or replace
8	Clearance between arm pin and bracket	55	-0.3 -0.5	+0.3 0	0.3 ~ 0.8	2	
9	Clearance between sphericity and cap	110 ball	0 -0.1	+0.5 +0.2	0.3 ~ 0.6	1	
10	Clearance between cap and bracket	120	-0.1 -0.2	+0.087 0	0.1 ~ 0.287	6	
11	Clearance between cylinder piston rod pin and bracket	45	-0.2 -0.3	+0.5 +0.2	0.4 ~ 0.8	2	Replace

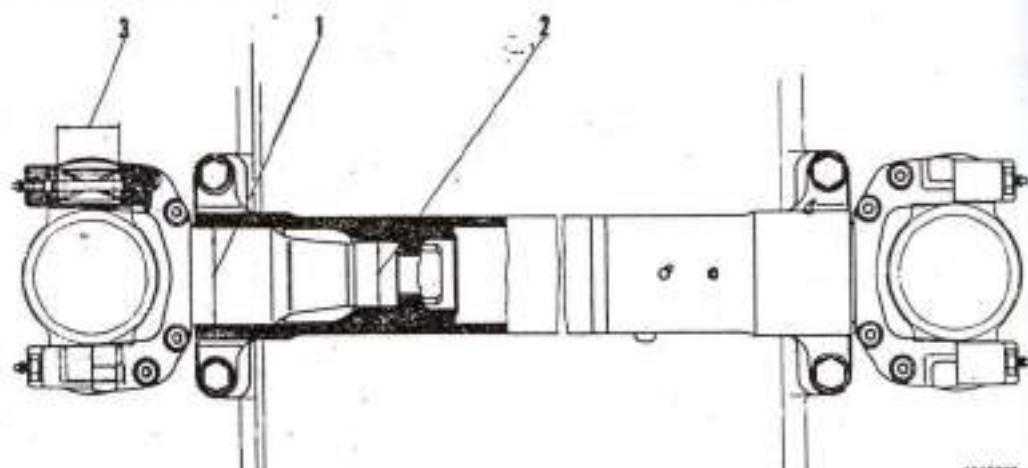
**(2) CUTTING EDGE AND END BIT**

1547205

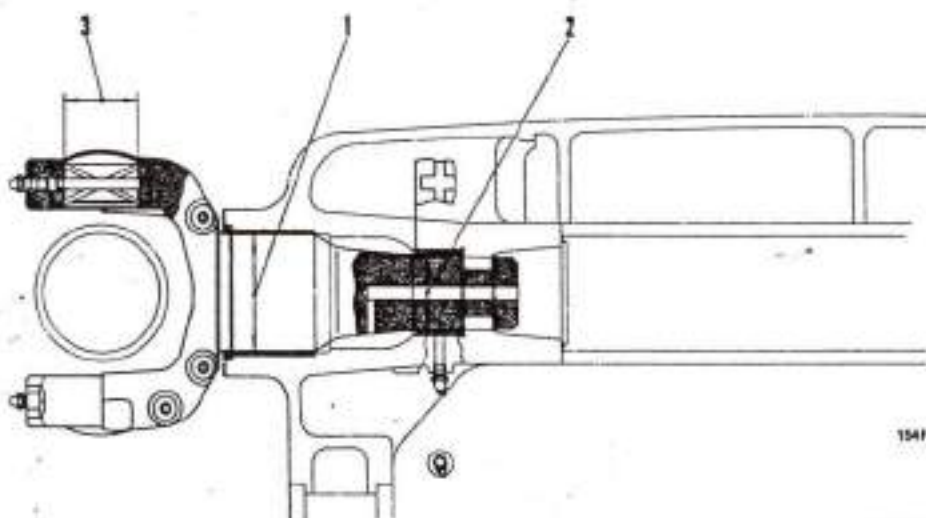
Unit: mm

No.	Check item	Criteria			Remedy
			Standard size	Repair limit	
1	Height of cutting edge		254	213	Replace or turning (after turning 140 max.)
2	Height of end bit (outside)		202	211	Replace
3	Height of end bit (inside)		254	211	
4	Width of end bit		435	360	
5	Tightening torque mounting bolt		54 ± 8 kg.m		Adjust



**CYLINDER STAY TY 220**


154F266

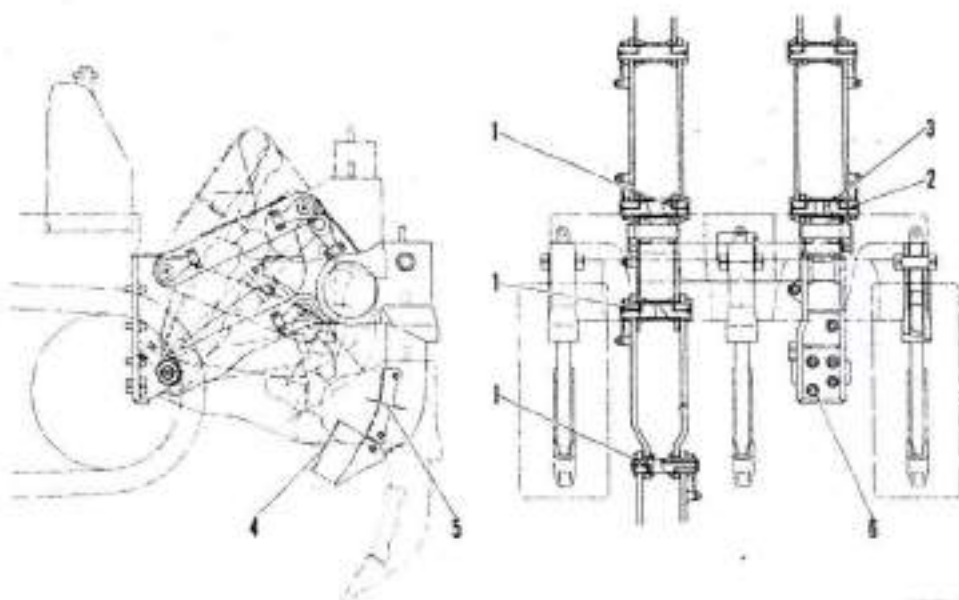
**CYLINDER STAY TS 220**


154F267

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
1	Clearance between cylinder yoke and bushing	115	-0.072 -0.126	+0.064 0	0.072 ~ 0.180	0.5	Replace
2	Clearance between cylinder yoke and bushing	75	-0.060 -0.106	+0.046 0	0.060 ~ 0.152	0.5	
3	Clearance between lift cylinder supporting shaft and bushing	75		+0.074 0		0.5	

## FIXED MULTI-SHANK RIPPER JY 220



104F208

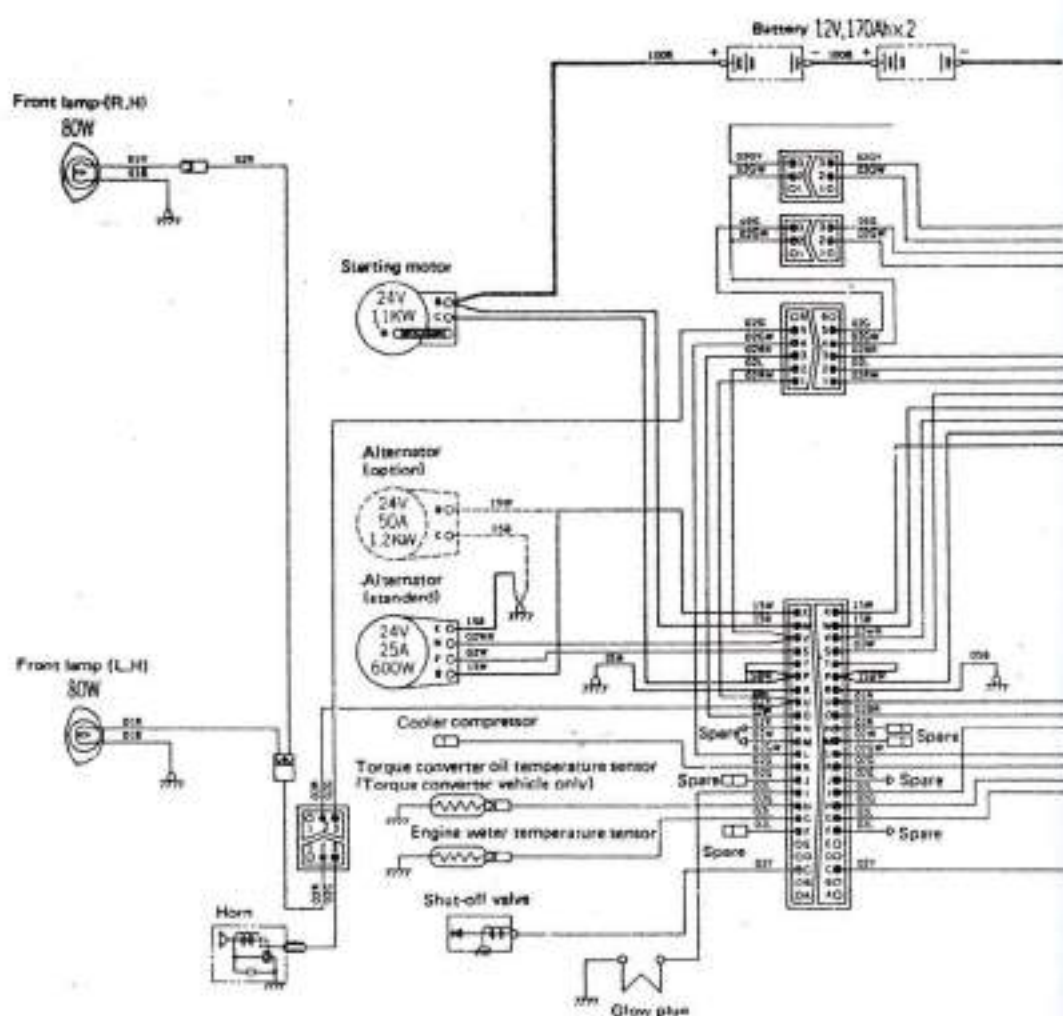
Unit: mm

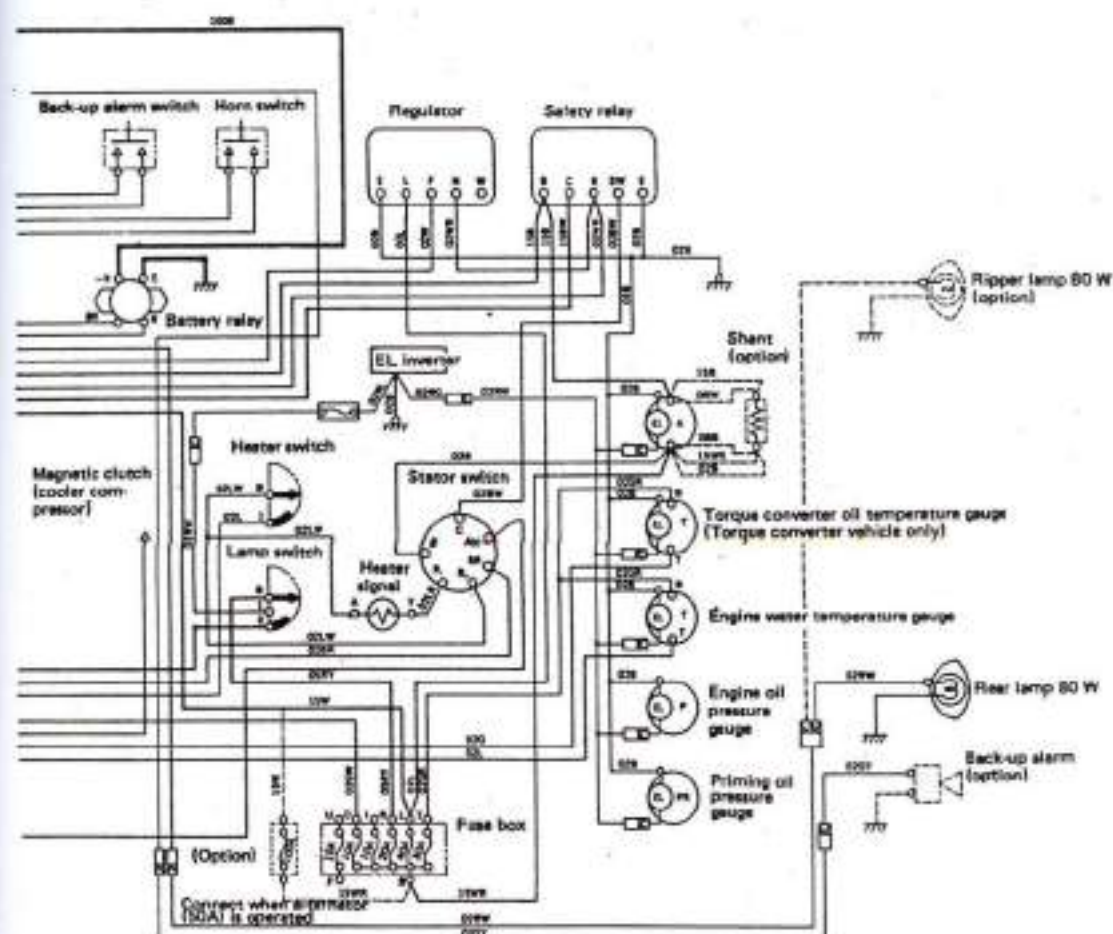
No.	Check item	Criteria						Remedy	
1	Clearance between link pin and bushing		Standard size	Tolerance		Standard clearance	Clearance limit	Replace	
				Shaft	Hole				
2	Clearance between shank holder and shank pin		75	-0.030 -0.076	+0.400 +0.200	0.230 ~ 0.476	1.5		
3	Clearance between shank pin and shank hole		Shaft 60 Hole 62	+0.3 -0.3	+0.3 -0.3	1.4 ~ 2.6	10.0		
4	Clearance between shank pin and shank hole		Shaft 60 Hole 65	+0.3 -0.3	+1.0 -1.0	3.7 ~ 6.5	15.0		
5	Wear of point		Standard size		Repair limit				
			335		225				
6	Wear of protector		113		93				
6	Tightening torque of mounting nut of ripper bracket	225 ± 25 kg·m							Adjust

**OTHERS**

# ELECTRICAL SYSTEM

## ELECTRICAL CIRCUIT





Starting switch connecting table

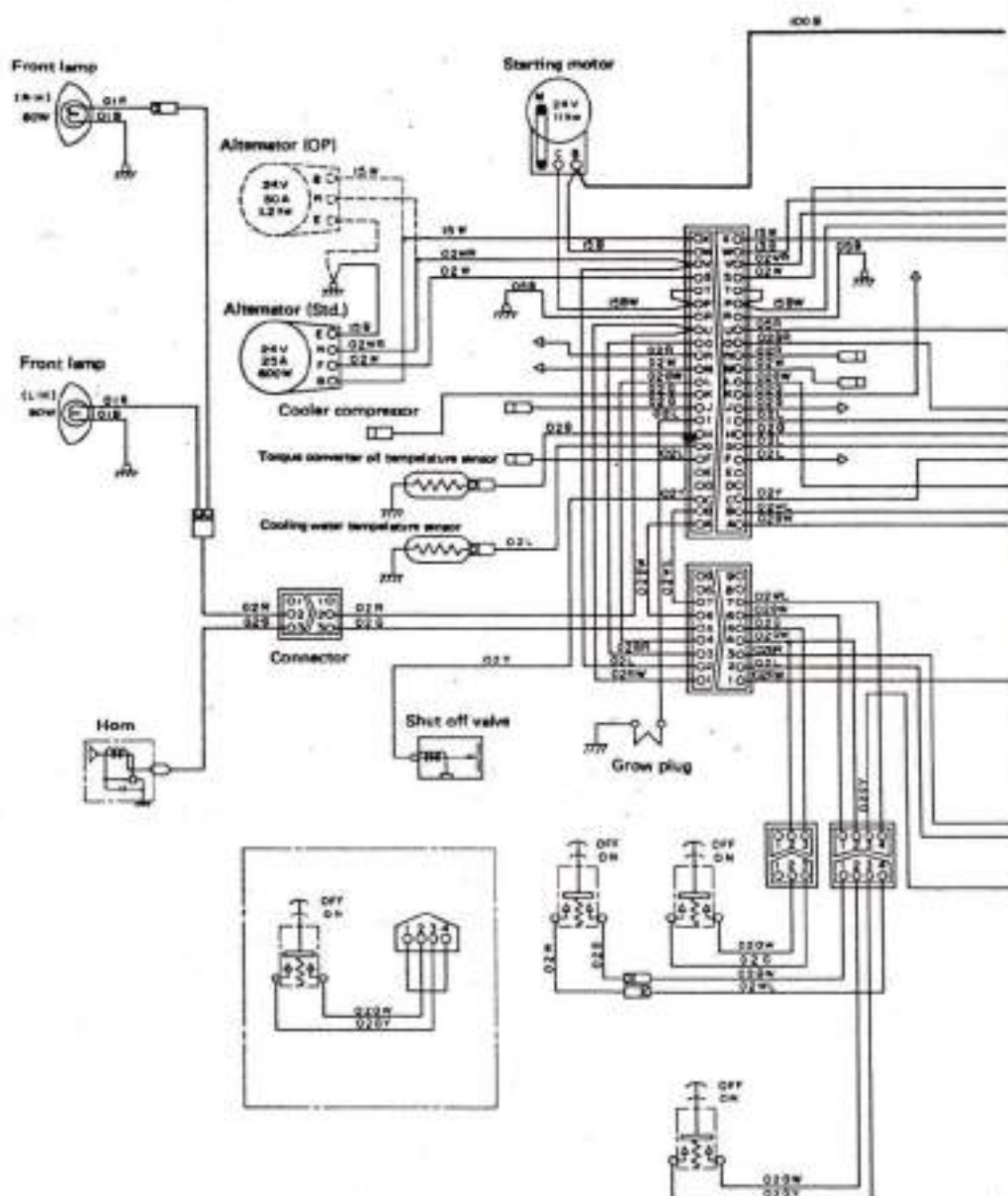
Acc./Pre-heat	B	BR	R <sub>1</sub>	R <sub>2</sub>	C	Acc
Pre-heat	○	○	○			○
OFF	○					
ON	○	○				○
Start	○	○		○	○	○

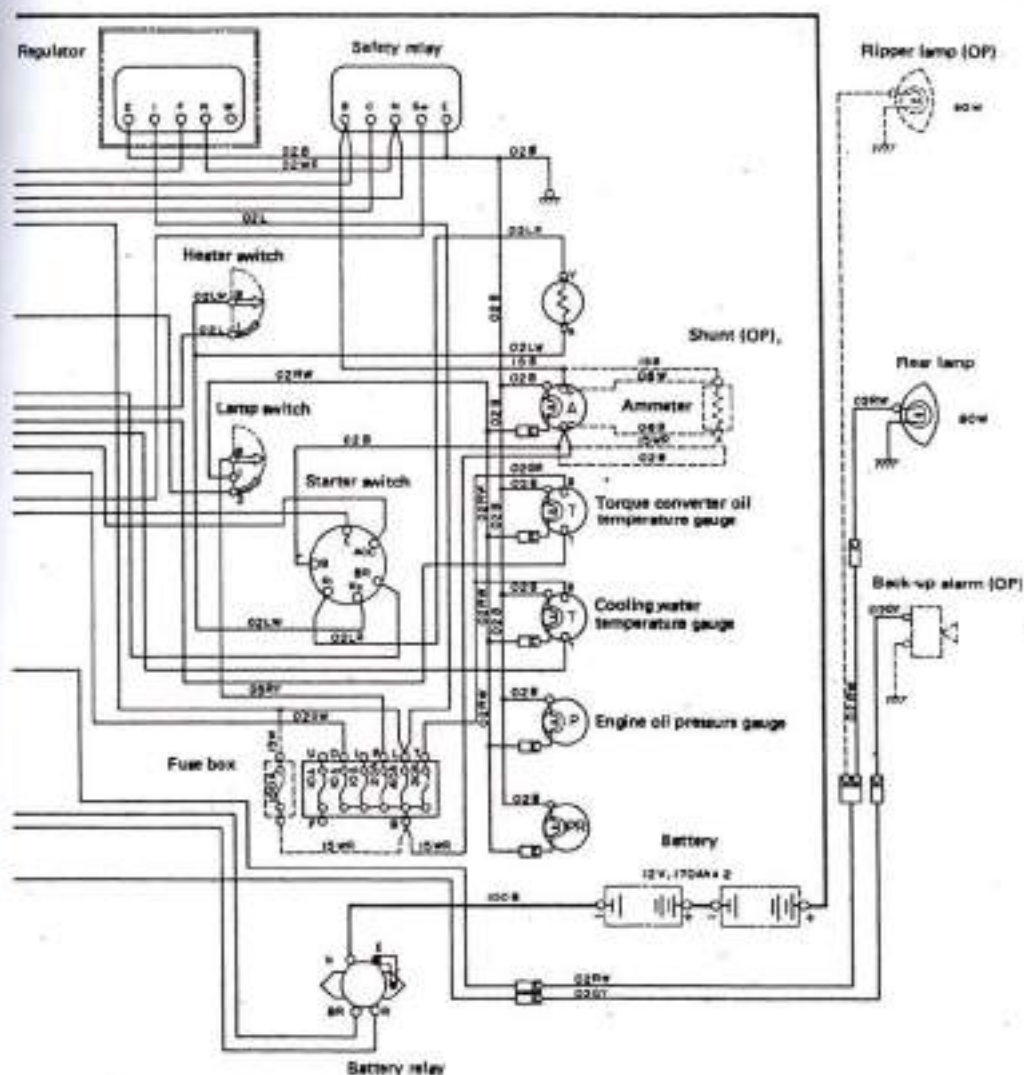
Starting switch key position

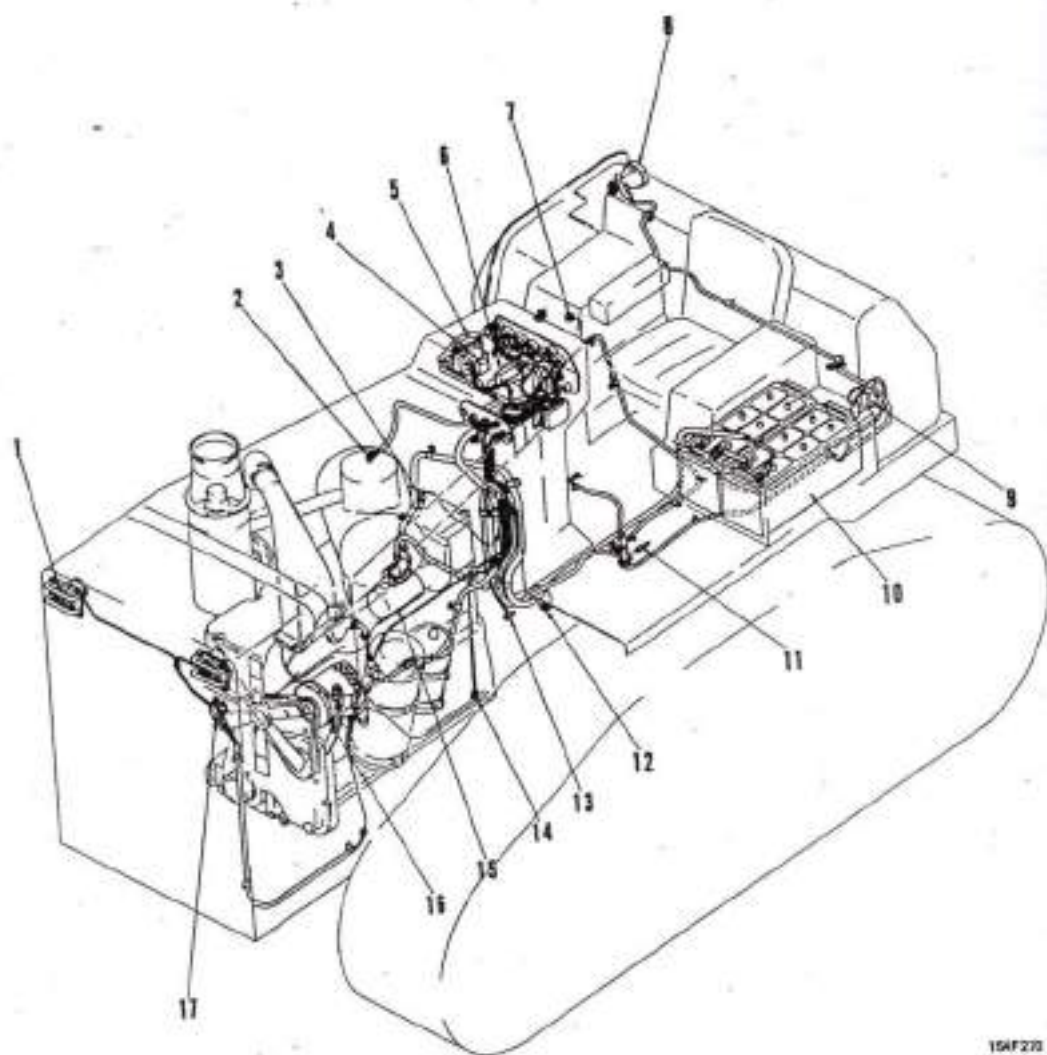




4





**WIRING DIAGRAM**

154F270

1. Head lamp
2. Dust indicator outlet
3. Engine water temperature gauge sensor
4. Regulator
5. Safety relay
6. Inverter
7. Horn switch
8. Rear lamp
9. Battery relay switch
10. Battery
11. Backup alarm switch
12. Torque converter oil temperature gauge sensor
13. Priming pump strainer outlet
14. Engine oil pressure gauge outlet
15. Starting motor
16. Alternator
17. Horn