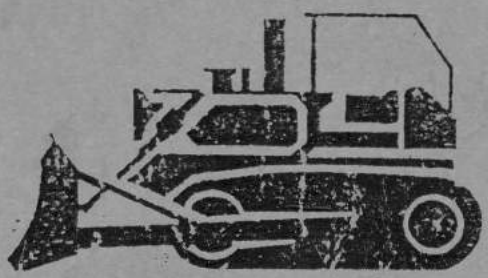
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TY220 CRAWLER BULLDOZER

SHOP MANUAL



TIANJIN CONSTRUCTION MACHINERY WORKS
THE PEOPLE'S REPUBLIC OF CHINA

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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**

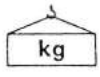
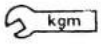
This manual has been compiled in order to provide useful material for the serviceman to acquire correct knowledge of products and correct methods of performing repairs, and also to improve the quality of repairs through accurate judgement. Therefore, get a good grasp of its contents and make full use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

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Symbols

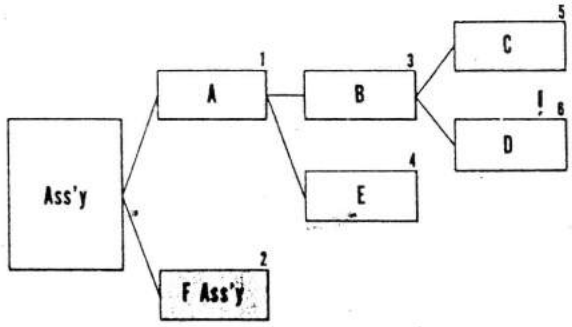
So that the shop manual can be of sufficient practical use, we have marked important places for safety and quality with the following symbols.

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.

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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 existance of a previous work network. For assembly the sequence is shown using the same king of network.

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MEANING OF TERMINOLOGY

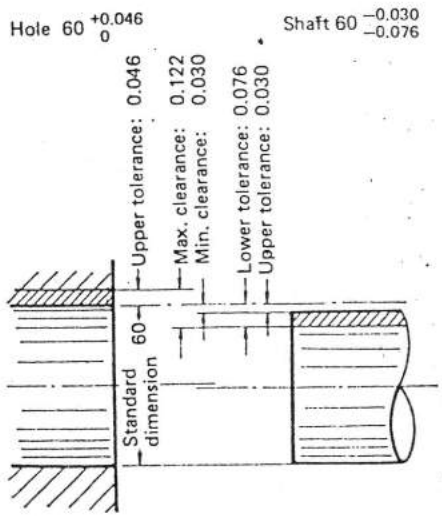
Standard Dimensions, Tolerance

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: $120\ ^{-0.022}_{-0.126}$

Moreover, usually when expressing the dimensions of a hole and the shaft that goes inside it, for the sake of convinience, 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.



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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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GENERAL

General view 1
Specifications 2
General assembly 4
List of weight 5
List of lubricant and water 8

ENGINE

STRUCTURE AND FUNCTION

Radiator 9
P.T.O. (Power take off) 11
Engine control 12
Fuel line 13

INSPECTION AND ADJUSTMENT

Fuel system
Inspection of fuel 14
Coolying system
Inspection of cooling water level 15

https://truckmanualshub.com/

Water temperature measurement 15
Inspection of fan belt tension 16
Inspection and adjustment of alternator drive belt tension 16

DISASSEMBLY AND ASSEMBLY

Dismounting radiator guard assembly 17
Mounting radiator guard assembly 20
Dismounting radiator assembly 23
Mounting radiator assembly 26
Dismounting fuel tank assembly 29
Mounting fuel tank assembly 29
Dismounting P.T.O. assembly 30
Mounting P.T.O. assembly 32
Disassembling P.T.O. assembly 35
Assembling P.T.O. assembly 37
Dismounting engine assembly 40
Mounting engine assembly 45
Dismounting chassis-related parts 50
Mounting chassis-related parts 52

POWER TRAIN

STRUCTURE AND FUNCTION

General 54
Torque converter 56
Torque converter relief valve 59

https://truckmanualshub.com/

Torque converter regulator valve 59
Scavenging pump 59
TORQFLOW transmission 60
Power transmission route 66
Transmission control valve 70
Modulating relief valve 71
Reducing valve 74
Safety valve 75
Transmission lubrication valve 76
Transmission pump 77
TORQFLOW hydraulic system 80
TORQFLOW hydraulic circuit 81
Bevel gear shaft · steering clutch 82
Steering control valve 85
Steering pump 90
Steering hydraulic system 92
Steering hydraulic circuit 93
Steering brake 94
Brake booster valve 97
Brake hydraulic system 98
Brake hydraulic circuit 99
Final drive 100
Steering and TORQFLOW hydraulic piping 103
TORQFLOW transmission control 104
Steering control 105

INSPECTION AND ADJUSTMENT

General 107
Oil pressure measuring points 109
Outline of oil pressure and temperature measurements 110
Travel measurements 115
Operating force measurements 115
Standard values 116

https://truckmanualshub.com/

DISASSEMBLY AND ASSEMBLY

Dismounting torque converter assembly 120
Mounting torque converter assembly 125
Disassembly of torque converter assembly 130
Assembly of torque converter assembly 138
Dismounting torque converter relief valve assembly 148
Mounting torque converter relief valve assembly 148
Dismounting torque converter regulator valve assembly 149
Mounting torque converter regulator valve assembly 149
Dismounting TORQFLOW transmission assembly 150
Mounting TORQFLOW transmission assembly 158
Disassembly of TORQFLOW transmission assembly 166
Assembly of TORQFLOW transmission assembly 183
Dismounting TORQFLOW transmission control valve assembly 202
Mounting TORQFLOW transmission control valve assembly 202
Disassembly of TORQFLOW transmission control valve assembly 203
Assembly of TORQFLOW transmission control valve assembly 206
Dismounting transmission lubrication valve assembly 209
Mounting transmission lubrication valve assembly 209
Dismounting transmission pump assembly 210
Mounting transmission pump assembly 210
Dismounting steering pump assembly 211
Mounting steering pump assembly 211
Dismounting bevel gear and bevel gear shaft 212
Mounting bevel gear and bevel gear shaft 215
Dismounting steering clutch assembly 222
Mounting steering clutch assembly 226
Disassembly of steering clutch assembly 231
Assembly of steering clutch assembly 233
Dismounting steering control valve assembly 236
Mounting steering control valve assembly 236

https://truckmanualshub.com/

Disassembly of steering control valve assembly 237
Assembly of steering control valve assembly 239
Dismounting brake safety valve assembly 242
Mounting brake safety valve assembly 242
Disassembly of brake safety valve assembly 243
Assembly of brake safety valve assembly 243
Disassembly of brake booster assembly 244
Assembly of brake booster assembly 244
Disassembly of final drive assembly 245
Assembly of final drive assembly 252
Dismounting floor frame assembly 259
Mounting floor frame assembly 262

MAINTENANCE STANDARD

TORQUE CONVERTER
(1) Torque converter 265
(2) Relief valve, regulator valve 267
TORQFLOW TRANSMISSION
(1) Transmission 268
(2) Transmission control valve 271
BEVEL GEAR SHAFT, STEERING CLUTCH
(1) Bevel gear shaft 273
(2) Steering clutch 275
(3) Steering brake 277
(4) Steering control valve 278
(5) Steering brake valve, booster 279
FINAL DRIVE
Final drive 280

https://truckmanualshub.com/

UNDER CARRIAGE

STRUCTURE AND FUNCTION

Track group 283
Recoil spring 285
Idler 286
Track roller 287
Carrier roller 288
Track 289
Suspension 291

DISASSEMBLY AND ASSEMBLY

Dismounting track frame assembly 293
Mounting track frame assembly 295
Dismounting recoil spring assembly 297
Mounting recoil spring assembly 300
Disassembly of recoil spring assembly 304
Assembly of recoil spring assembly 306
Dismounting idler assembly 308
Mounting idler assembly 309
Dismounting track roller assembly 310
Mounting track roller assembly 311
Dismounting carrier roller assembly 312
Mounting carrier roller assembly 312
Separation of track 313
Connection of track 314

https://truckmanualshub.com/

MAINTENANCE STANDARD

UNDERCARRIAGE
(1) Track frame (TY 220) 315
(1) Track frame (TS 220) 316
(2) Recoil spring 317
(3) Idler 318
(4) Track roller 320
(5) Carrier roller 322
(6) Track (Shoe) (TY 220) 323
(6) Track (Shoe) (TS 220) 325

HYDRAULIC CONTROL

STRUCTURE AND FUNCTION

Hydraulic pump 327
Hydraulic tank 328
Work equipment control valve 329
Work equipment cylinder 332
Quick drop valve 337
Work equipment hydraulic system 338
Work equipment hydraulic circuit 339
Rotary servo valve 340
Servo valve hydraulic system 344
Servo valve hydraulic circuit 344
Work equipment hydraulic piping (Pump ⟷ Tank) 345

https://truckmanualshub.com/

Work equipment hydraulic piping (Blade lift) 346
Work equipment hydraulic piping (Blade tilt) 347
Work equipment hydraulic piping (Ripper) (TY 220) 348
Servo valve hydraulic piping 349
Work equipment control 350

INSPECTION AND ADJUSTMENT

General 352
Oil pressure measuring points 353
Outline of oil pressure and temperature measurements 354
Oil flow measurements 356
Measurement of operating force 357
Standard values 358

DISASSEMBLY AND ASSEMBLY

Dismounting hydraulic pump assembly 361
Mounting hydraulic pump assembly 361
Dismounting blade control valve assembly 362
Mounting blade control valve assembly 364
Disassembly of blade control valve assembly 366
Assembly of blade control valve assembly 367
Dismounting ripper control valve assembly 368
Mounting ripper control valve assembly 371
Disassembly of ripper control valve assembly 374
Assembly of ripper control valve assembly 374

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Dismounting blade lift servo valve assembly 375
Mounting blade lift serve valve assembly 375
Dismounting blade tilt servo valve assembly 376
Mounting blade tilt servo valve assembly 376
Dismounting ripper servo valve assembly 377
Mounting ripper servo valve assembly 377
Dismounting blade lift cylinder assembly 378
Mounting blade lift cylinder assembly 378
Dismounting blade tilt cylinder assembly 379
Mounting blade tilt cylinder assembly 379
Dismounting ripper cylinder assembly 380
Mounting ripper cylinder assembly 380
Disassembly of cylinder assembly 381
Assembly of cylinder assembly 384

MAINTENANCE STANDARD

Work equipment control valve 387
(1) Blade lift and tilt valve 387
(2) Ripper valve TY 220 388
(3) Main relief, suction, safety valve 389
Work equipment cylinder 390
(1) Blade lift cylinder 390
(2) Blade tilt cylinder 391
(3) Ripper Cylinder TY 220 392
Quick drop valve 393
Rotary servo valve 394

https://truckmanualshub.com/

WORK EQUIPMENT

STRUCTURE AND FUNCTION

Straight tiltdozer TY 220 395
Straight tiltdozer TS 220 397
Fixed multi-shank ripper TY 220 399

DISASSEMBLY AND ASSEMBLY

Dismounting blade assembly 401
Mounting blade assembly 401
Disassembly of blade assembly 402
Assembly of blade assembly 403
Disassembly of ripper assembly 409
Assembly of ripper assembly 412

MAINTENANCE STANDARD

Straight tiltdozer TY 220 415
Straight tiltdozer TS 220 417
Cylinder stay TY 220 420
Cylinder stay TS 220 420
Fixed multi-shank ripper TY 220 421

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OTHERS

ELECTRICAL SYSTEM

Electrical circuit 422
Wiring diagram 424

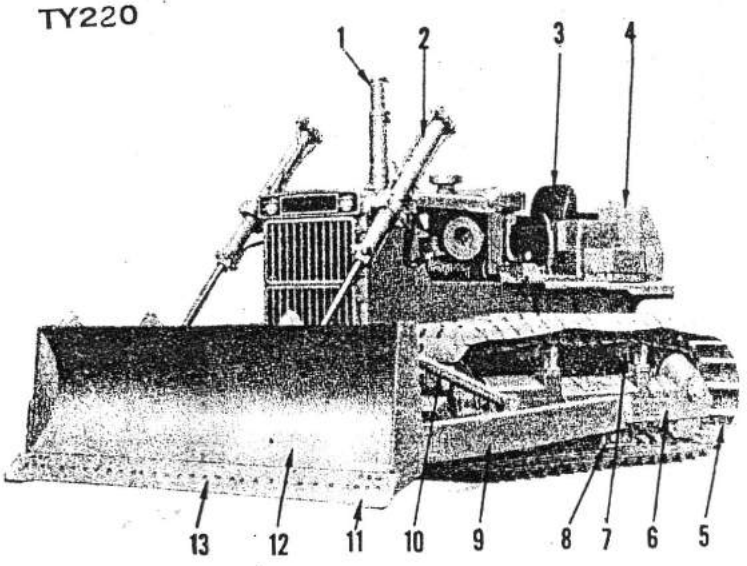
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GENERAL

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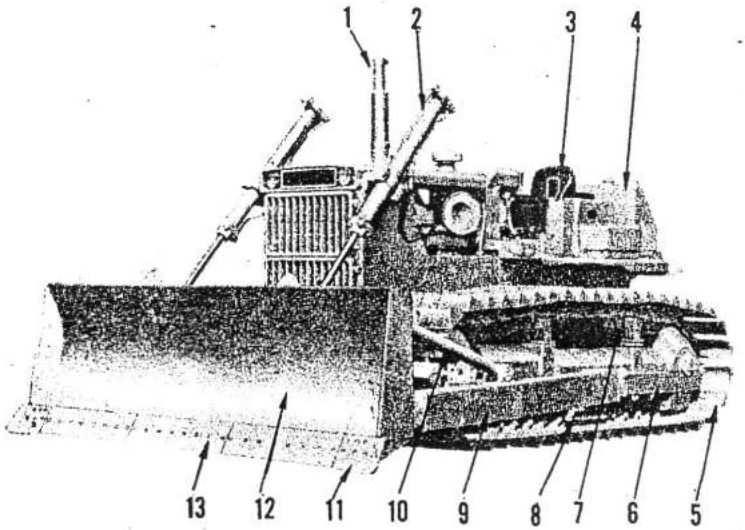
GENERAL VIEW

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

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SPECIFICATION

Machine Model				TY 220	TS 220
Weight	Operating weight		(kg)	23, 450	25,700
	Tractor weight		(kg)	19, 800	22, 250
Dimension	Overall length	Tractor	(mm)	4,675	4,715
		Bulldozer	(mm)	5,750	6,060
	Overall weight	Tractor	(mm)	2,620	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^2)	0.648	0.34
		Bulldozer	(kg/cm^2)	0.767	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 stages			Forward: 3 Reverse: 3	

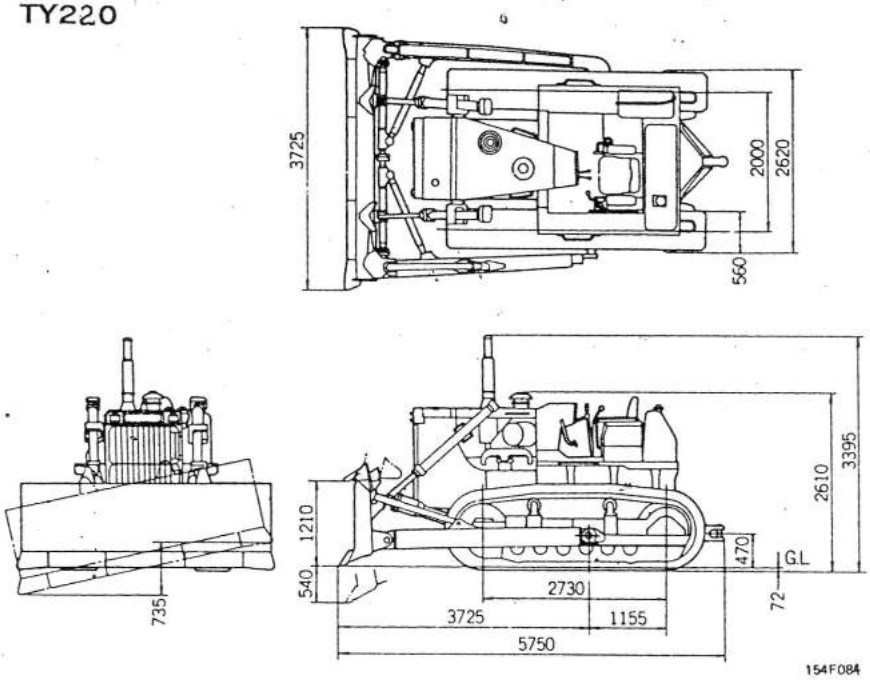
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	Machine Model	TY 220	TS 220
Power train	Torque converter	3 element, single stage single phase	
	TORQFLOW transmission	Planetary gear, multi-disc clutch, hydraulically actuated, forced lubrication Forward: 3 speeds Reverse: 3 speeds	
	Bevel gear shaft	Sprial 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	
	Track 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^2	
	Hydraulic cylinder	Piston type, Double action	
	Control valve	Spool type	
	Pump delivery	257 ℓ /min.	
	Hydraulic tank	Control valve built-in type	

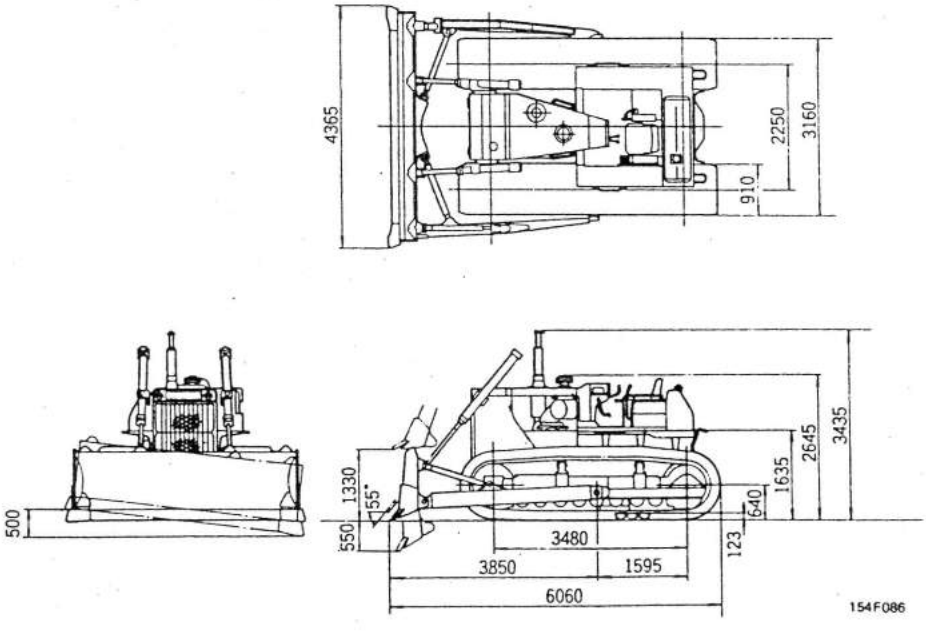
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GENERAL ASSEMBLY DRAWING OF MACHINE

TY220



TS220



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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	466	639
• Radiator assembly	250	250
• Lift cylinder assembly (R.L.)	270	320
Fuel tank assembly	185	
Universal joint assembly	10	
Torqflow 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 fram 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

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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 lift cylinder assembly (one side)	135	160
Blade tilt cylinder assembly	180	
Ripper cylinder assembly	100	
Work equipment assembly	100	
• Servo valve assembly	12	

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Machine Model	TY 220	TS 220
Straight tilt dozer assembly	3,020	3,015
• Straight blade	1,550	1,460
• 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	–

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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 975 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	51 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		

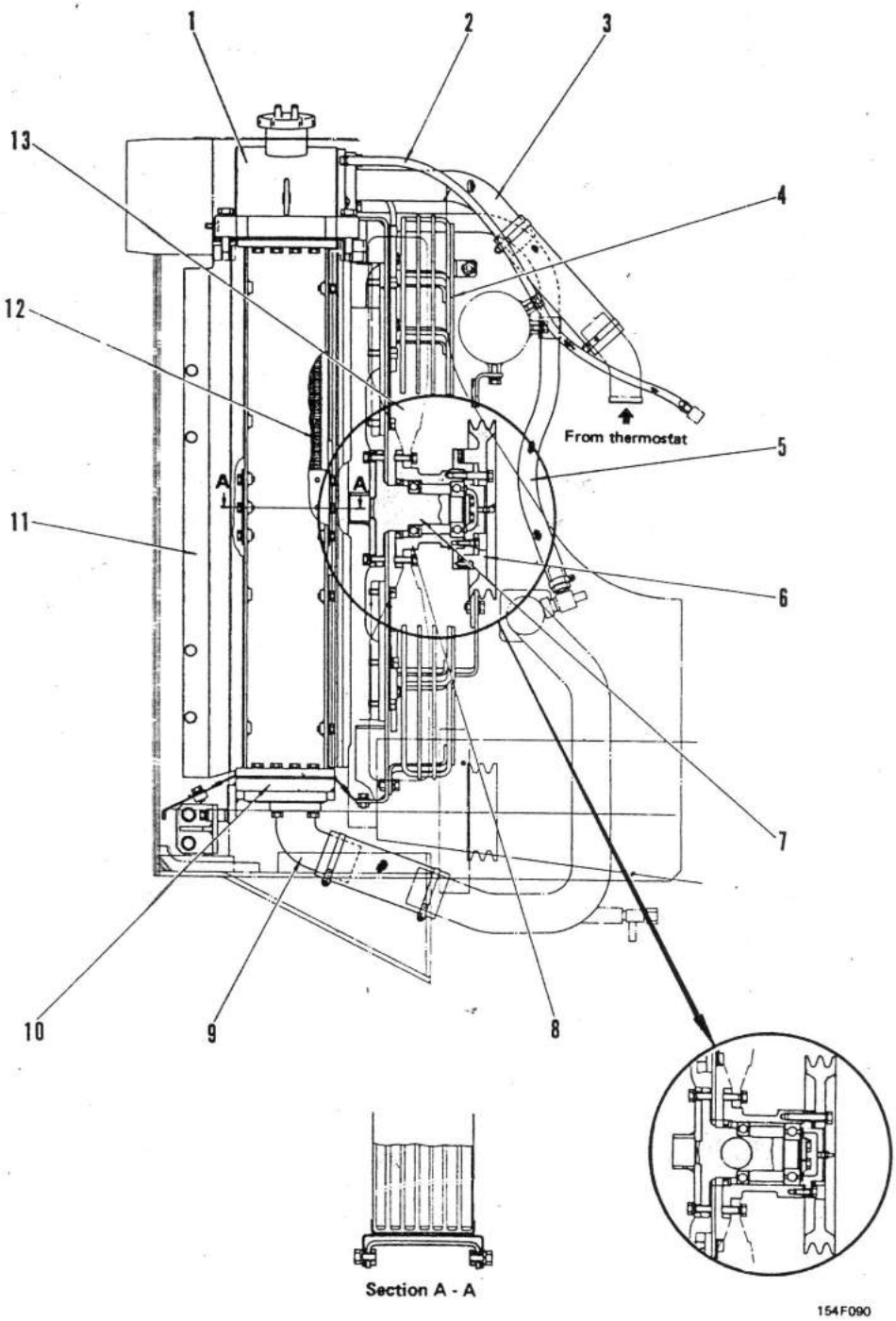
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ENGINE

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STRUCTURE AND FUNCTION

RADIATOR



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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 of pressure valve fitted to the upper tank is 0.75 kg/cm^2 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.

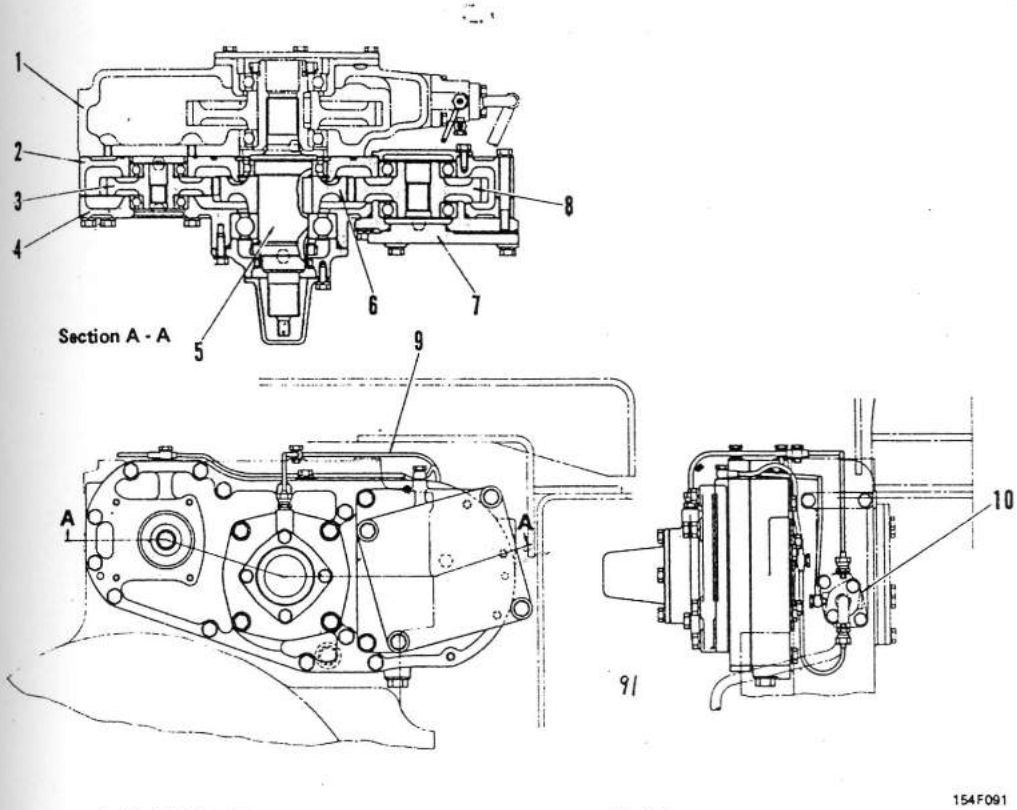
A fan (13), driven by a V-belt between the fan pulley (6) and the engine side pulley, provides forced wind for improved core heat dissipation.

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. Boss
9. Outlet tube
10. Lower tank
11. Wind brake
12. Radiator core
13. Fan

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P.T.O (POWER TAKE OFF)



154F091

1. Flywheel housing
2. P.T.O case
3. Driven gear
4. Case
5. Main shaft
6. Drive gear
7. Case cover
8. Driven gear
9. Lubrication tube
10. Block

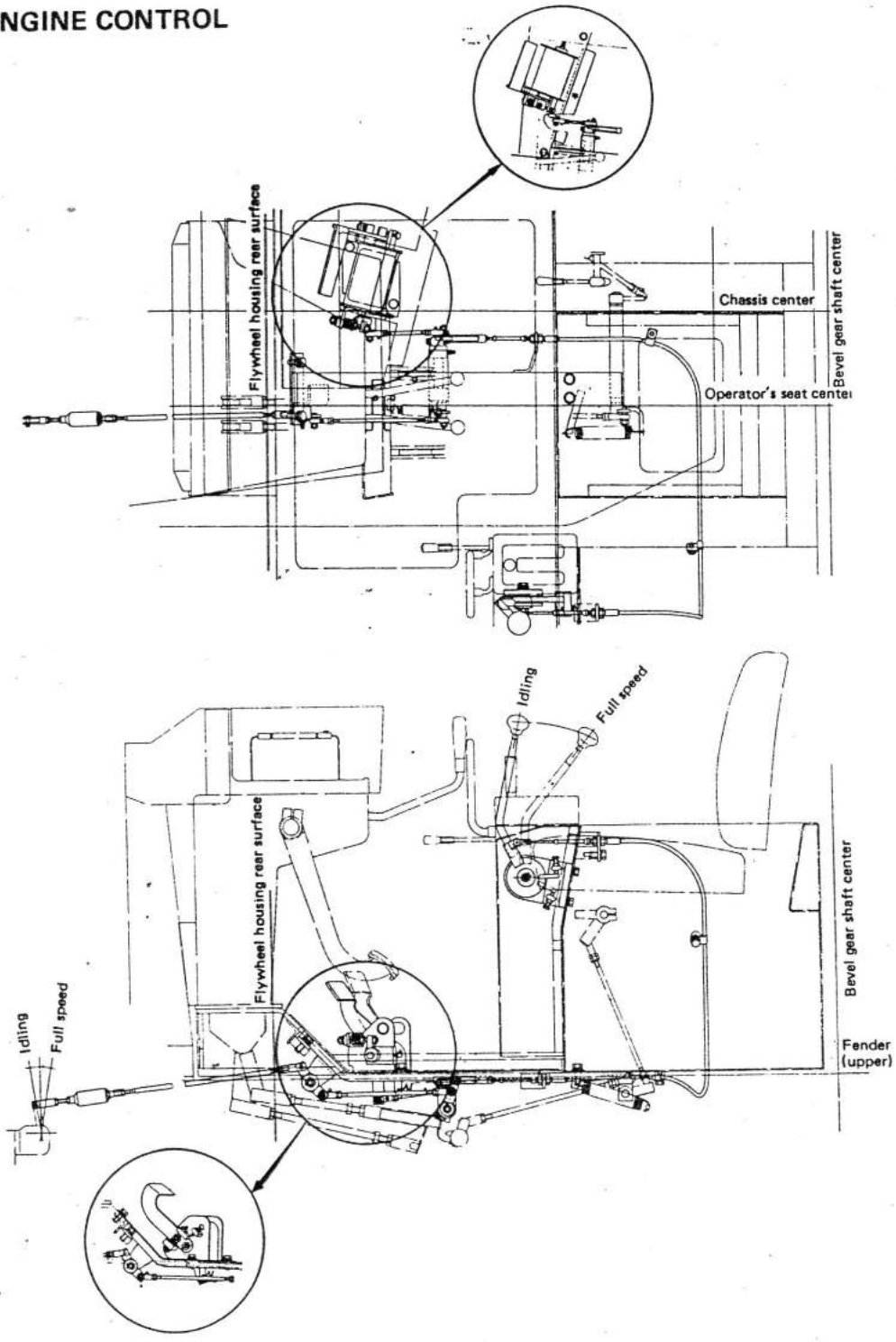
STRUCTURE

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 boss 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.

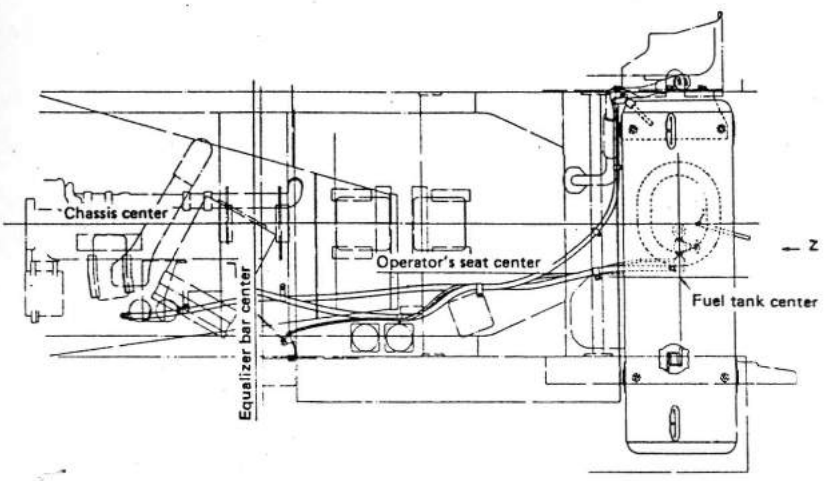
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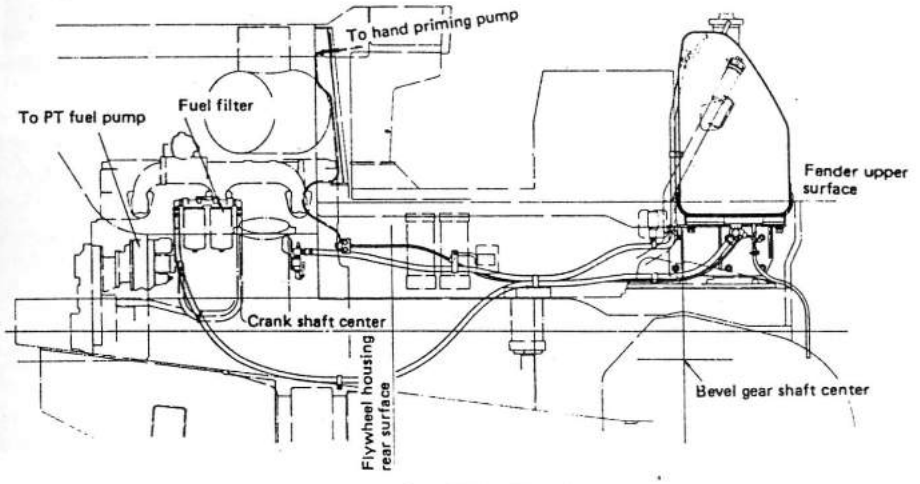
ENGINE CONTROL

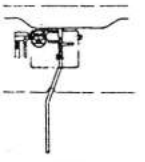


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FUEL LINE







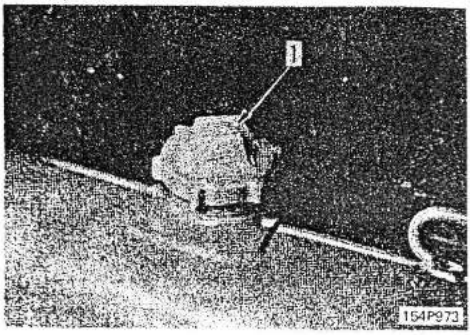
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INSPECTION AND ADJUSTMENT

FUEL SYSTEM

INSPECTION OF FUEL

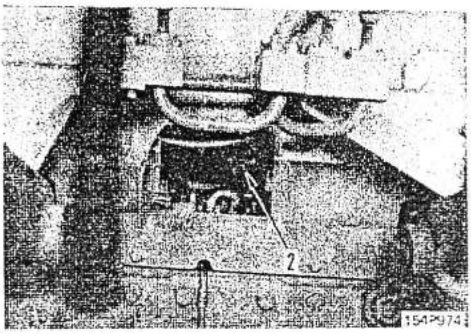


INSPECTION OF FUEL LEVEL

- 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 thank 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

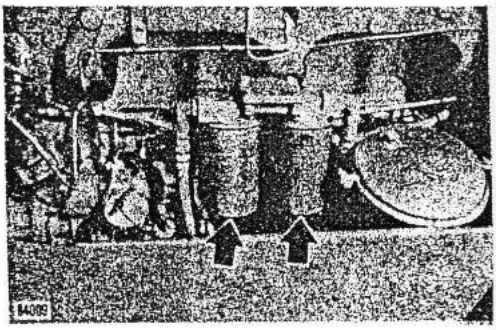
- Fuel tank
  1) Gradually loosen drain cock (2) and check for presence of dirt and water.
  2) Remove strainer and check for presence of dirt. Clean strainer as necessary.
- Fuel filter (cartridge type)



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

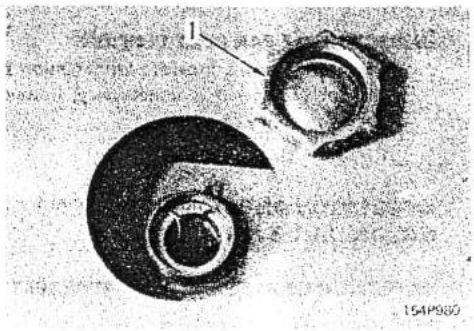
- Remove air by filling filter with fuel.
- ★ Be careful not to damage gasket of filter cover.

⚠ 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.

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COOLING SYSTEM

INSPECTION OF COOLING WATER LEVEL



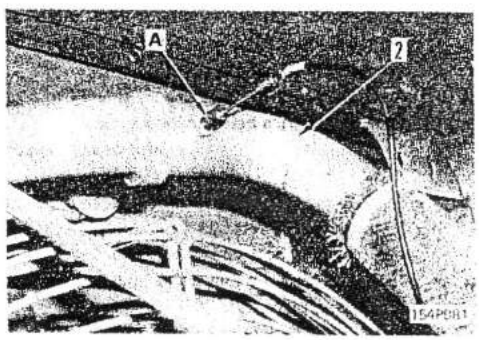
- Remove radiator cap (1) and check that cooling water comes as far as top of upper tank.

  ⚠ 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.

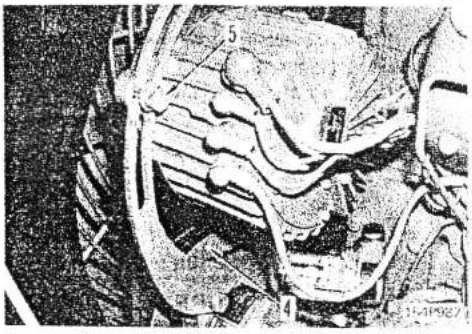
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INSPECTION OF FAN BELT TENSION

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



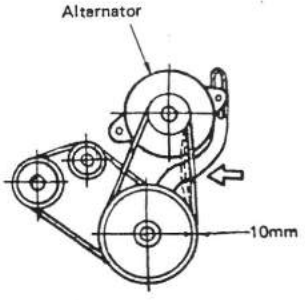
INSPECTION OF ALTERNATOR DRIVE BELT TENSION

- Check amount of sag of alternator drive belt when pressed with fingers with force of about 6 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



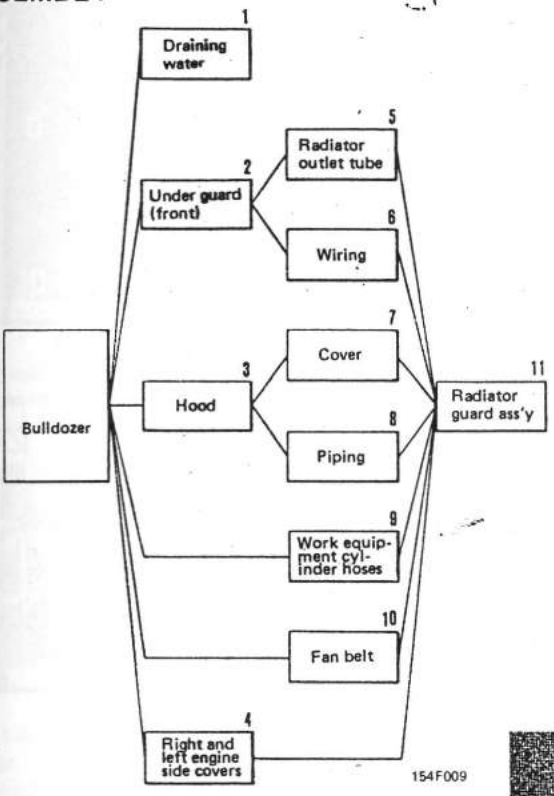
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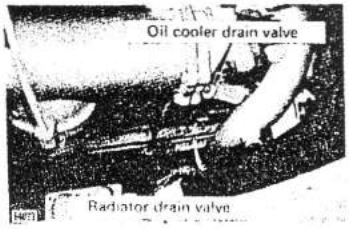
★ Check for damage to pulleys, wear of V-grooves and also wear of V-velt. In particular, check that V-belt is not touching bottom of V-groove.
★ If V-belt can no longer be adjusted, or is broken or cracked, replace it.
★ Replace both fan belts or both alternator belts when replacing.
★ If V-belt is replaced, readjust tension after running for about one hour.

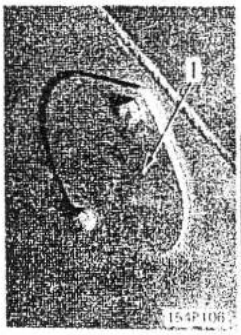
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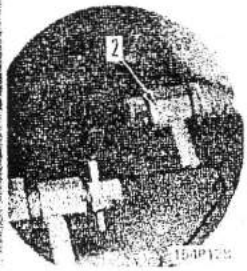
DISASSEMBLY AND ASSEMBLY

DISMOUNTING RADIATOR GUARD ASSEMBLY





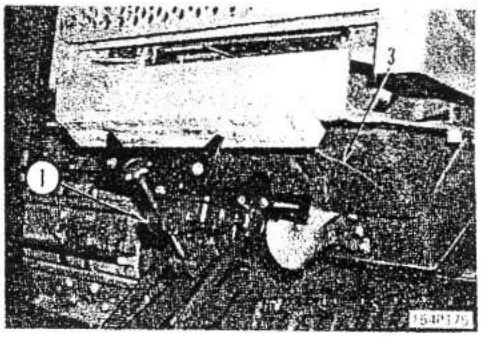




1. **Draining water**
   Remove cover (1), loosen radiator drain cock (2) and drain water.
   ★ When anti-freeze has been added to the water, dispose of the drained water as a chemical. Do not simply let the water drain away.

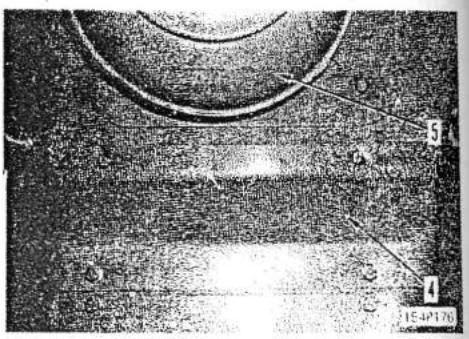
2. **Underguard (front)**
   Support underguard (front) (3) with mission jack (1) and remove.

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

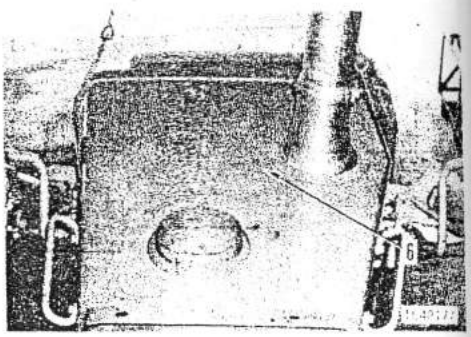


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3. **Hood**
   1) Remove cover (4) and air cleaner cover (5).



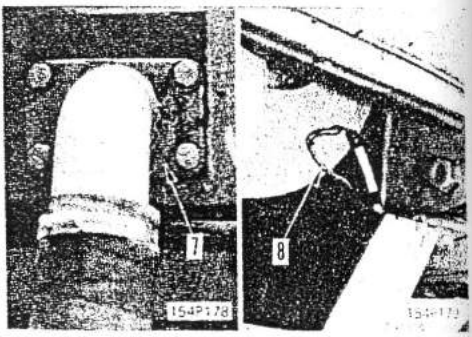
   2) Lift off hood (6).



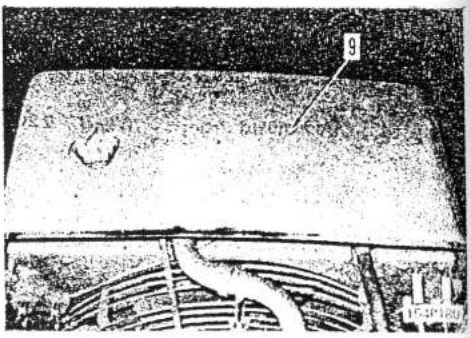
4. **Right and left engine side covers.**
   Remove right and left engine side covers.

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

6. Wiring
   Disconnect wiring (8).

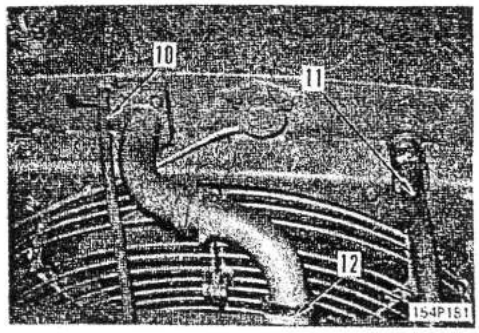


7. Cover
   Remove cover (9).

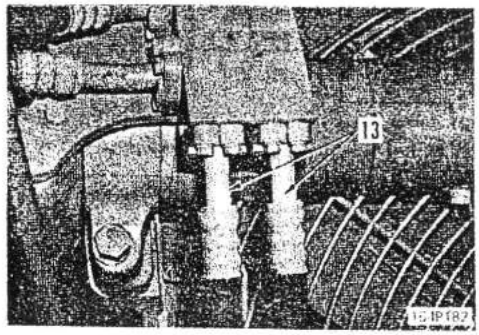


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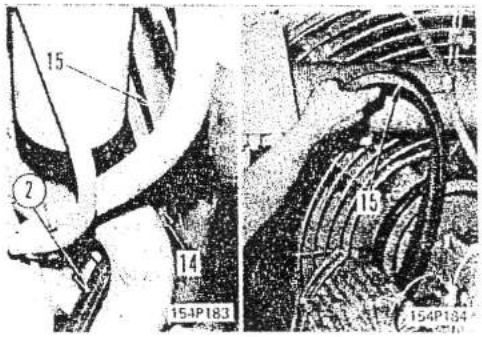
8. Piping
Disconnect hoses (10) and (11) and leave clamp of hose (12) loose.



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

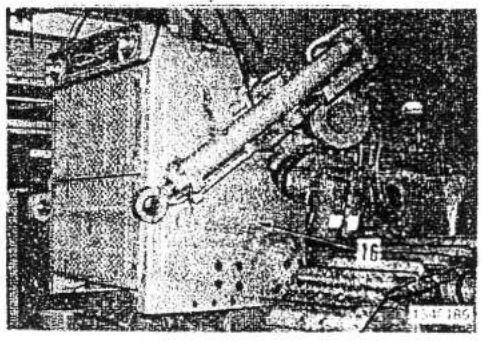


10. Fan belt
Force tension pulley (14) to inside with bar (2) and remove fan belt (15).



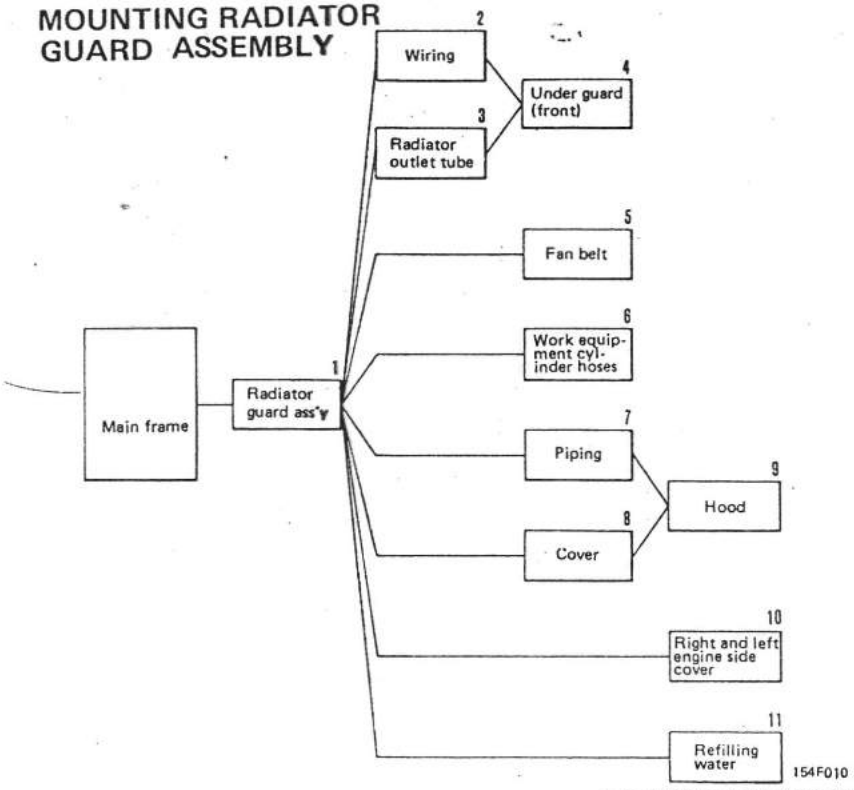
11. Radiator guard assembly
Hoist radiator guard assembly (16), remove radiator guard mounting bolts and lift away.
* Lift while at the same time pulling radiator inlet tube from engine hose.

kg Guard assembly: 1,600 kg



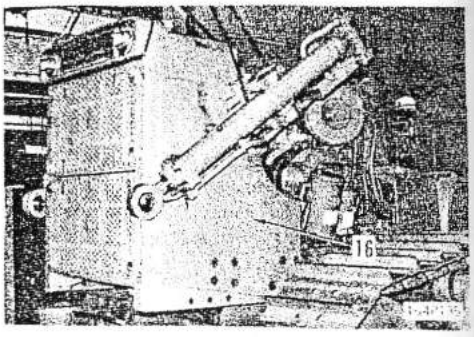
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MOUNTING RADIATOR GUARD ASSEMBLY



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.

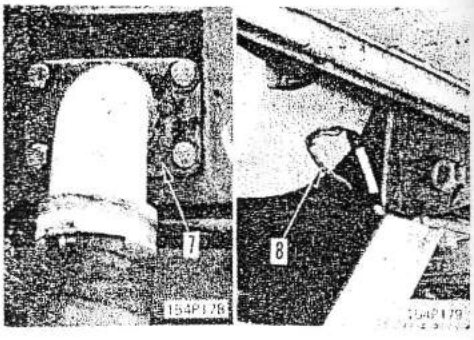
   Mounting bolt: 135±15 kg.m



2. Wiring
   Connect wire (8).

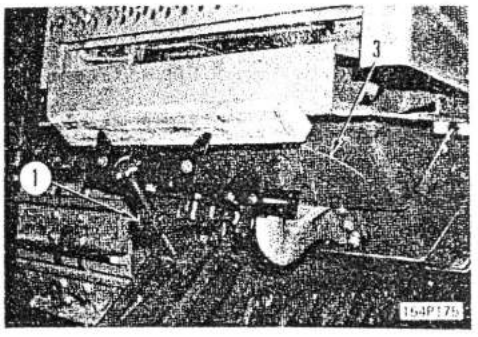
3. Radiator outlet tube
   Fit gasket and connect tube (7).

   Gasket: Liquid gasket

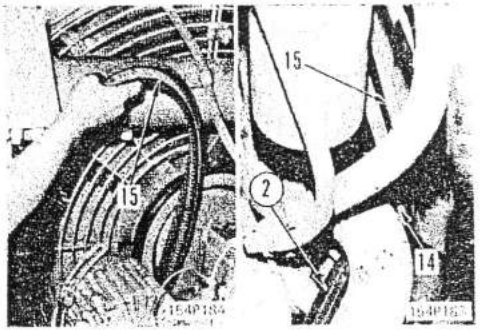


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4. **Underguard (front)**
   Support underguard (front) (3) with transmission jack (1) and install.

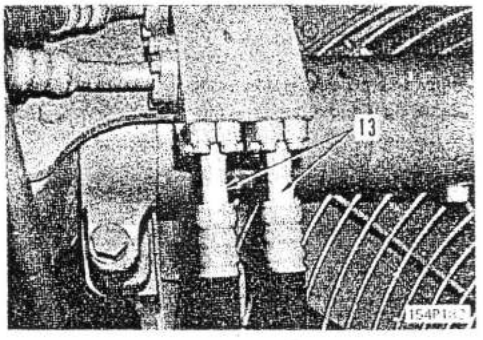


5. **Fan belt**
   Force tension pulley (14) to inside with bar and attach fan belt (15).

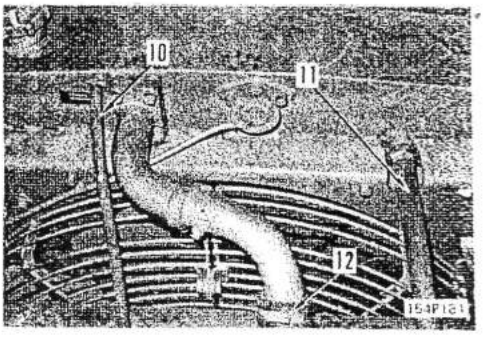


6. **Work equipment cylinder hoses**
   Fit O-ring and connect hoses (13).

   ⊕ Fit O-rings securely in grooves.

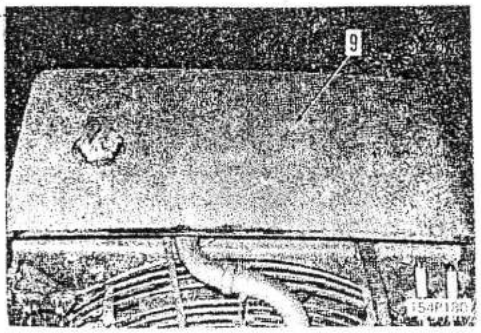


7. **Piping**
   Tighten clamp of hose (12) and connect hoses (11) and (10).

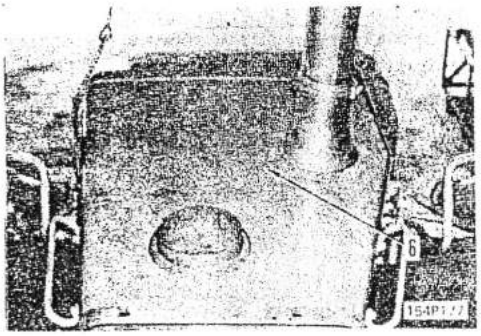


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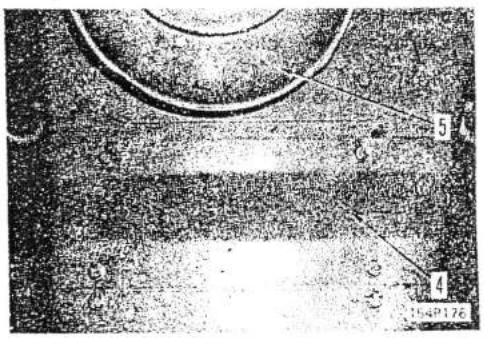
8. Cover
   Install cover (9).



9. Hood
   1) Lift hood (6) and install.

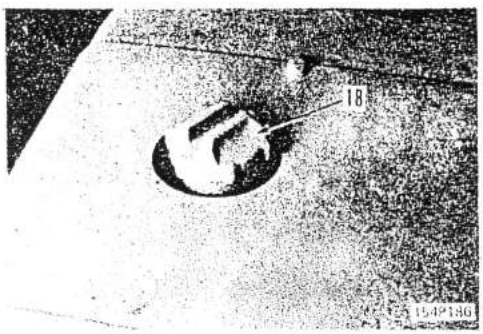


   2) Install air cleaner cover (5) and cover (4).



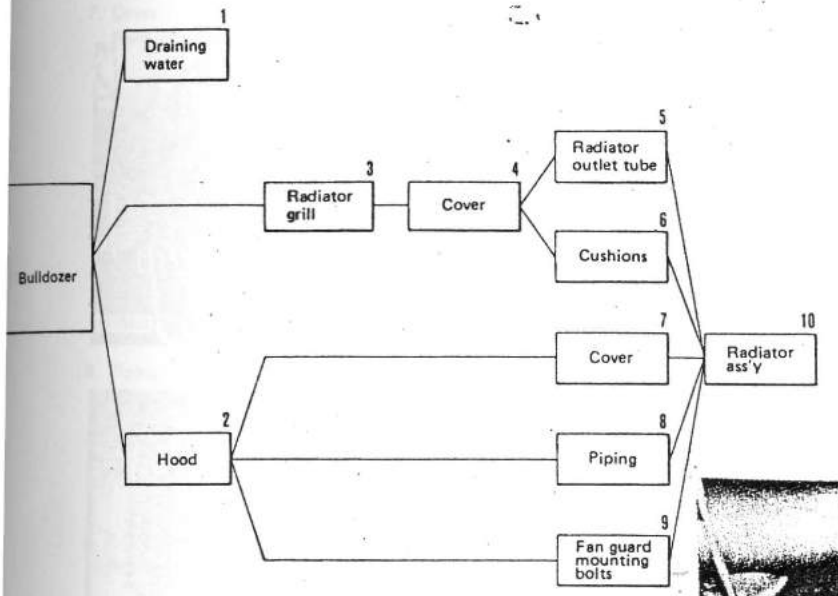
10. Right and left engine side covers
    Install right and left engine side covers.

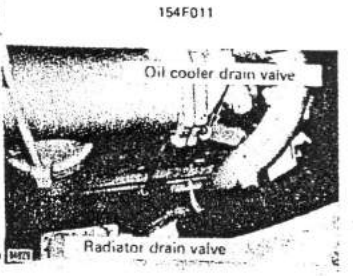
11. Refilling water
    1) Close drain cock securely.
    2) Refill cooling system by pouring in water through the filler until water reaches the specified level.
       ★ Start and run engine to let cooling water circulate in cooling system.
       Check cooling water level again.



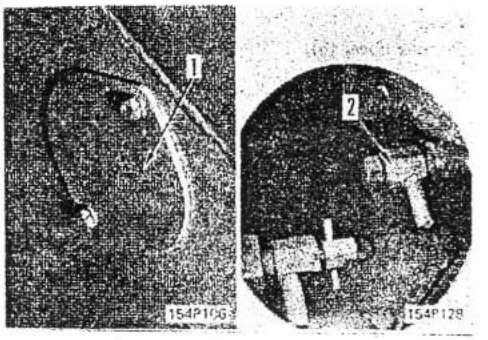
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DISMOUNTING RADIATOR ASSEMBLY

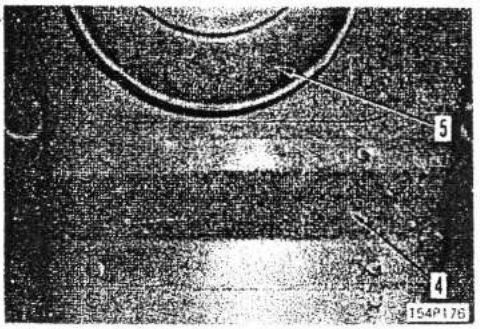




1. **Draining water**
   Remove inspection cover (1) and loosen radiator drain cock (2) to drain cooling water.
   * When anti-freeze has been added to the water, dispose at of the drained water as a chemical liquid. Do not simply let the water drain away.

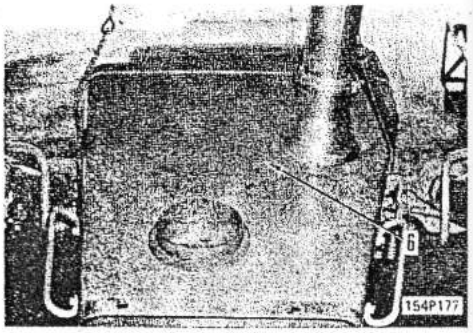


2. **Hood**
   1) Remove cover (4) and air cleaner cover (5).

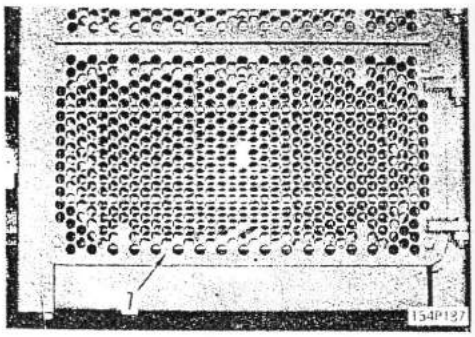


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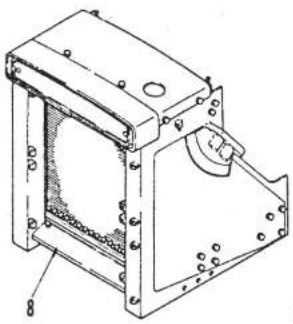
2) Lift hood (6) and remove.



3. Radiator grill
Remove radiator grill (7).

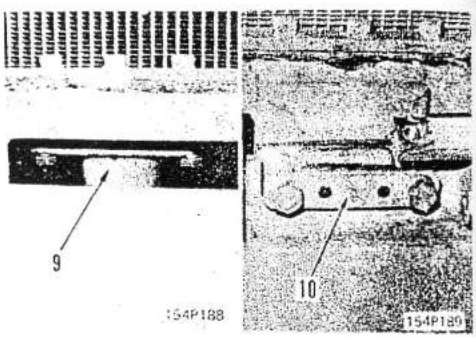


4. Cover
Remove cover (8).



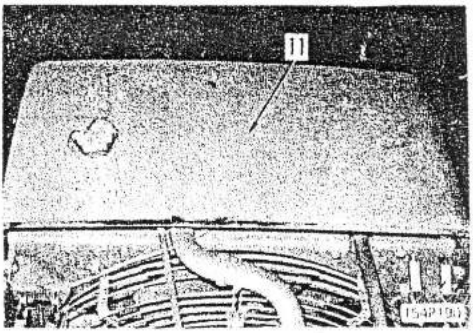
5. Radiator outlet tube
Disconnect radiator outlet tube (9).

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



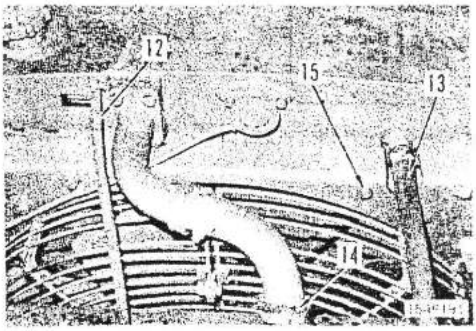
https://truckmanualshub.com/

7. Cover
   Remove cover (11).

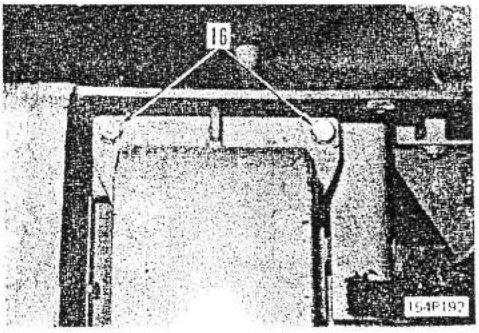


8. Piping
   Disconnect hoses (12) and (13) and leave clamp of hose (14) loose.

9. Fan guard mounting bolts
   Remove four fan guard mounting bolts at top.

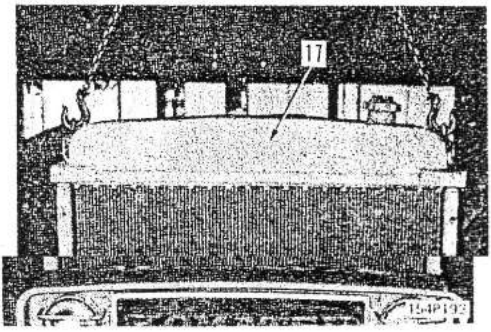


10. Radiator assembly
    1) Remove right and left radiator mounting bolts (16).



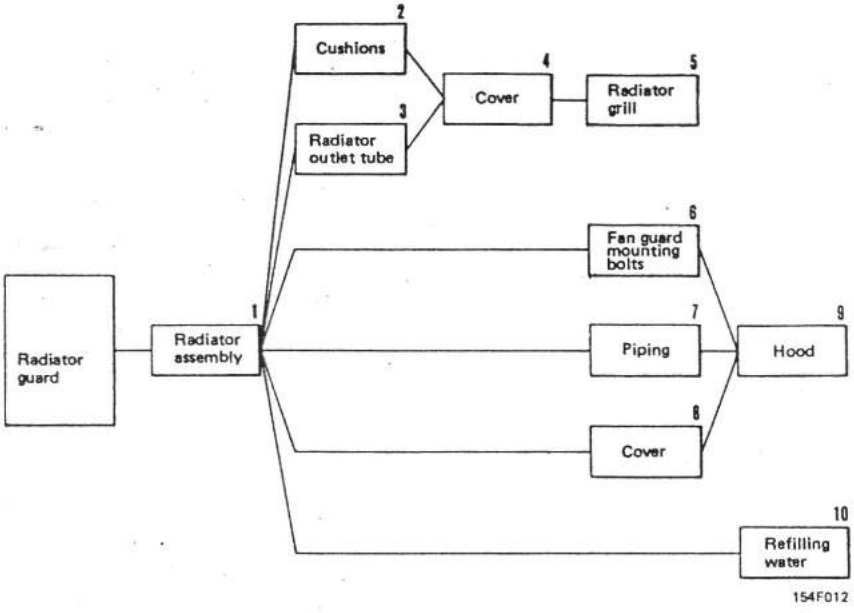
    2) Lift radiator assembly (17) and remove.
       ★ Lift while at the same time pulling radiator inlet tube from engine hose.

       kg Radiator: 260 kg.

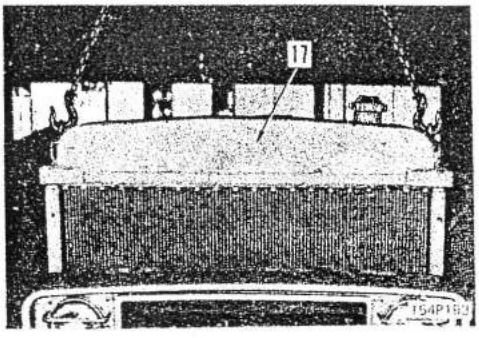


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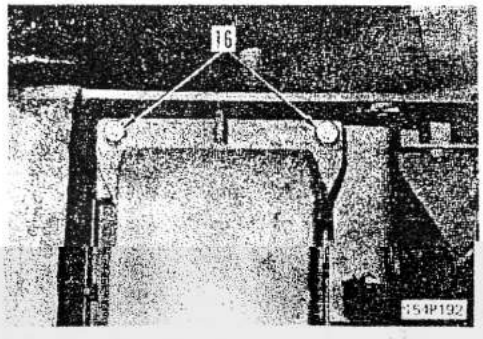
MOUNTING RADIATOR ASSEMBLY



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

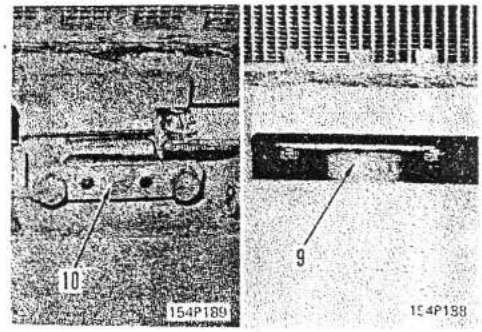


   2) Tighten right and left radiator mounting bolts (16).



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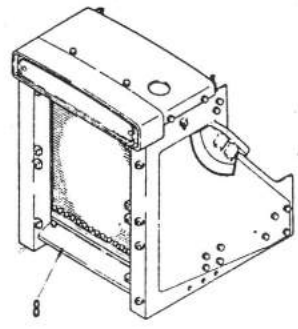
2. **Cushions**
   Insert shims which were removed during dismounting, and install right and left cushions (10).



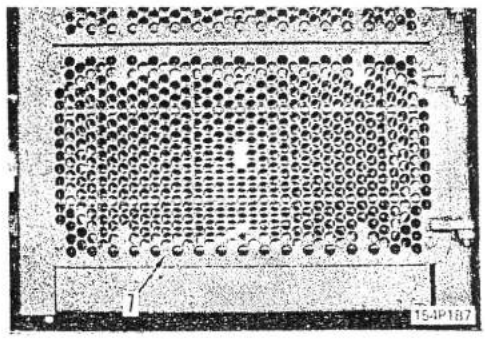
3. **Radiator outlet tube**
   Fit gasket and connect radiator outlet tube (9).

   Gasket: **Liquid gasket**

4. **Cover**
   Install cover (8).

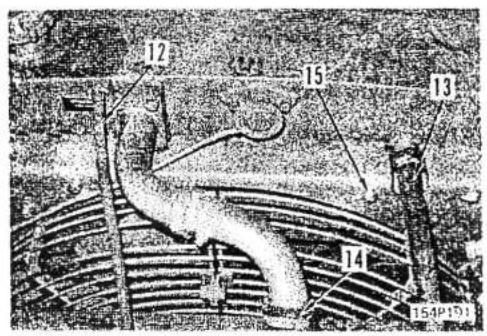


5. **Radiator grill**
   Mount radiator grill (7).



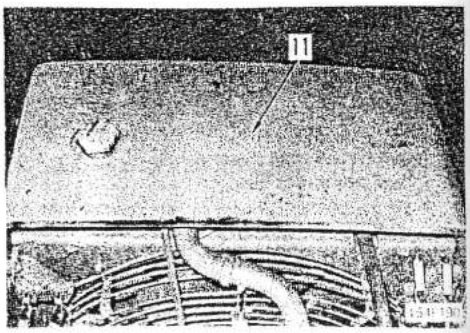
6. **Fan guard mounting bolts**
   Install four fan guard mounting bolts (15):
   ★ Bend lock plates securely for both end bolts.

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

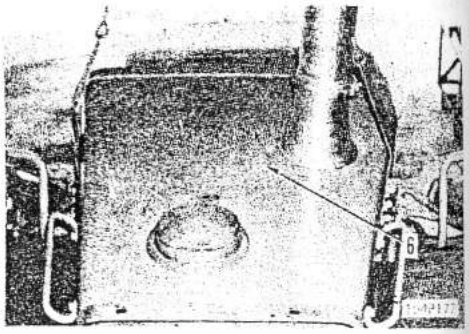


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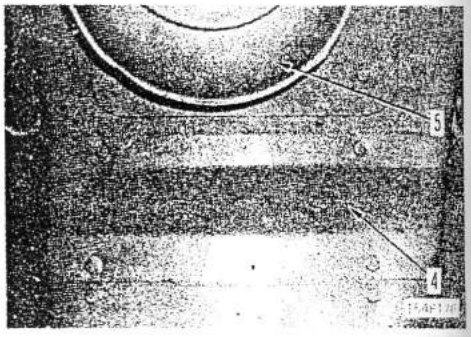
8. Cover
   Install cover (11).



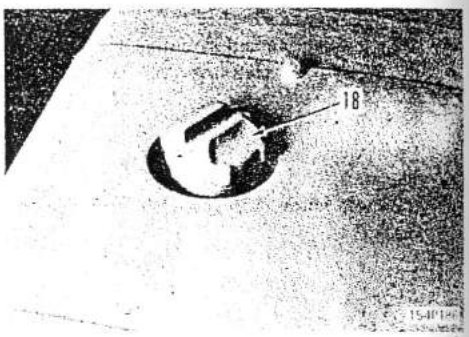
9. Hood
   1) Lift hood (6) and install.



   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.



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DISMOUNTING FUEL TANK ASSEMBLY

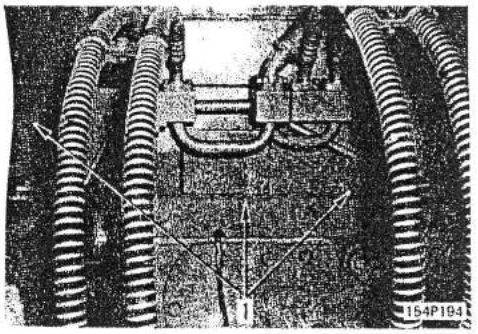
1. Remove three rear covers (1).

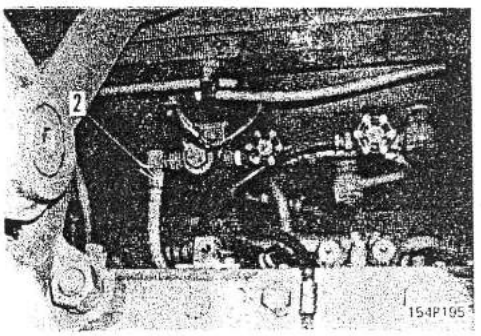
2. Remove supply lines and backflow lines of fuel tank.

3. Remove four fuel tank mounting bolts (3).

4. Remove fuel tank assembly (4).

kg Fuel tank assembly:





MOUNTING FUEL TANK ASSEMBLY

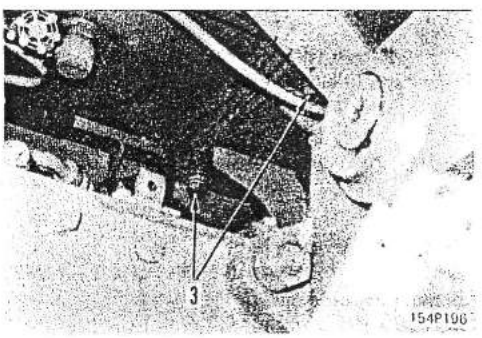
1. Lift fuel tank assembly (4) and position it on fender.

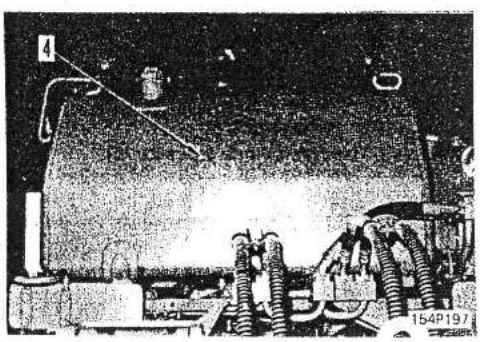
2. Tighten four fuel tank mounting bolts (3).

Mounting bolt: Thread tightener

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

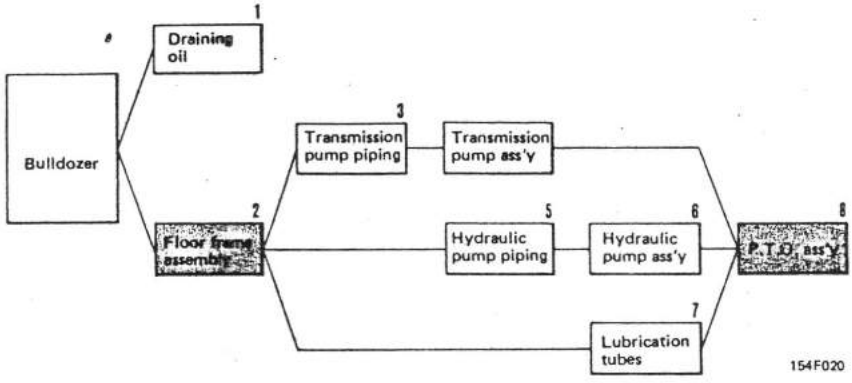
4. Install rear covers (1)





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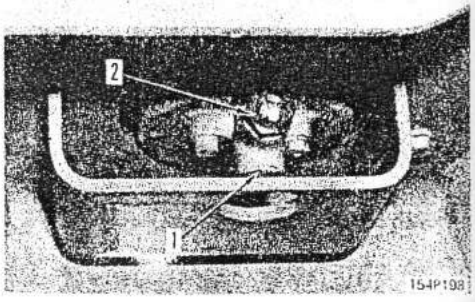
DISMOUNTING P.T.O. ASSEMBLY



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.

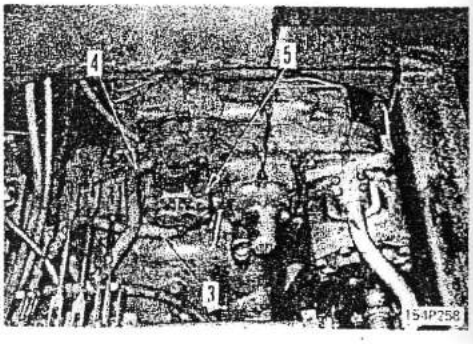
   Hydraulic oil tank: Approx. 70 ℓ



2. **Floor frame assembly**
   See P. 259 DISMOUNTING FLOOR FRAME for dismounting procedure.

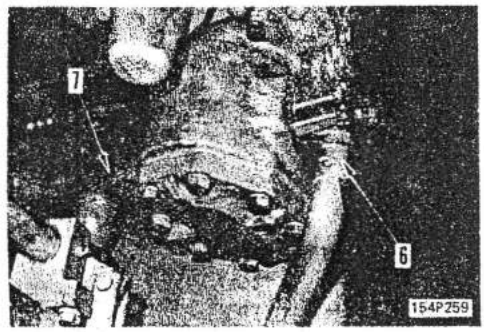
3. **Transmission pump piping**
   Disconnect outlet tube (3) and inlet tube (4).

4. **Transmission pump assembly**
   Remove transmission pump assembly (5).



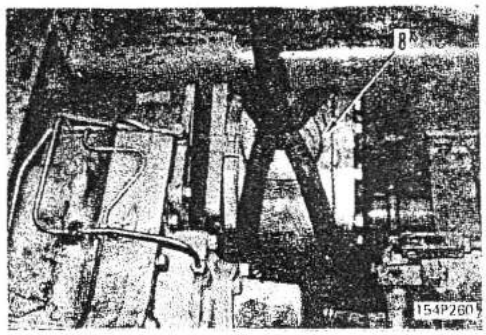
https://truckmanualshub.com/

5. Hydraulic pump piping
Disconnect hydraulic pump outlet hose (6) and inlet tube (7).

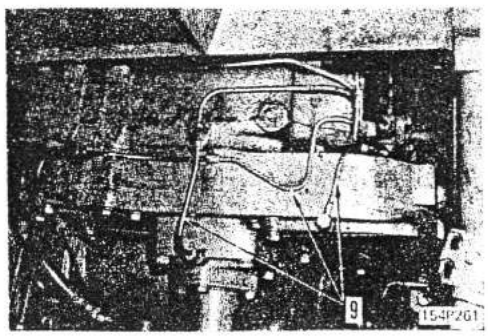


6. Hydraulic pump assembly
1) Remove two mounting bolts under hydraulic pump and use a nylon sling to hold the assembly.
2) Remove the two upper mounting bolts and remove hydraulic pump assembly (8).

kg Hydraulic Pump assembly: 40 kg



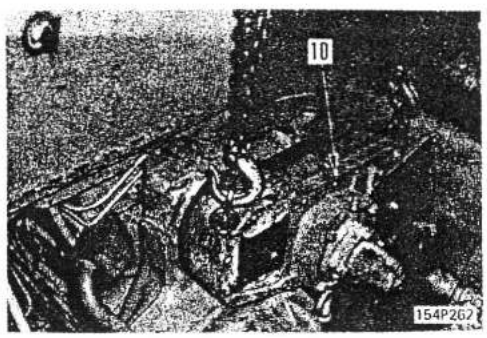
7. Lubrication tubes
Remove P.T.O. lubrication tubes (9).



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

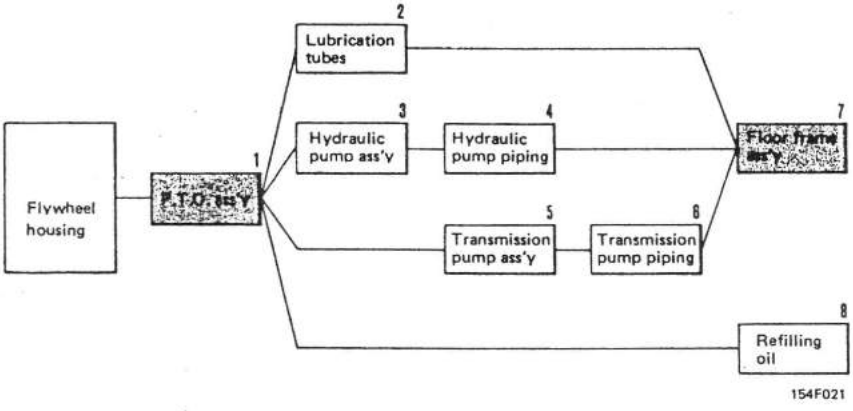
kg P.T.O. assembly: 80 kg

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

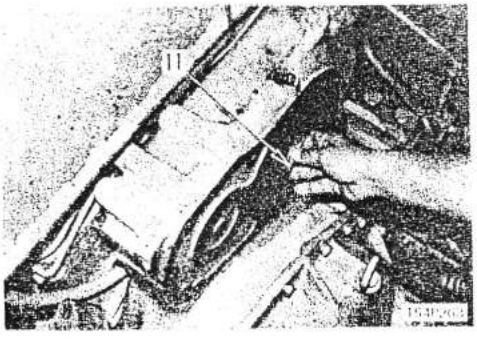


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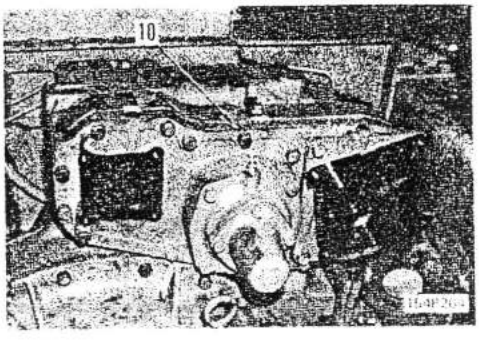
MOUNTING P.T.O. ASSEMBLY

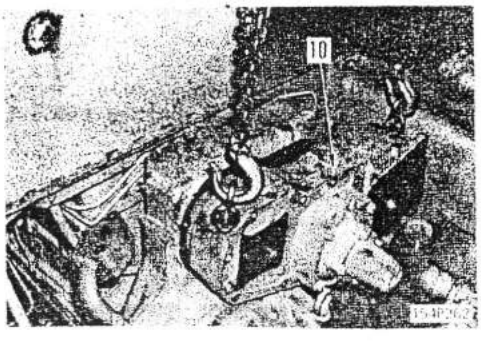


1. P.T.O. assembly
   1) Install ring (11) in flywheel housing.



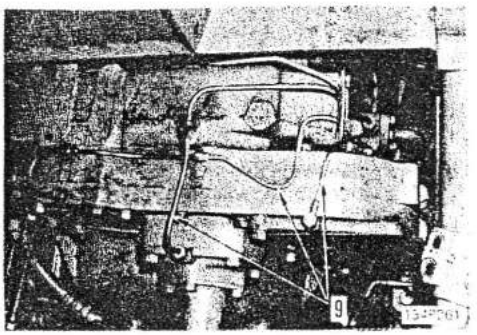
   2) Fit O-ring on P.T.O. assembly (10) and attach eyebolt (12 mm, P = 1.75). Lift and install P.T.O. assembly.



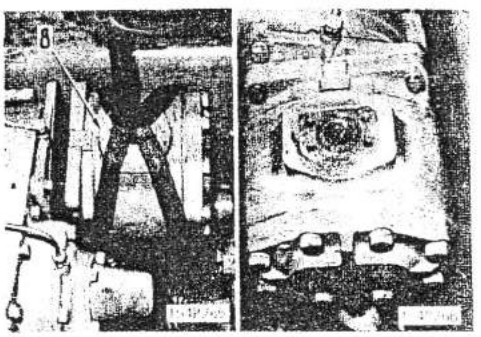


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2. Lubrication tubes
   Install P.T.O. lubrication tubes (9).

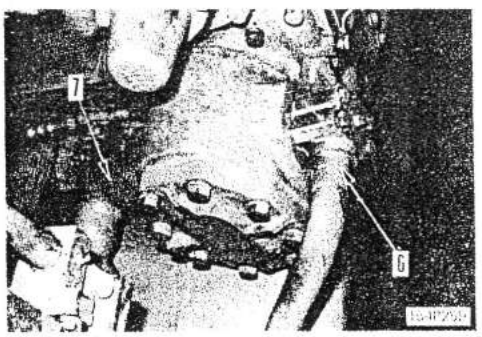


3. Hydrauli pump assembly
   1) Fit O-ring on P.T.O. case.
   2) Use a nylon sling to lift and install work equipment pump assembly (8) on P.T.O. case.

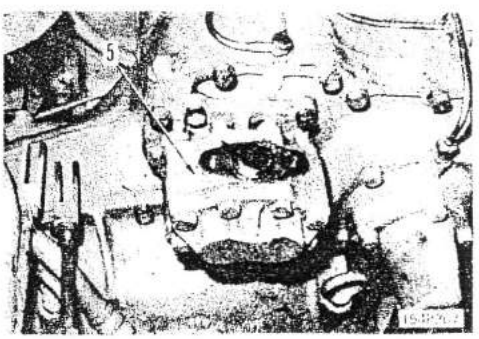


4. Hydraulic pump piping
   Fit O-ring and connect inlet tube (7) and outlet tube (6) to work equipment.

   ⊕ Fit O-rings securely in grooves.



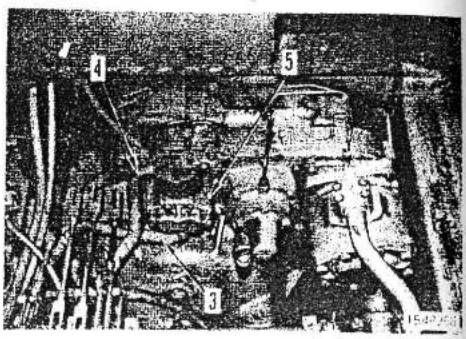
5. Transmission pump assembly
   Fit O-ring on P.T.O. case and mount transmission pump assembly (5).



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6. **Transmission pump piping**
   Fit O-ring and connect outlet tube (3) and inlet tube (4).

   ⊕ Fit O-ring securely in groove.

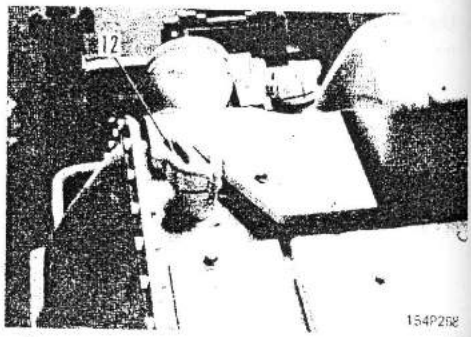


7. **Floor frame assembly**
   See P. 262 MOUNTING FLOOR FRAME ASSEMBLY for mounting procedure.

8. **Refilling oil**
   1) Close drain cock.
   2) Refill engine oil in through oil filler (12) until it reaches prescribed level.

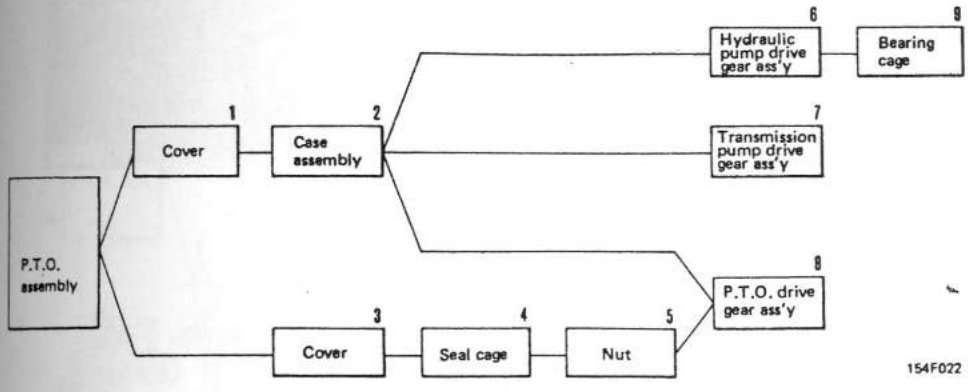
      Hydraulic oil tank: approx. 70 ℓ

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

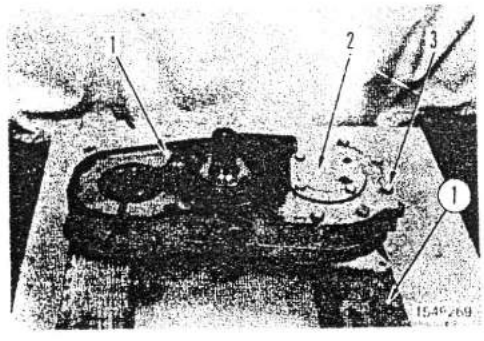


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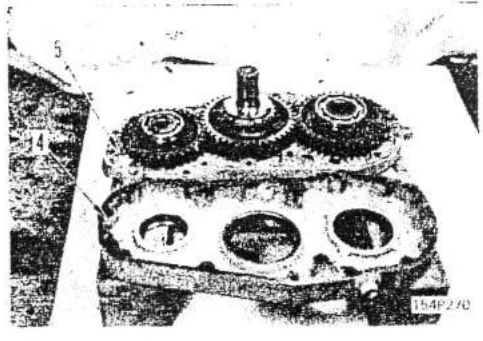
DISASSEMBLY OF P.T.O. ASSEMBLY



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

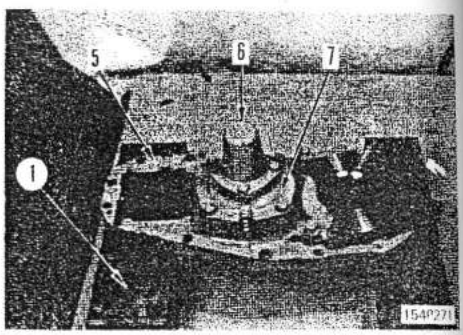


2. Case assembly
   Remove mounting bolts (3) and divide into case (4) and case assembly (5).



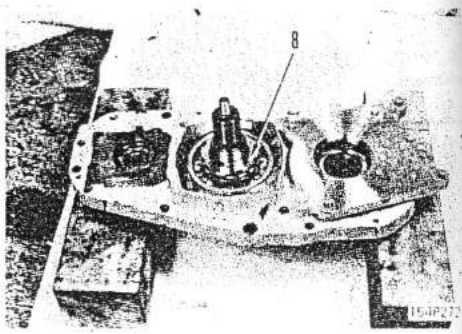
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3. **Cover**
   1) Turn case assembly (5) upside down and set on block ① (height: Approx. 150 mm).
   2) Remove cover (6).



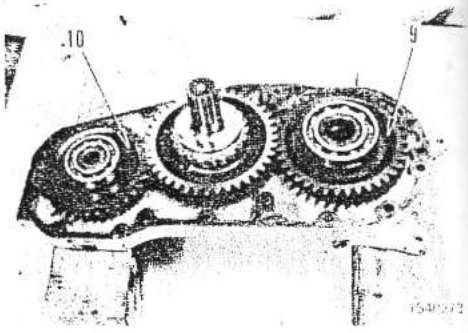
4. **Seal cage**
   Remove seal cage (7).

5. **Nut**
   Using wrench kit remove nut (8).



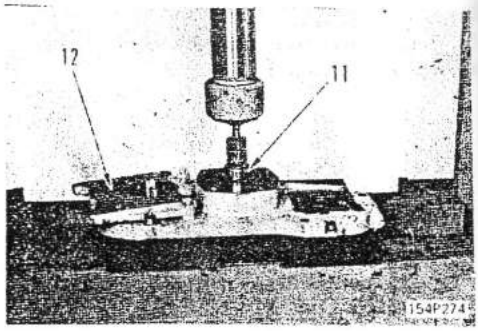
6. **Hydraulic pump drive gear assembly**
   Remove hydraulic pump drive gear assembly (9) tapping back with copper hammer, etc.

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



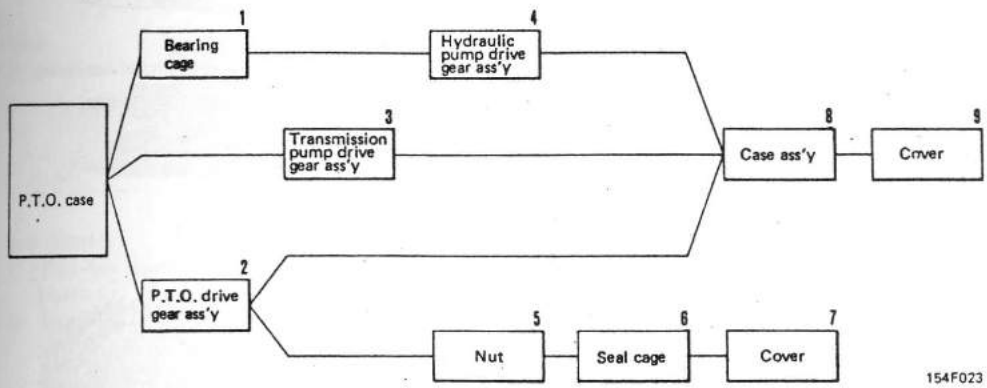
8. **P.T.O. drive gear assembly**
   Remove P.T.O. drive gear assembly (11) using press.

9. **Bearing cage**
   Remove bearing cage (12).

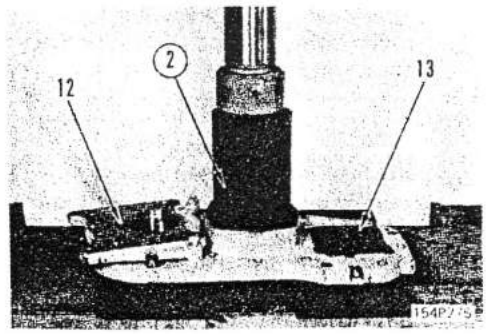


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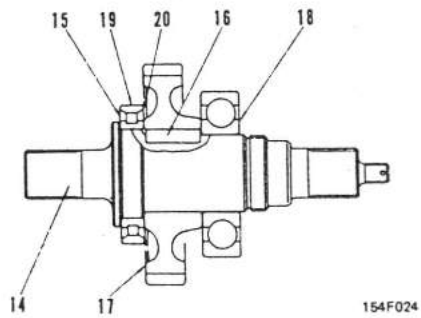
ASSEMBLY OF P.T.O. ASSEMBLY



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

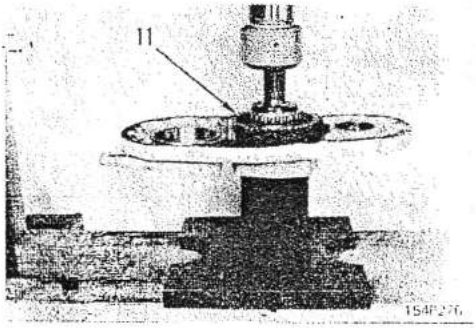


2. **P,T.O. drive gear assembly**
   1) Using push tool (80 mm inside dia.), pressfit bearing into shaft (14).
   2) Install key (16) in shaft and using push tool (70 mm inside dia.) pressfit gear (17).
   3) Using push tool (2) (ϕ150 mm) pressfit bearing (18) into case (13).
   4) Using push tool (ϕ125 mm) pressfit outer race (19) into case (4), and install snap ring (20).

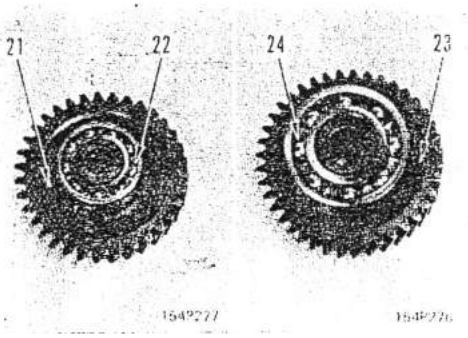


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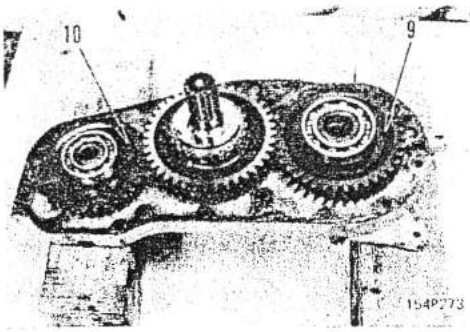
5) Using push tool ② containing bearing, press-fit P.T.O. drive gear assembly (11).



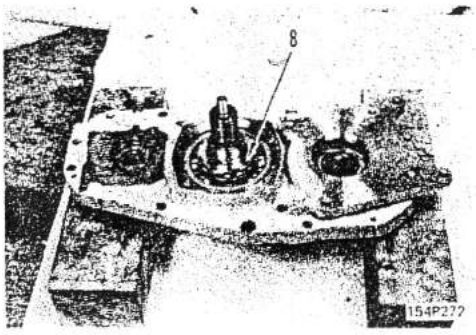
3. Transmission pump drive gear assembly
   1) Using push tool (45 mm inside dia.) pressfit upper and lower bearings (22) into gear (21).
   2) Install transmission pump drive gear assembly (10) into case with a copper hammer, etc.



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.

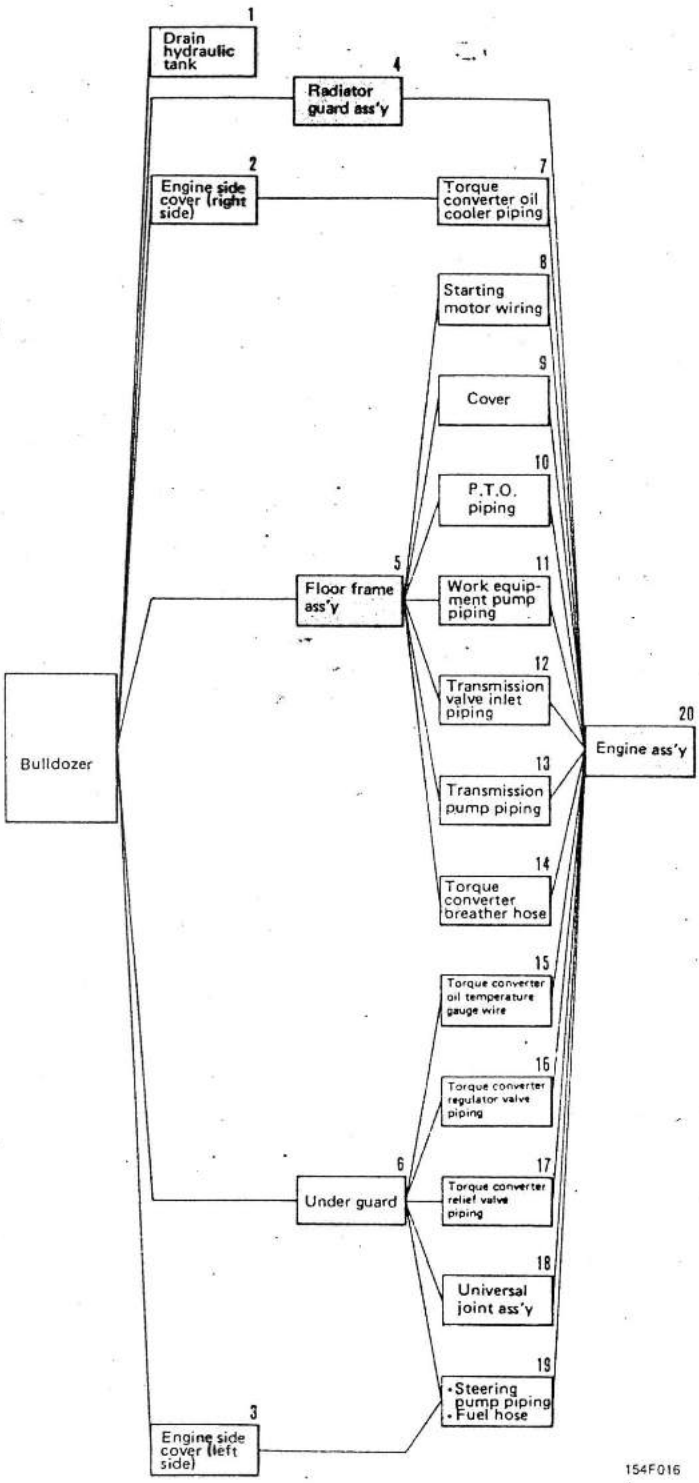


5. Nut
   Install spacer and lock plate. Using wrench kit, tighten nut (8).
   ★ Bend lock plate securely.



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DISMOUNTING ENGINE ASSEMBLY

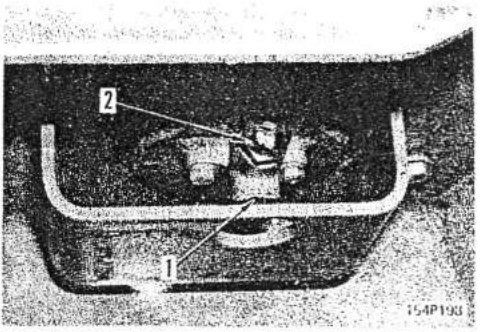


https://truckmanualshub.com/

1. **Drain hydraulic tank**

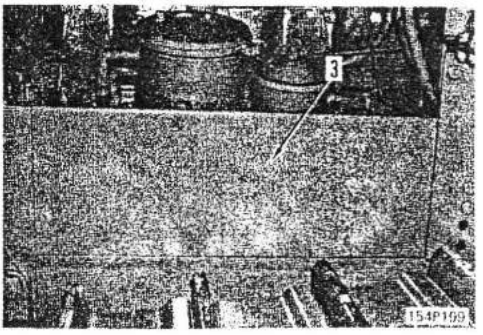
Loosen oil filler cap to release internal pressure from tank.
Remove drain plug (1). Loosen drain cock (2) and drain oil from hydraulic tank.

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.

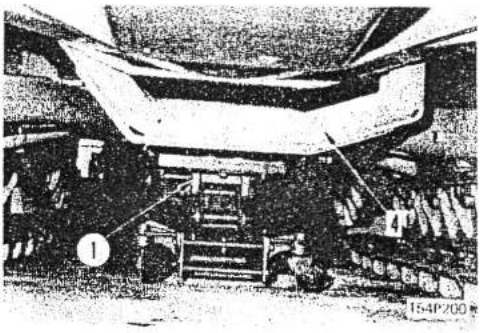


4. **Radiator guard assembly**
See Section DISMOUNTING RADIATOR GUARD for dismounting procedure.

5. **Floor frame assembly**
See Section DISMOUNTING FLOOR ASS'Y for dismounting procedure.

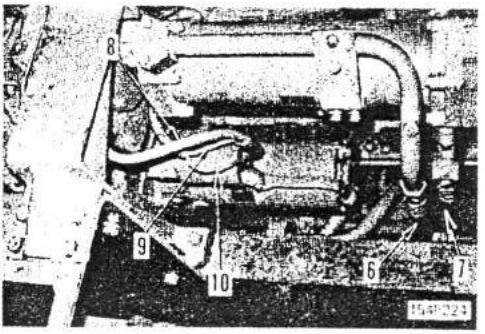
6. **Under guard**
Support under guard (4) with transmission jack ① and remove.

kg Under guard: 160 kg.



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

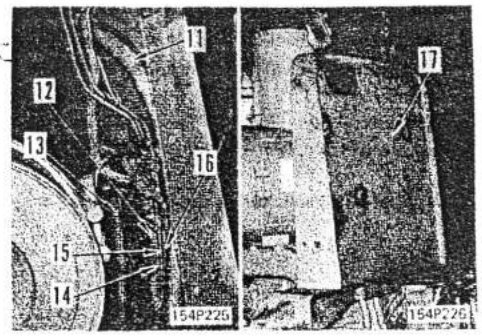
8. **Starting motor wiring**
Disconnect wires (8), (9) and (10).



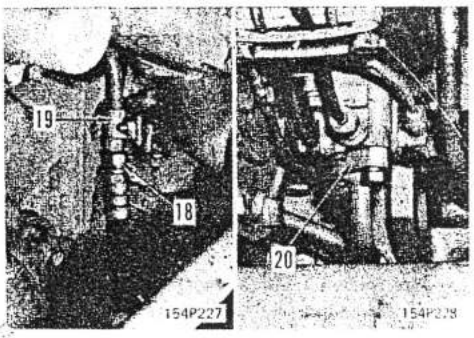
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9. Cover
   1) Release clamp and disconnect wires (11), (12) and (13).
   2) Disconnect priming pump tube (14) at engine end, and tube (15) at body.
   3) Disconnect oil pressure gauge tube (16) at engine end.
   4) Install two eyebolts (12 mm, P = 1.75) to cover (17) and lift away.

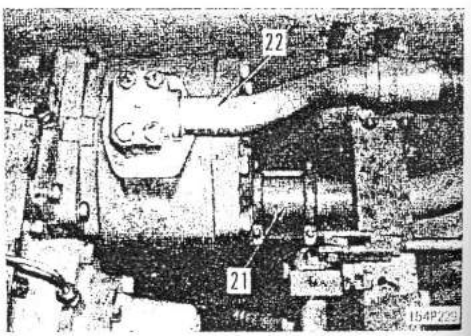
   kg Cover: 50 kg



10. P.T.O piping
    1) Disconnect hose (18).
    2) Release clamp (19) and remove tube (20).

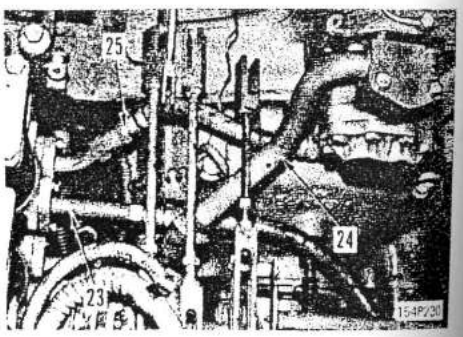


11. Work equipment pump piping
    Disconnect pump inlet tube (21) and outlet tube (22).



12. Transmission valve inlet piping
    Disconnect transmission valve inlet tube (23) at filter.

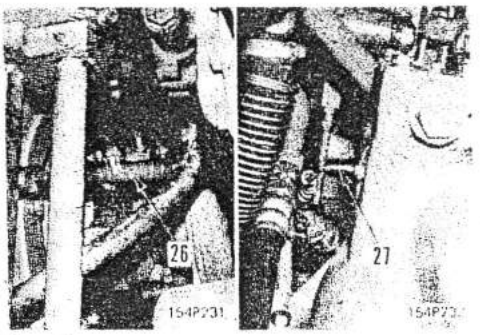
13. Transmission pump piping
    1) Remove pump inlet tube (24).
    2) Disconnect pump outlet hose (25) at filter.



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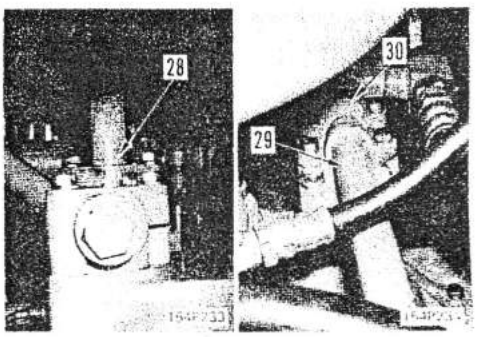
14. **Torque converter breather hose**
Remove torque converter breather hose (26).

15. **Torque converter oil temperature gauge wire**
Disconnect torque converter oil temperature gauge wire (27).

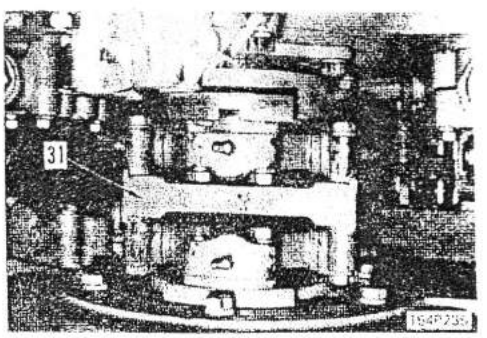


16. **Torque converter regulator valve piping**
Disconnect torque converter regulator valve outlet tube (28).

17. **Torque converter relief valve piping**
Disconnect torque converter relief valve inlet tube (29) and outlet tube (30).

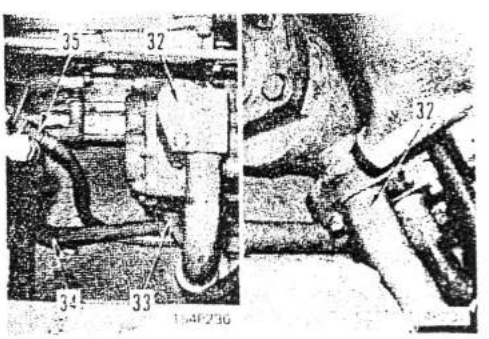


18. **Universal joint assembly**
Remove universal joint assembly (31).



19. **Steering pump piping and fuel hose**

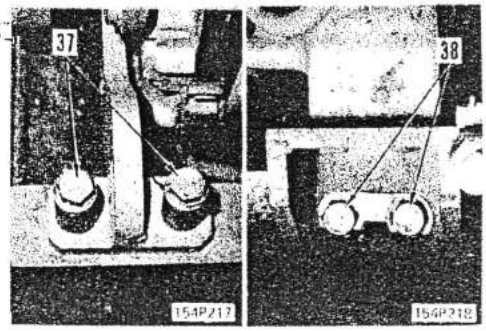
1) Remove steering pump inlet tube (32).
2) Disconnect steering pump outlet tube (33).
3) Disconnect filter inlet hose (34) and injector drain hose (35).



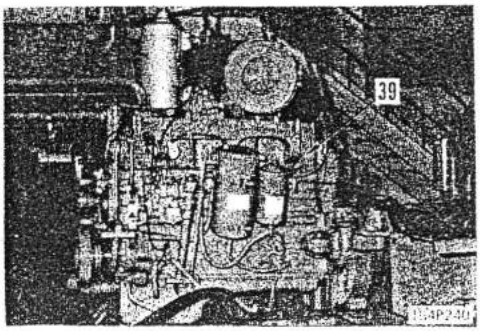
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20. Engine assembly

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).

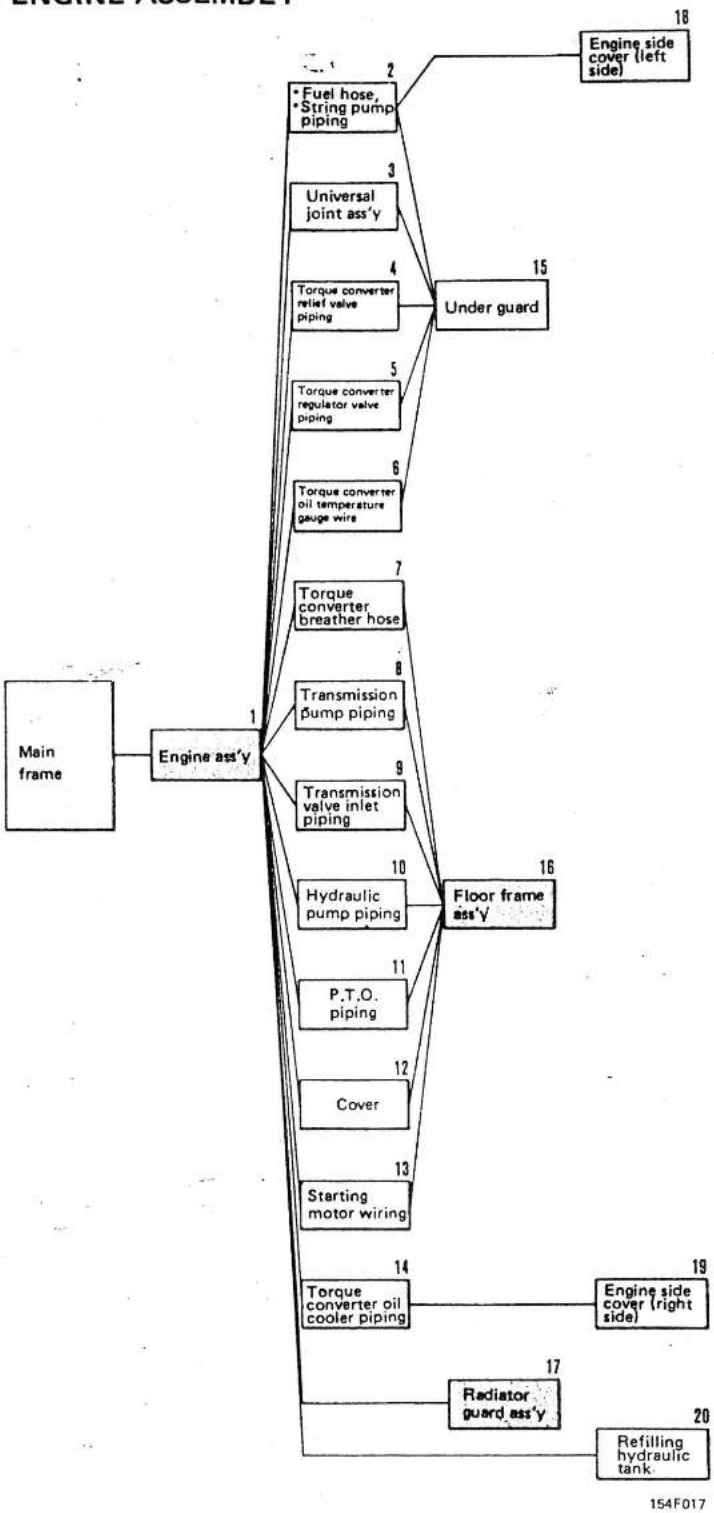


kg Engine assembly: 2,200 kg

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

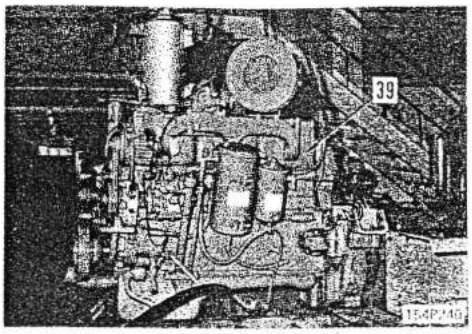
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MOUNTING ENGINE ASSEMBLY



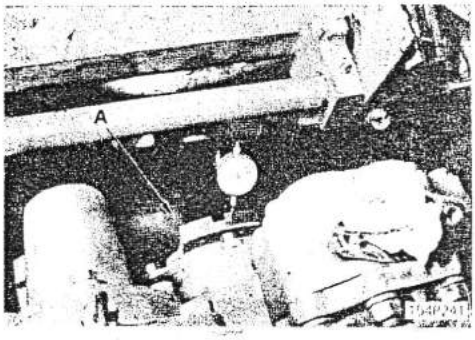
https://truckmanualshub.com/

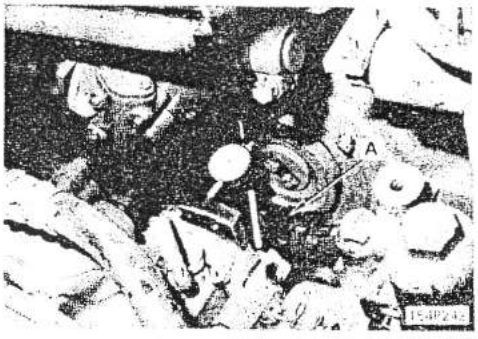
1. Engine assembly
   1) Install all mount shims in their correct positions (front and rear, left and right). Lift en ine assembly (39), mount on frame, and tighten mounting bolts.



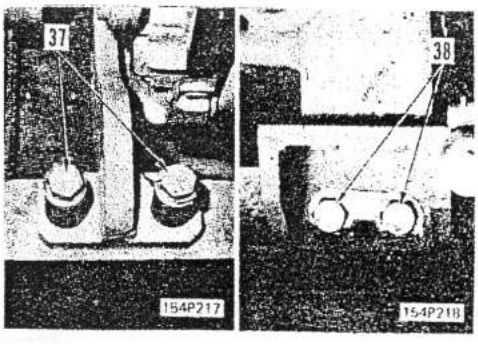
      Mounting bolt: 76±8.5 kg.m (front and rear)

   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)





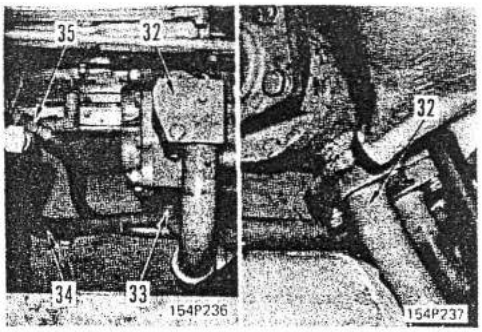
   3) Tighten mounting bolts and lock
      ★ Lock front mounting bolts (37) securely with wire.
      ★ Bend lock plate of rear mounting bolts (38) securely.



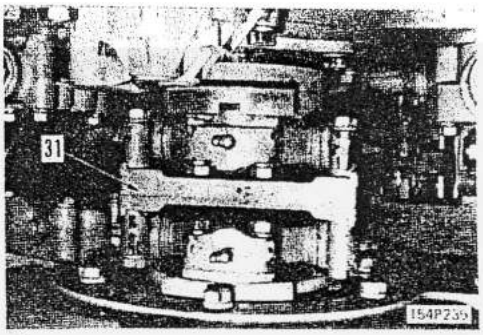
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2. **Fuel hose, steering pump piping**
   1) Connect injector return hose (35) and fuel filter inlet hose (34).
   2) Fit O-ring and connect tube (33) to steering pump.

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

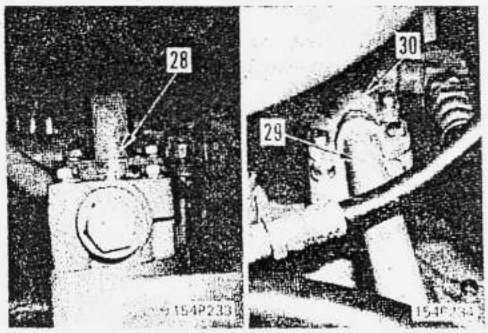


3. **Universal joint assembly**
   Install universal joint ass'y (31).
   ★ After completion of installation, apply grease (G2-L1).



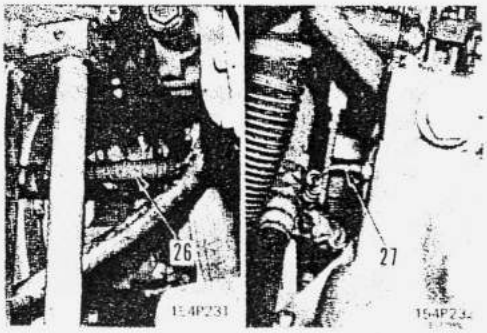
4. **Torque converter relief valve piping**
   Fit O-ring and connect outlet tube (30) and inlet tube (29) to torque converter relief valve.

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).

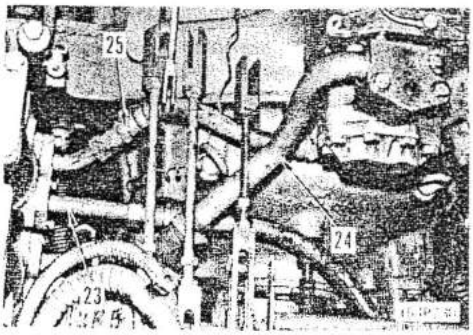
7. **Torque converter breather hose**
   Install torque converter breather hose (26).



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

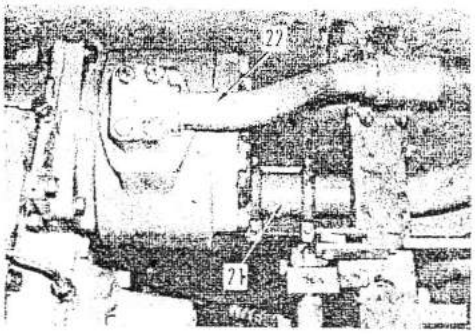
      ⊕ Fit O-ring securely in groove.
   2) Fit O-ring and install pump inlet tube (24) between pump and strainer.



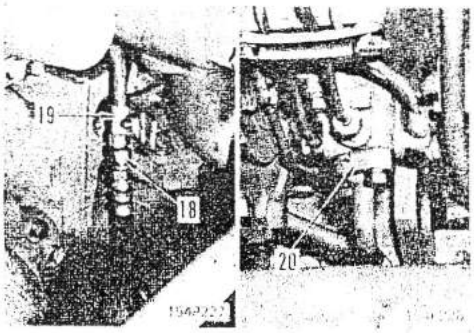
9. **Transmission valve inlet piping**
   Fit O-ring and install transmission valve inlet tube (23) to filter.

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

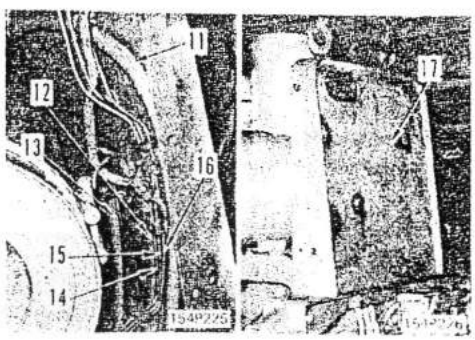
    ⊕ Fit O-rings securely in grooves.



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

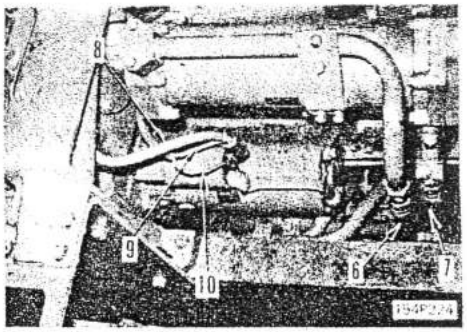


12. Cover
    1) Attach two eyebolts (12 mm, P = 1.75) to cover (17). Lift and mount.
    2) Connect oil pressure gauge tube (16) to engine.
    3) Connect priming pump tube (15) to engine, and tube (14) to body.
    4) Connect wires (13), (12) and (11) to cover.



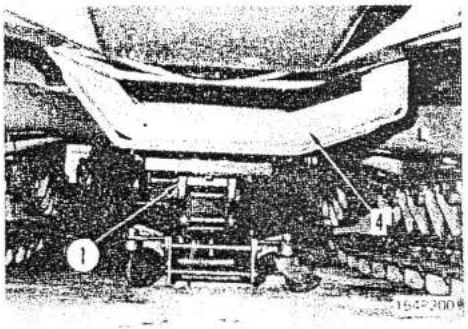
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13. **Starting motor wiring**
Connect starting motor wires (10), (9) and (8).



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.

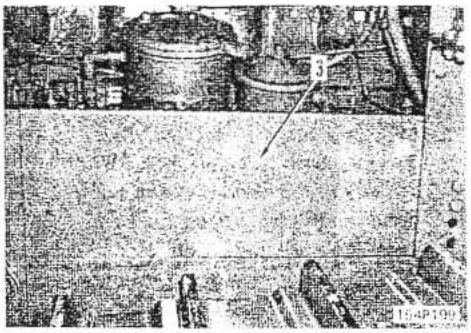


16. **Floor frame assembly**
See Section MOUNTING FLOOR FRAME for mounting procedure.

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.

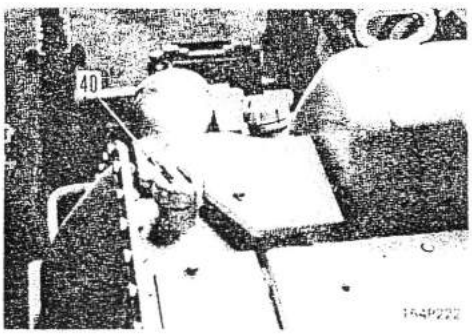
19. **Engine side cover (right side)**
Install right side cover of engine.



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.

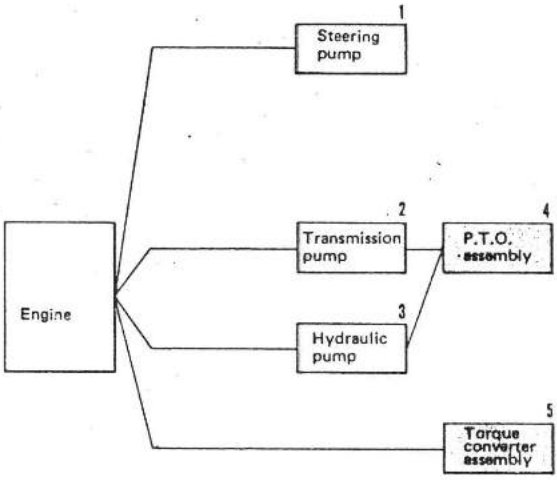
Hydraulic oil tank: approx. 70 ℓ

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



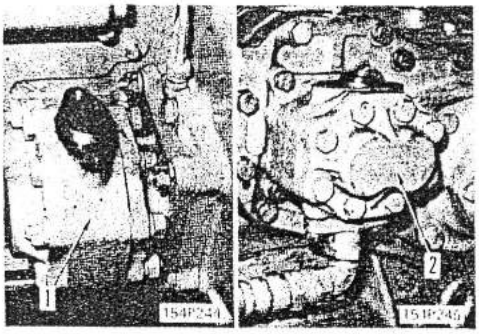
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DISMOUNTING CHASSIS-RELATED PARTS FROM ENGINE



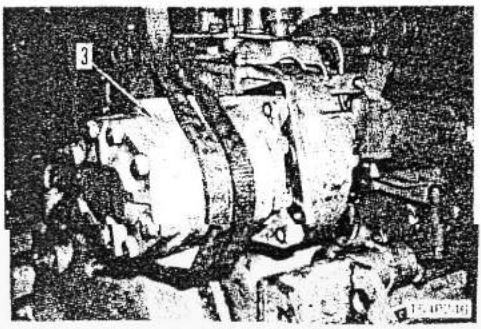
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1. **Steering pump**
   Remove steering pump (1).



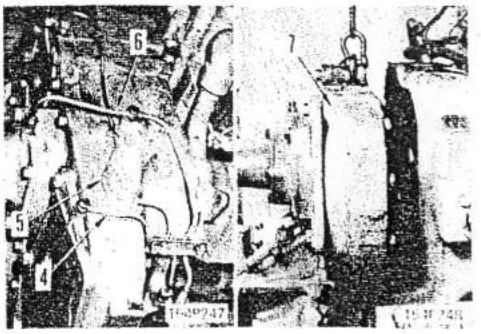
2. Transmission pump
   Remove transmis sion pump from TY 220 or TS 220

3. **Hydraulic pump**
   Remove hydraulic pump (3).

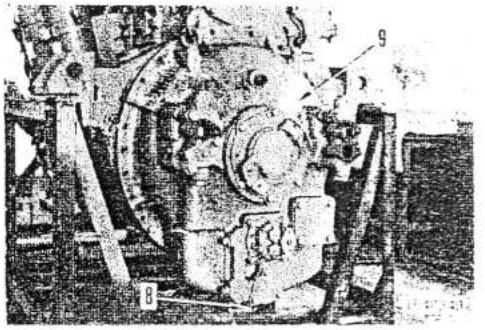


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4. P.T.O assembly
   1) Remove lubrication tubes (4), (5) and (6).
   2) Fit two eyebolts (12 mm, P = 1.75) and hoist. Remove mounting bolts and lift away P.T.O. assembly (7).

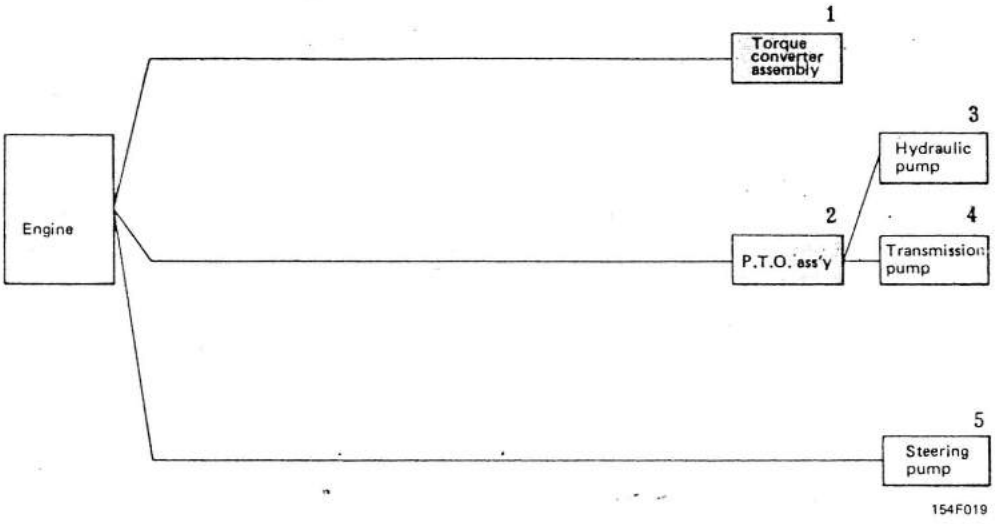


5. Torque converter assembly
   1) Remove drain plug (8) and drain oil from torque converter.
   2) Attach hooks to housing and hoist. Remove mounting bolts and screw in jack bolts to remove torque converter assembly (9).



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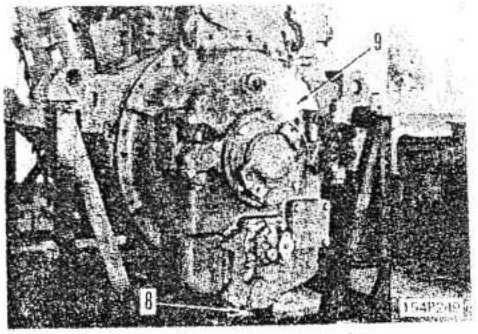
MOUNTING CHASSIS-RELATED PARTS ON ENGINE



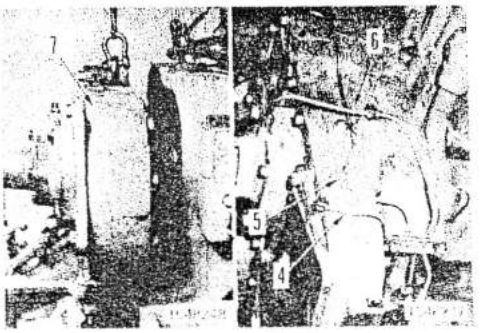
https://truckmanualshub.com/

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.

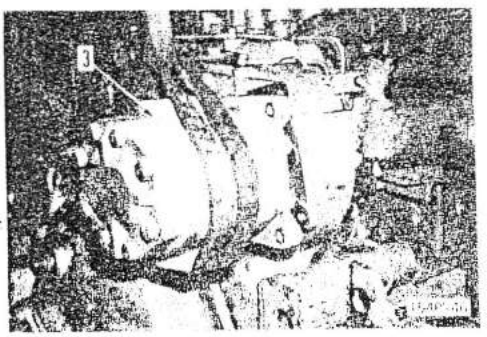
   Gasket: **Liquid gasket**



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), (5) 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).



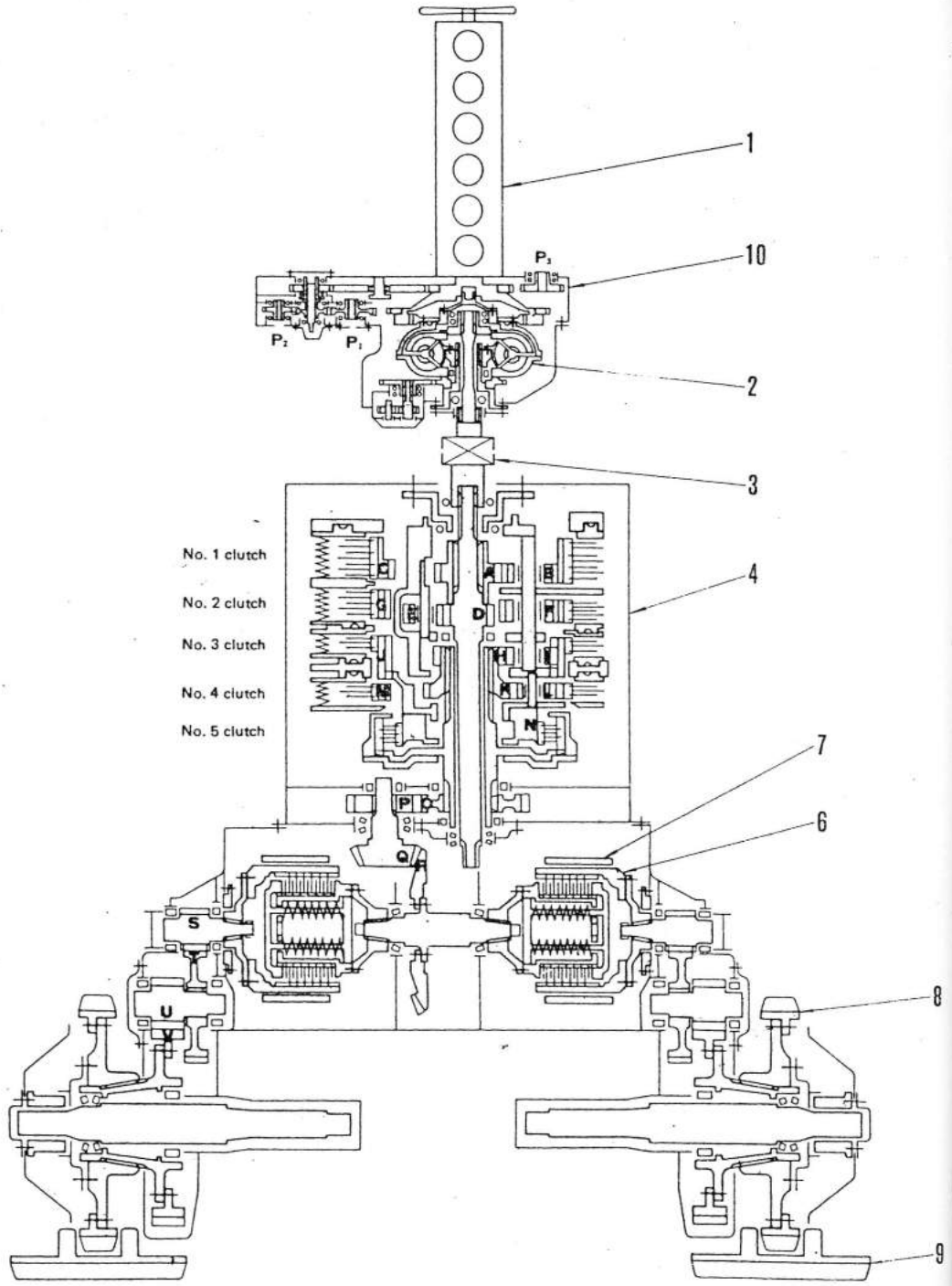
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POWER TRAIN

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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. TORQFLOW pump
P3. Steering pump

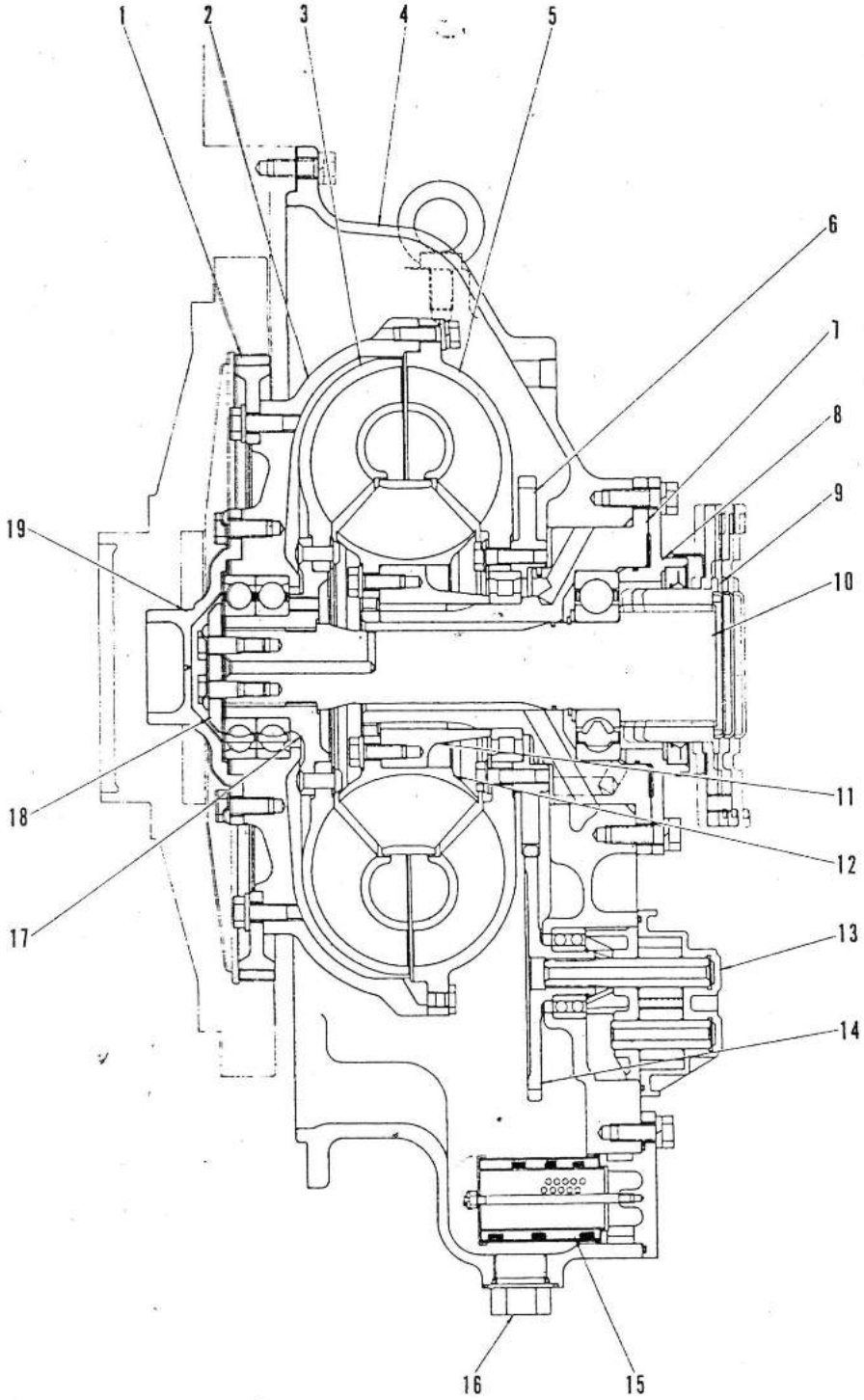
SPEED STAGE AND POWER TRANSMISSION ROUTE

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

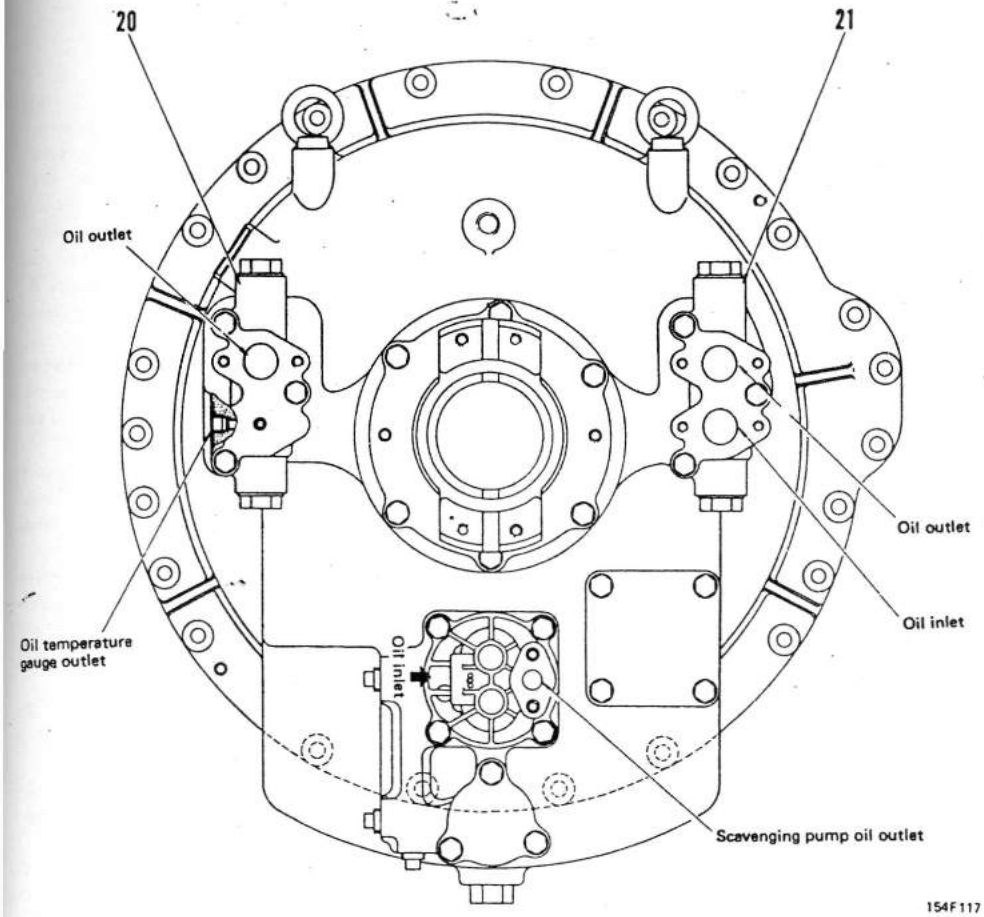
A.	No. 1 sun gear	(33 teeth)	No. 1 clutch (forward)
B.	No. 1 planetary pinion	(24 teeth)	
C.	No. 1 ring gear	(81 teeth)	
D.	No. 2 sun gear	(21 teeth)	No. 2 clutch (reverse)
E.	No. 2 planetary gear	(23 teeth)	
F.	No. 2 planetary pinion	(24 teeth)	
G.	No. 2 ring gear	(81 teeth)	
H.	No. 3 sun gear	(33 teeth)	No. 3 clutch (3rd speed)
I.	No. 3 planetary pinion	(24 teeth)	
J.	No. 3 ring gear	(81 teeth)	
K.	No. 4 sun gear	(42 teeth)	No. 4 clutch (2nd speed)
L.	No. 4 planetary pinion	(19 teeth)	
M.	No. 4 ring gear	(81 teeth)	
N.	No. 5 ring gear		No. 5 clutch (1st speed)
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)	

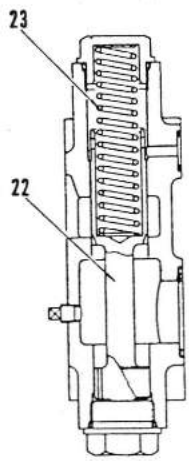
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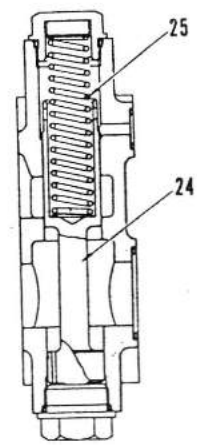
TORQUE CONVERTER



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STRUCTURE AND FUNCTION

The $\frac{TY\ 220}{TS\ 220}$ is installed with a 3-element, single stage, single phase torque converter which uses oil to automatically transmit power from the engine and vary the machine speed in accordance with load fluctuations.

The torque converter consists of a pump (5) which converts the engine output into kinetic energy of the oil, turbine (3) which reconverts the kinetic energy of the oil into mechanical energy and stator (12) which directs the flow of the oil.

When the drive gear (1) which meshes with the internal teeth of the flywheel is rotated by engine starting, the pump (5) which is integral with the drive gear and the drive case (2) is rotated on the stator shaft.

When the pump starts rotating, the oil inside the pump flow along the vanes and is expelled by centrifugal force. It then enters the turbine while undergoing a spiral motion.

The oil which enters the turbine will strike the turbine blades with great force, causing it to change direction and flow into the stator. The resulting reaction will cause the turbine to rotate, thus transmitting the engine power to the subsequent stages in the power train.

The oil in the turbine flows from the center part of the turbine through the stator, where it is redirected to enter the pump once again.

In this way, while the oil flows from the pump → turbine → stator → pump, power is transmitted from pump → turbine shaft.

Because the pump rotates on the stator shaft (7) via the bearing and the turbine is fixed by the spline of the turbine shaft (10), the rotation of the turbine is transmitted from the turbine shaft to the universal joint. The stator is fixed to the spline of the stator shaft and does not rotate.

A torque converter such as that used by $\frac{TY\ 220}{TS\ 220}$ which consists of one pump, one turbine and one stator which does not rotate is known as a 3-element, single stage, single phase torque converter.

1. Drive gear
2. Drive case
3. Turbine
4. Torque converter housing
5. Pump
6. Drive gear
7. Stator shaft
8. Housing
9. Coupling
10. Turbine shaft
11. Stator boss
12. Stator
13. Scavenging pump
14. Drive gear
15. Strainer
16. Drain plug
17. Turbine boss
18. Holder
19. Pilot
20. Regulator valve
21. Relief valve
22. Regulator valve spool
23. Regulator valve spring
24. Relief valve spool
25. Relief valve spring

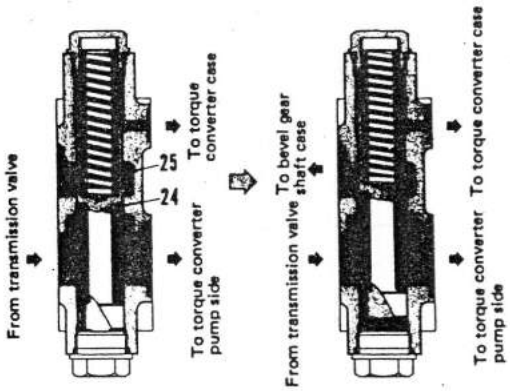
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TORQUE CONVERTER RELIEF VALVE

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 $8.7^{+0.3}_{0}$ kg/cm^2.

Pressurized oil from the transmission and steering pump enters port A, and then passed 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 $8.7^{+0.3}_{0}$ 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.



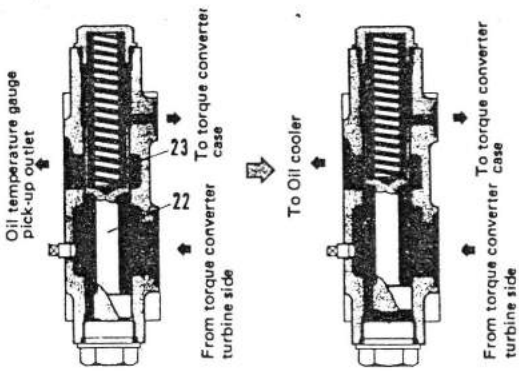
154F120

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 ± 0.1 kg/cm^2.

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

When the pressure at port C exceeds 3 ± 0.1 kg/cm^2, the oil compressed the spring (23), pushing the spool (22) open, and then flows from port D into the oil cooler.

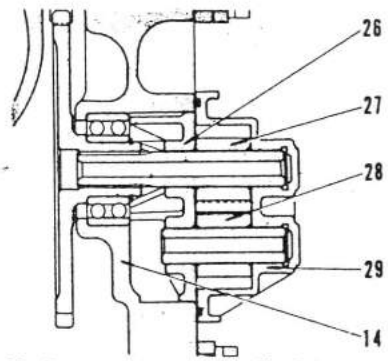


154F121

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.

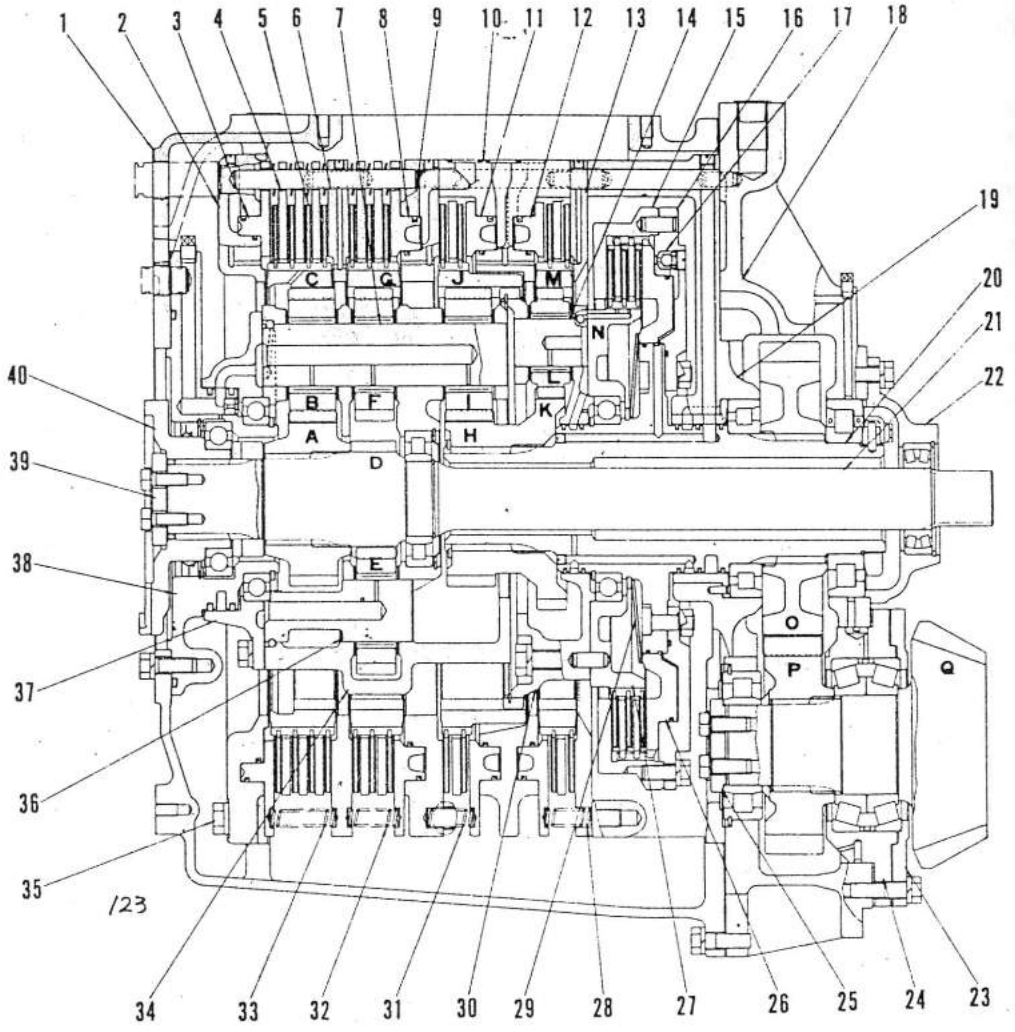


154F122

26. Pump case
27. Drive gear
28. Driven gear
29. Cover

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TORQFLOW TRANSMISSION



154F123

OUTLINE

The $\frac{TY\ 220}{TS\ 220}$ 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.

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1. Transmission case	A. No. 1 sun gear	(33 teeth)	
2. No. 1 clutch housing	B. No. 1 planetary pinion	(24 teeth)	No. 1 clutch (forward)
3. No. 1 clutch piston	C. No. 1 ring gear	(81 teeth)	
4. Clutch plate	D. No. 2 sun gear	(21 teeth)	
5. Clutch disc	E. No. 2 planetary pinion	(23 teeth)	
6. Plate	F. No. 2 planetary pinion	(24 teeth)	No. 2 clutch (reverse)
7. No. 1, 2 and 3 pinion shafts	G. No. 2 ring gear	(81 teeth)	
8. No. 2 clutch piston	H. No. 3 Sun gear	(33 teeth)	
9. No. 2 clutch housing	I. No. 3 planetary pinion	(24 teeth)	No. 3 clutch (3rd speed)
10. No. 3 & 4 clutch housing	J. No. 3 ring gear	(81 teeth)	
11. No. 3 clutch piston	K. No. 4 sun gear	(42 teeth)	
12. No. 4 clutch piston	L. No. 4 planetary pinion	(19 teeth)	No. 4 clutch (2nd speed)
13. Plate	M. No. 4 ring gear	(81 teeth)	
14. No. 4 pinion shaft	N. No. 5 ring gear		No. 5 clutch (1st speed)
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

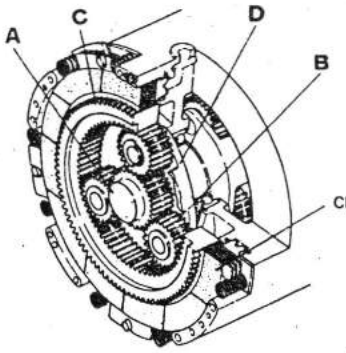
Forward/ reverse	Speed stage	Clutch to be engaged
Forward	1st speed	No. 1 · No. 5
	2nd speed	No. 1 · No. 4
	3rd speed	No. 1 · No. 3
Reverse	1st speed	No. 2 · No. 5
	2nd speed	No. 2 · No. 4
	3rd speed	No. 2 · No. 3

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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.

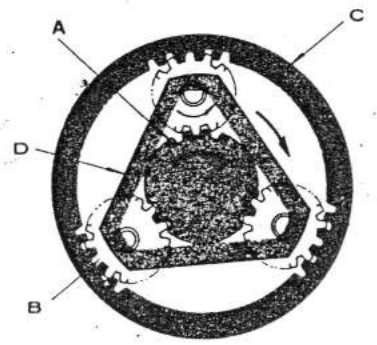


154F124

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

WHEN THE RING GEAR IS FIXED:

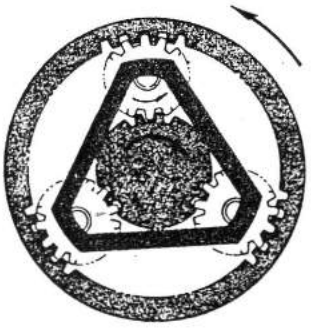
The rotation of sun gear A is transmitted to planetary pinions B.
Because the planetary pinions mesh with sun gear C, and the ring gear is fixed, they cannot rotate at the same position. Consequently, they revolve around the sun gear along the ring gear, while rotating on their own axes.
The torque of 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 rotates 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 $\frac{\text{TY 220}}{\text{TS 220}}$. No. 1 clutch receives its torque from the sun gear and transmits it to the carrier, while No. 3 and 4 clutches receives their torque from the carrier and transmit it to No. 3 and 4 sun gears respectively.



154F126

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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 $\frac{TS\ 220}{TY\ 220}$ and is used for reverse operation.

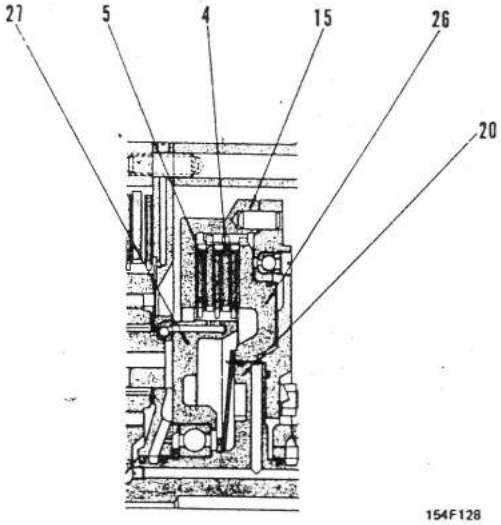


154F127

ROTARY CLUTCH

The No. 5 clutch used in the $\frac{TY\ 220}{TS\ 220}$ 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

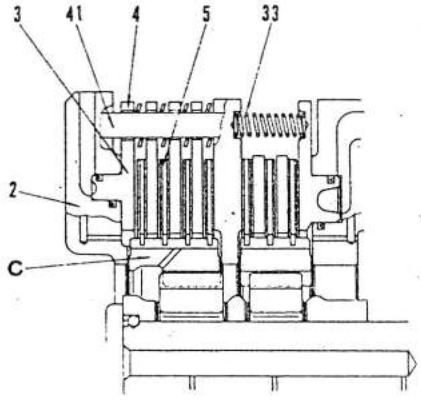
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WHEN FIXING THE RING GEAR (CARRIER)

In order to fix ring gear C, the disc clutch is incorporated. It consists of a disc clutch sonsisting 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.

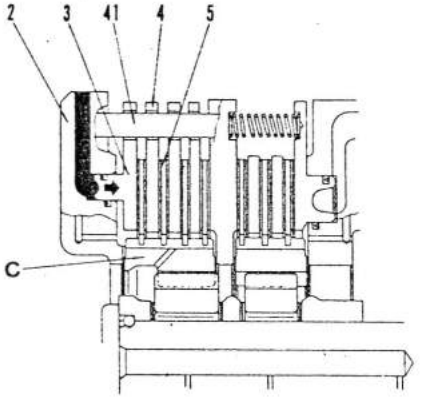
The plate, whose notch on the outside diameter meshes with the pins (41) fixed on the housing, is fixed against the direction of rotation. Similarly, the piston is also fixed against the direction of rotation.



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.

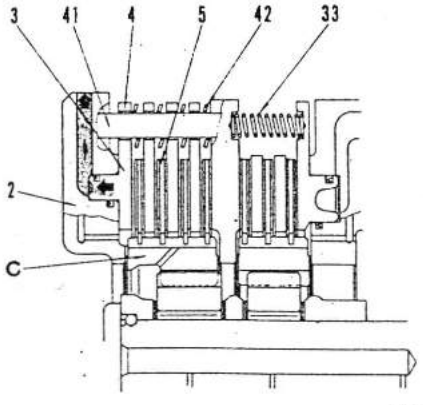


154F130

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

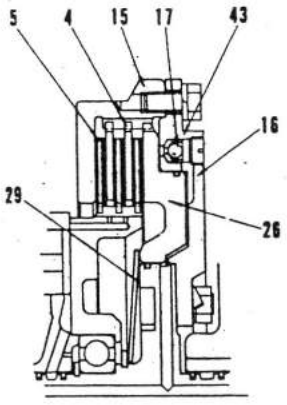
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NO. 5 CLUTCH (BALL CHECK VALVE)

The No. 5 clutch of the $\frac{TY220}{TS220}$ 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.

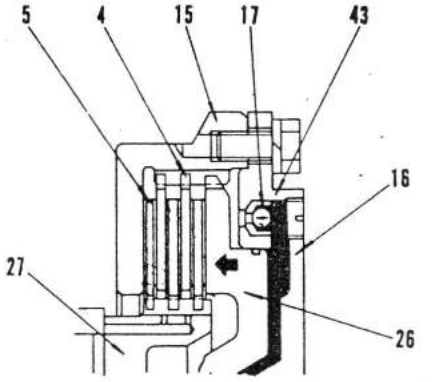
In order to eliminate this condition, a ball check valve (17) is incorporated in the piston of the rotary clutch.



154F132

ENGAGING (FIXING) CLUTCH

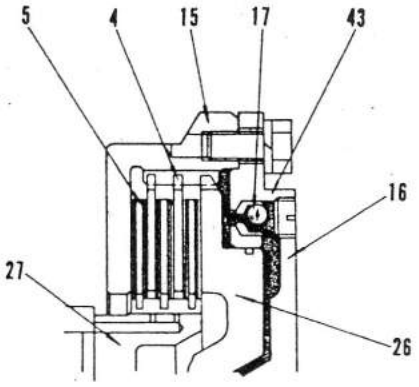
Pressurized oil from the control valve passes through the port to enter the housing (16), and then sent to the rear of the piston (26). The ball check valve (17) cloggs the valve seat (43) so that the piston presses the discs (5) and plates (4) together, thus causing the internal teeth of the discs to 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).

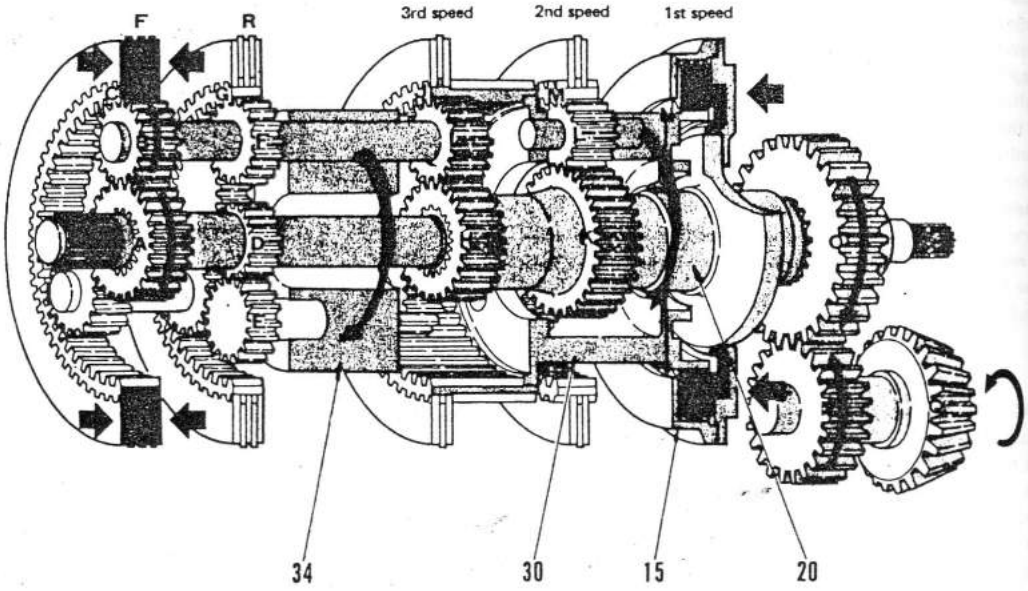


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POWER TRANSMITTING ROUTE

1. FORWARD, 1st SPEED



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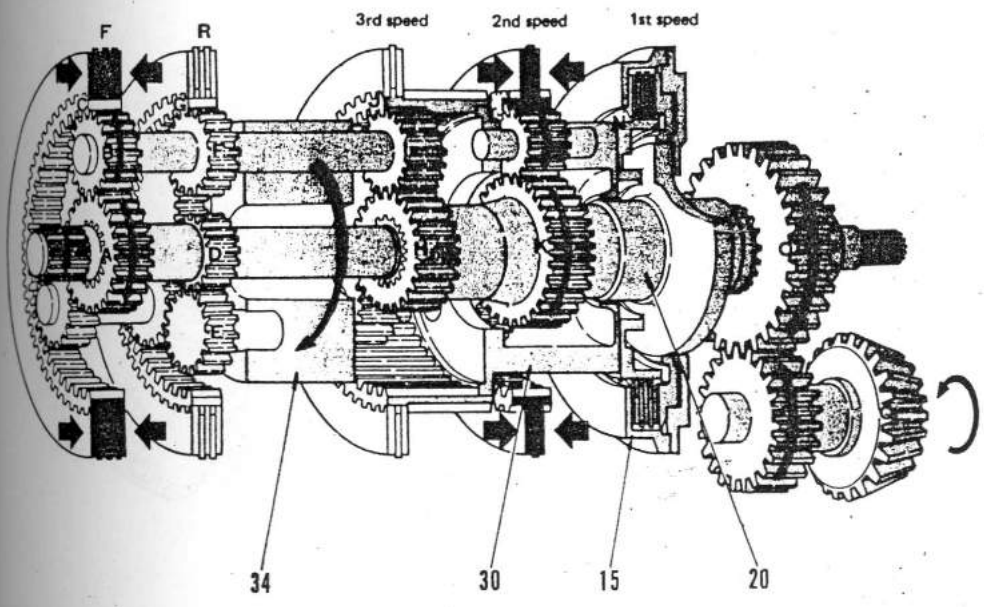
Engage No. 1 clutch and No. 5 clutch. Fix No. 1 ring gear. Connect No. 5 ring gear (integral with No. 4 carrier) directly to output shaft.

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).

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2. FORWARD, 2nd SPEED



154F136

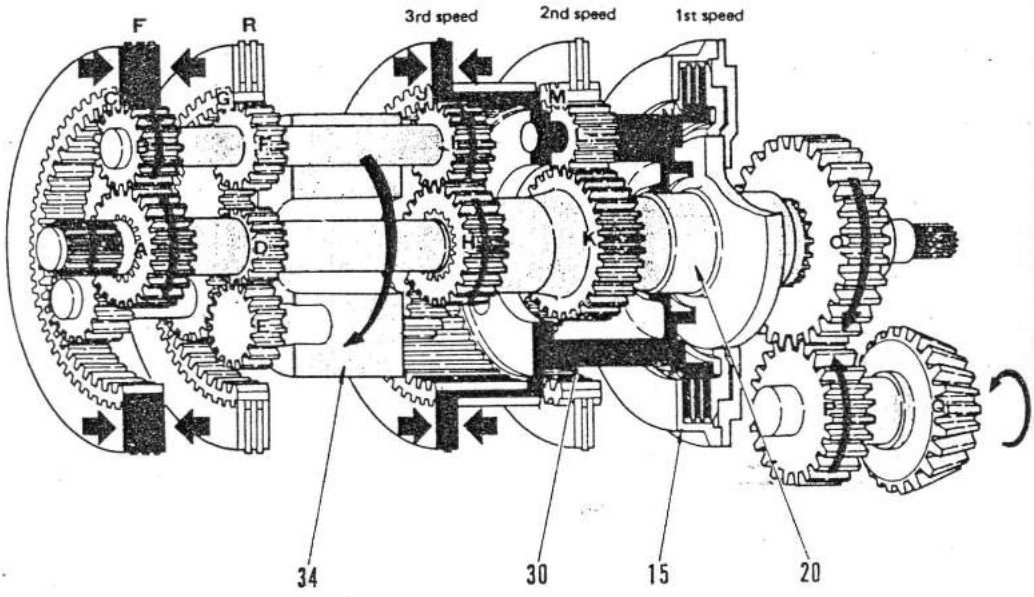
Engage No. 1 clutch and No. 4 clutch. Fix No. 1 ring gear and No. 4 ring gear.

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 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. 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).

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3. FORWARD, 3rd SPEED



154F137

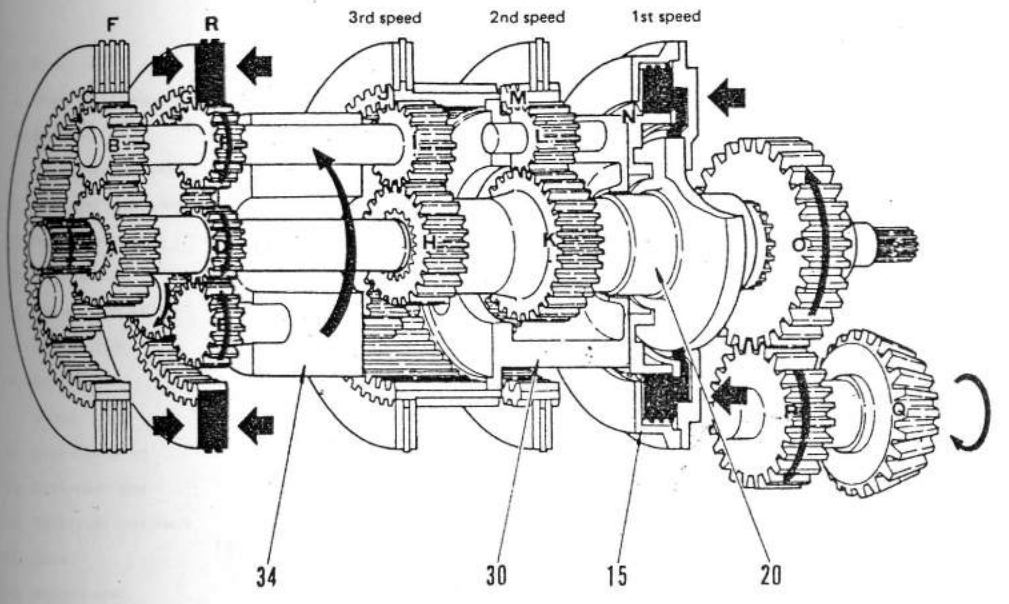
Engage No. 1 clutch and No. 3 clutch. Fix No. 1 ring gear and No. 3 ring gear.

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).

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4. REVERSE, 1st SPEED



154F138

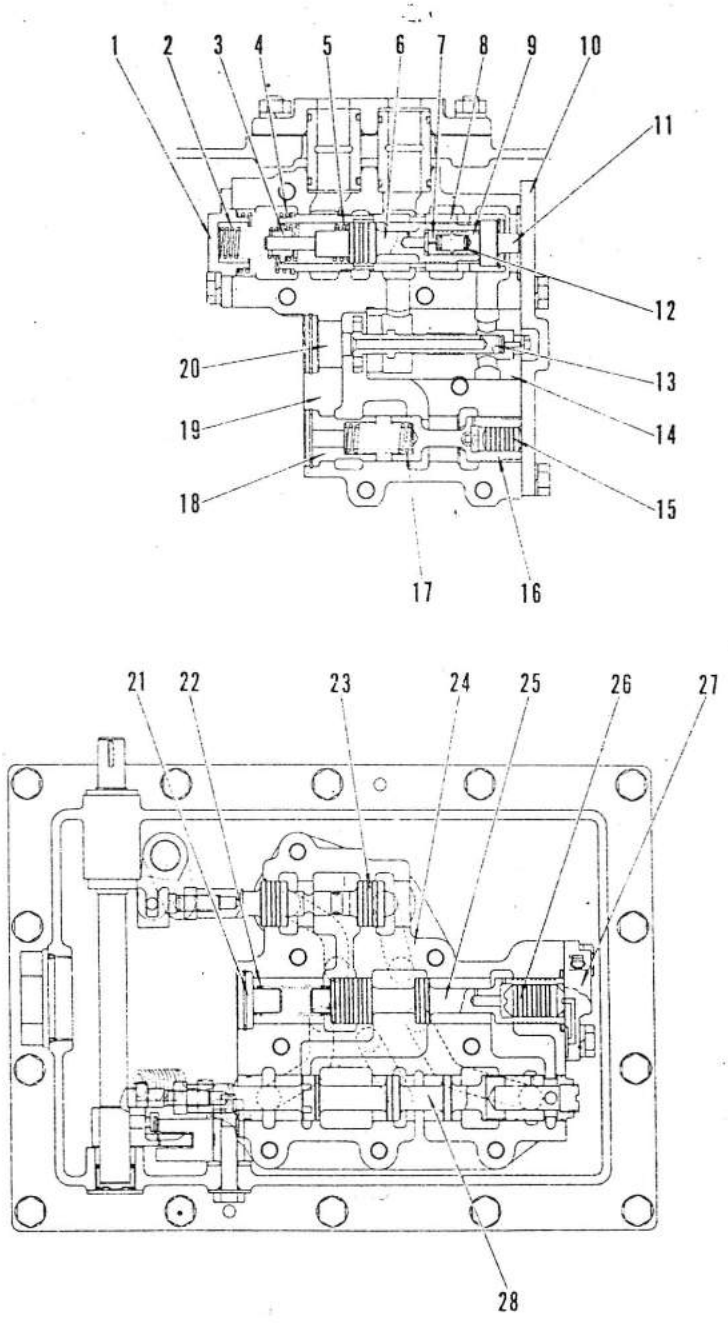
Engage No. 2 clutch and No. 5 clutch. Fix No. 2 ring gear. Connect No. 5 ring gear (integral with No. 4 carrier) directly to output shaft.

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.

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TRANSMISSION CONTROL VALVE

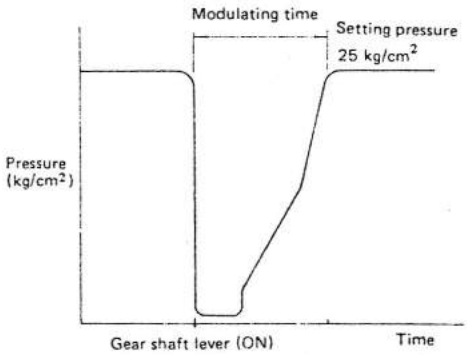


154E140

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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.



154F141

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

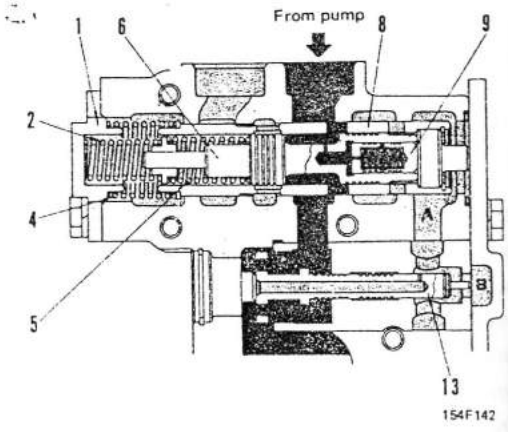
1. To 1st speed clutch (No. 5)
2. To 2nd speed clutch (No. 4)
3. To 3rd speed clutch (No. 3)

F. To forward clutch (No. 1)

R. To reverse clutch (No. 2)

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FUNCTION

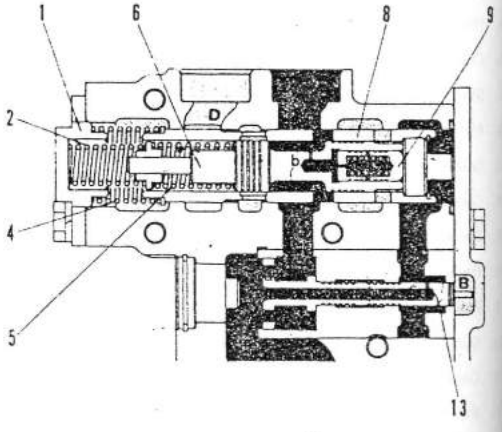


154F142

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 ⬅ direction, causing compartment A to be connected to passage B, relieving the back-pressure from modulating valve sleeve (8). Consequently, the modulating valve (6) and the modulating valve sleeve are drawn in the ➡ direction owing to the reaction force of springs (2), (4) and (5), thus shutting off the passage to the torque converter circuit.



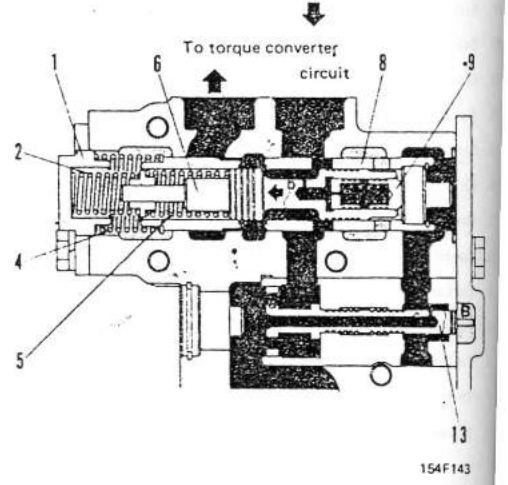
2. STARTING OF PRESSURE BUILDING, AND PRESSURE BUILDING UP

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 ➡ 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 ⬅ 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 ⬅ direction, and compress the spring (2).



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3. PRESSURE BUILDING UP, AND FINISHING OF PRESSURE BUILDUP

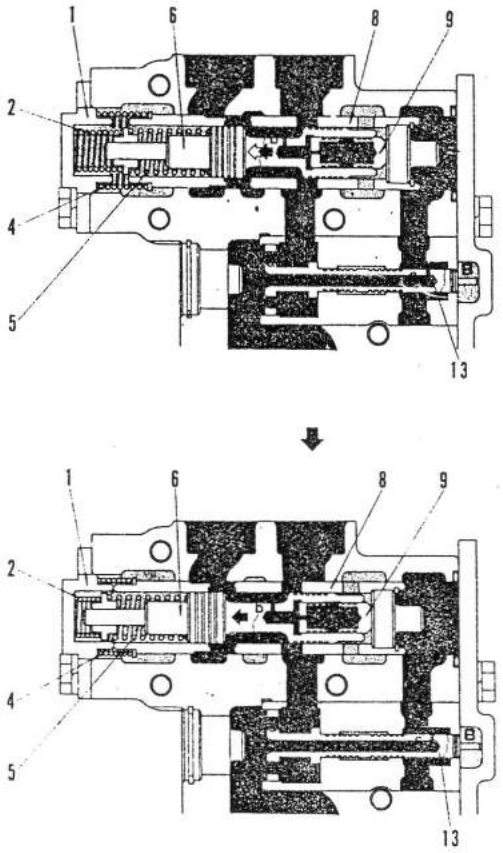
As pressure gradually builds up in the circuit, the back pressure of the modulating valve also increases, and when the modulating valve sleeve moves in the ⬅ direction, port D leading to the modulating valve closes up.

Furthermore, the modulating valve moves in the ⬅ 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 kg/cm^2.



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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 kg/cm^2**.

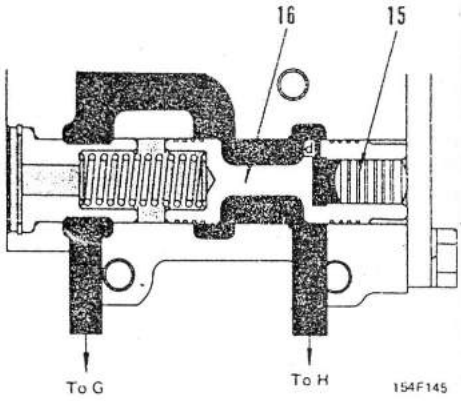
The entire circuit is set at a pressure of **25 kg/cm^2**, while the 1st speed clutch circuit alone is arranged so that when the internal pressure reaches **12.5 kg/cm^2**, it will be closed off by the reducing valve.

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

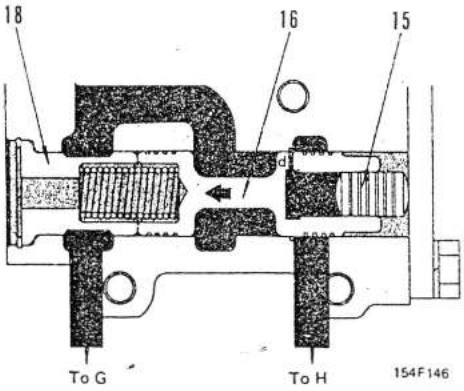
1. STARTING OF PRESSURE BUILDUP, AND PRESSURE BUILDING UP



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 d 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 kg/cm^2**.

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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.

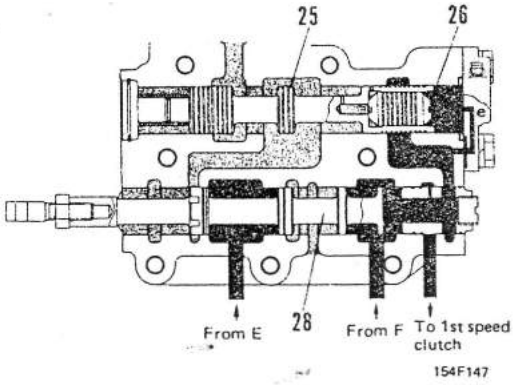
When starting up the machine, the gear shift lever must be put in the neutral position.

OPERATION

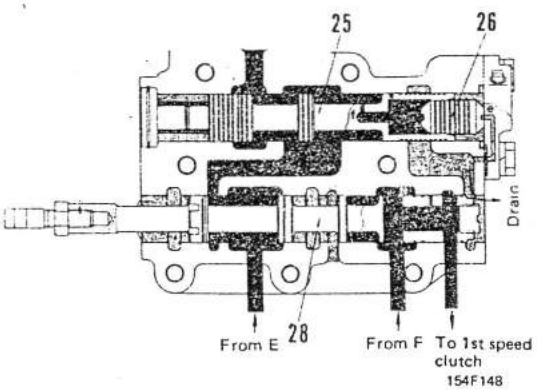
1. When gear shift lever is in neutral position.
   Oil from the reducing valve passed through the speed valve and the orifice e, pushing the whole safety valve (25) to the left, thus opening the circuit between the modulating valve and the directional valve.

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.

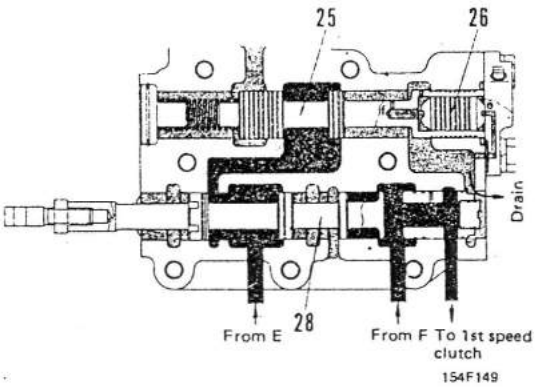
3. When engine is started with gear shift lever engaged.
   When the engine is started under the conditions of paragraph 2. above, the oil pressure disappears and the safety valve moves to the right under the action of the spring, thus closing up the circuit to the directional valve.
   If the engine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



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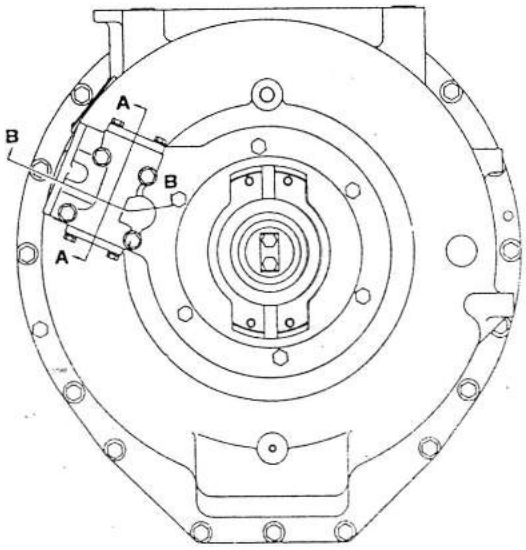
154F148

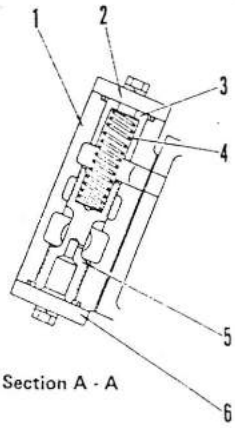


154F149

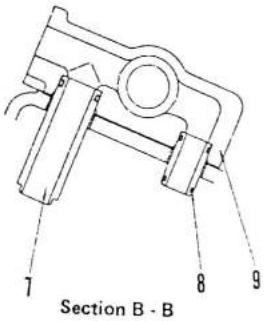
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TRANSMISSION LUBRICATION VALVE





Section A - A



Section B - B

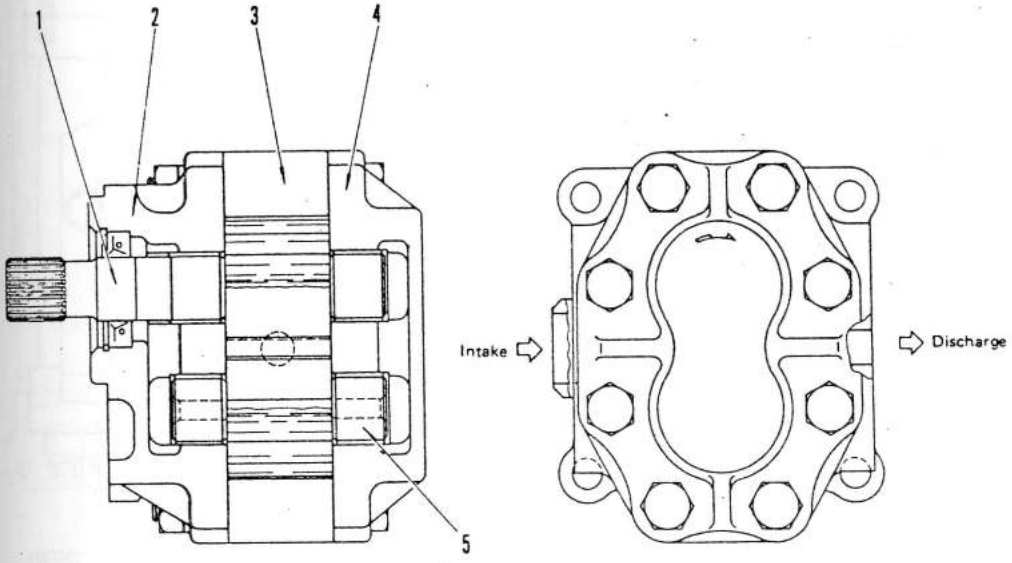
Cracking pressure : 1.24 kg/cm²

154F150

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

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TRANSMISSION PUMP

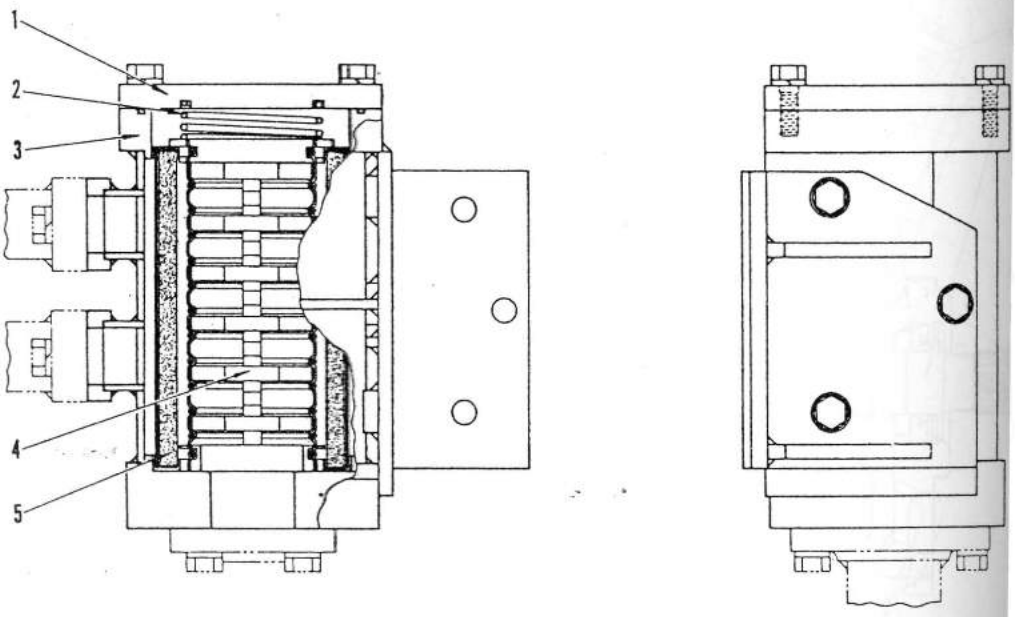


154F151

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

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TRANSMISSION, STEERING OIL STRAINER

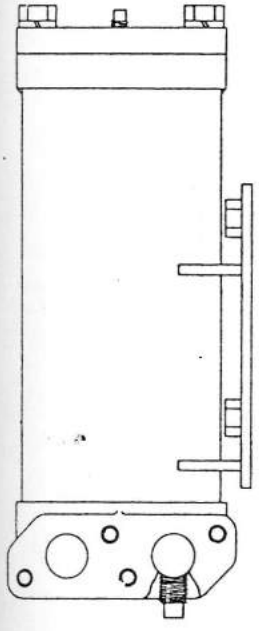


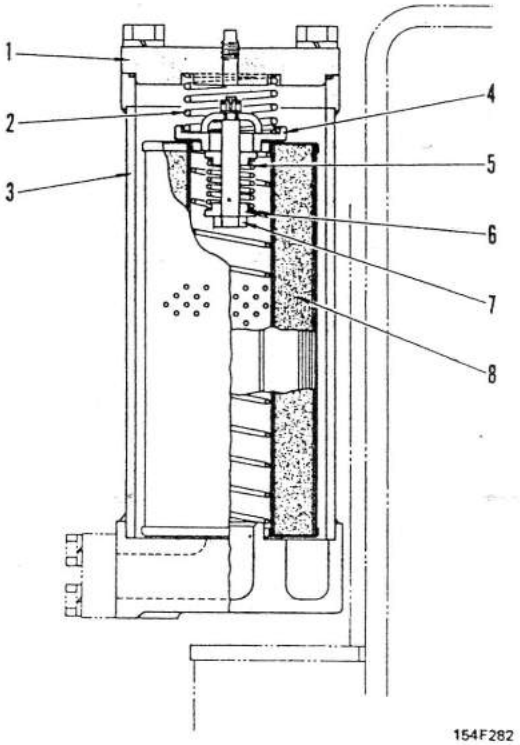
1. Strainer cover
2. Spring
   - Free length : 23 mm
   - Installation length : 50 mm
   - Installation load : 6.8 kg
3. Strainer case
4. Magnet
5. Screen

Flow : 183 ℓ/min.

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TRANSMISSION OIL FILTER





154F282

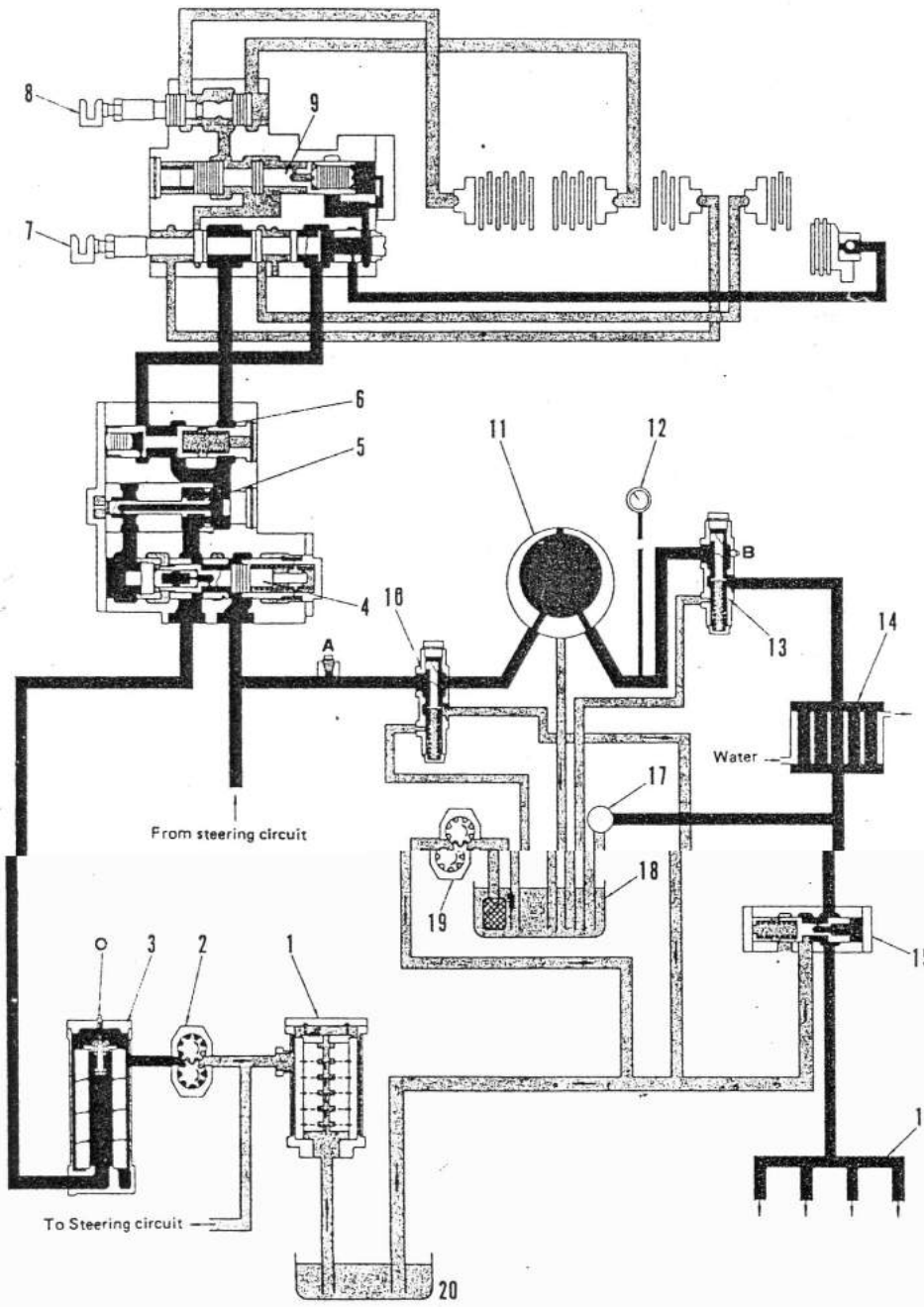
1. Filter cover
2. Spring Installation length : 35.5 mm
   Installation load : 10 kg
3. Filter case
4. Gauge
5. Spring
6. Sleeve
7. Bolt
8. Element

Cracking pressure : 1.21 kg/cm^2
Flow : 74.1ℓ/min.

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TORQFLOW HYDRAULIC SYSTEM

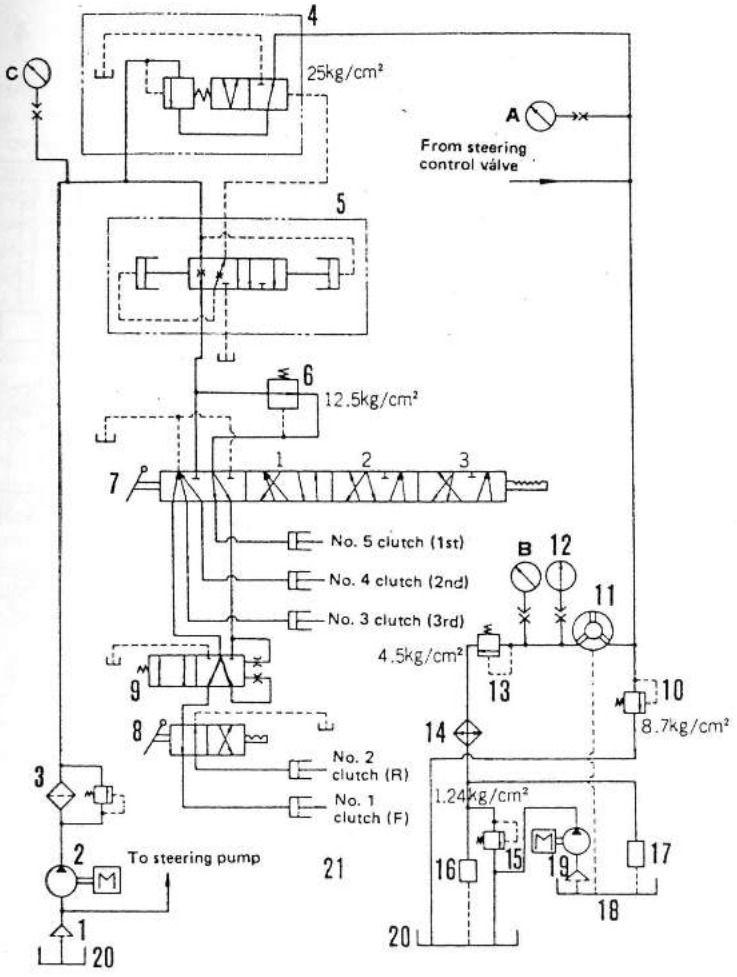
NEUTRAL



154F152

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TORQFLOW HYDRAULIC CIRCUIT



154F153

1. Magnet strainer
2. Transmission pump (FAL040)
3. Oil filter
4. Modulating valve
5. * Quick return valve
6. Reducing valve
7. Speed valve
8. Directional valve
9. Safety valve
10. Relief valve
11. Torque converter
12. Oil temperature gauge
13. Regulator valve
14. Oil cooler
15. Lubrication relief valve
16. Transmission lubrication
17. P.T.O. lubrication
18. Torque converter case
19. Scavenging pump
20. Steering case

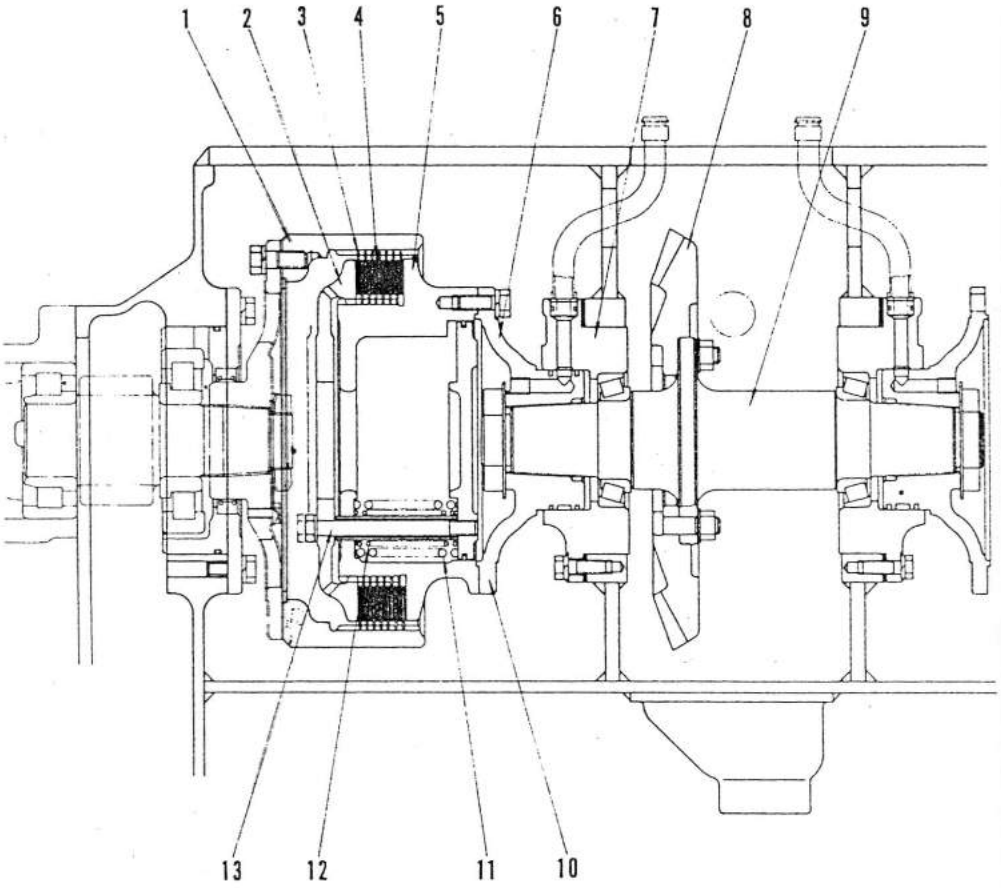
A. Relief pressure pickup plug (PT 1/8)

B. Regulator pressure pickup plug (PT 1/8)

C Transmission clutch pressure pickup plug (PT 1/8)

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BEVEL GEAR SHAFT · STEERING CLUTCH



154F154

1. Outer drum (Brake drum)
2. Pressure plate
3. Disc
4. Plate
5. Inner drum (clutch drum)
6. Bevel gear shaft hub
7. Bearing cage
8. Bevel gear
9. Bevel gear shaft
10. Piston
11. Spring
12. Spring
13. Bolt

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STRUCTURE

BEVEL GEAR SHAFT

TY220,TS220 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 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

TY220,TS220 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 splin 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.

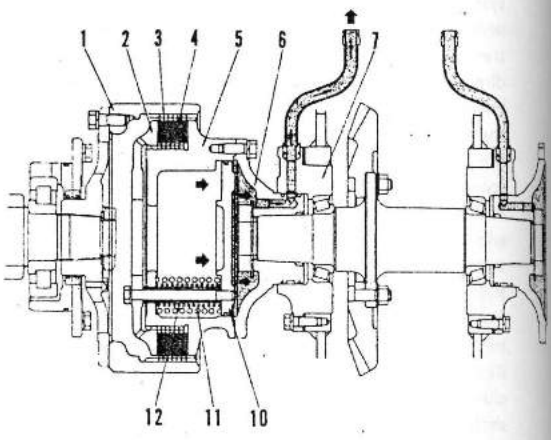
In the steering clutch, the plates drive and the discs are driven.

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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.



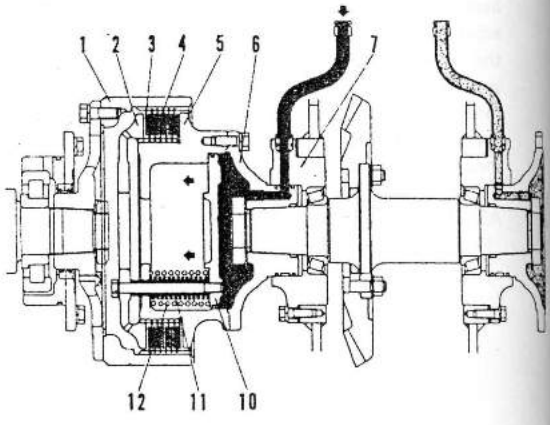
154F155

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.

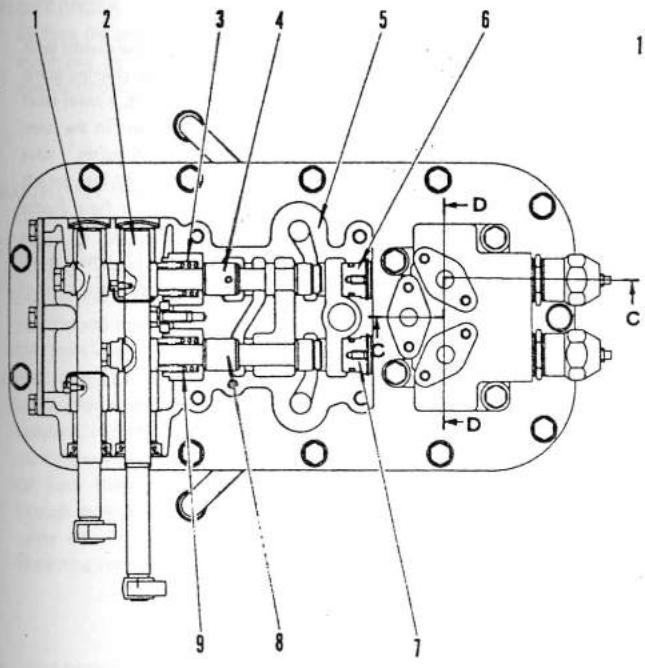
When the left steering clutch is disengaged, power is transmitted only to the right steering clutch, and hence the machine turns to the left.



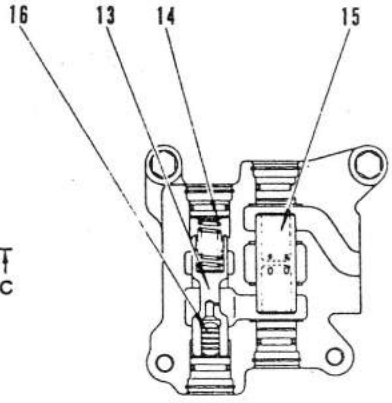
154F156

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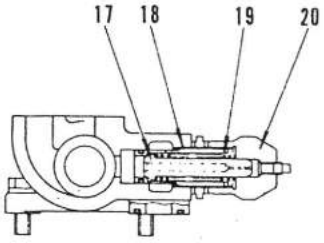
STEERING CONTROL VALVE



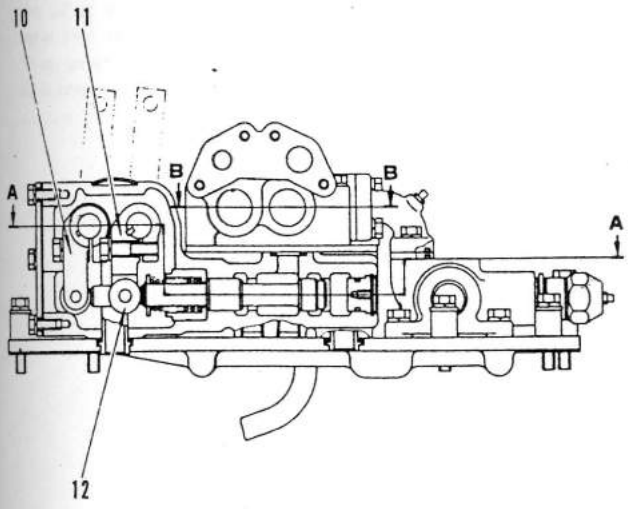
Section A - A

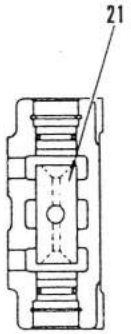


Section B - B



Section C - C





Section D - D

154F157

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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 kg/cm²**, 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 kg/cm²**.

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

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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.

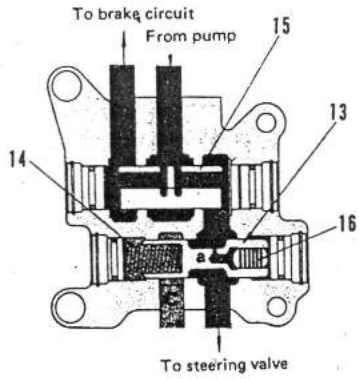
MAIN RELIEF VALVE

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.

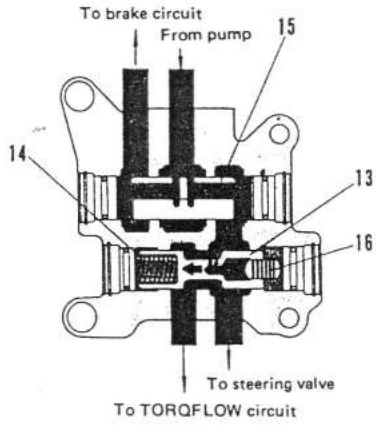
Oil from port B passes through orifice A of the relief valve (13) to push the piston (16). The resulting reaction causes the relief valve to move in the ⬅ direction, compressing the spring (14), until it strikes the stopper and comes to rest.

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

Thesetting pressure is **12.5 kg/cm²**.



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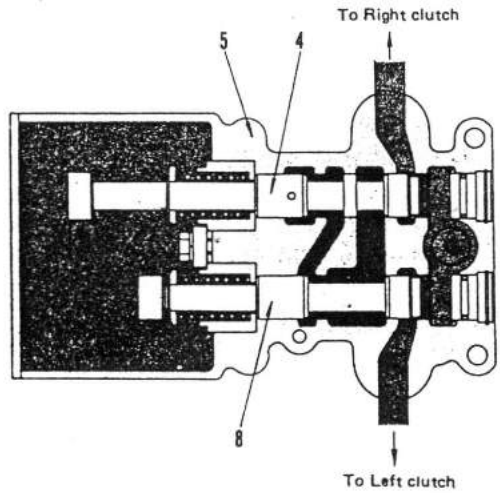
154F159

1. 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

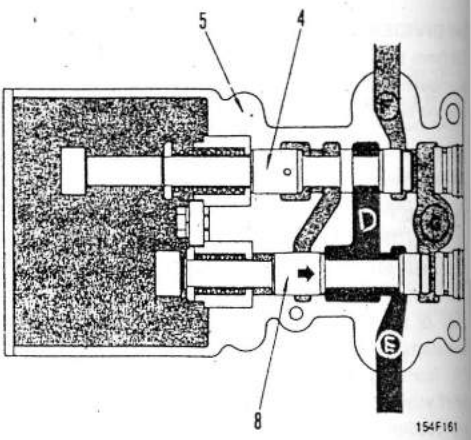
https://truckmanualshub.com/

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

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

Oil from the pump passes through the main relief valve and 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 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.

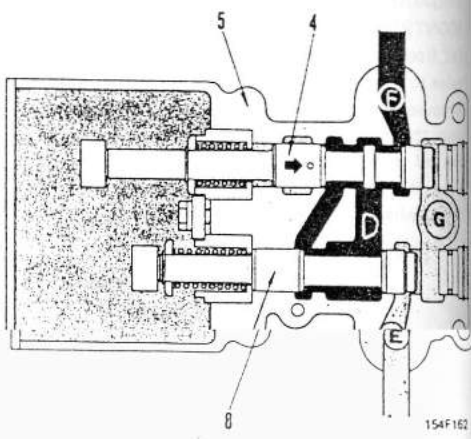


3. ENGAGING LEFT CLUTCH, DISENGAGING RIGHT CLUTCH (RIGHT LEVER PULLED)

When the right steering lever is pulled, the right spool (4) moves in the ➡ 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.

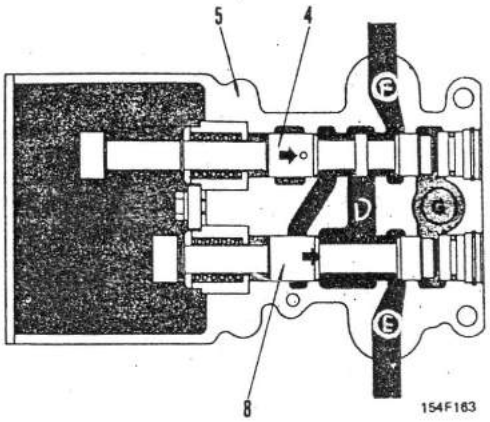


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4. DISENGAGING LEFT AND RIGHT CLUTCHES (LEFT AND RIGHT LEVERS PULLED)

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 is returned by the clutch springs to drain off from port **G**.



154F163

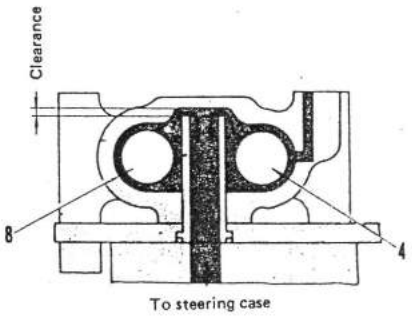
DRAIN PORT TUBE

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.

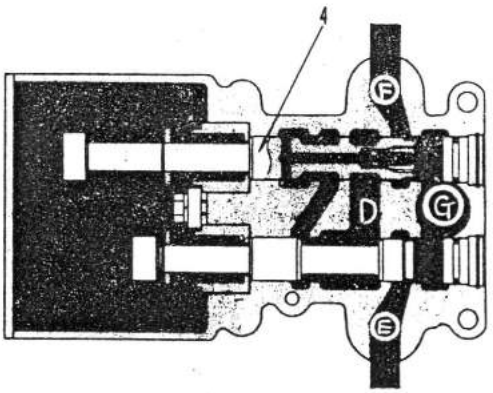
Unless the oil returned from the clutch piston fills up the housing, a considerable time will be required for the oil to reach the housing port when the spool is operated, causing the steering disengagement to become sluggish.

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.



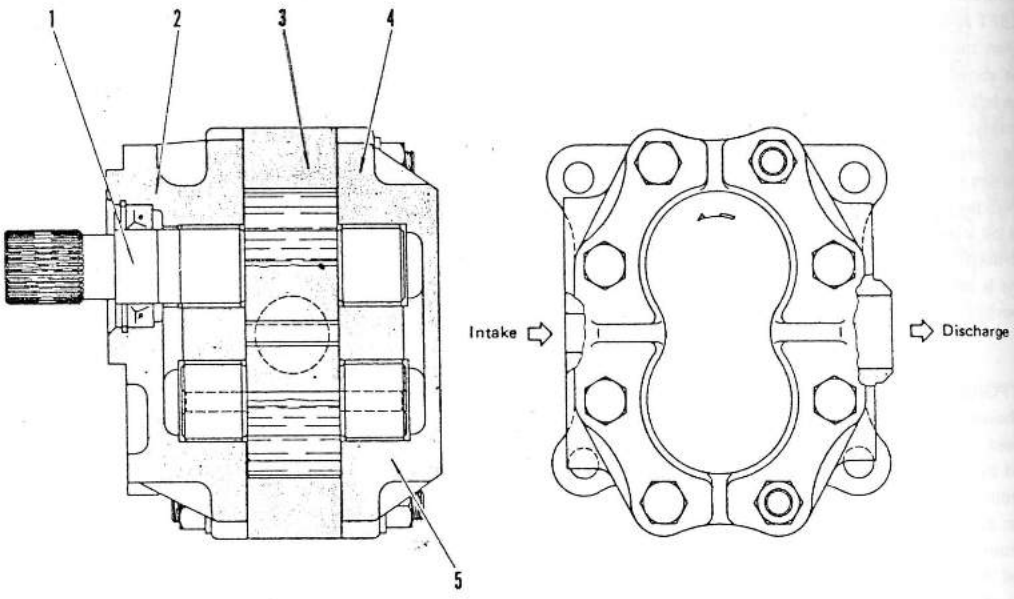
154F164



154F165

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STEERING PUMP (C BJ-63)

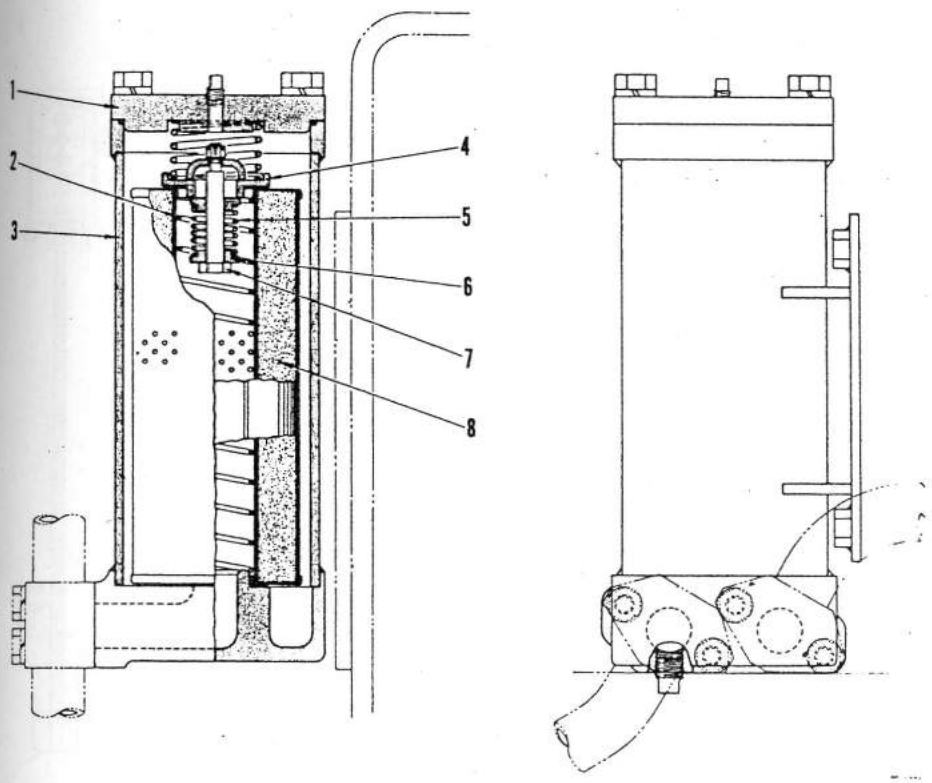


154F168

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

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STEERING OIL FILTER



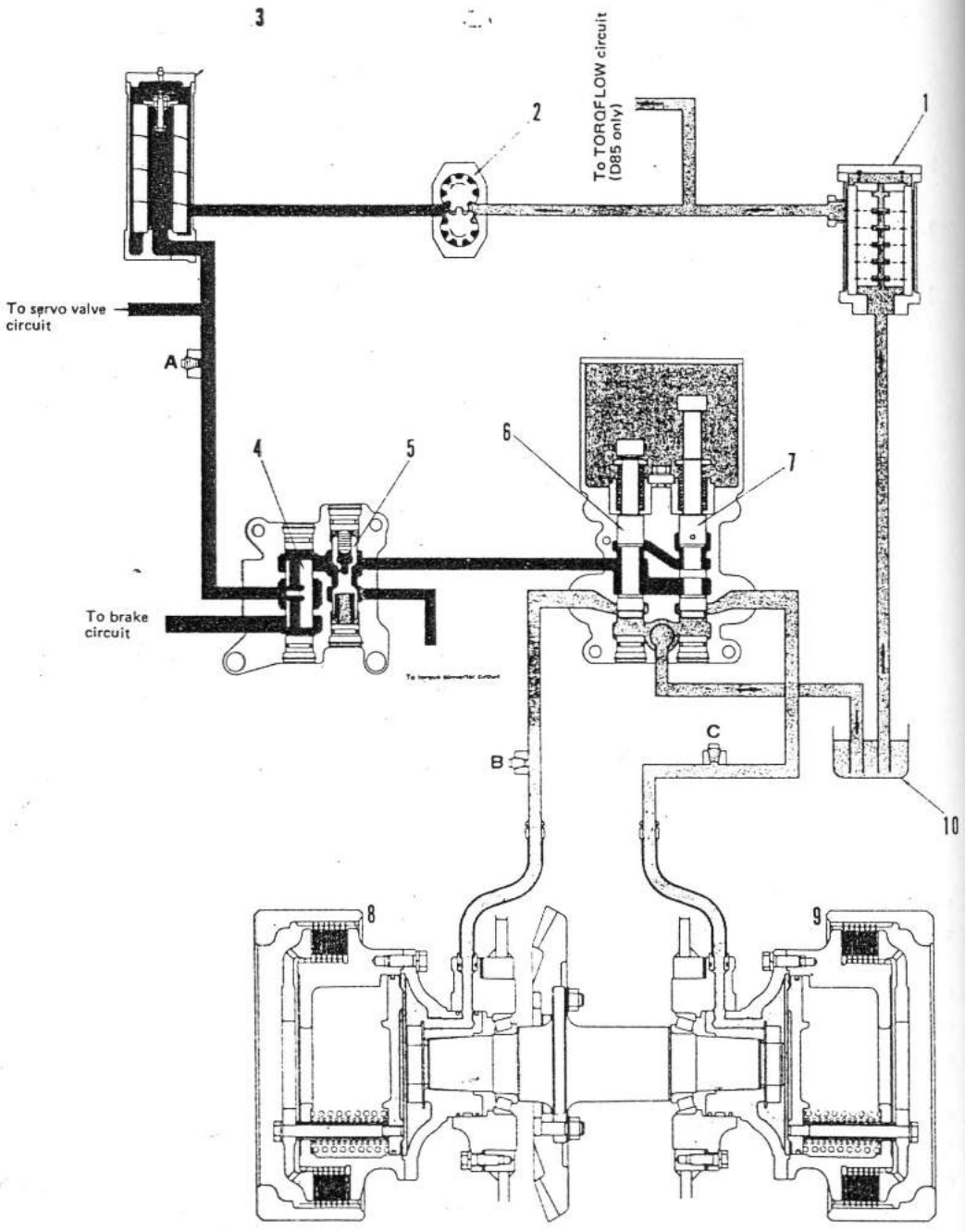
1. Filter cover
2. Spring Installation length : 35.5 mm
   Installation load : 10 kg
3. Filter case
4. Gauge
5. Spring Installation length : 26.0 mm
   Installation load : 4.95 kg
6. Sleeve
7. Bolt
8. Element

Cracking pressure : 1.21 kg/cm^2

Flow : 109ℓ/min.

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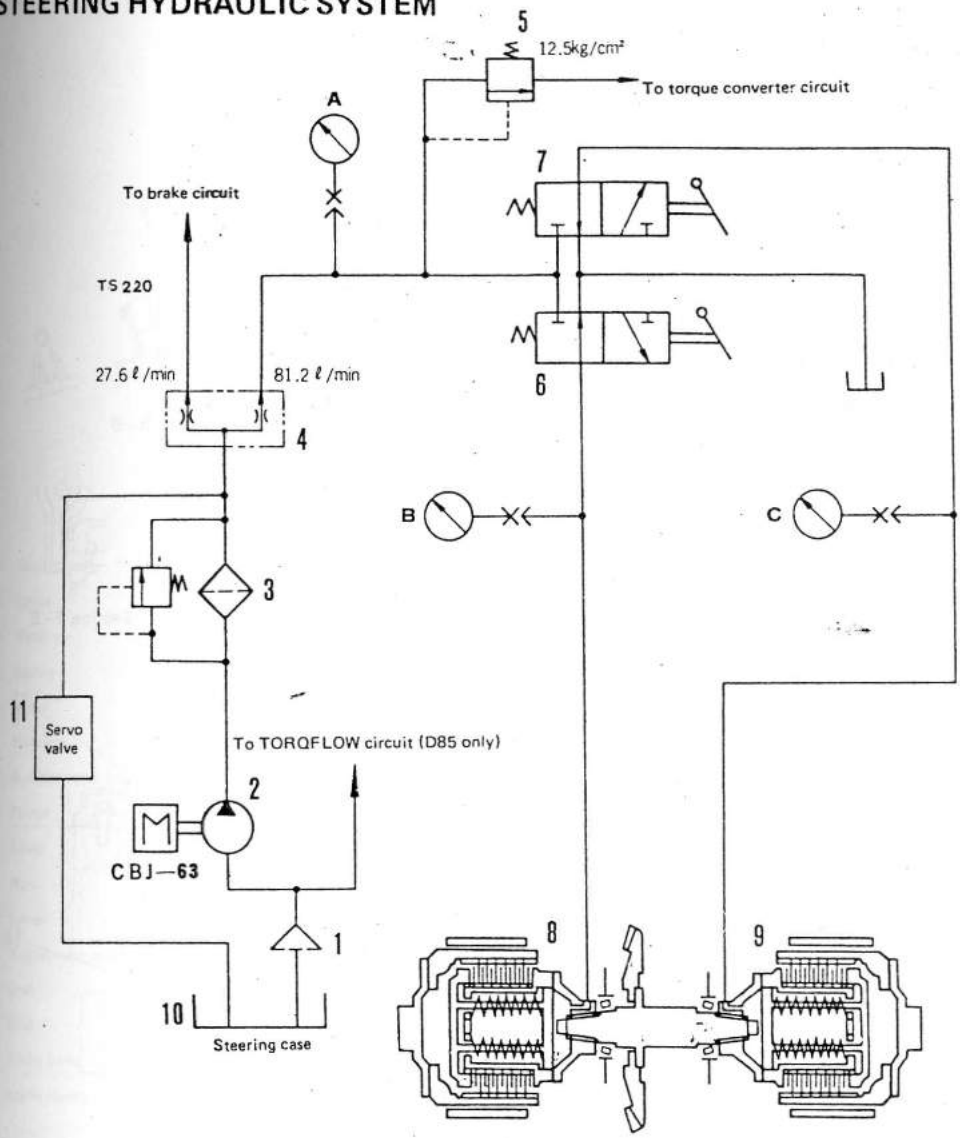
STEERING HYDRAULIC CIRCUIT



154F167

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STEERING HYDRAULIC SYSTEM



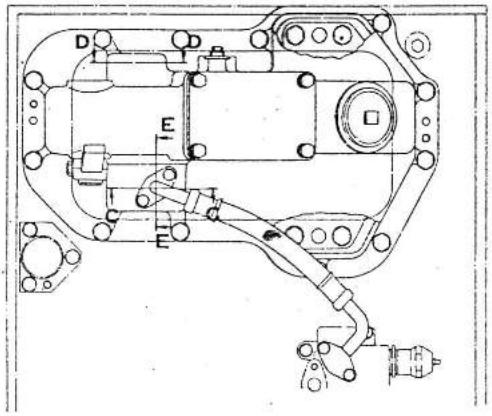
154F168

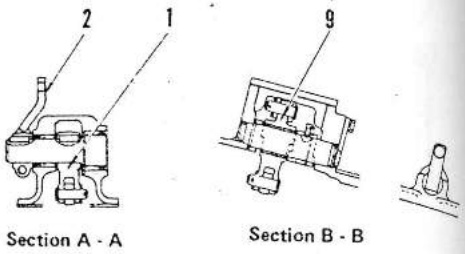
1. Magnet strainer
2. Steering pump
3. Steering filter
4. Flow divider
5. Main relief valve
6. Left clutch spool
7. Right clutch spool
8. Left clutch
9. Right clutch
10. Steering case
11. Rotary servo booster valve

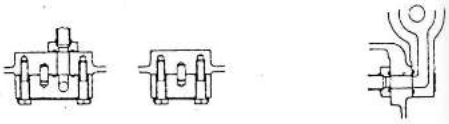
A. Clutch main pressure pickup plug (PT 1/8)
B. Left clutch pressure pickup plug (PT 1/8)
C. Right clutch pressure pickup plug (PT 1/8)

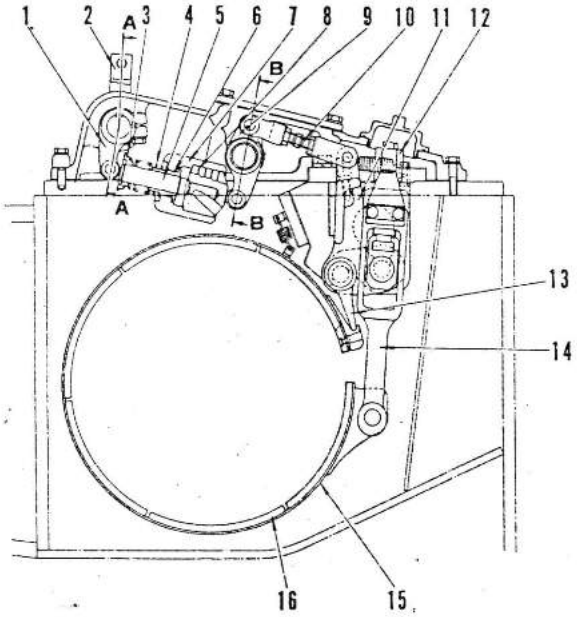
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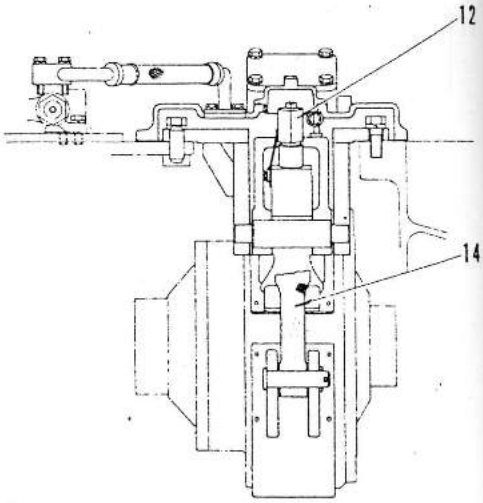
STEERING BRAKE











154F169

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STRUCTURE

TY 220,TS 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.

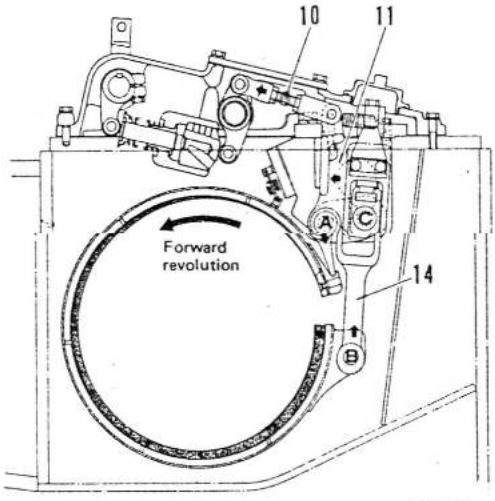
1. Control lever
2. Lever
3. Retainer
4. Spring
5. Spool
6. Retainer
7. Booster valve body
8. Piston
9. Lever
10. Rod
11. Lever
12. Adjustment bolt
13. End
14. Rod
15. Brake band
16. Brake lining

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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.

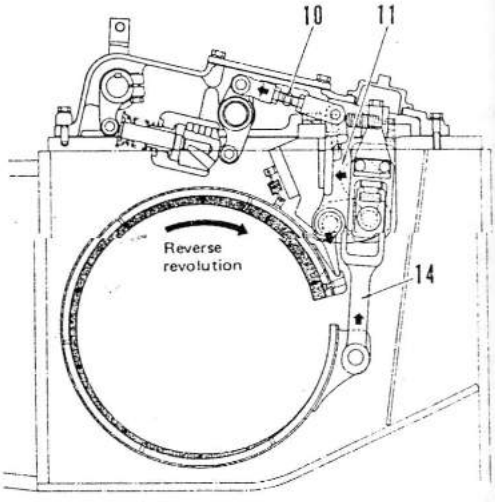
1. BRAKE OPERATION DURING FORWARD TURNING



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 ⬅ direction, and the lever is also pulled in the ⬅ direction. As a result, the brake band tends to move about support point C on the lever, so that poing 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.

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BRAKE BOOSTER VALVE

TY 220,TS 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 kg/cm^2, and enters port A of the brake booster valve.

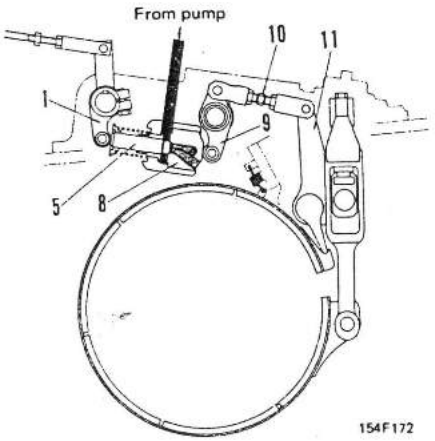
When brake pedal is depressed, the lever (1) pushes the spool (5), shutting off the passage between the spool and the piston. As a result, the pressure of the oil between the flow divider port A starts to rise, causing a pressure differential to occur between the left and right ports of the free piston 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 ➡ 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.

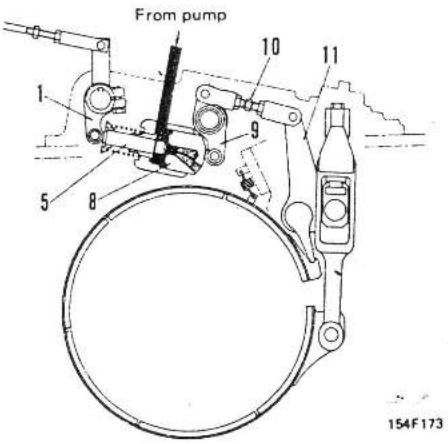
When the above actions are followed through, the end of the piston will push the lever (9), causing the rod to be pulled in the ⬅ direction, so that the brake operates by means of the lever (11).

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.

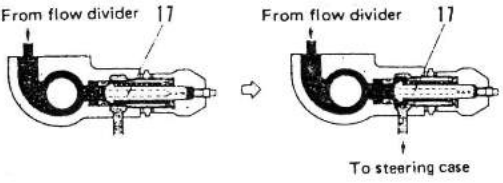
The relief valve setting pressure is 17 kg/cm^2.



154F172



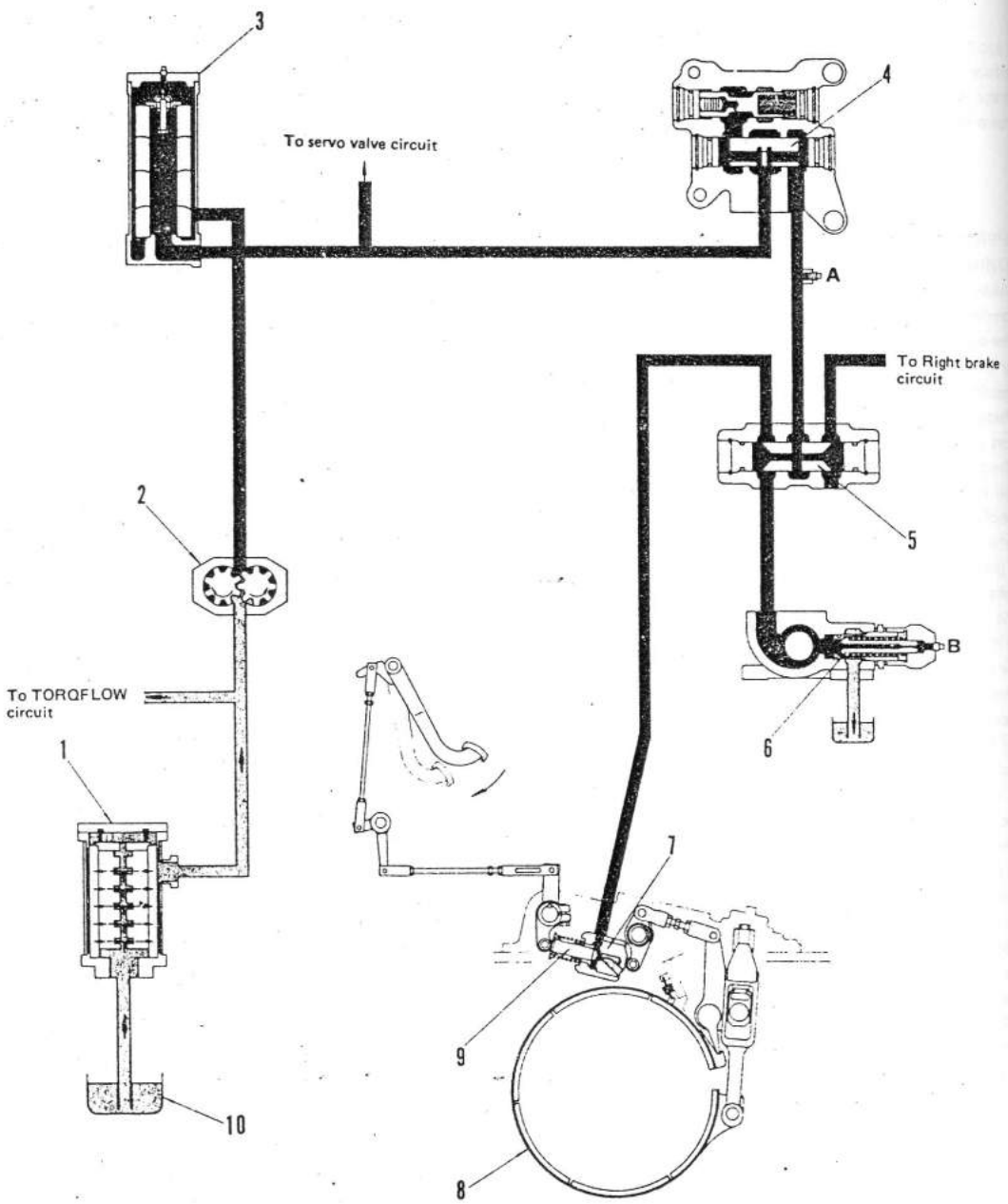
154F173



154F174

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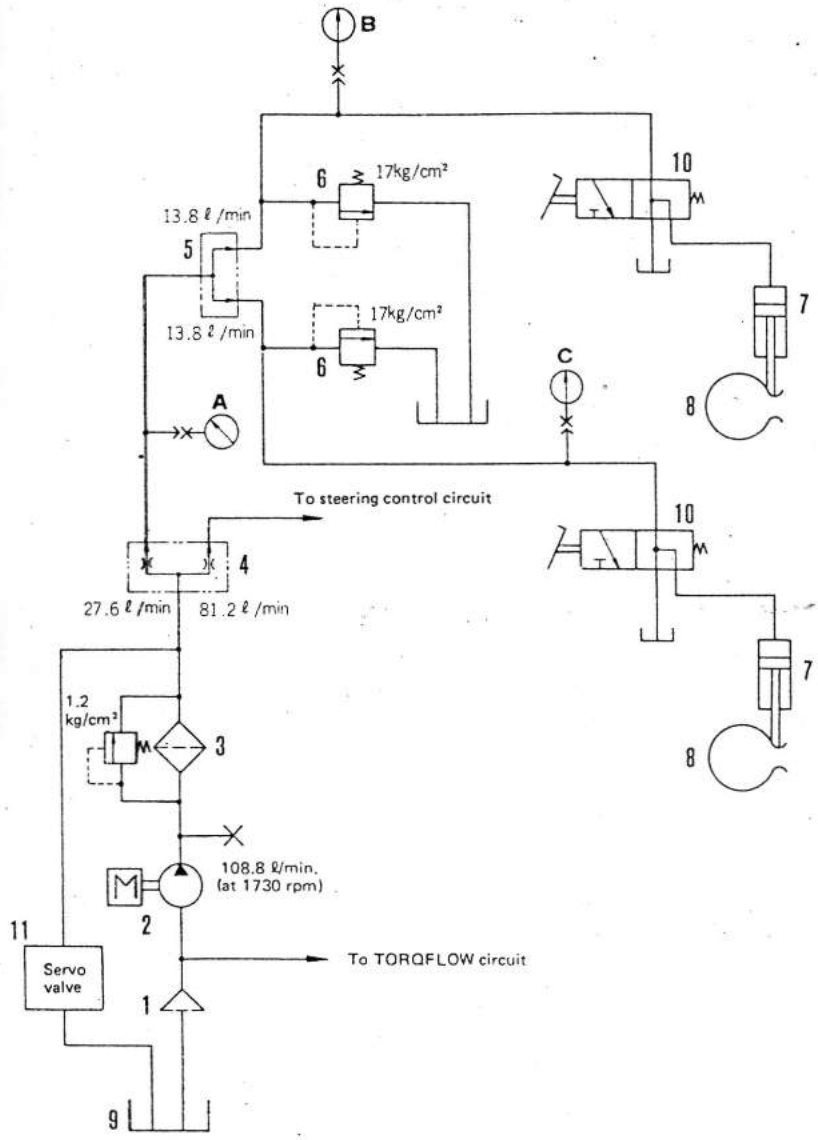
BRAKE HYDRAULIC SYSTEM



154F175

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STEERING BRAKE HYDRAULIC CIRCUIT



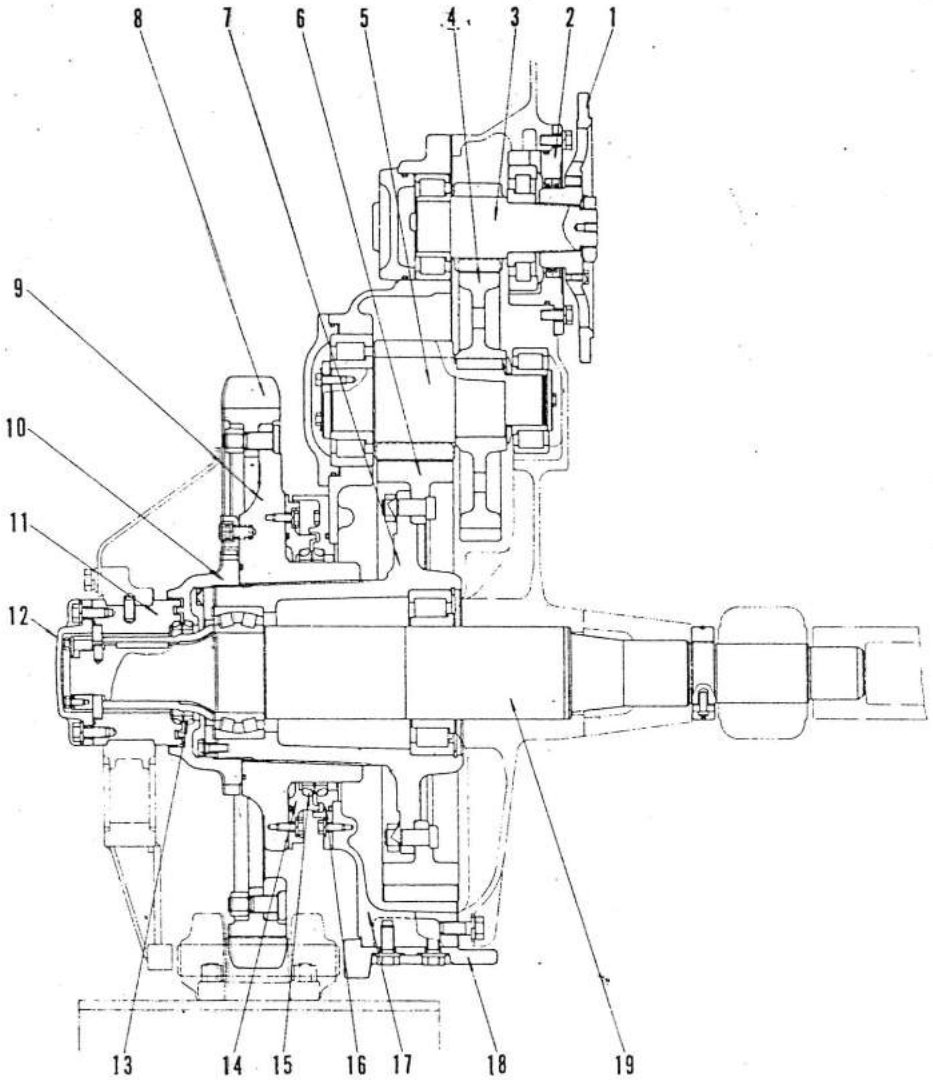
154F176

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

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FINAL DRIVE TY220

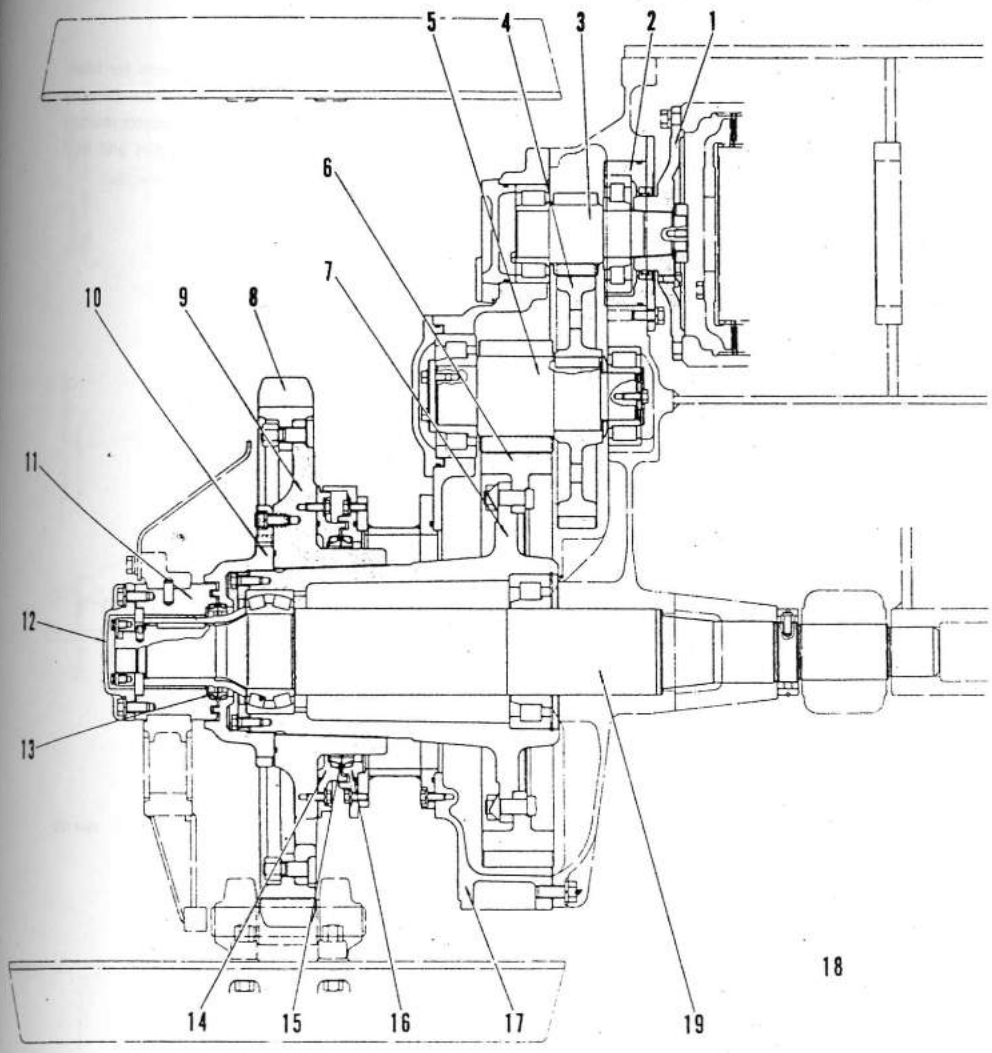


154F177

1. Final drive frange
2. Bearing cage
3. Final drive 1st pinion (12 teeth)
4. Final drive 1st gear (45 teeth)
5. Final drive 2nd pinion (12 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

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FINAL DRIVE TS 220



154F177

1. Final drive frange
2. Bearing cage
3. Final drive 1st pinion (12 teeth)
4. Final drive 1st gear (45 teeth)
5. Final drive 2nd pinion (12 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

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STRUCTURE AND FUNCTION

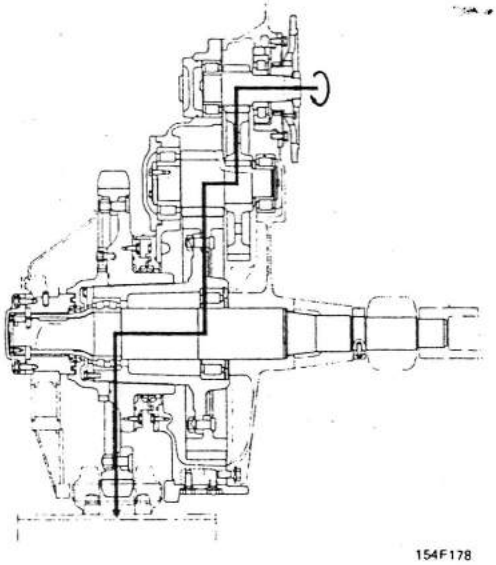
TY 220, TS 220 employ the two-step reduction method using spur gears and splash lubrication by gear rotation is used.

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.

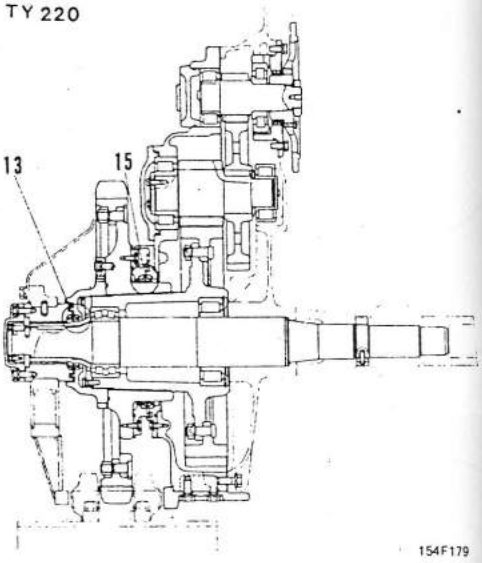
The sprocket teeth (8) are mounted on the sprocket boss with nuts and bolts.



154F178

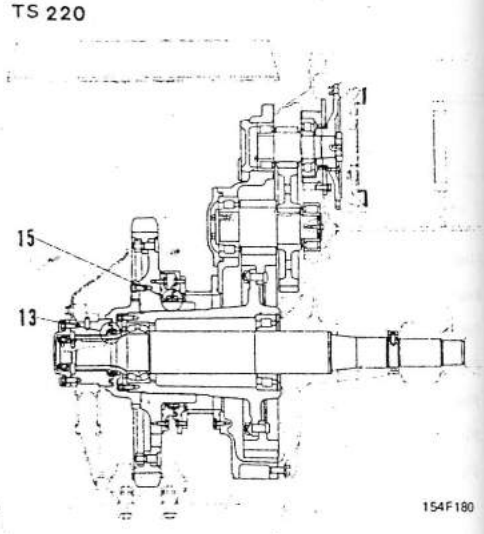
The final drive case (17) acts as an oil bath for lubricating the various gears in the final drive. Floating seals (13), (15) are fitted to the case to protect rotating and sliding parts of the sprocket from dirt and mud and also to prevent oil leakage.

TY 220



154F179

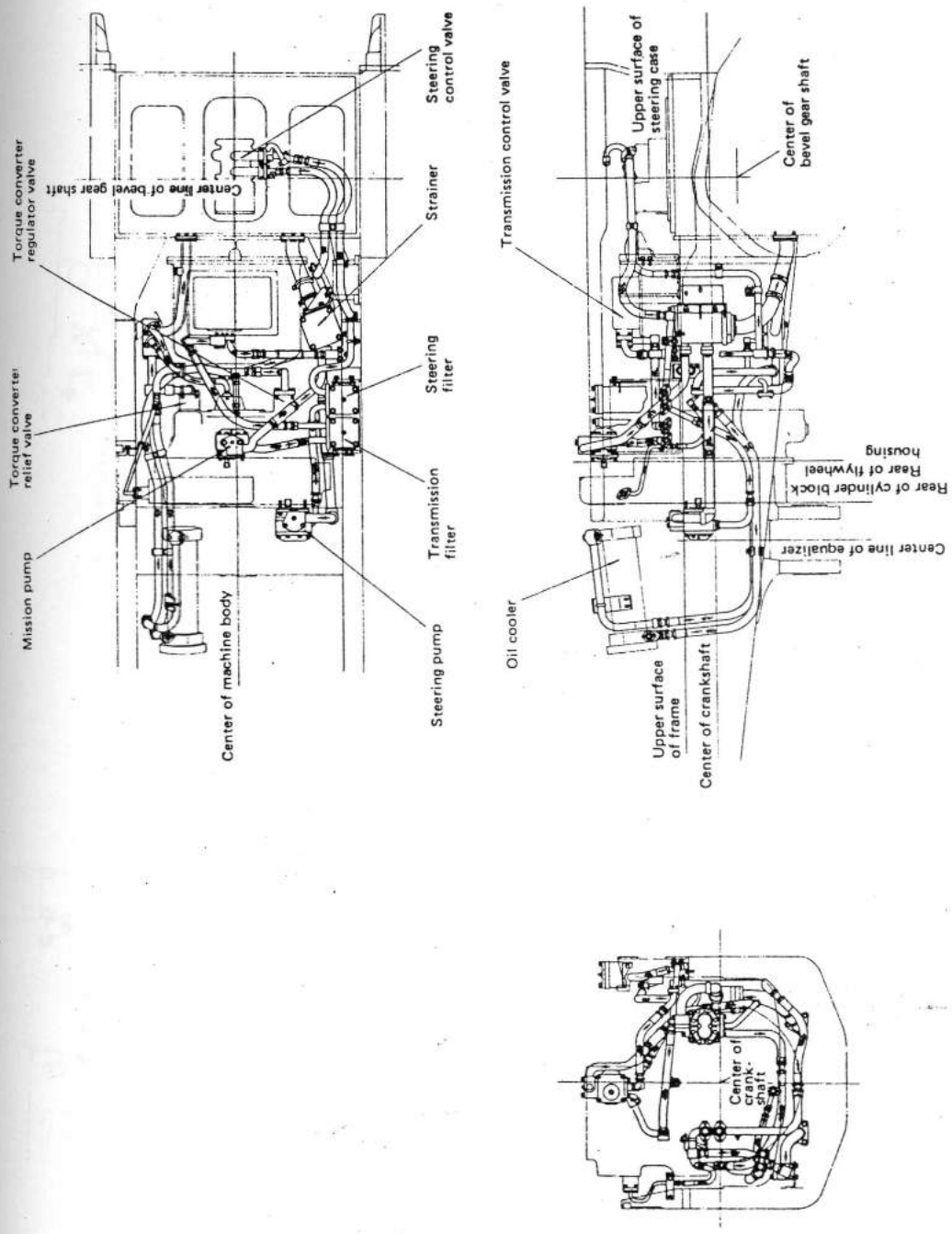
TS 220



154F180

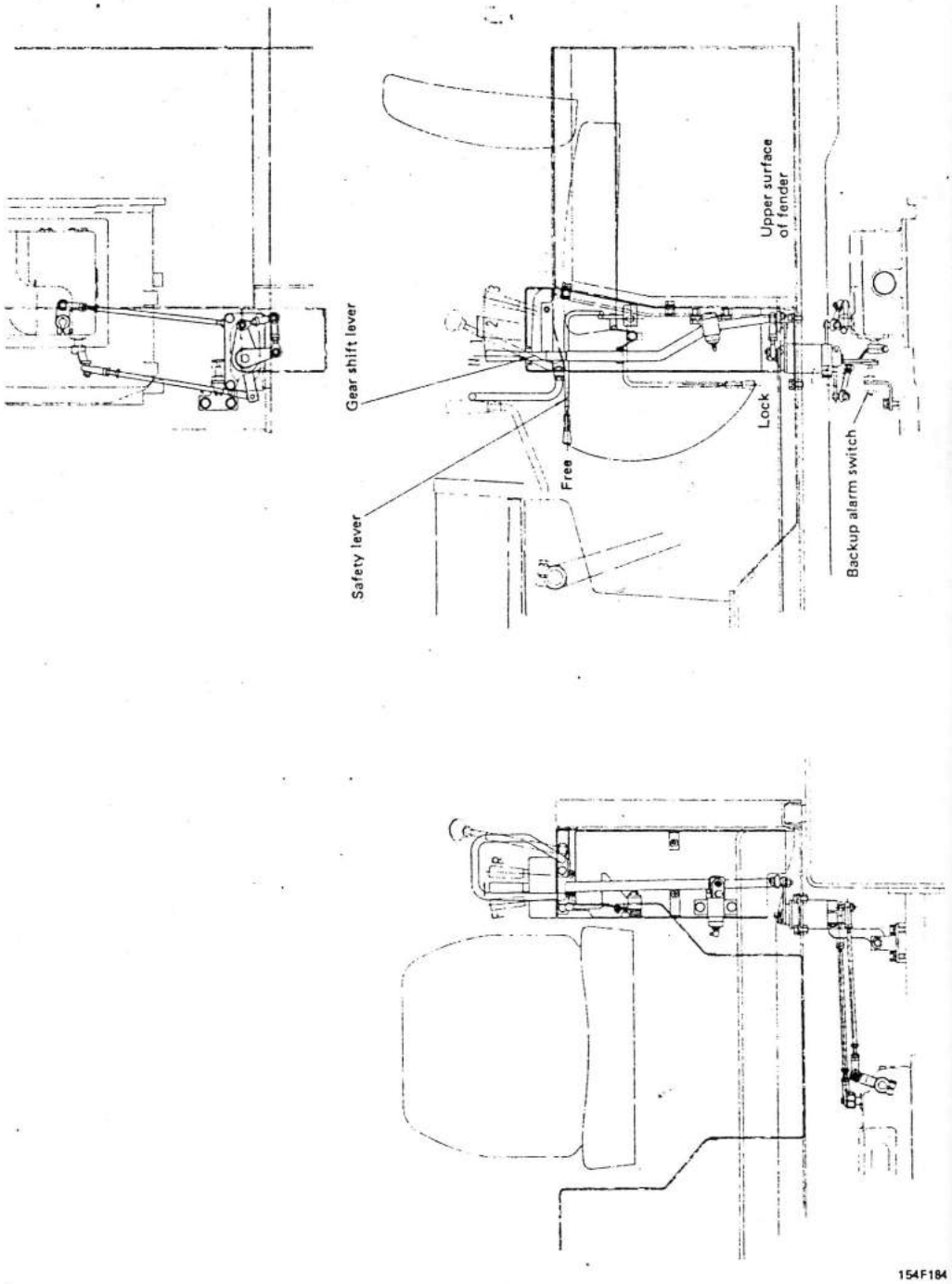
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STEERING AND TORQFLOW HYDRAULIC PIPING



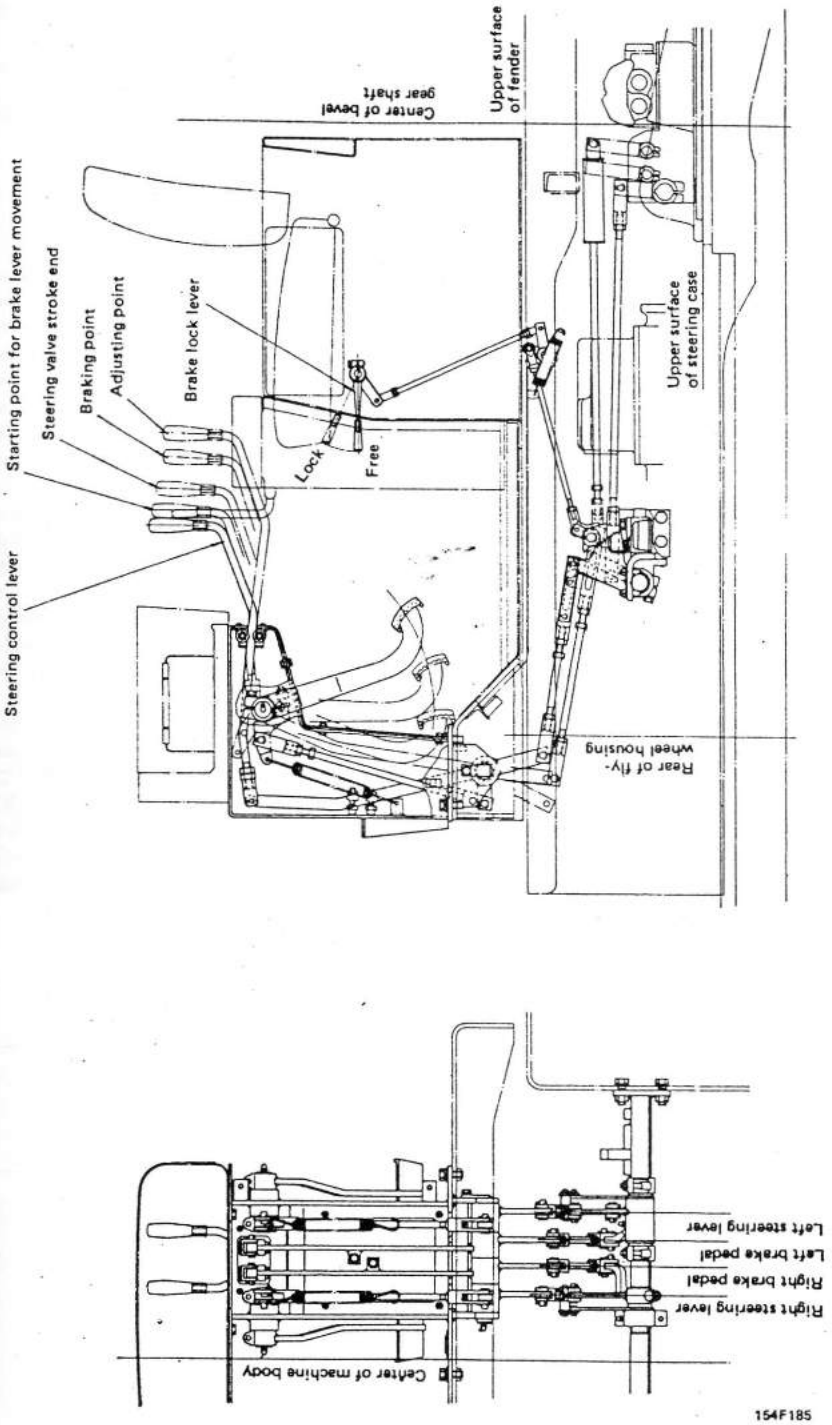
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TORQFLOW TRANSMISSION CONTROL

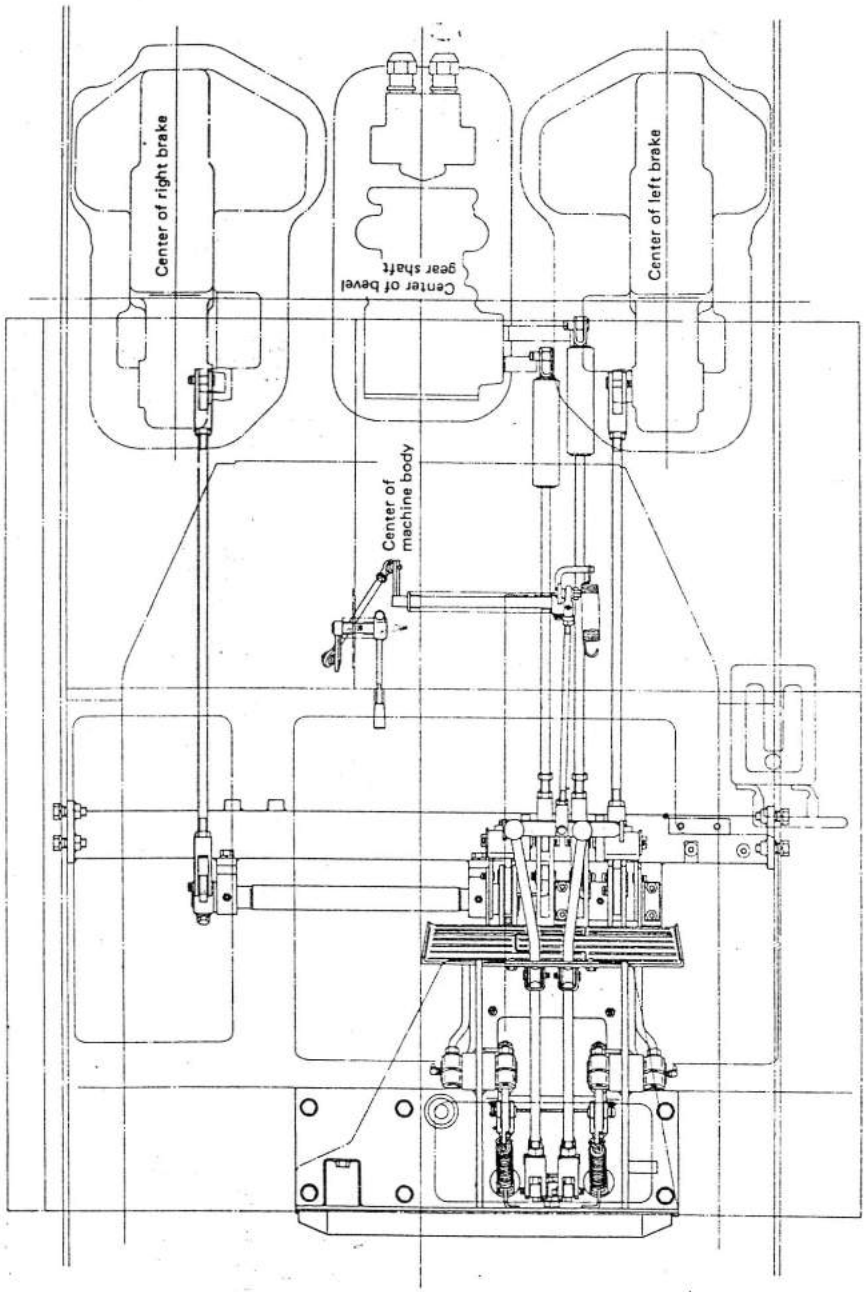


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STEERING CONTROL



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154F186

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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 last.

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.

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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.

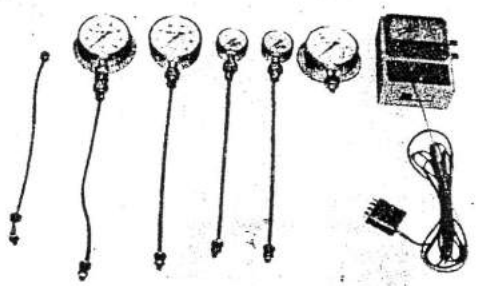
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OIL PRESSURE MEASURING POINTS

Item	Measuring point	Measuring plug size	Oil temperature during measurement (°C)	Set oil pressure (kg/cm²)		Remarks
				Engine fullspeed	Engine idling	
TORQFLOW hydraulic transmission	Torque converter relief pressure (inlet)	R ⅛ (PT⅛) 07042 – 00108	70 ~ 80	7 ~ 9		
	Torque converter regulator pressure (outlet)			3 ~ 5	2 ~ 3	
	Transmission clutch pressure	R ⅛ (PT ⅛) 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	R⅛ (PT⅛) 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

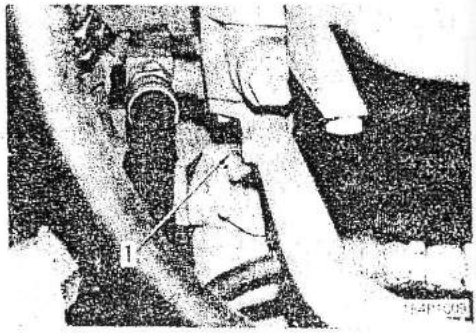
Part Name	A	B
Hydraulic tester	1	
Thermistor kit		1



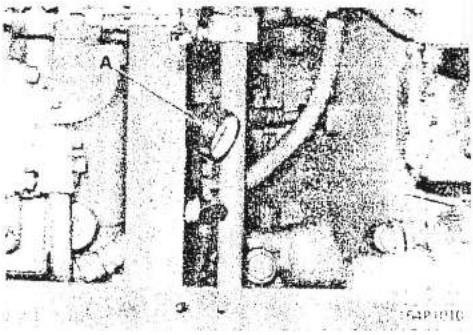
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OUTLINE OF OIL PRESSURE AND TEMPERATURE MEASUREMENTS

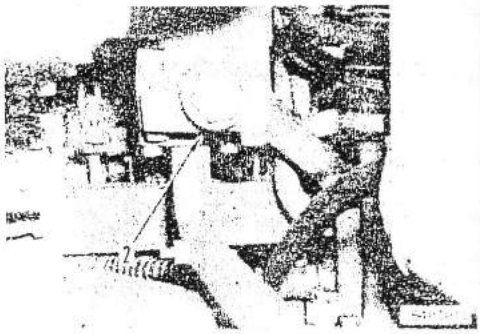
1. **Torque converter relief pressure measurement**
   1) Installation of oil pressure gauge
      i) Stop engine. Remove floor plate and then take out torque converter relief valve plug (1).
      ii) Fit pressure gauge **A** (25 kg/cm^2) with adaptor and hose.



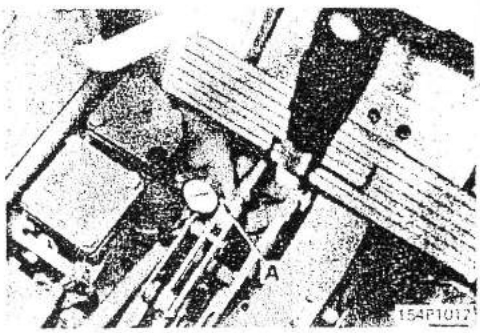
   2) Oil pressure measurement
      Put gear shift lever in "N" position and start engine. Measure oil pressure at both idle and full speed.
      ★ **Oil temperature during measurement: 70 to 80°C**
      ★ Be sure to lock parking brake.



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^2) with 90° adaptor and hose.

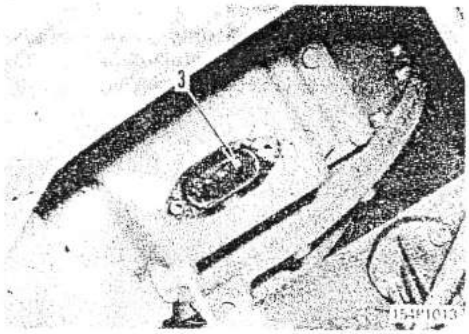


   2) Oil pressure measurement
      Put gear shift lever in "N" position and start engine. Measure oil pressure at both idle and full speed.
      ★ **Oil temperature during measurement: 70 to 80°C**
      ★ Be sure to lock parking brake.

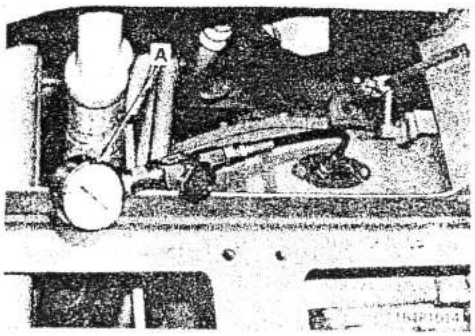


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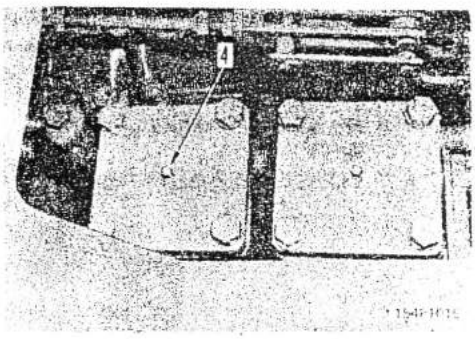
3. **TORQFLOW transmission 1st speed clutch pressure**
   1) Installation of oil pressure gauge
      i) Stop engine. Remove servo-valve front cover and transmission valve top cover, and take out plug (3).
      ii) Fit pressure gauge A (25 kg/cm^2) with adaptor and hose.



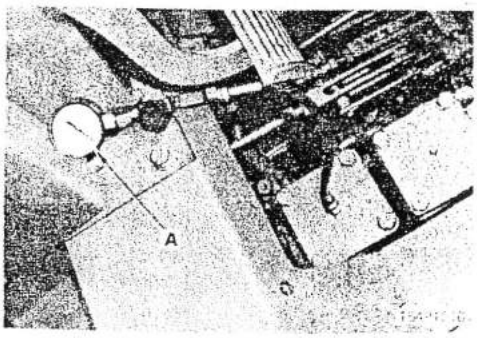
   2) Oil pressure measurement
      ★ Put gear shift lever in "N" position and start engine. Put gear shift lever in either forward or reverse position and measure oil pressure.
      ★ Note that machine will start moving when engine is set at full speed.
      ★ **Oil temperature during measurement: 70 to 80°C**



4. **TORQFLOW 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 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°C**
      ★ Be sure to lock parking brake.

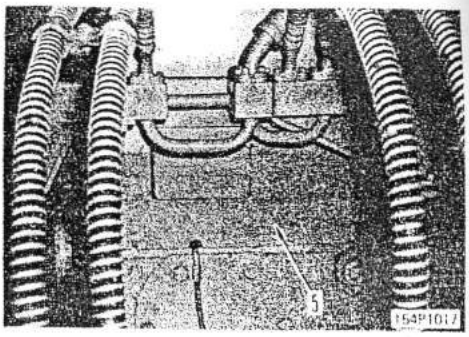


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5. Left and right steering clutch pressure measurement

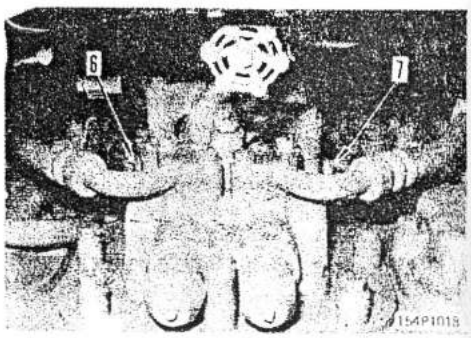
1) Installation of oil pressure gauge

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^2) with adaptor and hose.

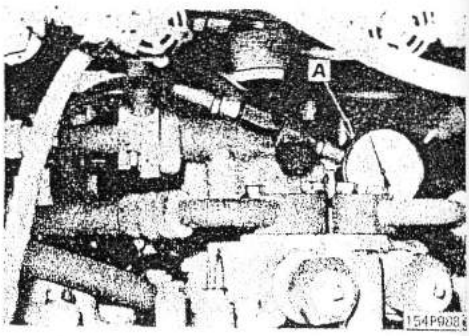


2) Oil pressure measurement

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

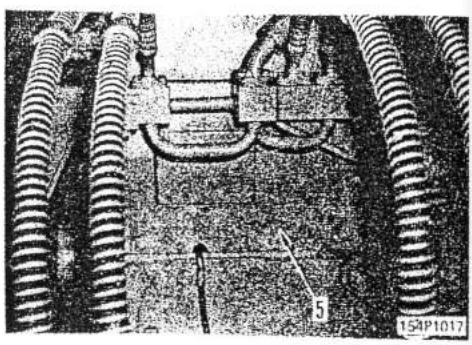
★ Be sure to lock parking brake.



6. Left and right brake relief pressure measurement

1) Installation of oil pressure gauge

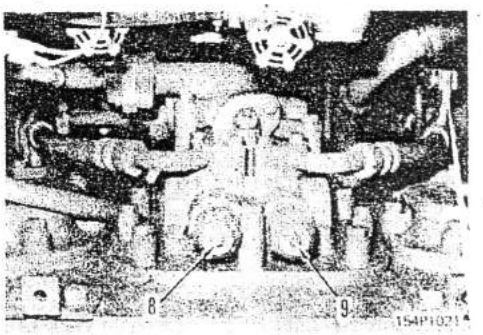
i) Stop engine and remove rear cover (5).



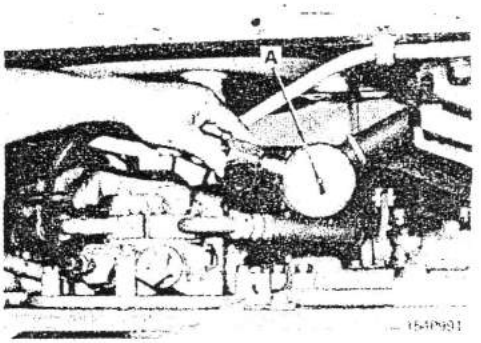
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ii) When measuring left brake relief pressure, remove plug (8), and when measuring right brake relief pressure, remove plug (9).

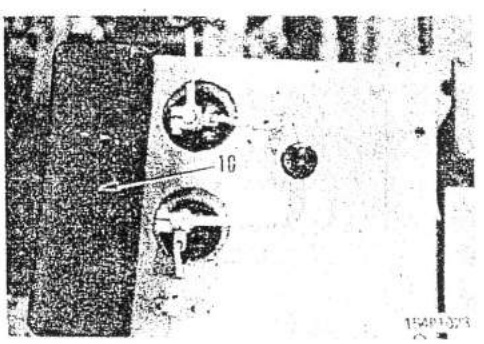
iii) Install oil pressure gauge A (70 kg/cm^2) with adaptor and hose.



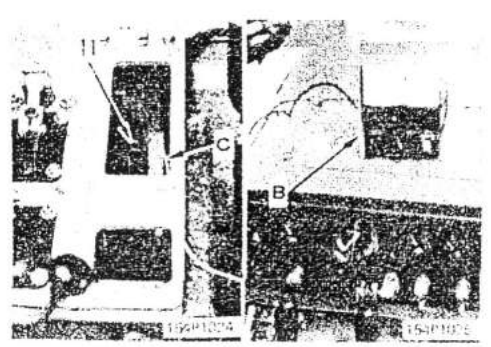
2) Oil pressure measurement
Put gear shift lever in "N" position and start engine. Depress brake pedal and measure oil pressure at both idle and full speed.
★ Oil temperature during measurement: 70 to 80°C
★ Be sure to lock parking brake.



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.

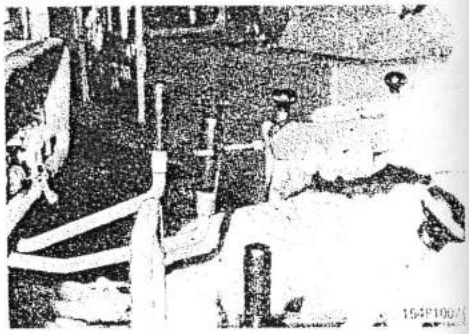


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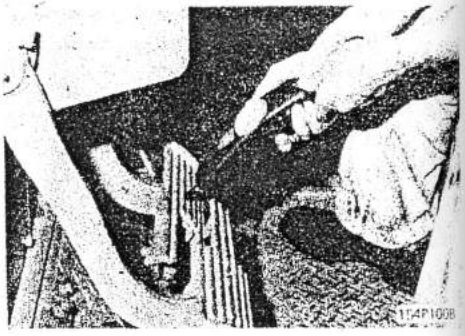
8. **Gear shift lever**
   1) Stop engine and hook push-pull scale onto lever knob.
   2) Pull scale and measure force required to move lever through each speed position.



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.



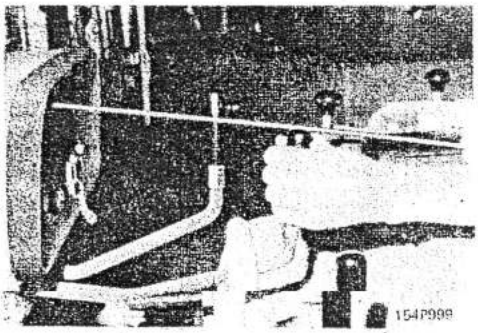
10. Brake pedal
   1) Put gear shift lever in "N" position and start engine. Set engine speed at 1000 rpm.
   2) Apply push-pull scale to center of brake pedal and put gear shift lever in 1st speed position. Push in pedal and measure force at instant engine stops or torque converter stalls on half brake.



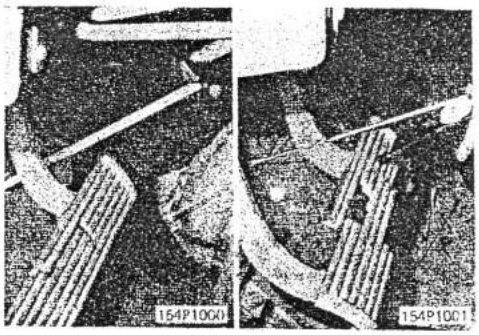
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TRAVEL MEASUREMENTS

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.



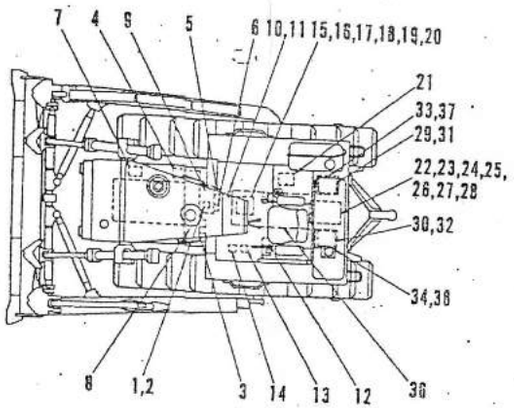
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STANDARD VALUES

	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	38 ~ 50 mm	
			Left/right direction (between F ↔ R)	60 ~ 80 mm	
	Steering lever	Engine idle	Until clutch disengages	81 ~ 101 mm	
			Until brake operates	129 ~ 159 mm	
	Brake pedal	Engine idle	Pedal pressure 15 kg	110 ~ 130 mm	
			Until engine stops to torque converter stalls		
Operating force	Fuel control lever		Idling → Full speed	4 ~ 8 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	7 kg max.	
			Until brake operates and muchine turns	10 kg max.	
	Brake pedal	Until engine stops or torque converter stalls on one brake		15 kg max.	
Oil pressure	Torque converter	Oil temp. 70 ~ 80°C	Inlet Idle		
			Inlet Full speed	7 ~ 9 kg/cm²	
			Outlet Idle	2 ~ 3 kg/cm²	
			Outlet Full speed	3 ~ 5 kg/cm²	
	TORQFLOW transmission	Oil temp. 70 ~ 80°C	Idle	18 ~ 24 kg/cm²	
			Full speed	23 ~ 27 kg/cm²	
	Steering clutch	Oil temp. 70 ~ 80°C	Idle	9 ~ 13 kg/cm²	
			Full speed	12 ~ 17 kg/cm²	
	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/cm²	Within 2 kg/cm² difference left & right brakes
			Full speed	15 ~ 20 kg/cm²	

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Item		Condition	Standard value	Tolerance value
Heat balance	Engine water temperature	TEST CONDITIONS 1. Specified amount of oil and water. 2. Excavate 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.	



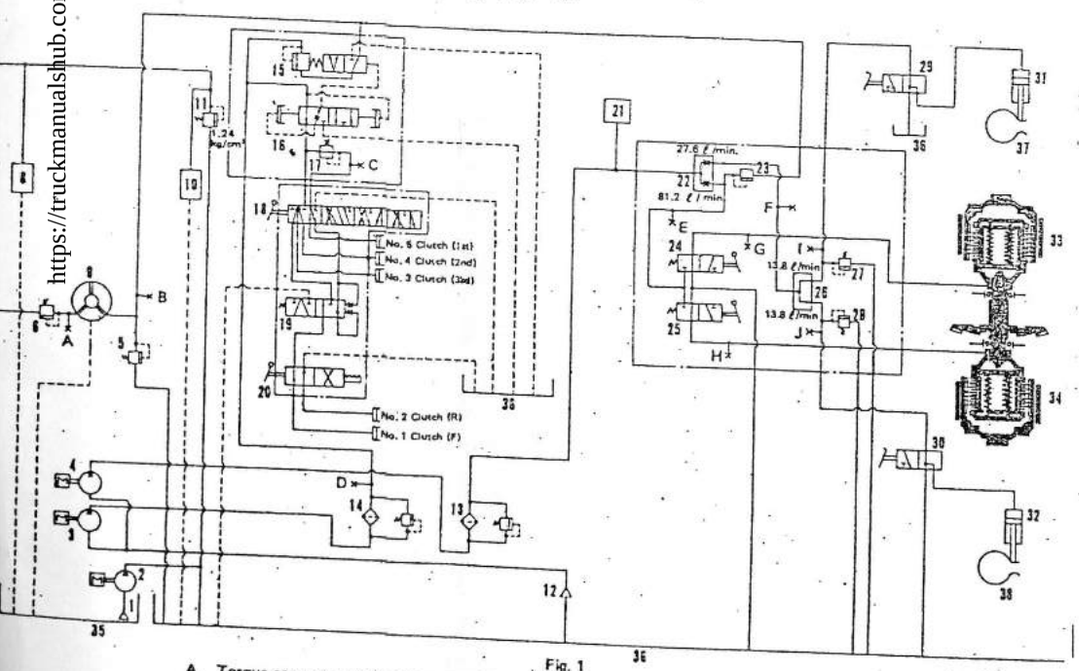


Fig. 1

A. Torque converter regulator 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 main pressure pickup plug (PT 1/8)
F. Steering brake pressure pickup plug (PT 1/8)
G. Right steering clutch pressure pickup plug (PT 1/8)
H. Left steering clutch pressure pickup plug (PT 1/8)
I. Right steering brake pressure pickup plug (PT 1/8)
J. Left steering brake pressure pickup plug (PT 1/8)

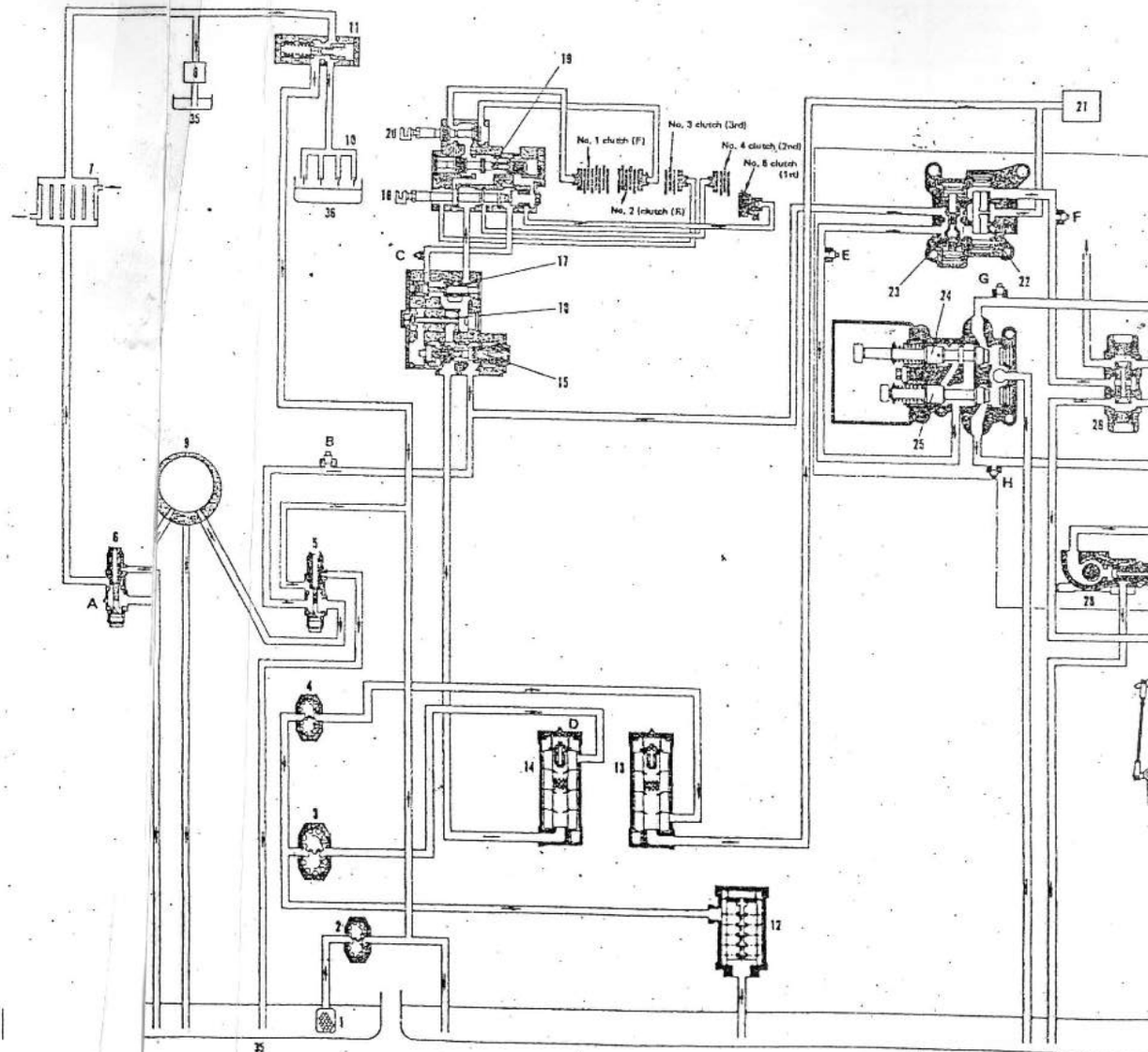


Fig. 2

1. Magnet strainer
2. Scavenging pump
3. Transmission pump (FAL040)
4. Steering pump (063)
5. Torque converter relief valve
6. Torque converter regulator valve
7. Oil cooler
8. P.T.O. lubrication
9. Torque converter
10. TORQFLOW transmission lubrication
11. Lubrication relief valve
12. Magnet strainer
13. Steering oil filter
14. TORQFLOW transmission oil filter
15. TORQFLOW transmission modulating valve
16. TORQFLOW transmission quick return valve
17. TORQFLOW transmission reducing valve
18. TORQFLOW transmission speed valve
19. TORQFLOW transmission safety valve
20. TORQFLOW transmission directional valve
21. Rotary servo valve
22. Steering flow divider
23. Steering main relief valve
24. Steering right clutch spool
25. Steering left clutch spool
26. Steering brake flow divider
27. Right steering brake relief valve
28. Left steering brake relief valve
29. Right steering brake spool
30. Left steering brake spool
31. Right ste
32. Left stee
33. Right ste
34. Left stee
35. Torque c
36. Steering
37. Right ste
38. Left stee

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OIL PRESSURE MEASURING POINT

Pressure	Measuring		Measuring method	Set oil pressure (kg/cm²)	
	Plug size	Location		Engine full speed	Engine idle speed
Torque converter regulator pressure	PT 1/8	Fig.1,2-A	Fit oil pressure gauge (25m²) with adapter and hose. Put gear shift lever in "N"tion and start engine. Measure oil pressure at both idle and speed. ★ Oil temperature during rement: 70 to 80°C ★ Be sure to lock parking.	3~6	2~3
Torque converter relief pressure	PT 1/8	Fig.1,2-B	Fit oil pressure gauge (2cm²) with adapter and hose. Put gear shift lever in "N"tion and start engine. Measure oil pressure at full speed. ★ Oil temperature duringurement: 70 to 80°C ★ Be sure to lock parking.	8.7~9	–
TORQFLOW transmission modulating pressure	PT 1/8	Fig.1,2-C	Fit oil pressure gauge (2cm²) with adapter and hose. Put gear shift lever in "N"tion and start engine. Put gear shift lever in either forw reverse position and measure oil pressure. ★ Note that machine w't moving when engine is set at full speed. ★ Oil temperature duriourement: 70 to 80°C	12.5	–
TORQFLOW transmission modulating pressure	PT 1/8	Fig.1,2-D	Fit oil pressure gauge g/cm²) with adapter and hose. Put gear shift lever in "sition and start engine. Measure oil pressure at both idle ull speed. ★ Oil temperature duriurement: 70 to 80°C ★ Be sure to lock parkike.	23~27	18~24
Left and right steering clutch pressure	PT 1/8	Fig.1,2-G,H	Fit oil pressure gauge g/cm²) with adapter and hose. Put gear shift lever in position and start engine. Pull steering lever until clutengages, and measure oil pressure at both idle and full spe ★ Oil temperature duri surement: 70 to 80°C ★ Be sure to lock park ke.	12~17	9~13
Left and right steering brake relief pressure	PT 1/8	Fig.1,2-I,J	Fit oil pressure gauge g/cm²) with adapter and hose. Put gear shift lever in position and start engine. Depress brake pedal and meas pressure at both idle and full speed. ★ Oil temperature dur asurement: 70 to 80°C ★ Be sure to lock park ke. ★ Within 2 kg/cm² diffe left and right brakes.	15~20	15~20

STANDARD VALUES

	Item	Condition		Standard 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	38 ~ 50 mm
			Left/right direction (between F ~ R)	60 ~ 80 mm
	Steering lever	Engine idle	Until clutch disengages	81 ~ 101 mm
			Until brake operates	129 ~ 159 mm
	Brake pedal	Engine idle	Pedal pressure 15 kg	110 ~ 130 mm
			Until engine stops to torque converter stalls	
Operating force	Fuel control lever		Idling → Full speed	4 ~ 8 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	7 kg max.
			Until brake operates and machine turns	10 kg max.
	Brake pedal	Until engine stops or torque converter stalls on one brake		15 kg max.
Heat balance	Engine water temperature	TEST CONDITIONS 1. Specified amount of oil and water. 2. Excavate 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.
Engine speed: Full				1950 ± 50 rpm
Engine speed: Slow				660 ± 50 rpm
Engine speed: When torque converter stalls		★ Torque converter oil temperature 70 ~ 80°C ★ Horizontal machine body		1540 ± 50 rpm
Machine speed	Forward 1st speed	★ Engine speed: Full ★ Road: Level (Slope: within 1%) ★ Work equipment: No load ★ Track shoe tension: Prescribed value ★ Measurement of time required to run 20 m after traveling the following distance: F1, R1: Over 15 m; F3, R3: Over 30 m F2, R2: Over 20 m		Within 20 sec.
	Forward 2nd speed			Within 11.1 sec.
	Forward 3rd speed			Within 6.4 sec.
	Reverse 1st speed			Witnin 16.8 sec.
	Reverse 2nd speed			Within 9.4 sec.
	Reverse 3rd speed			Within 5.5 sec.
Drawbar pull	Forward 1st speed	★ Engine speed: Full ★ Road condition: μ = 0.7 to 0.9 (Compacted level road) ★ Work equipment lever: Neutral ★ Torque converter oil temperature: 70 to 80°C		Shoe: Slip
	Forward 2nd speed			Torque converter : Stall
	Forward 3rd speed			Torque converter: Stall
Time lag when gear shifting transmission		★ Engine speed: Full ★ Torque converter oil temperature: 70 to 80°C ★ Time taken for track shoes to start to move after gear shift lever from neutral position to any other position.		0.2 to 0.8 sec.
Leakage inside torque converter		★ Stall torque converter, increase torque converter oil temperature up to 120°C and then decrease it down to 70°C at middle speed of engine. ★ Increase torque converter oil temperature up to 120°C by re-stalling torque converter and then idle engine at full speed and neutral for 5 minutes. ★ Stop engine suddenly, and drain all oil inside torque converter case within 5 minutes. Then, measure quantity of oil drained.		Within 10 ℓ

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

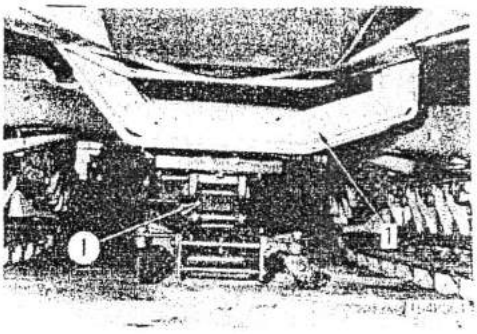
   ⚠ Insert blocks firmly so that machine does not tilt in any direction.

   ⚠ Apply steering brake firmly.

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

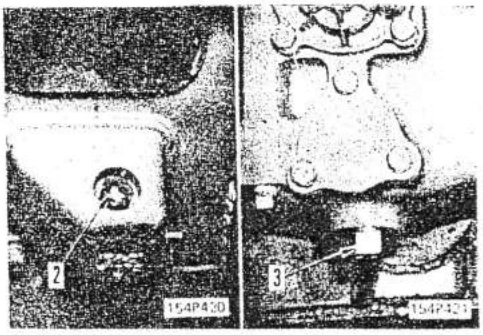
   ⚠ To avoid interference between under guard and diagonal brace, remove under guard by pushing it forward while gradually lowering transmission jack.

   kg Under guard: 160 kg

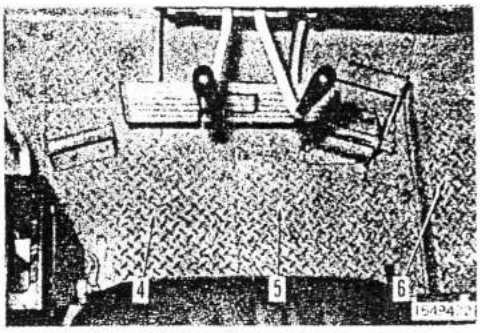


3. **Draining steering and transmission case**
   Remove drain plug (2) and drain off oil in transmission case.

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

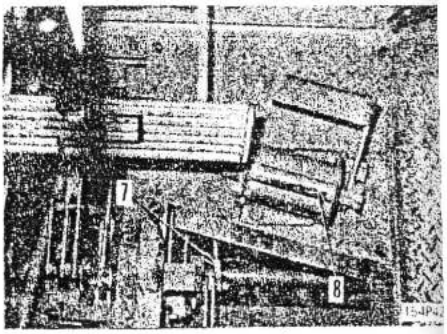


5. **Floor plate**
   1) Remove floor plates (4), (5) and (6).



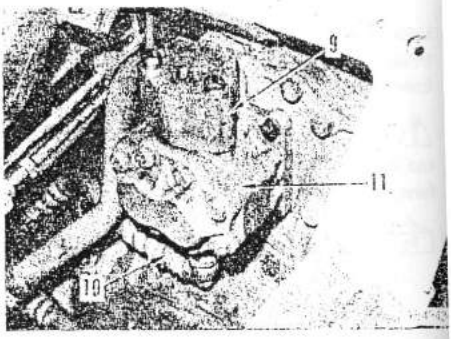
https://truckmanualshub.com/

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

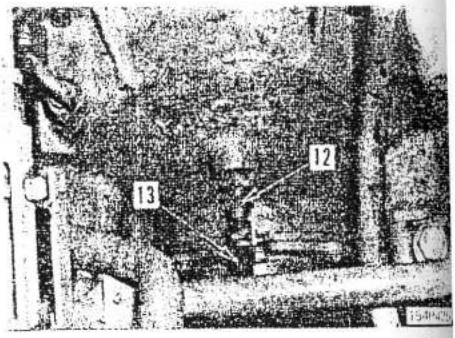


6. **Piping**
Disconnect transmission pump inlet tube (9) and outlet tube (10).

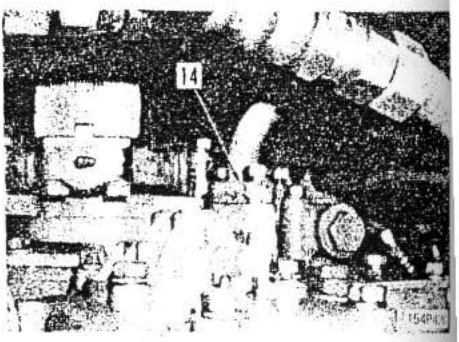
7. **Transmission pump assembly**
Remove transmission pump assembly (11).



8. **Torque converter breather hose**
Remove two sleeve nuts (12) and remove breather hose (13).

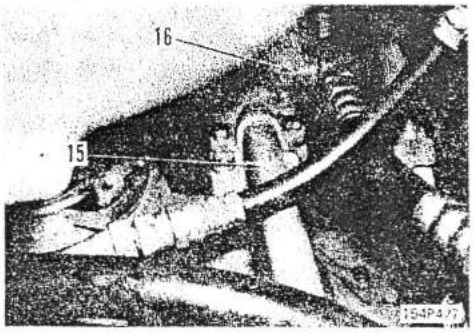


9. **Scavenging pump piping**
Disconnect scavenging pump outlet pipe (14).

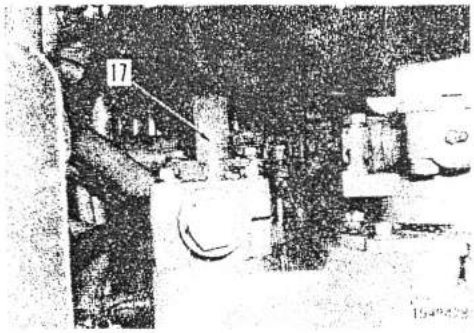


https://truckmanualshub.com/

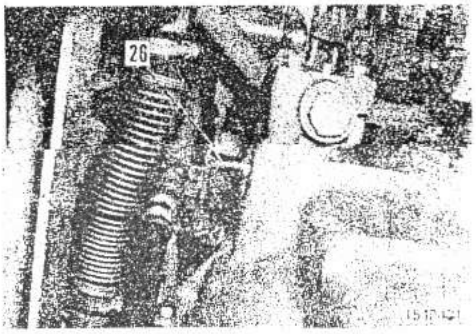
10. **Relief valve piping**
Disconnect relief valve inlet tube (15) and outlet tube (16).



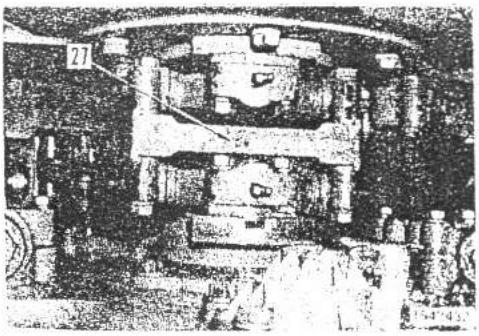
11. **Regulator valve piping**
Disconnect regulator valve outlet tube (17).



12. **Oil temperature gauge wiring**
Disconnect torque converter oil temperature gauge wiring (26).



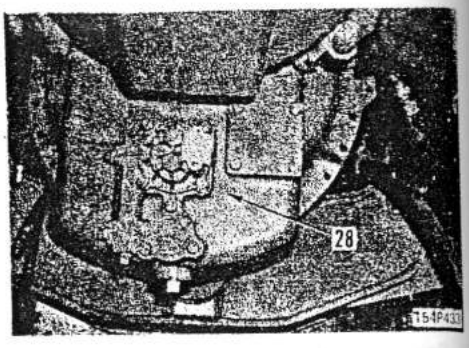
13. Universal joint assembly
Remove universal joint assembly (27).
★ Remove all mounting bolts with joint mounted on machine. Remove all mounting bolts from torque converter side and then remove mounting bolts from transmission side.



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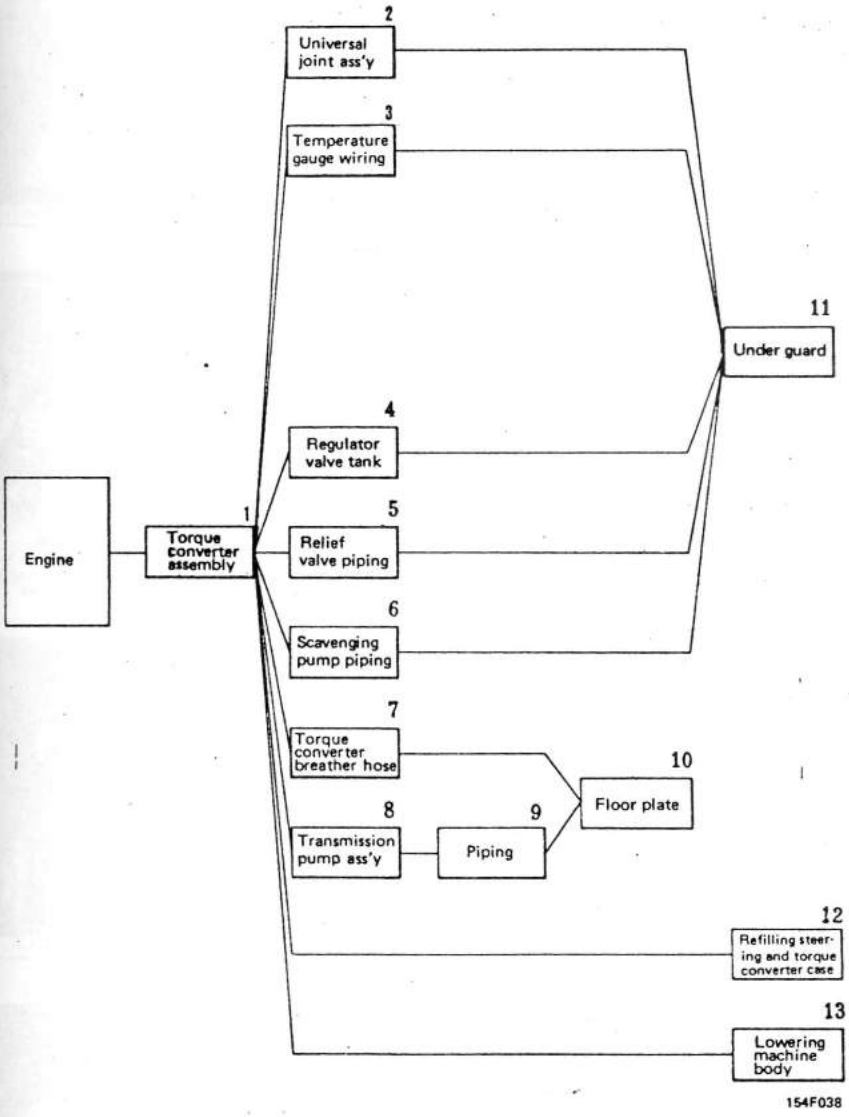
14. Torque converter assembly
    1) Temporarily hoist torque converter assembly (28).
    2) Remove 22 mounting bolts.
    3) Separate torque converter assembly from flywheel housing with extraction bolts, and lower it away.

    kg Torque converter assembly: 210 kg



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MOUNTING TORQUE CONVERTER ASSEMBLY



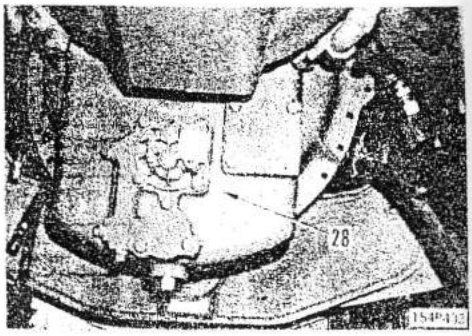
https://truckmanualshub.com/

1. Torque converter assembly

1) Fit gasket to flywheel housing.

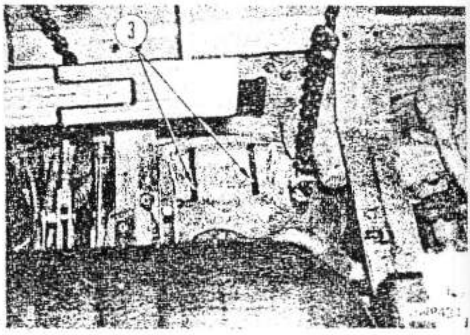
Gasket: Liquid gasket

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.

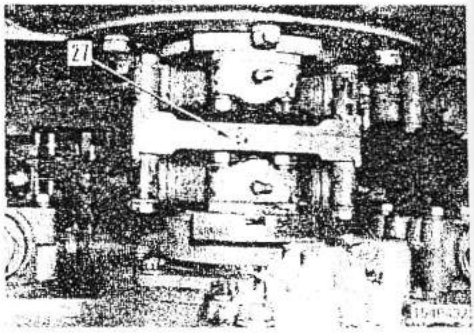
4) Tighten 22 mounting bolts.



2. Universal joint assembly

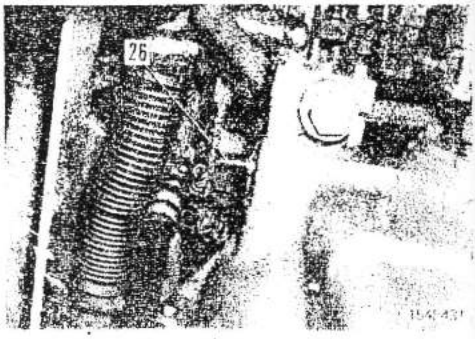
1) Position universal joint assembly (27). Fit transmission side mounting bolts and then fit converter side mounting bolts.

2) Additionally tighten all mounting bolts.



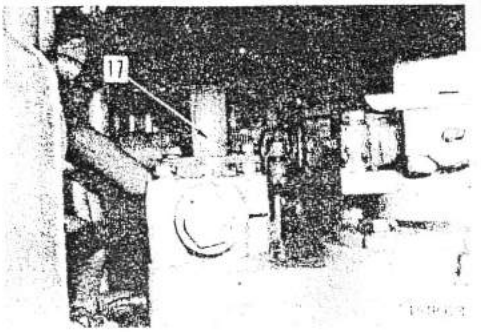
3. Oil temperature gauge wiring

Connect oil temperature gauge wiring (26).

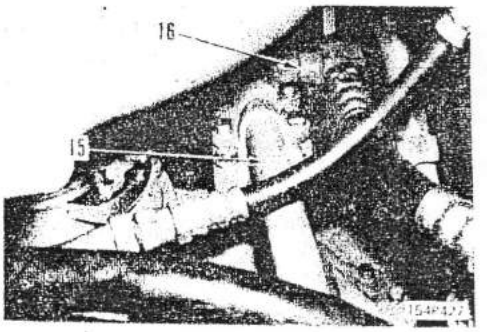


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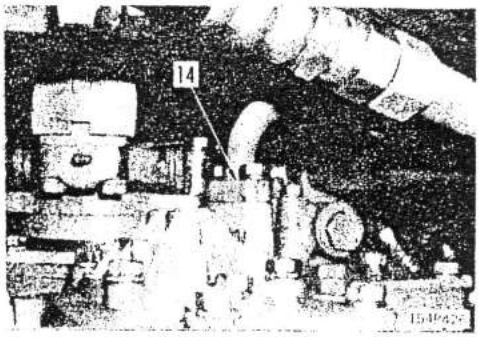
4. **Regulator valve piping**
   Fit O-ring and connect regulator valve outlet tube (17).



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

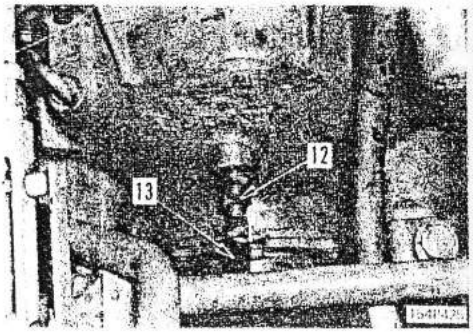


6. **Scavenging pump piping**
   Fit O-ring and connect scavenging pump outlet tube (14).



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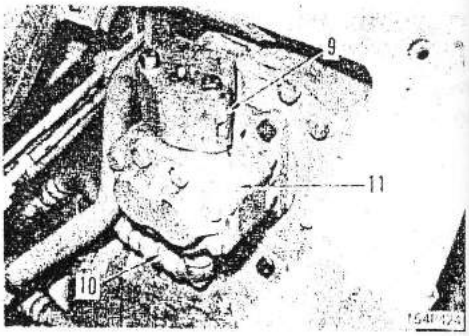
7. **Torque converter breather hose**
Fit breather hose (13) and connect sleeve nut (12).



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

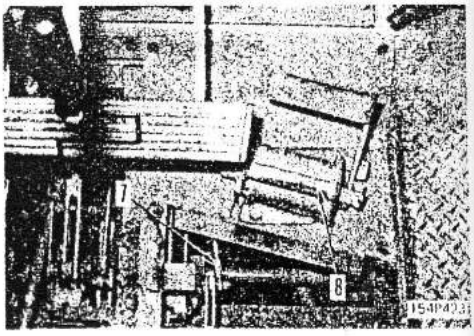
9. **Piping**
Fit O-ring and connect transmission pump outlet tube (10) and inlet tube (9).

⊕ Fit O-ring securely in groove.



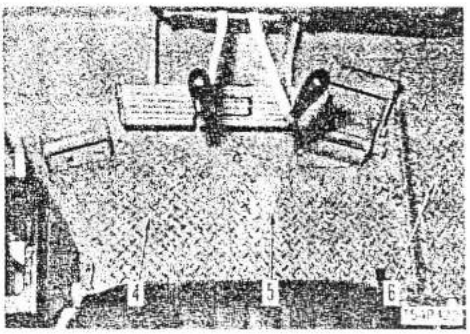
10. **Floor plate**
1) Install floor plate (8) and connect decelerator pedal rod (7).

⊕ Bend cotter pin securely.



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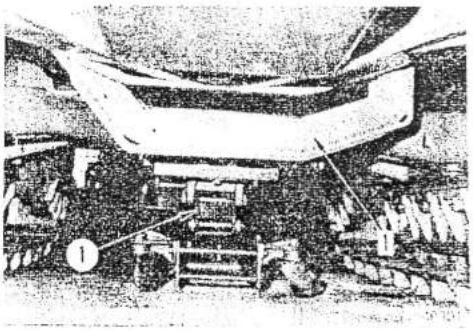
2) Install floor plates (6), (5) and (4).



11. Under guard

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

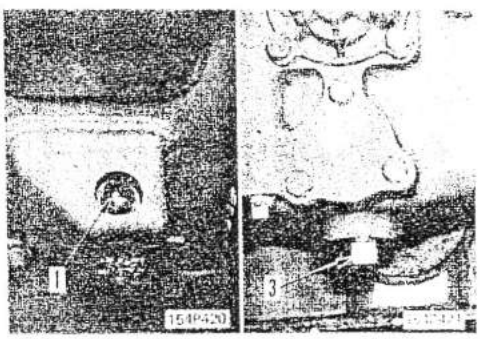
⚠ To avoid interference between under guard and diagonal brace, install under guard by shifting it into position while gradually raising mission jack.



12. Refilling steering and torque converter case

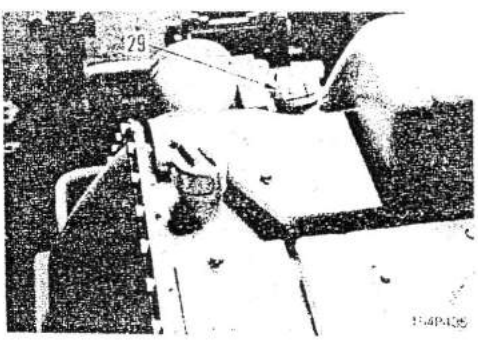
1) Tighten up drain plugs (2) and (3) on steering case and torque converter sides respectively.
2) Fill hydraulic tank through oil filler (29) with engine oil until specified level is reached.

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



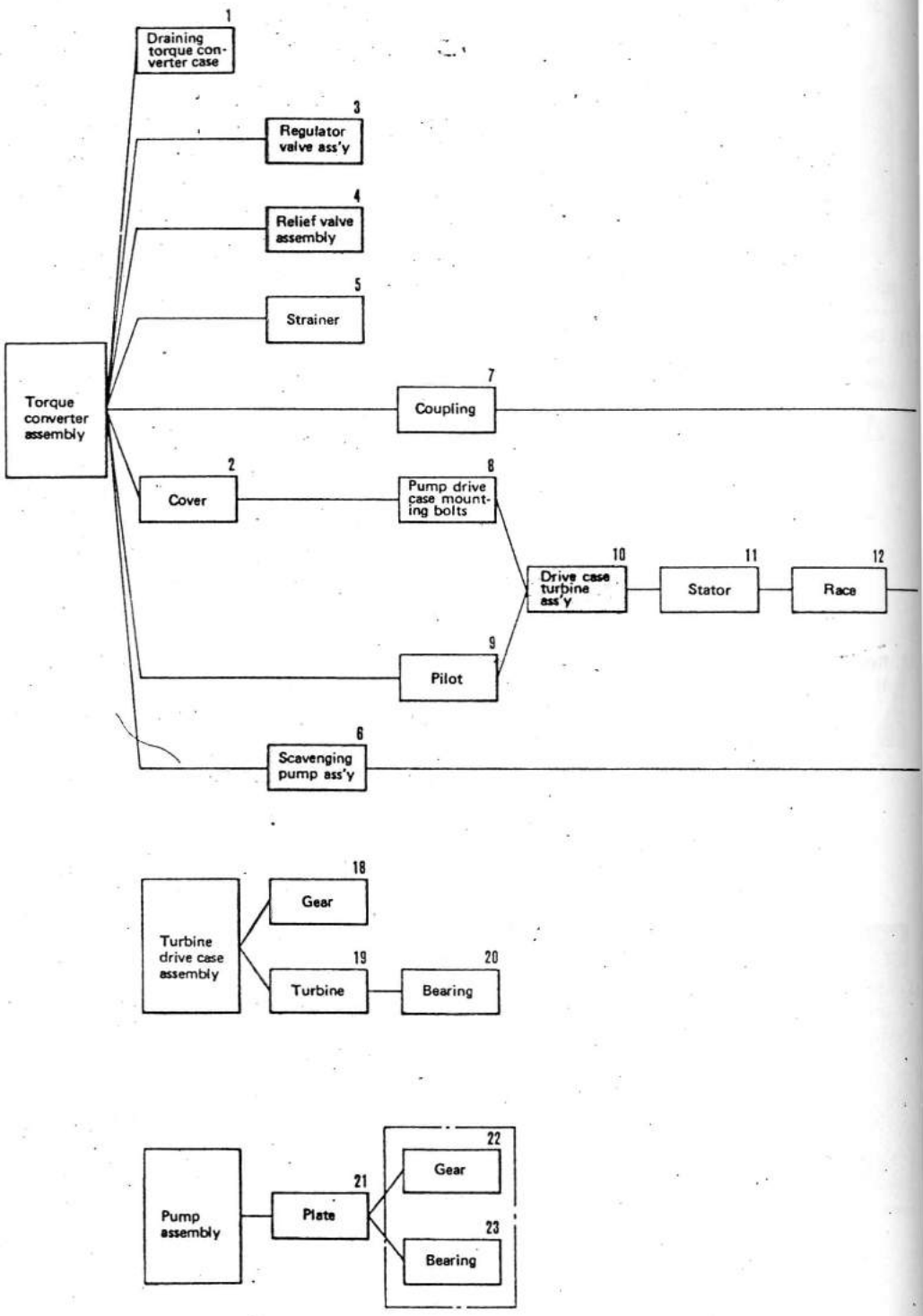
13. Lowering machine body

Lower machine body by removing blocks from under tracks.

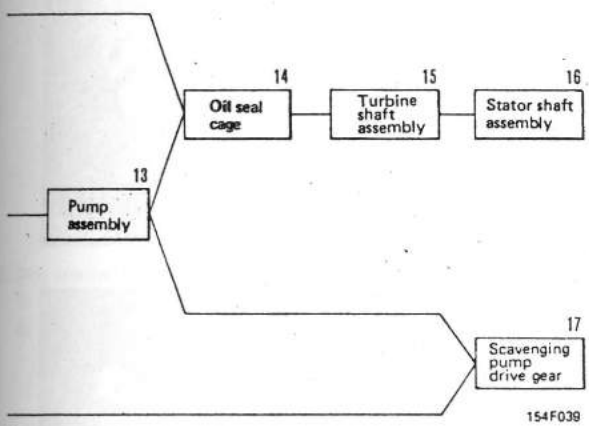


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DISASSEMBLY OF TORQUE CONVERTER ASSEMBLY



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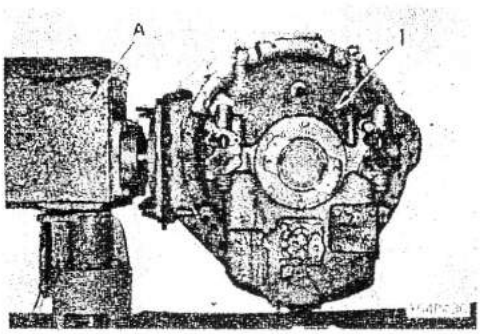
Special tools

Part Name	A
Unit repair stand	1
Bracket	1

Preparatory work

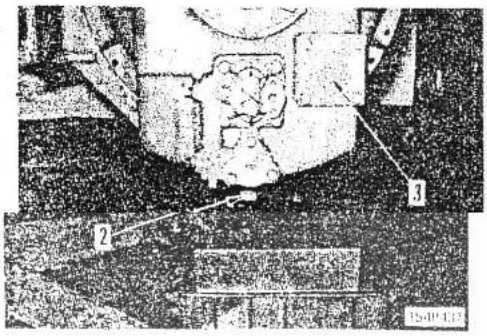
- Set torque converter assembly **(1)** on unit repair stand A.

kg Torque converter assembly: 210 kg

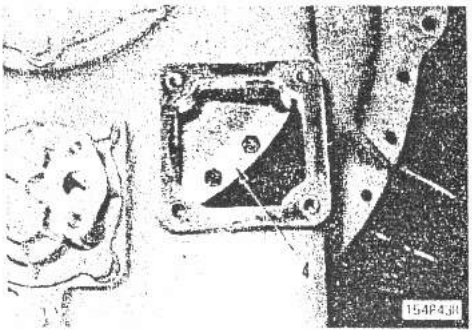


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1. **Draining torque converter case**
   1) Remove drain plug (2).

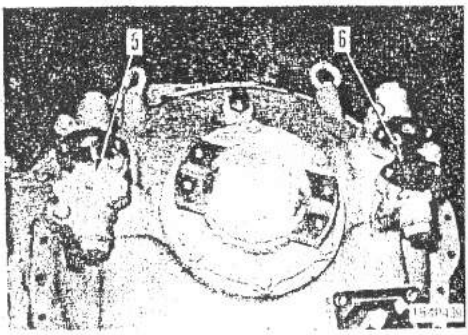


2. **Cover**
   1) Remove cover (3).
   2) Remove two drain plugs (4), and drain off oil in drive case.



3. **Regulator valve assembly**
   Remove regulator valve assembly (5).

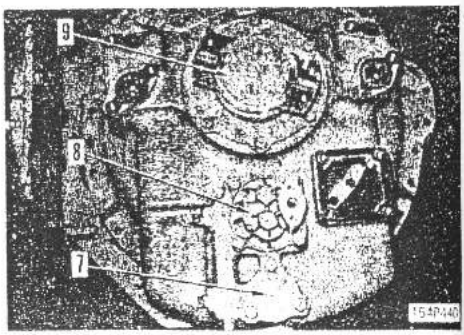
4. **Relief valve assembly**
   Remove relief valve assembly (6).



5. **Strainer**
   Remove strainer (7).

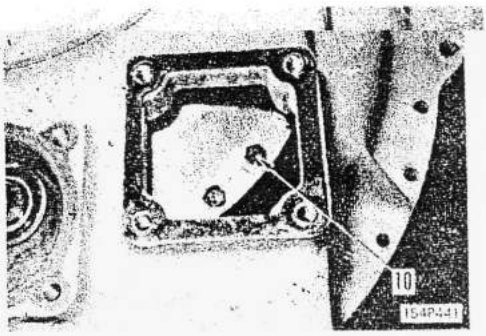
6. **Scavenging pump assembly**
   Remove scavenging pump assembly (8).

7. **Coupling**
   Remove coupling (9).

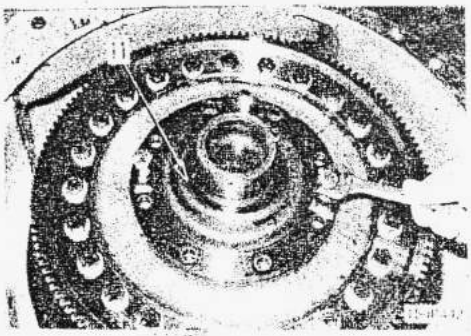


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8. Pump and drive case mounting bolts
Remove 30 pump and drive case mounting bolts (10).

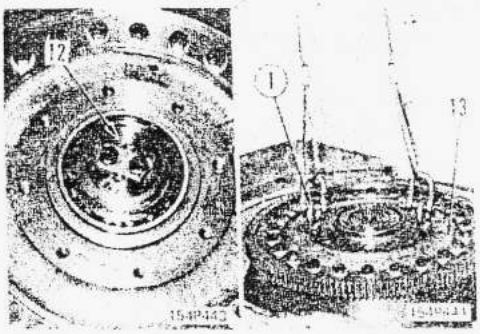


9. Pilot
1) Rotate repair stand so that input side of torque converter is facing upwards.
2) Remove mounting bolts and remove pilot (11) using extraction bolts.

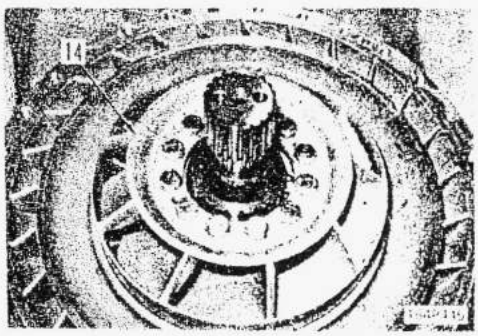


10. Drive case and turbine assembly
1) Remove mounting bolts and remove holder (12).
2) Lift out drive case and turbine assembly (13) with hanging bolts ① (12 mm, P = 1.75).

kg Drive case and turbine assembly: 55 kg

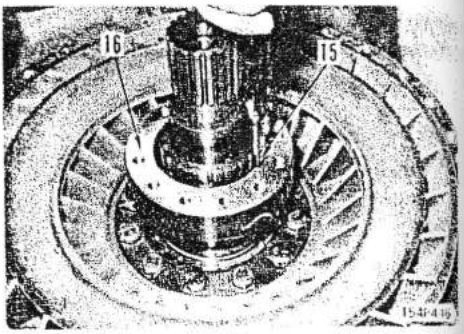


11. Stator
Remove mounting bolts and remove stator (14).

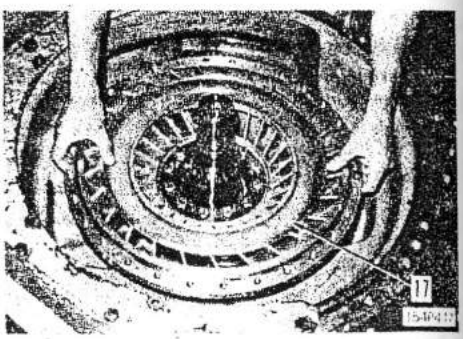


https://truckmanualshub.com/

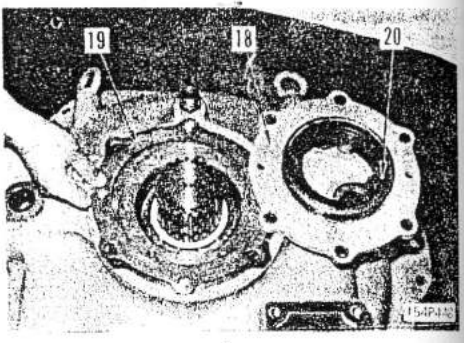
12. Race
Take off snap ring (15) and remove race (16).



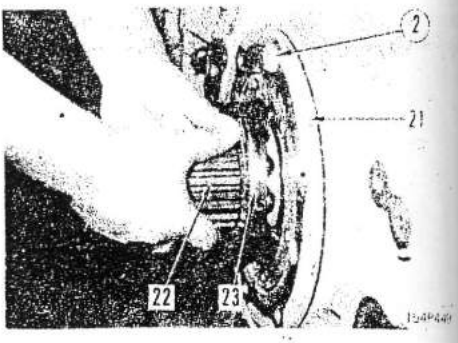
13. Pump assembly
Remove pump assembly (17).



14. Oil seal cage
1) Rotate repair stand no 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.

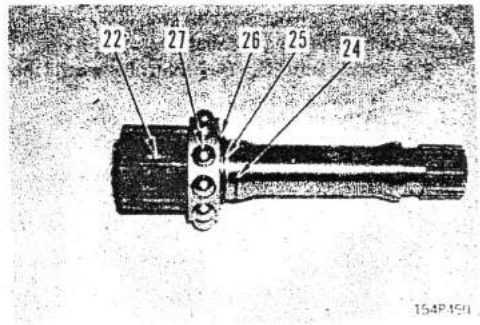


15. Turbine shaft assembly
1) Secure stator shaft (21) with bolts ②
2) Rotate repair stand and remove turbine shaft (22) by lightly tapping it with plastic hammer from inside of torque converter.
★ Outer race (23) will come away together with turbine shaft.



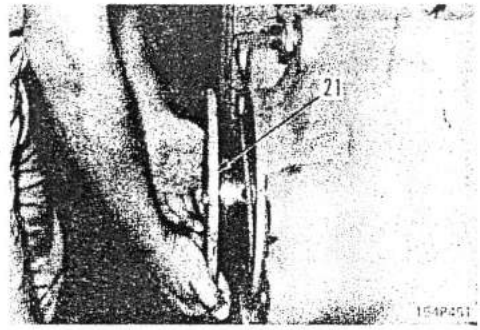
https://truckmanualshub.com/

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

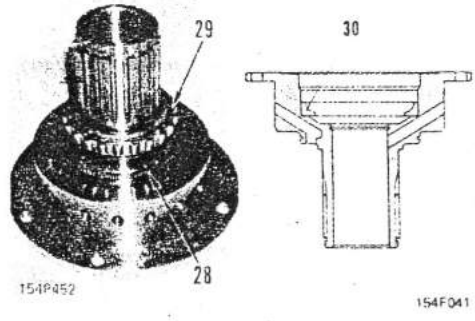


16. Stator shaft assembly

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

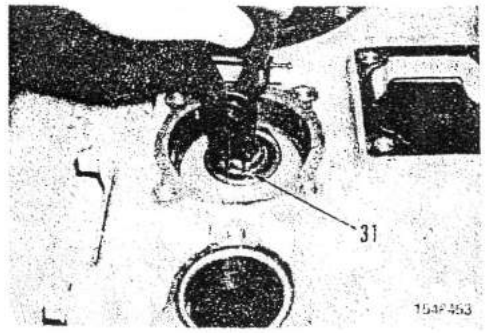


2) Remove seal ring (28), bearing (29) and outer race (30) from stator shaft assembly.



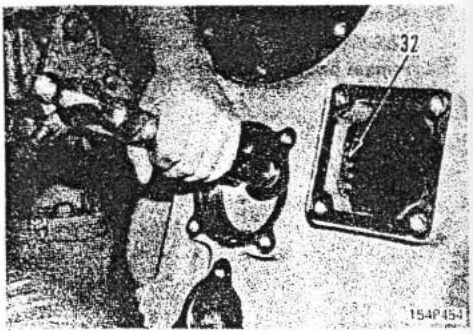
17. Scavenging pump drive gear

1) Remove snap ring (31).

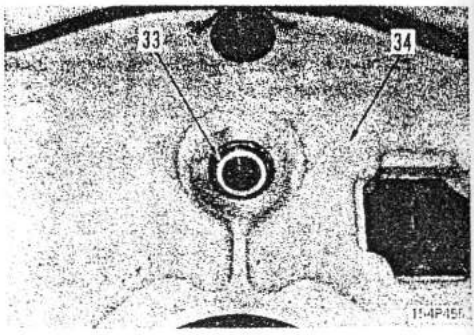


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2) Remove scavenging pump gear (32) from inside of case by knocking out shaft.
★ When knocking out shaft be careful not to damage gear spline.

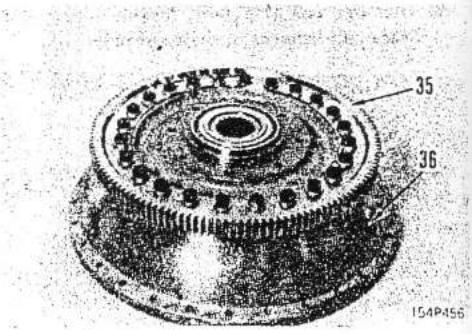


3) Remove bearing (33) from case (34).

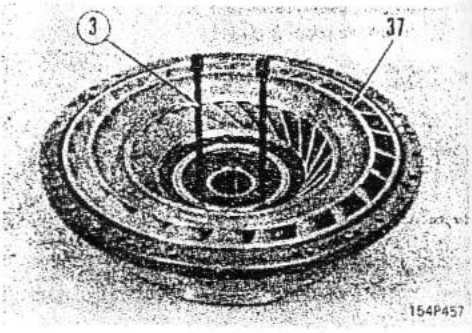


DISASSEMBLY OF DRIVE CASE AND TURBINE ASSEMBLY

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

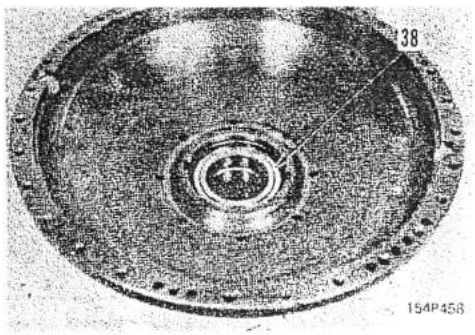


19. Turbine
Remove turbine (37) from drive case with extraction bolts (3) (10 mm, P = 1.5, = 100 mm).



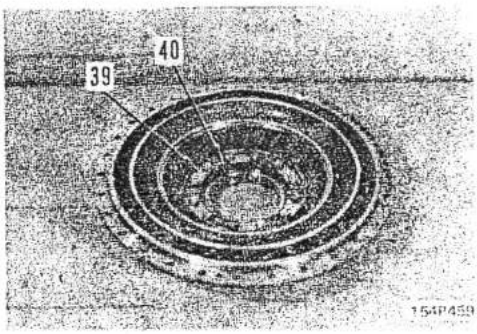
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20. Bearing
Remove bearing (38) from drive case.

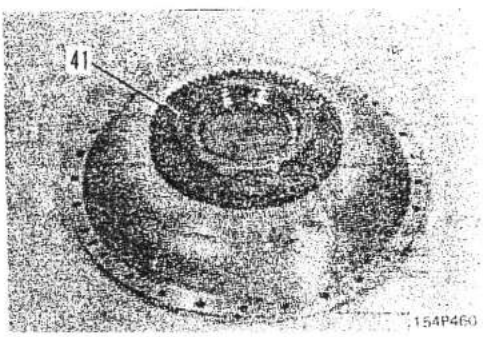


DISASSEMBLY OF PUMP

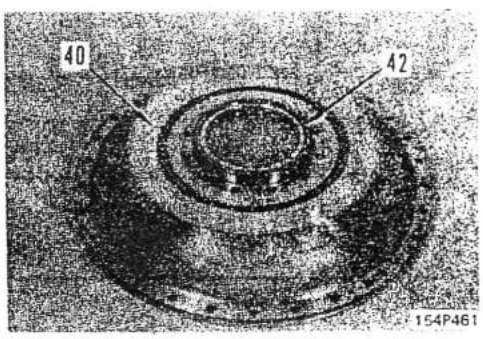
21. Plate
Remove mounting bolts and remove plate (39) from pump (40).



22. Gear
Remove gear (41) from bearing.

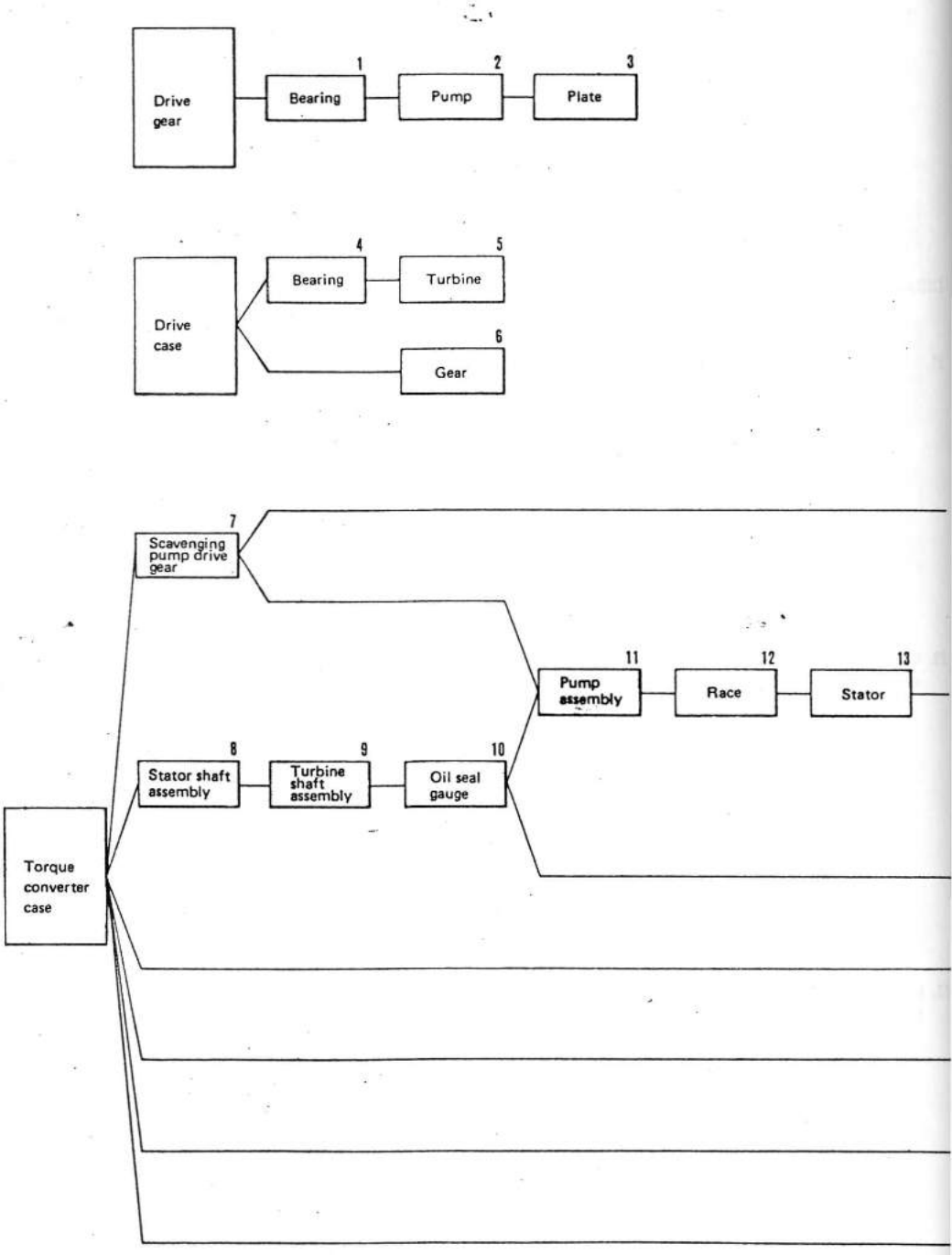


23. Bearing
Remove bearing (42) from pump (40).

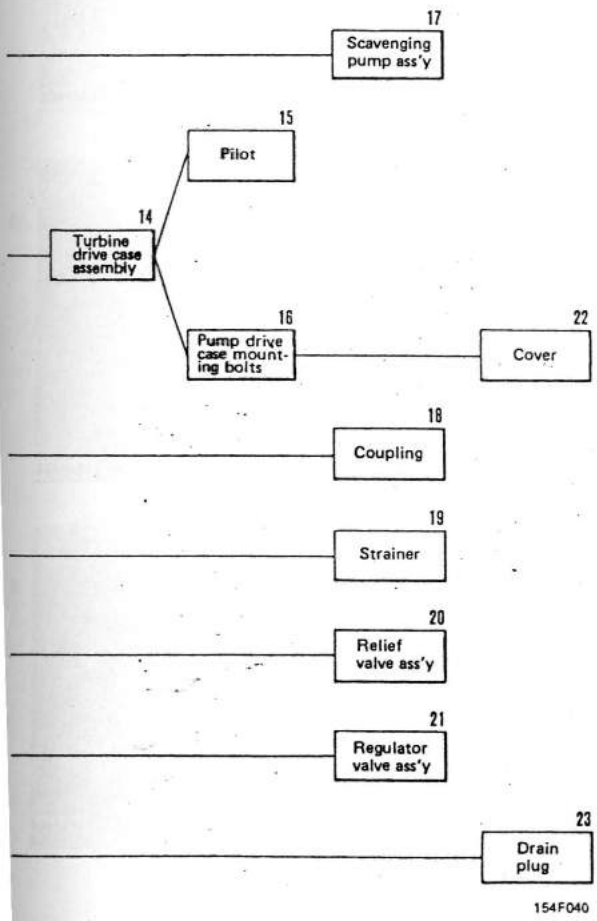


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ASSEMBLY OF TORQUE CONVERTER ASSEMBLY



https://truckmanualshub.com/



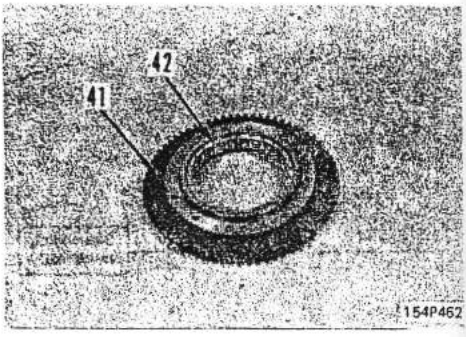
https://truckmanualshub.com/

Special tools

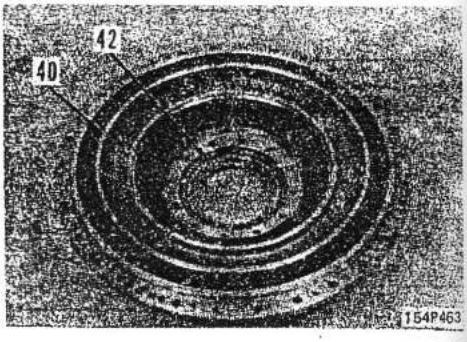
Part Name	A
Unit repair stand	1
Bracket	1

ASSEMBLY OF PUMP ASSEMBLY

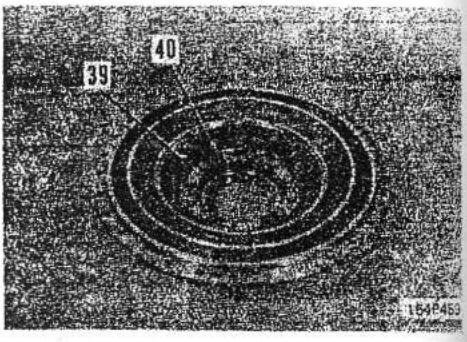
1. Bearing
   Fit bearing (42) to gear (41).



2. Pump
   Fit pump (40) to bearing (42).
   ★ Install pump after aligning bolt holes of pump and pump gear.



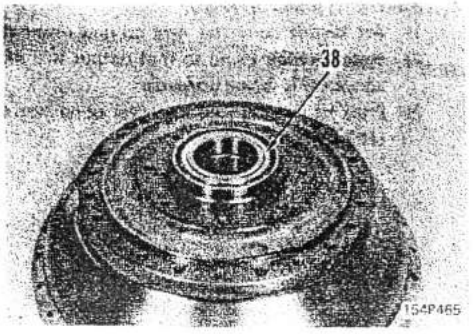
3. Plate
   Install plate (39). Fit lock plates and tighten bolts.
   ★ Bend lock plates securely.



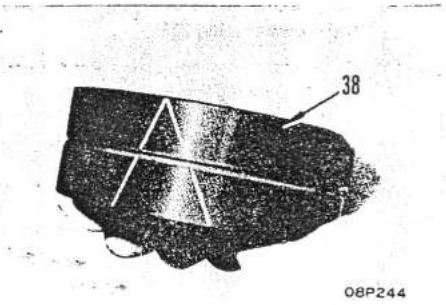
https://truckmanualshub.com/

ASSEMBLY OF DRIVE CASE AND TURBINE ASSEMBLY

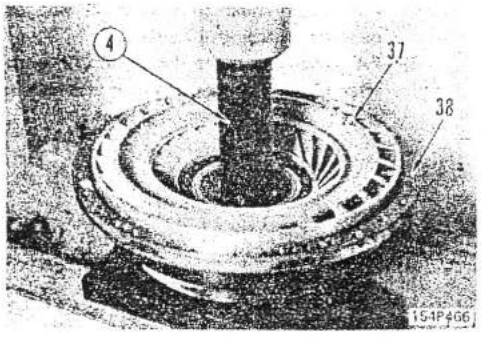
4. Bearing
   Press fit bearing (38) using push tool (internal dia. 70 mm).



★ 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.

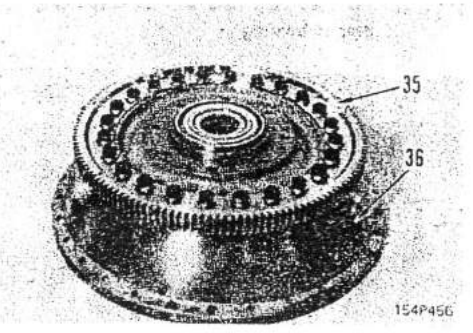


5. Turbine
   Press fit turbine (37) into drive case (36) using push tool (4) (ϕ60 mm).



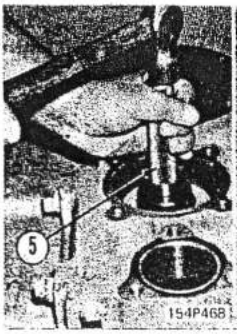
6. Gear
   Fit gear (35) into drive case (36) and tighten mounting bolts.

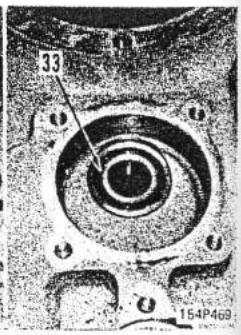
   Mounting bolts: 11.25±1.25 kg.m



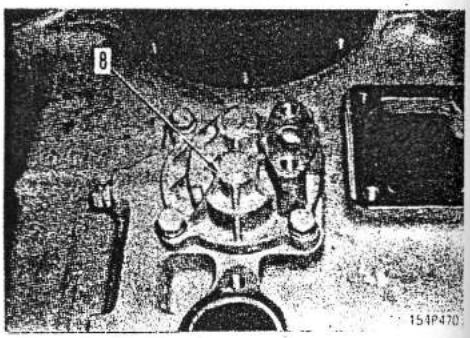
https://truckmanualshub.com/

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) (ø62 mm).

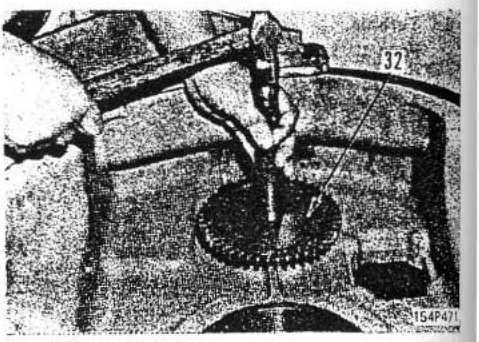




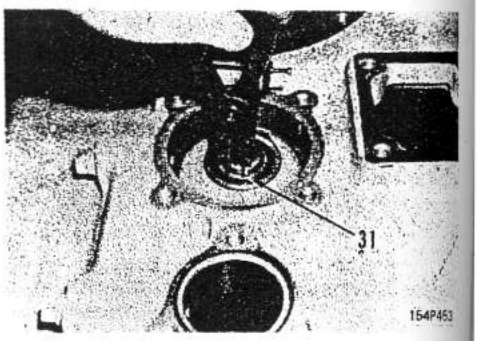
   4) Temporarily fit scavenging pump assembly (8) and secure bearing (33).



   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.

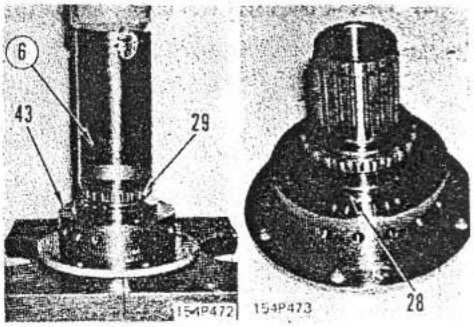


   7) Fit snap ring (31) and fix scavenging pump drive gear to bearing.

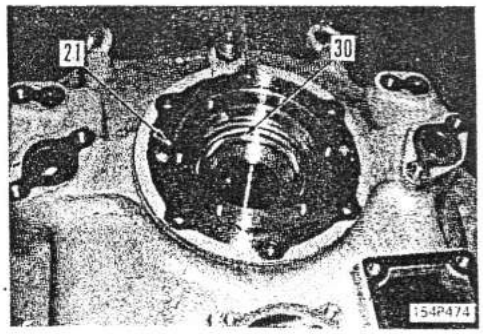


https://truckmanualshub.com/

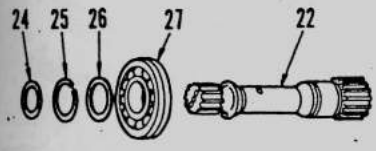
8. Stator shaft assembly
   1) Press fit bearing (29) onto stator shaft (43) using push tool (6) (inside dia. 85 mm).
   2) Install seal ring (28) on stator shaft.



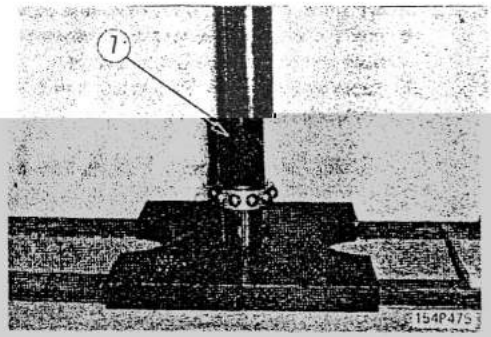
   3) Fit O-ring and install stator shaft assembly (21) in torque converter case.
   4) Fit outer race (30) onto stator shaft.



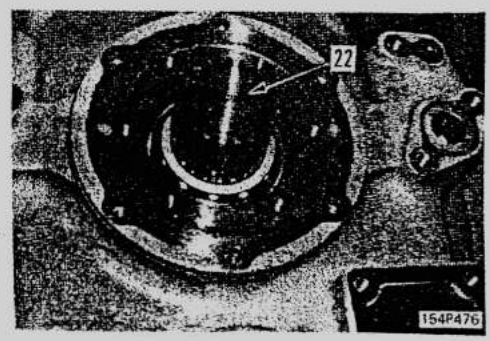
9. Turbine shaft assembly
   1) Force-fit bearing (27) onto turbine shaft (22) using push tool (7) (inside dia. 60 mm).
   2) Insert spacer (26) and fit snap ring (25).
   3) Fit seal ring (24) onto shaft.



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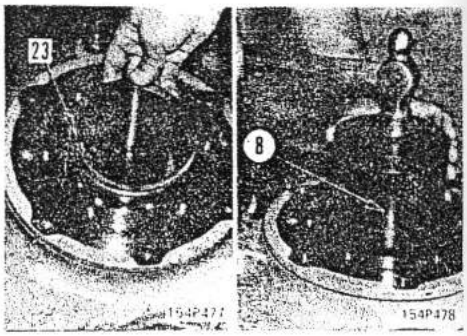


   4) Install turbine shaft assembly (22) onto stator shaft.
      ★ Apply grease to turbine shaft and install it while taking care to avoid damaging it.

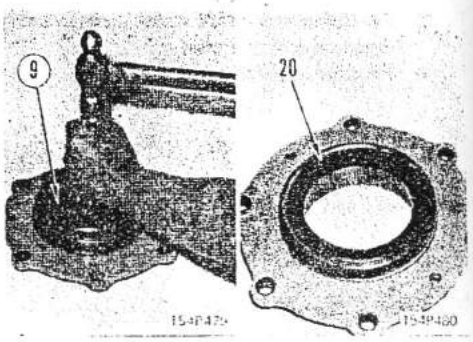


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5) Press fit outer race (23) using push tool ⑧ (ø130 mm).

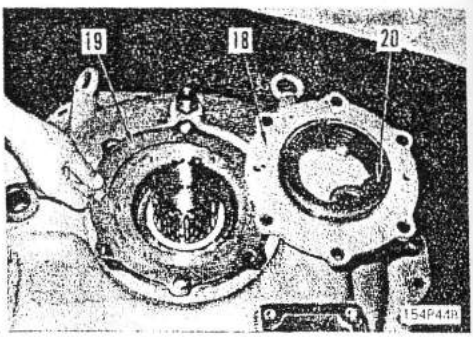


10. Oil seal cage
    1) Press fit oil seal (20) into cage using push tool ⑨ (ø135 mm).

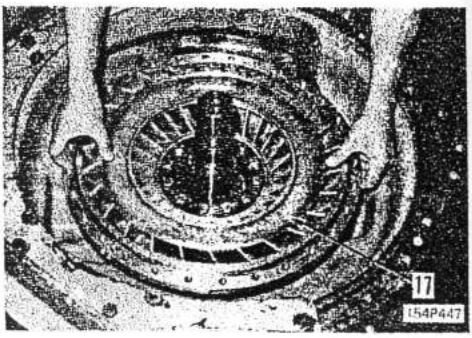


    2) Insert shim (19) and install oil seal cage (18).
       ★ Insert shims so that clearance between stator shaft and oil seal cage is 0 to 0.05 mm.
       ★ Types of shim: t = 0.05 mm, t = 0.1 mm, t = 0.2 mm.

       Mounting bolts: 11.25±1.25 mm

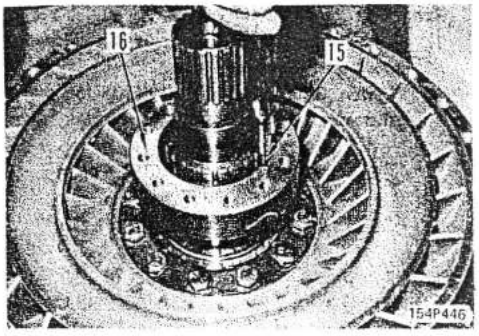


11. Pump assembly
    1) Rotate repair stand so that input side of torque converter is facing upwards.
    2) Fit pump assembly (17) onto stator shaft.
       ★ Fix seal ring on stator shaft with grease to prevent it opening, and securely mount pump assembly.



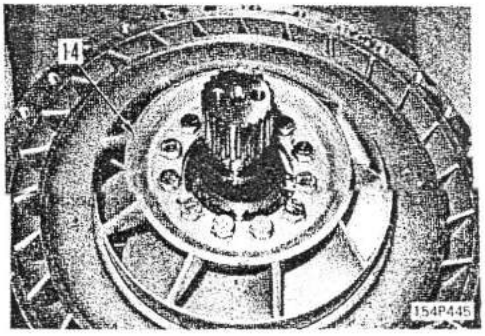
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12. Race
Fit race (16) to stator shaft, and install snap ring (15).



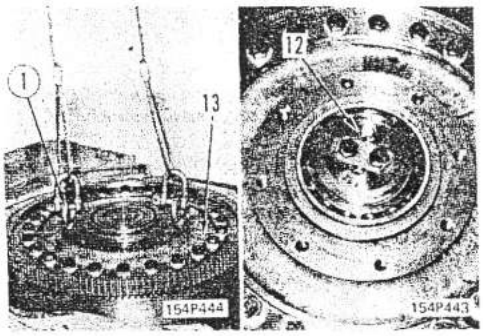
13. Stator
Fit stator (14) onto race, and tighten up mounting bolts.

Mounting bolts: 6.75±0.75 kg.m

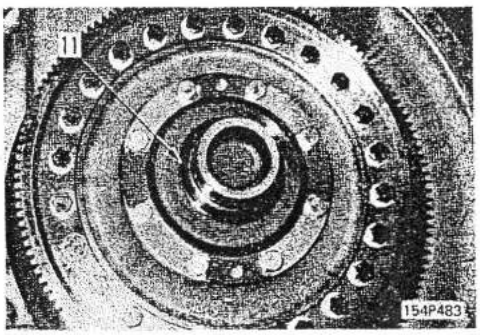


14. Turbine drive case assembly
1) Fit eye bolts ① (12 mm, P = 1.75) and hoist turbine drive case assembly (13). Fit drive case assembly to turbine shaft after aligning splines.
★ Align drain plug position with pump assembly and turbine drive case mounting position.
2) Temporarily fit two or three mounting bolts.
3) Install holder (12). Fit lock plate and tighten up mounting bolts.

kgm Mounting bolts: 5.75±0.25 kg.m
★ Bend lock plate securely.



15. Pilot
Install pilot (11). Fit lock plate and tighten mounting bolts.
★ Bend lock plate securely.



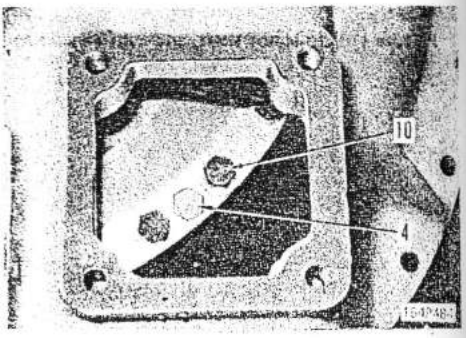
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16. Pump and drive case mounting bolts

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).

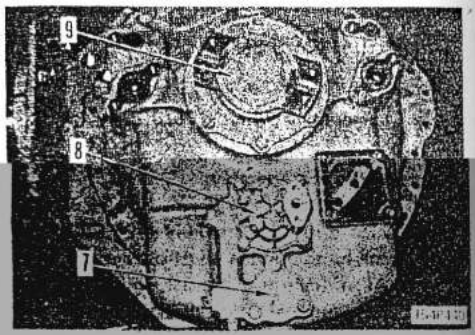
kgm Mounting bolts: 5.5±0.5 kg.m

kgm Drain plugs: 1.15±0.15 kg.m



17. Scavenging pump assembly

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

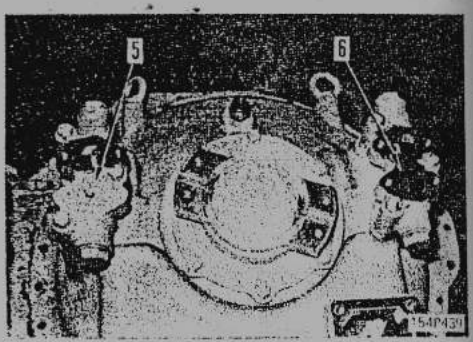


18. Coupling

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

19. Strainer

Fit O-ring and install strainer (7).



20. Relief valve assembly

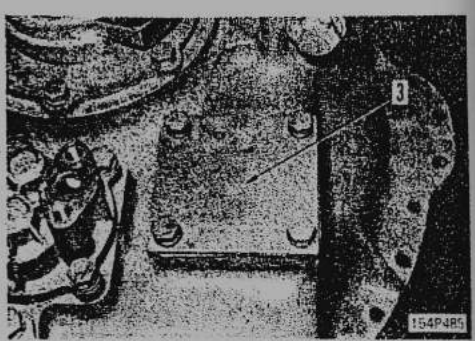
Fit O-ring and install relief valve assembly (6).

21. Regulator valve assembly

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

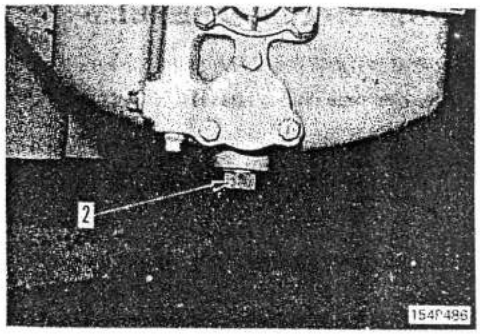
22. Cover

Fit gasket and install cover (3).



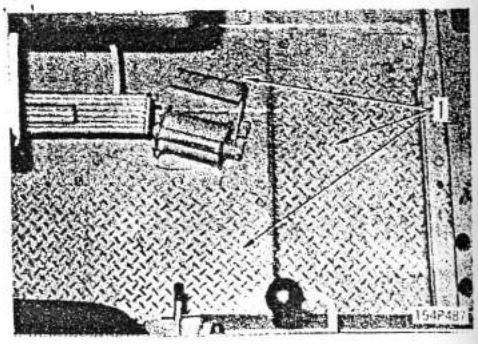
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23. Drain plug
Fit O-ring and tighten drain plug (2).

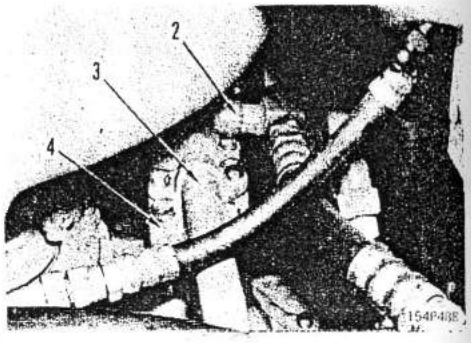


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DISMOUNTING TORQUE CONVERTER RELIEF VALVE ASSEMBLY



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).



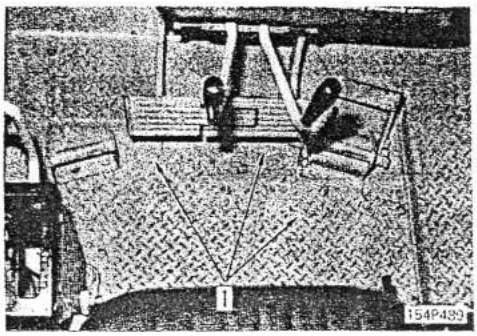
MOUNTING TORQUE CONVERTER RELIEF VALVE ASSEMBLY

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).

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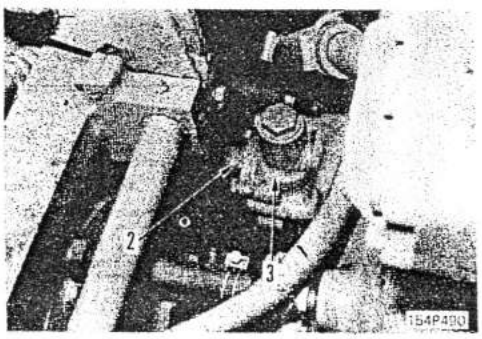
DISMOUNTING TORQUE CONVERTER REGULATOR VALVE ASSEMBLY

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



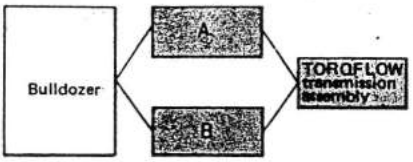
MOUNTING TORQUE CONVERTER REGULATOR VALVE ASSEMBLY

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).

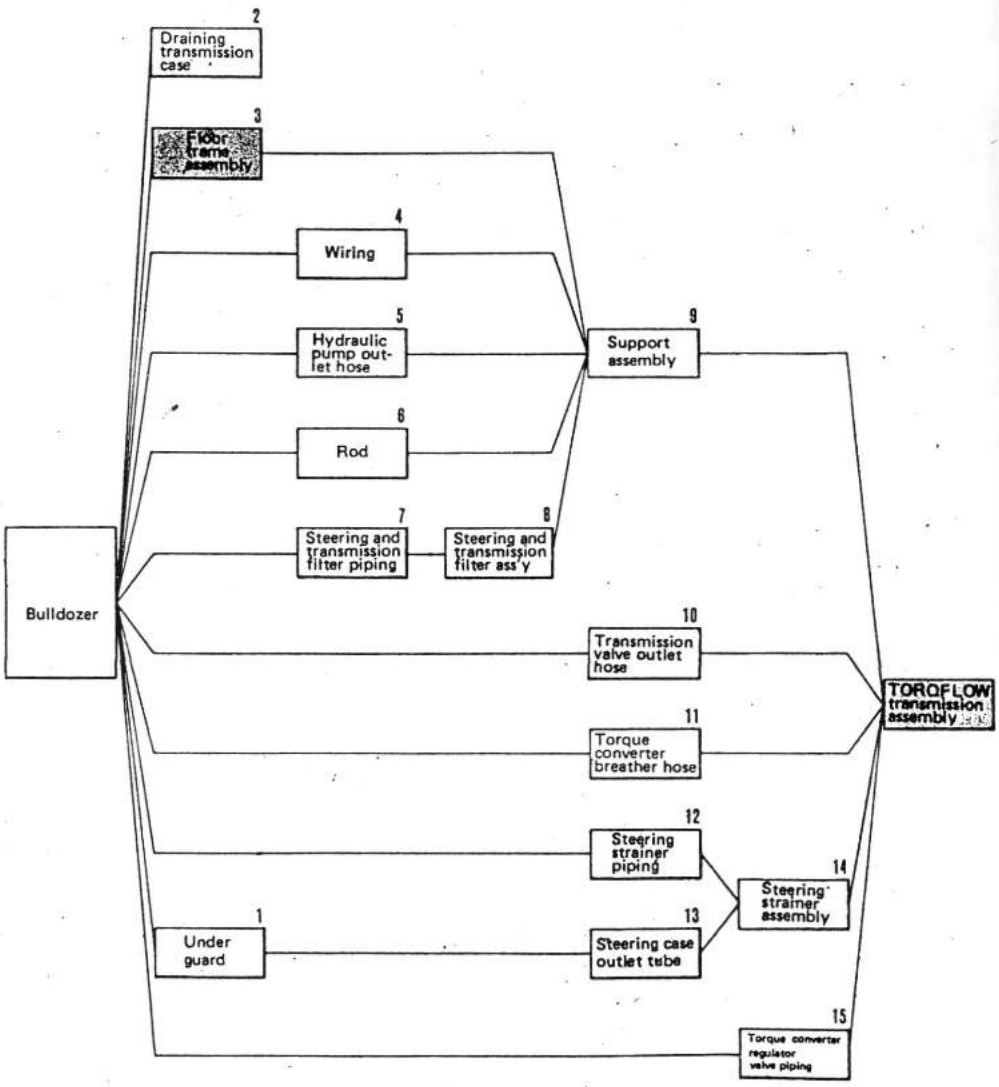


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DISMOUNTING TORQFLOW TRANSMISSION ASSEMBLY

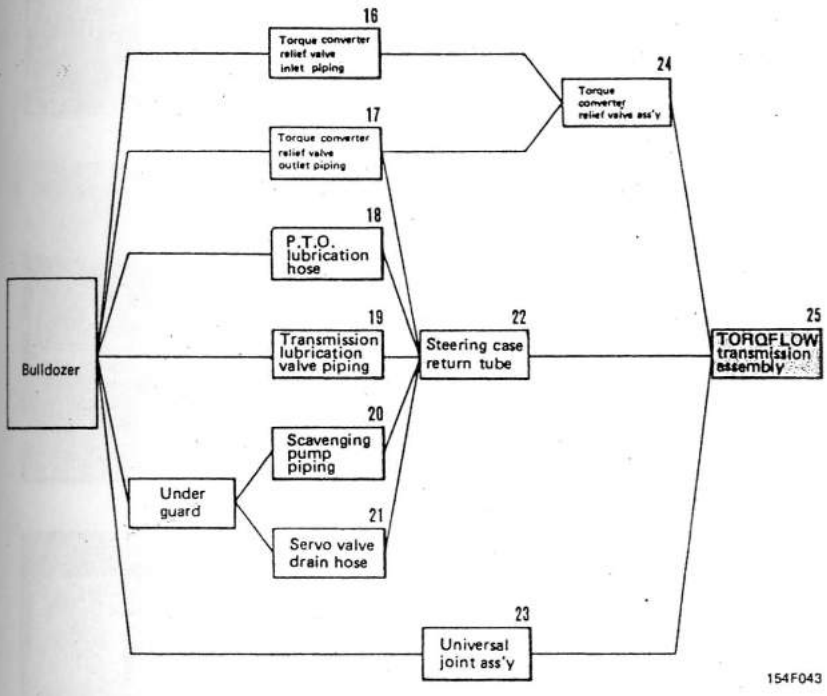


A network



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B network

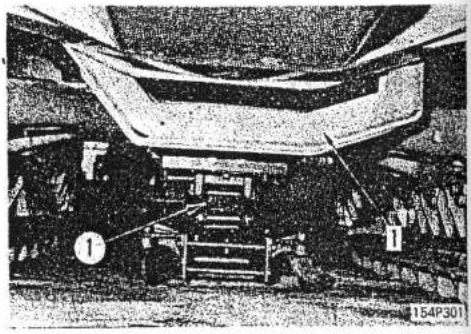


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1. **Under guard**
   Remove rear under guard **(1)** and mission jack ①

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

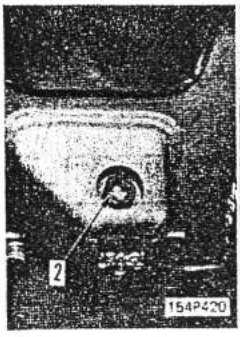
   kg Under guard: **160 kg**

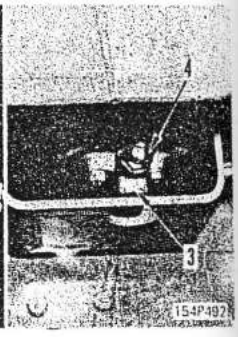


2. **Draining transmission case, steering case and hydraulic tank**
   1) Remove drain plug **(2)** and drain off oil in steering case and transmission case.

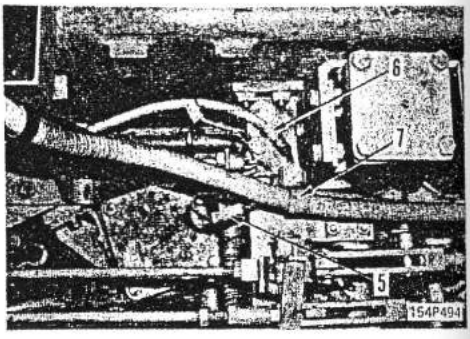
   2) ⚠ Loosen lubricating oil cap to relief internal pressure from tank.
   Remove drain plug **(3)** and open drain cock (4) to drain off oil.

   Hydraulic oil tank: approx. 70 ℓ



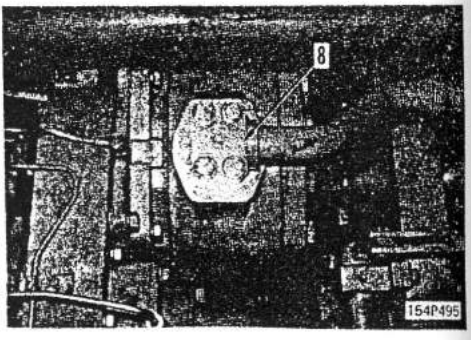


3. Floor frame assembly
   See "DISMOUNTING FLOOR FRAME ASSEMBLY".



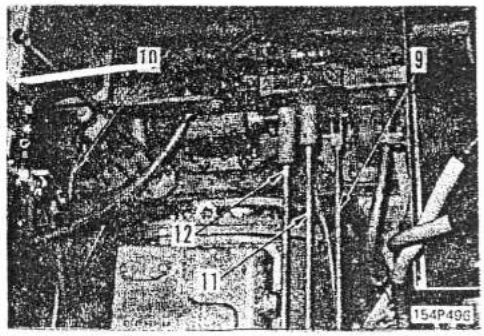
4. **Wiring**
   1) Disconnect connector **(5)** from back-up buzzer wiring.
      ★ Clearly mark disconnected wires to prevent confusion with horn wiring.
   2) Remove clamps **(6)** and **(7)** and disconnect wiring from support.

5. **Hydraulic pump outlet hose**
   Disconnect hydraulic pump outlet hose (8).

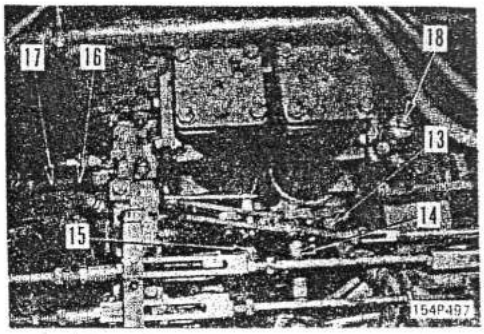


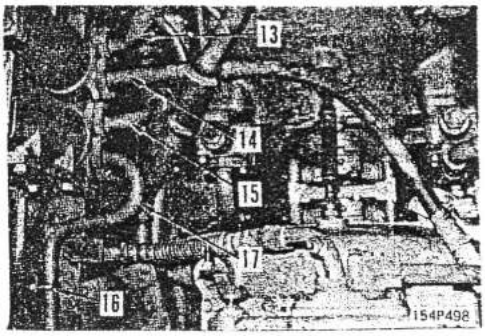
https://truckmanualshub.com/

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.

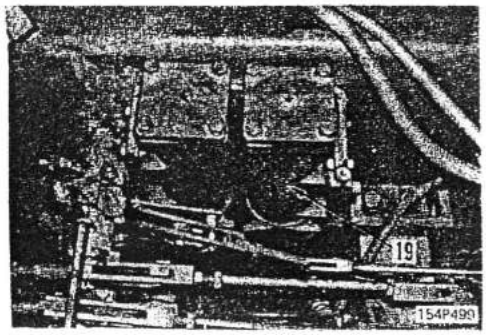


7. Steering and transmission oil filter piping
   1) Disconnect piping (13) between transmission pump and transmission oil filter, at oil filter side.
   2) Remove pipe (14) between transmission oil filter and transmission valve.
   3) Disconnect pipe (15) between steering pump and steering oil filter,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



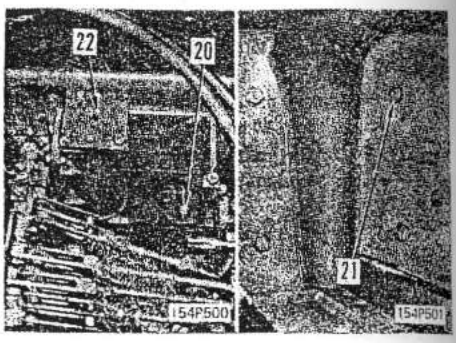


8. Steering and transmission oil filter assembly
   1) Remove steering oil filter (19).



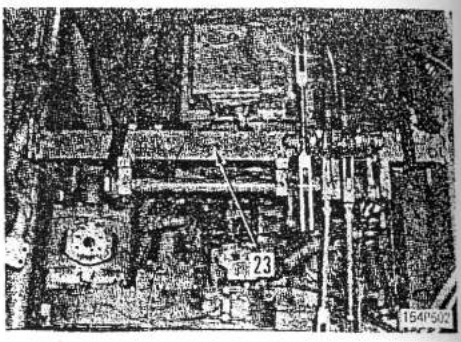
https://truckmanualshub.com/

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



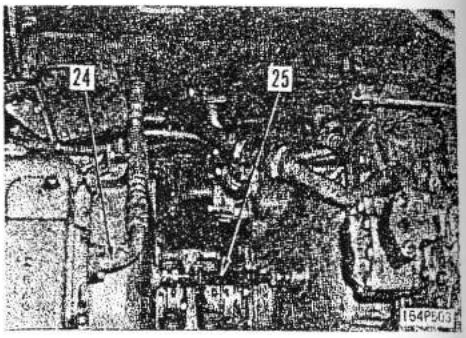
9. Support assembly
Remove eight left and right mounting bolts and remove support assembly (23).

kg Support assembly: 45 kg

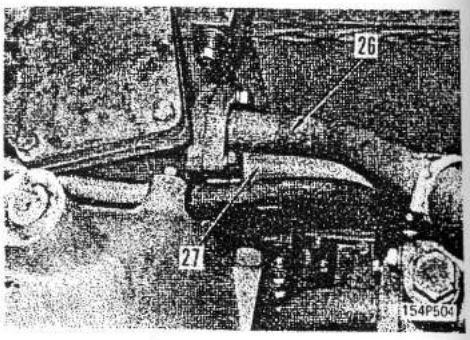


10. Transmission outlet hose
Remove transmission control valve outlet hose (24).

11. Torque converter breather hose
Remove torque converter breather hose (25).

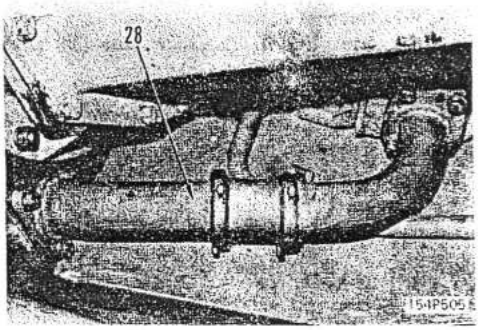


12. Steering strainer piping
1) Remove steering piping (26) between steering strainer and transmission pump.
2) Disconnect piping (27) between steering strainer and steering pump.



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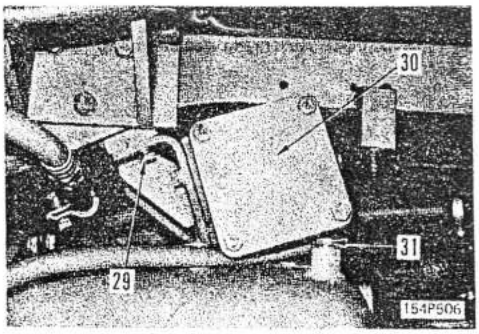
13. Steering case outlet tube
Remove tube (28) between steering case and steering strainer.



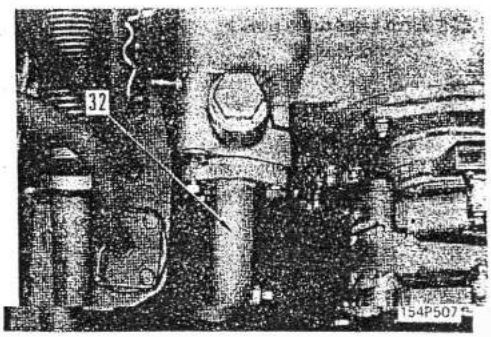
14. Steering strainer assembly
1) Remove three mounting bolts (29) and remove steering strainer assembly (30) together with bracket.

kg Steering strainer assembly: 35 kg

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

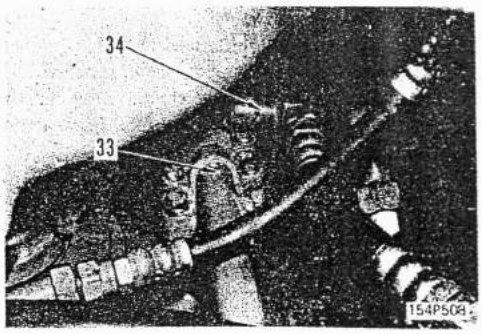


15. Torque converter regulator valve piping
Disconnect regulator valve tube (32).



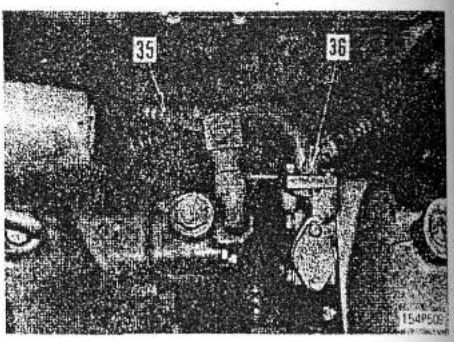
16. Torque converter relief valve inlet piping
Disconnect relief valve inlet piping (33) from valve.

17. Torque converter relief valve outlet piping
Disconnect relief valve outlet piping (34) from valve.



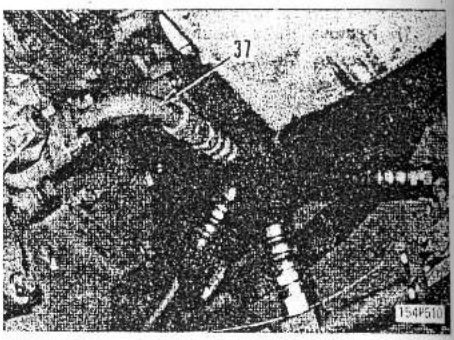
https://truckmanualshub.com/

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



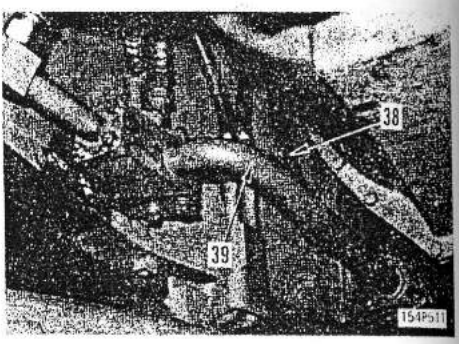
19. Transmission lubrication valve piping
Disconnect transmission lubrication valve inlet and outlet piping (36) from valve.

20. Scavenging pump outlet piping
Disconnect scavenging outlet piping (37) from pump.

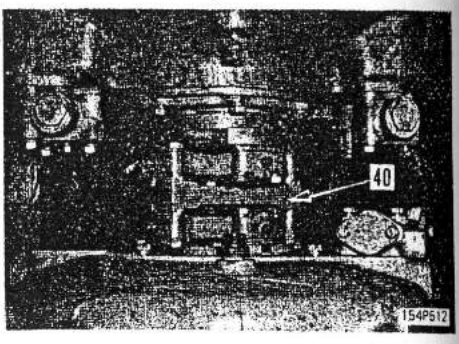


21. Servo valve drain hose
Disconnect servo valve drain hose (38).

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

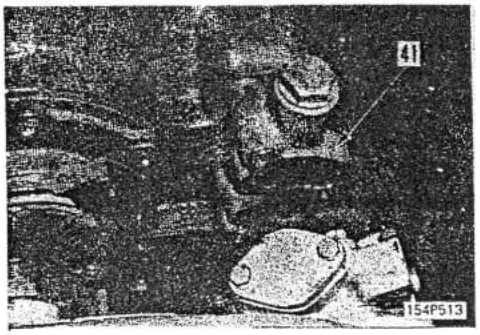


23. Universal joint assembly
Remove universal joint assembly (40).
★ Loosen all bolts with joint installed. Remove mounting bolts from torque converter side and then remove mounting bolts from transmission side.

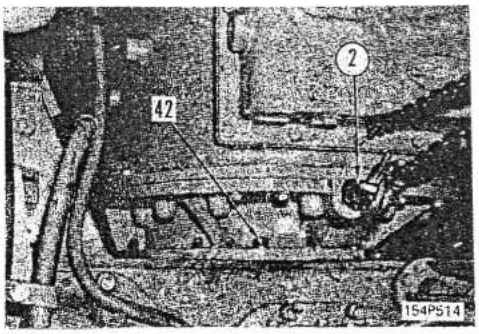


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24. **Torque converter relief valve assembly**
Remove relief valve assembly (41).

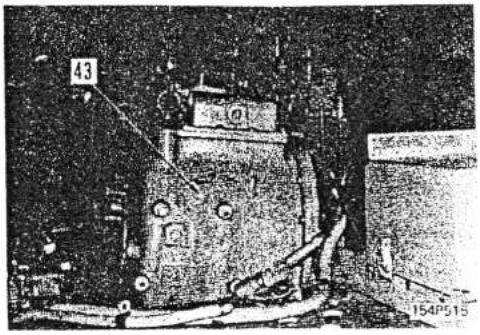


25. **Torqflow transmission assembly**
1) Lift transmission with three eye bolts ② (24 mm, P = 3.0), and remove 10 mounting nuts (42).



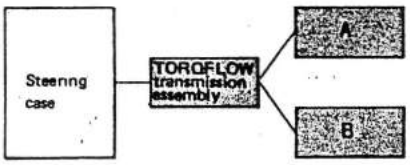
2) Disconnect transmission assembly (43) from steering case. Lift out transmission assembly taking care to prevent interference with other components.

kg Transmission assembly: 800 kg

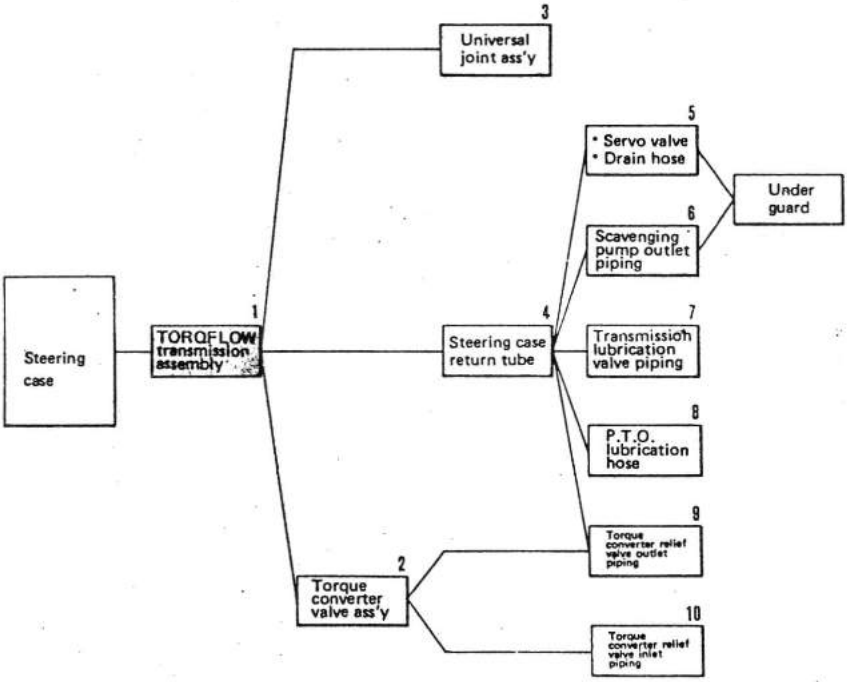


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MOUNTING TOROFLOW TRANSMISSION ASSEMBLY

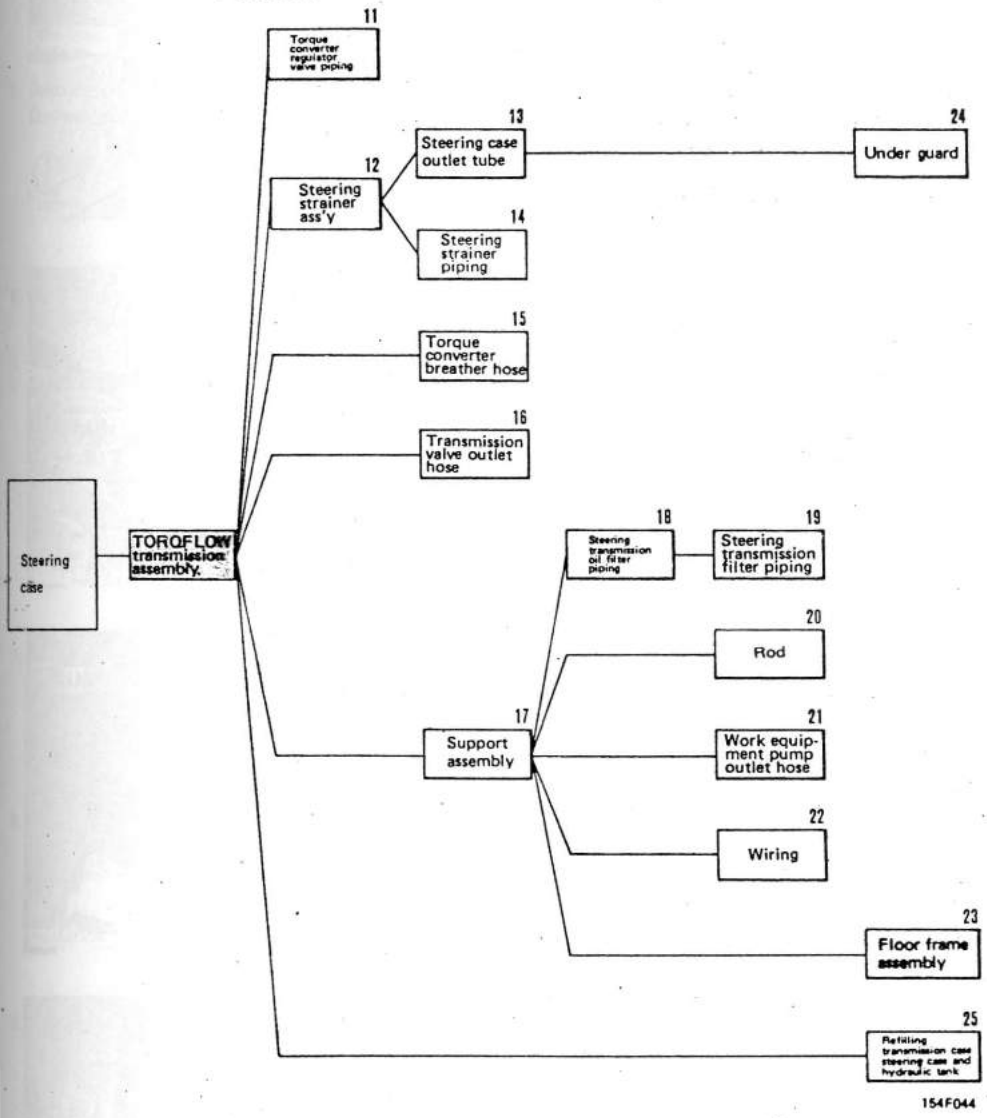


A Network



https://truckmanualshub.com/

B Network



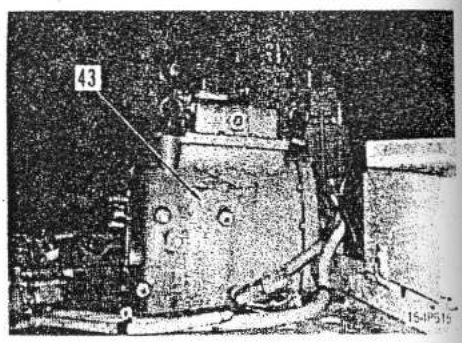
https://truckmanualshub.com/

1. Torqflow transmission assembly

1) Fit gasket to steering case.

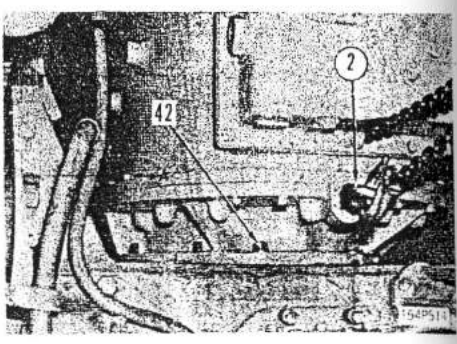
Gasket: Liquid gasket

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.



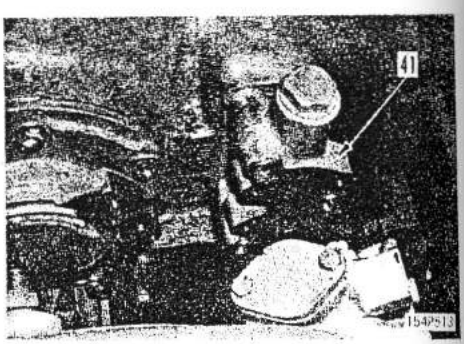
3) Tighten 10 mounting nuts (42).

Mounting nuts: 38±5.5 kg.m



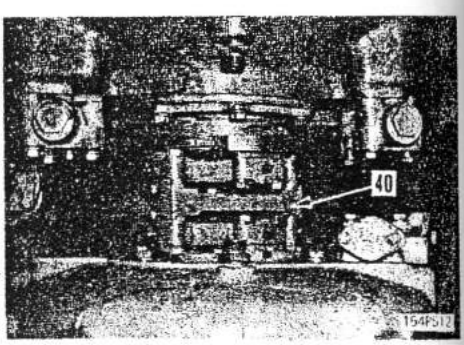
2. Torque converter return valve assembly

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



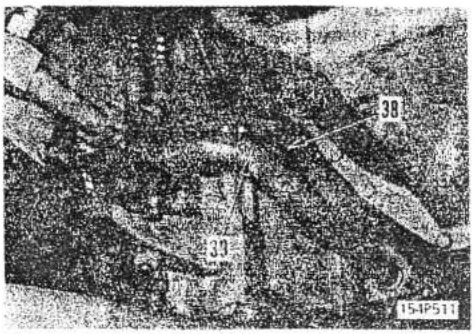
3. Universal joint assembly

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.



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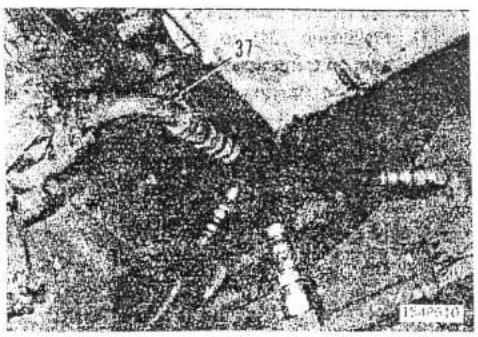
4. Steering case return tube
Fit O-ring and connect steering case return tube (39) together with related piping to case.



5. Servo valve drain hose
Connect servo valve drain hose (38).

⊕ Install hose without twist or interference.

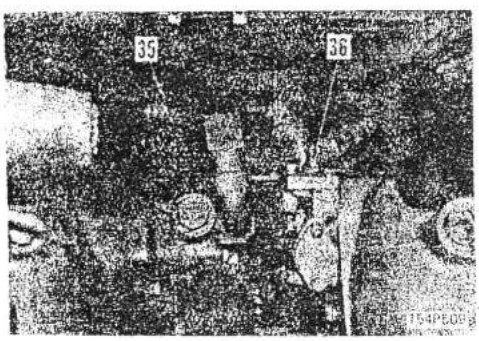
6. Scavenging pump outlet piping
Fit O-ring and connect scavenging pump outlet tube (37).



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

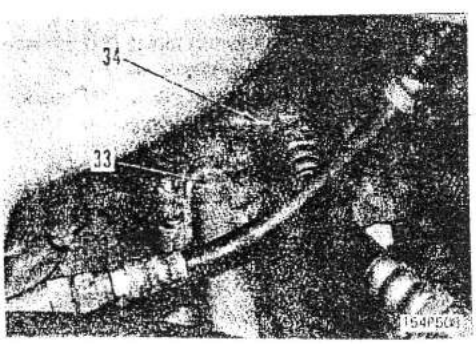
8. P.T.O lubrication hose
Connect up P.T.O lubrication hose (35) to transmission lubrication valve inlet tube.

⊕ 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.

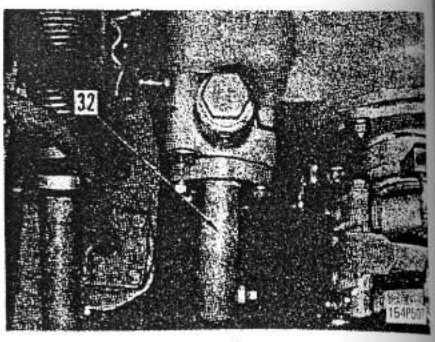
10. Torque converter relief valve inlet piping
Fit O-ring and connect torque converter inlet pipe (33) to valve.



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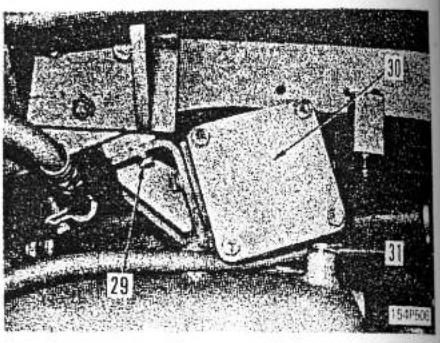
11. Torque converter regulator valve piping

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



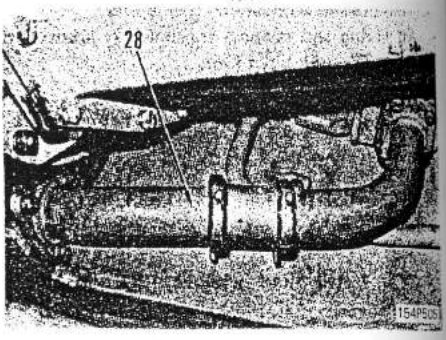
12. Steering strainer assembly

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

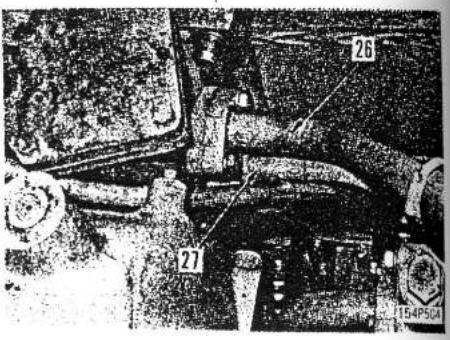
1) Fit O-ring and install tube (28) between steering case and steering strainer tube.



14. Steering strainer piping

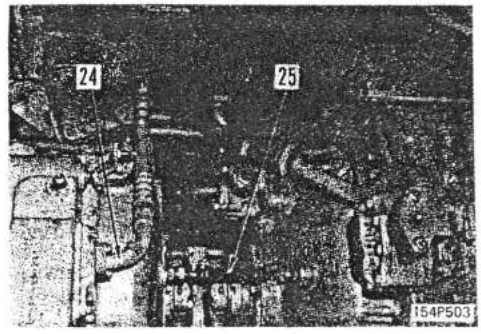
1) Fit O-ring and connect piping (27) between steering strainer and steering pump.
2) Fit O-ring and connect piping (26) between steering strainer and transmission pump.

⊕ Fit O-ring securely in groove.



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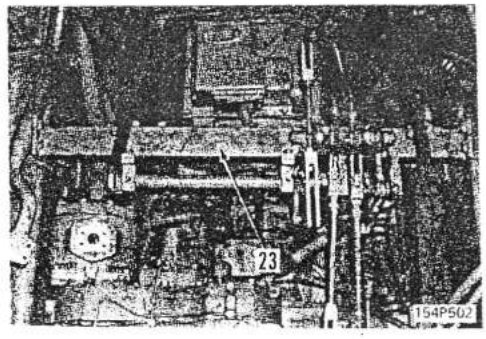
15. **Torque converter breather hose**
Connect torque converter breather hose (25), and tighten sleeve nut.



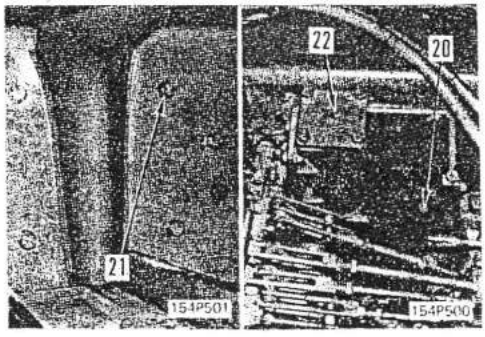
16. **Transmission valve outlet hose**
Fit O-ring and connect transmission outlet side tube (24). Tighten sleeve nut on tube side.

⊕ Install hose twist or interference.

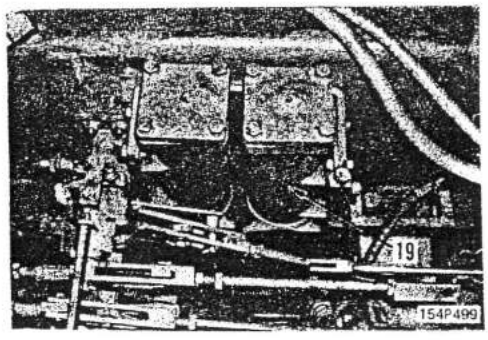
17. **Support assembly**
Position support assembly (23) between left and right fenders, and tighten eight left and right mounting bolts.



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).

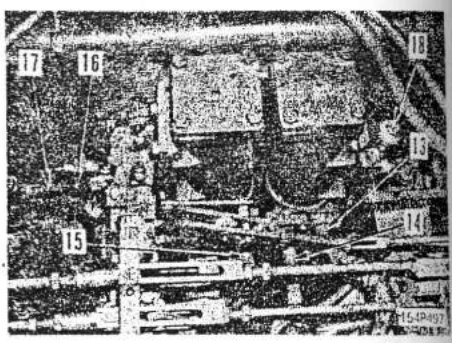


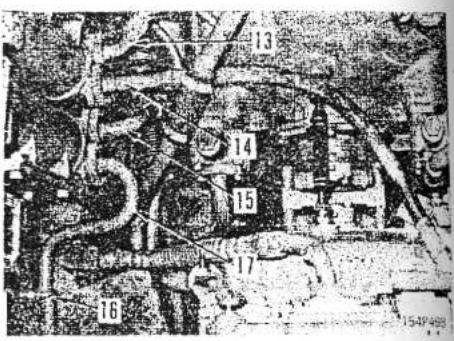
https://truckmanualshub.com/

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.

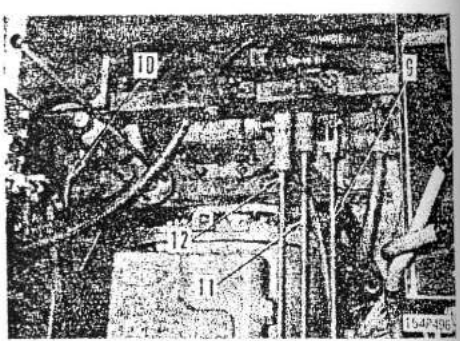




20. Rod

⊕ Bend cotter pin securely at each rod linkage.

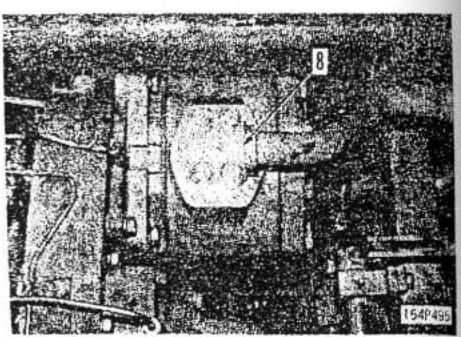
1) Install left brake rod (9) and right brake rod (10).
   ★ When installing rods do not confuse left and right or front and rear.
2) Connect left steering control rod (11) and right steering control rod (12).



21. Hydraulic pump outlet hose

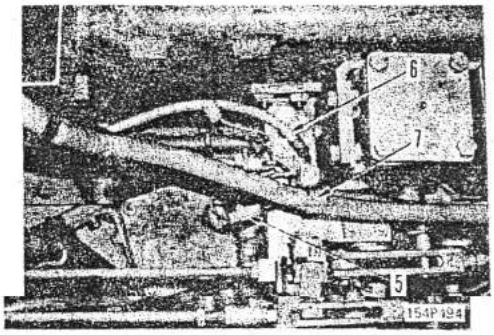
Fit O-ring and connect hydraulic pump outlet hose (8).

⊕ Fit O-ring securely in groove.



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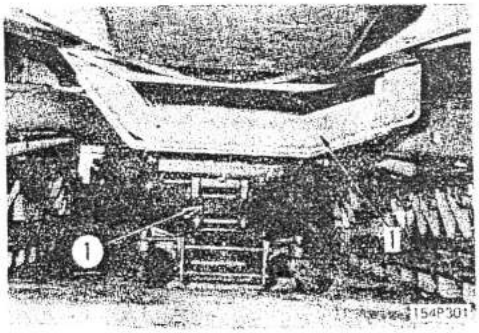
22. Wiring
1) Position wiring on support and fix it with clamps (6) and (7).
2) Connect back-up buzzer wiring connector (5).
★ Do not confuse back-up buzzer wiring connector with horn wiring connector.



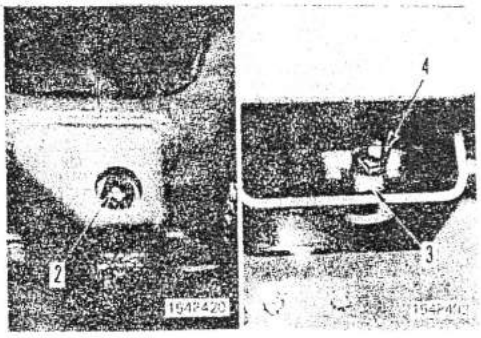
23. Floor frame assembly
See "MOUNTING FLOOR FRAME ASSEMBLY".

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.



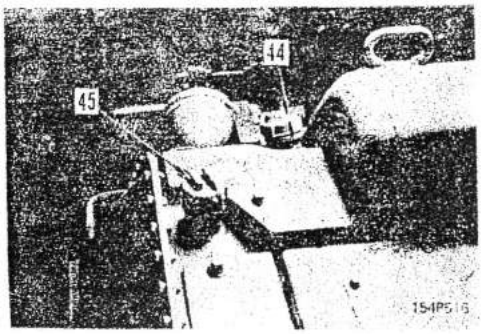
. Refilling transmission case, steering case and hydraulic tank
1) Steering and transmission cases.
i) Tighten drain plug (2).
ii) Refill steering and transmission cases through oil filler (44) with engine oil until specified oil level is reached.



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.

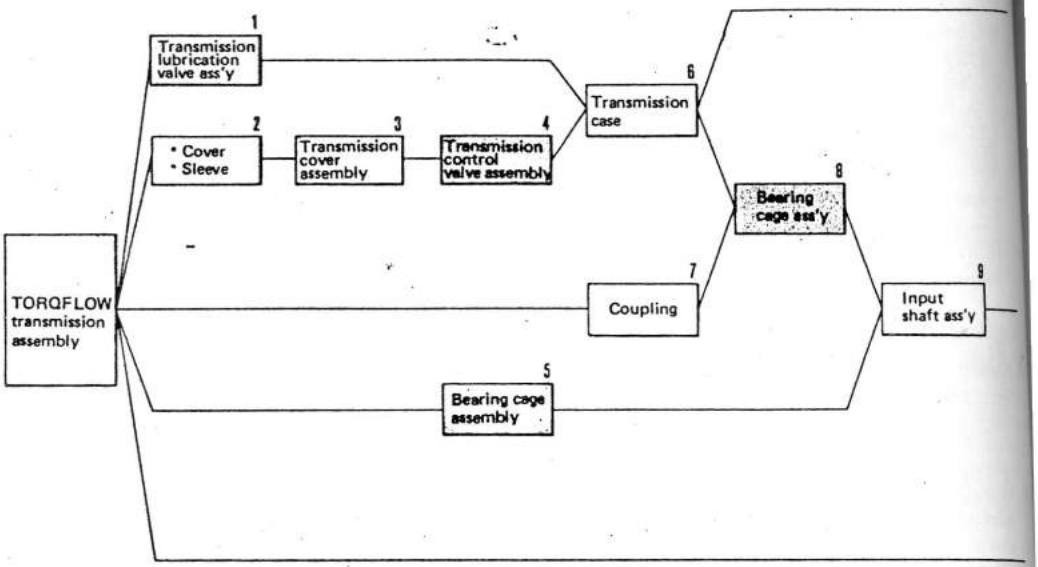
Hydraulic tank: approx. 70 ℓ

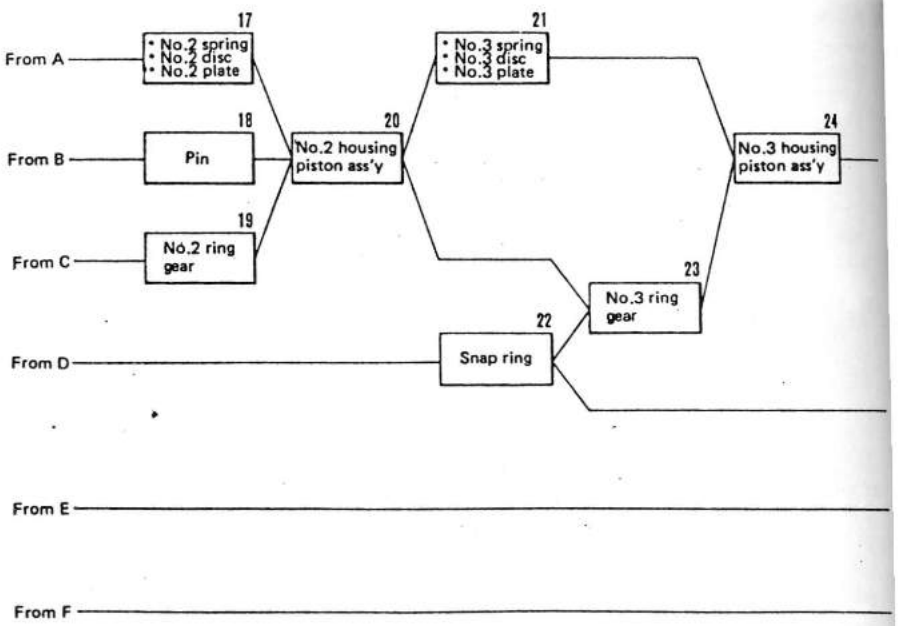
Run engine to circulate oil through hydraulic system. Check oil level again.



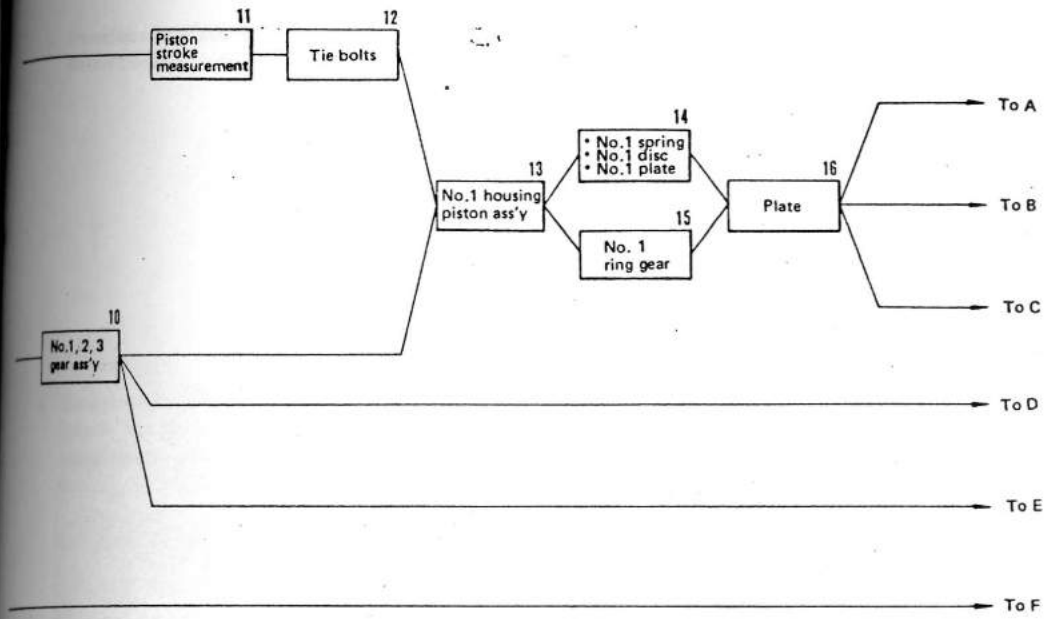
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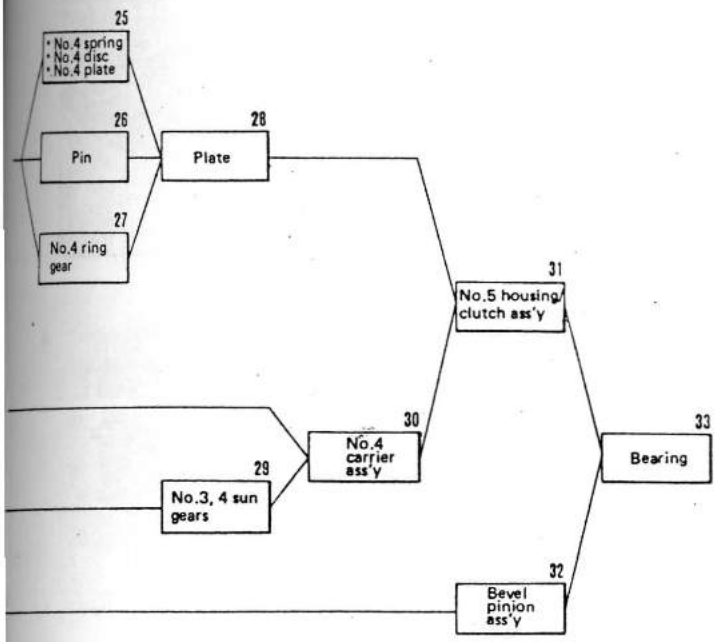
DISASSEMBLY OF TORQFLOW TRANSMISSION ASSEMBLY (1/2)





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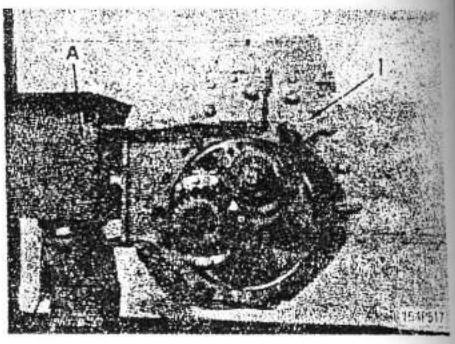
Special tools

Part Name	A
Unit repair stand	1
Bracket	1

Preparatory work

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

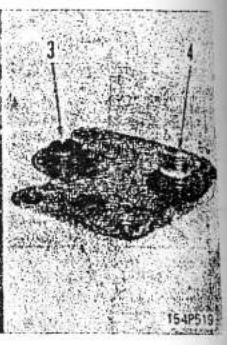
kg Transmission assembly: 750 kg



1. Transmission lubrication valve assembly

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

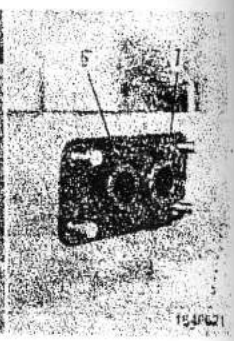




2. Cover and sleeve

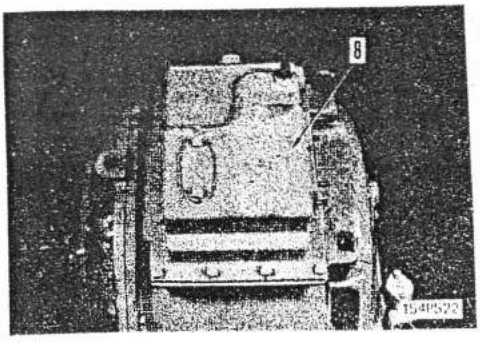
Remove cover (5) and remove sleeves (6) and (7).





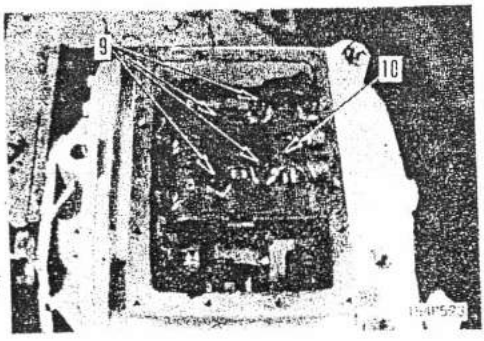
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3. **Transmission cover assembly**
   Remove transmission cover assembly (8).

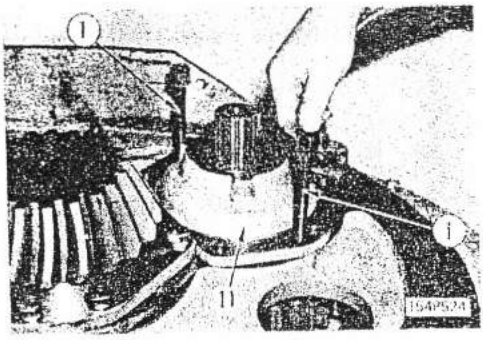


4. **Transmission control valve assembly**
   Remove four mounting bolts (9) and remove transmission control valve assembly (10) together with seat.

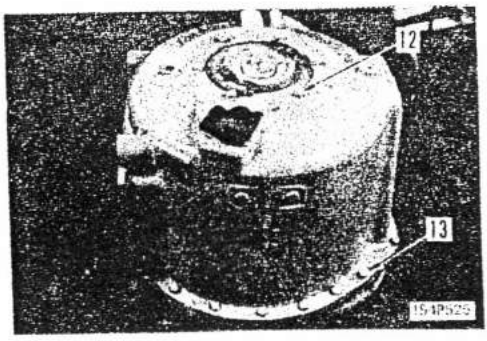
   kg Transmission control valve assembly: 30 kg



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



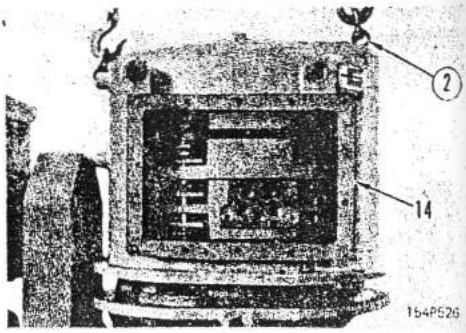
6. **Transmission case**
   1) Rotate transmission assembly in opposite direction.
   2) Remove bearing cage and transmission case mounting bolts (12).
   3) Remove transmission case and rear case mounting bolts (13).
      ★ Four mounting bolts are tightened from rear case side.



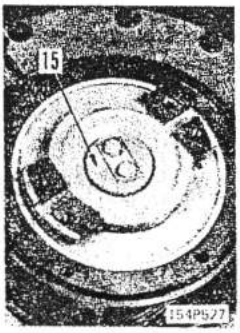
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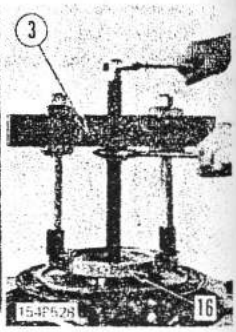
4) Gradually lift out transmission case (14) using eye bolts ② (10 mm, P = 1.5).

kg Transmission case: 95 kg

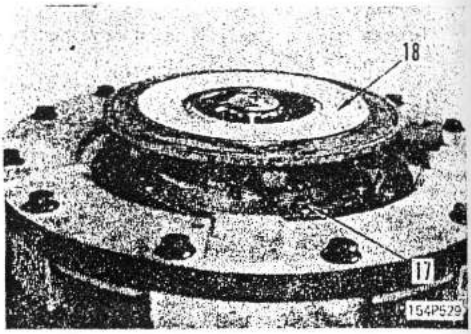


7. Coupling
   1) Remove holder (15).
   2) Remove coupling (16) using puller ③.

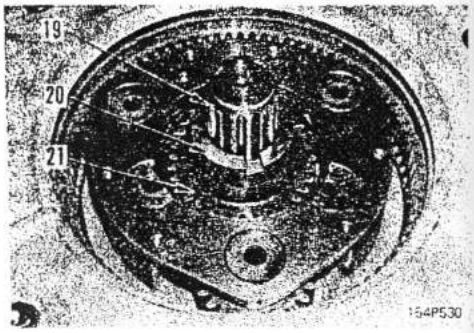




8. Bearing cage assembly
   Remove six mounting bolts (17) and remove bearing cage assembly (18).

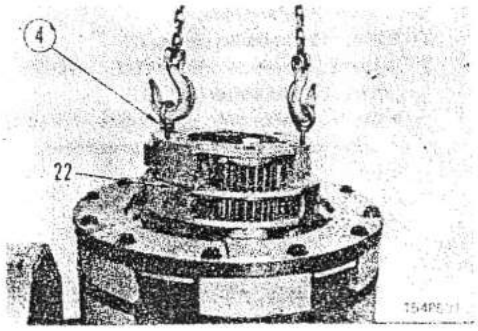


9. Input shaft assembly
   Remove input shaft assembly (19) together with spacer (20) and gear (21).



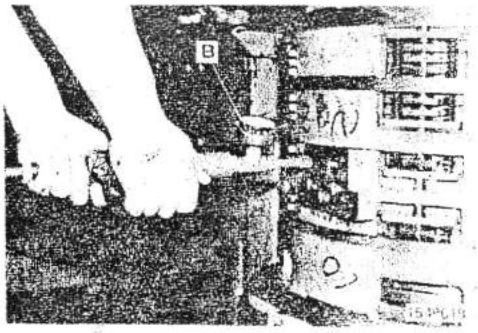
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10. **No. 1, 2 and 3 carrier assembly**
Fit eye bolts (4) (12 mm. P = 1.75) and remove carrier assembly (22).
★ If gears do not disengage easily, remove carrier while rotating entire carrier assembly.

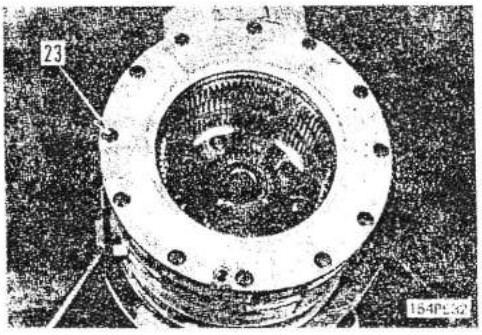


11. **Piston stroke measurement**
Using air checker B, check operation and stroke of each piston.
★ Air pressure: 6 to 7 kg/cm²
★ Stroke

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



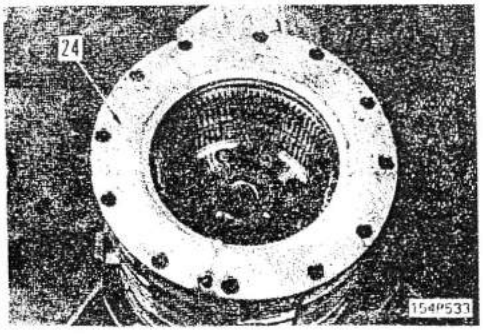
12. **Tie bolts**
Remove tie bolts (23).



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

kg No.1 housing and piston assembly: 45 kg
★ Support assembly during removal to prevent it from falling.

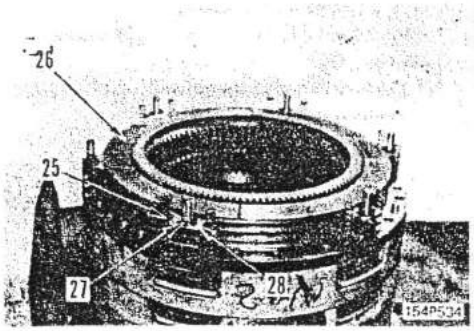
⚠ Because assembly is heavy, remove it using two people.



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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.

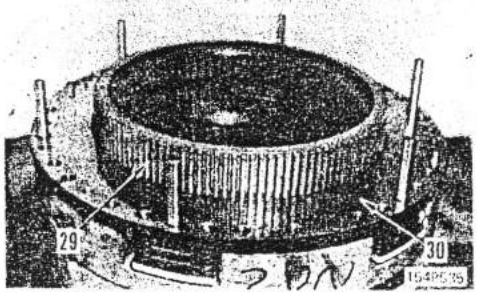


15. No.1 ring gear

Remove No. 1 ring gear (29).

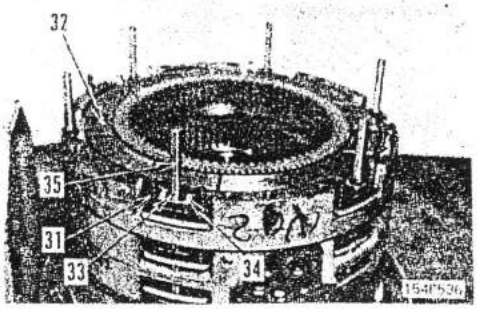
16. Plate

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.

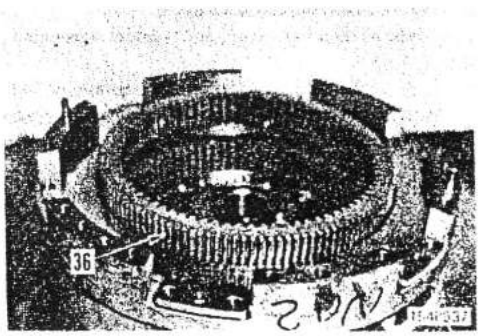


18. Pins

Remove six guide pins (35).

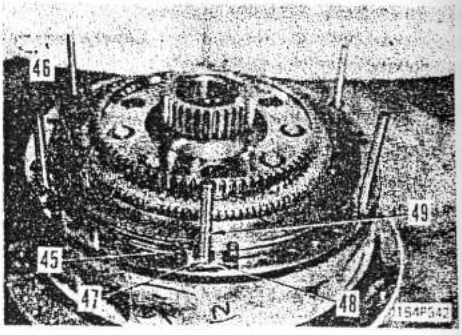
19. No.2 ring gear

Remove No.2 ring gear (36).



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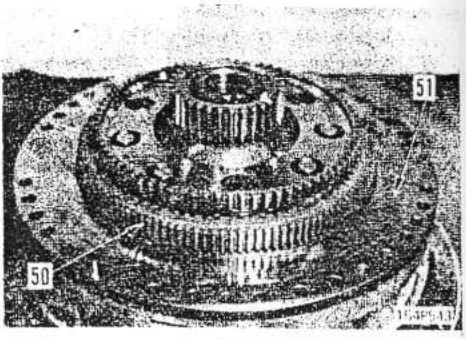
25. **No.4 springs, discs and plates**
    1) Remove No.4 piston spring (45).
    2) Alternately remove discs (46), washer return spring (47) and plates (48).
       ★ After dismounting, place discs and plates on a flat surface to prevent them warping.



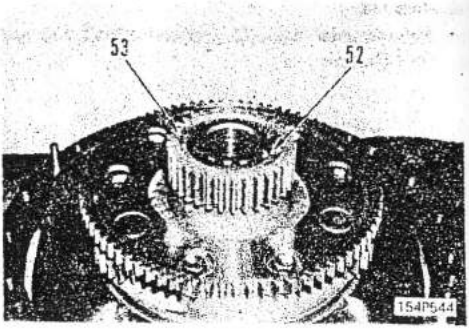
26. **Pins**
    Remove six guide pins (49).

27. **No.4 ring gear**
    Remove No.4 ring gear (50).

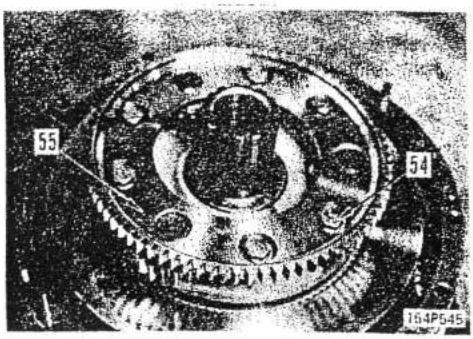
28. **Plate**
    Remove plate (51).



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



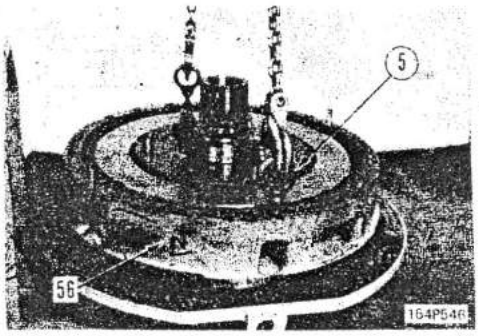
30. **No. 4 carrier assembly**
    Remove mounting bolts (54) and remove No.4 carrier assembly (55).



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

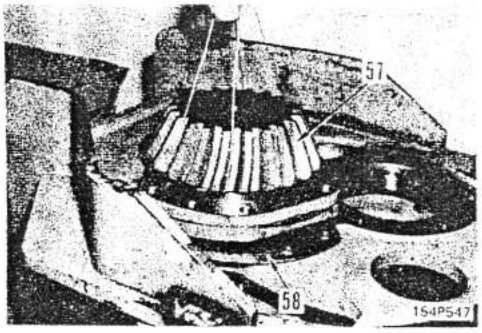
kg No.5 housing and clutch assembly: 145 kg



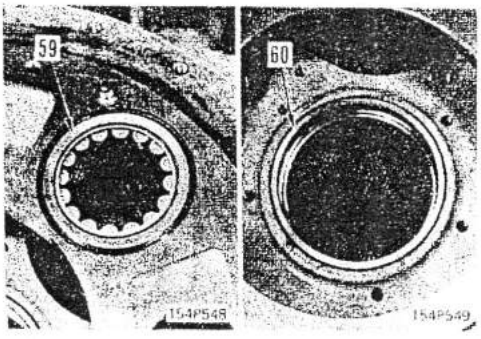
32. Bevel pinion assembly
1) Rotate repair stand in opposite direction so that bevel pinion side is uppermost.
2) Remove mounting bolts and remove bevel pinion assembly (57).

kg Bevel pinion assembly: 35 kg

3) Remove left and right shims (58).

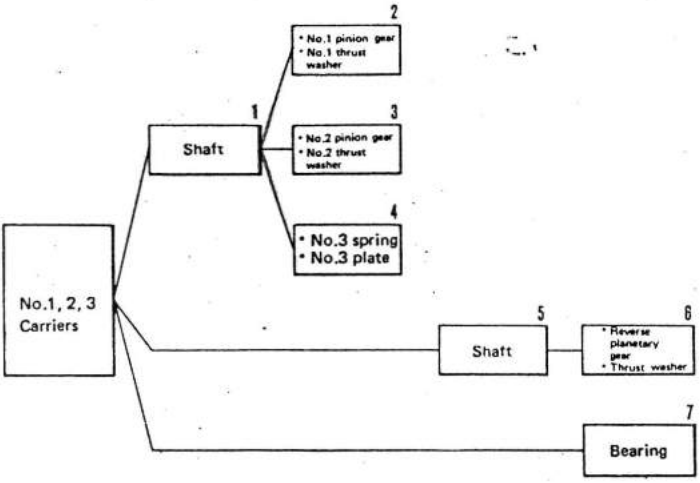


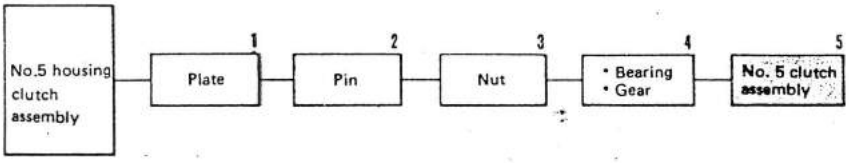
33. Bearing
Remove bearing (59) and outer race (60) from rear case.

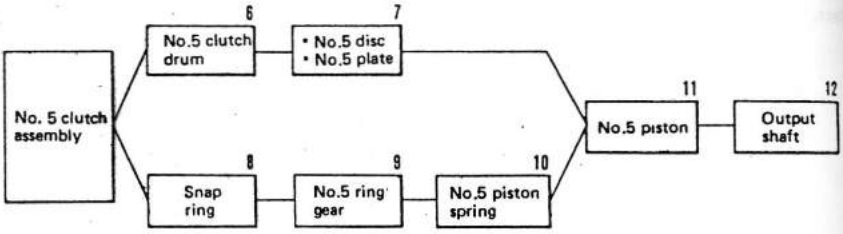


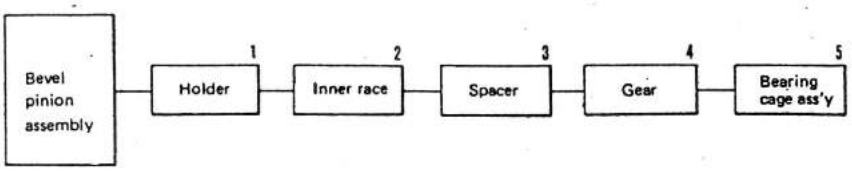
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DISASSEMBLY OF TORQFLOW TRANSMISSION ASSEMBLY (2/2)







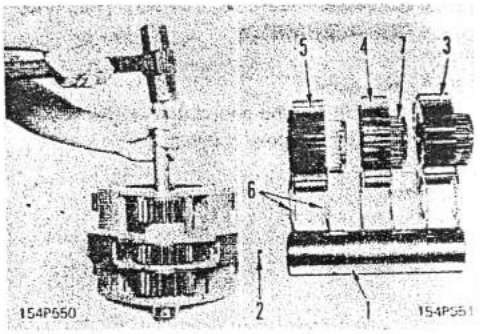


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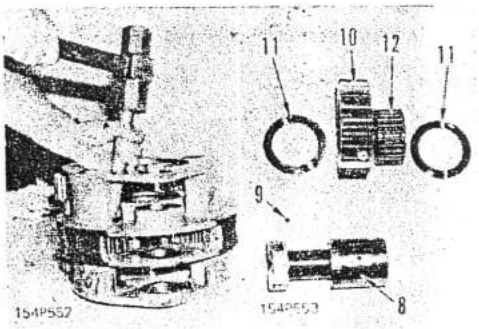
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DISASSEMBLY OF NO.1, 2 and 3 CARRIER ASSEMBLY

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

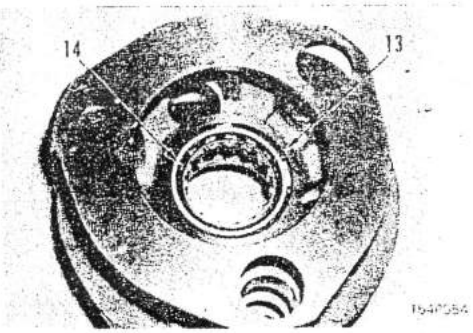


2. **No.1 pinion gear and thrust washer**
3. **No.2 pinion gear and thrust washer**
4. **No.3 pinion gear and thrust washer**
   Dismount No. 1 pinion gear (3), No. 2 pinion gear (4), No. 3 pinion gear (5) and also thrust washer (6) and needle bearings (7) of each gear.



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).

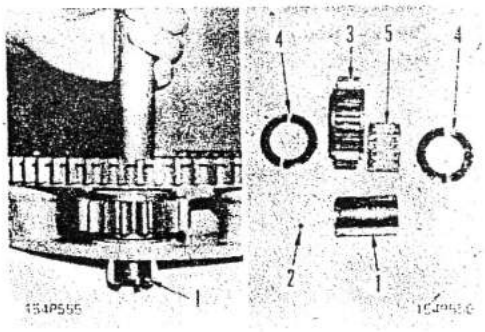


7. **Bearing**
   Remove snap ring (13) and remove bearing (14) from carrier (15).

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).

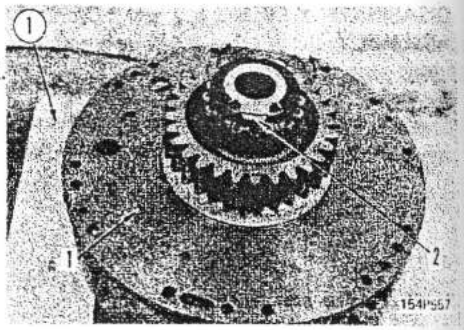


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DISASSEMBLY OF NO. 5 HOUSING AND CLUTCH ASSEMBLY

Preparatory work

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

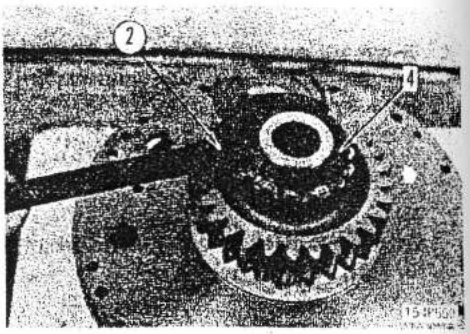


1. **Plate**
   Remove plate (2).

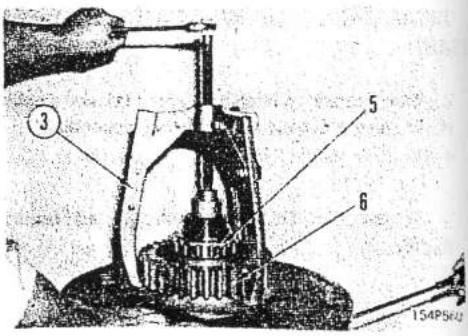
2. **Pin**
   Remove nut retaining pin (3).



3. **Nut**
   Remove nut (4) using nut wrench ②.

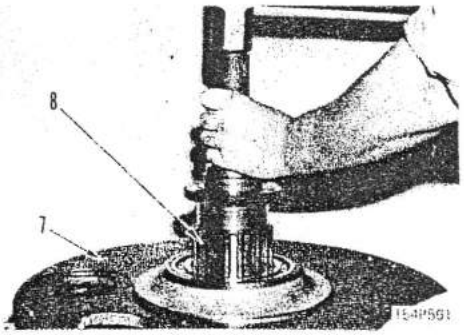


4. **Bearing and gear**
   Remove bearing (5) and gear (6) together using gear puller ③.

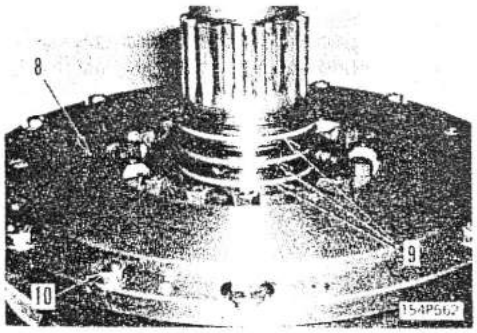


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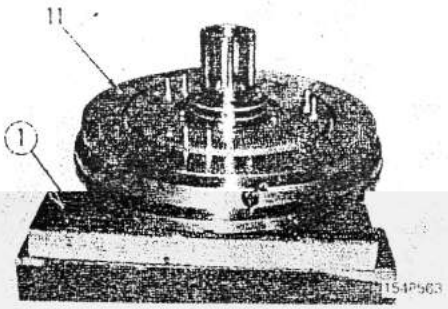
5. No. 5 clutch assembly
Remove No. 5 housing (7) and disassemble clutch assembly (8).



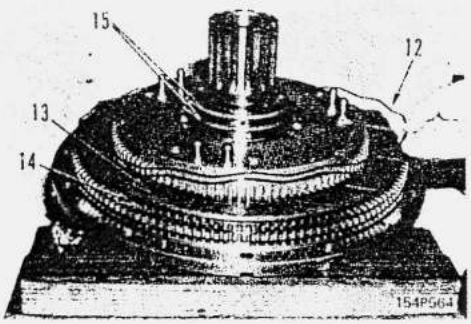
6. No. 5 clutch drum
1) Remove seal ring (9).
2) Remove all drum mounting bolts (10) except for two diagonally opposited bolts. Rotate No. 5 clutch assembly (8) in pooosite direction and set it on block (1).



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



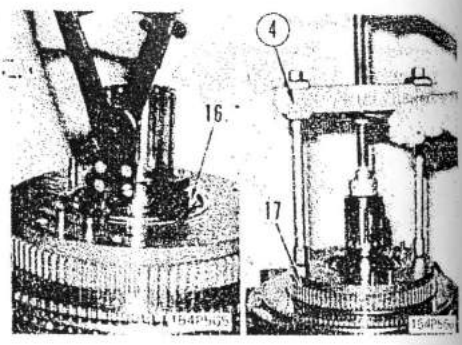
7. No. 5 discs and plates
1) Alternately remove wave springs (12), discs (13) and plates (14).
★ After dismounting, place discs and plates on a flat surface to prevent them warping.
2) Remove seal rings (15).



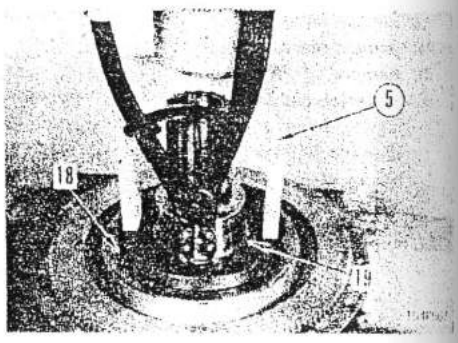
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8. **Snap ring**
   Remove snap ring (16).

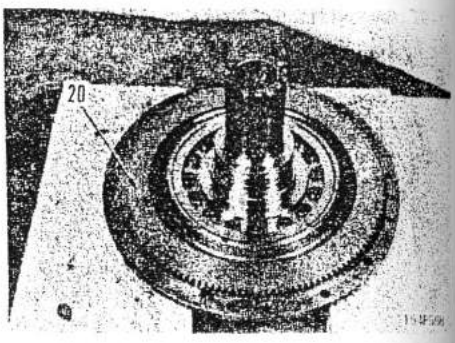
9. **No. 5 ring gear**
   Remove No. 5 ring gear (17) using puller (4).



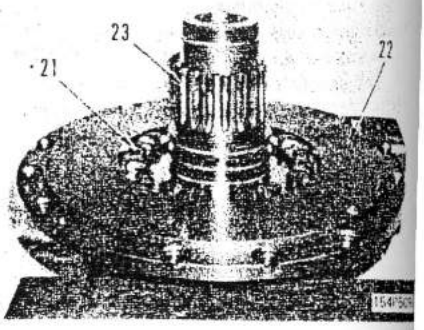
10. **No. 5 piston spring**
    1) Set pusher (5) to return spring (18). Using a press, compress spring slightly, and remove snap ring (19).
    2) Remove No. 5 piston spring.



11. **No. 5 piston**
    Remove No. 5 piston (20).



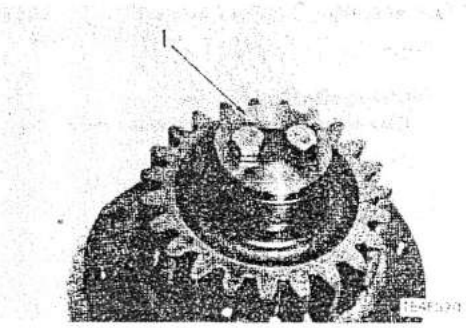
12. **Output shaft**
    1) Remove mounting nut (21).
    2) Remove output shaft (23) from clutch housing (22).



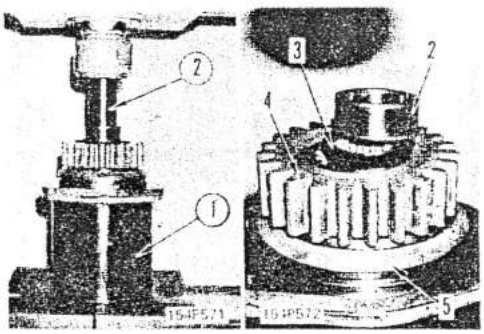
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DISASSEMBLY OF BEVEL PINION ASSEMBLY

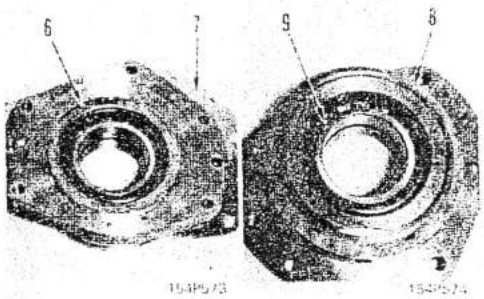
1. Holder
   Remove holder (1).



2. Inner race
3. Spacer
4. Gear
   1) Set bevel pinion assembly on push tool ① (ϕ220 mm, height: approx. 200 mm).
   2) Using push tool ② (ϕ50 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).

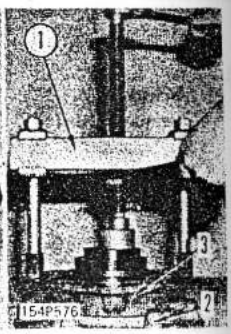


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DISASSEMBLY OF BEARING CAGE ASSEMBLY

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

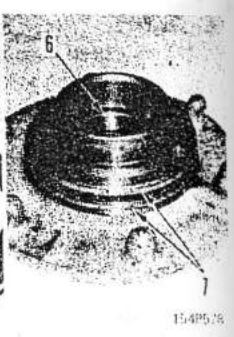




3. Remove oil seal from cage (2) and remove snap ring (4) and spacer (5).
4. Remove bearing (6).
5. Remove seal ring (7).

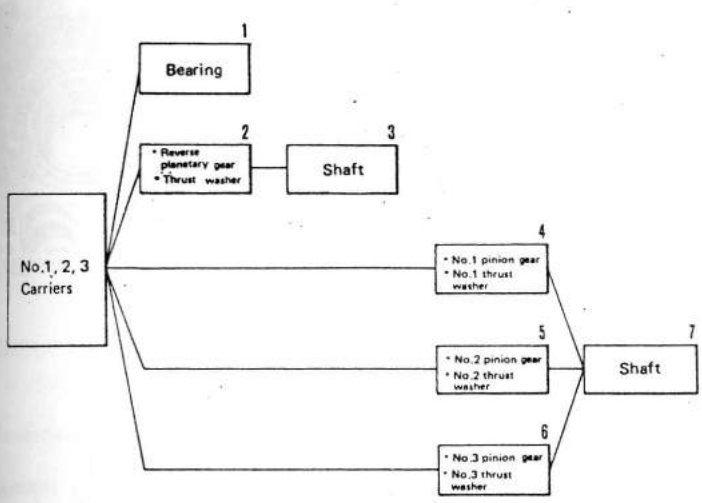
6. Remove bearing (8) from cage (3).

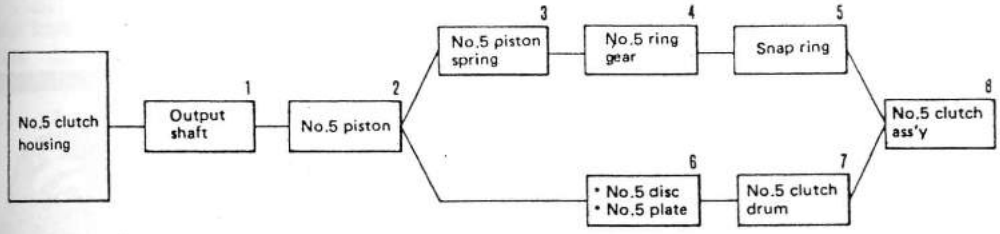


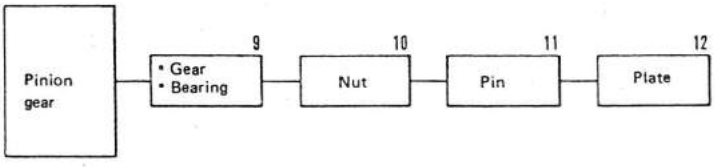


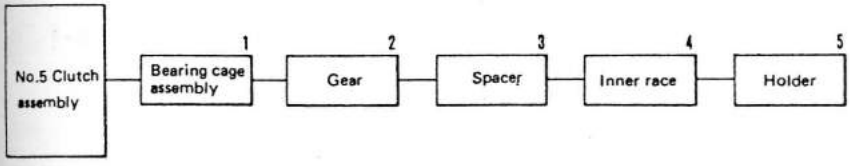
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ASSEMBLY OF TORQFLOW TRANSMISSION ASSEMBLY (1/2)





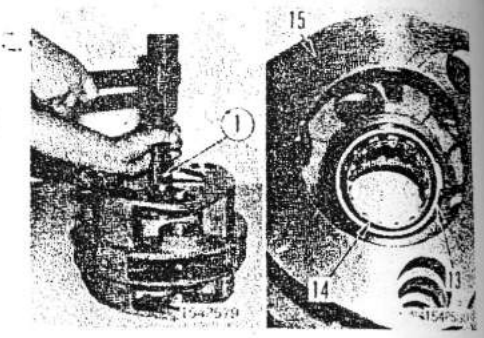




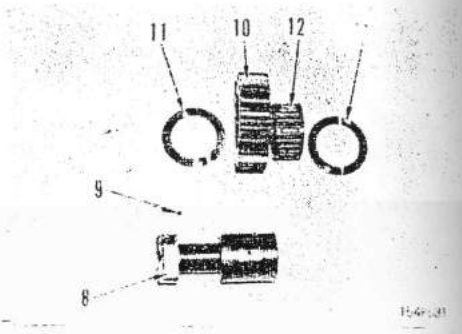
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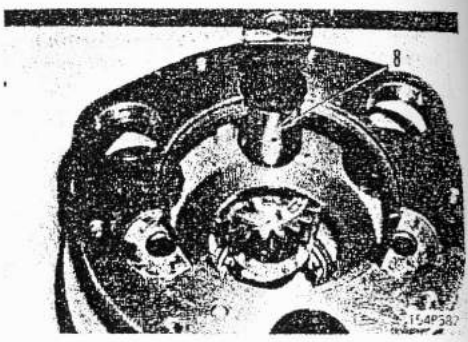
ASSEMBLY OF NO. 1, 2 AND 3 CARRIER



1. Bearing
   1) Using push tool ① (ϕ110 mm), press-fit bearing (14) onto carrier (15).
   2) Install snap ring (13).



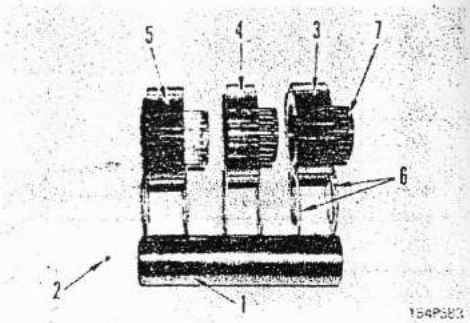
2. Reverse planetary gear and thrust washer
   1) Fit needle bearing (12) onto planetary gear (10).
   2) Assembly planetary gear, needle bearing assembly and left and right thrust washers (11), and position resulting assembly on carrier.
      ★ Apply engine oil (EO30-CD) to bearing and washer before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

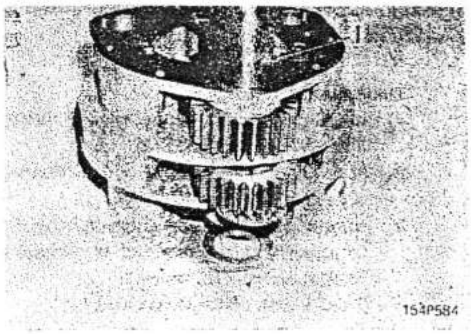
5. No. 2 pinion gear and thrust washer



6. No. 3 pinion gear and thrust washer
   1) Assembly 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.

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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.

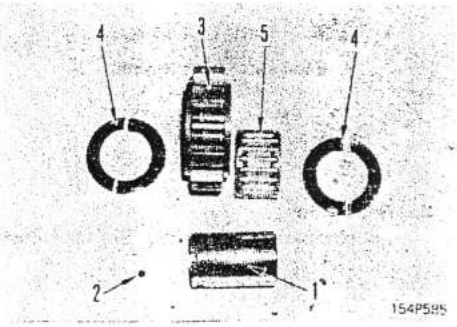


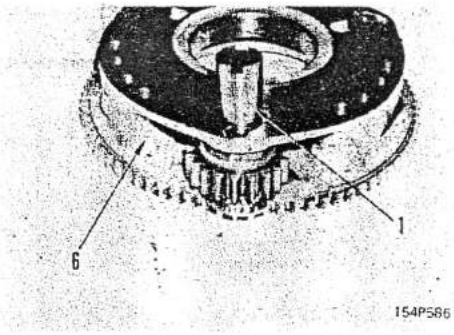
ASSEMBLY OF NO. 4 CARRIER ASSEMBLY

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.

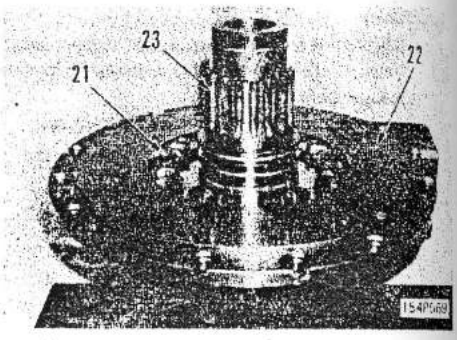
3. Align shaft side and carrier side stopper ball mounting holes. Drive shaft (1) with plastic hammer and fit stopper balls (2).





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ASSEMBLY OF NO. 5 HOUSING AND CLUTCH ASSEMBLY

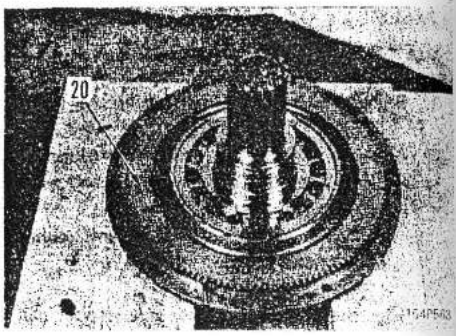


1. Output shaft
   1) Fit O-rings to mounting face of clutch housing (22) and output shaft (23).
   2) Position output shaft on clutch housing, and fit mounting bolts.
   3) Rotate clutch housing and output shaft assembly in opposite direction, and set it on block (1) (height: approx. 250 mm).
   4)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

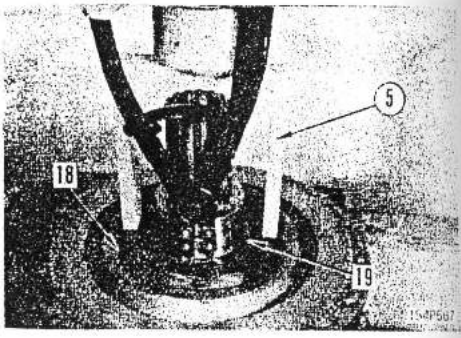
      Nut: Adhesive

      Nut: 11 ± 1.5 kg.m

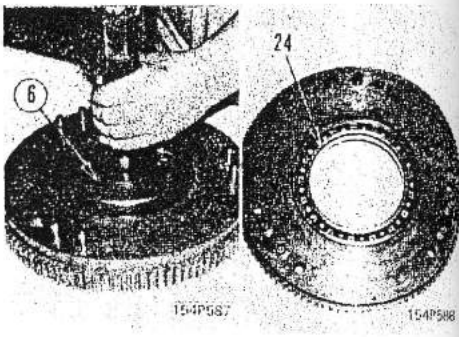
      ★ Bend lock plates securely.



2. No. 5 piston
   Fit piston rings on piston (20), and install housing.



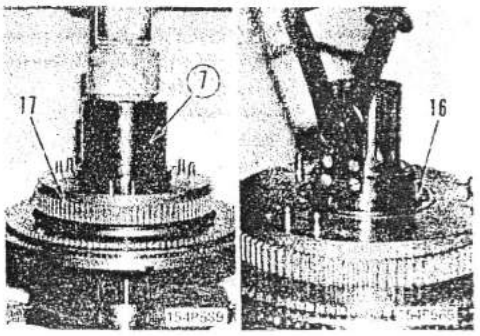
3. No. 5 piston spring
   1) Install No. 5 piston spring (18).
   2) Set pusher (5) to spring. Compress spring using press, and install snap ring (19).



4. No. 5 ring gear
   1) Using push tool (6) (ϕ165 mm), press-fit bearing (24) onto ring gear.

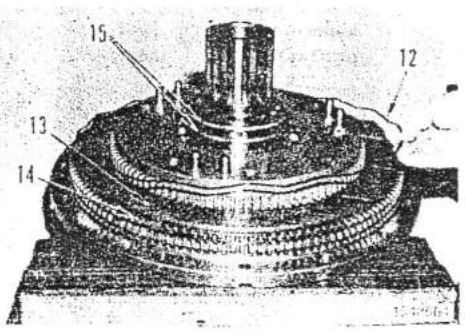
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2) Using push tool ⑦ (internal ϕ120 mm), press-fit No. 5 ring gear (17).

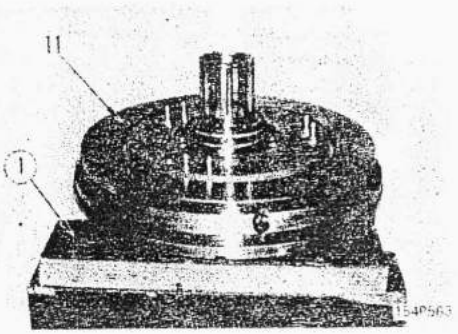


5. Snap ring
Install snap ring (16).

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.

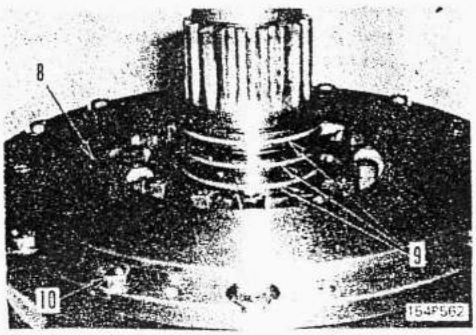


3) Tighten mounting bolts (10).

Mounting bolts: Adhesive

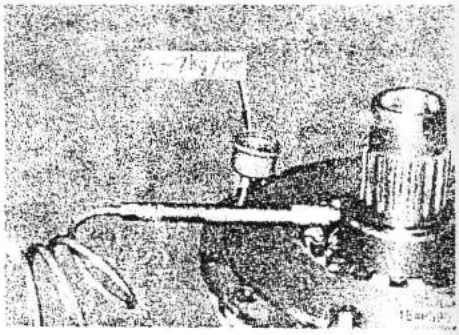
Mounting bolts: 11 ± 1.5 kg m

4) Install seal ring (9).

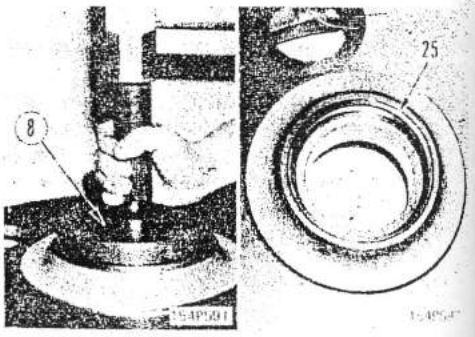


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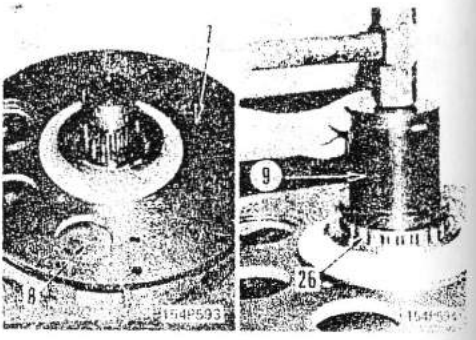
5) Using air checker apply 6 to 7 kg/cm^2 air pressure and check operation of No. 5 clutch piston.
   ★ If air pressure does not rise or cannot be maintained, seal ring is faulty.
   ★ No. 5 clutch stroke: 3 mm



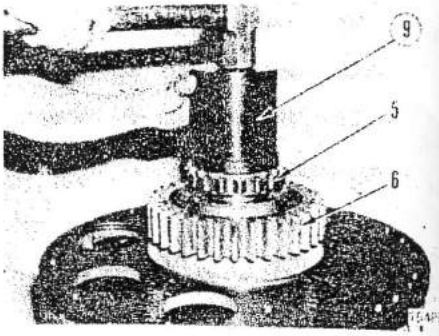
8. No. 5 clutch assembly
   1) Using push tool ⑧ (ϕ160 mm), press-fit outer race (25) into No. 5 housing.



   2) Align No. 5 housing on clutch assembly (8).
   3) Using push tool ⑨ (inside ϕ105 mm), press-fit bearing (26).

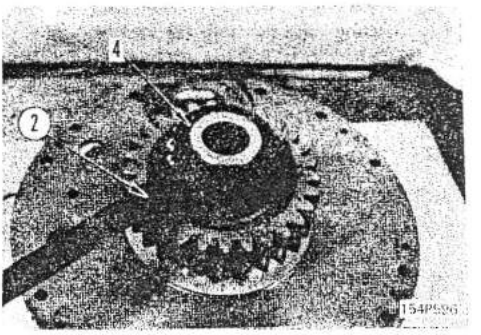


9. Bearing and gear
   Install gear (6). Using push tool ⑨ (inside ϕ90 mm), press-fit bearing (5).



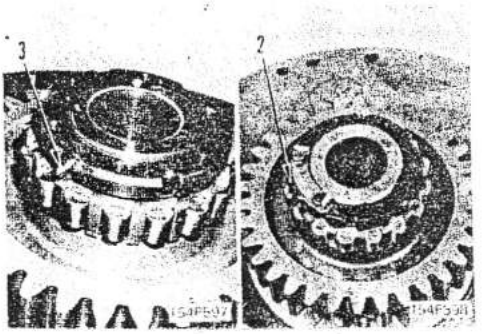
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10. Nut
Tighten nut (4) using nut wrench (2).
★ When tightening nut, locate nut retaining pin in one of three positions.



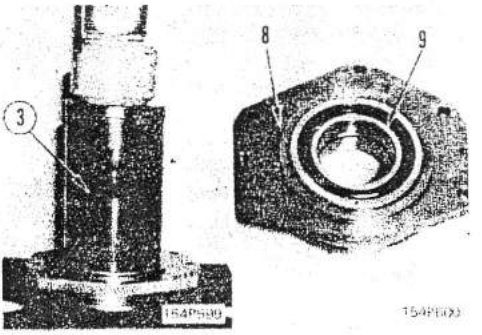
11. Pin
Install pin (3).

12. Plate
Install plate (2) and lock plate. Tighten nut.
★ Bend lock plate securely.

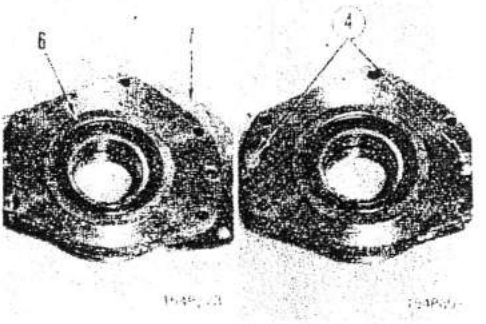


ASSEMBLY OF BEVEL PINION ASSEMBLY

1. Bearing cage assembly
1) Using push tool (3) (ϕ140 mm), press-fit bearing (9) onto bearing cage (8).

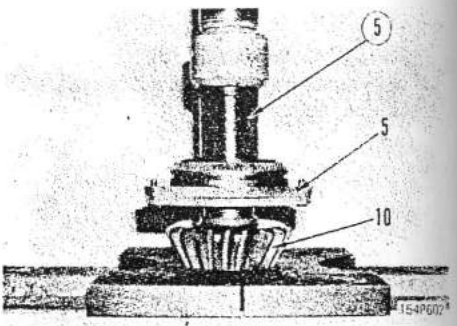


2) Insert shim (7) and install cover (6). Insert temporary mounting bolts (4) (12 mm, P = 1.75) into extraction bolt holes to secure bearing cage assembly.
★ Standard shim thickness: 0.45 mm



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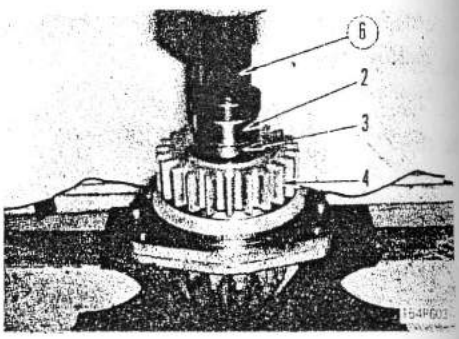
3) Using push tool ⑤ (inside dia. 80 mm), press bearing cage assembly (5) into bevel pinion (10).



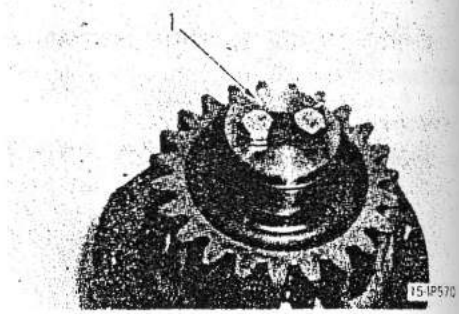
2. **Gear**
   Install gear (4).

3. **Spacer**
   Install spacer (3).

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



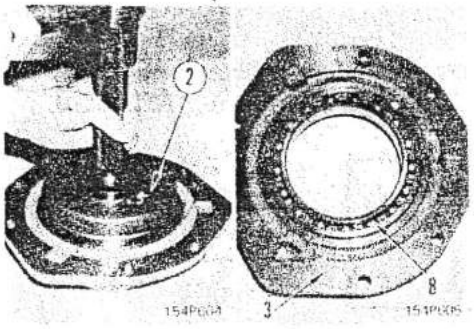
5. **Holder**
   Fit holder (1) and lock plate, and tighten bolts.
   ★ Bend lock plate securely.



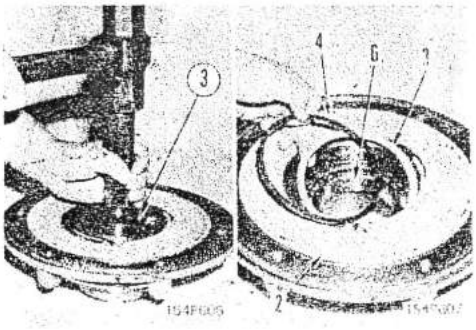
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ASSEMBLY OF BEARING CAGE ASSEMBLY

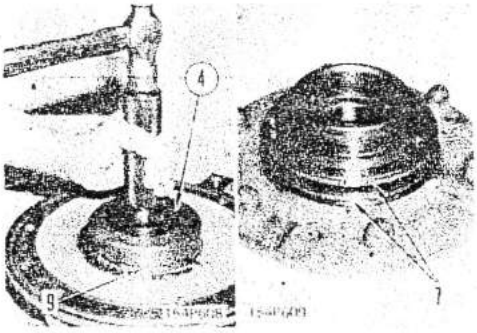
1. Using push tool ② (ϕ165 mm), press-fit bearing (8) into cage (3).



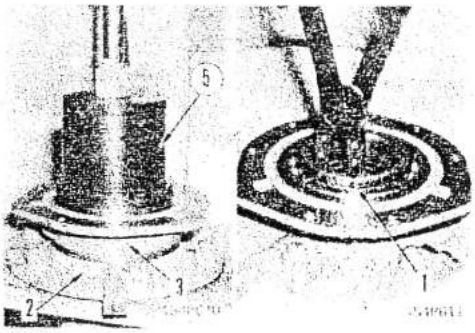
2. Using push tool ③ (ϕ125 mm), press-fit bearing (6) into cage (2).



3. Using push tool ④ (ϕ125 mm), press-fit oil seal (9).
4. Install seal ring (7).

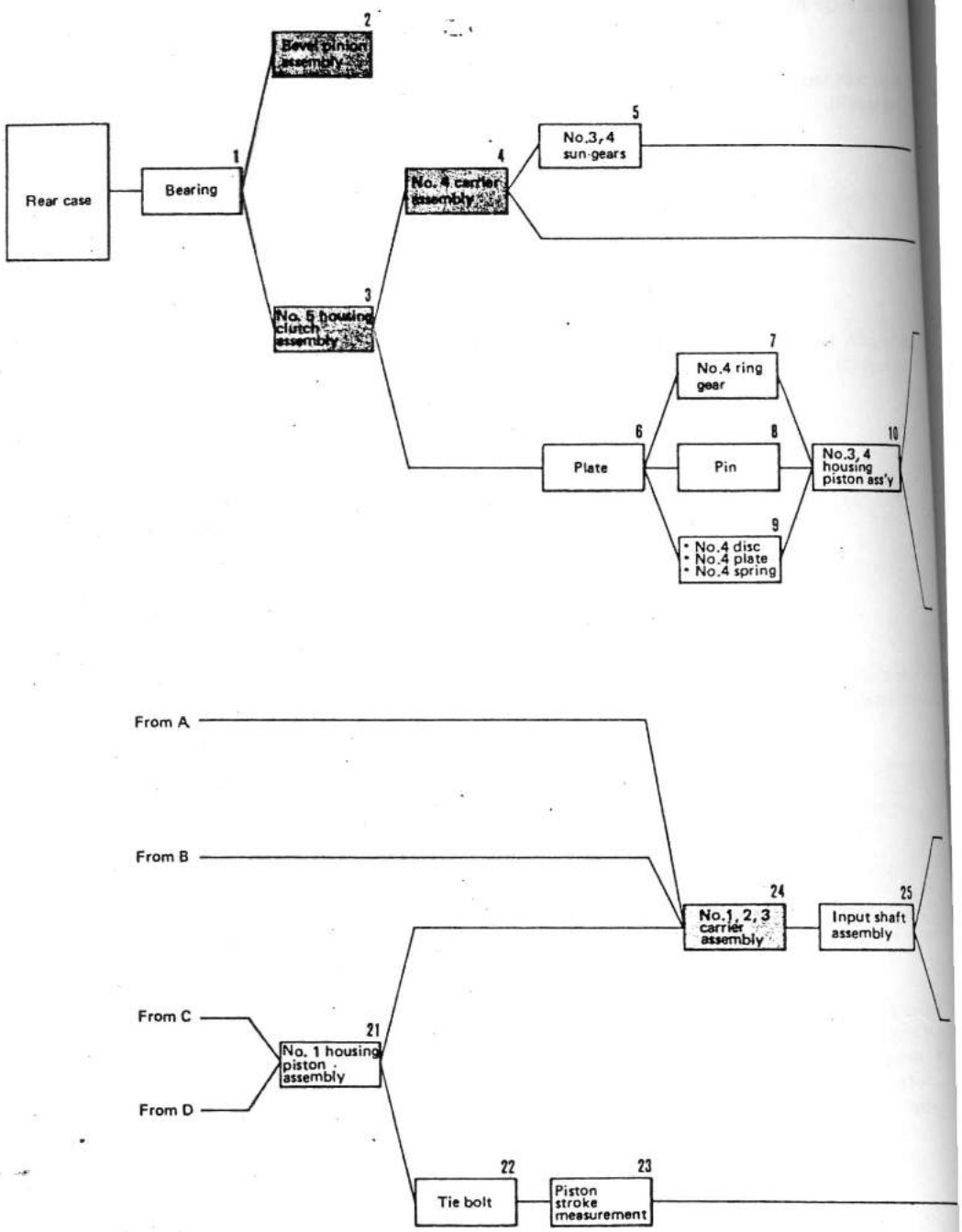


5. Using push tool ⑤ (inside dia. 120 mm), press cage (2) into cage (3).
   ★ Before assembly, apply engine oil to sliding face of seal ring.
6. Install snap ring (1).

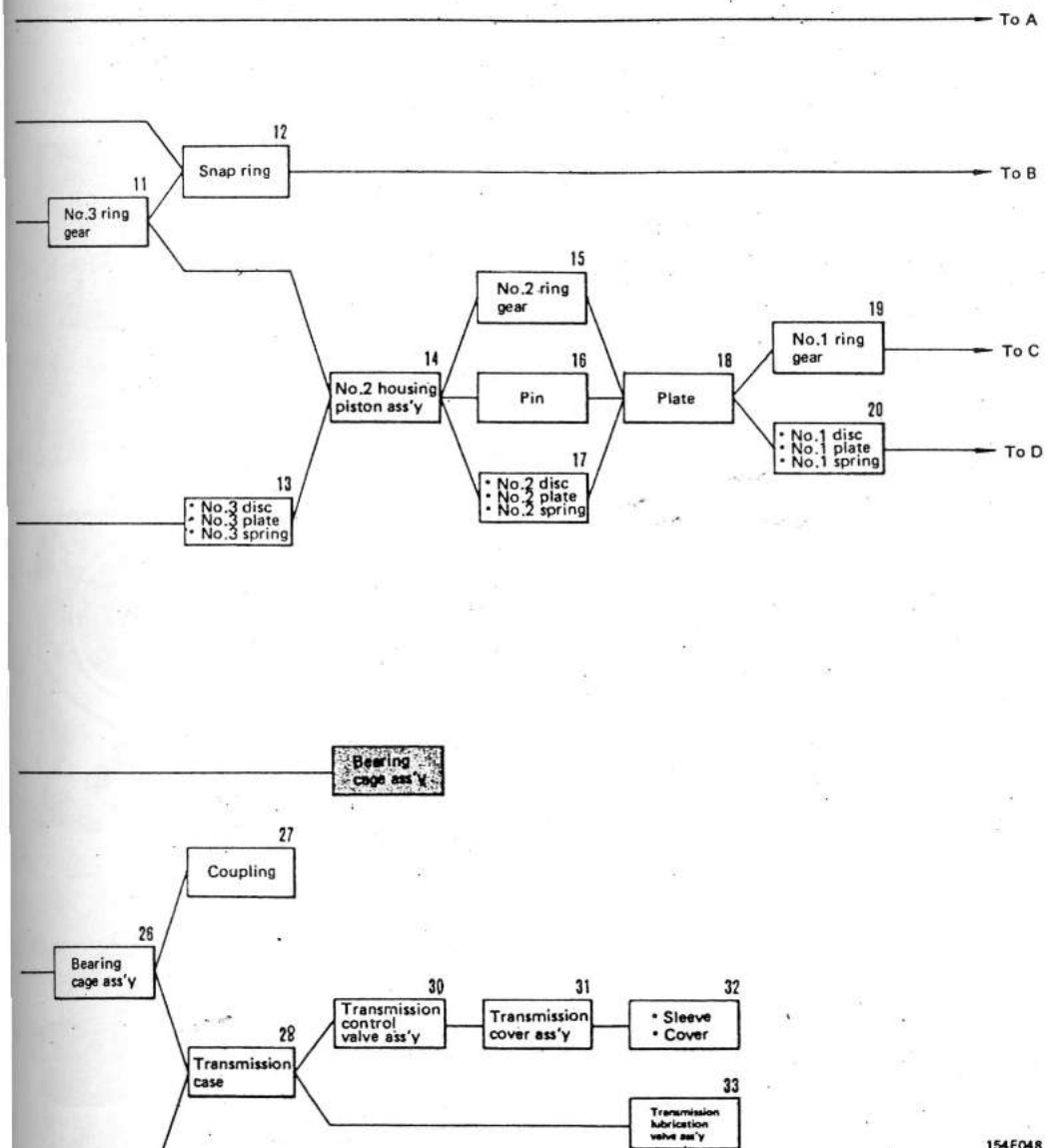


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ASSEMBLY OF TORQFLOW TRANSMISSION ASSEMBLY (2/2)



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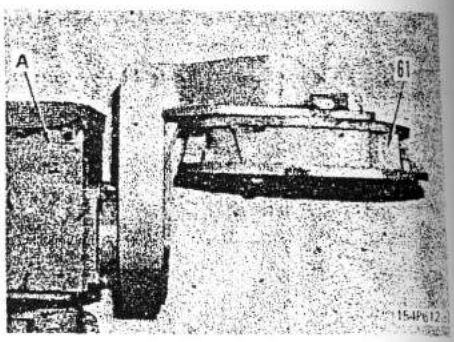
Special tools required

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

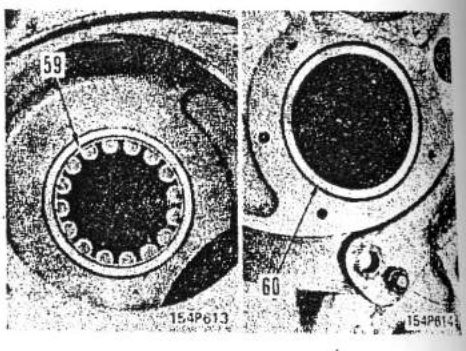
★ Before assembly, apply engine oil to sliding surfaces of each bearing, seal ring, plate and disc, etc., and also apply grease to lip surface of oil seal.

Preparatory work

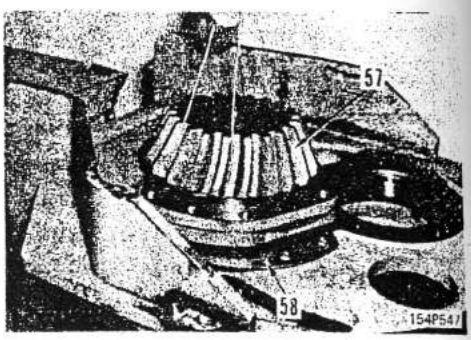
- Set rear case (61) on unit repair stand A.



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

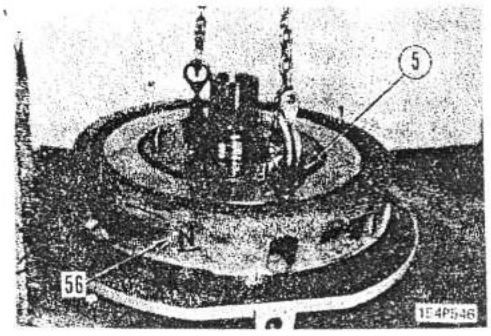


2. **Bevel pinion assembly**
   Insert tooth contact adjusting shim (58), and install bevel pinion assembly (57).
   ★ Standard shim thickness: 2.0 mm
   ★ Types of shims: t=1.0 mm, t=0.2 mm, t=0.3 mm



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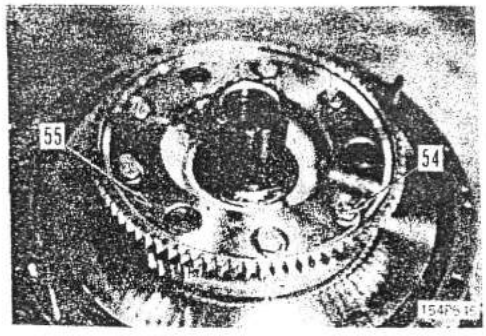
3. No. 5 housing and clutch assembly
   1) Rotate repair stand in opposite direction and set assembly so that bevel pinion is facing downwards and rear case side is horizontal.
   2) Raise assembly using eye bolts ⑤ (14 mm, P = 2.0. Align dowel pin positions and install No. 5 housing and clutch assembly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



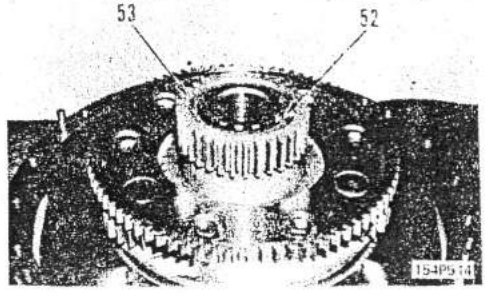
4. No. 4 carrier assembly
   Install No. 4 carrier assembly (55), and tighten mounting bolts (54).

   Mounting bolts: Adhesive

   Mounting bolts: 17.5 ± 2.5 kg.m

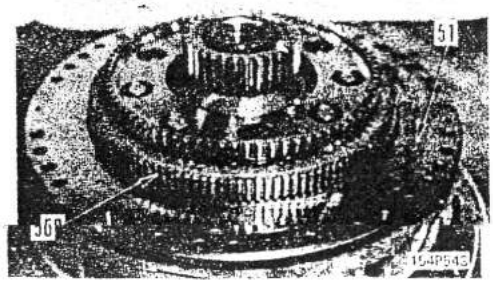


5. No. 3 and 4 sun gears
   Install No. 3 and 4 sun gears (53), and fit spring (52).



6. Plate
   Align dowel pin positions and install plate (51).

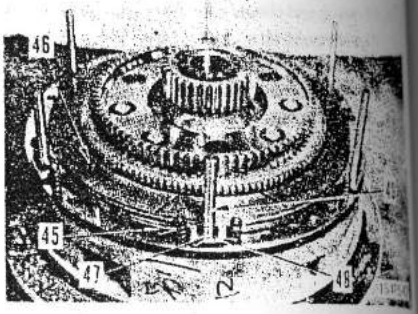
7. No. 4 ring gear
   Install No. 4 ring gear (50).



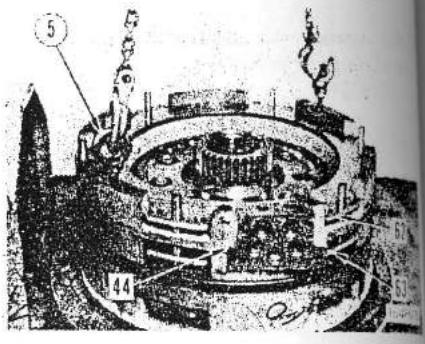
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8. **Pins**
   Install guide pins (49).

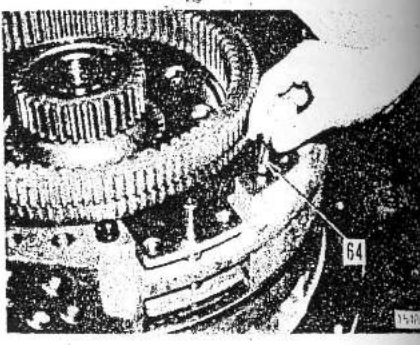
9. **No. 4 discs, plates and springs**
   1) Mount discs (46), washer return springs (47) and plates (48) in that order.
      ★ Assemble discs so that notches on inner teeth are in line with each other.
   2) Install No. 4 piston spring (45).
      ★ Free height of spring: 45.7 mm



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.

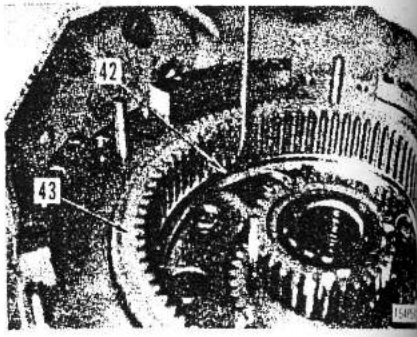


   3) Install sleeve (64) to housing.



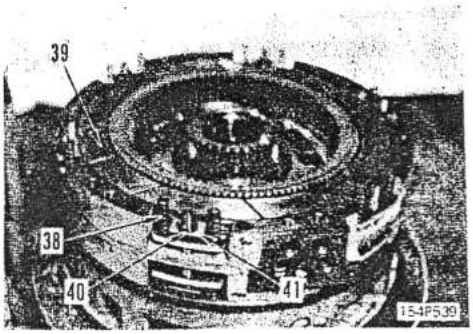
11. **No. 3 ring gear**
    Install No. 3 ring gear

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.

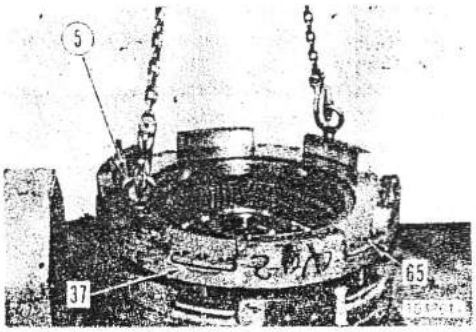


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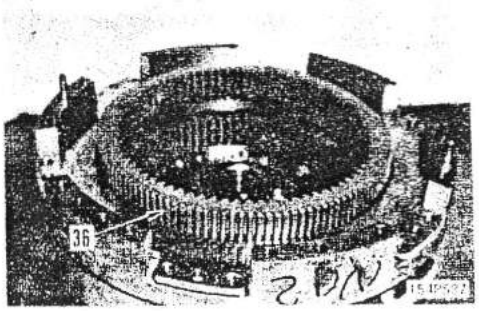
13. No. 3 discs, plates and springs
1) Mount discs (39), washer return springs (40) and plates (41) in that order.
★ Assemble discs so that notches on inner teeth are in line with each other.
2) Install No. 3 piston spring (38).
★ Free height of spring: 45.7 mm



14. 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 = 2.0). Align dowel pin positions and install No. 2 housing and piston assembly (37).



15. No. 2 ring gear
Install No. 2 ring gear (36).



16. Pins
Install guide pins (35).

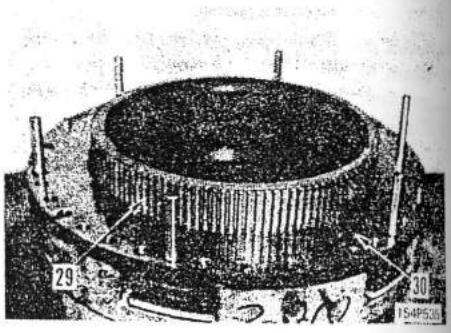
17. No. 2 discs, plates and springs
1) Mount discs (32), washer return springs (33) and plates (34) in that order.
★ Assemble discs so that notches on inner teeth are in line with each other.
2) Install No. 2 piston spring (31).
★ Free height of spring: 45.7 mm



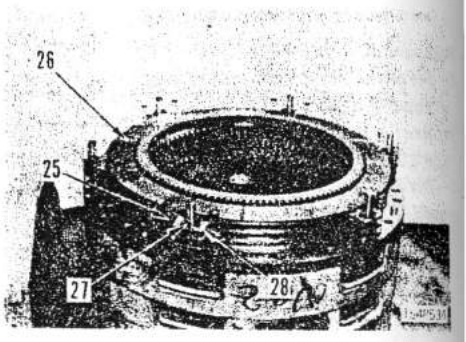
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18. **Plate**
Install plate (30).

19. **No. 1 ring gear**
Install No. 1 ring gear (29).
★ Install ring gear so that notch on inner teeth is uppermost (input side).



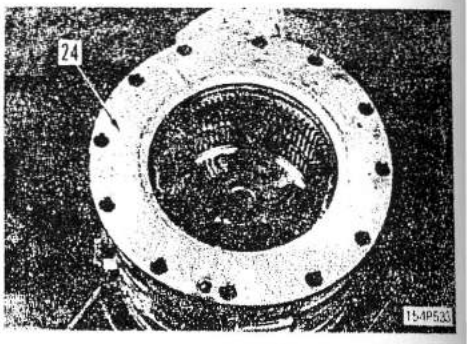
20. **No. 1 discs, plates and springs**
1) Mount discs (26), washer return springs (29) and plate (28) in that order.
★ Assemble discs so that notches on inner teeth are in line with each other.
2) Install No. 1 piston spring (25).
★ Free height of spring: 66 mm



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 housing and piston assembly (24).

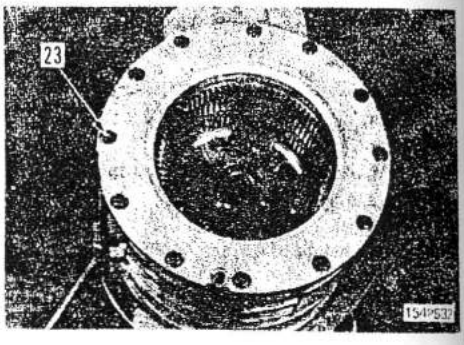
⚠ Because assembly is heavy, lift it using two people and install it carefully.

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



22. **Tie bolts**
Tighten tie bolts (23).

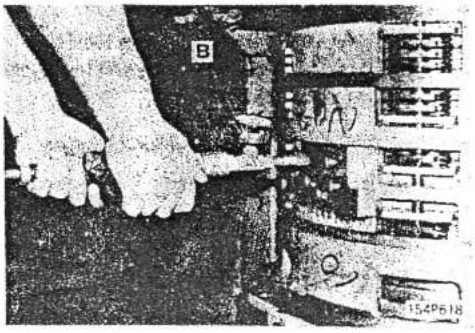
Tie bolts: 17 ± 1.0 kg.m



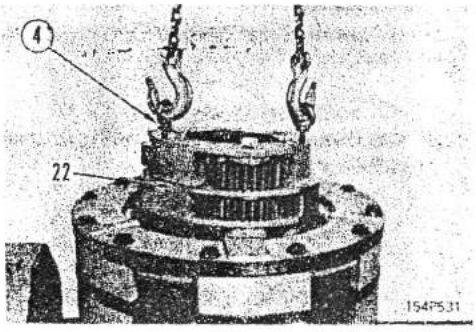
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23. Piston stroke measurement
Using air checker B, check operating condition and stroke of each piston.
★ Air pressure: 6 to 7 kg/cm²
★ Stroke

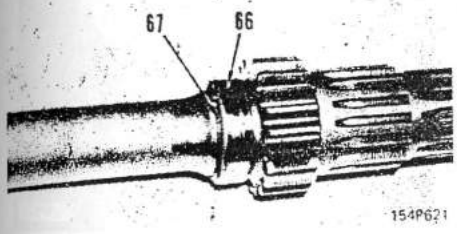
Clutch No.	Stroke
No. 1 clutch	5 mm
No. 2 clutch	4 mm
No. 3 clutch	4 mm
No. 4 clutch	4 mm

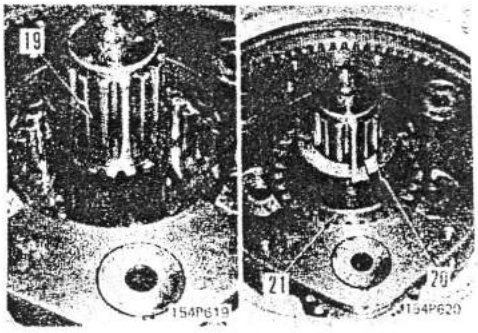


24. No. 1, 2 and 3 carrier assembly
Lift assembly with eye bolts ④ (12 mm, P = 1.75), and install No. 1, 2 and 3 carrier assembly (22).
★ If gears do not mesh satisfactorily, rotate complete carrier during installation.



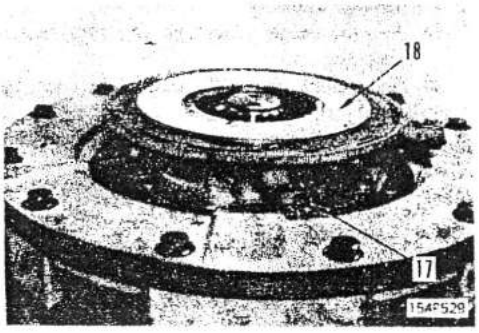
25. Input shaft assembly
1) Press-fit inner race (66) onto input shaft, and fit snap ring (67).





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).

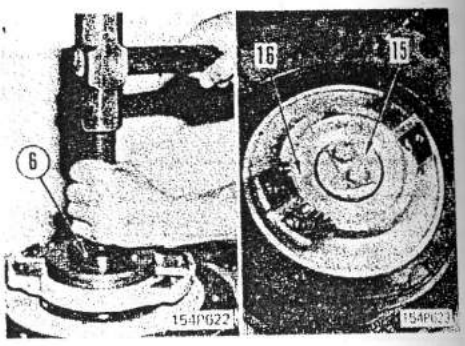


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27. Coupling
    1) Press-fit coupling (16) using push tool ⑥.
    2) Fit O-ring. Install holder (15) and lock plate and tighten mounting bolts.

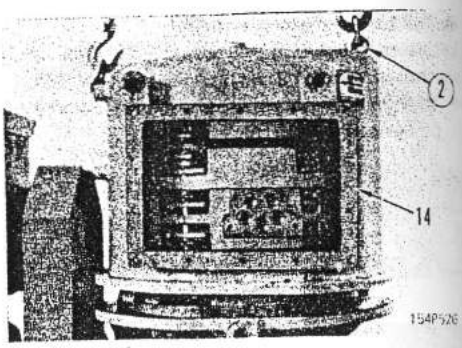
       Mounting bolts: 4.5 ± 1.0 kg.m

       ★ Bend lock plate securely.

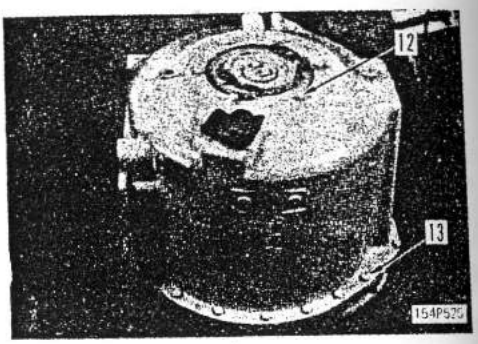


28. Transmission case
    1) Fit gasket to rear case and fit O-ring to bearing cage.

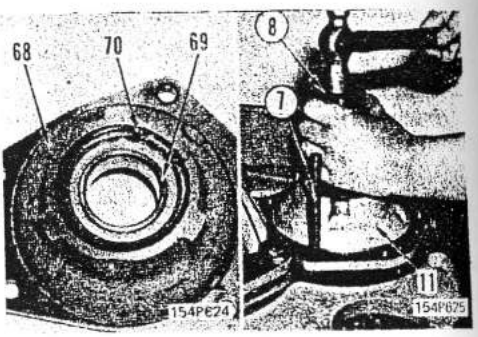
       Gasket: Liquid gasket
    2) Lift transmission case (14) with eye bolts ② (10 mm, P = 1.5) and install it.



    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).



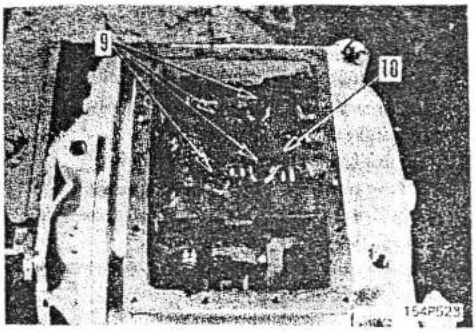
29. Bearing cage assembly
    1) Press-fit bearing (69) into cage (68), and install snap ring (70).
    2) Using guide bolts ⑦, position bearing cage assembly (11).
    3) Using push tool ⑧ (internal dia. 50 mm), press-fit bearing cage assembly.



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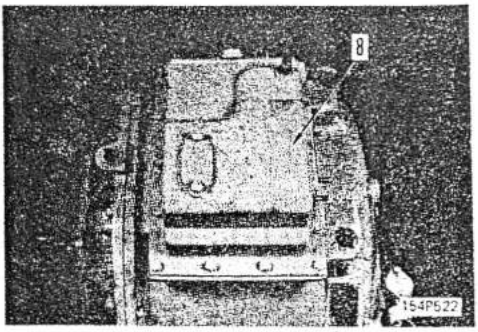
30. Transmission control valve assembly
    1) Fit O-ring to clutch housing side, and install transmission control valve assembly (10) together with seat.
    2) Tighten mounting bolts (9).

    Mounting bolts: 4.25 ± 1.25 kg.m

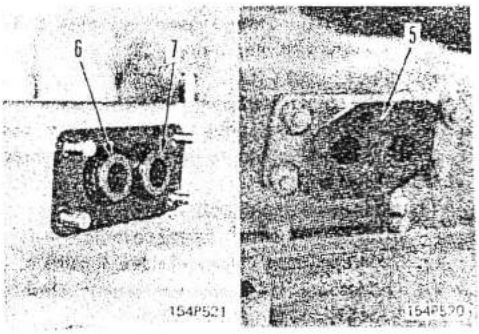


31. Transmission cover assembly
    Fit gasket to transmission case. Align connecting parts of spool and yoke and install transmission cover assembly (8).

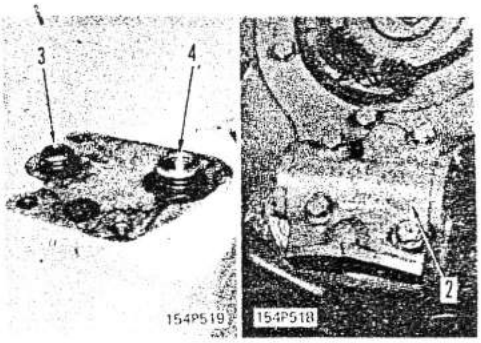
    Gasket: Liquid gasket



32. Sleeve 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).

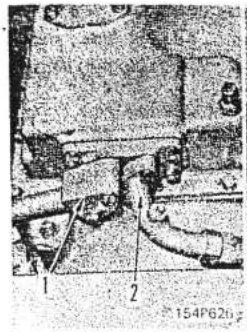


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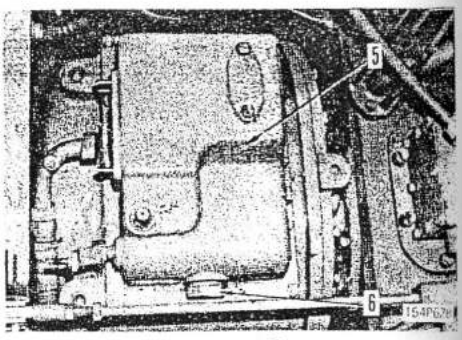
DISMOUNTING TRANSMISSION CONTROL VALVE ASSEMBLY

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).

kg Transmission control valve assembly: 30 kg





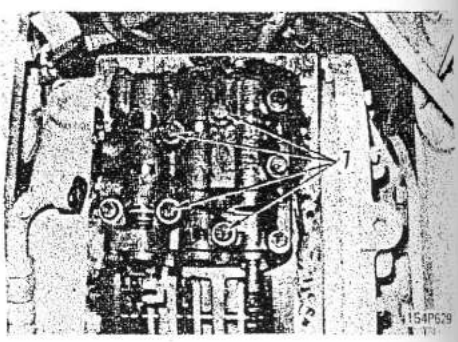


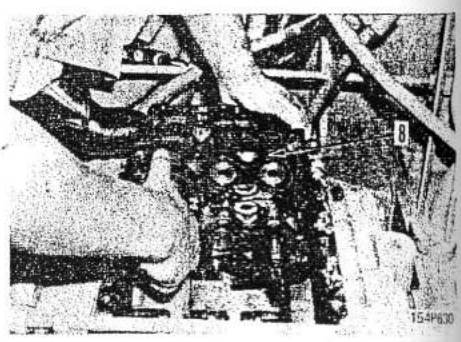
MOUNTING TRANSMISSION CONTROL VALVE ASSEMBLY

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.

kgm Mounting bolts: 4.25±1.25 kg.m

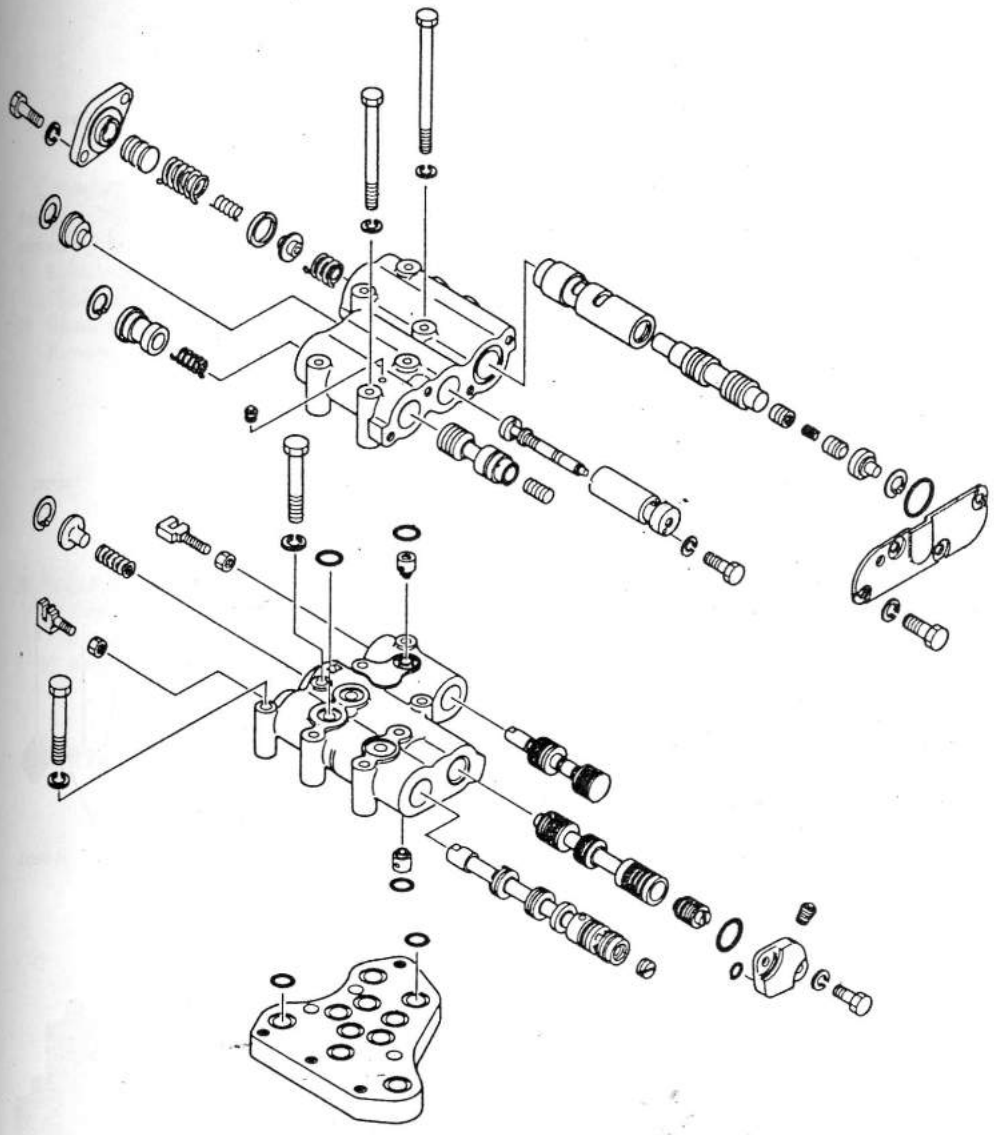
3. Fit gasket. Align spool yoke and lever mounting positions while observing inspection plug hole, and install cover (5).
4. Tighten inspection plug (6).
5. Fit sleeve (4) and O-ring. Install cover (3).
6. Fit gasket and install cover and sleeve together.
7. Fit O-rings and connect transmission control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





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DISASSEMBLY OF TRANSMISSION CONTROL VALVE ASSEMBLY



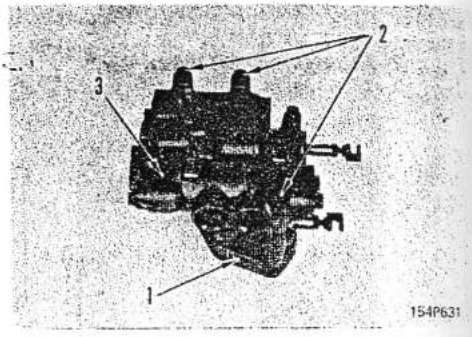
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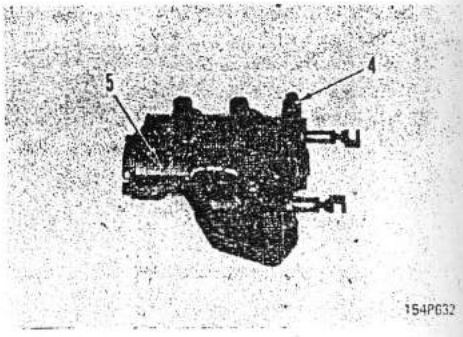
1. Disassembly of control valve assembly

1) Remove valve seat (1) and through-bolts (2).

2) Remove modulating, reducing and quick return valve assembly (3).

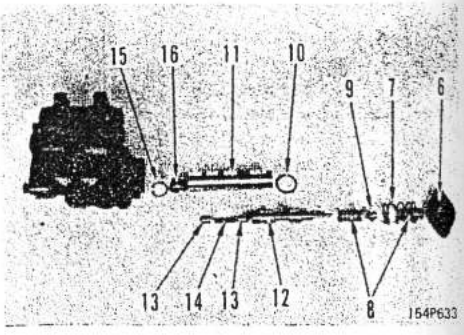
3) Remove valve seat and coupling bolts (4). Dismount speed, directional and safety valve assembly (5).



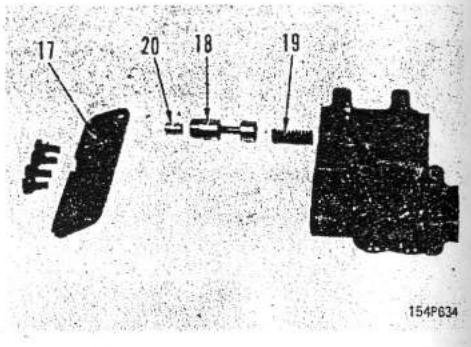


2. Disassembly of modulating, reducing and quick return valve assembly

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).

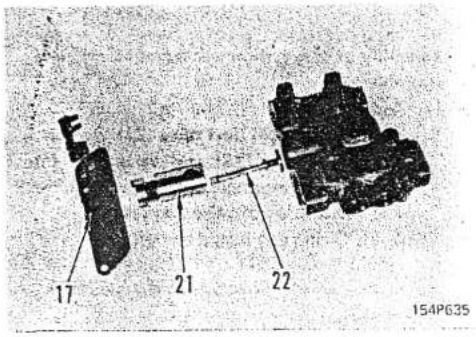


2) Disassembly of reducing valve
   i) Remove cover (17).
   ii) Extract valve (18) and spring (19).
   iii) Extract sleeve (21) and valve (22).

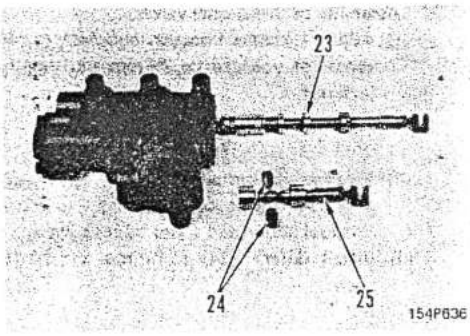


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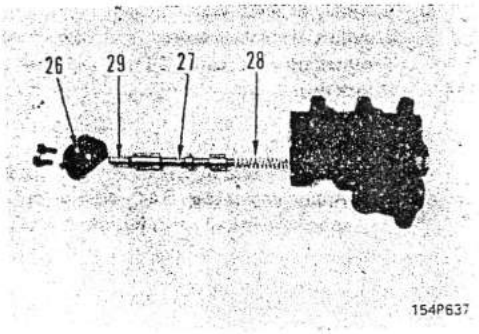
3) Disassembly of quick return valve
   i) Remove cover **(17)**.
   ii) Extract sleeve **(21)** and valve (22).



3. **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).



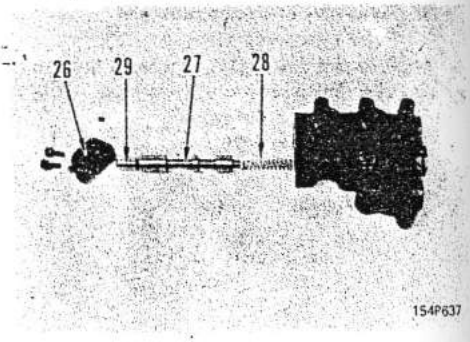
   3) Disassembly of safety valve
      i) Remove cover **(26)** and extract valve (27) and spring (28).
      ii) Remove piston **(29)** from valve.



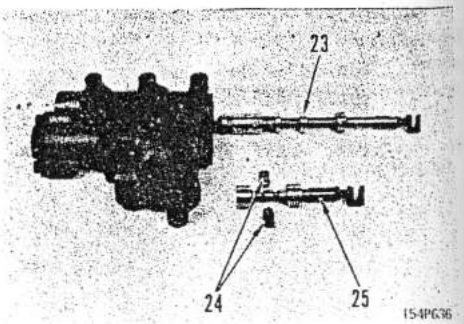
https://truckmanualshub.com/

ASSEMBLY OF TRANSMISSION CONTROL VALVE ASSEMBLY

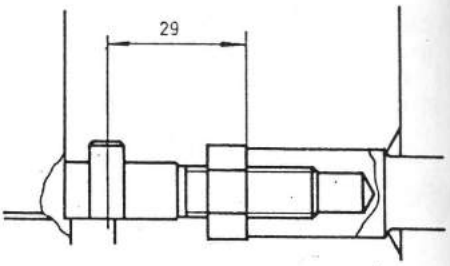
1. **Assembly of speed, directional and safety valve assembly**
   1) Assembly of safety valve
      i) Fit piston (29) into valve (27).
      ii) Insert spring (28) and valve (27) into body.
      ★ Before assembly apply engine oil SAE 30 to outside of valve and piston.
      iii) Fit O-ring and install cover (26).



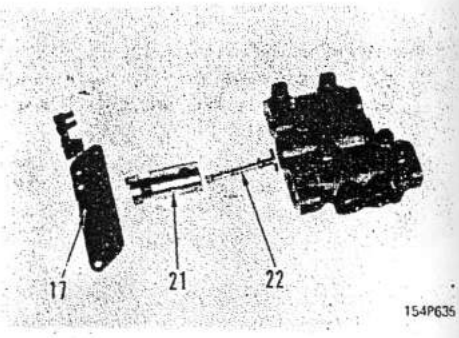
   2) Assembly of directional valve
      i) Adjust distance between end face of nut and center of yoke to be 29 mm and then tighten lock nut.
      ii) Fit spool (25) into body.
      ★ Apply engine oil SAE 30 to outside of spool and install spool by rotating it.
      iii) Install detent (24) from top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



   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 hut.
      ii) Install spool (23) into body.
      ★ Apply engine oil SAE 30 to outside of spool and install spool by rotating it.

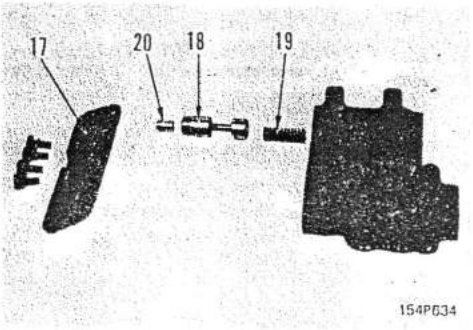


2. **Assembly of modulating, quick return and reducing valve assembly**
   1) Assembly of quick return valve
      i) Fit valve (22) onto sleeve (21), and install assembly onto body.
      ★ Before assembly, apply engine oil SAE 30 to outside of sleeve.
      ii) Install cover (17).

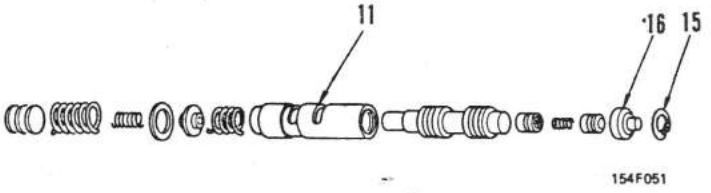


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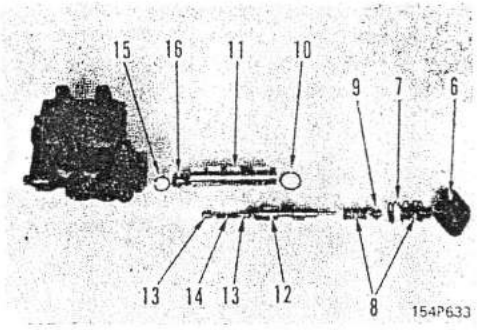
2) Assembly of reducing valve
   i) Fit piston (20) onto valve (18).
   ii) Install sleeve (19) and valve (18) onto body.
   ★ Before assembly, apply engine oil SAE 30 to outside of valve.
   iii) Install cover (17).



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.

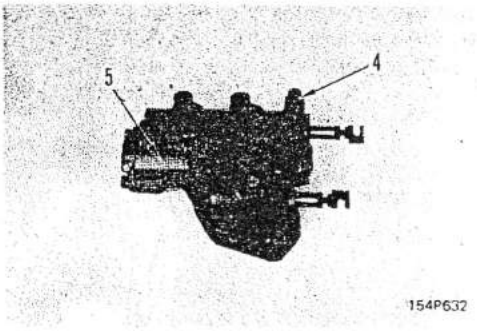


   ii) Install piston (13) and spring (14) onto washer (12).
   iii) Install valve (12) onto sleeve (11) and install assembly onto body.
   ★ Before assembly, apply engine oil SAE 30 to outside of sleeve and valve.
   iv) Assemble washer (10), valve spring (8), seat (9) and sleeve spring (7). Install cover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



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

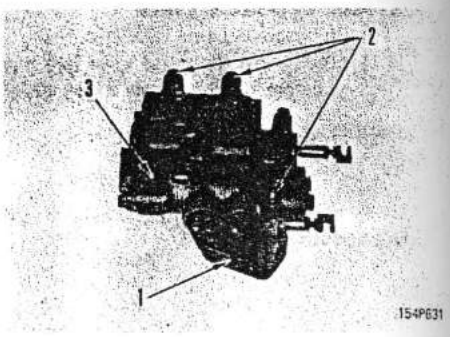
   Through bolt: 4.25 ± 1.25 kg.m



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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).

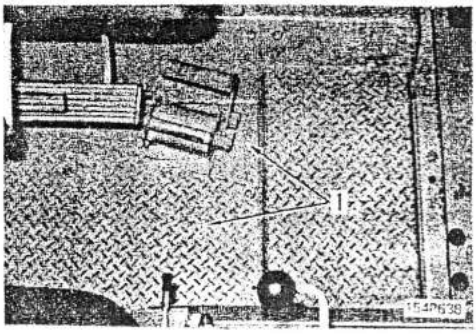
kgm Through bolts: 4.25±1.25 kg.m



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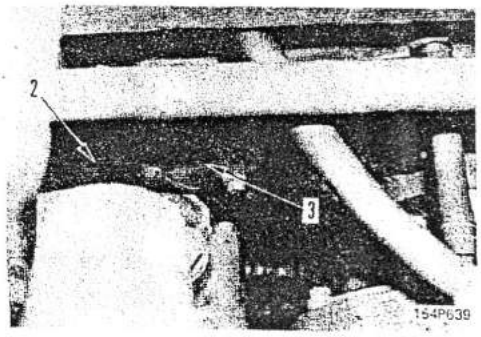
DISMOUNTING TRANSMISSION LUBRICATION VALVE ASSEMBLY

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

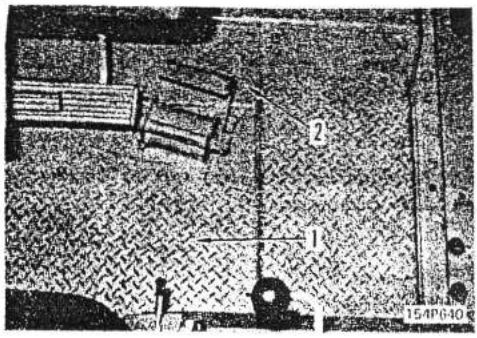
1. Fit gasket and mount transmission lubrication valve assembly (3).
2. Fit O-ring and connect up lubrication valve inlet and outlet pipes (2).
3. Install two floor plates (1).

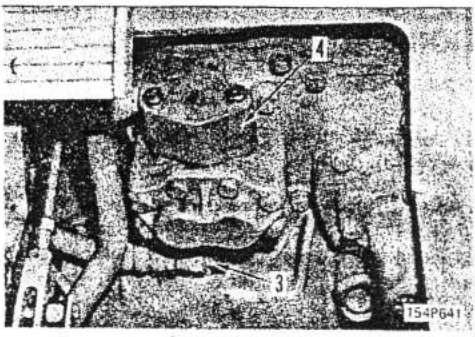


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DISMOUNTING TRANSMISSION PUMP ASSEMBLY

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).



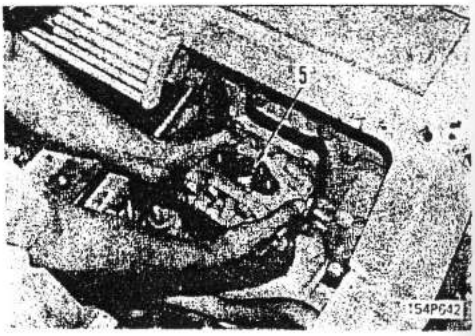


MOUNTING TRANSMISSION PUMP ASSEMBLY

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.

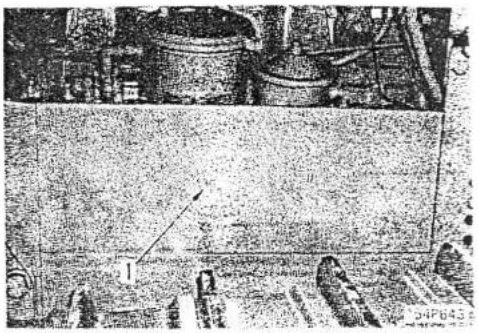
   ⊕ Bend cotter pin securely.
4. Install floor plate (1).



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DISMOUNTING STEERING PUMP ASSEMBLY

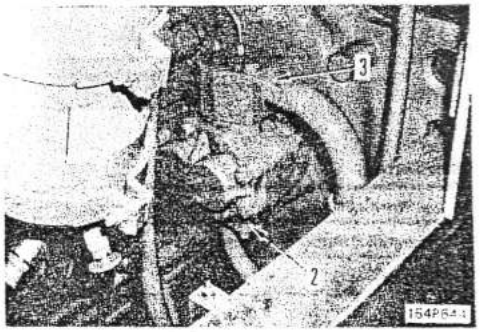
1. Remove engine left side cover (1).
2. Disconnect pump outlet tube (2) and inlet tube (3).
   ★ Sling inlet tube.
3. Remove pump assembly (4).

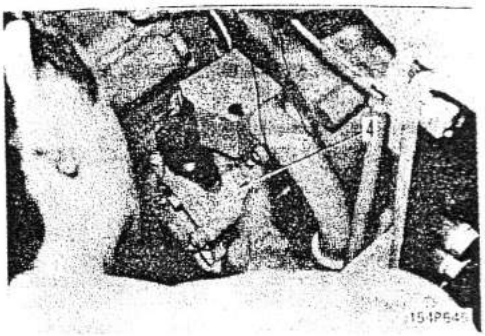


MOUNTING STEERING PUMP ASSEMBLY

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).

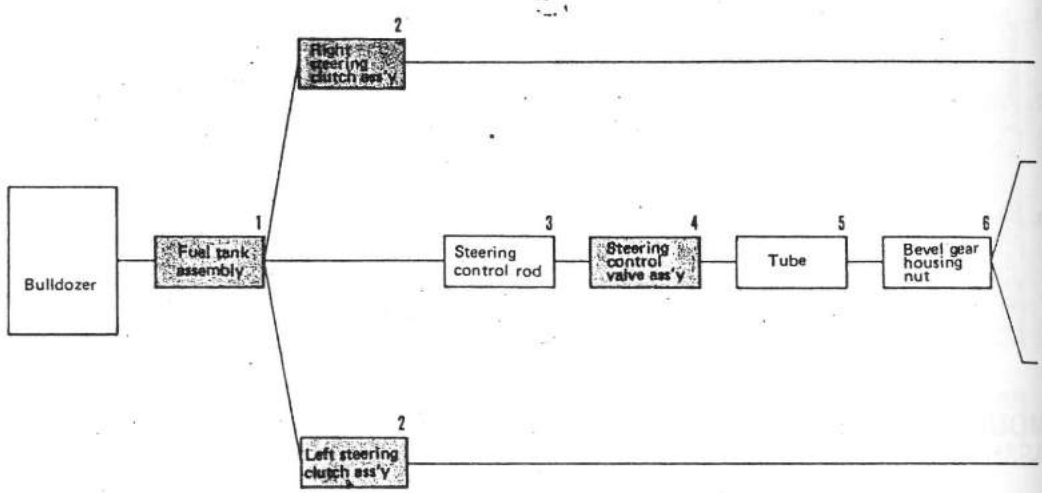
   ⊕ Fit O-ring securely in groove.
3. Install engine side cover (1).





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DISMOUNTING BEVEL GEAR SHAFT AND BEVEL GEAR



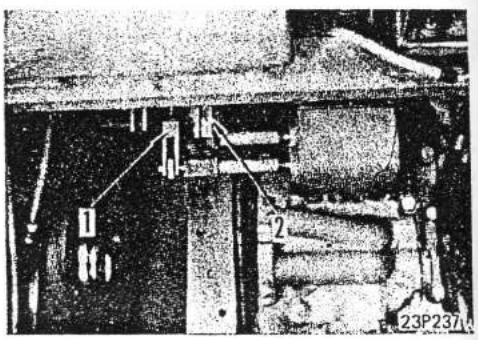
Special tools

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

1. **Fuel tank assembly**
   See "DISMOUNTING FUEL TANK ASSEMBLY".

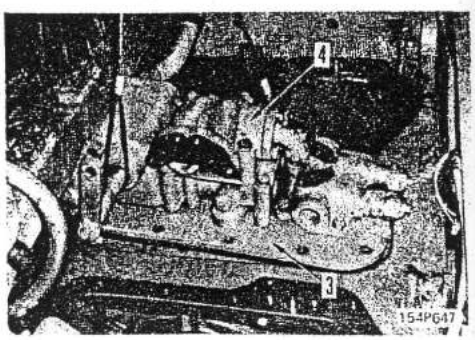
2. **Steering clutch assembly**
   See "DISMOUNTING STEERING CLUTCH ASSEMBLY".

3. **Steering control rod**
   Disconnect steering control rod valve operating rods (1) and (2).

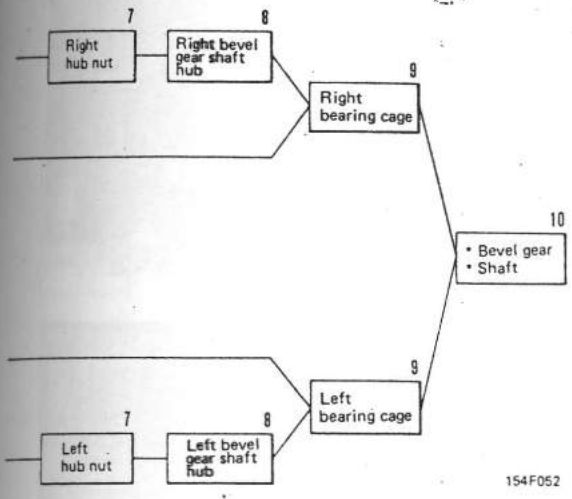


4. **Steering control valve assembly**
   Remove valve seat (3) mounting bolts and remove valve seat together with steering control valve assembly (4).

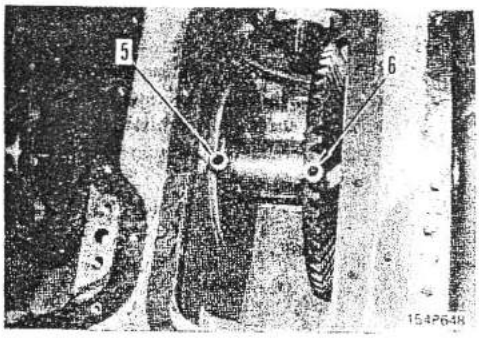
   kg Steering control valve assembly: 65 kg



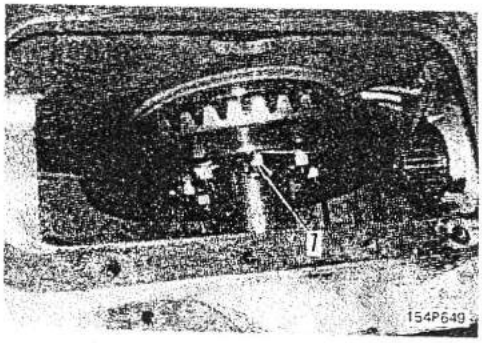
https://truckmanualshub.com/



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

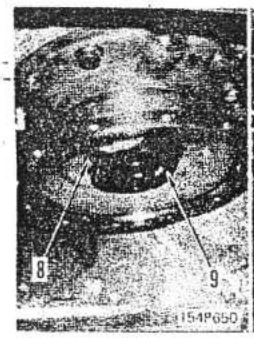


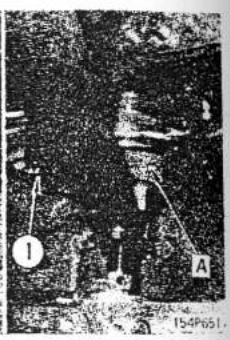
6. **Bevel gear mounting nuts**
   Lock bevel gear shaft using shaft hub bolt holes.
   Remove bevel gear mounting nuts (7).



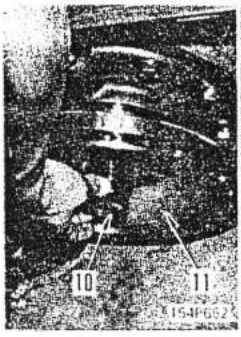
https://truckmanualshub.com/

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).



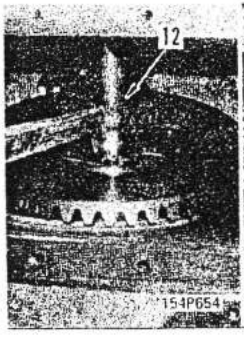


8. Bevel gear shaft hub
   1) Remove left and right hubs and shaft gasket (10).
   2) Set tool B and remove left and right bevel gear shaft hub (11).





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.

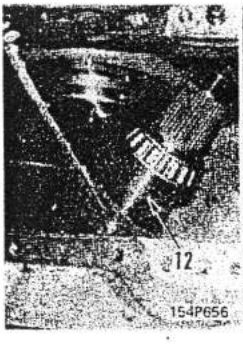


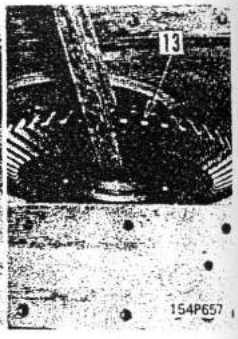


10. Bevel gear and shaft
    1) Lightly strike bevel gear to separate pilot bore part of shaft (12). Remove shaft from right clutch housing.

       kg Shaft assembly: 35 kg
    2) Remove bevel gear (13).

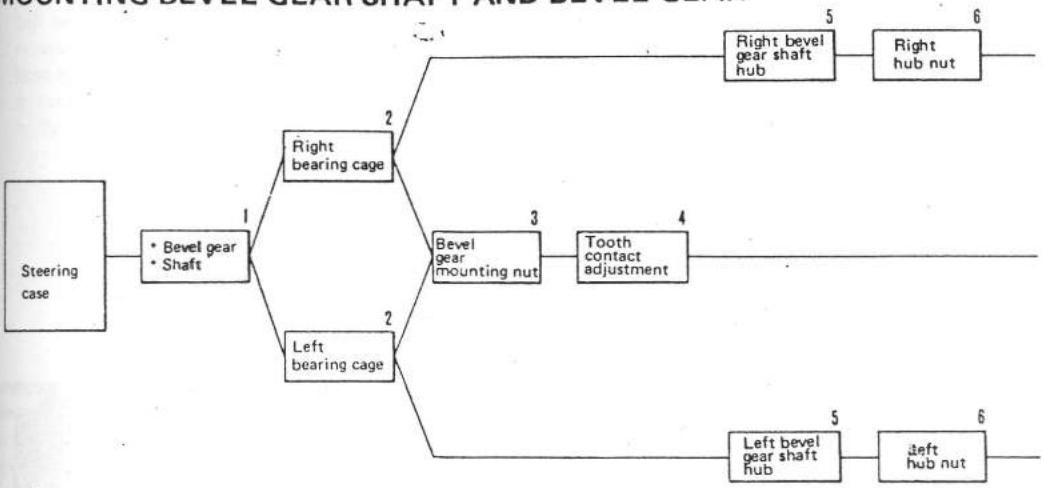
       kg Bevel gear: 30 kg





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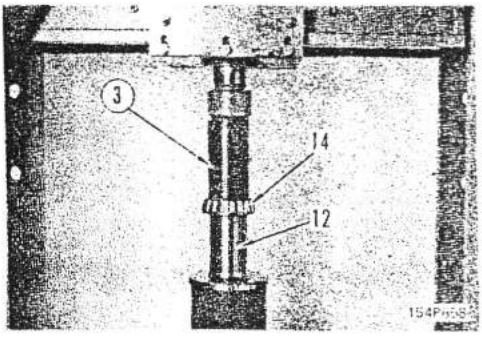
MOUNTING BEVEL GEAR SHAFT AND BEVEL GEAR



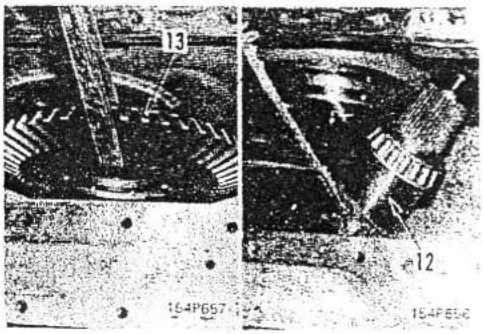
Special tools

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

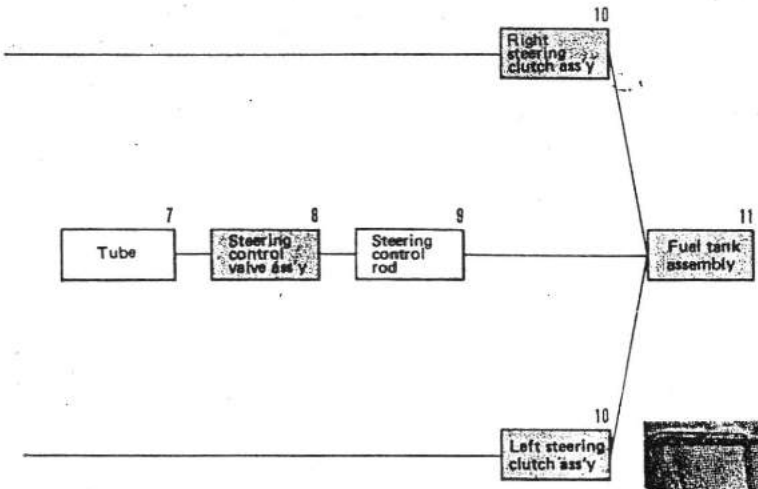
1. Bevel gear and shaft
   1) Press fit shaft (12) into left and right bearings (14) using push tool ③ (inside dia. 80 mm)



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

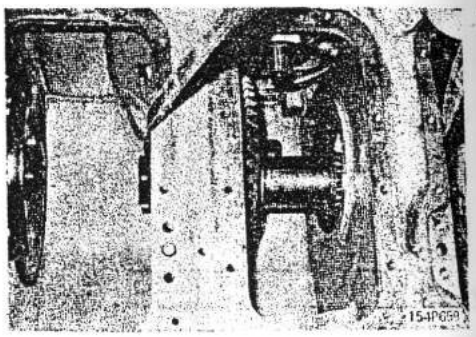


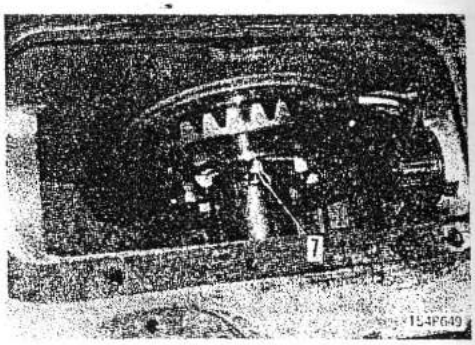
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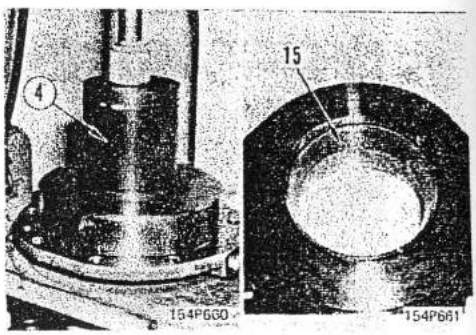
4) Fit hub nuts on both ends of shaft and raise shaft. Align bevel gear with pilot bore part of shaft.
5) Fit mounting bolts. Install lock plates and temporarily tighten nuts (7).
   ★ When tightening bolts, check that chambered part of bolt head is in firm contact with shaft.





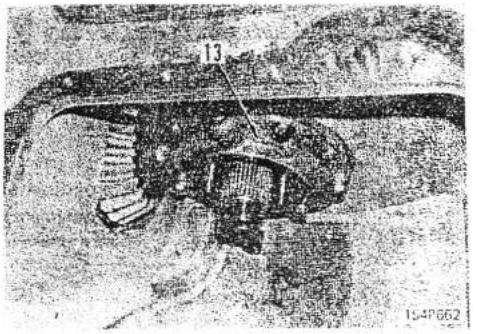
2. Bearing cage

1) Press fit outer race (15) onto cage using push tool ④ (ø140 mm).



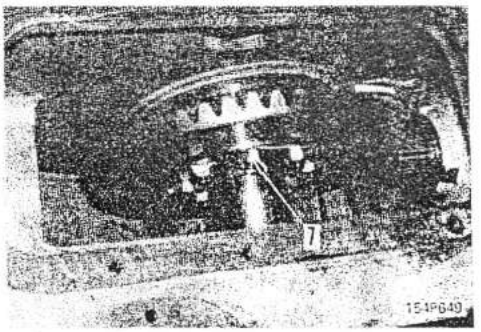
https://truckmanualshub.com/

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

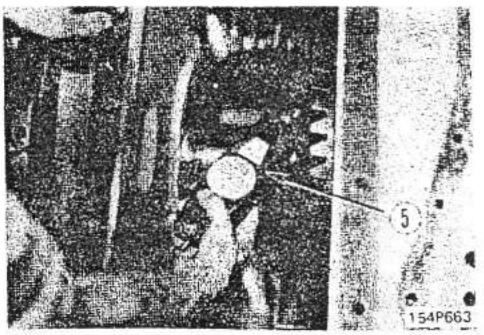


3. **Bevel gear mounting nut**
   Temporary fit bevel gear shaft hub. Insert retaining pin in hub bolt hole and tighten up bevel gear mounting nut (7).

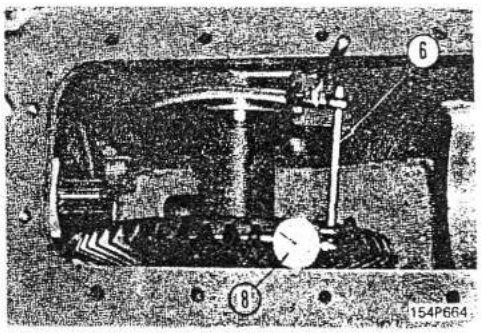
   Mounting nut: 39.25±4.25 kg.m
   - ★ Bend lock plates securely.



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.

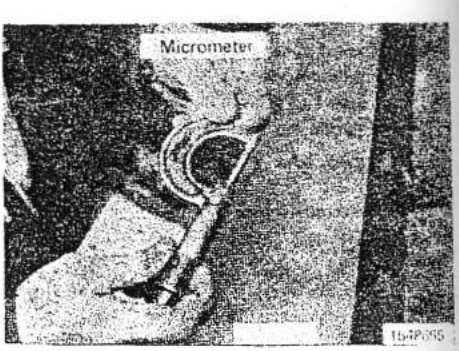


   2) Measurement and adjustment of backlash
      i) Dial gauge measurement
      Fix stand (6) on steering case. Apply tip of dial gauge (8) square on to tooth face of bevel gear. Fix bevel pinion. Rotate bevel gear and measure backlash at a minimum of three diagonally opposite points.

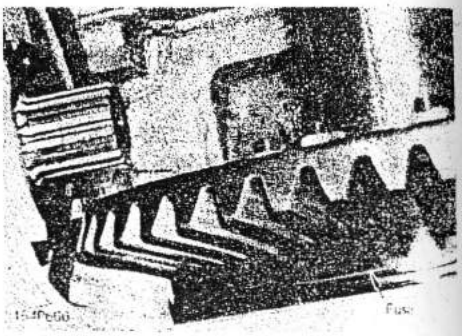


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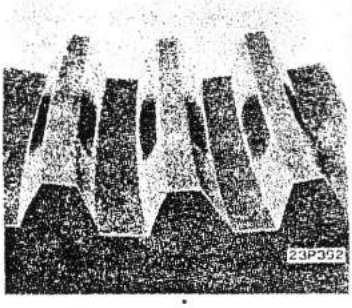
ii) Fuse measurement
Insert fuse wire (ϕ1.5 mm) between bevel pinion and bevel gear forward side tooth face. Rotate bevel gear and measure thickness of fuse wire using micrometer (7).
★ Insert fuse in center part of bevel pinion tooth contact pattern (30% of distance from small end). Perform measurements 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.



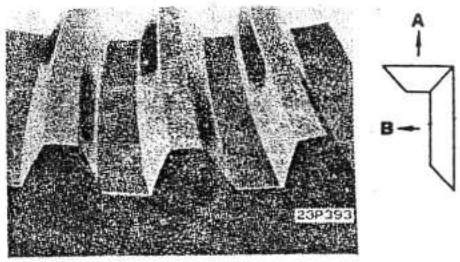
3) Tooth contact adjustment
Apply thin coating of red lead to tooth face of bevel pinion. Rotate bevel gear back and forth and inspect tooth contact pattern.
★ Ideally, tooth contact pattern should start from vicinity of small end and extend over about 30% of tooth length. It should be located in center of tooth face width. If adjustment is carried out in this manner, correct tooth contact will be obtained when load is applied.



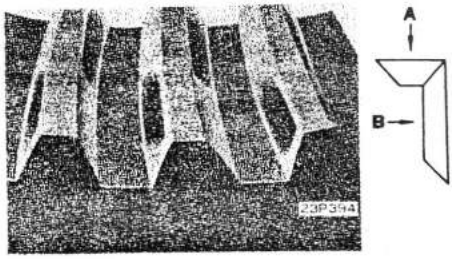
If correct tooth contact pattern is not obtained, carry out adjustment once again according to directions given on following page.

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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.



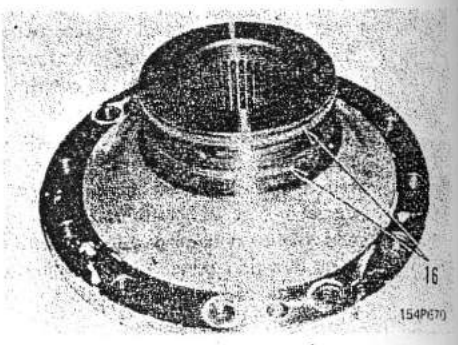
★ To increase or decrease adjusting shims on bevel pinion side, remove transmission assembly, remove bevel pinion assembly mounting bolts and pull out assembly with extraction bolts by an amount sufficient to permit adjustment of shims.
★ When moving bevel gear to adjust, transfer adjusting shims on 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.

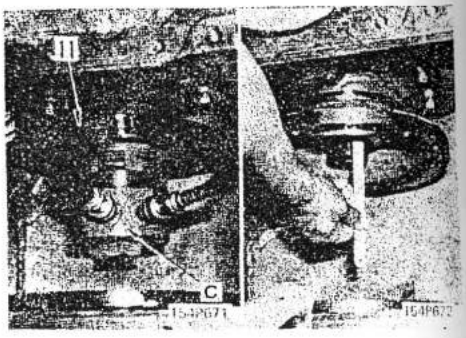
https://truckmanualshub.com/

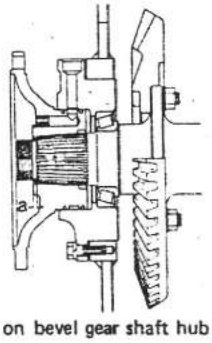
5. Bevel gear shaft hub
   1) Fit seal ring (16) to bevel gear shaft.
   2) Fit left and right bevel gear shaft hubs (11) together with taper separation parts to bevel gear shaft.

      Taper separation part: Anti-friction compound

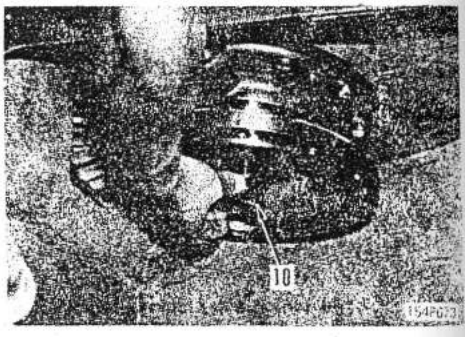


   3) Set tool C and press fit left and right bevel gear shaft hubs.
      ★ Pressure: 30 to 40 ton
   4) After press fitting hubs, measure dimension "A" between bevel gear shaft stepped part and bevel gear shaft hub end face.
      ★ Standard dimension: 5 to 6.5 mm
      ★ Be sure to check that bevel gear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

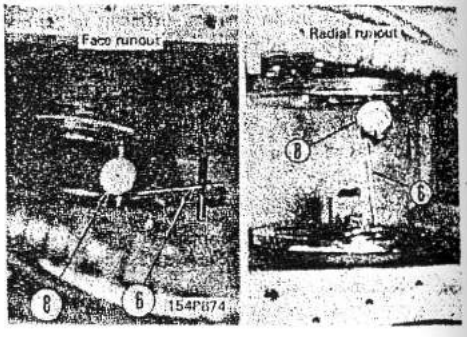




   5) Fit gasket on bevel gear shaft hub and bevel gear shaft (10).



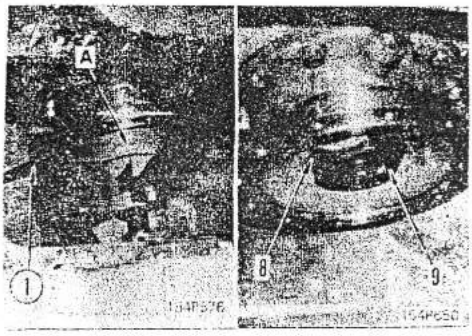
6. Hub nut
   1) Fix stand (6) to steering case and measure face runout and radial runout, of hub with dial gauge (8).
      ★ Standard values: face runout 0.15 mm
      radial runout 0.15 mm



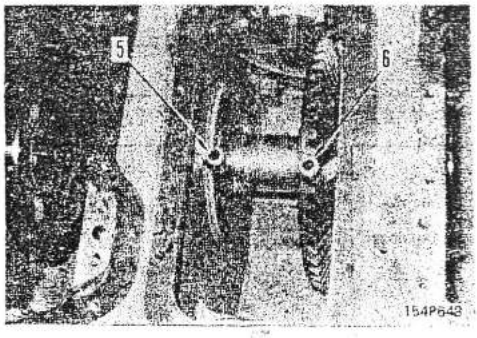
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2) Fit retaining pin (1) in bevel gear shaft hub bolt hole. Install lock plate (8), and tighten hub nut (9) using tool A.

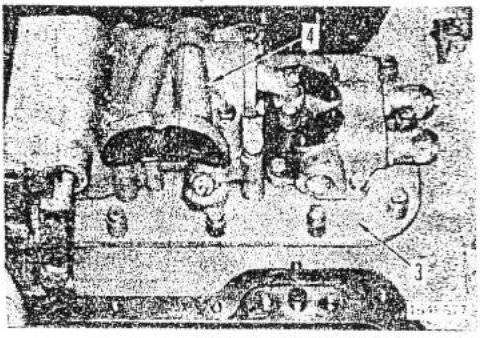
Hub nut: 70±5 kg.m
★ Bend lock plate securely.



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

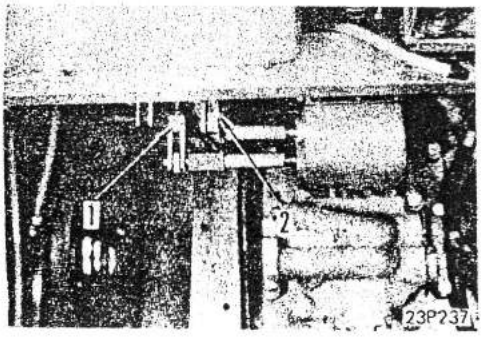


8. Steering control valve assembly
1) Fit gasket to steering case.
2) Raise valve seat (3) together with steering control valve assembly (4). Align it on mounting part and tighten mounting bolts.



9. Steering control rod
Connect steering control valve operating rods (1) and (2).

Bend cotter pin securely.

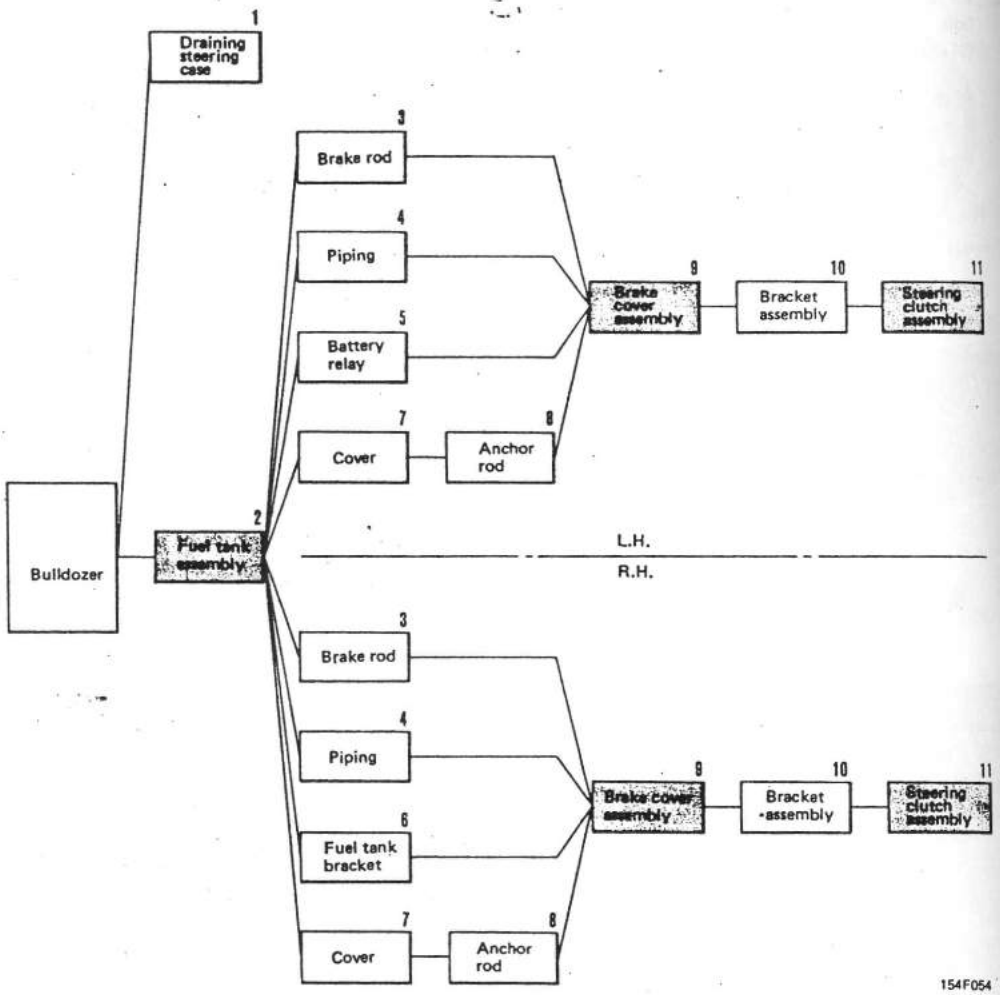


10. Steering clutch assembly
See "MOUNTING STEERING CLUTCH ASSEMBLY".

11. Fuel tank assembly
See "MOUNTING FUEL TANK ASSEMBLY".

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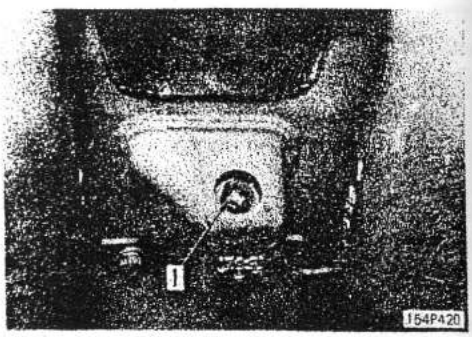
DISMOUNTING STEERING CLUTCH ASSEMBLY



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

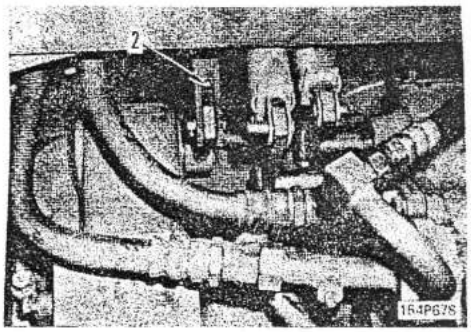
   Steering case:
   TY 22090 ℓ

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

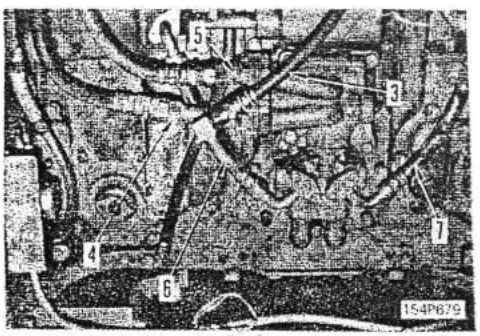


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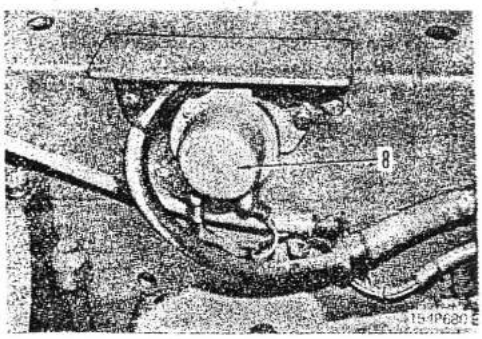
3. **Brake rod**
   Disconnect left and right brake rods (2).



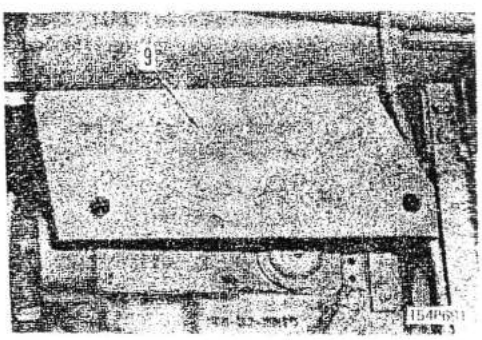
4. Piping
   (When dismounting left steering clutch)
   1) Disconnect hose (3) between servo valve and steering valve inlet tube.
   2) Disconnect steering control valve inlet tube (4) and outlet tube (5).
   3) Disconnect hose (6) between brake valve and brake cover, at cover side.
   (When dismounting right steering clutch)
   4) Disconnect hose (7) between brake valve and brake cover, at cover side.



5. **Battery relay**
   (When dismounting left steering clutch)
   Remove battery relay (8) together with bracket.



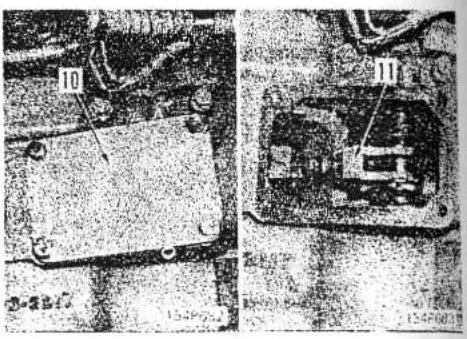
6. **Fuel tank bracket**
   (When disconnecting right steering clutch)
   Remove fuel tank bracket (9).



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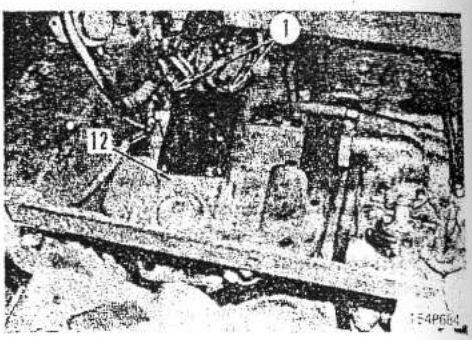
7. Cover
Remove cover (10).

8. Anchor rod
Disconnect anchor rod (11).

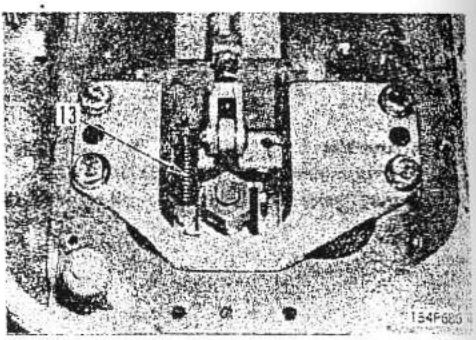


9. Brake cover assembly
Temporary lift brake cover assembly (12) with eye bolts ① (12 mm, P = 1.75). Separate it from steering case using extraction bolts and remove it.

kg Brake cover assembly: 45 kg

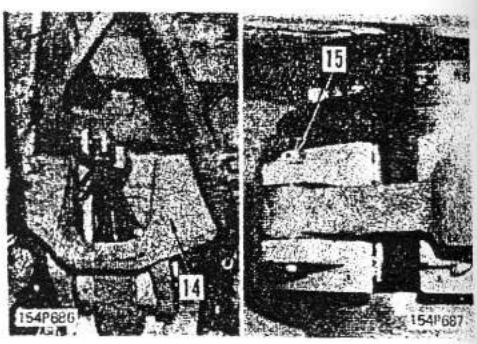


10. Bracket assembly
1) Remove brake lever return spring (13).
2) Remove mounting bolts.



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

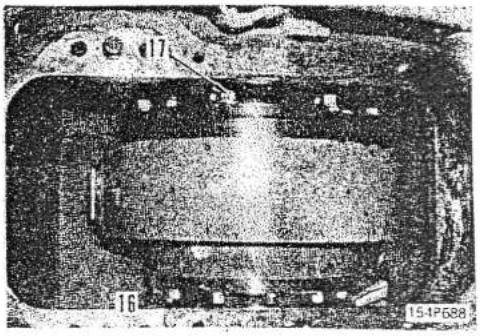
kg Bracket assembly: 35 kg



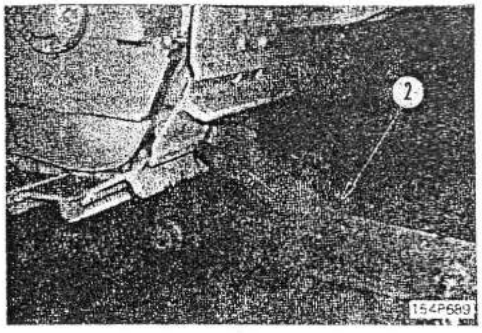
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11. Steering clutch assembly

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

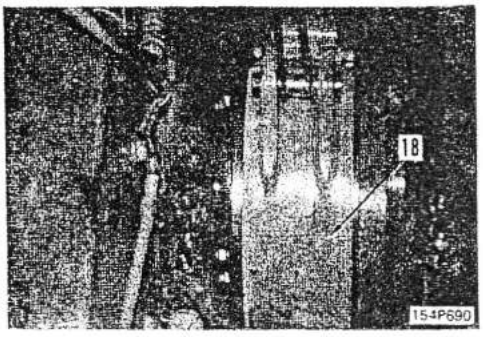


★ Apply jack (2) to grouser part of track. Gradually turn track and remove bolts.



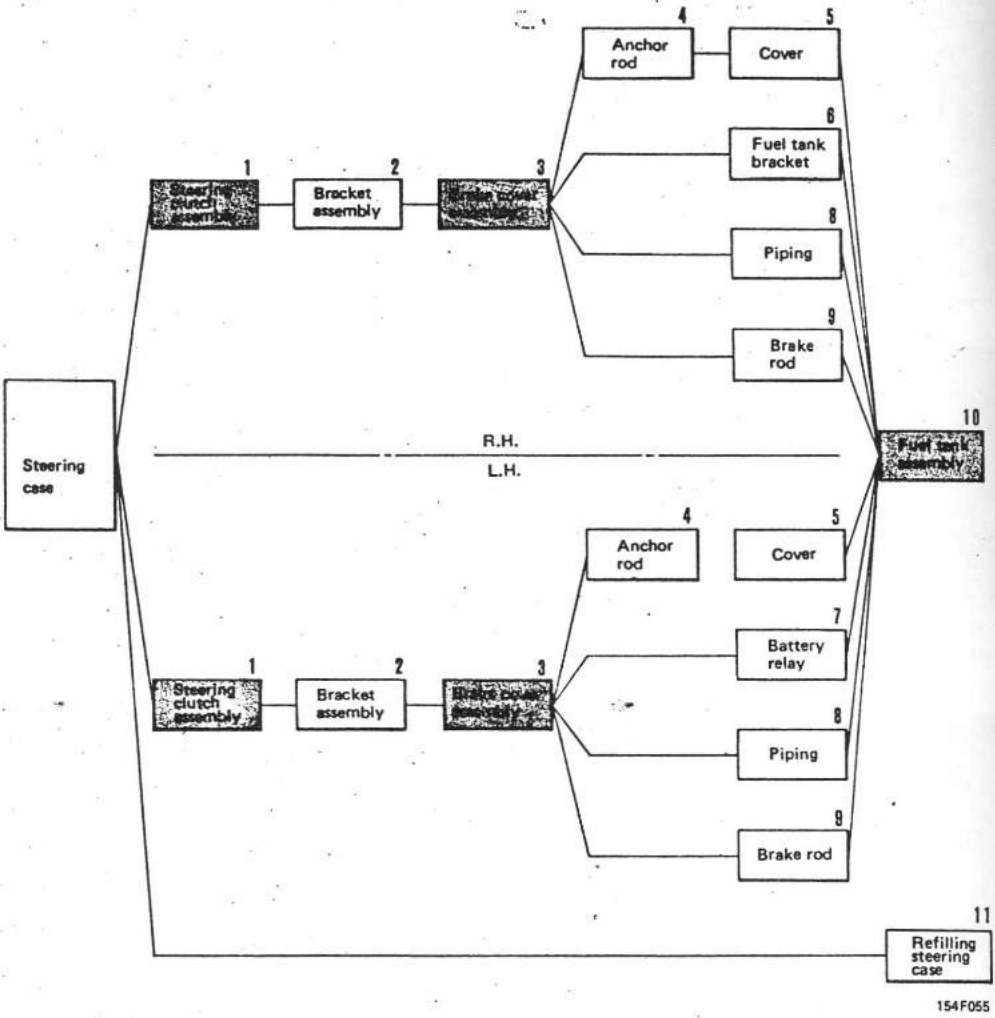
2) Install pin on brake band. Lift steering clutch assembly with wire. Shift inner drum to inner side of steering case, remove pilot bore part and dismount assembly.

kg Steering clutch assembly: 125 kg

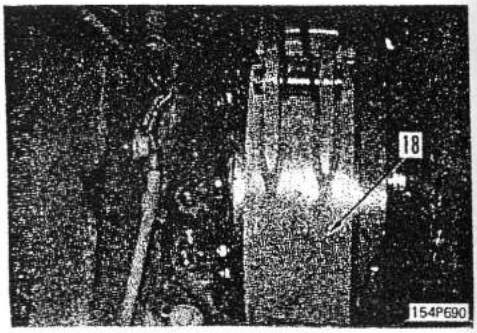


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MOUNTING STEERING CLUTCH ASSEMBLY

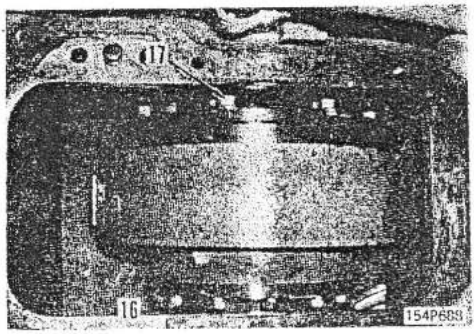


1. **Steering clutch assembly**
   1) Install pin on brake band. Lift steering clutch assembly (18) with wire and align it on steering case.
      ★ Install brake band so that pin is at rear of steering clutch assembly.



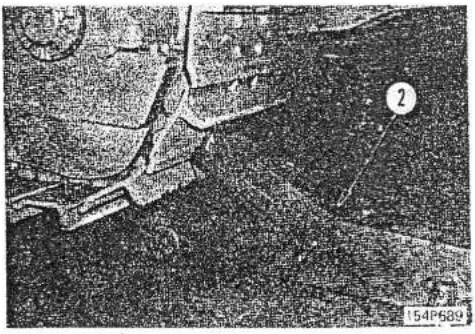
https://truckmanualshub.com/

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.



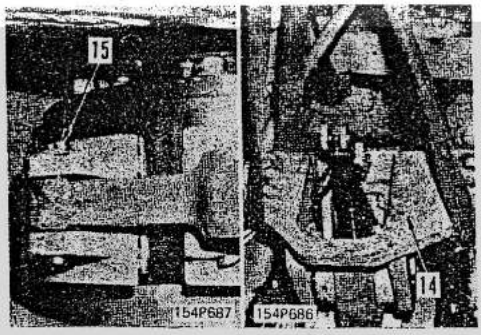
Outer drum mounting bolts:
39.25±4.25 kg.m

Inner drum mounting bolts:
28.25±3.25 kg.m



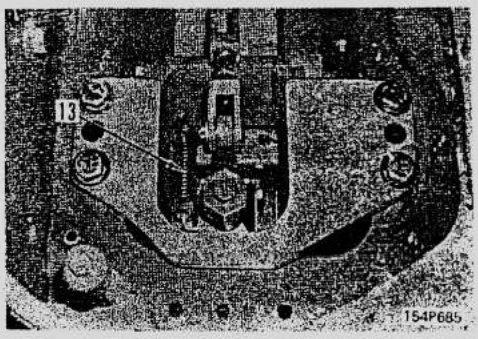
2. Bracket assembly
   1) Lift bracket assembly (14) and install brake band and rod connecting pin (15).

⊕ Bend cotter pin securely.



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

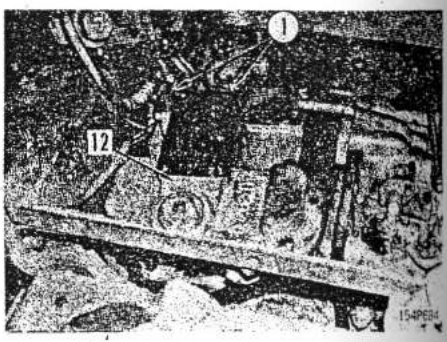
Mounting bolts: 39.25±4.25 kg.m



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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 ± 1.25 kg.m

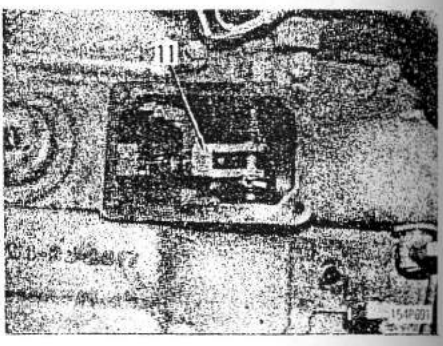


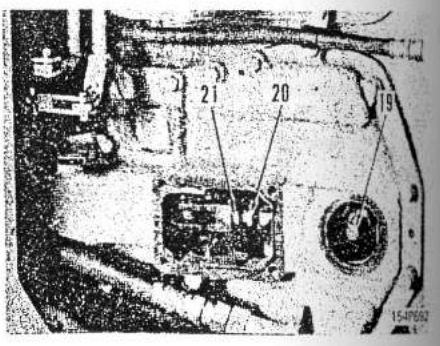
4. Anchor rod
   1) Connect up anchor rod (11).

      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 1-1/6 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.

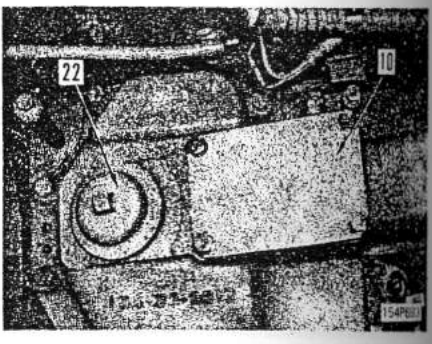




5. Cover
   1) Fit O-ring and tighten adjusting bolt cover (22).

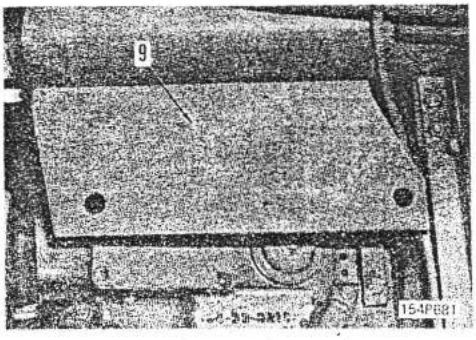
      Cover: 3±0.5 kg.m

   2) Fit gasket and install cover (10).

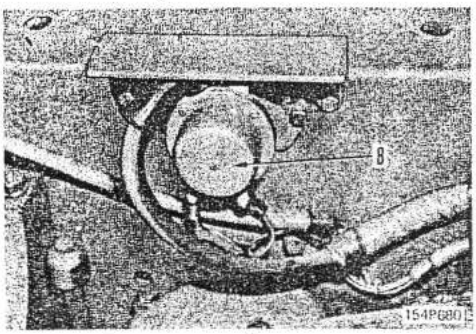


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6. **Fuel tank bracket**
(When mounting right steering bracket)
Install fuel tank bracket (9).



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



8. **Piping**

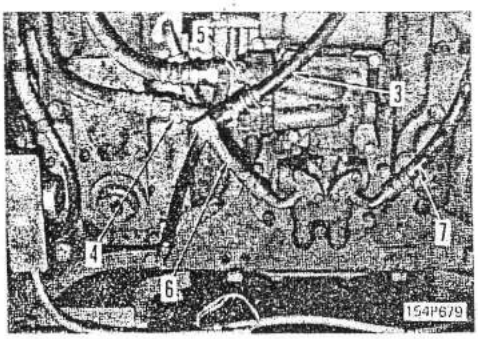
⊕ Fit O-ring properly in groove and install hose without twist or interference.

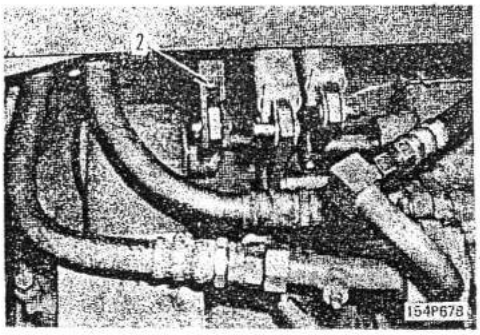
(When mounting right steering clutch)

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.



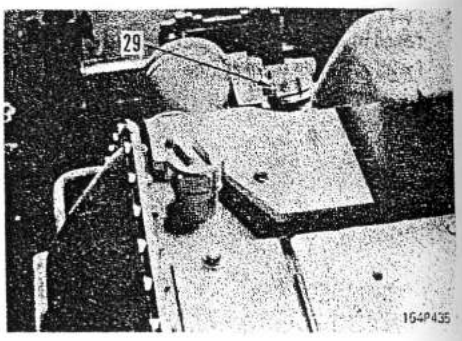


9. **Brake rods**
Connect left and right brake rods (2).

⊕ Bend cotter pin securely.

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10. Fuel tank assembly
    See "MOUNTING FUEL TANK ASSEMBLY".

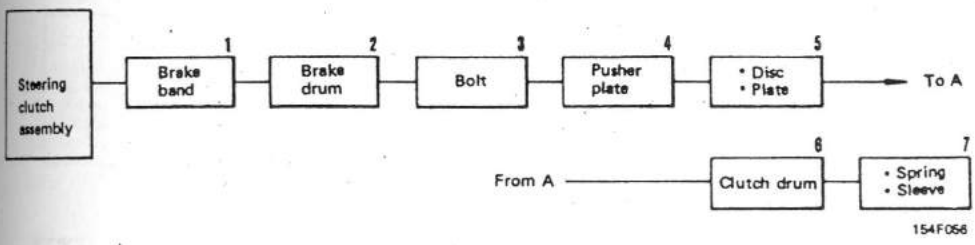


11. Refilling steering case
    1) Fit O-ring and tighten drain plug.
    2) Refill steering case through oil filler (29) until specified oil level is reached.

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

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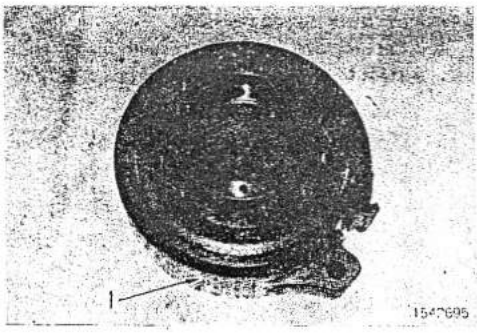
DISASSEMBLY OF STEERING CLUTCH ASSEMBLY



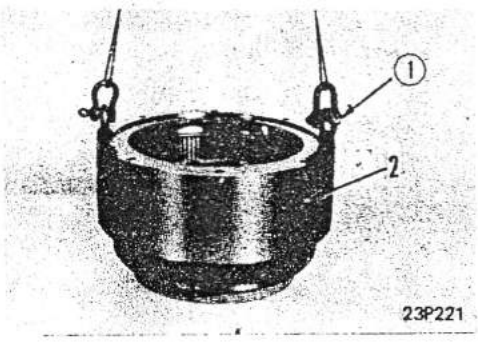
Special tools

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

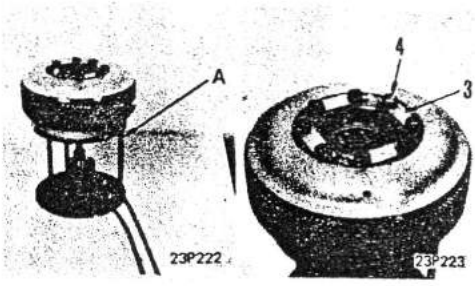
1. Brake band
   Remove brake band (1).



2. Brake drum
   Fit eye bolts ① (18 mm, P = 2.5) and lift out brake drum (2).

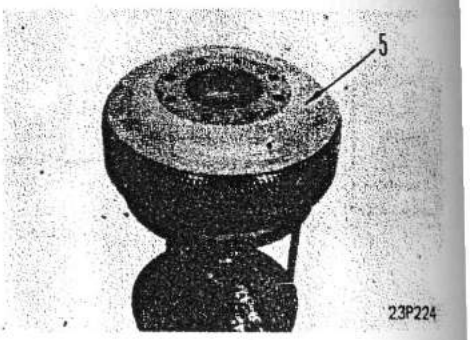


3. Bolt
   1) Install clutch assembly on tool A (compressor).
   2) Flatten out lugs on lock plates (3). Extend tool A (puller) and remove bolts (4).

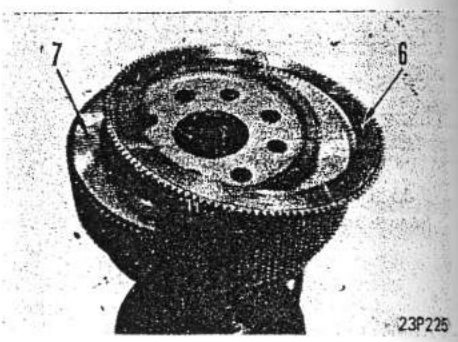


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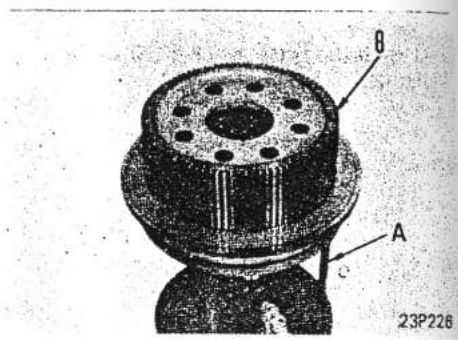
4. **Pressure plate**
   Retract tool A and remove push plate (5).



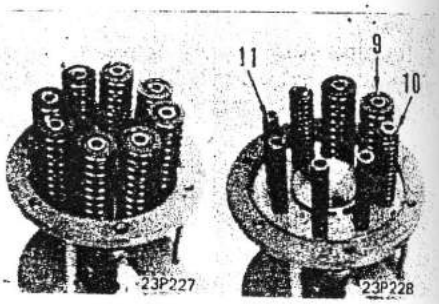
5. **Discs and plates**
   Remove discs (6) and plates (7).
   ★ After removal, place discs and plates on a flat surface to prevent them warping.



6. **Clutch drum**
   Remove clutch drum (8) by removing connecting bolts from tool A (compressor).

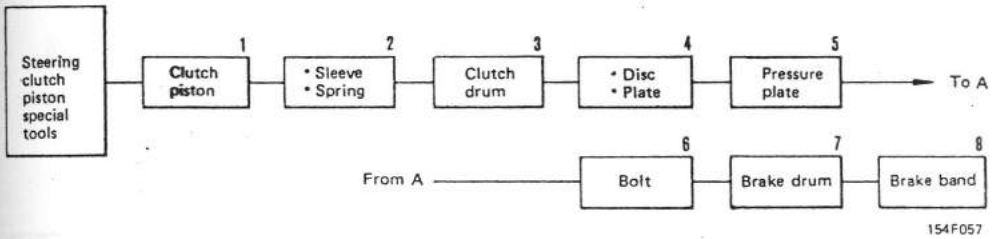


7. **Springs and sleeves**
   Remove large springs (9), small springs (10) and sleeves (11).



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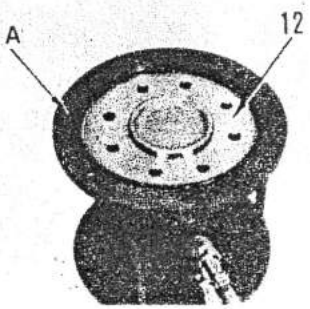
ASSEMBLY OF STEERING CLUTCH ASSEMBLY



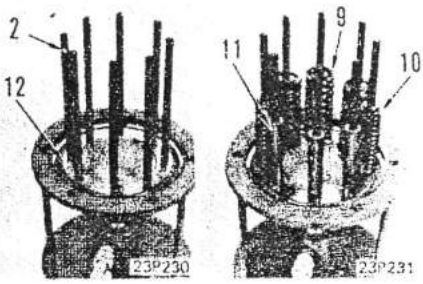
Special tools

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

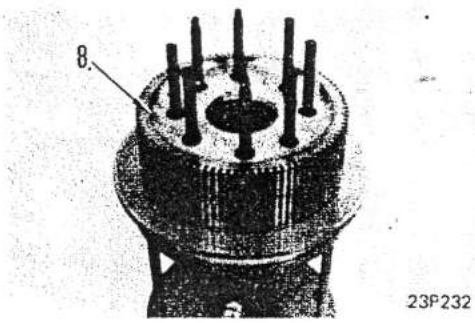
1. **Clutch piston**
   Install seal ring to clutch piston (12). Set piston on tool A (puller) after aligning center of piston with center of tool.



2. **Sleeves and springs**
   Insert guide bolts (2). Install sleeve (11), small spring (10) and large spring (9).

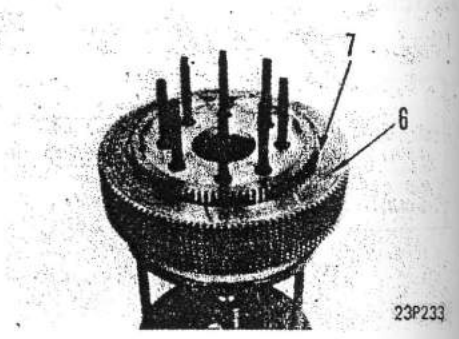


3. **Clutch drum**
   Align clutch drum (8) and temporary insert bolts into tool A (compressor).

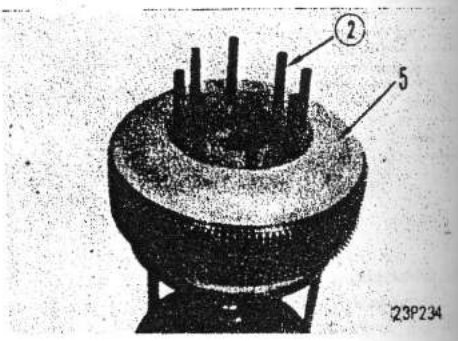


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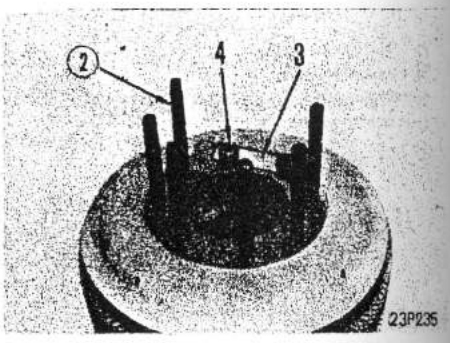
4. Plates and discs
   Install discs (6) and plates (7).
   ★ Before assembly, apply engine oil SAE 30 to sliding faces of discs and plates.



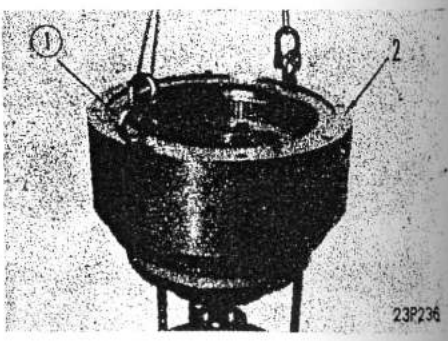
5. Pressure plate
   Install pressure plate (5).



6. Bolts
   Extend puller and remove guide bolts. Fit lock plates (3) and tighten bolts (4).
   ★ Bend lock plates securely.

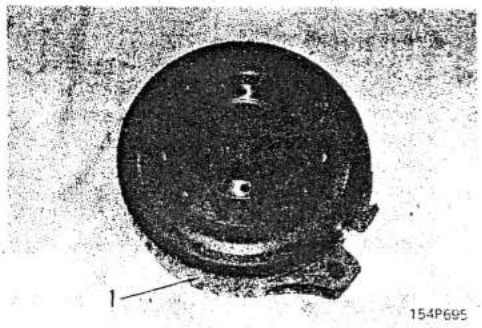


7. Brake drum
   1) Extend puller and free plates and discs. Lift brake drum with eye bolts (1) (18 mm, P = 2.5). Align teeth of discs and fradually assembly them.
   2) Remove clutch assembly from tool A.



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8. **Brake band**
   Install brake band **(1)**.

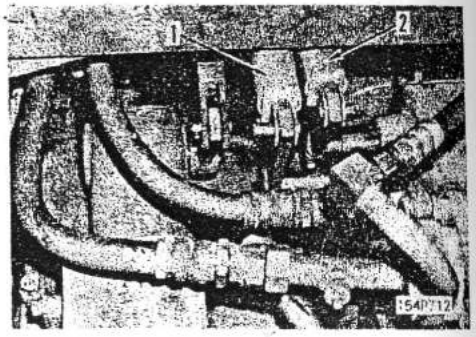


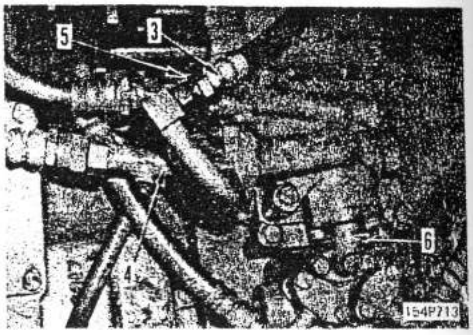
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DISMOUNTING STEERING CONTROL VALVE ASSEMBLY

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).

kg Steering control valve assembly: 40 kg



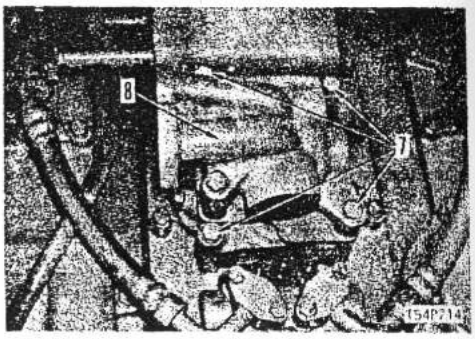


MOUNTING STEERING CONTROL VALVE ASSEMBLY

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.

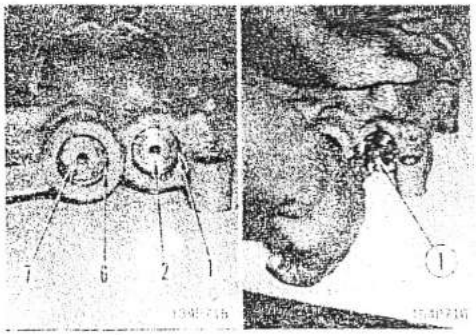
8. Install fuel tank assembly while referring to "MOUNTING FUEL TANK ASSEMBLY".



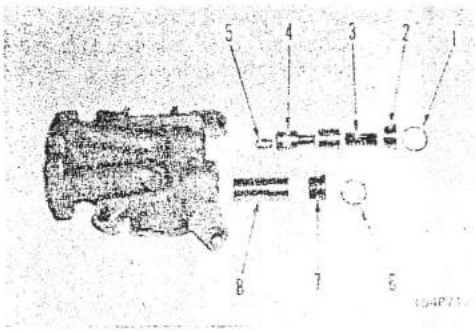
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DISASSEMBLY OF STEERING CONTROL VALVE

DISASSEMBLY OF MAIN RELIEF VALVE

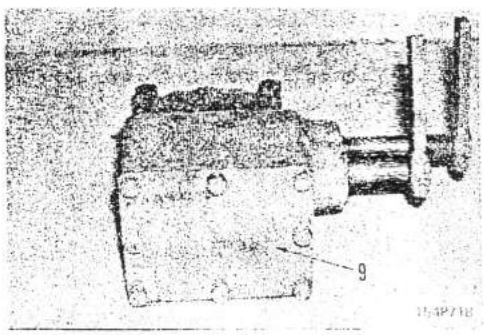


1. Relief valve
   1) Remove snap ring (1).
   2) Extract stopper (2). Tighten extraction bolt (1) (8 mm, P = 1.25). Remove relief valve by pulling extraction bolt and pliers, etc.
   3) Remove spring (3), valve (4) and piston (5) from housing.

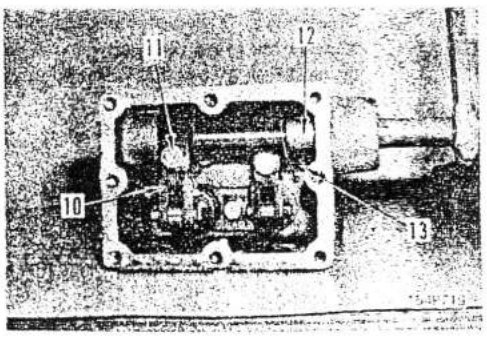


2. Piston
   1) Remove snap ring (6).
   2) Insert extraction bolts (1) (8 mm, P = 1.25) into stopper. Remove piston by pulling extraction bolt and pliers, etc.
   3) Remove piston (8) from housing.

DISASSEMBLY OF STEERING CONTROL VALVE



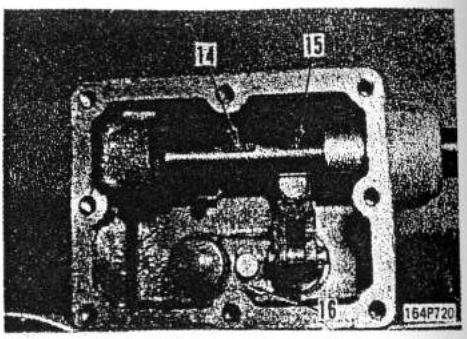
3. Cover
   Remove cover (9).



4. Right lever shaft
   1) Loosen mounting bolt (11) of lever (10).
   2) Remove wire and remove lock bolts (13) of bush (12).

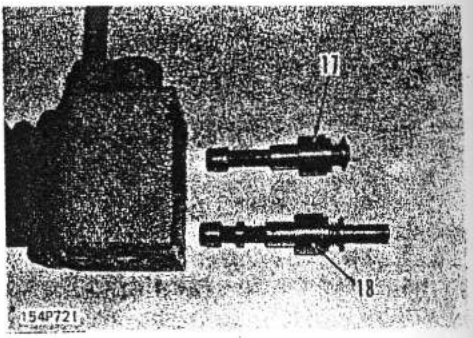
https://truckmanualshub.com/

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.

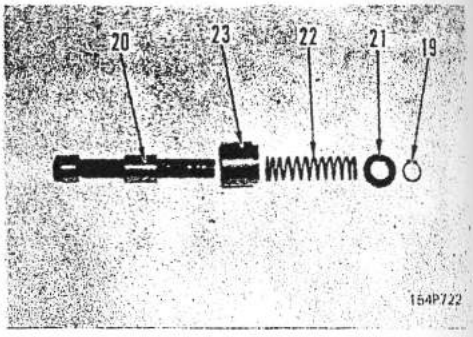


5. Plate
Remove plate (16).

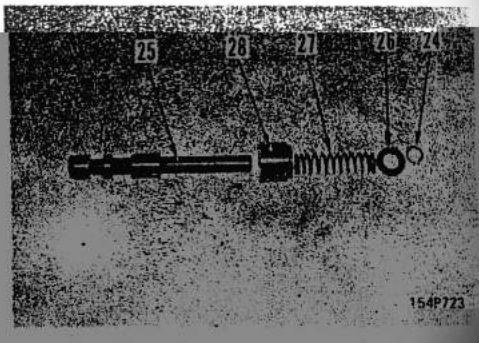
6. Left and right steering clutch spools
1) Extract left spool assembly (17) and right spool assembly (18) from housing.



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).

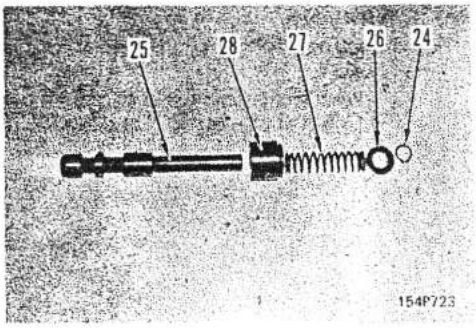


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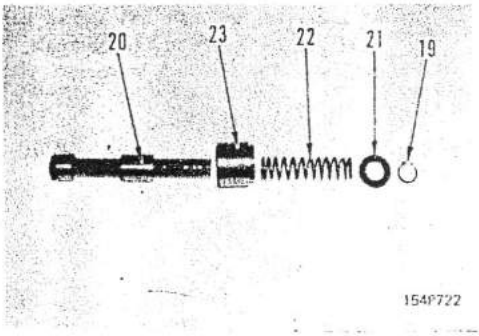
DISASSEMBLY OF MAIN RELIEF VALVE

ASSEMBLY OF STEERING CONTROL VALVE

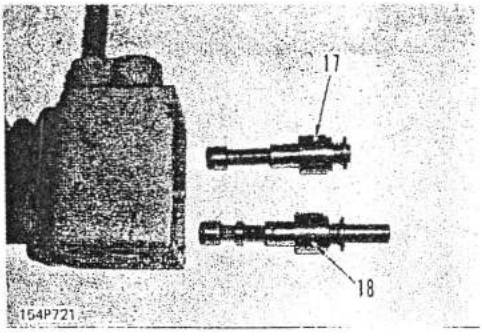
1. **Left and right steering clutch spool**
   1) Assembly of right spool assembly
   Assemble bush (28), spring (27) and washer (26) on spool (25). Install snap ring (24).



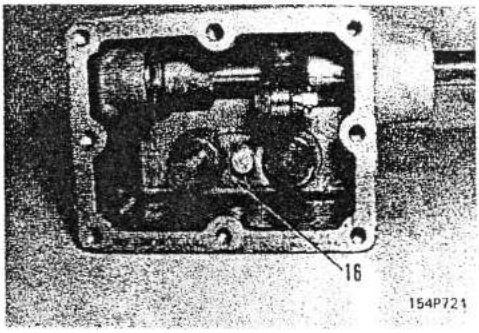
   2) Assembly of left spool assembly
   Assemble bush (23), spring (22) and washer (21) on spool (20). Fit snap ring (19).



   3) Fit right spool assembly (18) and left spool assembly (17) into housing.
   ★ Apply engine oil to outer surface of spools. Fit spools while rotating them.

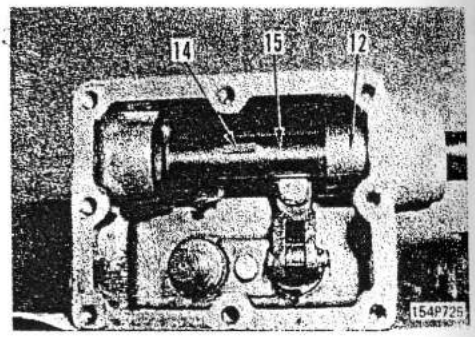


2. **Plate**
   Install plate (16).

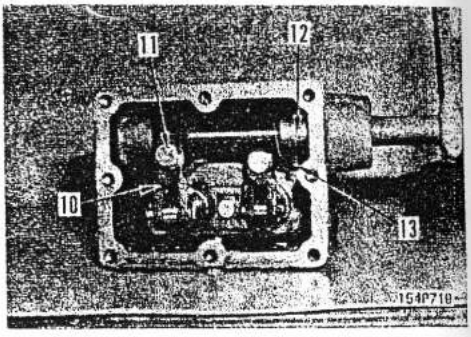


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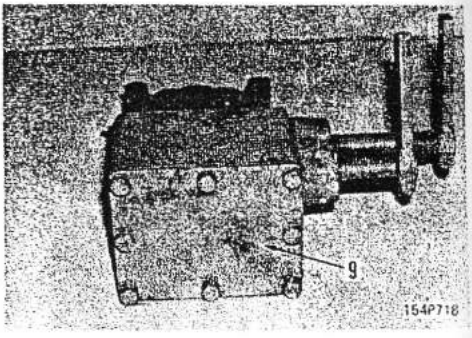
3. **Right lever shaft**
   1) Push lever shaft (15) into housing. Fit bush (12) on shaft.
      ★ When pushing on shaft, take care not to damage lip face of oil seal.
   2) Drive in key (14) into shaft.



   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.



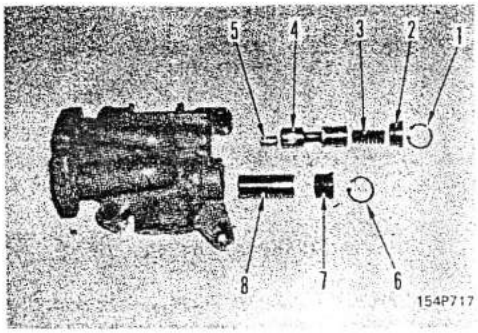
4. **Cover**
   Fit gasket and install cover (9).



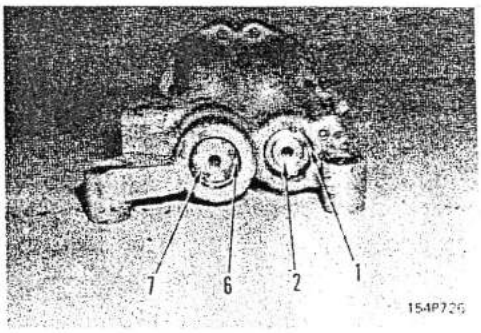
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ASSEMBLY OF MAIN RELIEF VALVE

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).



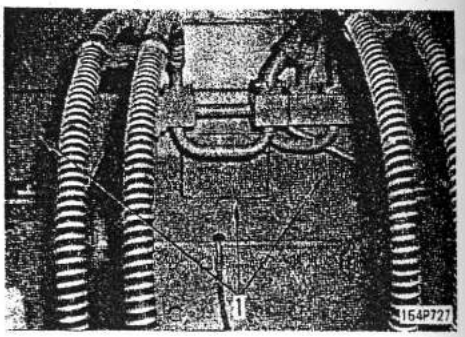
6. Relief valve
   1) Install piston (5) onto valve (4).
   2) Install piston, valve assembly and spring (3) in housing.
      ★ Apply engine oil SAE 30 to outside of piston before installing it.
   3) Fit O-ring and install stopper (2). Install snap ring (1).



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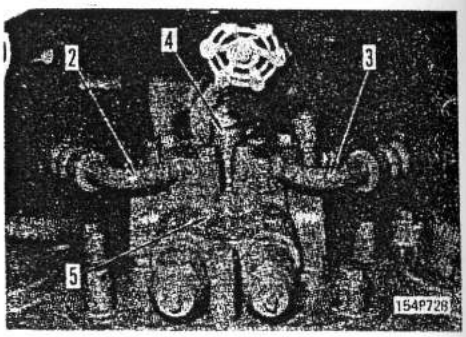
DISMOUNTING BRAKE SAFETY VALVE ASSEMBLY

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).

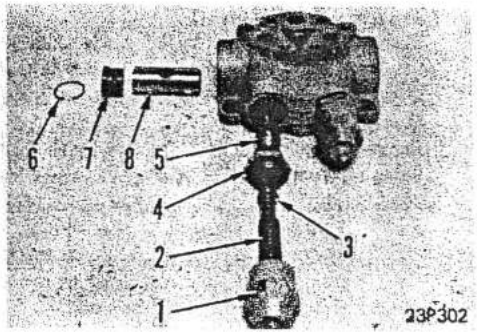


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DISASSEMBLY OF BRAKE SAFETY VALVE

1. **Safety valve**
   1) Remove cap nut (1) and remove spring (2) and plunger (3).
   2) Loosen lock nut (4) and remove seat (5).

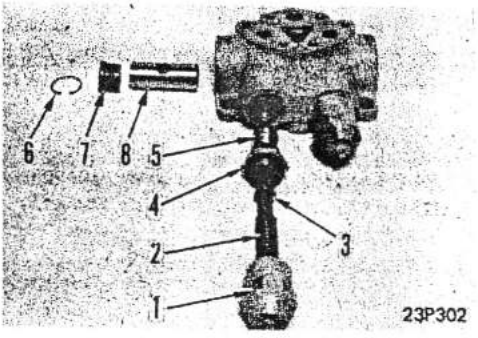
2. **Piston**
   Remove snap ring (6) and stopper (7) and remove piston (8).



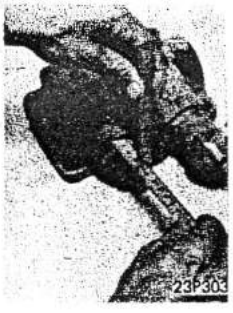
ASSEMBLY OF BRAKE SAFETY VALVE

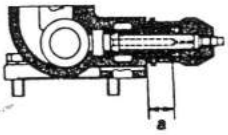
1. **Piston**
   Install piston (8) into valve body. Insert stopper (7) and install snap ring (6).
   ★ Apply engine oil SAE 30 to piston before installing it.

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).



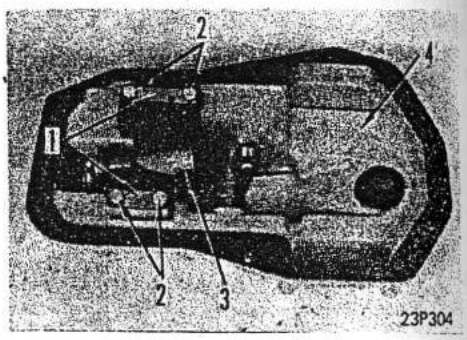
★ Adjust pressure so that standard dimension "A" between end face of valve body and end face of plunger seat assembly is 27 mm (17 kg/cm^2).





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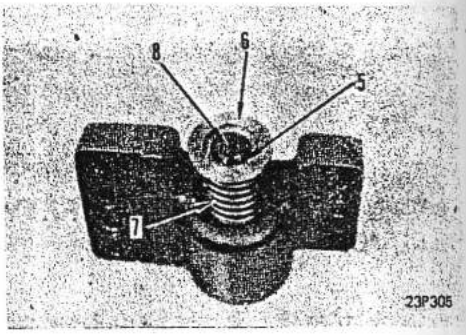
DISASSEMBLY OF BRAKE BOOSTER



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.

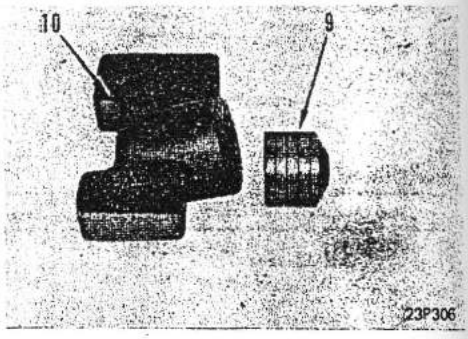
   ★ Spring mounting load: 10 kg
3. **Piston**
   Extract piston (9) from valve body (10).
   ★ When extracting piston, be careful not to damage sliding parts of piston or valve body.
4. **Spool**
   Remove spool (8) from valve body (10).

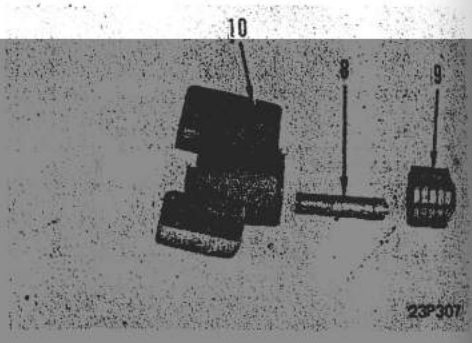


ASSEMBLY OF BRAKE BOOSTER

★ Before assembly, thoroughly clean various constituent parts and apply engine oil SAE 30 thereto.

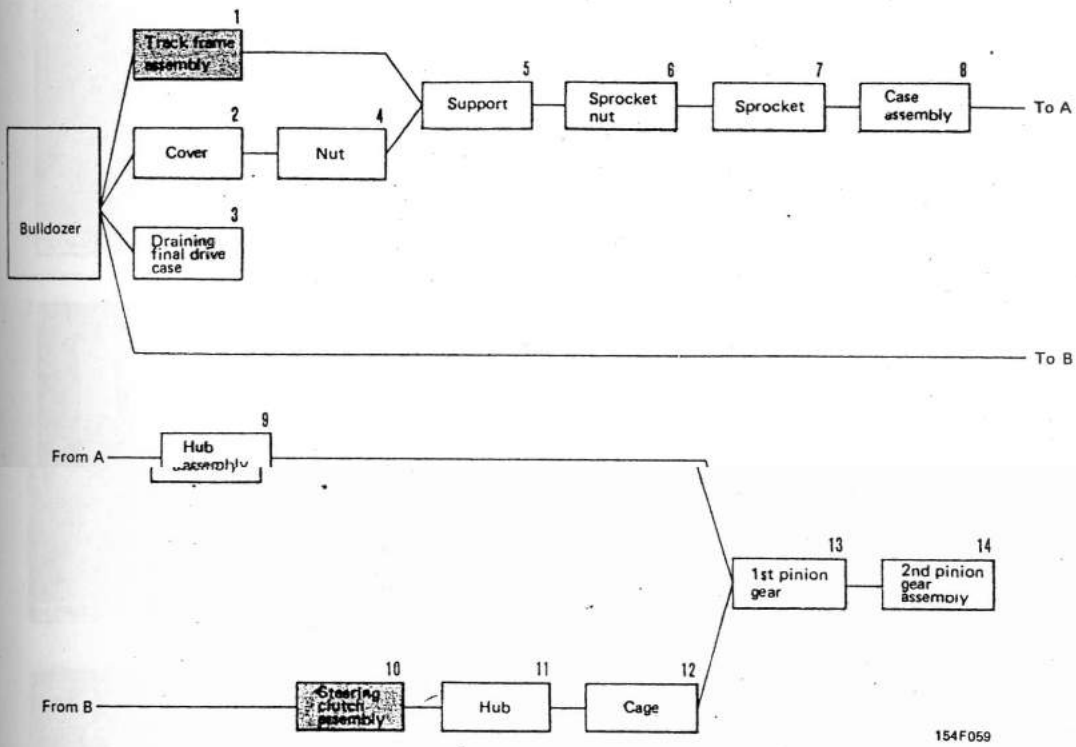
1. **Spool**
   Install valve body (10) and spool (8).
   ★ Install spool so that taper seal face is on piston side.
2. **Piston**
   Install piston (9) on valve body (10).
3. **Spring**
   Fix valve body. Install spring (7) and retainer (6) on spool and secure assembly with snap ring (5).
4. **Brake 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.





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DISASSEMBLY OF FINAL DRIVE ASSEMBLY

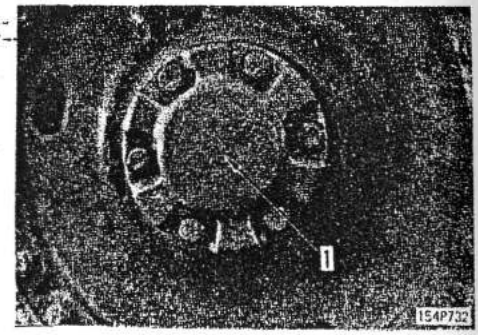


Special tools

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	
Spacer								1

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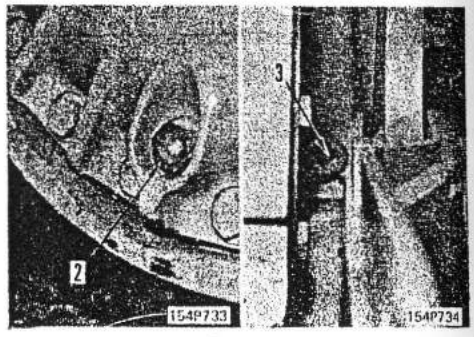
1. **Track frame assembly**
   See "MOUNTING TRACK FRAME ASSEMBLY".



2. **Cover**
   Remove cover (1).

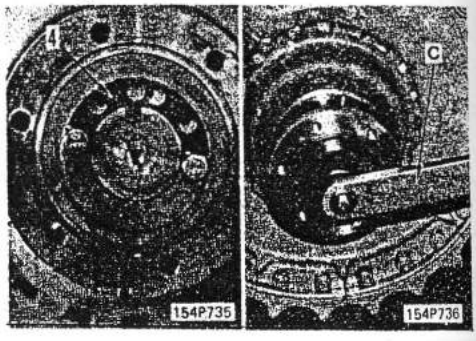
3. **Draining final drive case**
   Remove drain plug (2) and drain off oil in final drive case. If oil does not drain off easily, remove oil filler plug (3)

   Final drive case: 36ℓ (TY220)
   51ℓ (TS220)



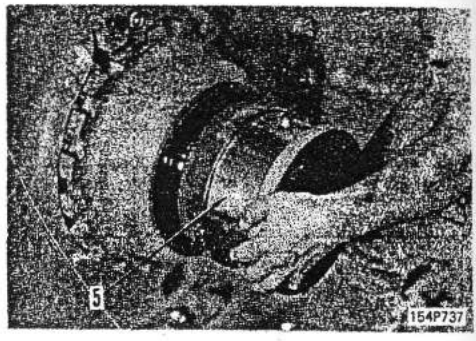
4. **Nut**
   1) Remove lock plate (4).

   2) Using tool C, remove nut.



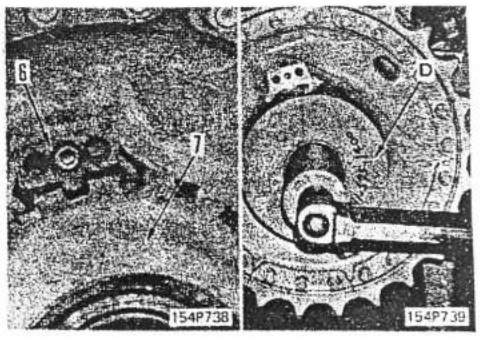
5. **Support**
   Remove support (5).

   kg Support: 28 kg

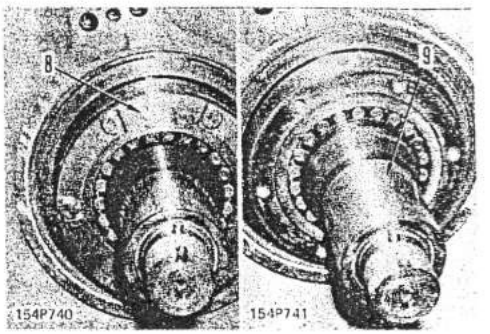


https://truckmanualshub.com/

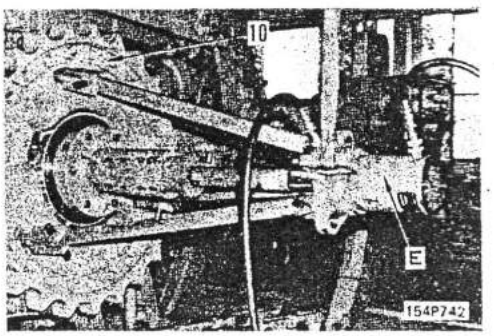
6. Sprocket nut
   1) Remove lock (6).
   2) Using tool D, remove sprocket nut (7).



7. Sprocket
   1) Remove retainer (8).
   2) Remove collar (9).

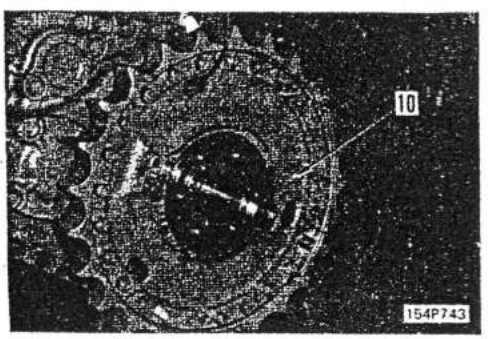


   3) Using tool E, extract sprocket nut (10).



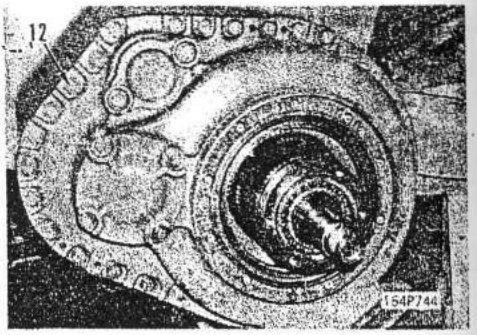
   4) Lift out sprocket (10).
      ★ When removing sprocket, be careful not to damage thread at end of shaft.

      kg Sprocket: 245 kg



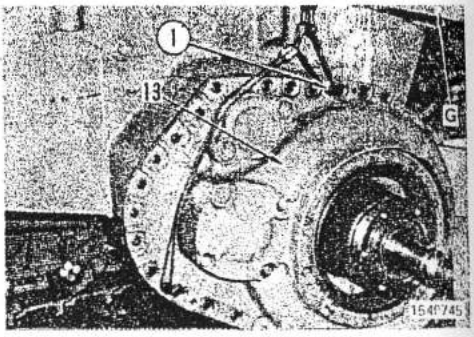
https://truckmanualshub.com/

8. **Case assembly**
   1) Remove case mounting bolts (12).

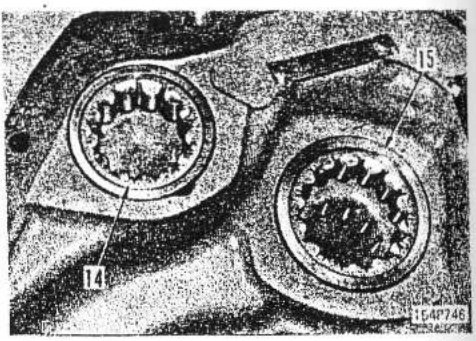


   2) Using tool G, temporary sling case assembly (13). Remove assembly with extracting bolts ① (ϕ20 mm, P = 2.5).
   3) Remove assembly while slinging case.

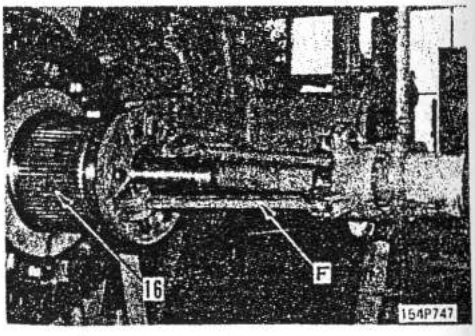
   kg Case assembly: 210 kg



   4) Remove bearings (14) and (15) from case.



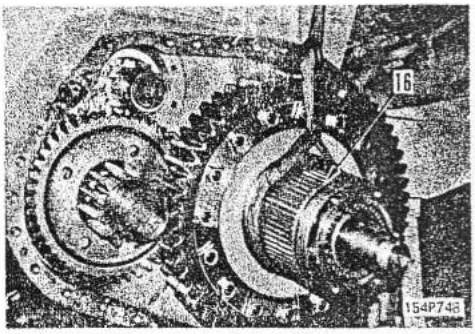
9. **Hub assembly**
   Using tool F, extract hub assembly (16).



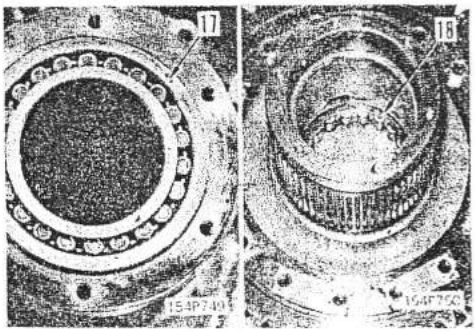
https://truckmanualshub.com/

2) Lift out hub assembly (16).

kg Hub assembly: 250 kg

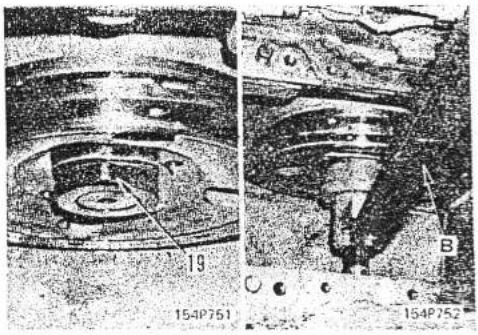


3) Remove bearings (17) and (18).

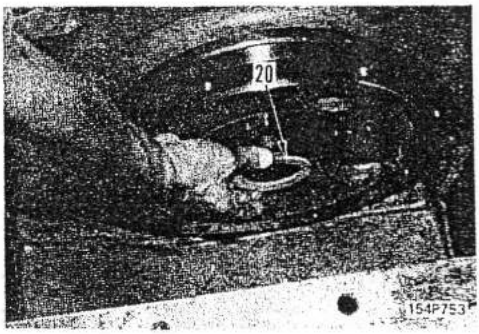


10. Steering clutch assembly
See "DISMOUNTING STEERING CLUTCH ASSEMBLY".

11. Hub
1) Remove hub nut (19) using wrench B.

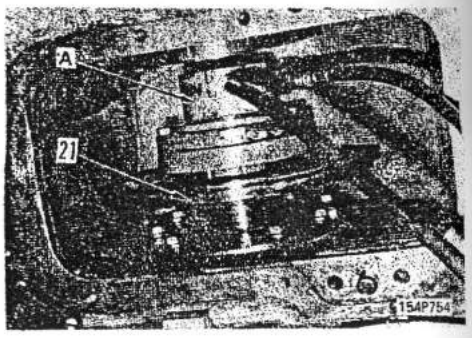


2) Remove collar (20).

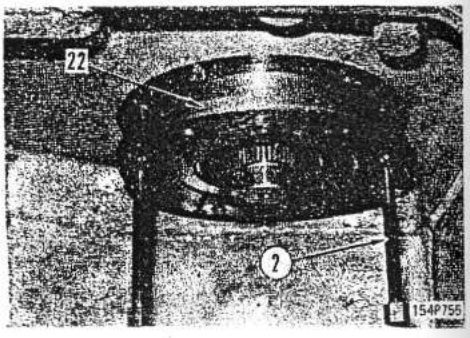


https://truckmanualshub.com/

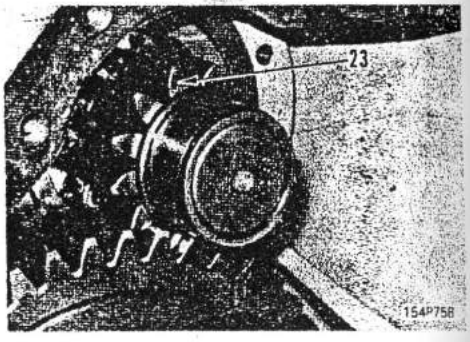
3) Extract hub (21) using tool A.



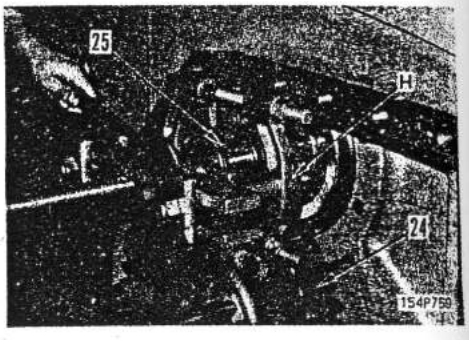
12. Cage
    1) Remove cage mounting bolts. Using extracting bolts ② (ϕ16mm, P = 2.0) extract cage (22).
    2) Extract seal using tool
    3) Extract bearing using tool



13. 1st pinion gear
    Remove 1st pinion gear (23).



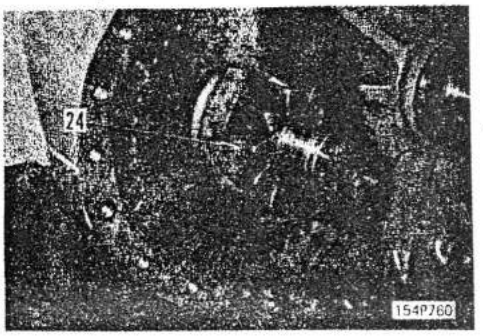
14. 2nd pinion gear assembly
    1) When removing 2nd pinion gear assembly (24) before 1st pinion gear, use tool H to remove bearing inner race (25) to prevent inner race striking 2nd pinion gear.



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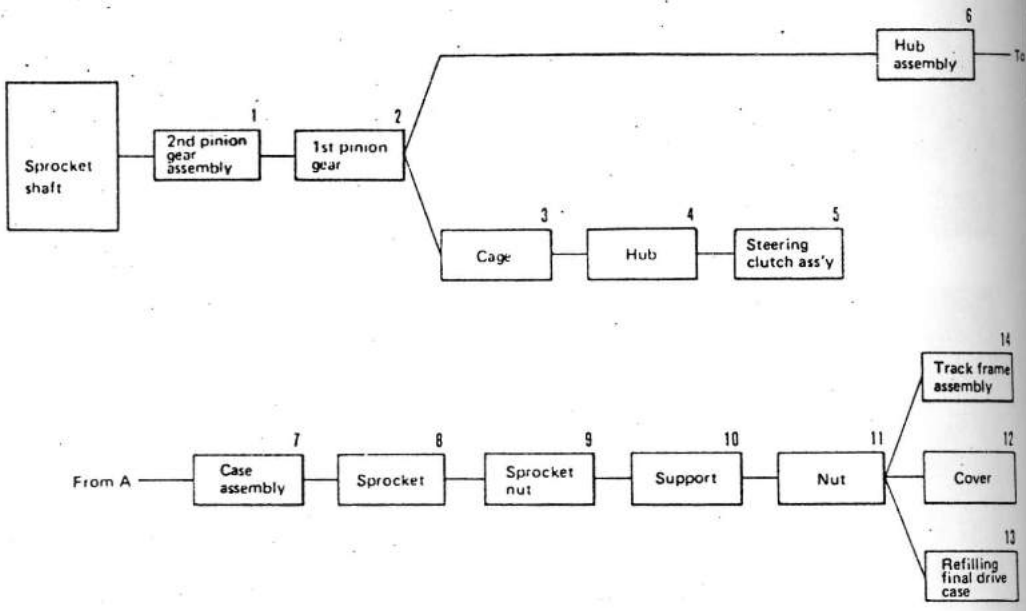
2) Lift out 2nd pinion gear assembly (24).

3) Separate 2nd pinion gear and 1st driven gear.



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ASSEMBLY OF FINAL DRIVE ASSEMBLY

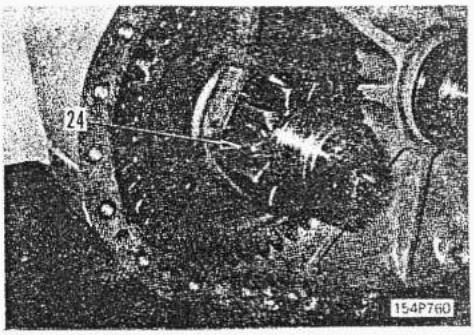


Special tools

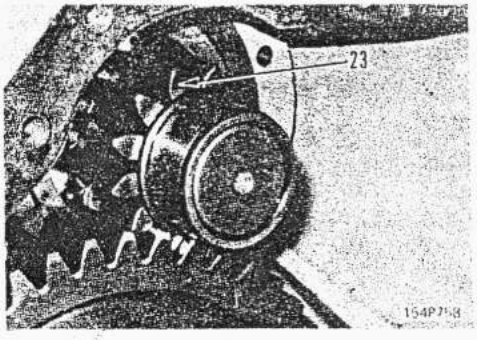
Part Name	A	B	C	D	E	F	G	H
Installer	1							
Pump	1				1	1		
Puller (50 ton)	1							
Remover & installer		1						
Wrench			1					
Remover & installer				1				
Installer A					1			
Cylinder (70 ton)					1			
Installer A						1		
Puller (30 ton)						1		
Installer							1	
Installer							1	
Lifting tool								1

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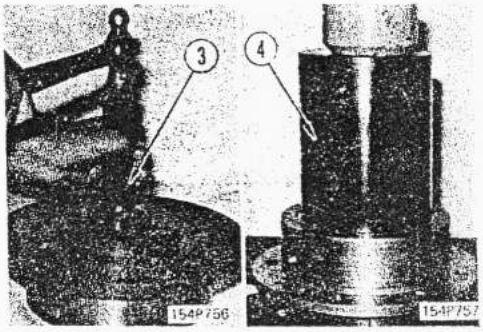
1. 2nd pinion gear assembly
   1) Assemble 2nd pinion gear and 1st driven gear.
   2) Lift 2nd pinion gear assembly (24) into position and install it.



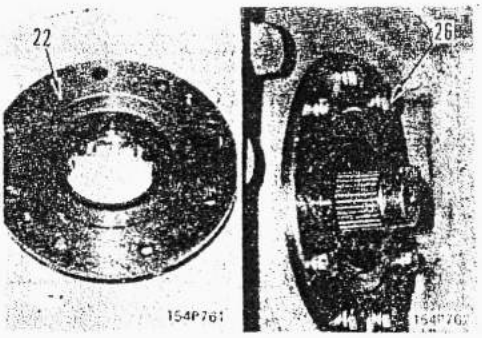
2. 1st pinion gear
   1) Press fit bearing inner race (25).
   2) Install 1st pinion gear (23).



3. Cage
   1) Press fit bearing using press tool ④ (ϕ190 mm).
   2) Press fit seal using push tool ③ (ϕ150 mm).



   3) Push in cage (22) and fix it with cage mounting bolts (26).

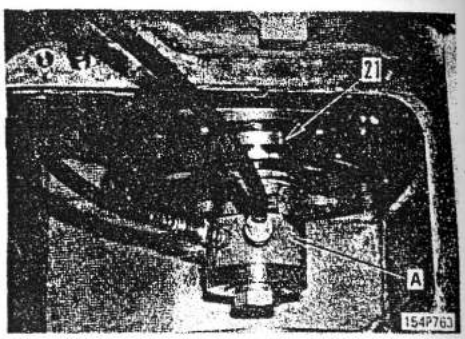


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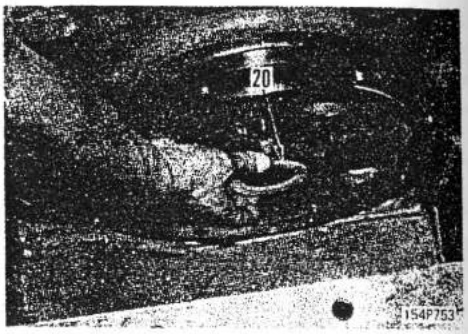
4. Flange
   1) Using tool A, install flange (21).

      Flange mounting part:
      Anti-friction compound Mo S_2 NO.1

      ★ Press fit force 30 ~ 40 ton



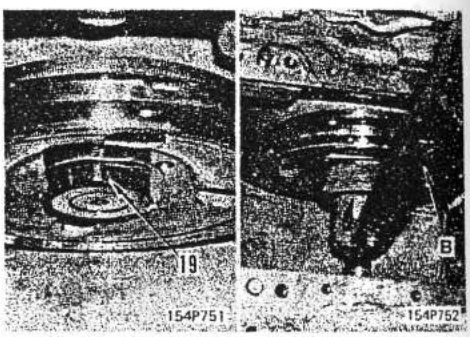
   2) Install collar (20)



   3) Using tool B, install flange nut (19).

      Bend washer properly.

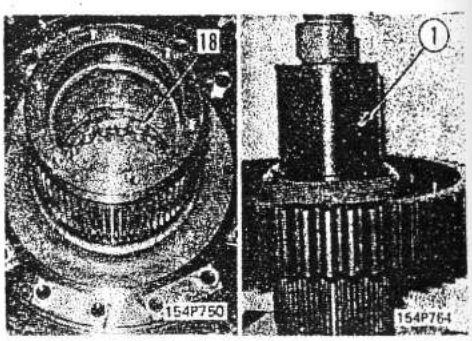
      Flange nut: 70 ± 5 kg.m



5. Steering clutch assembly
   See "MOUNTING STEERING CLUTCH ASSEMBLY".

6. Hub assembly
   1) Press fit bearing (18) with press tool ① (ø200 mm).
   2) Install hub and gear.

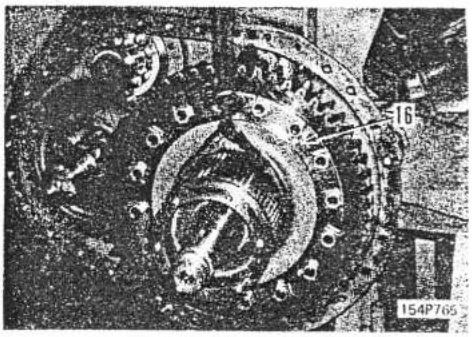
      Gear: 70 ± 5 kg.m



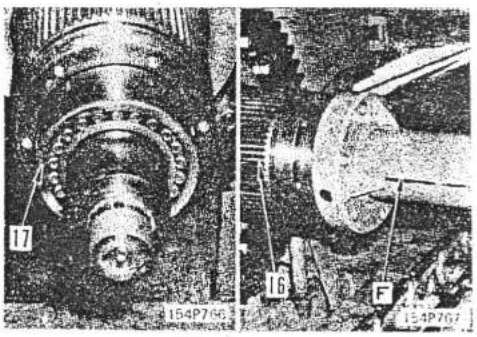
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3) Temporary sling hub assembly (16).

kg Hub assembly: 250 kg

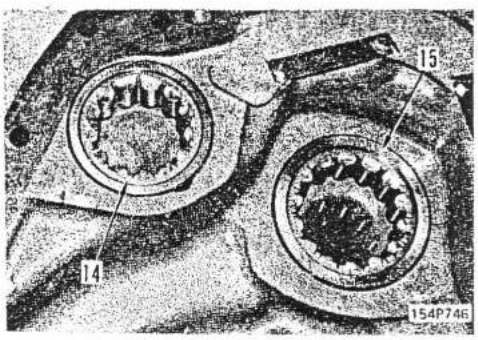


4) Align bearing (17) and press fit it using tool F.



7. Case assembly

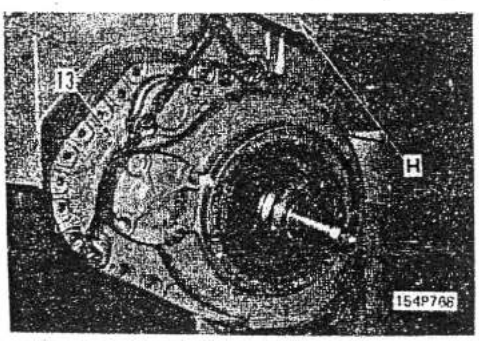
1) Press fit bearings (14) and (15) into case.



2) Mount gasket on case (13).

Gasket: Liquid gasket

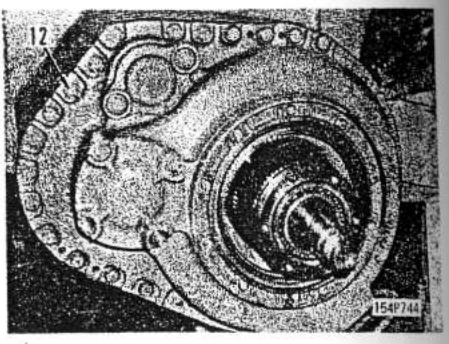
3) Using tool H, lift case assembly and align dowel pin holes.



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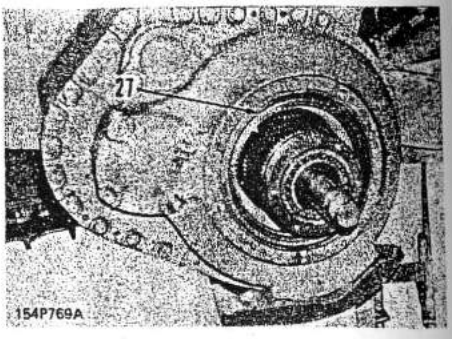
4) Drive in dowel pin and fit case mounting bolts (12).

Case: 56±6 kg.m



8. Sprocket

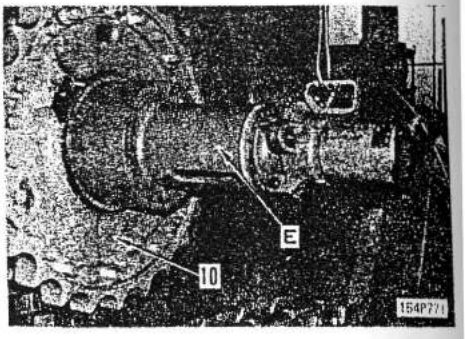
1) Install floating seals (27) on FINAL drive case and sprocket.



2) Temporarily sling sprocket (10), then press fit it using tool E.

Apply anti-friction agent to part of sprocket to be press fit.

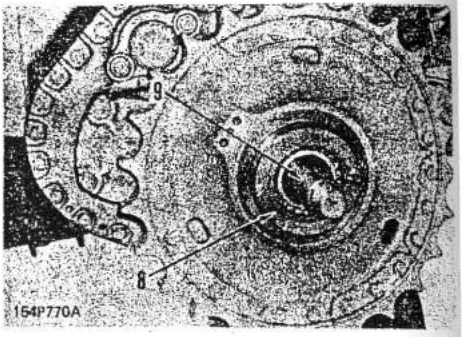
★ Sprocket press fit force: 50 to 60 t



3) Fit retainer (8).

★ Bend lock washer sucurely.

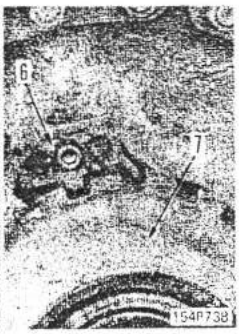
4) Install collar (9).



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9. Sprocket nut
   1) Using tool D, tighten sprocket nut (7).

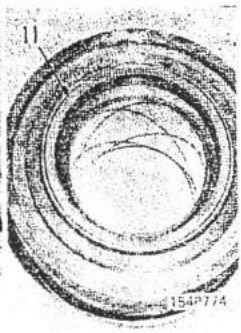




   2) Install lock (6).

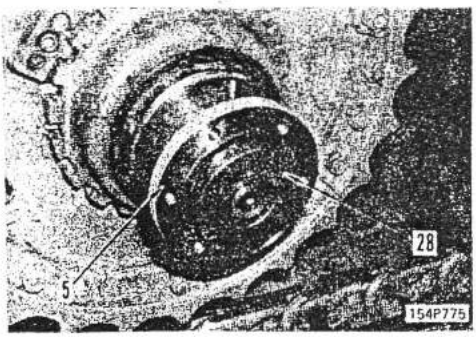
10. Support
   1) Using tool G, install floating seal (11) on sprocket nut and support.





   2) Install support (5).

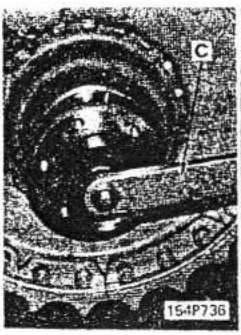
   3) Install collar (28).



11. Nut
   1) Tighten nuts using wrench C.

      kgm Nut: 105±15 kg.m

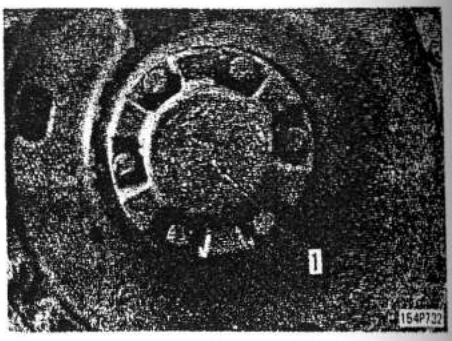
   2) Install lock plate (4).





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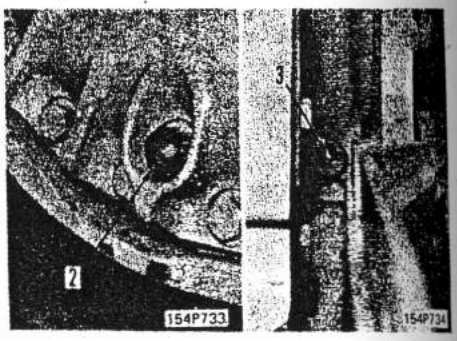
12. Cover
Install cover (1).



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.

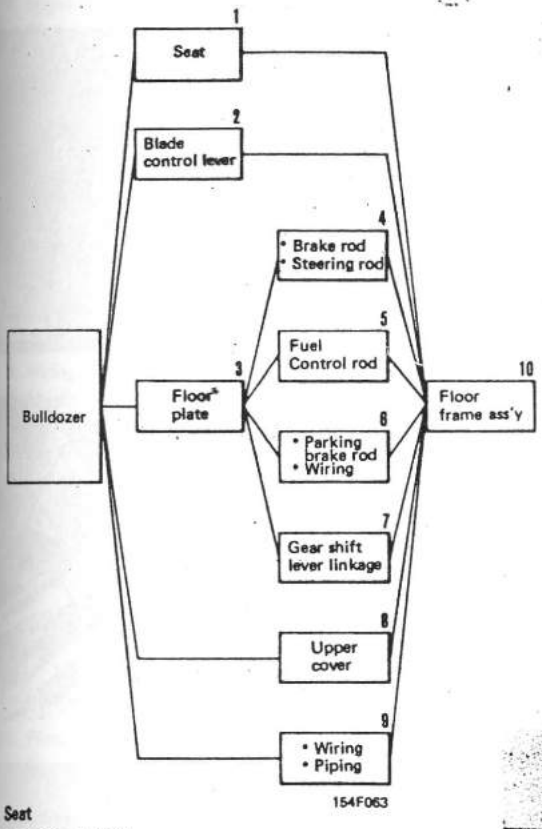
Final drive case: approx. 36 ℓ (TY 220)
51 ℓ (TS 220)



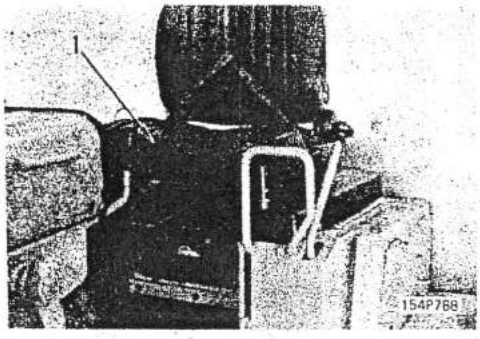
14. Track frame assembly
See "MOUNTING TRACK FRAME ASSEMBLY".

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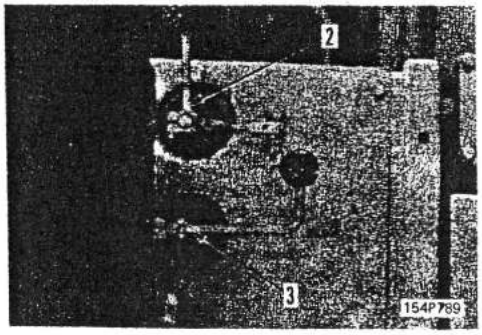
DISMOUNTING FLOOR FRAME ASSEMBLY



1. **Seat**
   Remove seat (1).

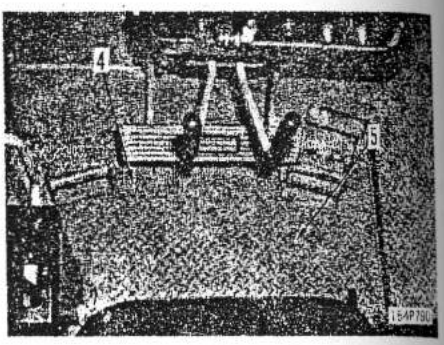


2. **Blade and ripper control levers**
   Remove blade control lever (2) and ripper control lever (3).



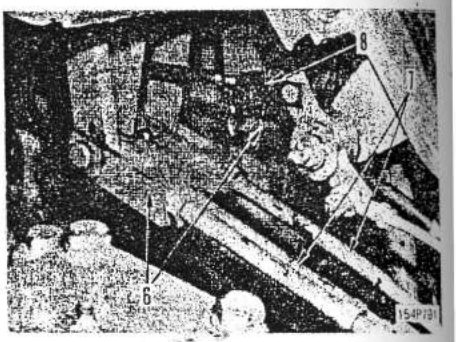
https://truckmanualshub.com/

3. **Floor plates**
   Remove floor plates (4) and (5).

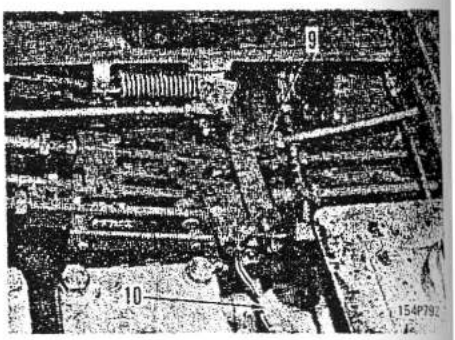


4. **Brake rod and steering rod**
   Disconnect brake rod (6) and steering rod (7).

5. **Fuel control rod**
   Disconnect fuel control rod (8).



6. **Parking brake rod and wiring**
   Disconnect parking brake rod (9) and horn wiring (10).

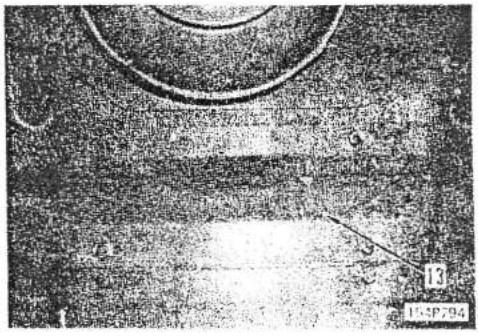


7. **Gear shift lever linkage**
   Disconnect speed valve lever (11) and directional lever (12).

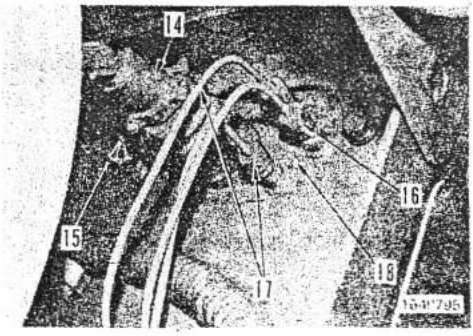


https://truckmanualshub.com/

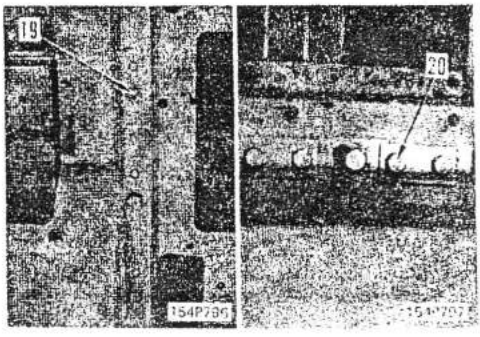
8. Upper cover
   Remove upper cover (13).



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.

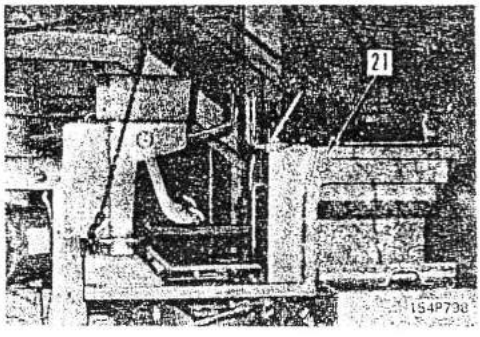


10. Floor frame assembly
    1) Remove frame left and right mounting bolts (19) and seat mounting bolts (20).



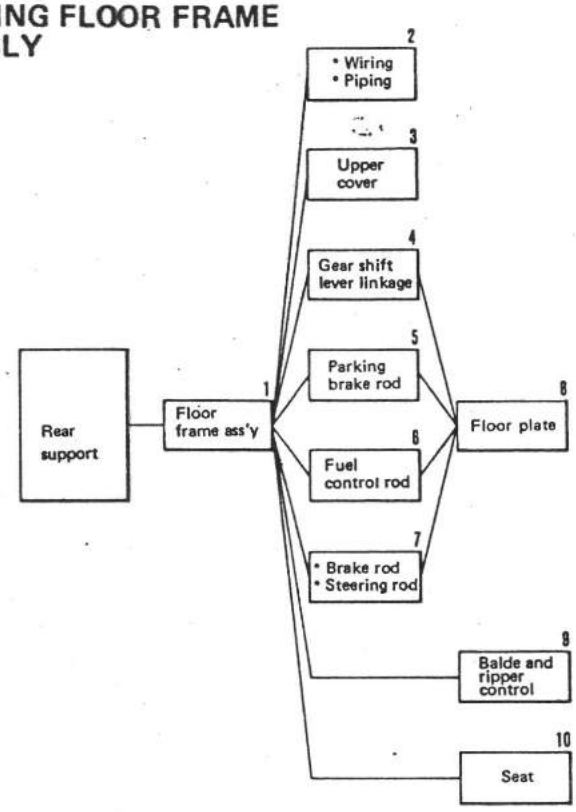
    2) Lift out floor frame assembly (21) with four eye bolts (14 mm, P = 2.0).

    kg Floor frame assembly: 300 kg



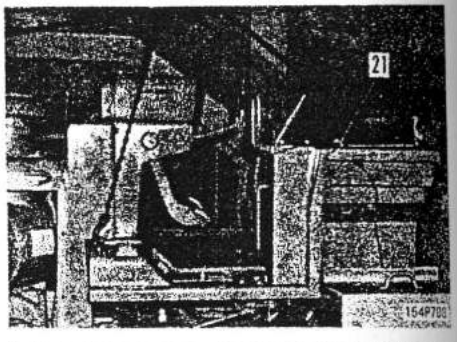
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MOUNTING FLOOR FRAME ASSEMBLY



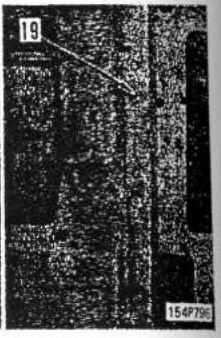
1. Floor frame assembly

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.



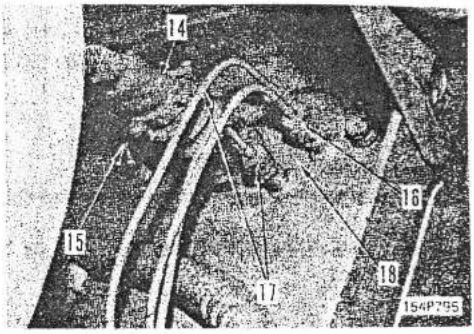
3) Tighten mounting bolts (20) and (19).



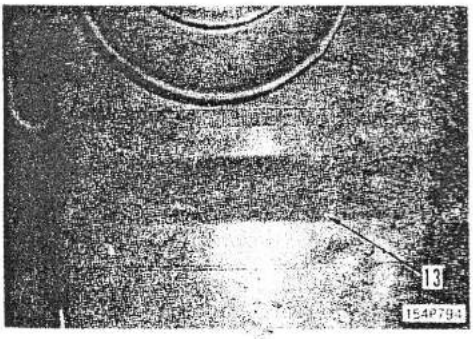


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2. Wiring and piping
   1) Connect plate (18) to cover.
   2) Connect priming pump tube (17) and engine oil pressure gauge tube (16).
   3) Connect dust indicator hose (15) and wiring (14).

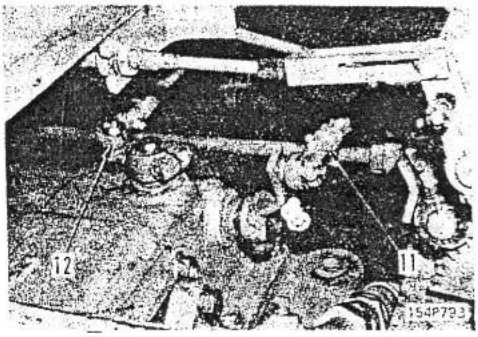


3. Upper cover
   Install cover (13).



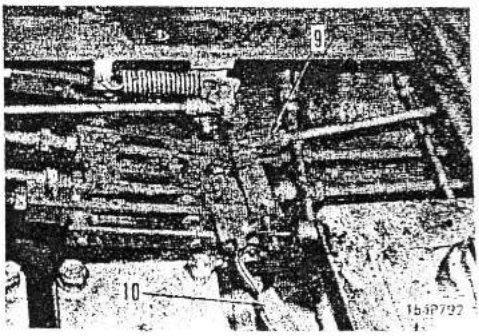
4. Gear shift lever linkage
   Connect directional lever (12) and speed valve lever (11).

   ⊕ Bend cotter pin securely.



5. Parking brake rod and wiring
   Connect wiring (10) to parking brake rod (9).

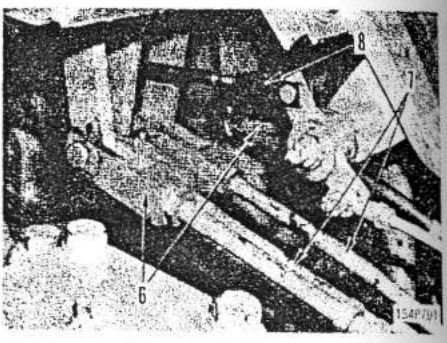
   ⊕ Bend cotter pin securely.



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6. **Fuel control rod**
   Connect fuel control rod (8).

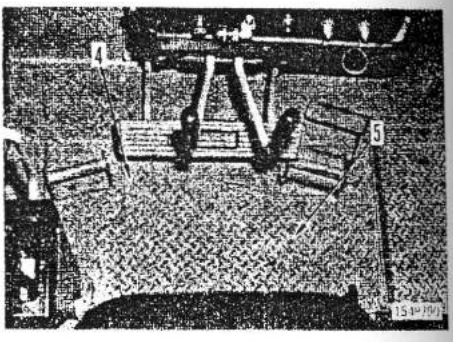
   ⊕ Bend cotter pin securely.



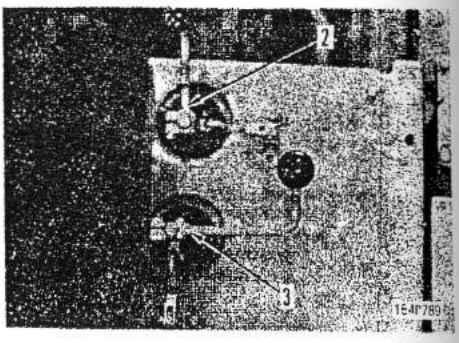
7. **Brake rod and steering rod**
   Connect steering rod (7) and brake rod (6).

   ⊕ Bend cotter pin securely.

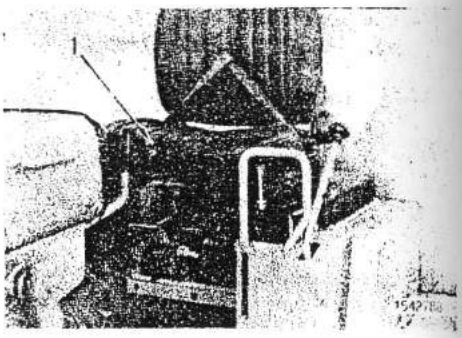
8. **Floor plates**
   Install floor plates (5) and (4).



9. **Blade and ripper control levers**
   Install blade control lever (2) and ripper control lever (3).



10. **Seat**
    Install seat (1).

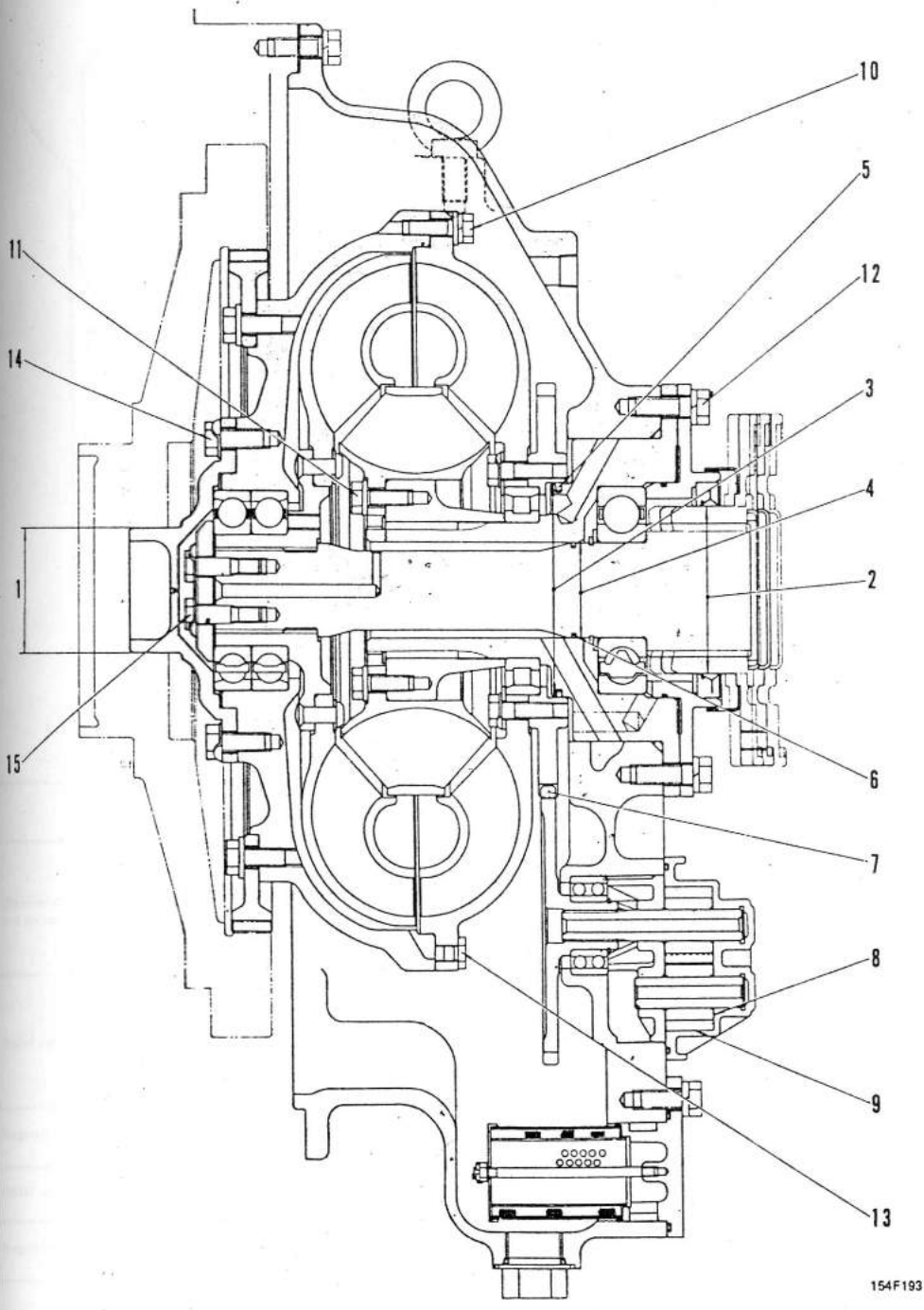


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MAINTENANCE STANDARD

TORQUE CONVERTER

(1) TORQUE CONVERTER



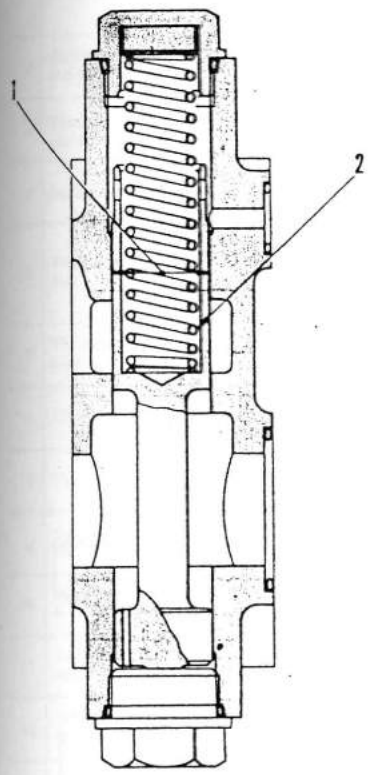
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Unit: mm

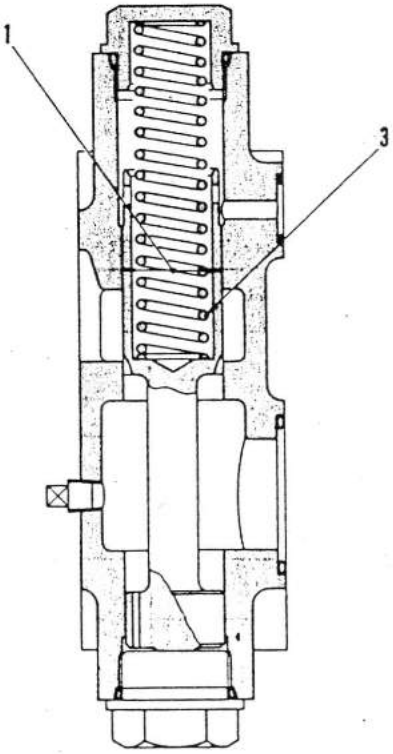
No.	Check item	Criteria		Remedy
1	Pilot outer dia.	Standard size: 78	Repair limit: 77.75	High chrome plating repair or replace
2	Contact surface outer dia. coupling oil seal	105	104.9	
3	Contact surface inner dia. of gear seal ring	135	135.3	
4	Contact surface inner dia. of stator shaft seal ring	60	60.1	
5	Stator shaft seal ring	Width: 4 Thickness: 5.2	3.5 4.9	Replace
6	Turbine shaft seal ring	Width: 2.5 Thickness: 2.5	2.0 2.2	
7	Backlash between scavenge pump drive shaft	Standard clearance: 0.16 ~ 0.43	Clearance limit: 0.50	
8	Side clearance of scavenge pump	0.13	0.25	
9	Top clearance of scavenge pump	0.15	0.30	
10	Tightening torque of mounting bolt of pump and drive case	6.5 ± 0.5 kg.m		Adjust
11	Tightening torque of stator mounting bolt	7 ± 0.5 kg.m		
12	Tightening torque of stator shaft mounting bolt	11.5 ± 1 kg.m		
13	Tightening torque of pump drain plug	1.2 ± 0.1 kg.m		
14	Tightening torque of mounting bolt of drive case drive gear	11.5 ± 1 kg.m		
15	Tightening torque of mounting reamer bolt of stator shaft	5.8 ± 0.2 kg.m		

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(2) RELIEF VALVE AND REGULATOR VALVE



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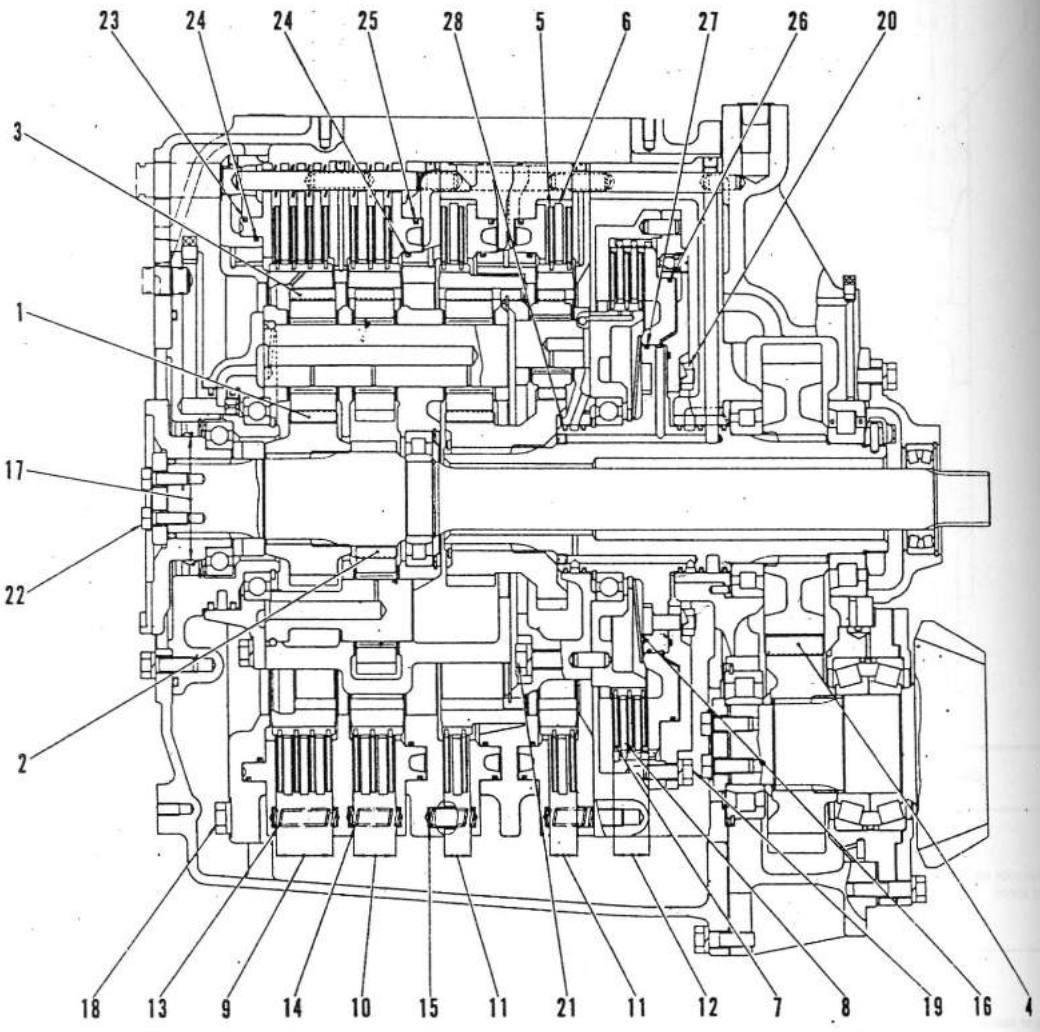
Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between valve body and spool	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		32	−0.050 −0.066	+0.025 0	0.050 ~ 0.091	0.2	
2	Relief valve spring	Standard size			Repair limit		
		Free length x O.D.	Installation length	Installation load	Free length	Installation load	
		137.7x14	98.0	63.5 kg	134.2	57.9 kg	
3	Regulator valve spring	126.6x23.5	106.5	20.9 kg	120	14.0 kg	
4	Relief valve set pressure	$8.7^{+0.3}_{0}$ kg/cm^2 Oil temperature 70 ~ 80°C					
5	Regulator valve set pressure	2.5 + 1.0 kg/cm^2 at 50 /min. 3.5 + 0.5 kg/cm^2 at 100 /min. 4.5 + 0.5 kg/cm^2 at 200 /min. Oil temperature 70 ~ 80°C					

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TORQFLOW TRANSMISSION

(1) TRANSMISSION



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Unit: mm

No.	Check item	Criteria					Remedy
1	Backlash between No. 1, 3 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, platte	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 x 15.3	56.6	13.3 kg	64.1	10.6 kg	
14	No. 2 clutch spring	45.7 x 15.3	41.2	9.6 kg	44.8	7.7 kg	
15	No. 3, 4 clutch spring	45.7 x 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					

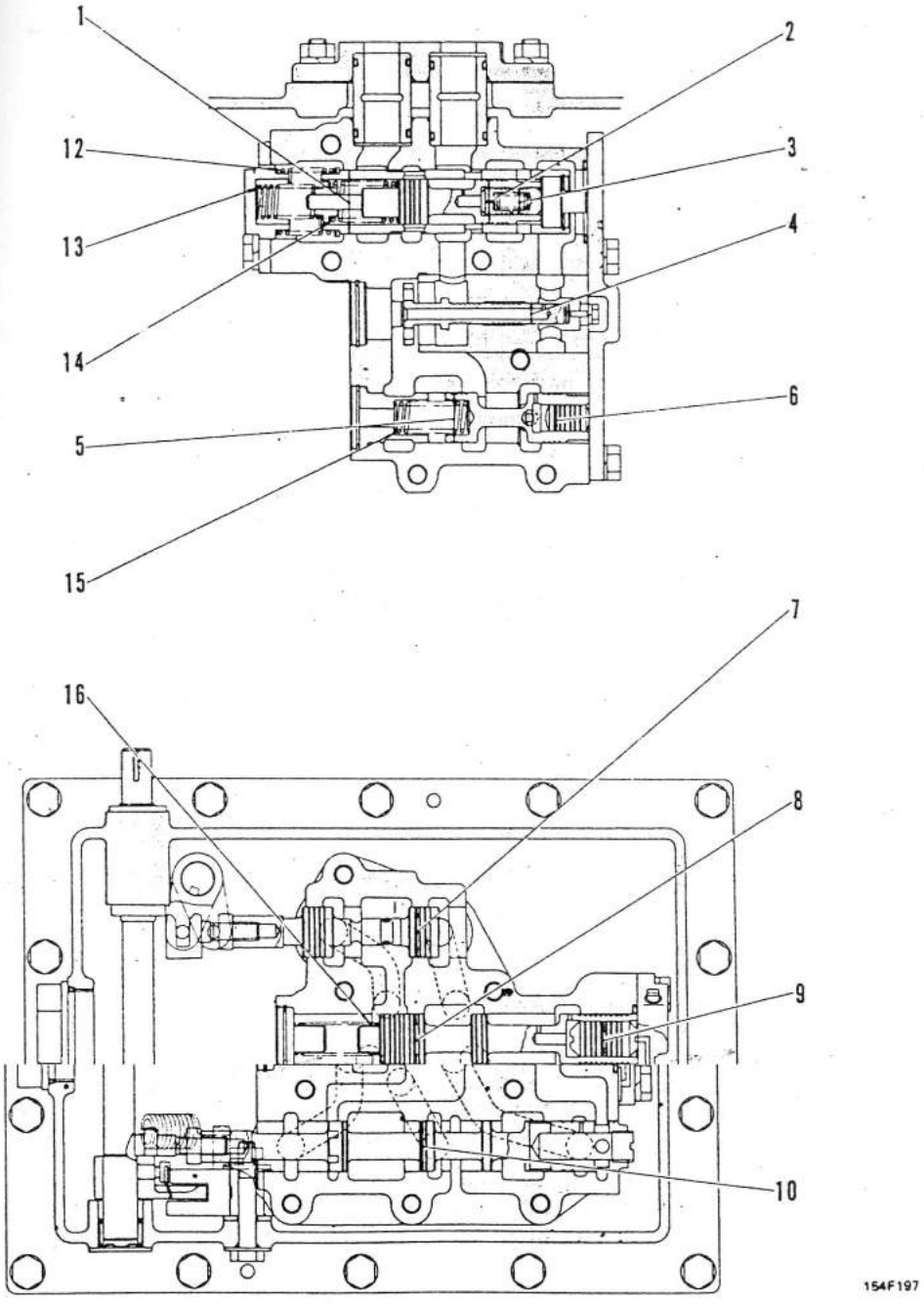
https://truckmanualshub.com/

Unit: mm

No	Check item	Criteria	Remedy
20	Tighteing torque of shaft mounting bolt	11 ± 1.5 kgm	Adjust
21	Tightening torque of carrier mounting bolt	18 ± 2 kgm	
22	Tightening torque of shaft mounting holder	4 ± 1.5 kgm	

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(2) CONTROL VALVE



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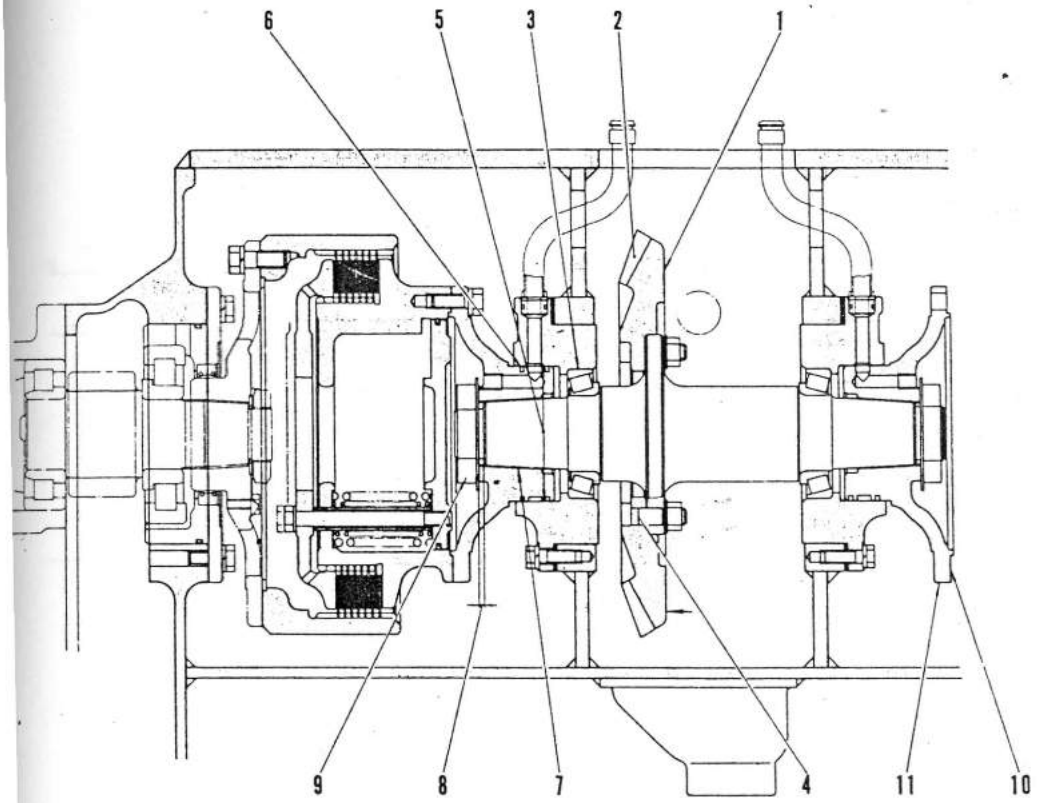
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between modulating valve and valve body	35	−0.035 −0.045	+0.013 0	0.035 ~ 0.058	0.064	
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	28	−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 x O.D.	Installation length	Installation load	Free length	Installation load	
		53x37.9	35.0	8.65 kg	51.2	7.79 kg	
13	Relief valve spring (Large)	38.5x22.9	26.5	21.7 kg	37.3	19.5 kg	
14	Relief valve spring (Small)	43.8x22.5	32.1	40.3 kg	42.6	36.3 kg	
15	Reducing valve spring	52x18.2	39.2	21.9 kg	50.7	19.7 kg	
16	Safety valve spring	79x17.2	47	1.41 kg	75.8	1.34 kg	
17	Lubrication valve spring	87x18	61	7.6 kg	84.1		
18	Clutch pressure	Engine slow 18 ~ 24 kg/cm^2 Engine full 23 ~ 27 kg/cm^2			Oil temperature 70 ~ 80°C		Adjust

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BEVEL GEAR SHAFT AND STEERING CLUTCH

(1) BEVEL GEAR SHAFT



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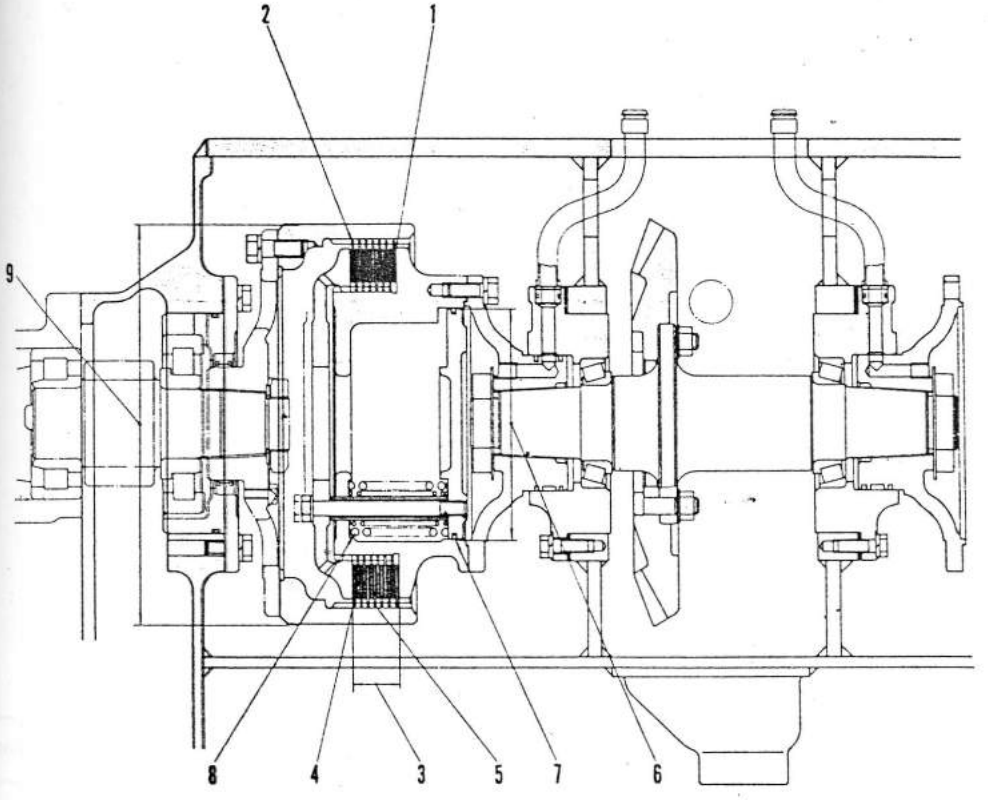
https://truckmanualshub.com/

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: 0.25 ~ 0.33; Clearance limit: 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 reamer bolt	Standard size: 18; Tolerance: Shaft 0 / −0.015, Hole +0.027 / 0; Standard clearance: 0 ~ 0.042; Clearance limit: 0.1	Replace
5	Contact surface of bearing cage seal ring	Standard size: 145; Repair limit: 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	Radian run-out of bevel gear shaft hub	Repair limit: 0.08	

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(2) STEERING CLUTCH



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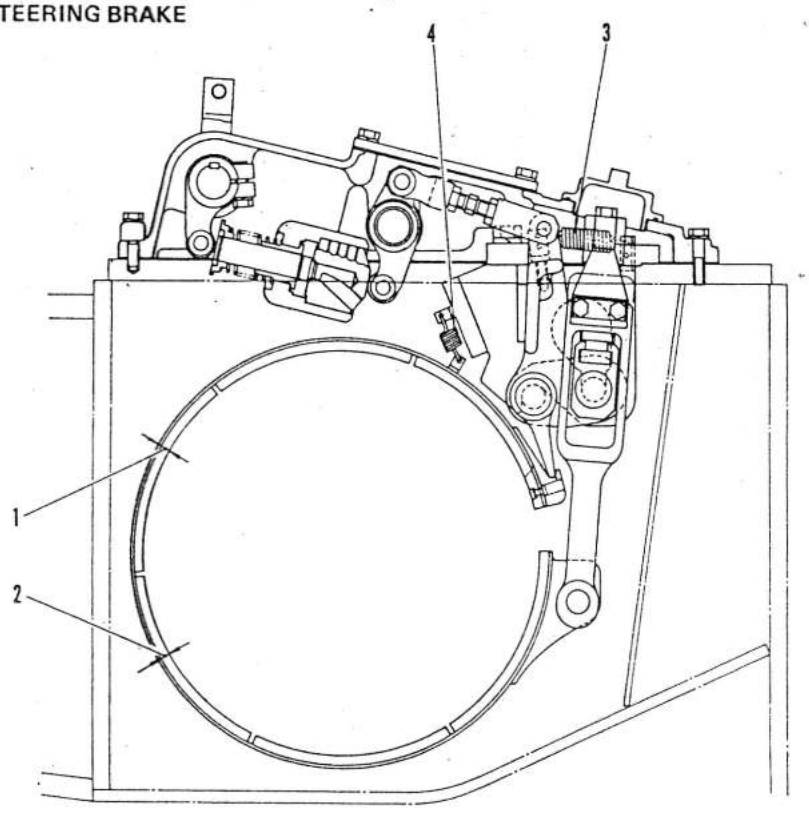
https://truckmanualshub.com/

Unit: mm

No.	Check item	Criteria				Remedy
1	Thickness of drive plate	Standard size		Repair limit		Replace
		2.9		2.0		
	Strain of drive plate	Tolerance		Repair limit		Repair or replace
		Within 0.2		0.3		
2	Thickness of driven plate	Standard size		Repair limit		Replace
		4.7		3.7		
	Strain of driven plate	Tolerance		Repair limit		Repair or replace
		Within 0.2		0.3		
3	Total assembly thickness of drive plate and driven plate	Standard size		Repair limit		Replace
		50.3		46		
4	Backlash between drive plate and clutch drum (inner drum)	Standard clearance		Repair limit		
		0.3 ~ 0.4		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		Repair limit		
		245		245.3		
7	Width of piston seal ring	4.9				
	Width of seal ring groove	5				
8	Clutch spring	Standard size			Repair limit	
		Free length x O.D.	Installation length	Installation load	Free length	Installation load
		(Large) 145.15x59	106.1	242 kg	141.0	229.1
		(Small) 137.83x39	106.1	138 kg	146.5	132.0
9	Outside dia. of brake drum (outer drum)	Standard size		Repair limit		Repair or replace
		425		420		
10	Face run-out of brake drum (outer drum)	Tolerance		Repair limit		
		Within 0.2		0.5		
11	Excentricity of brake drum (outer drum)	Within 0.2		0.3		

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(3) STEERING BRAKE

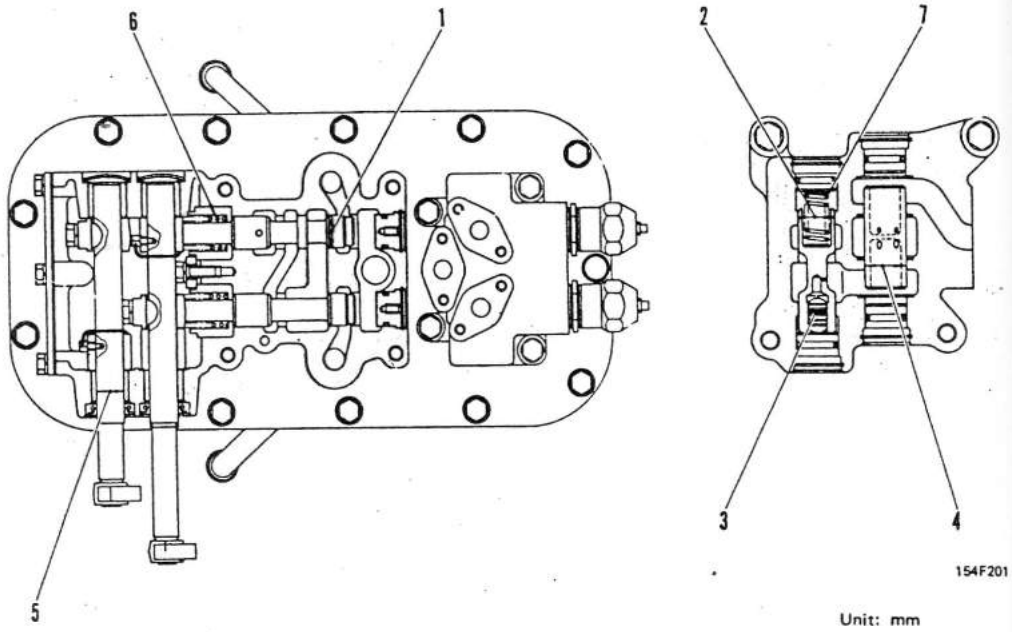


Unit: mm

No.	Check item	Criteria					Remedy
1	Assembly thickness of brake lining and brake band	Standard size: 14			Repair limit: 9.5		Replace
2	Thickness of brake lining	9.5					
3	Brake band return spring	Standard size: Free length x O.D. 78.3x23.2	Installation length 97	Installation load 20 kg	Repair limit: Free length 82	Installation load 16 kg	
4	Brake band lift spring	42.4x18.3	47.4	4.54 kg	43.3	3.6 kg	
5	Brake pedal travel	120 ± 10 Difference between right and left travel is within 10 mm.					Adjust
	Operating force of brake pedal	15 kg (Engine idling)					

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(4) STEERING CONTROL VALVE

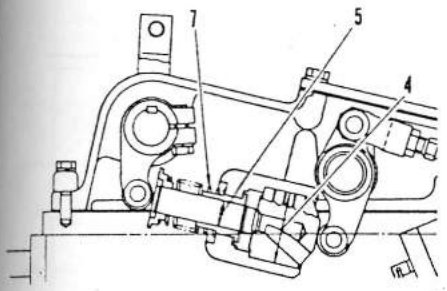


Unit: mm

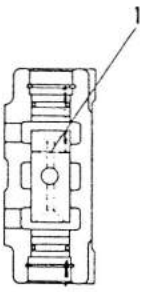
No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between spool and valve	30	−0.020 −0.041	+0.013 0	0.020 ~ 0.054	0.1	Repair or replace
2	Clearance between relief valve and valve body	28	−0.014 −0.023	+0.013 0	0.014 ~ 0.036	0.08	
3	Clearance between relief valve and piston	15	−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^2 (Engine slow) 12 ~ 17 kg/cm^2 (Engine full)					Adjust

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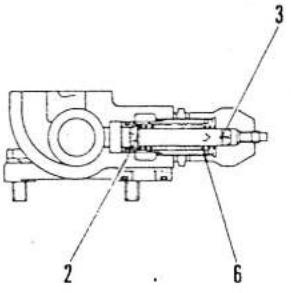
(5) STEERING BRAKE VALVE AND BOOSTER



154F202



154F204



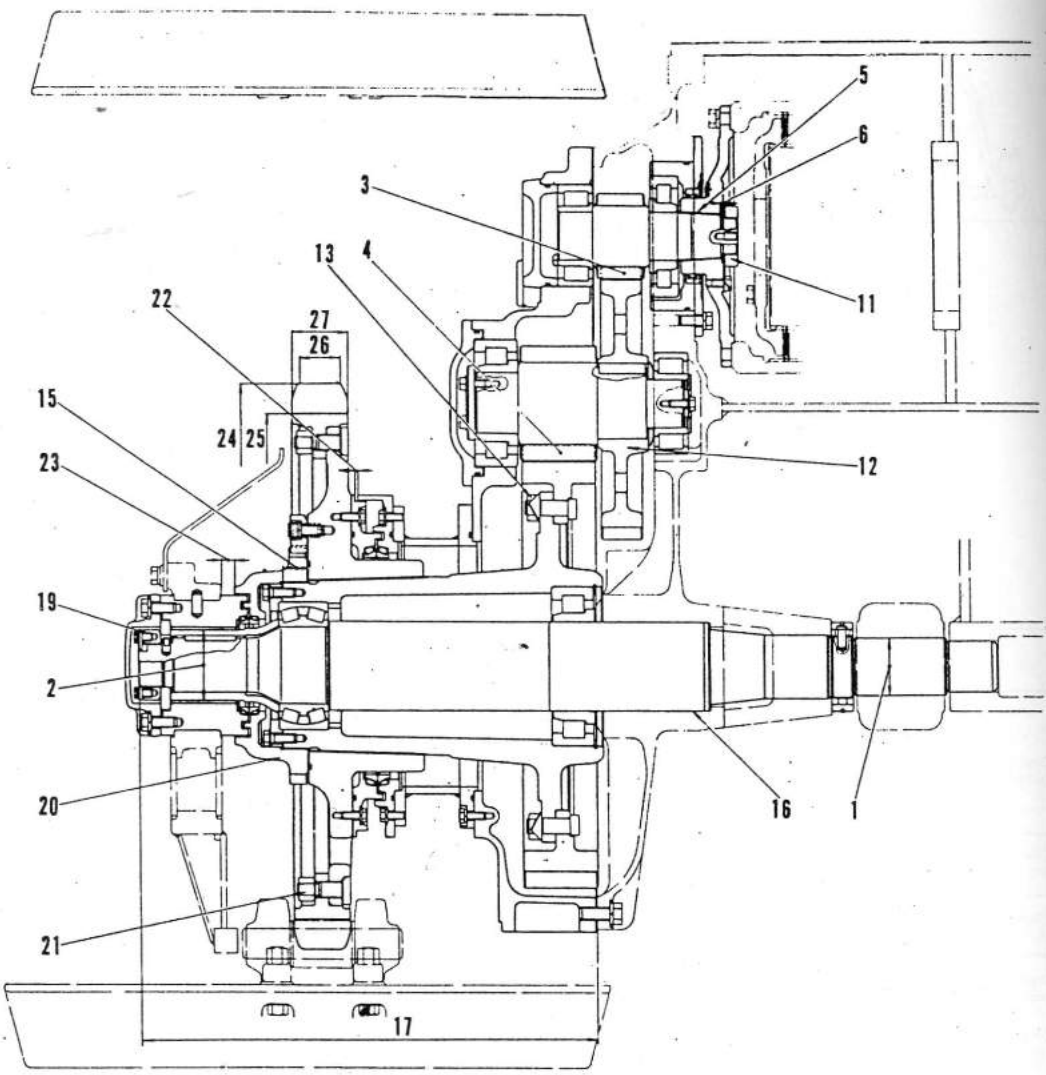
154F203

Unit: mm

No.	Check item	Criteria						Remedy
			Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between free piston and body		31	−0.016 −0.026	+0.017 0	0.016 ~ 0.043	0.1	
2	Clearance between valve seat and plunger		21	−0.065 −0.098	+0.021 0	0.065 ~ 0.119	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	Replace
5	Clearance between booster valve and valve seat		25	−0.005 −0.010	+0.064 +0.043	0.048 ~ 0.074	0.1	
			Standard size			Repair limit		
6	Relief valve spring		Free length x O.D.	Installation length	Installation load	Free length	Installation load	
			76.4x19.6	63	8 kg			
7	Booster valve return spring		89x46.5	58	10 kg	85.9	9 kg	
8	Brake relief pressure	15 ~ 20 kg/cm^2 (Engine slow) 15 ~ 20 kg/cm^2 (Engine full)			Difference between right and left: within 2 kg/cm^2			

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FINAL DRIVE



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Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between sprocket shaft and diagonal brace bushing	90	−0.036 −0.071	+0.035 0	0.036 ~ 0.106	0.5	Replace bushing
2	Clearance between support shaft collar and bushing	110	−0.036 −0.071	+0.199 +0.084	0.120 ~ 0.270	0.5	
3	Backlash between No. 1 pinion and No. 1 gear	Standard clearance: 0.400~0.623			Clearance limit: 1.5		Replace
4	Backlash between No. 2 pinion and No. 2 gear	Standard clearance: 0.475~0.847			Clearance limit: 1.5		
5	Force-fitting force final drive flange and No. 1 pinion	30 ~ 40 tpm					
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					Adjust
14	Force-fitting force of sprocket	50 ~ 60 ton					
15	Dimension between end surfaces of sprocket hub and sprocket boss	39 ~ 41					
16	Force-fitting force of sprocket shaft	12 ~ 46 ton					
17	Dimension between end surface of sprocket shaft and steering case	TY 220 599.5 TS 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					

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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 boss 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				

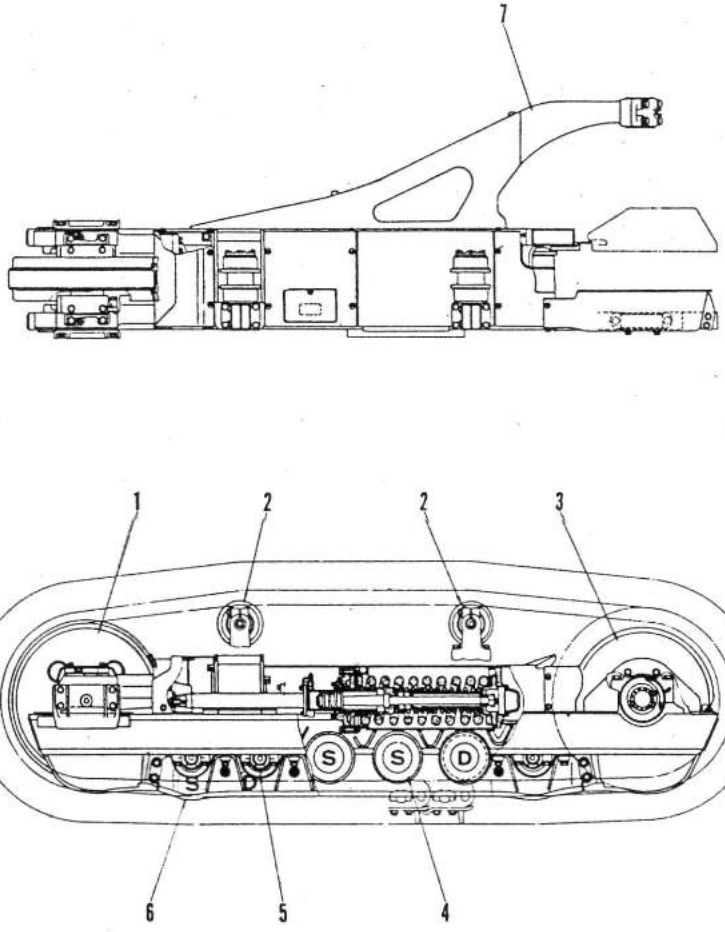
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UNDERCARRIAGE

https://truckmanualshub.com/

STRUCTURE AND FUNCTION

TRACK GROUP TY 220

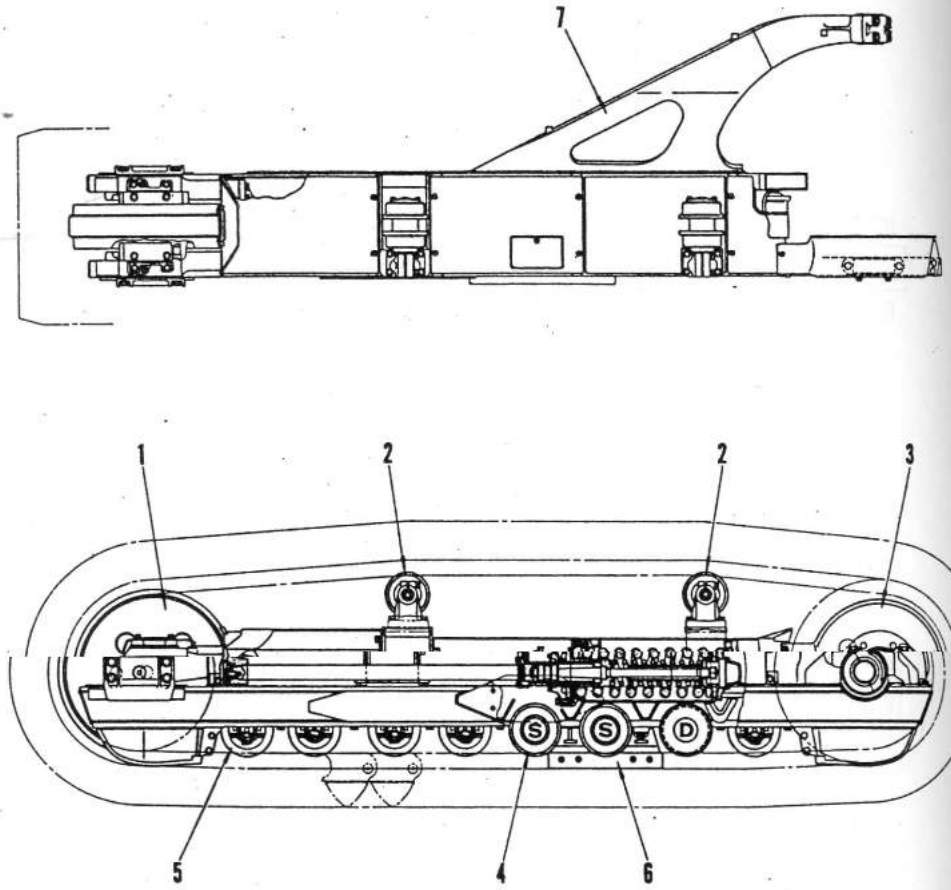


154F206

1. Idler
2. Carrier roller
3. Sprocket cover
4. Track roller (Single)
5. Track roller (Double)
6. Track roller guard
7. Diagonal brace

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TRACK GROUP TS 220

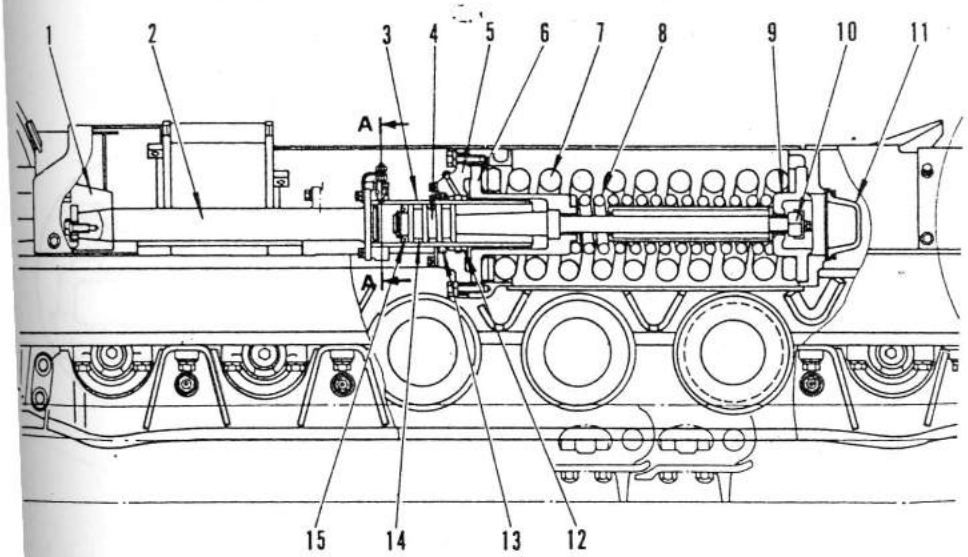


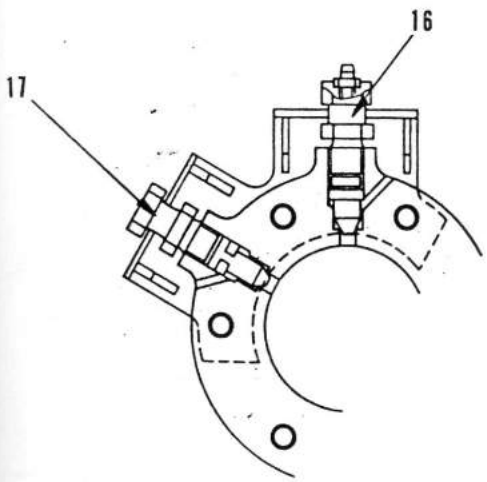
154F207

1. Idler
2. Carrier roller
3. Sprocket cover
4. Track roller (Single)
5. Track roller (Double)
6. Track roller guard
7. Diagonal brace

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RECOIL SPRING



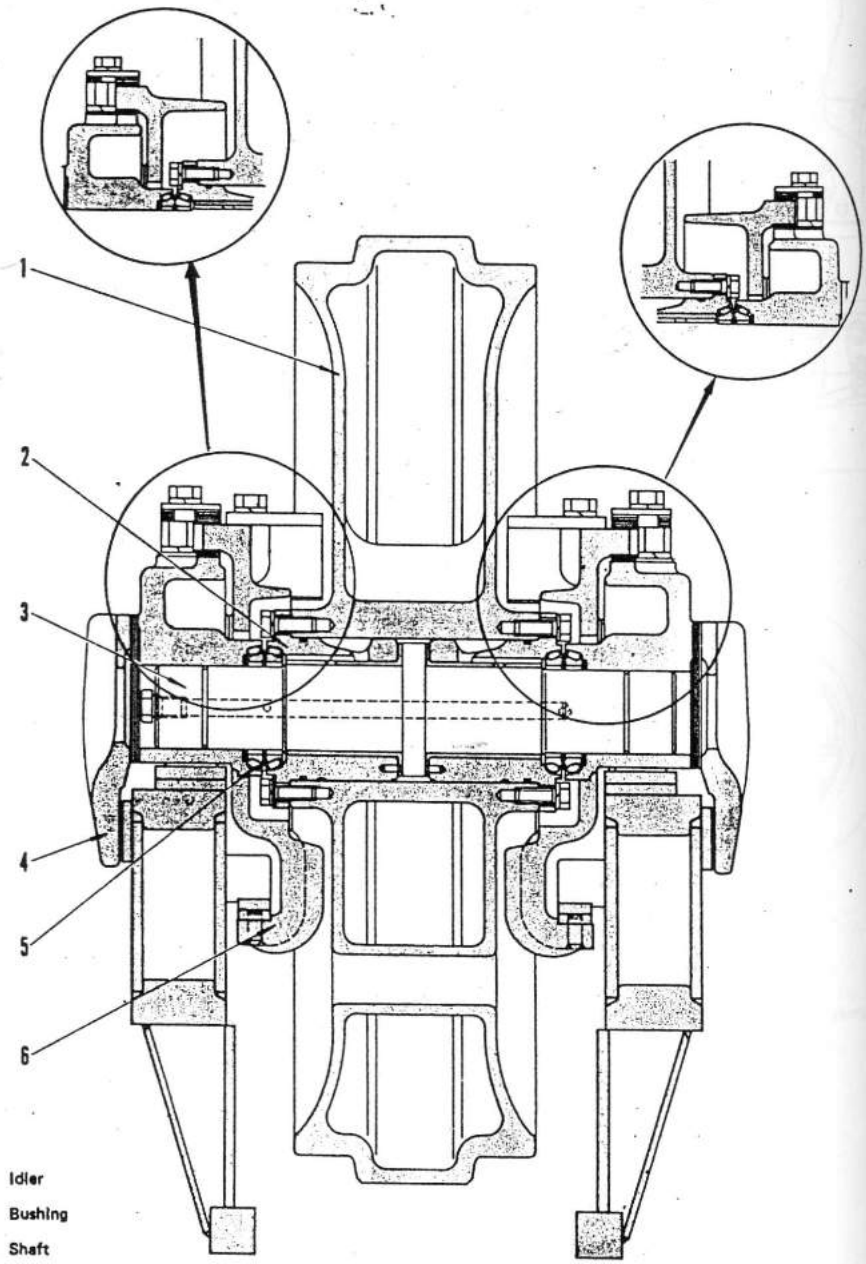


154F208

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

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IDLER

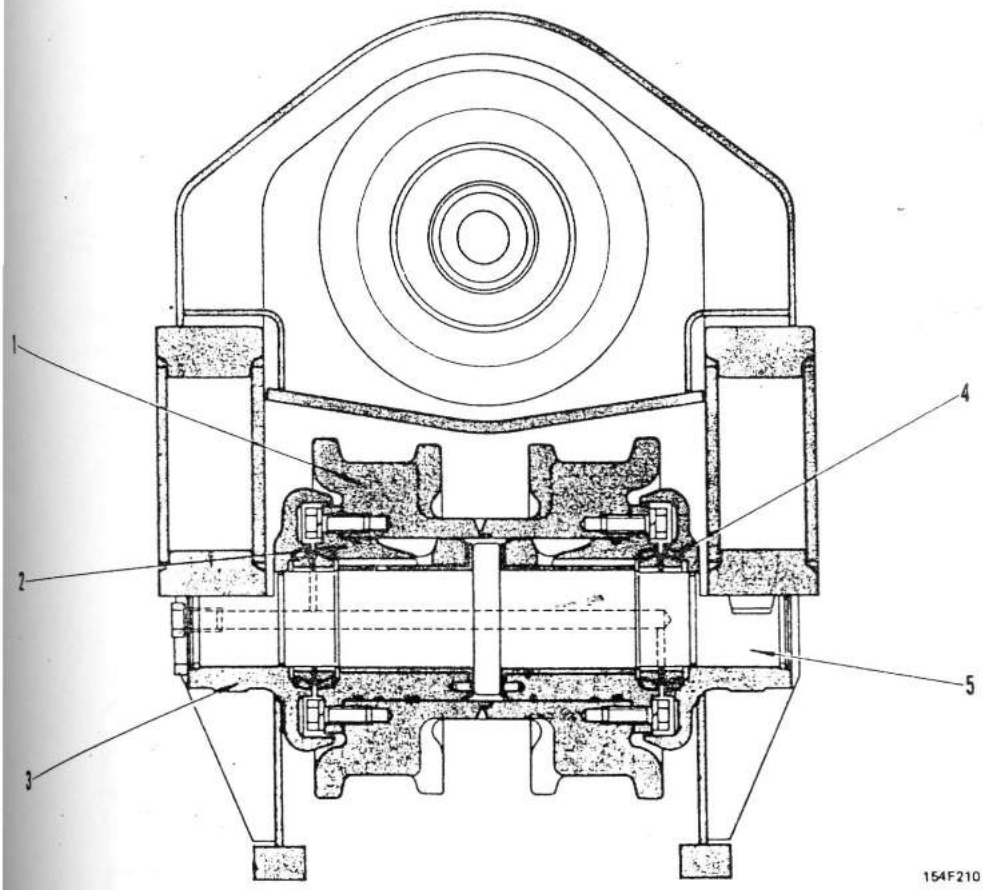


1. Idler
2. Bushing
3. Shaft
4. Cover
5. Floating seal
6. Support

154F209

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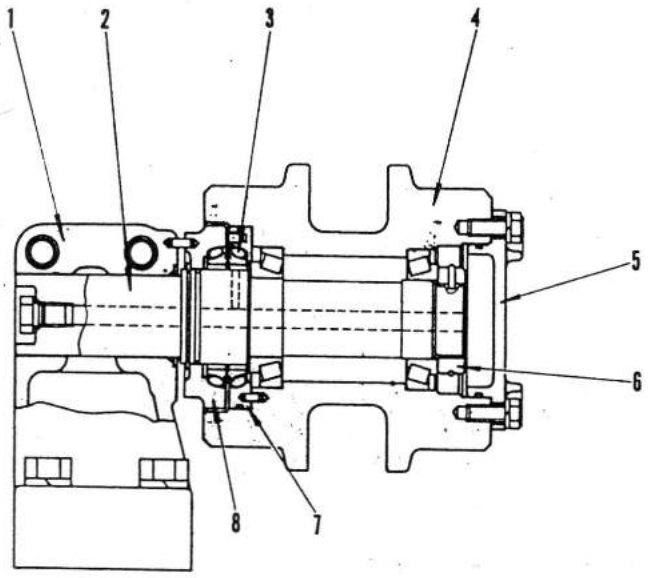
TRACK ROLLER



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

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CARRIER ROLLER

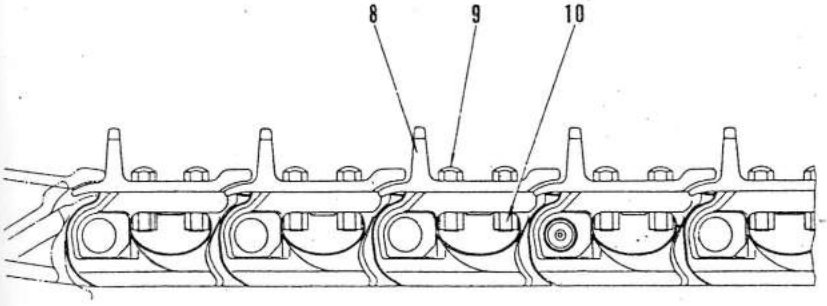


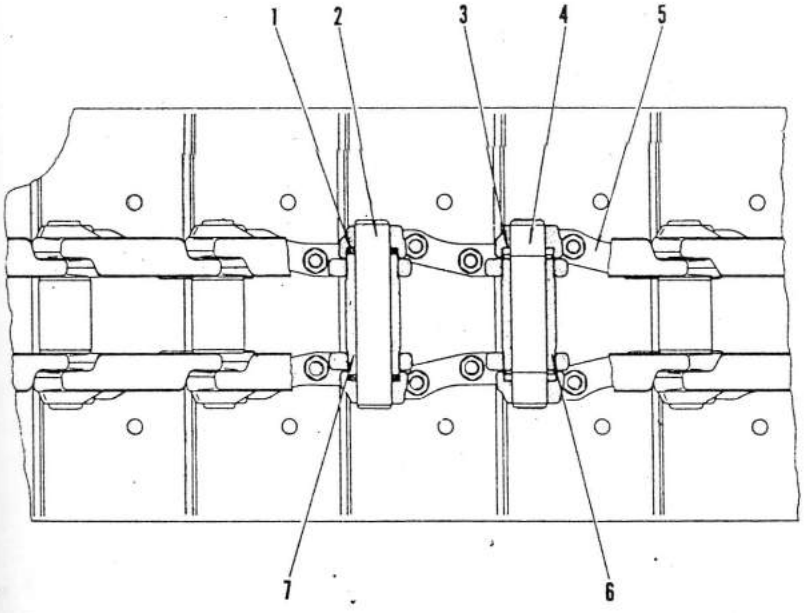
154F211

1. Support
2. Shaft
3. Floating seal
4. Carrier roller
5. Cover
6. Nut
7. Seal
8. Collar

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TRACK (SHOE) TY 220



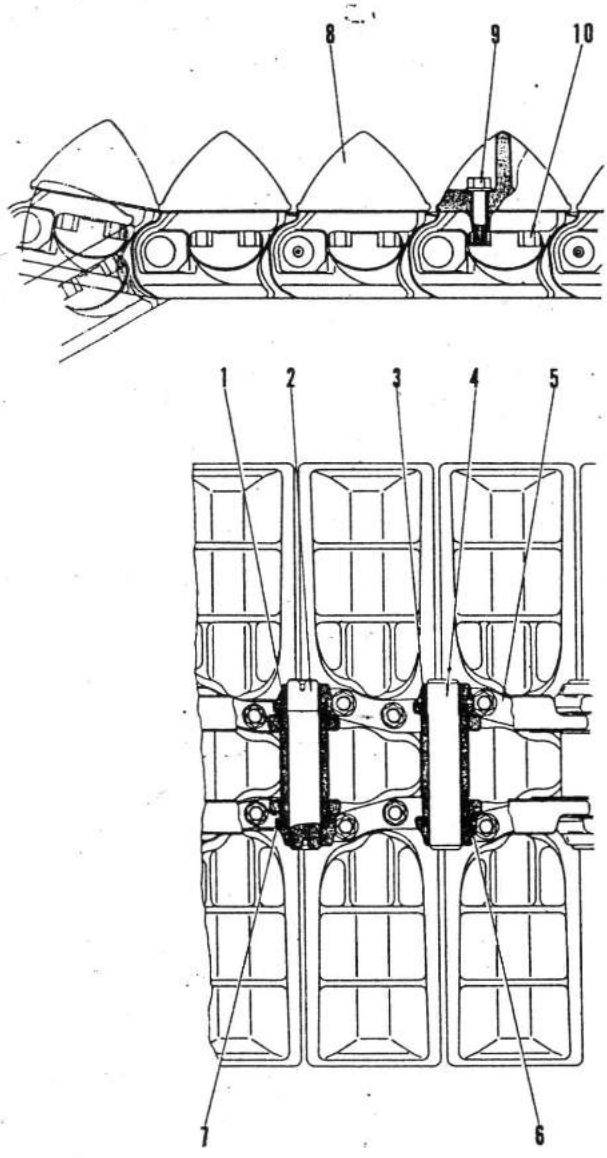


154F212

1. Regular dust seal
2. Regular pin
3. Mster dust seal
4. Master pin
5. Link
6. Master bushing
7. Regular bushing
8. Single shoe
9. Shoe bolt
10. Shoe nut

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TRACK (SHOE) TS220

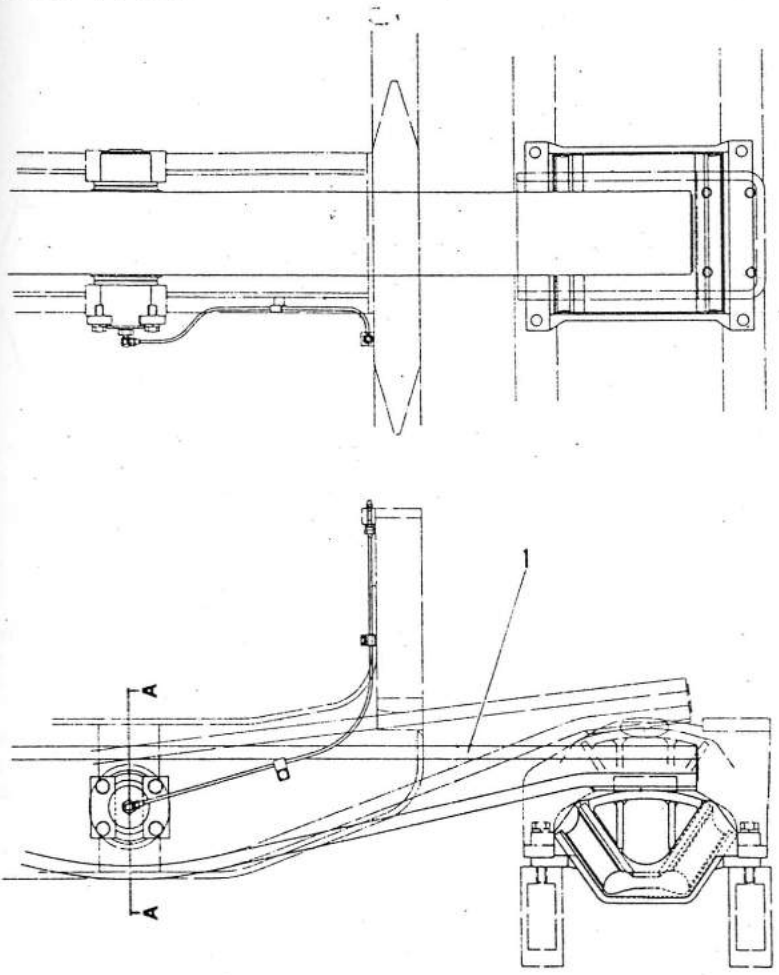


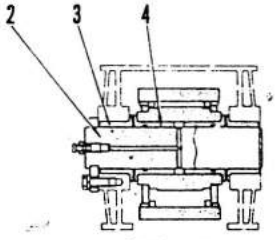
154F213

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

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SUSPENCION TY 220





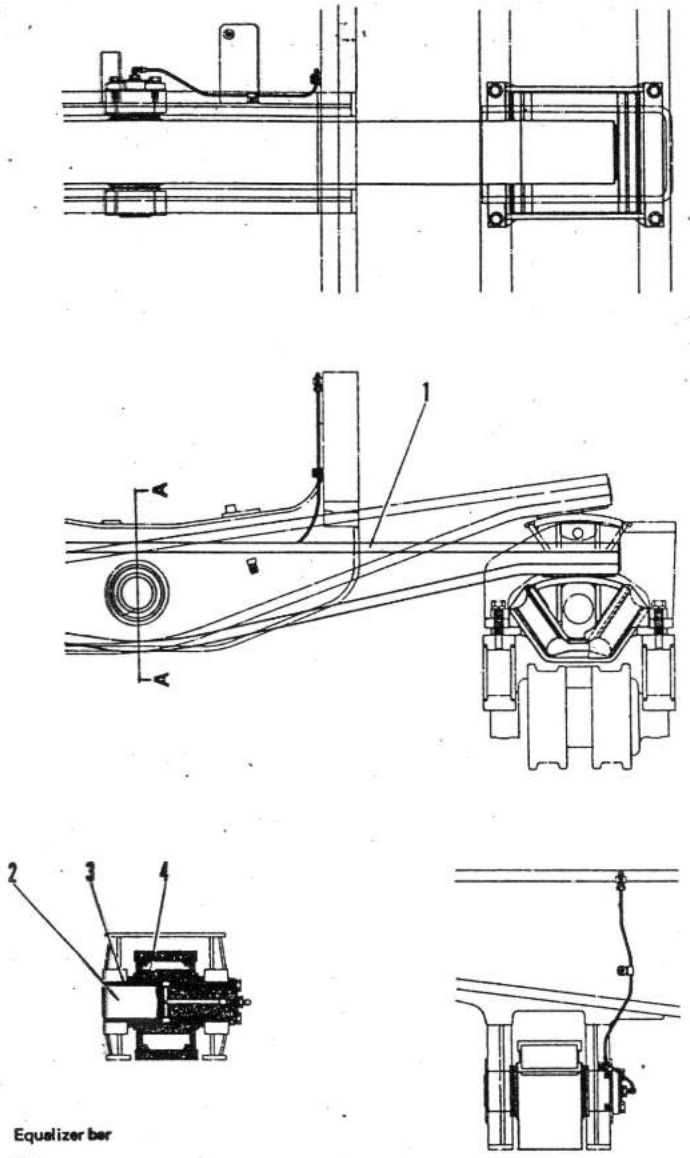
Section A - A

1. Equalizer bar
2. Pin
3. Bushing
4. Bushing

154F214

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SUSPENSION TS 220



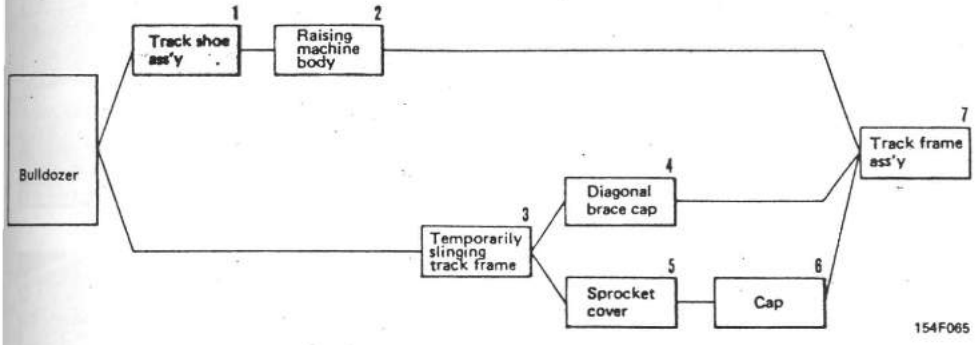
1. Equalizer bar
2. Pin
3. Support
4. Bushing

154F215

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DISASSEMBLY AND ASSEMBLY

DISMOUNTING TRACK FRAME ASSEMBLY

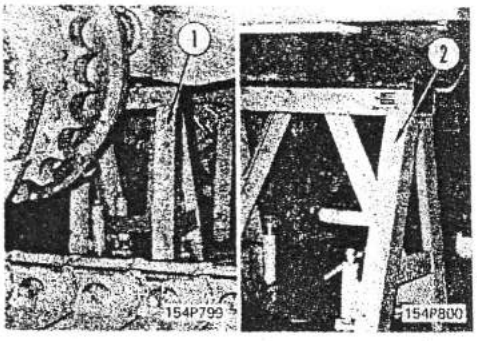


Track shoe assembly

See Section SEPARATION OF TRACK FOR dismounting procedure.

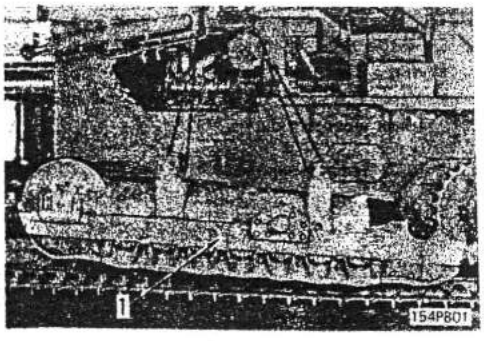
Raising machine body

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.



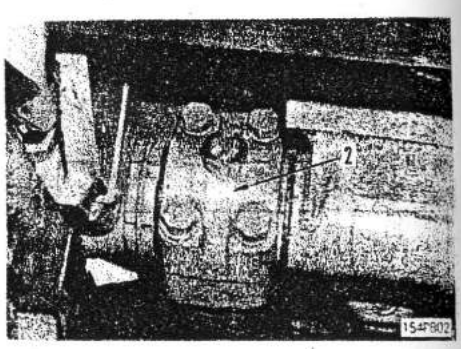
Track frame assembly

Temporarily sling track frame assembly (1).

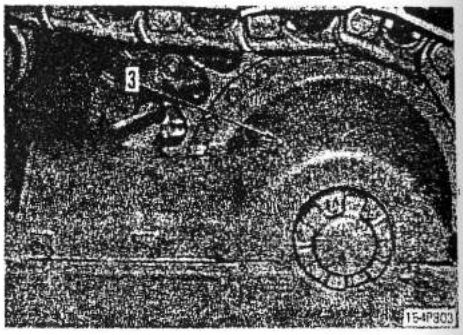


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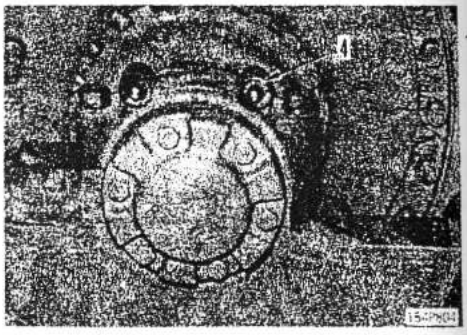
4. **Diagonal brace cap**
   Remove diagonal brace cap (2).
   ★ Before removing cap, make match marks on cap and diagonal brace.



5. **Sprocket cover**
   Remove sprocket cover (3).

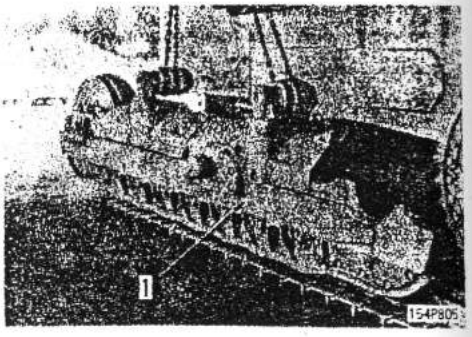


6. **Cap**
   Remove cap (4).



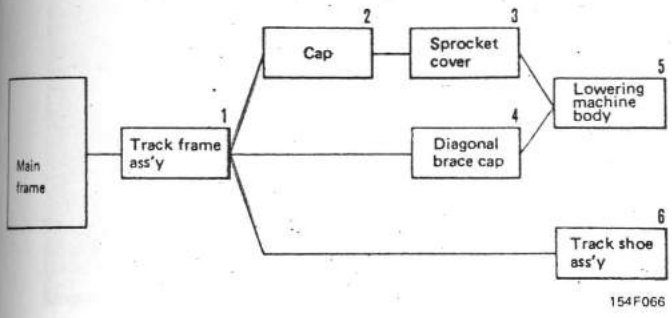
7. **Track frame assembly**
   Sling the track frame assembly (1) and disconnect it from the diagonal brace and sprocket shaft.
   ★ Keep rear part of track frame assembly slightly lower when removing.

   kg Track frame assembly: 2,300 kg (TY 220)
   2,560 kg (TS 220)



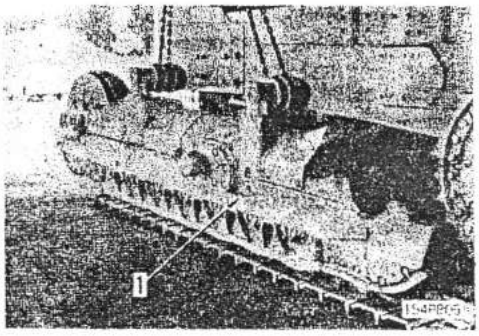
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MOUNTING TRACK FRAME ASSEMBLY



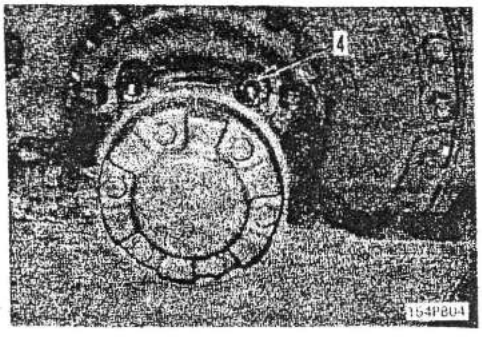
154F066

1. **Track frame assembly**
   Sling track frame assembly (1) and position it on diagonal frame and sprocket shaft.



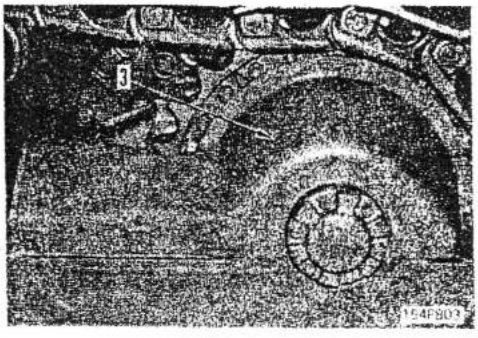
2. **Cap**
   Install cap (4).

   Cap: 94 ± 10 kg.m



3. **Sprocket cover**
   Install sprocket cover (3).
   ★ Mounting bolt: Thread tightener

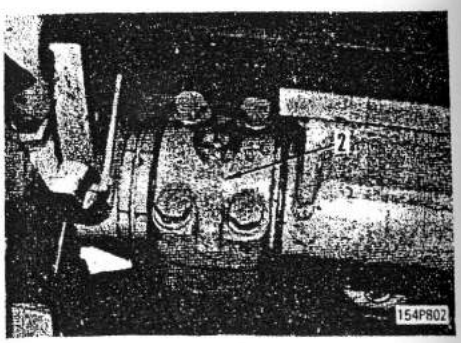
   Bolt: (16 mm) 25 ± 5 kg.m
   (14 mm) 11 ± 2 kg.m



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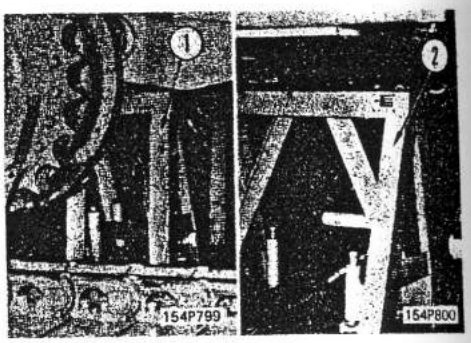
4. **Diagonal brace cap**
Align match marks on the cap and diagonal brace, and install cap (2).

Cap: 94 ± 10 kg.m



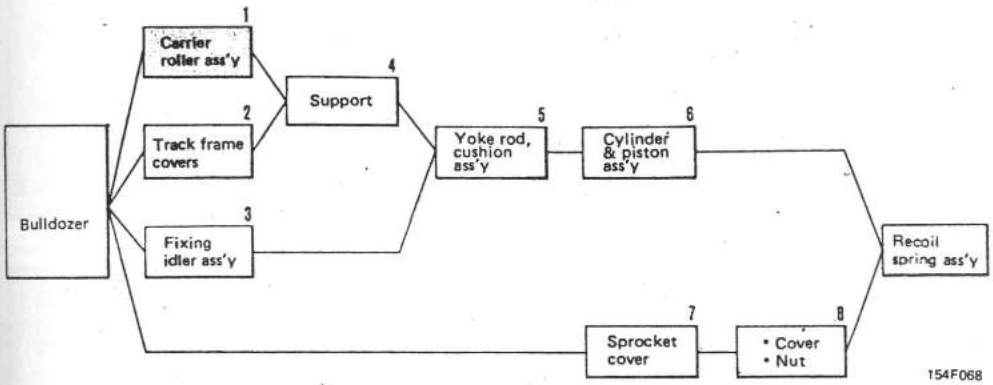
5. **Lowering machine body**
Raise machine body and remove blocks 1 (height: approx. 500 mm) from under both sides of steering case, and block 2 (height: approx. 850 mm) from under center of radiator guard. Lower machine body.

6. **Track assembly**
See Section CONNECTION OF TRACK for mounting procedure.



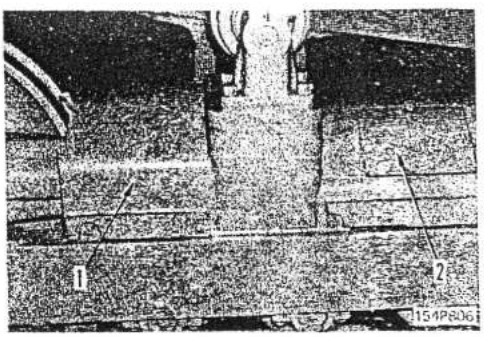
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DISMOUNTING RECOIL SPRING ASSEMBLY

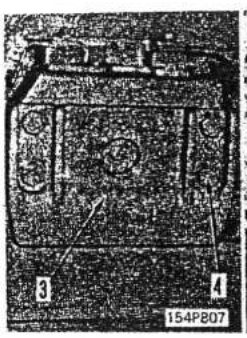


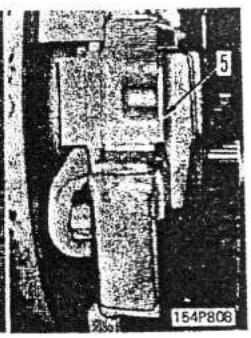
1. **Carrier roller assembly**
   See Section DISMOUNTING CARRIER ROLLER for dismounting procedure.

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.

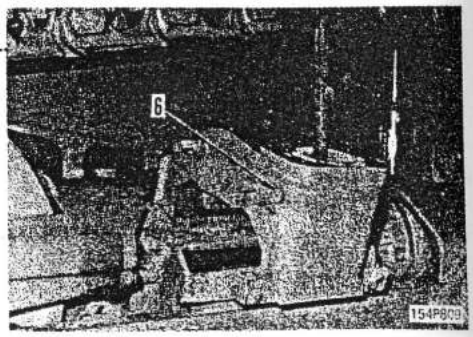




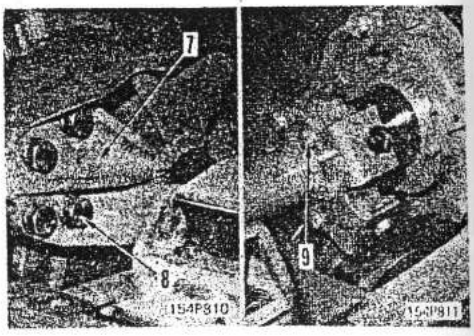
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4. Support
   1) Jack up equalizer bar to raise it from support (6).
   2) Hoist support to remove.

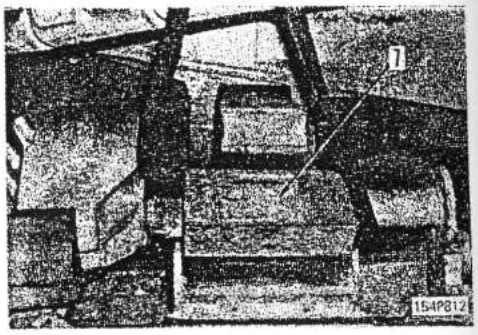
   kg Support: 75 kg



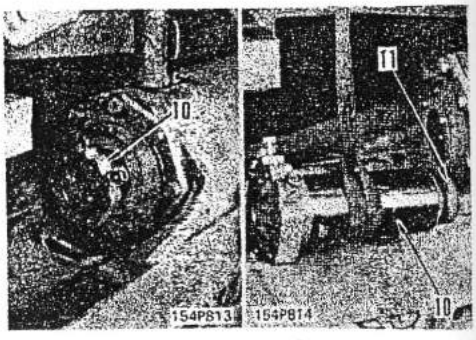
5. Yoke rod, cushion assembly
   1) Remove mounting bolts (8) and (9) from yoke rod and cushion assembly (7).



   2) Disconnect yoke rod pilot by pushing in cylinder. Lift out yoke rod and cushion assembly (7) as one unit.

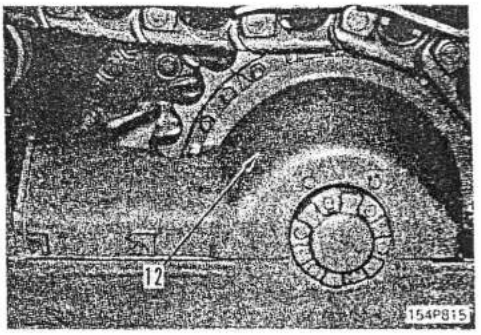


6. Cylinder and piston assembly
   Pull out cylinder (10) slightly. Attach lifting tool and remove cylinder and piston (11) as an assembly.



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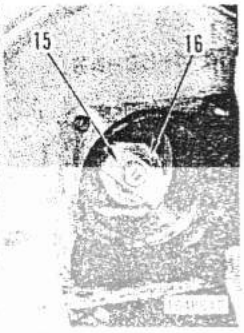
7. **Sprocket cover**
   Remove cover (12).



8. **Cover, nut**
   1) Remove cover (14).

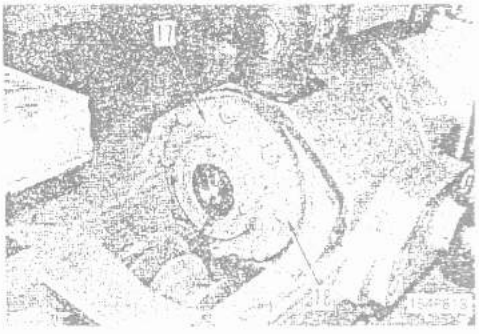
   2) Remover lock plate (15) and tighten nut (16).
      ★ Before tightening the nut, check the nut's mounting position, so that it can be returned to the same position when mounting.





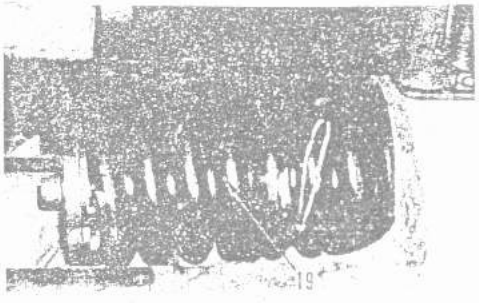
⚠ Do not fail to tighten the nut at this stage. It is very dangerous if the mounting bolt of the front cover is loosened while the nut is still loose because the recoil spring load is under tension.

9. Recoil spring assembly
   1) Loosen bolts (18) in turn and remove cover (17).



   2) Push recoil spring assembly (19) out from sprocket side, and sling at center to remove.

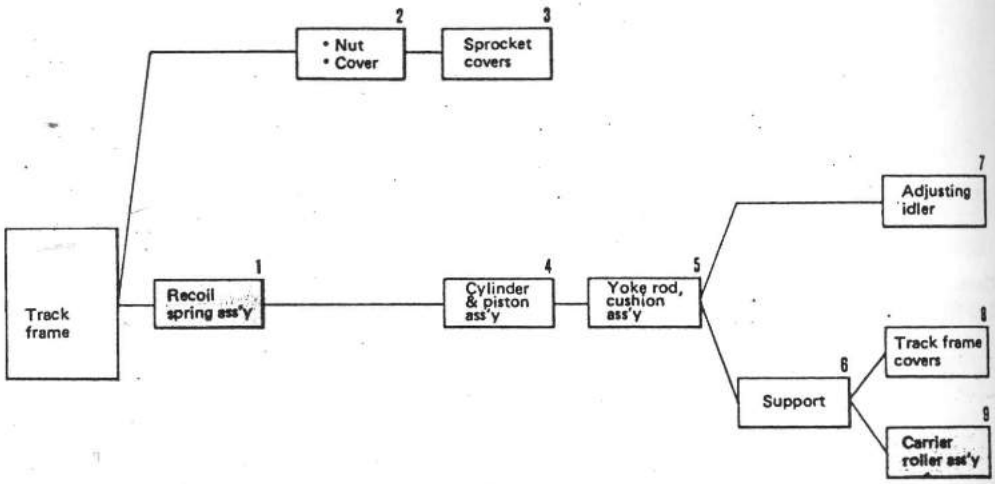
   kg Recoil spring: 165 kg



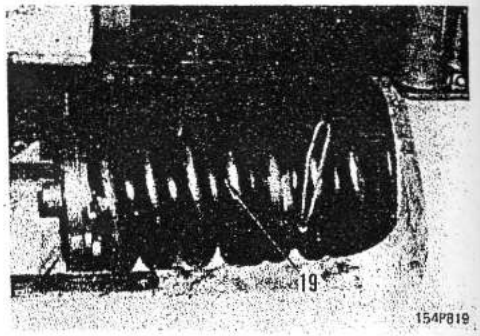
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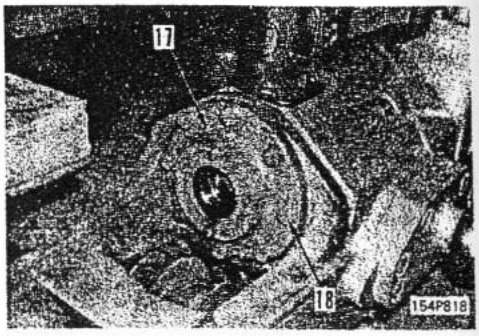
MOUNTING RECOIL SPRING ASSEMBLY



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.

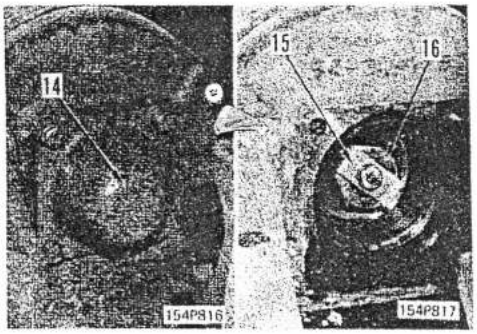


   2) Fit gasket on mounting face and mount cover (17). Tighten mounting bolts (18) in turn.

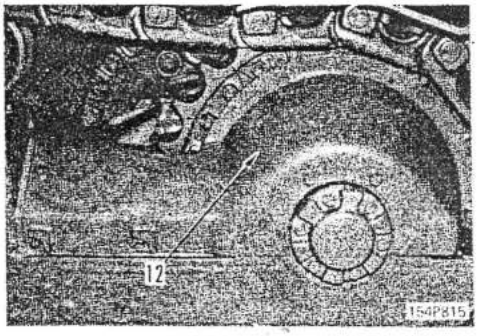


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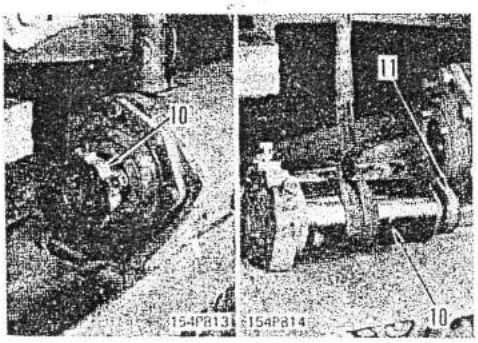
2. Nut, cover
   1) Confirm assembly position of nut (16), then secure in place with lock plate (15).
      ★ Tighten nut until it reaches position it was in at time of disassembly.
   2) Fit gasket and mount cover (14).



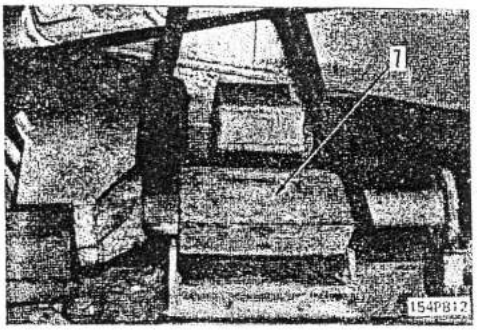
3. Sprocket covers
   Install sprocket covers (12) and (13).
   ★ Coat mounting bolts with thread tightener



4. Cylinder and piston assembly
   Hoist cylinder (10) and piston (11) as one unit.
   ★ Take care not to damage the seal ring.

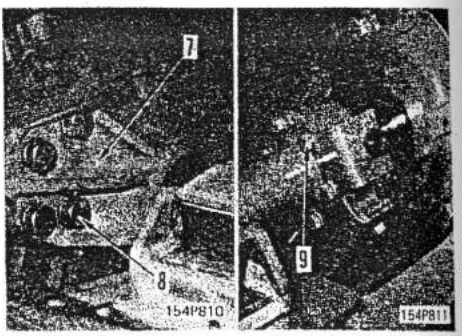


5. Yoke rod and cushion assembly
   1) Hoist yoke rod and cushion assembly (7) as one unit and align yoke rod pilot and pilot bore.

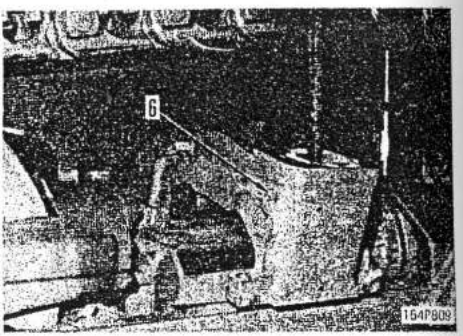


https://truckmanualshub.com/

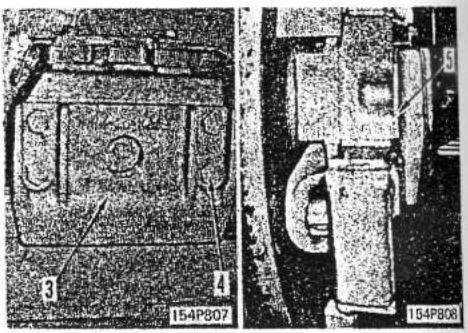
2) Fasten yoke rod and cushion assembly (7) with mounting bolts (8) and (9).



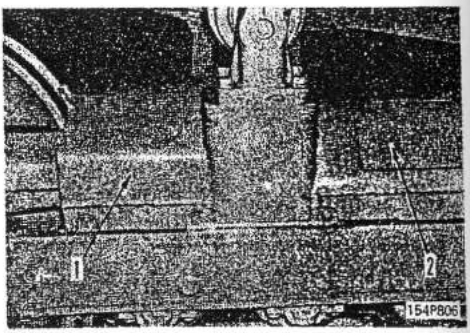
6. Support
   1) Hoist support (6) and install.
   2) Release jack position of equalizer bar.



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).

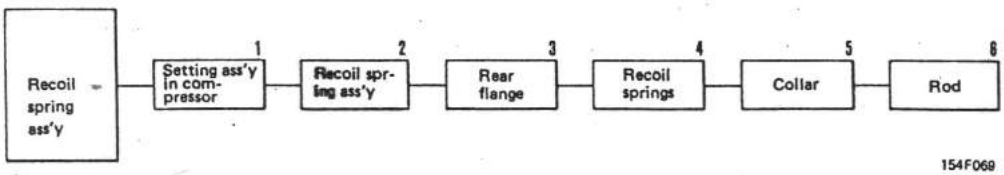


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9. **Mounting carrier roller assembly**
   See Section MOUNTING CARRIER ROLLER ASSEMBLY for mounting procedure.

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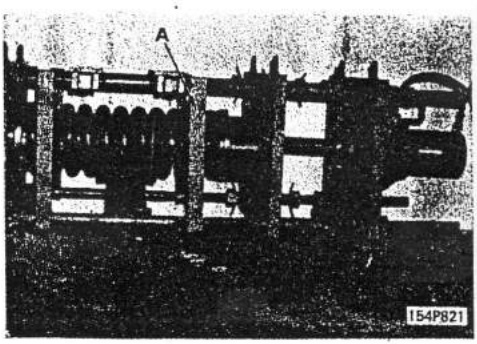
DISASSEMBLY OF RECOIL SPRING ASSEMBLY



Special tools required

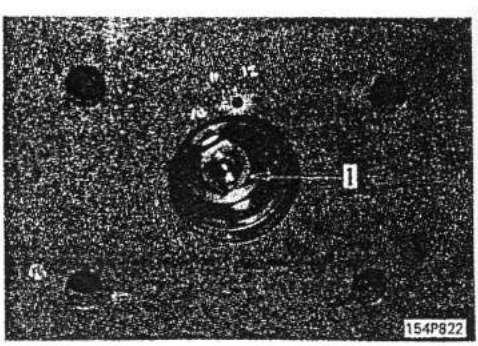
Part Name	A
Compressor	1
Cylinder (70 ton)	1
Pump	1

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.

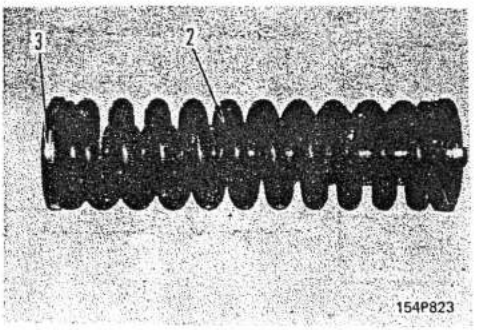
      kg Recoil spring assembly: 165 kg



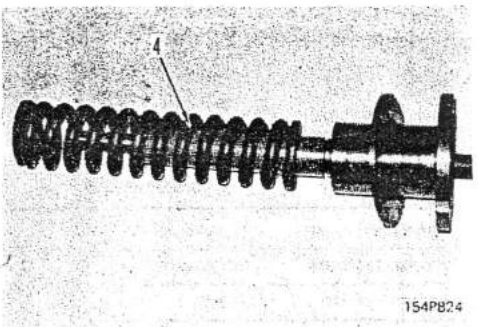
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2. **Recoil spring assembly**
   Release hydraulic pressure, and relieve spring tension. Remove recoil spring assembly (2) from compressor.

3. **Rear flange**
   Remove rear flange (3).

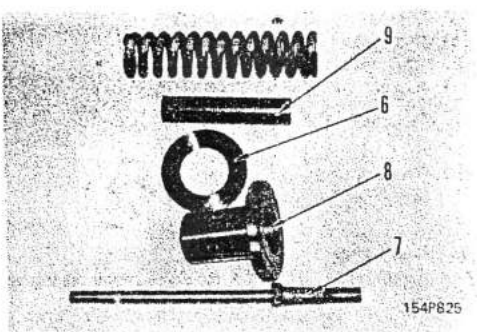


4. **Recoil springs**
   Remove recoil springs.



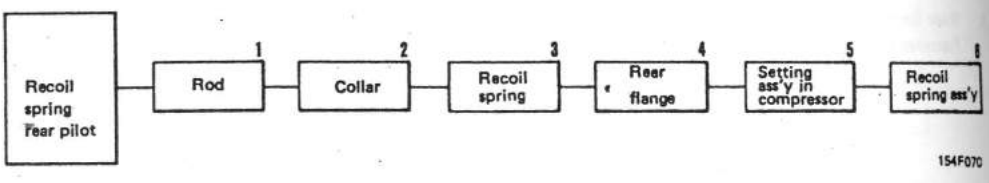
5. **Collar**
   Remove collar (6), flange (8) and guide (9).

6. **Rod**
   Remove rod (7).



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ASSEMBLY OF RECOIL SPRING ASSEMBLY



Special tools required

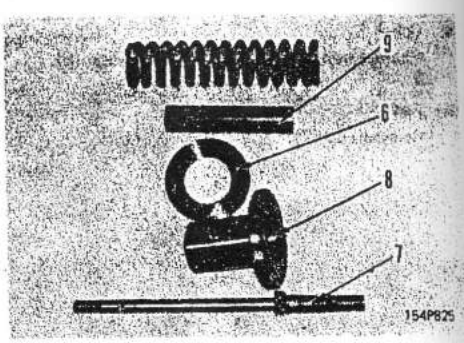
Part Name	A
Compressor	1
Cylinder (70 ton)	1
Pump	1

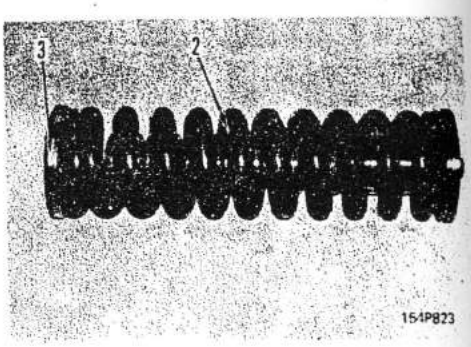
1. **Rod**
   Insert rod (7) into flange (8).

2. **Collar**
   Fit collar (6) over rod.

3. **Recoil springs**
   Install recoil springs.

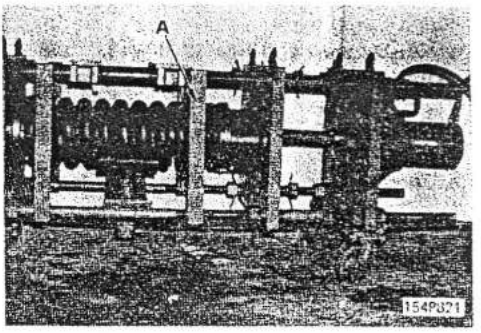
4. **Rear flange**
   Attach rear flange (3) to make recoil spring assembly (2).



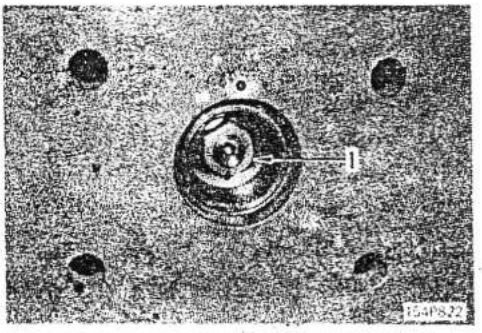


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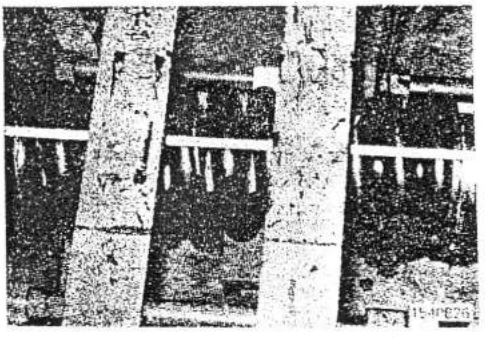
5. **Setting assembly in compressor**
   1) Set recoil spring assembly into compressor and attach cylinder pump.
      ★ Set with nut on opposite side from cylinder A.



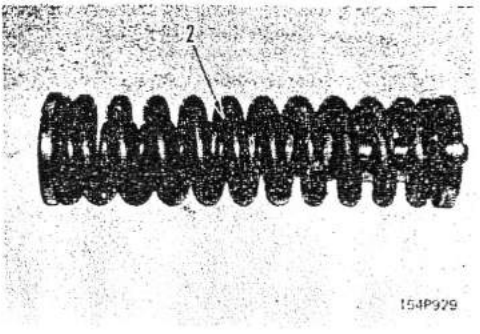
   2) Apply hydraulic pressure to cylinder and attach nut (1).



      ★ 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.



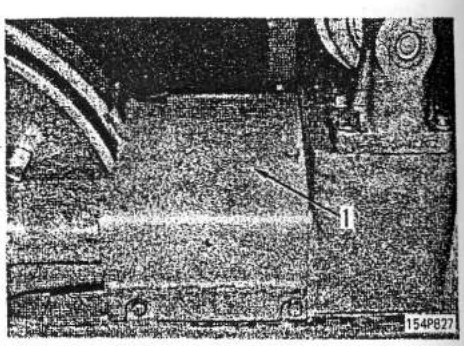
6. **Recoil spring assembly**
   Slowly release hydraulic pressure in cylinder, then remove recoil spring assembly (2) from compressor A.



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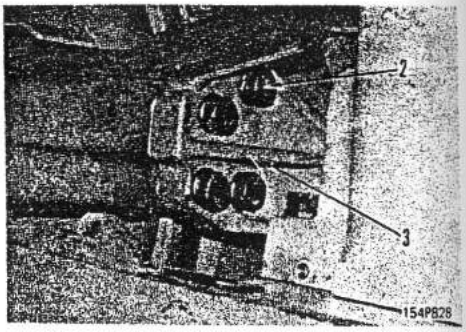
DISMOUNTING IDLER ASSEMBLY

1. See Section WORK EQUIPMENT DISASSEMBLY AND ASSEMBLY for dismounting 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).

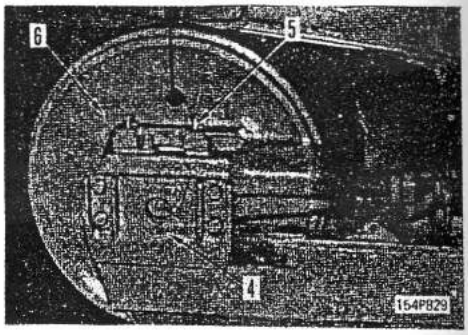
   Bolt: 55 ± 6.5 kg.m



5. Loosen mounting bolts of guide plate (4).
6. Loosen spring seat keep bolts (5).

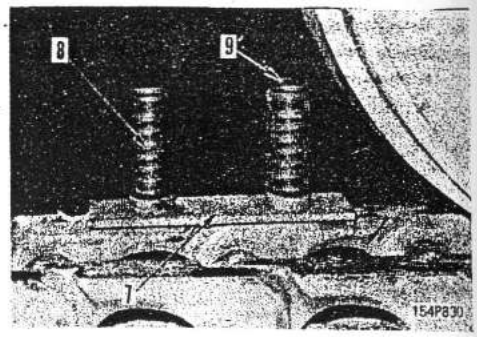
   Bolt: 55 ± 6.5 kg.m

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.

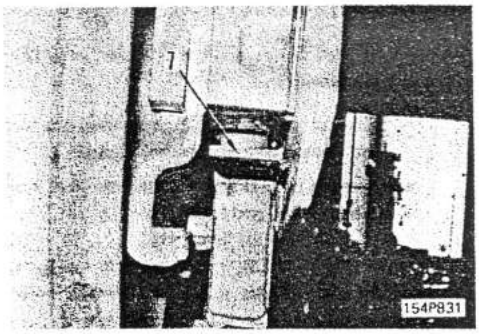
kg Idler assembly: 380 kg



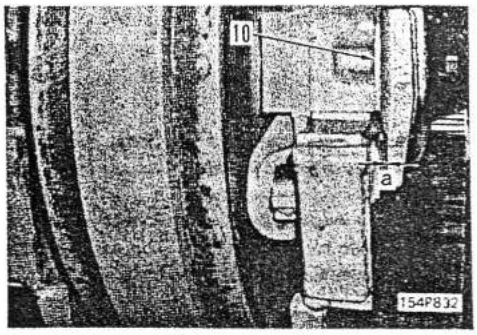
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MOUNTING IDLER ASSEMBLY

1. Slinging 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 os 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).



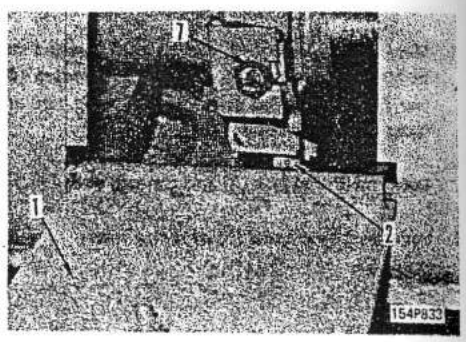
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DISMOUNTING TRACK ROLLER ASSEMBLY

1. Open inspection cover (1) and loosen plug (2) to relieve track tension.

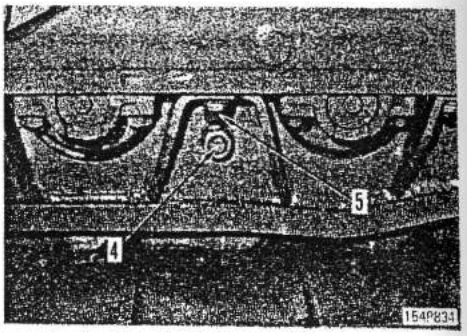
   ⚠ Do not loosen plug (2) more than one turn. Do not loosen any part except plug (2).

   ★ 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.

   kg Track roller guard: 47 kg

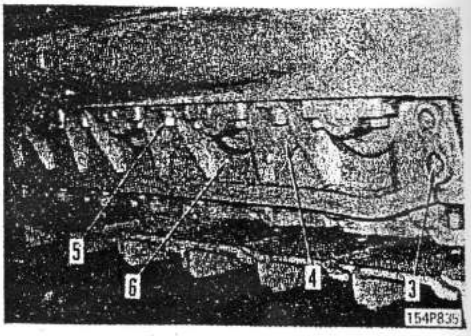


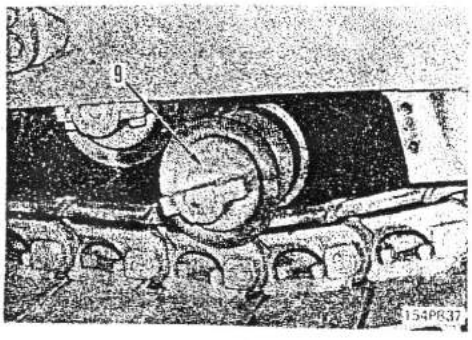
3. Remove mounting bolts (8) from the track roller assemblies to be dismounted.

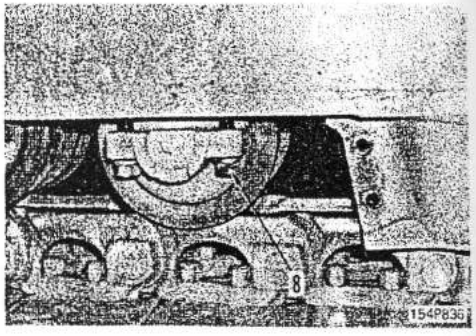
4. Raise the machine by backing it onto an approximately 300 mm high block 1 . This will leave the track roller assemblies resting on the links.

   ⚠ Be sure to lock brake after raising rear of machine.

5. Remove track roller assemblies (9).







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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.

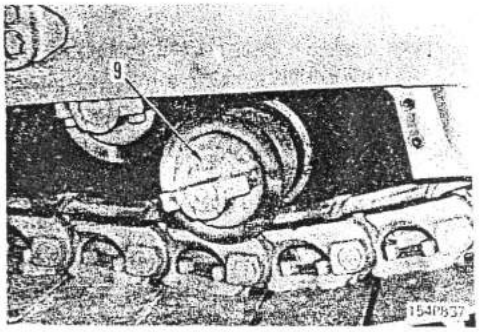
3. Drive machine forward until it is on the ground and tighten mounting bolts (8) securely to hold track roller assembly (9).
   ★ Coat bolts with thread tightener

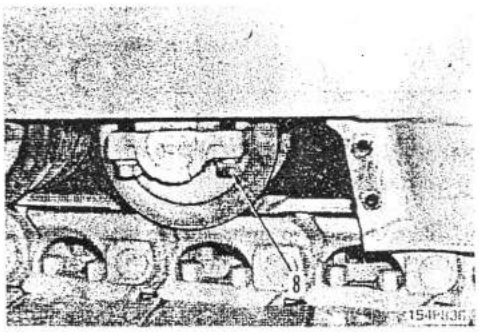
   Track roller: 80 ± 4.5 kg.m

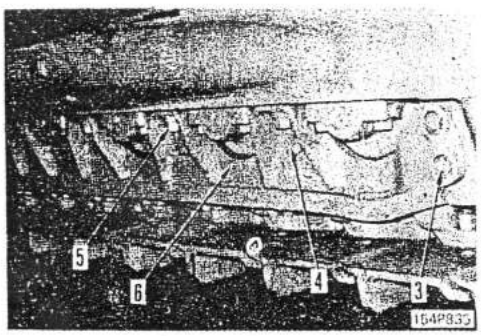
4. Install inner track roller guard (6) and outer track roller guard.
   ★ Insert guard tension bolts (4) from inside machine and tighten with nuts on outside.

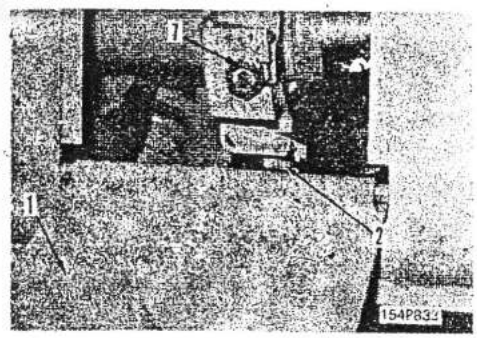
5. Install retainers (3).
   ★ Coat mounting bolts with thread tightener

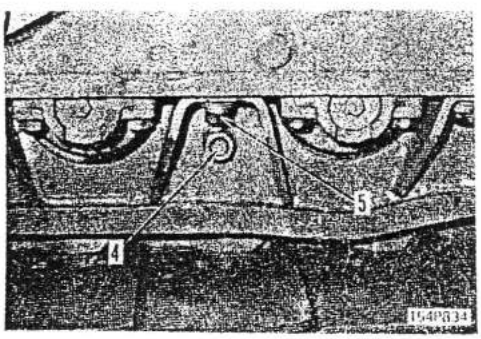
6. Open inspection cover (1) and pump grease through grease fitting of lubricator (7) to adjust track tension.
   ★ Place a strightedge on idler and front carrier roller. Adjust tension so that there is a clearance of 30 to 40 mm between tip of grouser and middle of straightedge.
   ★ When adjusting 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.











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DISMOUNTING CARRIER ROLLER ASSEMBLY

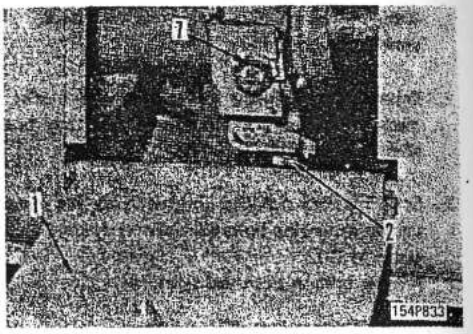
1. Open inspection cover (1) and loosen plug (2) to relieve track tension.

   ⚠ 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.

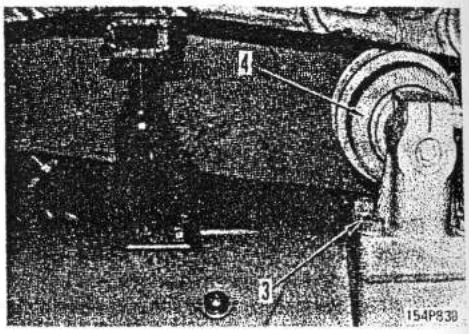


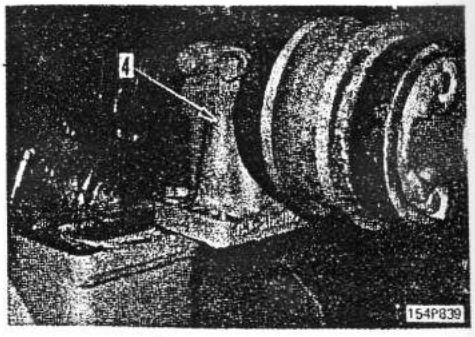
MOUNTING CARRIER ROLLER ASSEMBLY

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.



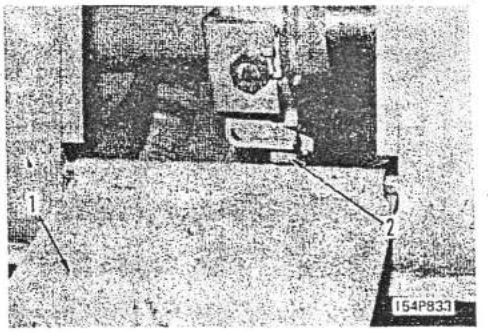


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SEPARATION OF TRACK

Special tools required

Part Name	A
Remover & Installer	1
Pump	1
Cylinder (100 ton)	1

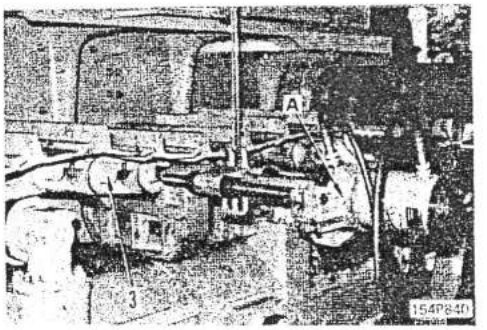


1. See Section WORK EQUIPMENT DISASSEMBLY AND ASSEMBLY for dismounting procedure.

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.

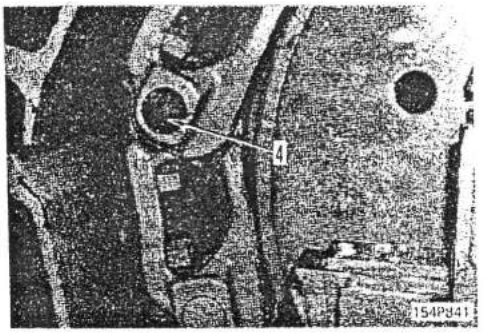


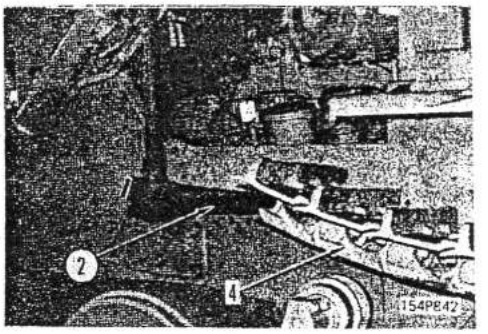
3. Start engine and position master pin between carrier rollers. Use special tool (A) to remove master pin.
   ★ Sling tool with crane.

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.



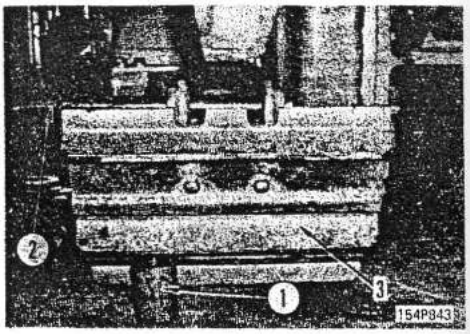


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CONNECTION OF TRACK

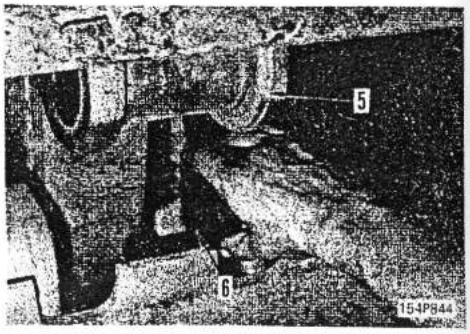
1. Insert bar 2 into last link of track. Move machine slowly forward until track winds round sprocket. Hoist bar with crane and move machine slowly forward until track is fully installed along track frame.

   ⚠ 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).

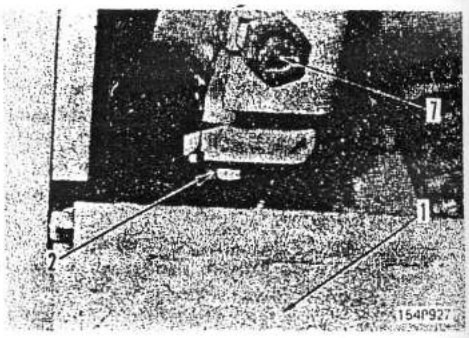
3. Back up machine until temporary pin is positioned between carrier rollers. Using special tool A, force-fit master pin.
   - ★ Hoist tool with crane.
   - ★ Fit master pin so that ends protrude equal distance from both sides of links.



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.

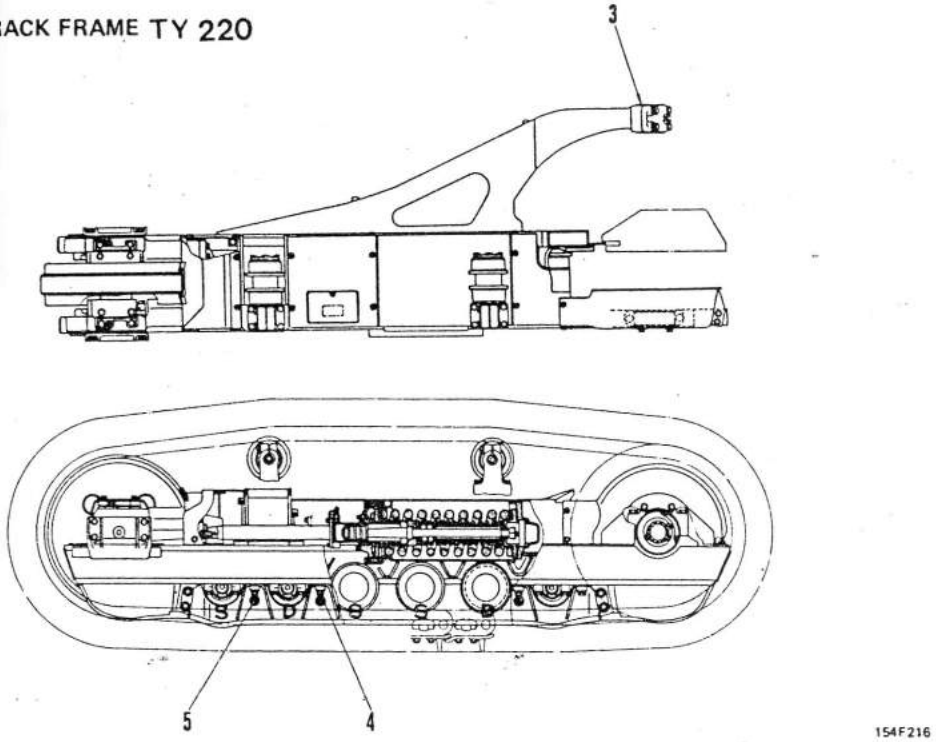


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MAINTENANCE STANDARD

UNDERCARRIAGE

(1) TRACK FRAME TY 220



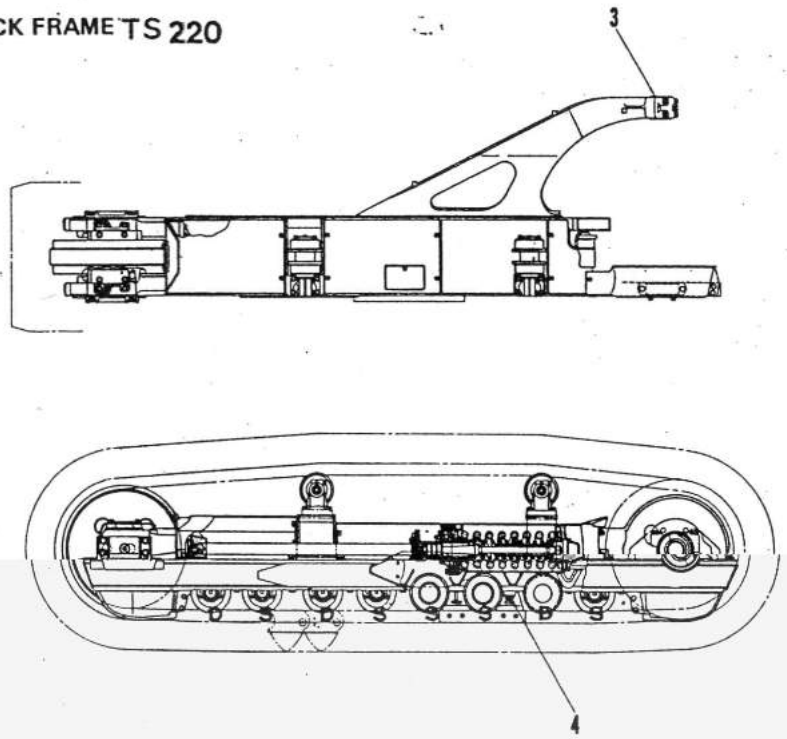
154F216

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 real 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				

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(1) TRACK FRAME TS 220



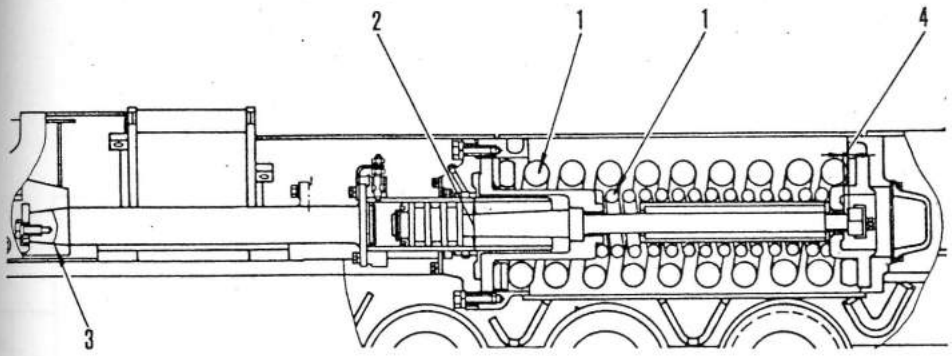
154F217

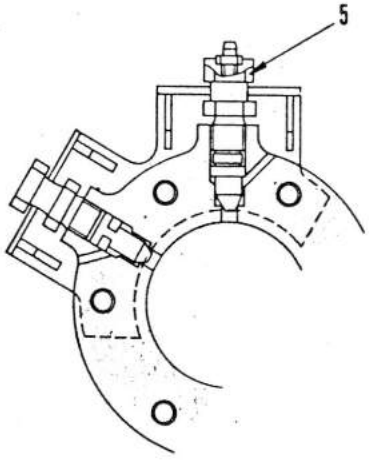
Unit: mm

No.	Check item	Criteria	Remedy
1	Deformation of track frame	Item: Bent — Repair limit: 7 (at length of 100) Item: Torsion — Repair limit: 3 (at length of 300) Item: Opening at idler — Repair limit: 5	Repair or replace
2	Center distance between right and left track frames	Standard size: 2250 — Repair limit: Front and real difference: within 15	Repair or replace
3	Clearance between sprocket shaft and diagonal brace bushing	Standard size: 90 — Tolerance: Shaft −0.036 −0.071, Hole +0.035 0 — Standard clearance: 0.036 ~ 0.106 — Clearance limit: 0.5	Replace
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	Adjust

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(2) RECOIL SPRING





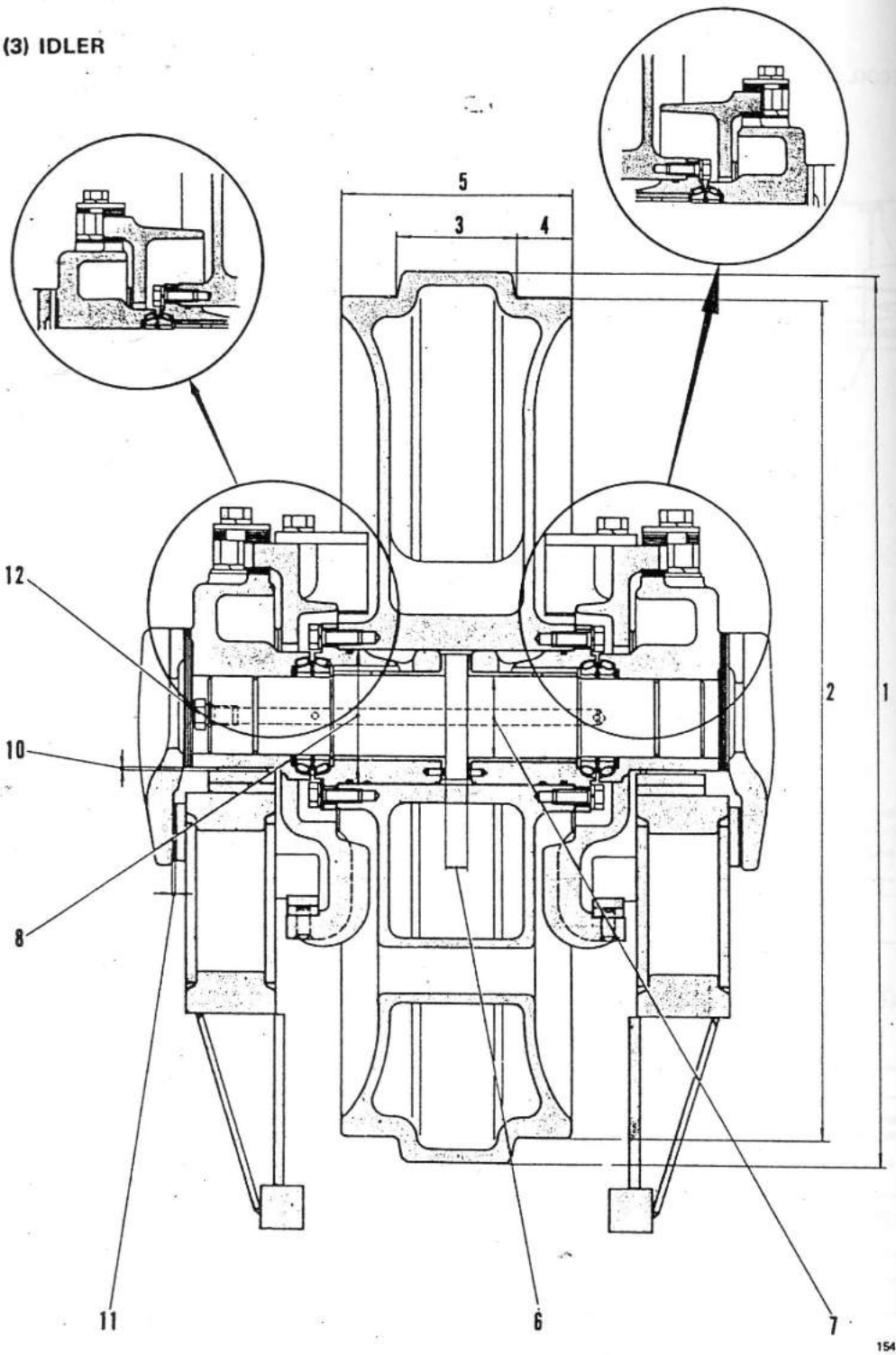
154F218

Unit: mm

No	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Recoil spring	Free length x O.D	Install length	Install load	Free length	Repair limit	Replace
		(large) 817x237 (small) 530x128	665 435	17,130 kg 3,250 kg		15,400 kg 2,900 kg	
		Standard size	Tolerance		Standard clearance	Clearance limit	
2	Clearance between adjust sylinder and bushing		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						

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(3) IDLER



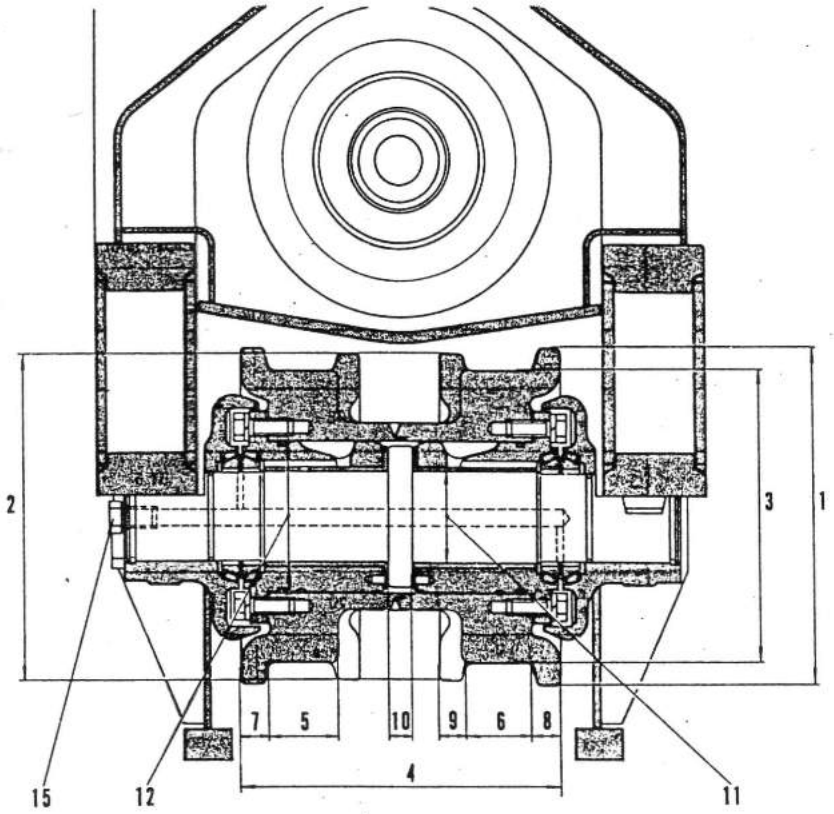
https://truckmanualshub.com/

Unit: mm

No.	Check item	Criteria				Remedy
1	Outer dia. of protrusion	Standard size: 774		Repair limit: 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: Shaft −0.210 −0.260 / Hole +0.130 +0.060	Standard clearance: 0.270 ~ 0.390	Clearance Limit: 1.5	
8	Interference of outer bushing and idler	Standard size: 115	Tolerance: Shaft +0.094 +0.040 / Hole +0.07 −0.05	Standard interference: −0.03 ~ 0.144	Allowable interference: −0.35	
9	Play at axial direction of shaft	Standard clearance: 0.27 ~ 0.39		Clearance limit: 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 (GO 140)				Filling oil

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(4) TRACK ROLLER



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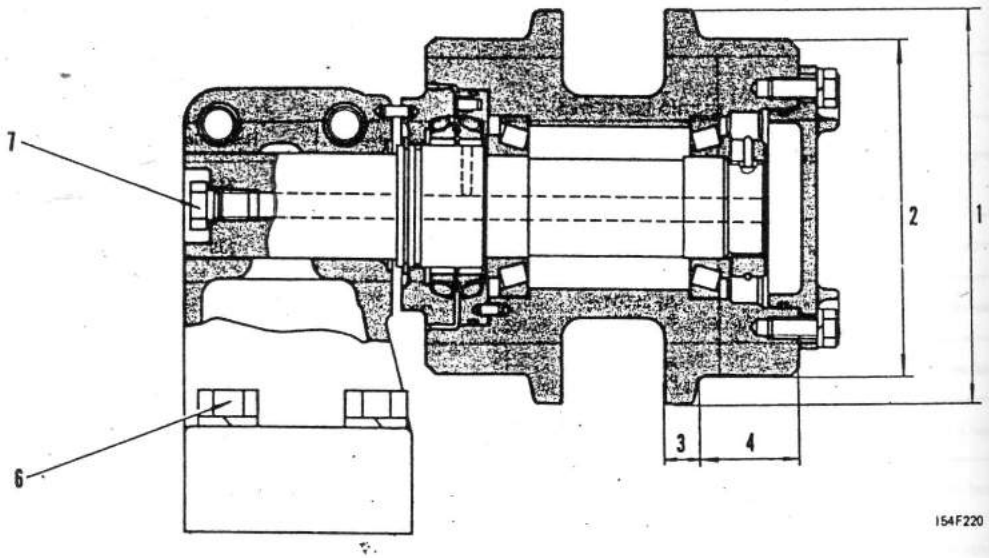
https://truckmanualshub.com/

Unit: mm

No.	Check item	Criteria	Remedy
1	Flange (outside) outer dia.	Standard size: 257 / Repair limit: 247	
2	Flange (inside) outer dia.	249 / 239	Build-up welding or replace
3	Tread outside dia.	222 / 198	
4	Total 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	Replace
11	Clearance between shaft and bushing	Standard size: 70; Tolerance: Shaft −0.210 −0.260, Hole +0.130 +0.100; Standard clearance: 0.31~0.39; Clearance limit: 1.0	
12	Interference between outer bushing and roller	Standard size: 115; Tolerance: Shaft +0.094 +0.040, Hole +0.027 −0.027; Standard interference: 0.013 ~ 0.121; Allowable interference: −0.35	
13	Play at axial direction of shaft	Standard clearance: 0.40 ~ 0.80 / Clearance limit: 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

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(5) CARRIER ROLLER

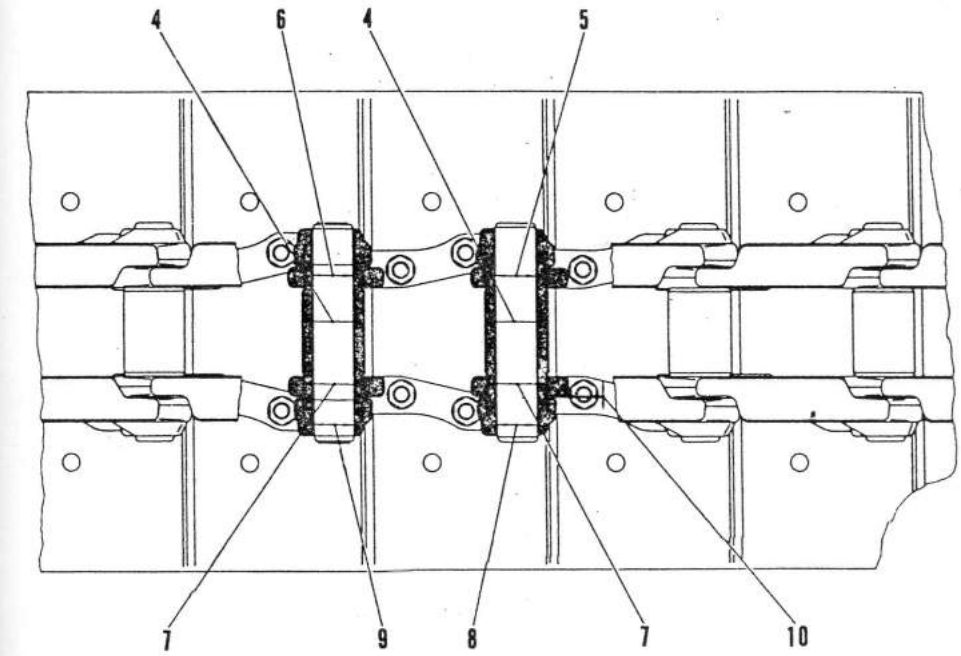


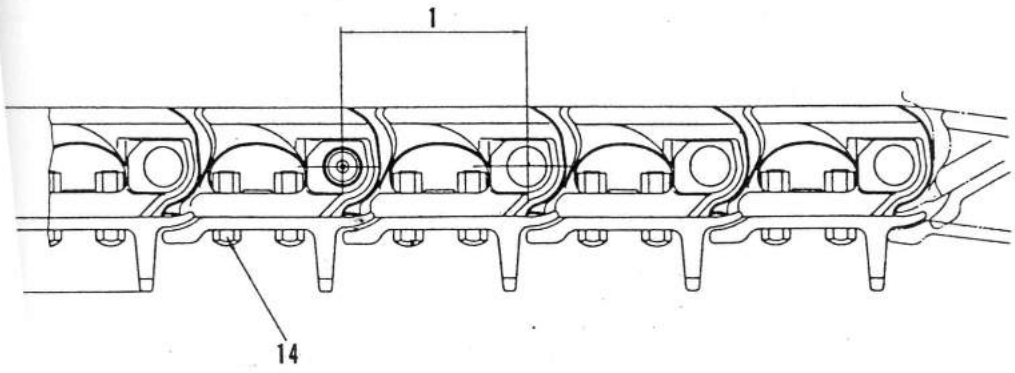
Unit: mm

No.	Check item	Criteria		Remedy
1	Flange outside dia.	Standard size: 217	Repair limit: 207	Build-up welding or replace
2	Tread outside dia.	185	166	
3	Flange width	19	10	
4	Tread width	57	66	
5	Play at axial direction of shaft	Standard clearance: 0.10 ~ 0.13	Clearance limit: 0.2	Nut adjust or bearing replace
6	Tightening torque of support mounting bolt	56 ± 6 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

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(6) TRACK (SHOE) TY 220





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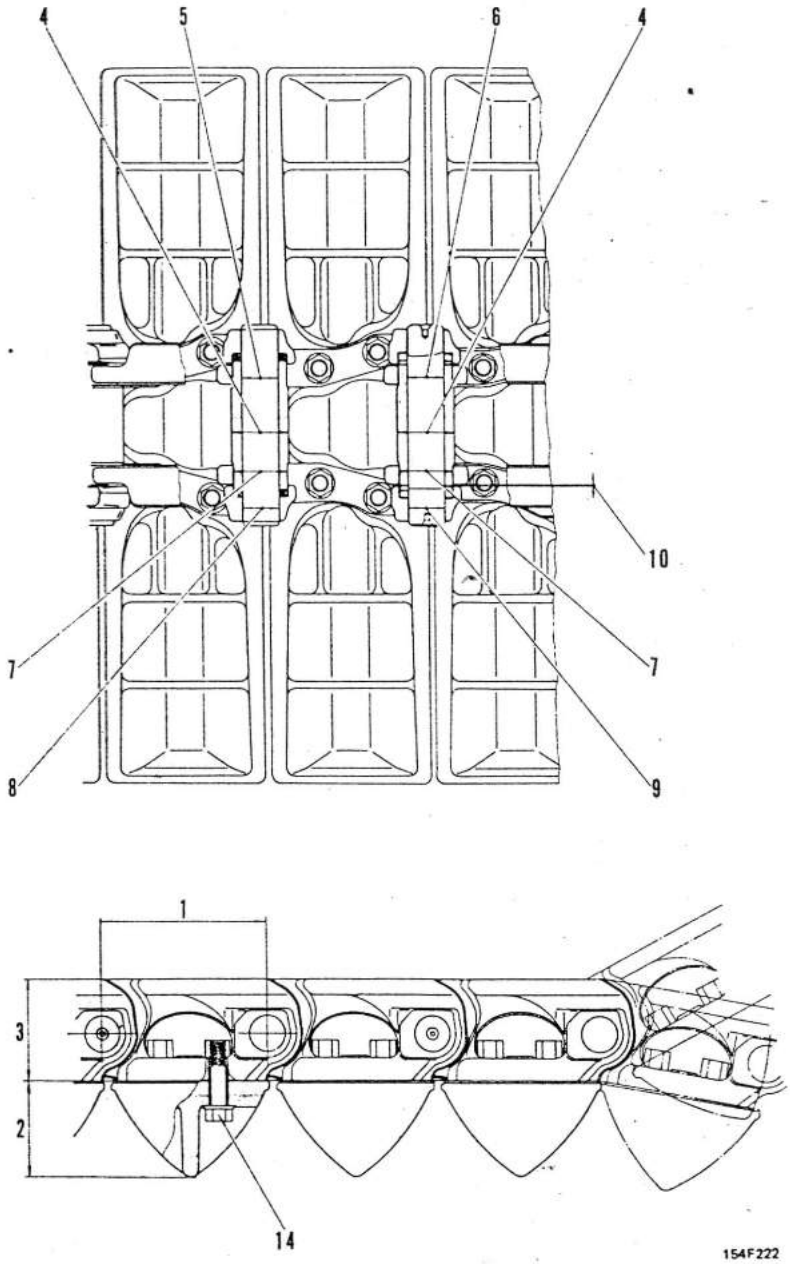
https://truckmanualshub.com/

Unit: mm

No.	Check item	Criteria					Remedy
1	Link pitch	Standard size: 216.25			Repair limit: 219.25 (Impact loading) 221.25 (Normal loading)		Reverse or replace
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: 47	Tolerance: Shaft +0.185 +0.085	Tolerance: Hole +0.915 +0.415	Standard clearance: 0.230 ~ 0.830	Clearance limit	Replace
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: 71	Tolerance: Shaft +0.344 +0.304	Tolerance: Hole +0.074 0	Standard interference: 0.230 ~ 0.344	Allowable interference: 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: (one side) 0 ~ 1.1 (each side) 0 ~ 2.2			Clearance limit: 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	13.3 ~ 22.1 ton					
14	Tightening torque of shoe bolt	76 ± 6 kg.m					

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(6) TRACK (SHOE) TS 220



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Unit: mm

No.	Check item	Criteria				Remedy
1	Link pitch	Standard size: 216.25		Repair limit: 219.25		Reverse or replace
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: 47	Tolerance: Shaft +0.185 +0.085; Hole +0.915 +0.415	Standard clearance: 0.230 ~ 0.830	Clearance limit:	Replace
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: 71	Tolerance: Shaft +0.344 +0.304; Hole +0.074 0	Standard interference: 0.230 ~ 0.344	Allowable interference: 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	+0.230 +0.200	+0.062 0	0.138 ~ 0.230	0.138
10	Clearance between link joint surface	Standard clearance: (one side) 0 ~ 1.1 (each side) 0 ~ 2.2		Clearance limit: 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	13.3 ~ 22.1 ton				
14	Tightening torque of shoe bolt	76 ± 6 kg.m				

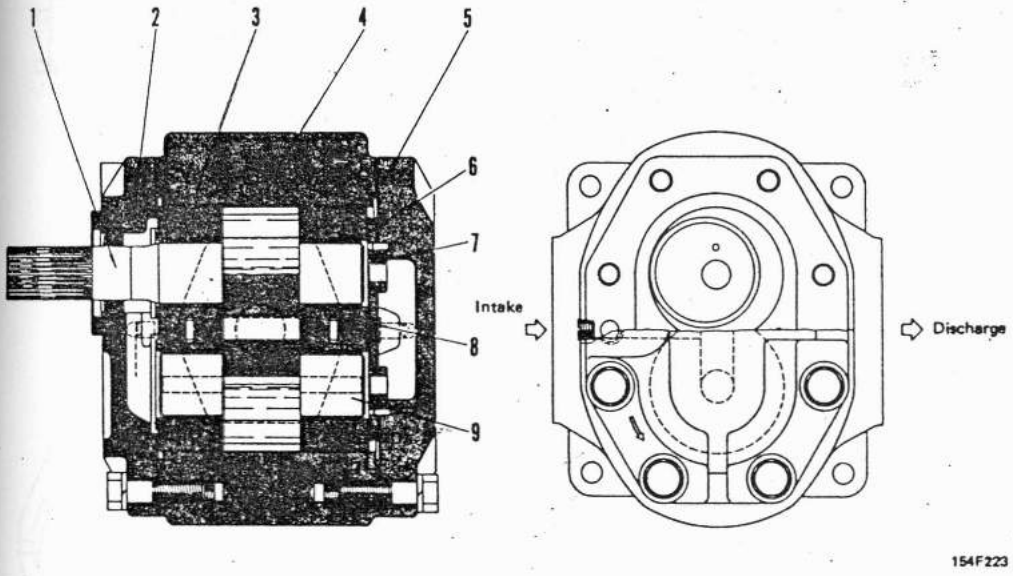
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HYDRAULIC CONTROL

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STRUCTURE AND FUNCTION

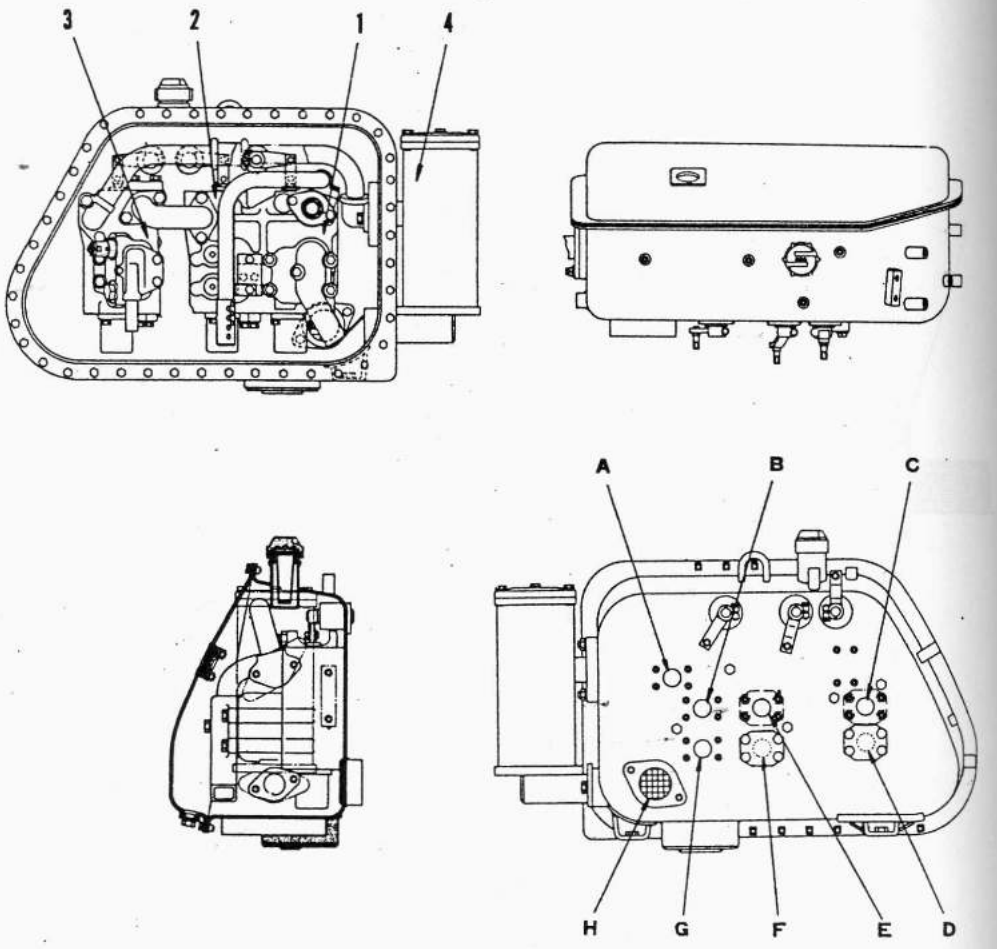
HYDRAULIC PUMP



1. Drive gear
2. Bracket
3. Bushing
4. Gear case
5. Cover
6. Seal plate
7. Collar
8. Backup ring
9. Driven gear

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HYDRAULIC TANK



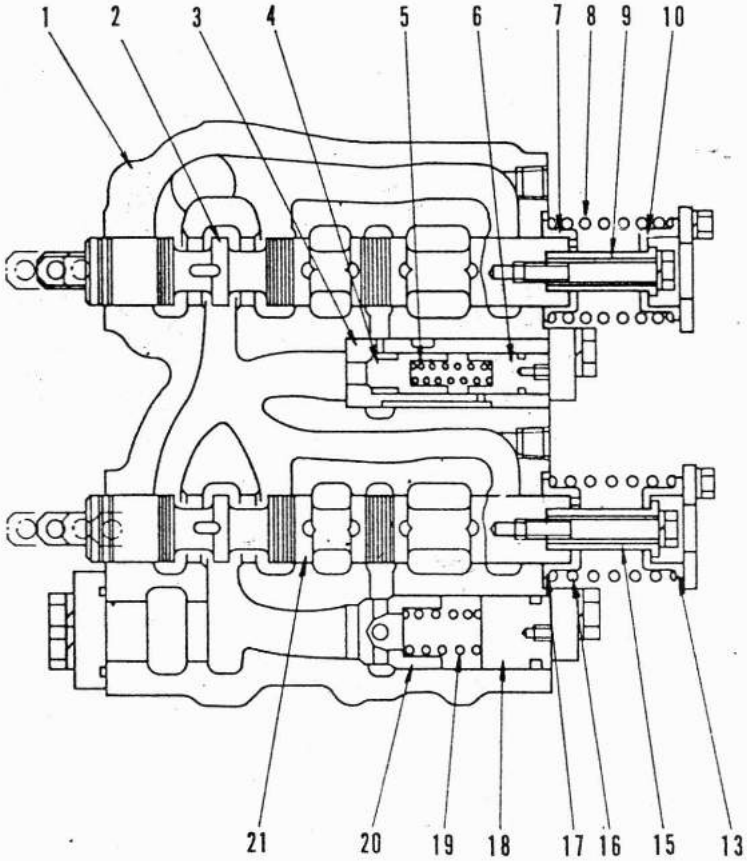
1. Brade lift control valve
2. Brade tilt control valve
3. Ripper control valve
4. Hydraulic filter

A. From pump
B. To Brade 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. Brade cylinder head side (raise)
H. To pump

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HYDRAULIC CONTROL VALVE

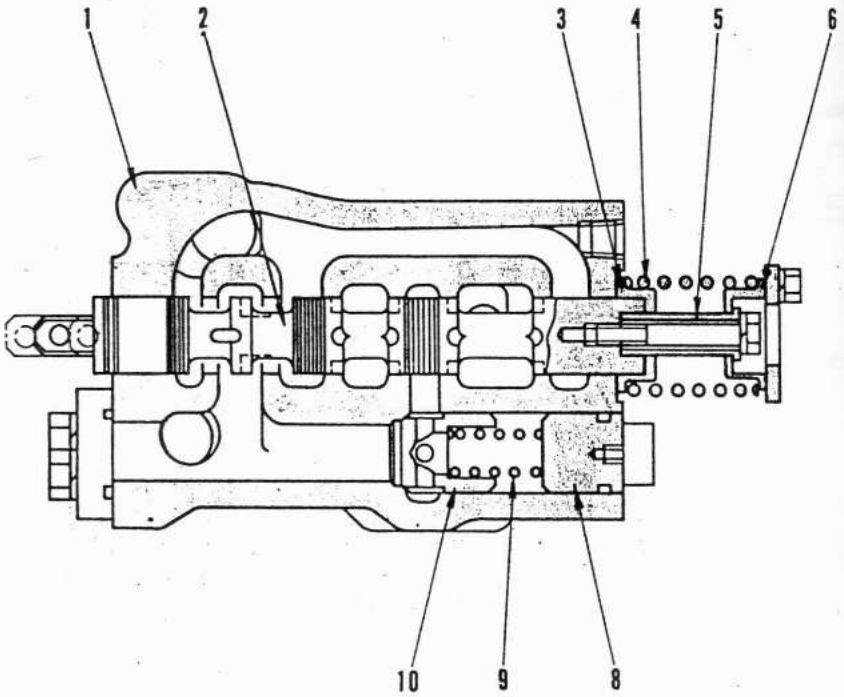
(1) BLADE LIFT AND TILT CONTROL VALVE



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

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(2) RIPPER CONTROL VALVE TY 220

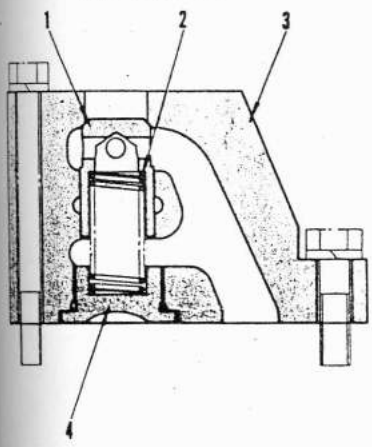


1. Valve body
2. Spool
3. Retainer
4. Spring
5. Collar
6. Retainer
8. Seat
9. Spring
10. Check valve

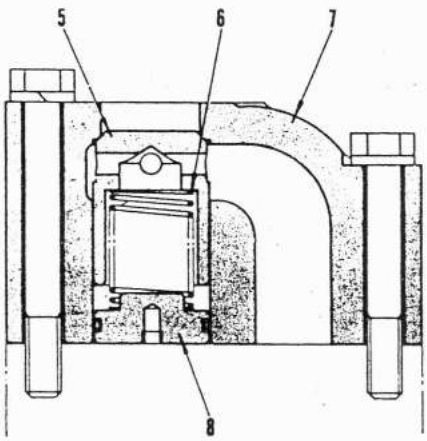
https://truckmanualshub.com/

(3) MAIN RELIEF, SUCTION, SAFETY VALVE

Ripper suction valve

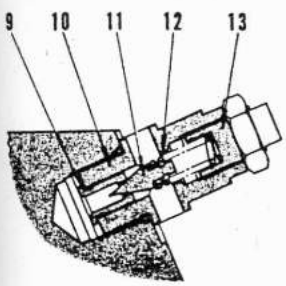


Blade suction valve

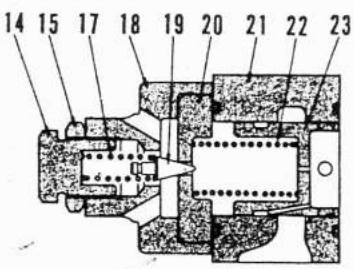


Main relief valve

Ripper safety valve



1. Ripper suction valve
2. Spring
3. Valve body
4. Plug seat
5. Plate 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

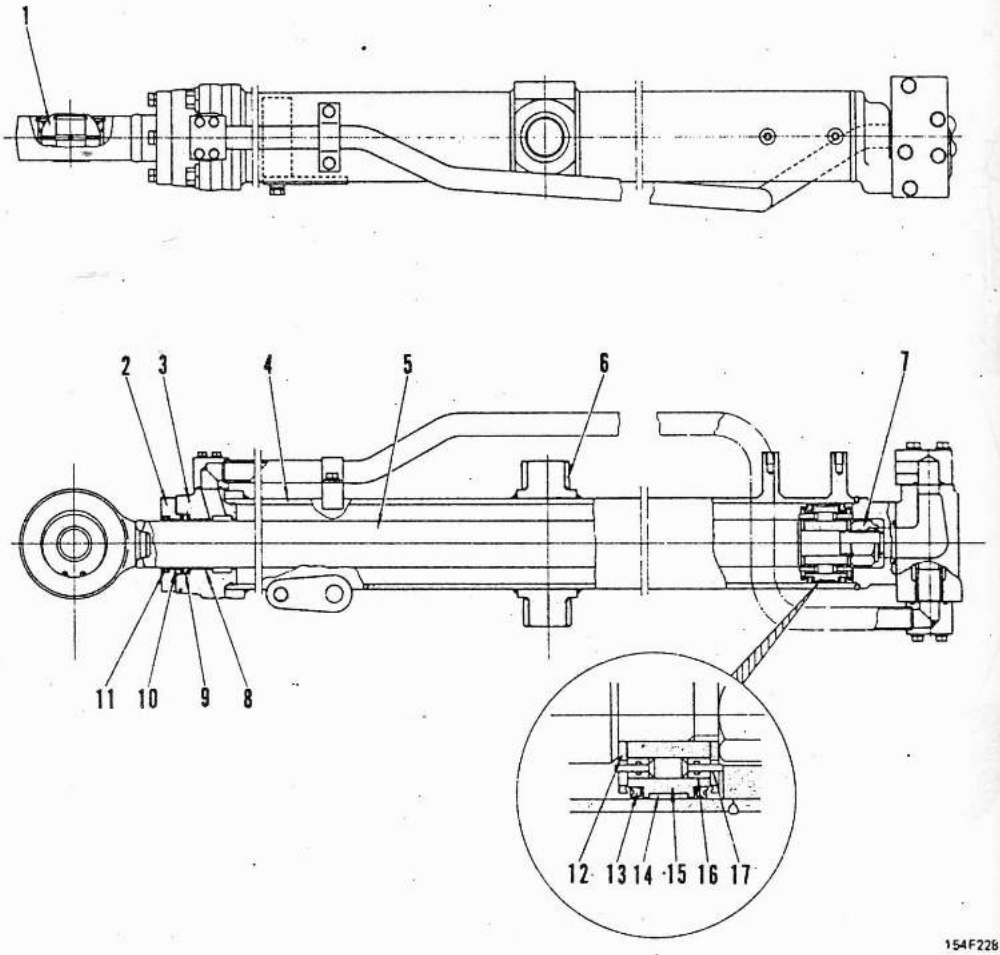


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HYDRAULIC CYLINDER

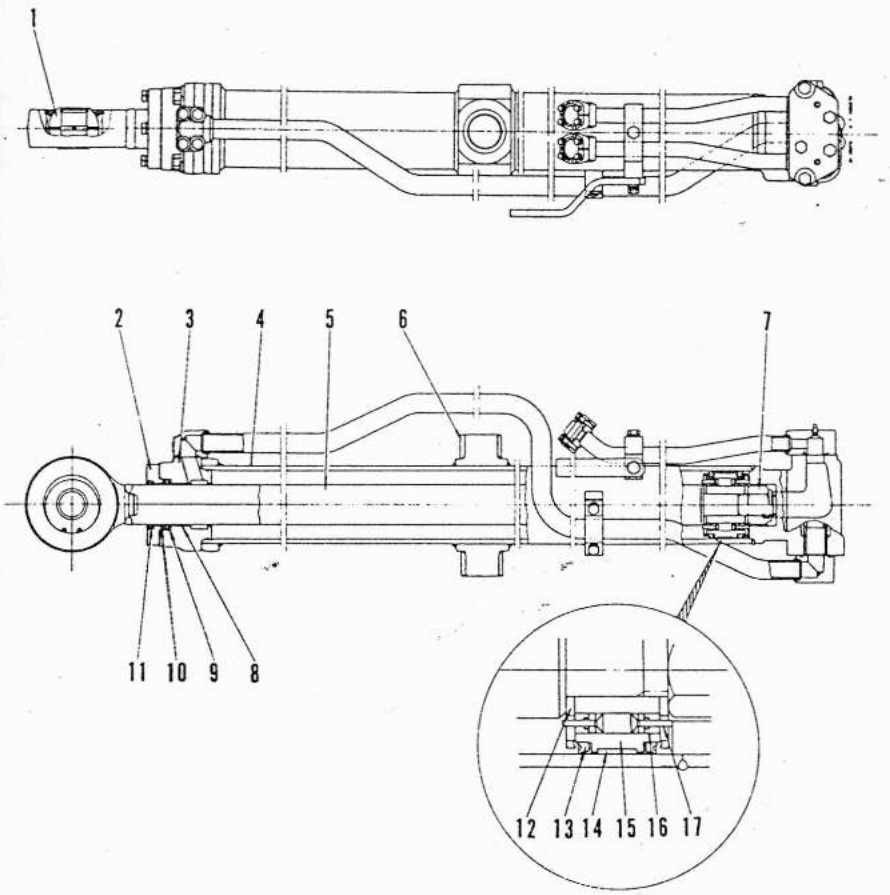
(1) BLADE LIFT CYLINDER TY 220



1. Bushing
2. Gland
3. Cylinder head
4. Cylinder
5. Piston rod
6. Bushing
7. Nut
8. Bushing
9. Packing
10. Bushing
11. Dust seal
12. Retainer
13. Packing
14. Wear ring
15. Piston
16. Valve seat
17. Piston valve

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(1) BLADE LIFT CYLINDER TS 220

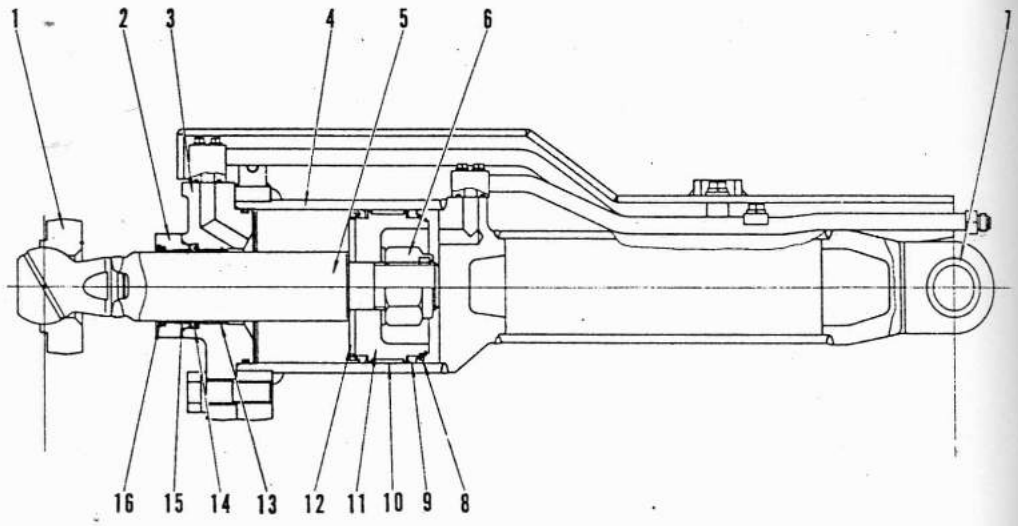


154F229

1. Bushing
2. Gland
3. Cylinder head
4. Cylinder
5. Piston rod
6. Bushing
7. Nut
8. Bushing
9. Packing
10. Bushing
11. Dust seal
12. Retainer
13. Packing
14. Wear ring
15. Piston
16. Valve seat
17. Piston valve

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(2) BLADE TILT CYLINDER

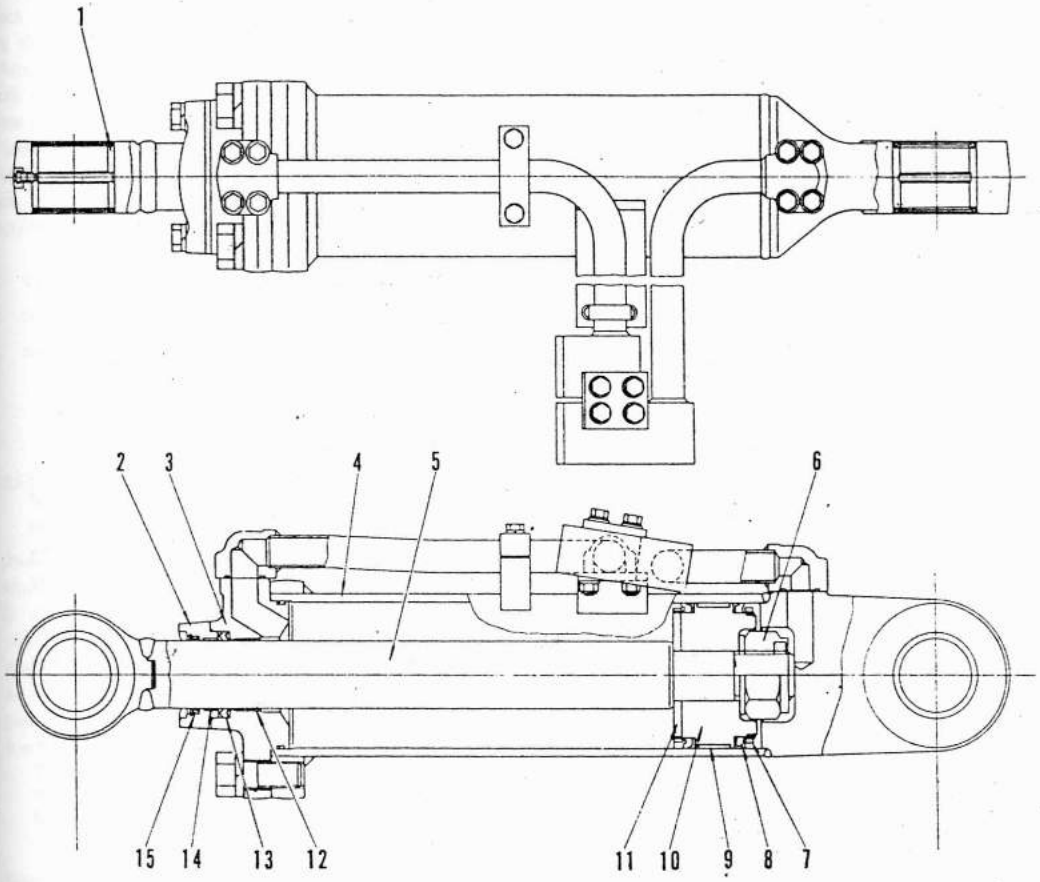


154F230

1. Cap
2. Gland
3. Cylinder head
4. Cylinder
5. Piston rod
6. Nut
7. Bushing
8. Retainer
9. Packing
10. Wear ring
11. Piston
12. Retainer
13. Bushing
14. Packing
15. Bushing
16. Dust seal

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(3) RIPPER CYLINDER TY 220



154F231

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

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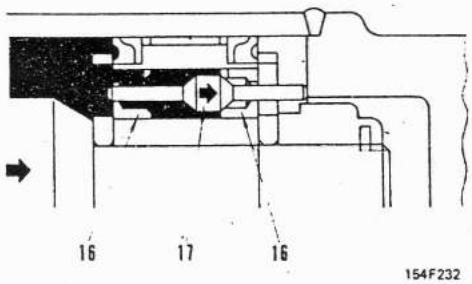
PISTON VALVE

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 relief 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.

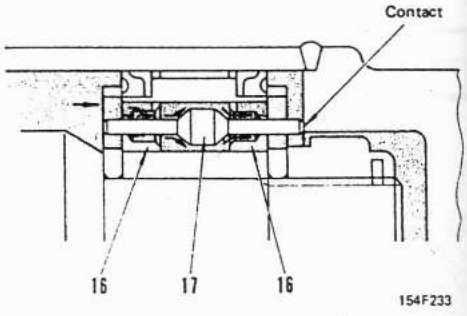
OPERATION

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 ➡ direction, thus sealing the taper part of the piston valve seat (16), the pressure in the cylinder will rise, causing the piston rod (5) to move the ➡ direction.

2. During piston valve operation



Just before the piston rod (5) 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.

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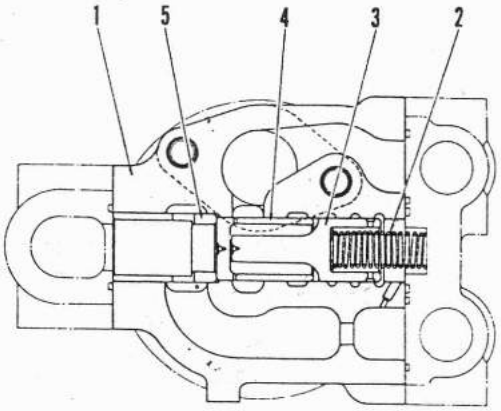
QUICK DROP VALVE

STRUCTURE

A 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 time loss until the digging operation starts.

The blade lowering speed is decided by pump discharge volume, thus greater lowering speed can be obtained by installation of the quick drop valve.

1. Valve body
2. Spring
3. Spool
4. Check valve
5. Collar



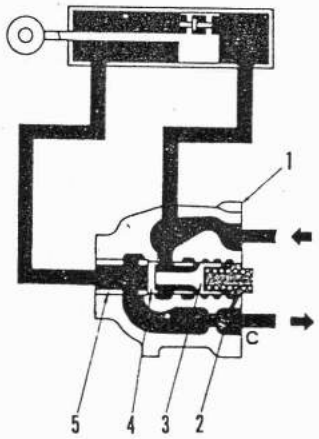
154F234

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.



154F272

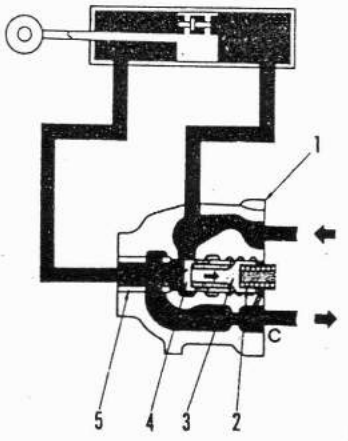
2. When blade is lowering:

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 sjde, 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.

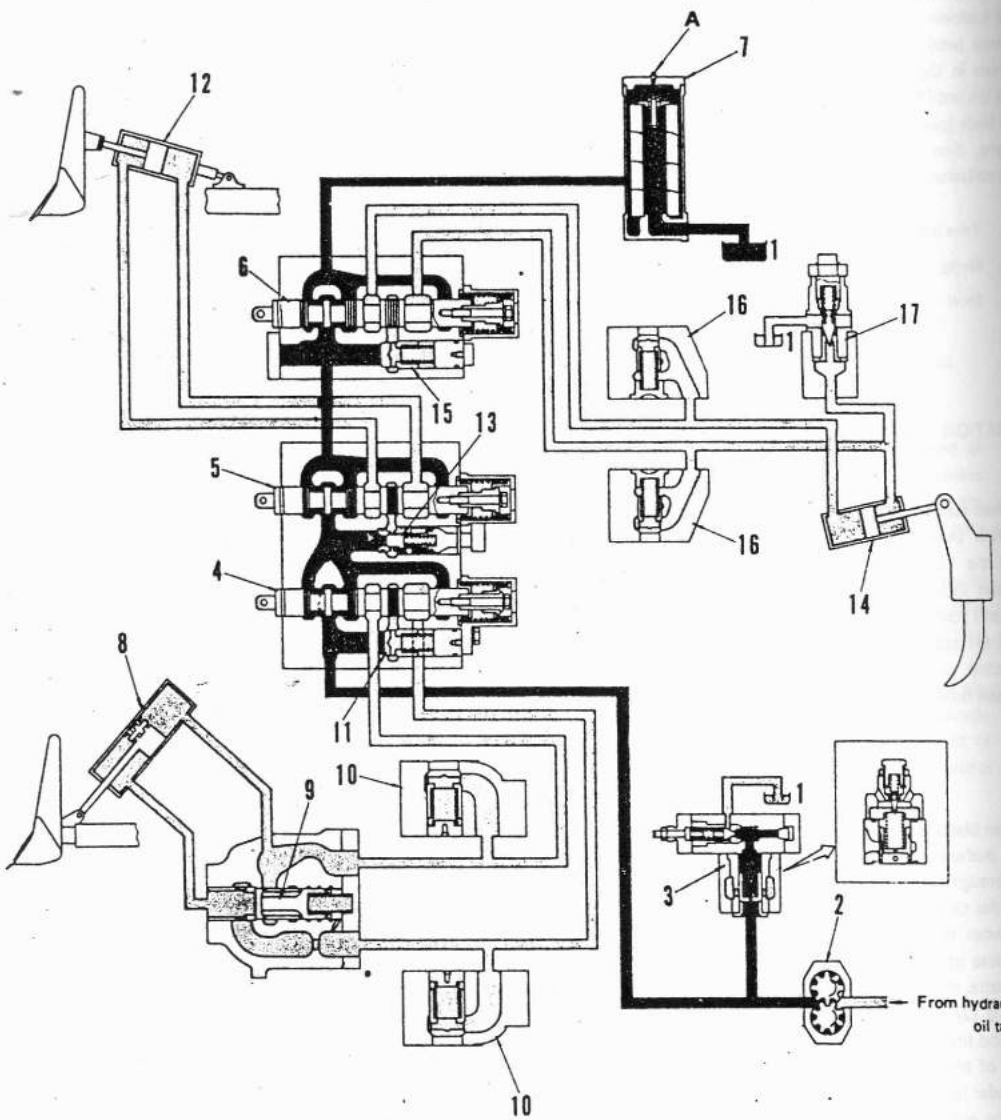
As seen from the above explanation the blade lowering speed is increased, with installation of the quick drop valve, because oil flows into the cylinder side, resulting in reducing the vacuum produced inside the cylinder bottom.



154F273

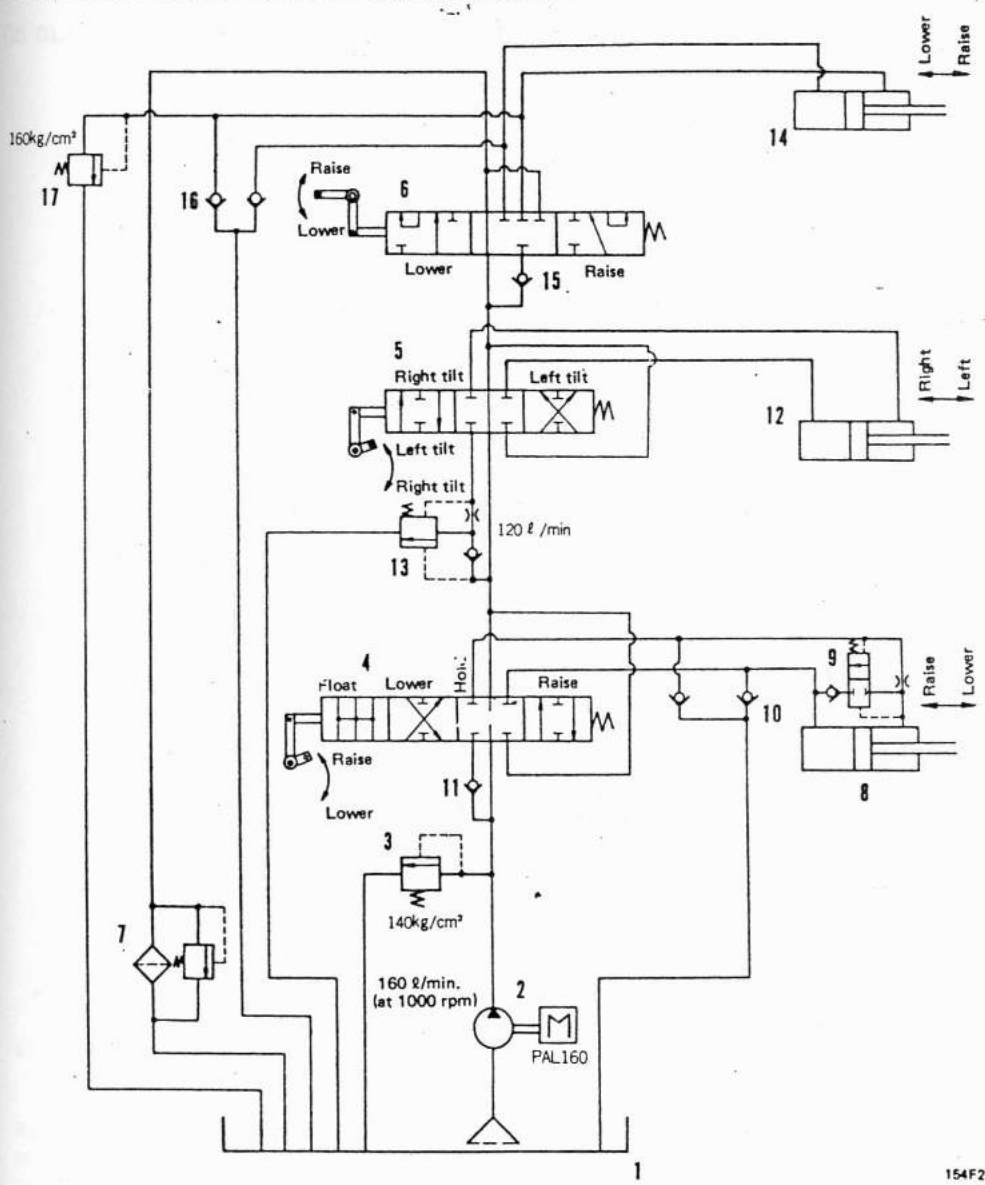
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WORK EQUIPMENT HYDRAULIC SYSTEM



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WORK EQUIPMENT HYDRAULIC CIRCUIT



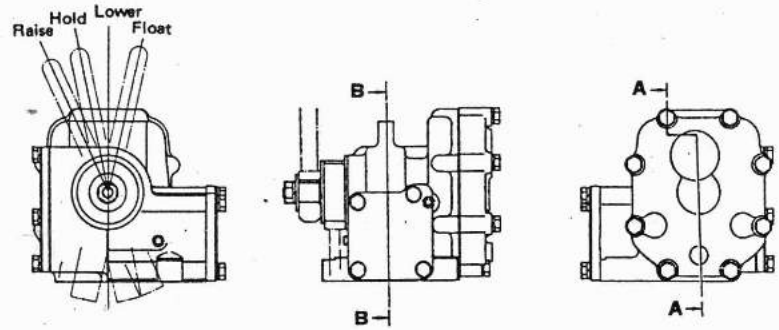
1. Hydraulic oil tank
2. Hydraulic pump (PAL160)
3. Main relief valve
4. Blade lift valve
5. Blade tilt valve
6. Ripper valve
7. Oil filter
8. Blade lift cylinder
9. Quick drop valve
10. Suction valve
11. Check valve
12. Blade tilt cylinder
13. Flow check valve
14. Ripper cylinder (only A)
15. Check valve
16. Suction valve
17. Rippen safety valve

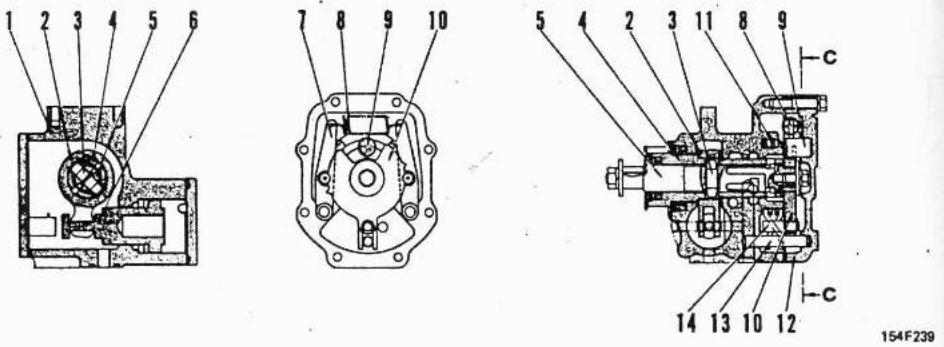
A. Main relief pressure output plug

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ROTARY SERVO VALVE

(1) BLADE LIFT



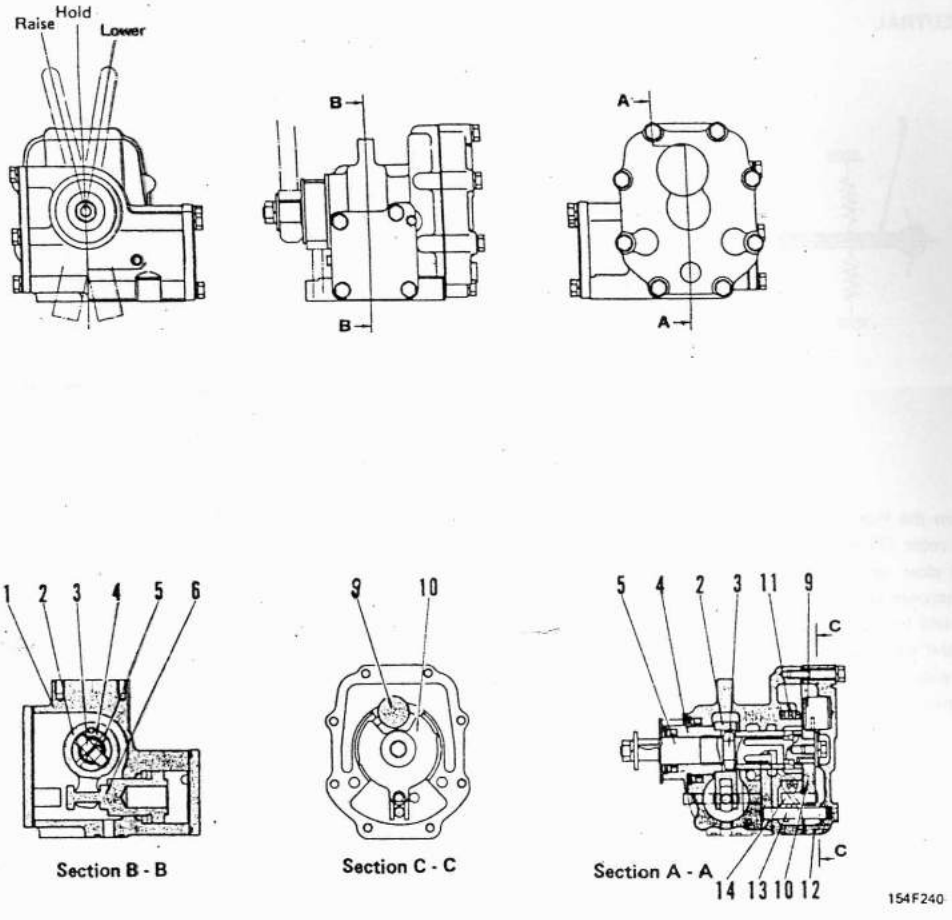


154F239

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

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(2) BLADE TILT & RIPPER (TY 220)



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.

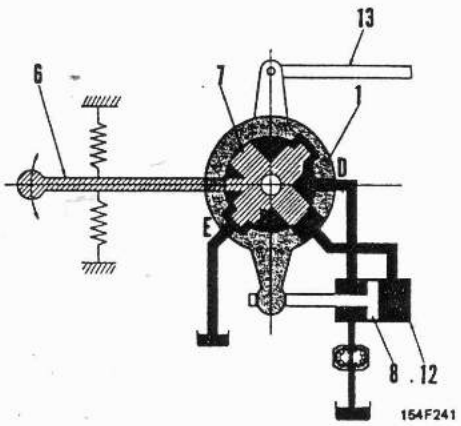
The rotary valve consists of a rotor (5) which is coupled to the work equipment control lever by the operator's seat, sleeve (4) which is coupled to the work equipment control valve spool, lever (2) which is fixed to the sleeve with a key, piston (6) which slides inside the valve body (1) by oil pressure, 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.

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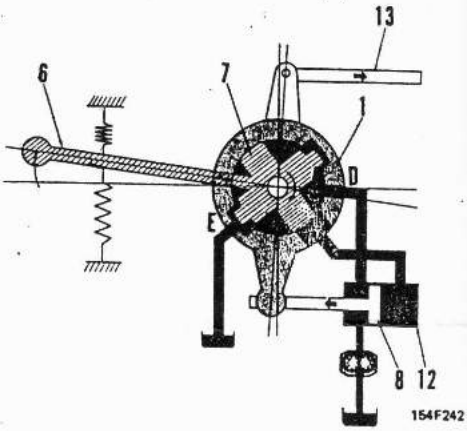
OPERATION

NEUTRAL



When the input lever (6) is put in the HOLD position, the 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 ➡ direction, the rotor (7) which is direct-coupled to the input lever will rotate in the ➡ 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 ⬅ direction.

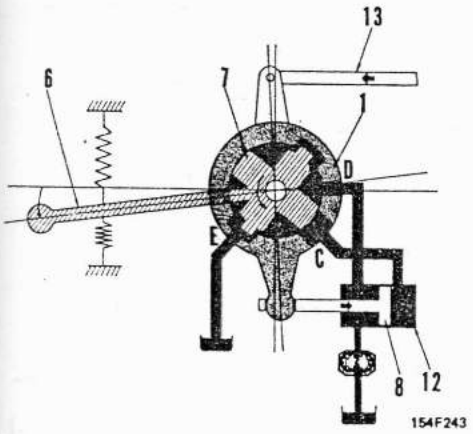
The piston will in turn push the lever of the sleeve (1), causing the sleeve to rotate, and thus the output shaft (13) which is coupled to the sleeve will move in the ➡ direction.

When the rotor (7) rotates in the ➡ 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.

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LEFT TURN



When the input lever (6) is moved in the ➡ direction, the rotor (7) which is direct-coupled to the input lever will rotate in the ➡ 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 ➡ direction from the head of the cylinder.

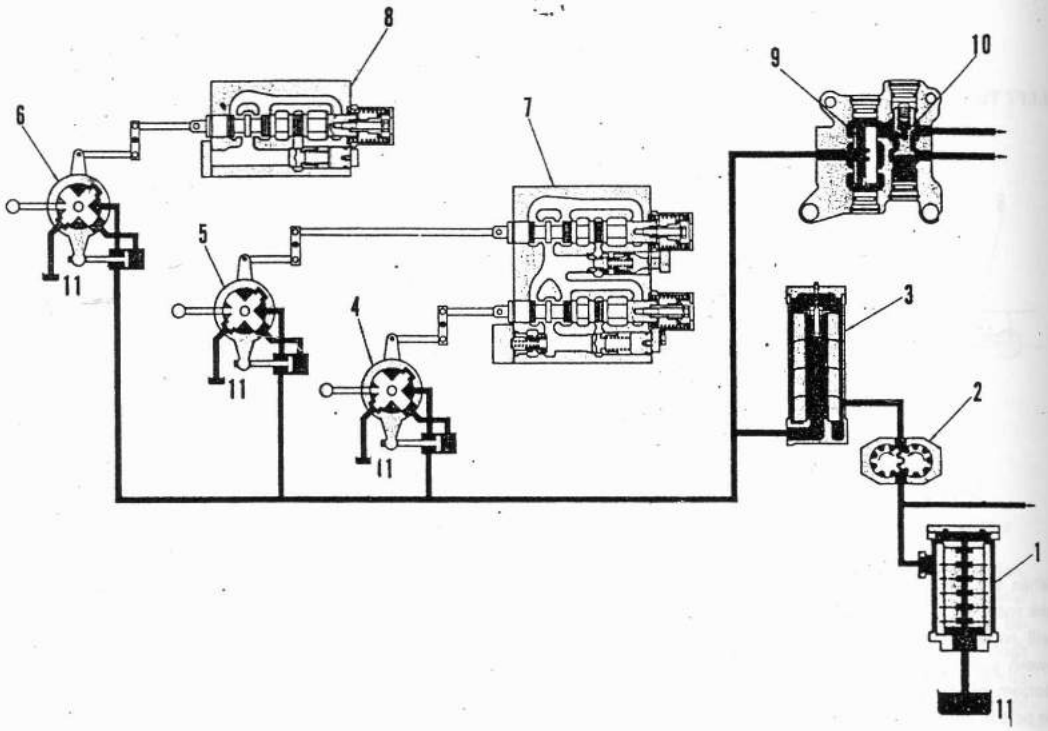
As the piston moves, it pulls the lever of the sleeve, causing the sleeve to rotate. As a result, the output shaft (13) which is coupled to the sleeve will move in the ➡ direction.

When the rotor (7) rotates in the ➡ 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.

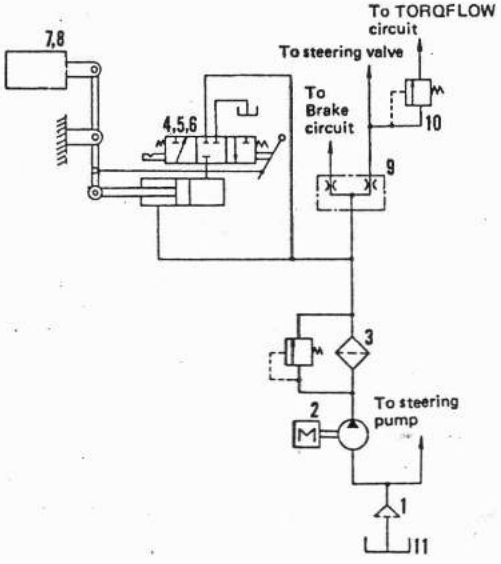
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SERVO VALVE HYDRAULIC SYSTEM



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SERVO VALVE HYDRAULIC CIRCUIT

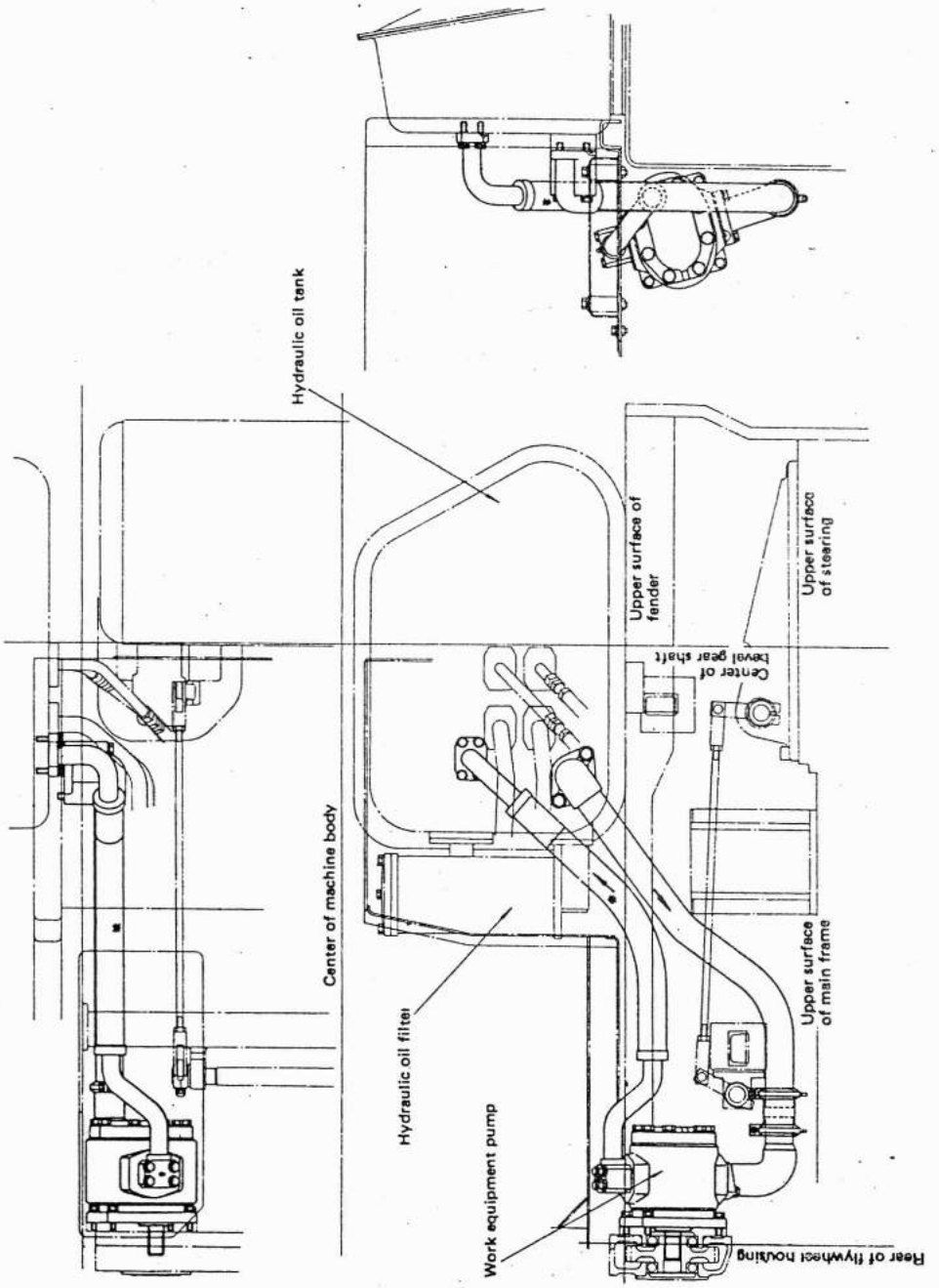


154F245

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

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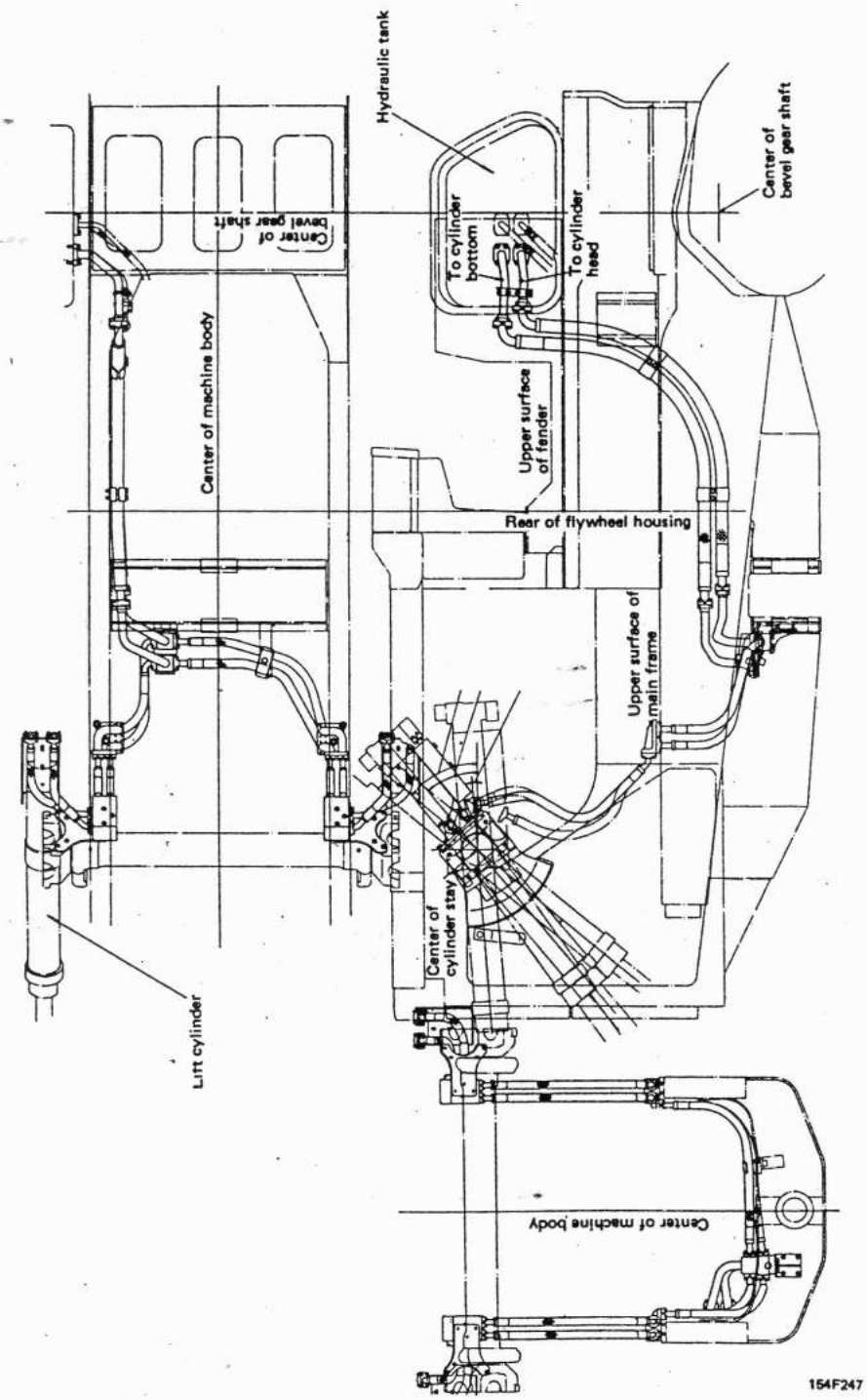
WORK EQUIPMENT HYDRAULIC PIPING (PUMP ⟷ TANK)



154F246

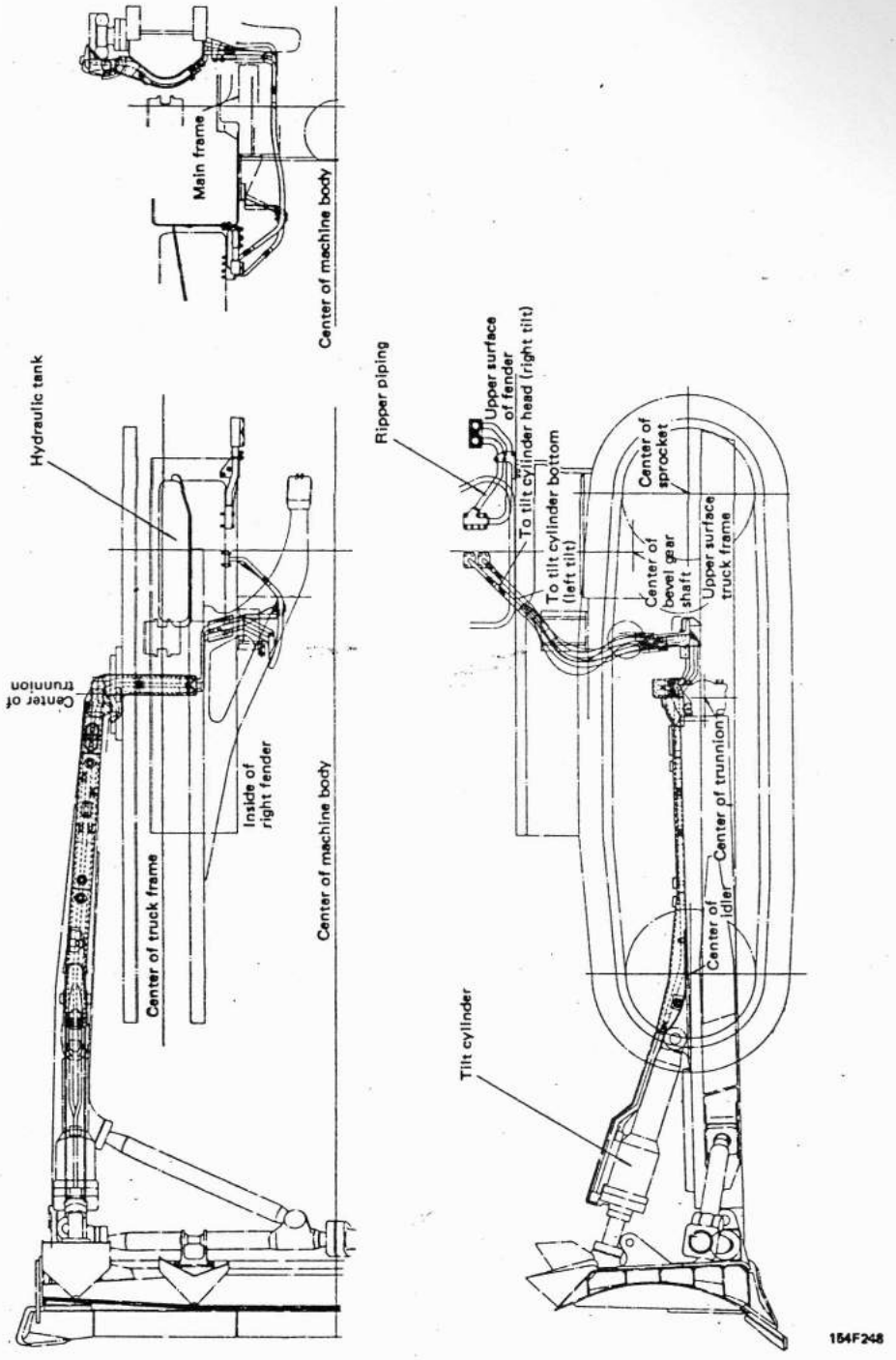
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WORK EQUIPMENT HYDRAULIC PIPING (BLADE LIFT)



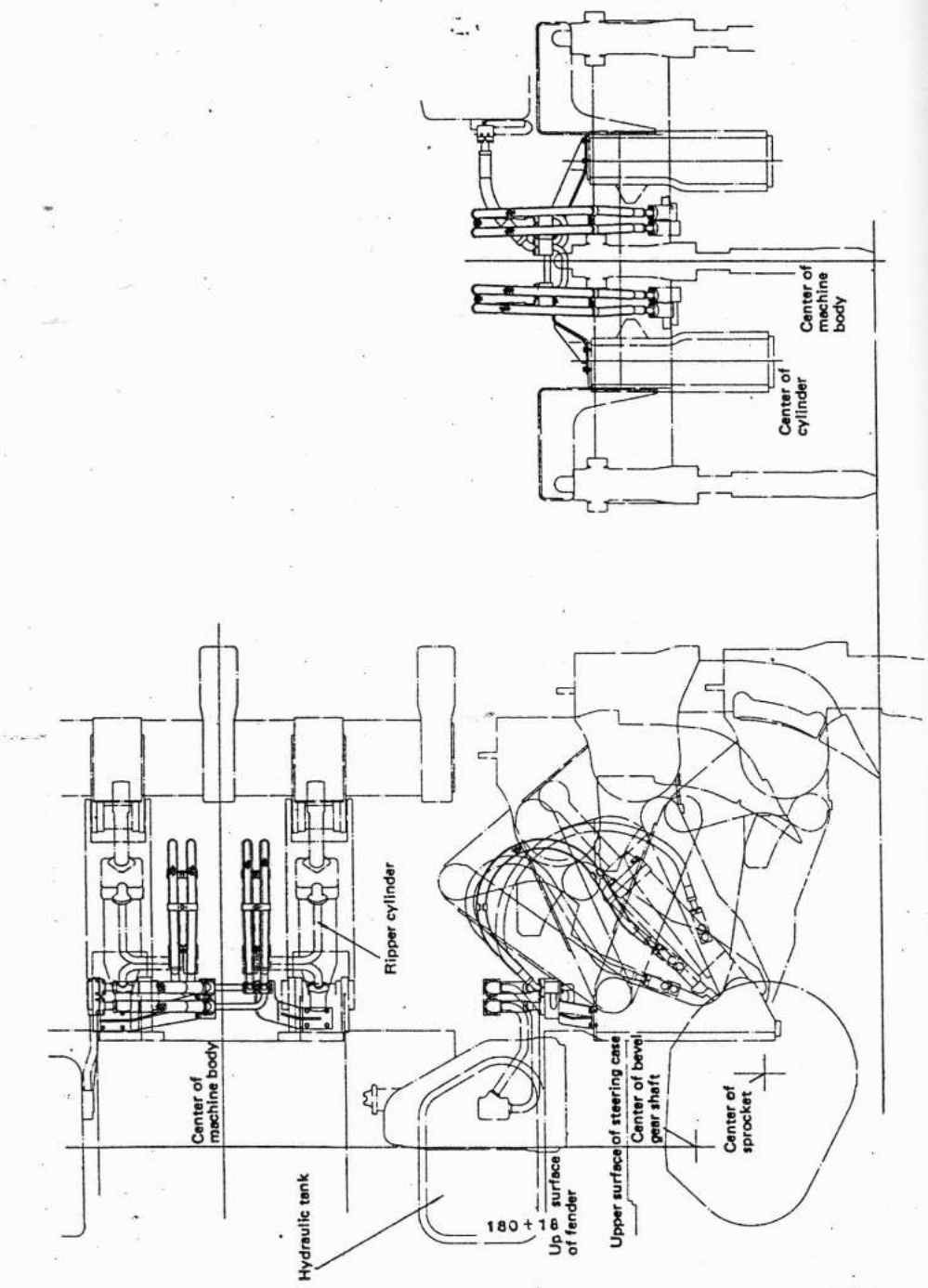
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WORK EQUIPMENT HYDRAULIC PIPING (BLADE TILT)



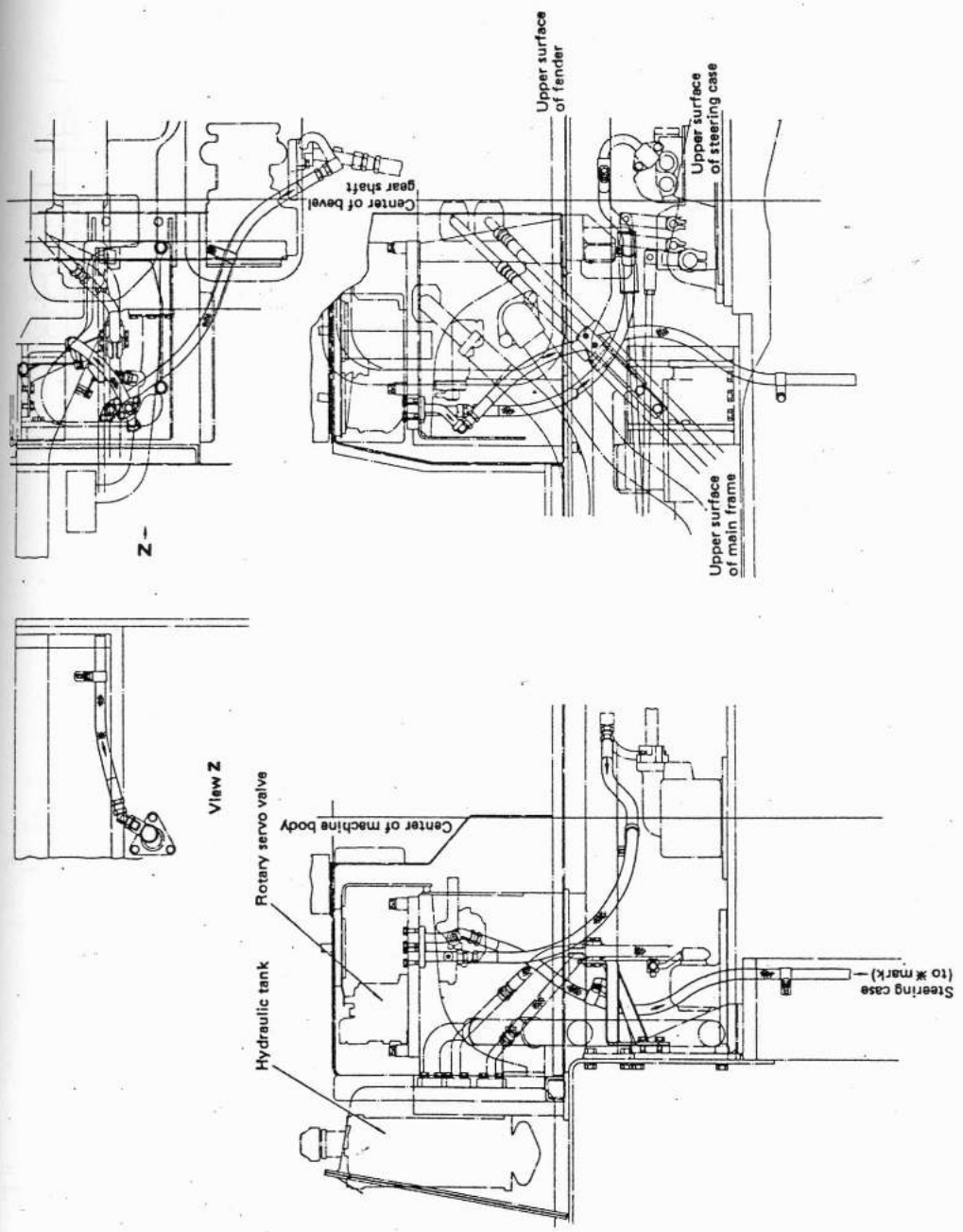
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WORK EQUIPMENT HYDRAULIC PIPING (RIPPER) TY 220



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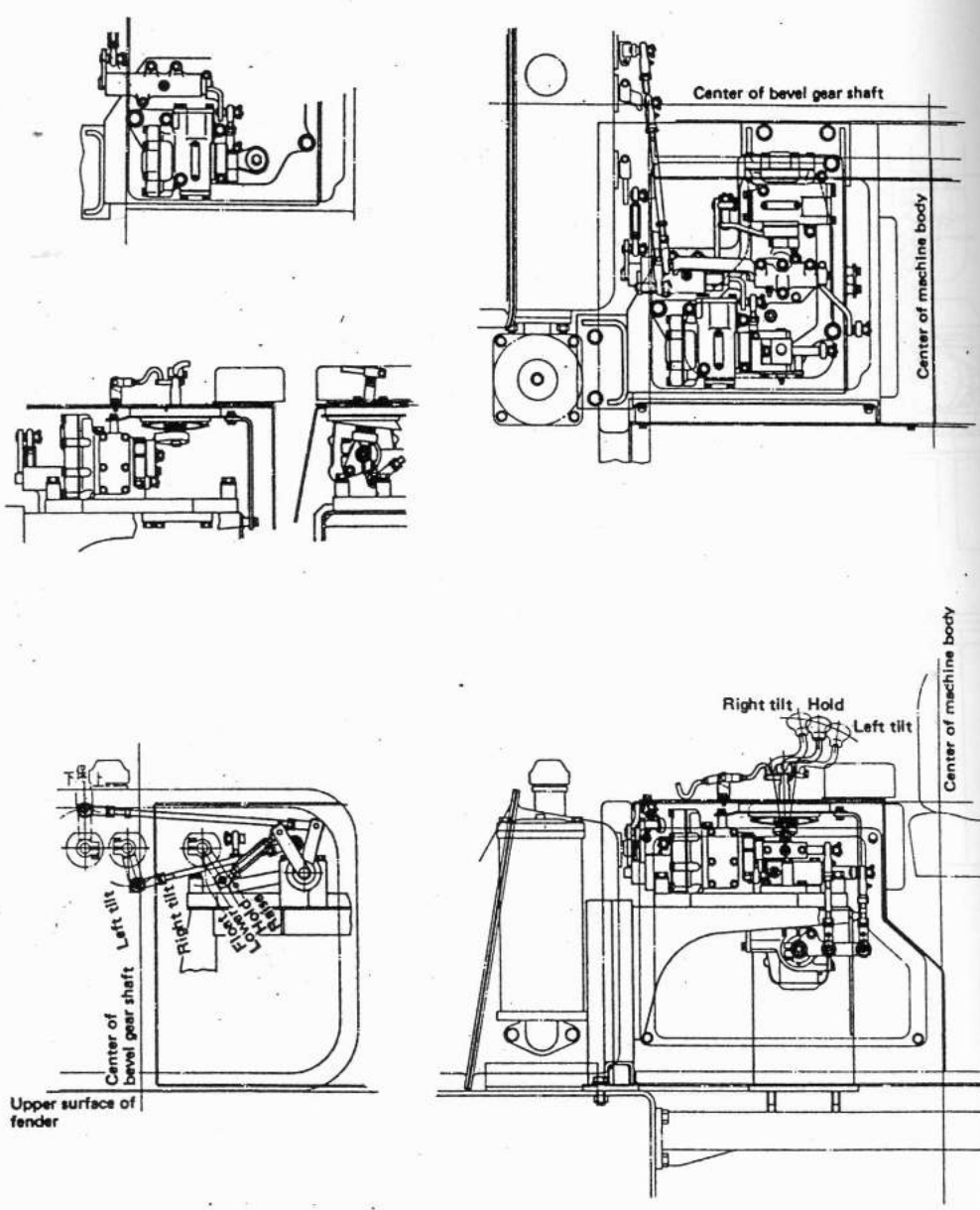
SERVO VALVE HYDRAULIC PIPING



154F250

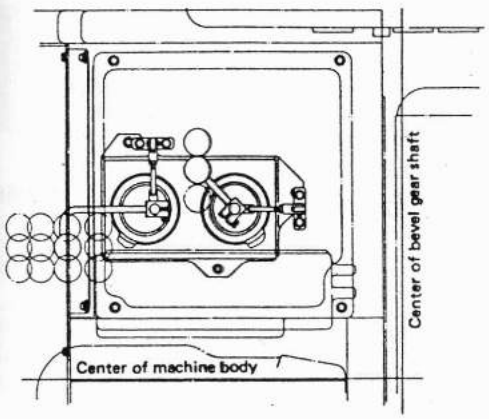
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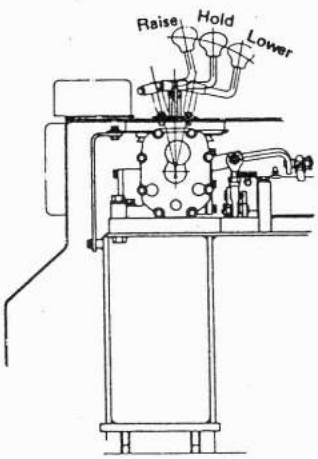
WORK EQUIPMENT CONTROL



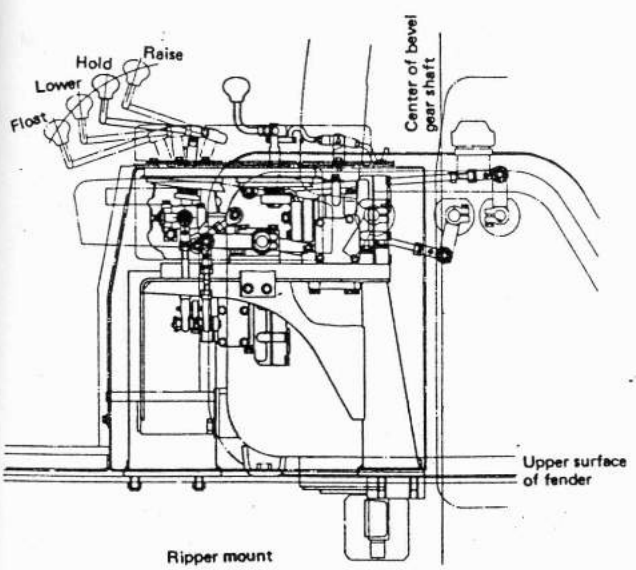
154F254

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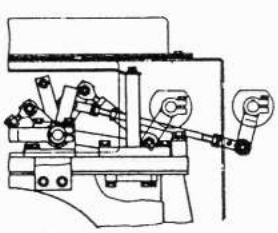




Ripper mount



Ripper mount



Ripper dismount

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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 m· ans 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.

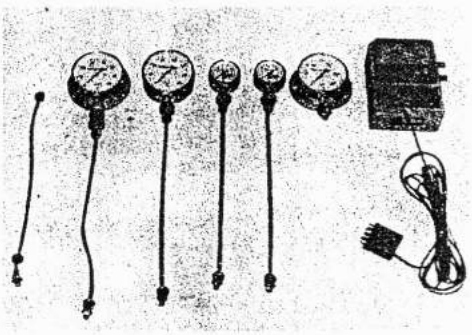
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OIL PRESSURE MEASURING POINTS

Item	Measuring point	Measuring plug size	Oil temperature during measurement (°)	Set oil pressure (kg/cm²)		Remarks
				Engine full speed 2000 rpm	Engine idling 600 rpm	
Work equipment hydraulic	Main relief pressure	PT 1/8 07042-00108	45 ~ 55	135 ~ 150	130 ~ 140	

OIL PRESSURE AND TEMPERATURE MEASURING EQUIPMENT

Part Name	A	B
Hydraulic tester	1	
Thermistor kit		1



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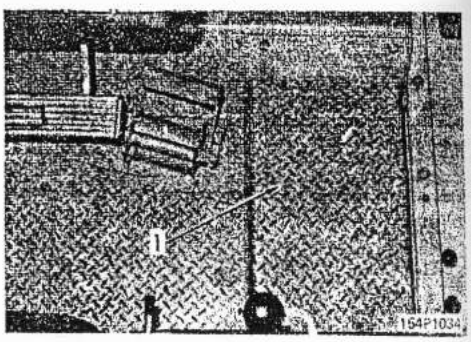
OUTLINE OF OIL PRESSURE AND TEMPERATURE MEASUREMENTS

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.

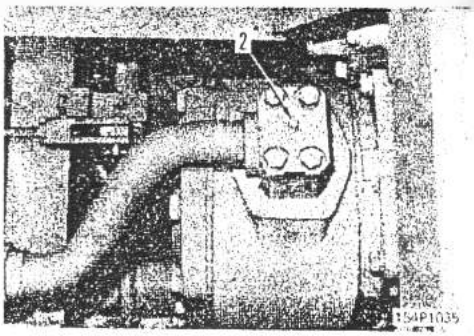
2) Installation of oil pressure gauge

i) Remove floor plate (1).



ii) Remove inspection plug (2) from hydraulic pump outlet tube.

iii) Install pressure gauge A (350 kg/cm^2) with hose and adaptor.

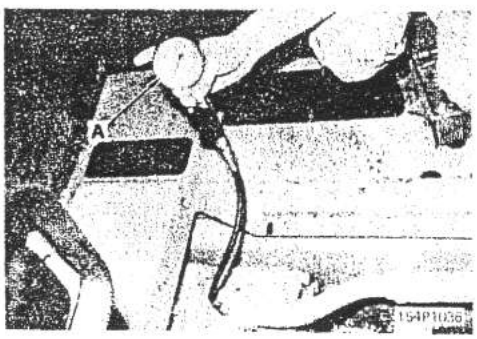


3) Oil pressure measurement

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.



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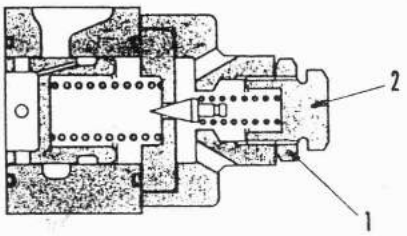
2. Oil pressure adjustment

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:

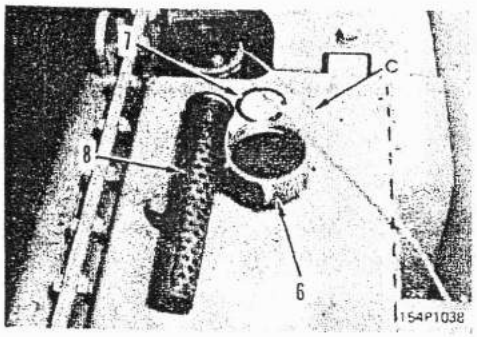


29.2 kg/cm²

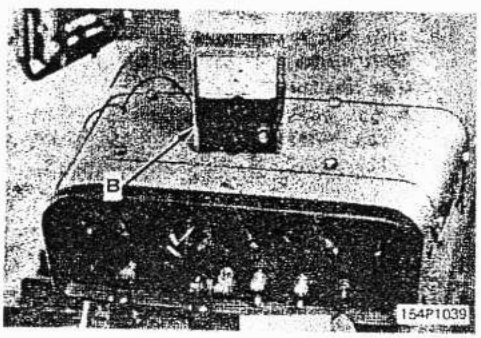


3. Oil temperature measurement

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.

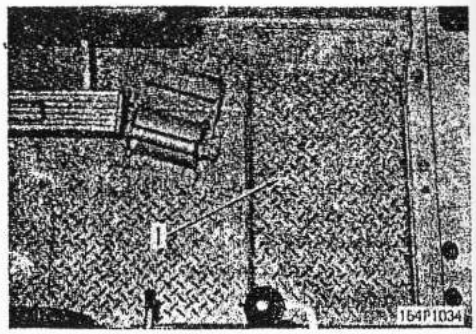


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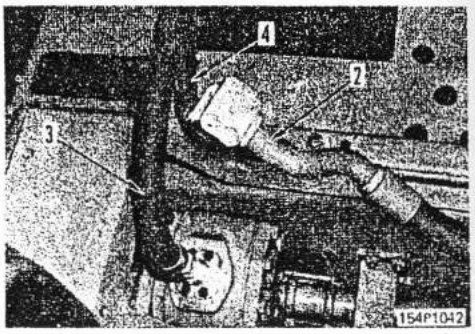
OIL FLOW MEASUREMENTS

FLOW MEASUREMENTS

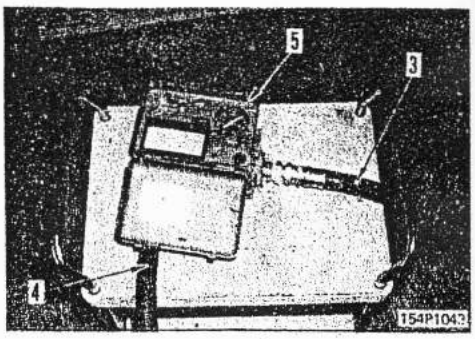
1. Installation of flowmeter
   1) Ground work equipment and turn off engine. Operate control lever two or three times to remove residual pressure. Lock lever in operating condition (position other than FLOAT).



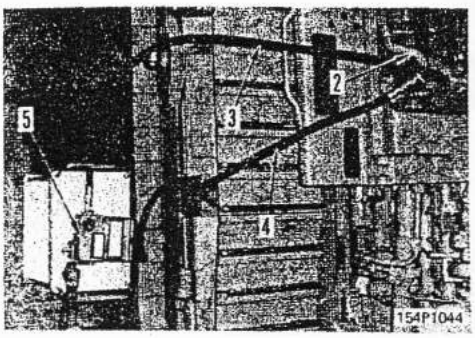
   2) Loosen oil feeder cap and bleed off air from hydraulic oil tank.
   3) Remove floor plate (1).
   4) Remove pump outlet tube (2).



   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.

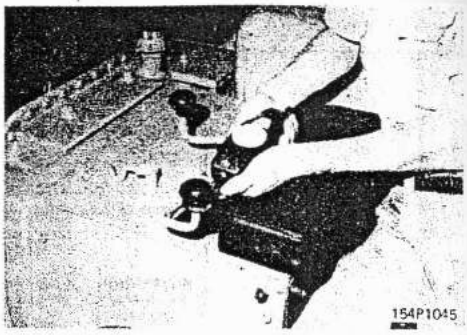


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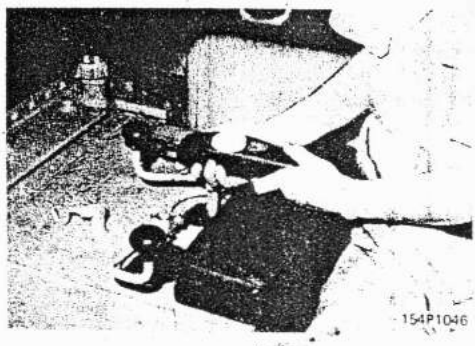
MEASUREMENT OF OPERATING FORCE

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 Kotasu'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).

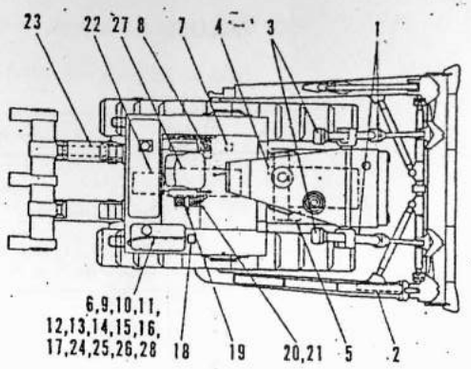


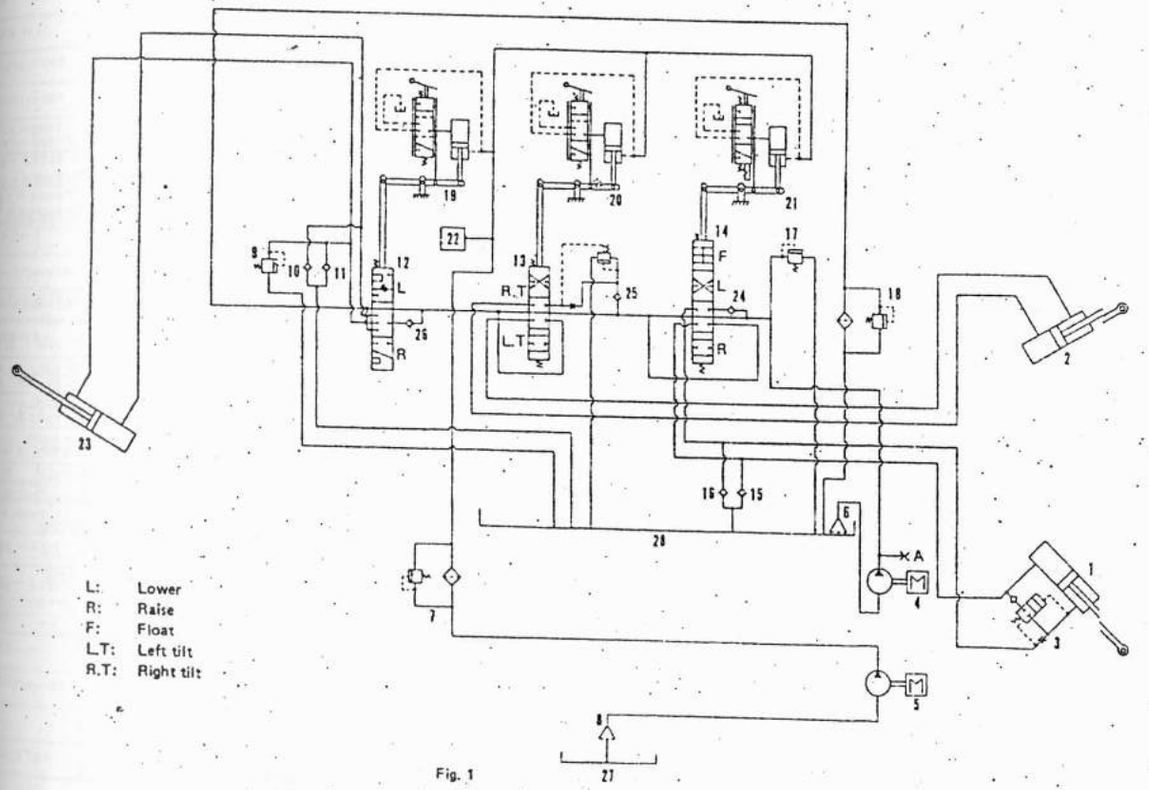
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STANDARD VALUES

Item			Condition			Standard value	Tolerance value
Stroke	Blade lever		Center of lever knob	Neutral → Blade rise/lower/float	C	47 ~ 67 mm	
					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 end 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 end 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/cm²	
				Full speed		135 ~ 150 kg/cm²	
Performance	Blade	Blade speed	• Oil temp. 45 ~ 55°C	Raise	Idling	TY 220 8 ~ 13 sec. TS 220 9 ~ 14 sec.	
					Full speed	TY220 2.1 ~ 3.1 sec. TS220 2.5 ~ 3.5	
			• Blade unloaded	Lower	Idling, Full speed	TY 220 1 ~ 1.5 sec. TS 220 1.4 ~ 1.9	
			• Ground level → Upper limit	Float	Idling, Full speed	1 ~ 1.5 sec.	
		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	Tilt speed	• Oil temp. 45 ~ 55°C • Blade unloaded	Left tilt	Idling	4 ~ 5.5 sec.	
					Full speed	TY 220 2.5 ~ 3.5 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.	Right tilt	Idling	TY 220 3.5 ~ 5 sec. TS 220 2.0 ~ 3.5	
					Full speed	TY 220 2 ~ 3 sec. TS 220 1.5 ~ 2.5 sec.	
		Tilt return (Tilt natural drop)	Oil temp. 40 ~ 50°C, blade tilted to push down blade and engine stopped. Measure time until machine fully grounded.	Left tilt		10 min. min.	
				Right tilt		8 min. min.	
	Ripper	Ripper speed	• Oil temp. 45 ~ 55°C	Raise	Idling	4 ~ 7 sec.	
					Full speed	1.5 ~ 2.5 sec.	
			• Shank high position • Ground level → Upper limit	Lower	Idling	1 ~ 2 sec.	
					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.	

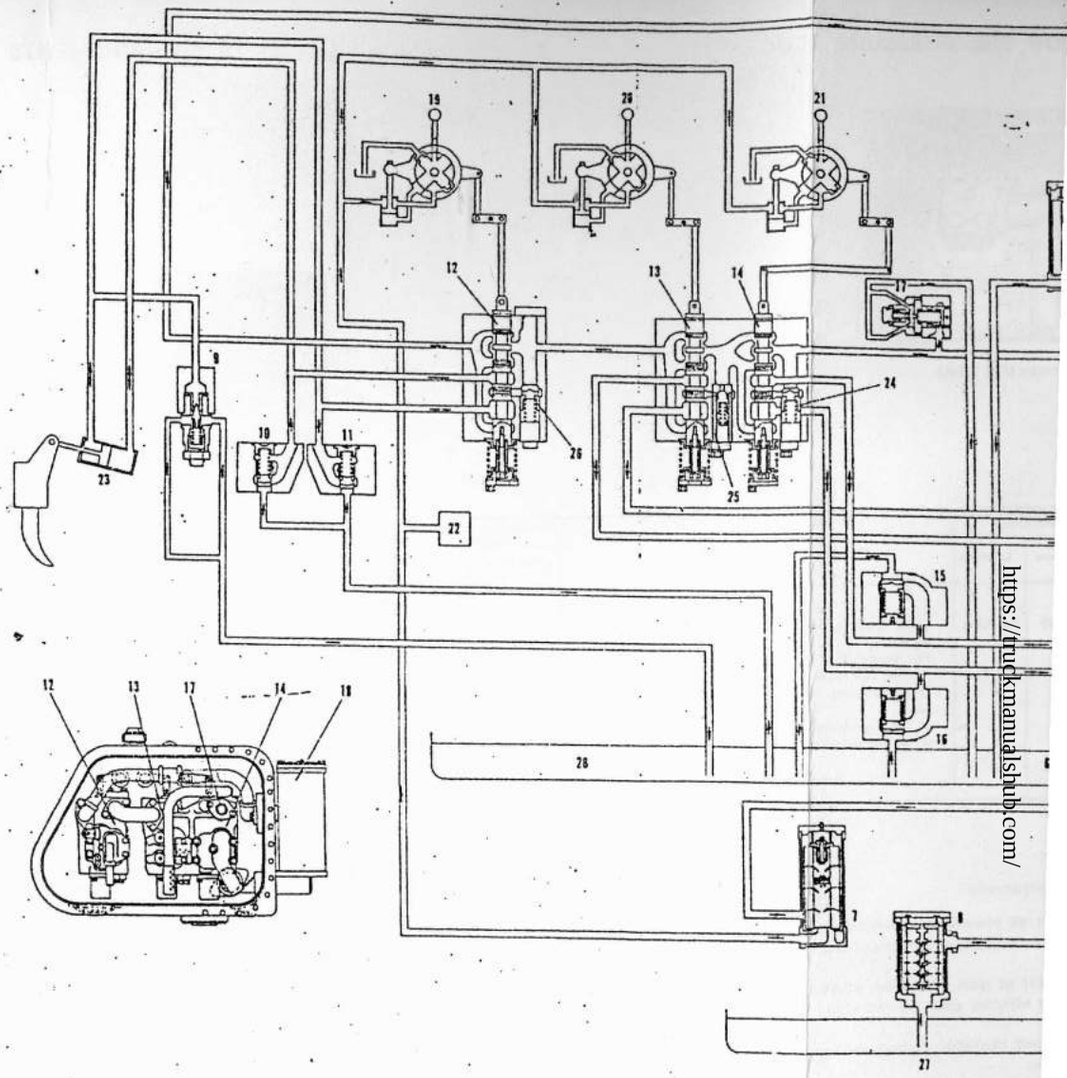
HYDRAULIC SYSTEM





L: Lower
R: Raise
F: Float
L.T: Left tilt
R.T: Right tilt

Fig. 1

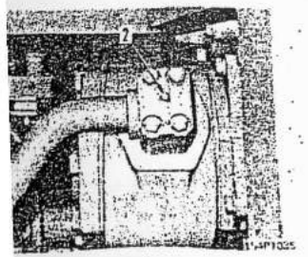


1. Blade lift cylinder
2. Blade tilt cylinder
3. Blade quick drop valve
4. Hydraulic pump (LAL 160)
5. Steering pump (FAR 063)
6. Strainer
7. Steering oil filter
8. Magnet strainer
9. Ripper safety valve
10. Ripper suction valve
11. Ripper suction valve
12. Ripper valve
13. Blade tilt valve
14. Blade lift valve
15. Blade lift suction valve
16. Blade lift suction valve
17. Hydraulic main relief valve
18. Hydraulic oil filter
19. Rotary servo valve (for ripper operation)
20. Rotary servo valve (for blade tilt operation)
21. Rotary servo valve (f
22. To steering and tran
23. Ripper cylinder
24. Flow check valve
25. Check valve
26. Check valve
27. Steering case
28. Hydraulic tank.

Fig. 2

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TION OF THE PRESSURE PLUG



lief oil pressure (Fig. 1.2-A)

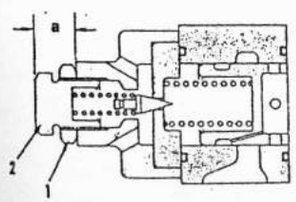
ethod.

Measuring		Measuring method	Standard values pressure (kg/cm²)	
ug size	Location		Engine full speed	Engine idle speed
T 1/8	Fig. 1.2-A	Install pressure gauge A (350 kg/cm²) with hose and adaptor. Put control lever in neutral position and start engine. Operate control lever and move cylinder to be measure 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.	135~150	130~140

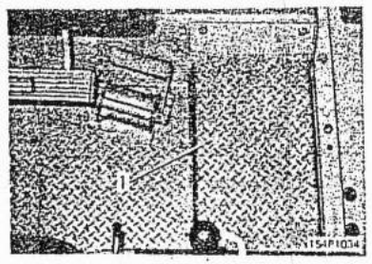
l pressure adjustment

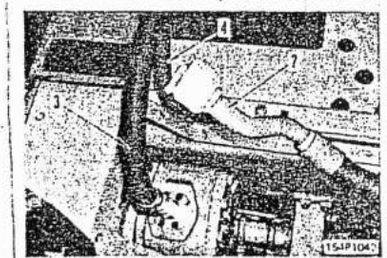
ary, adjust oil pressure as shown below.
f oil from hydraulic tank and remove tank

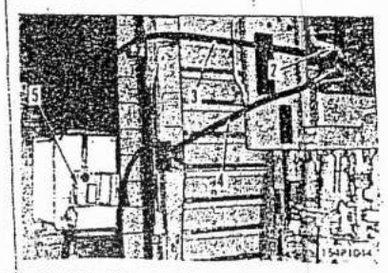
lock nut (1) of main relief valve adjust-
v. Rotate adjusting screw (2) and adjust
ire.
rew is turned clockwise, pressure will in-
nd vice-versa.
screw protrusion diamension a:
increase of decrease per turn of screw:
29.2 kg/cm²



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. Lock lever in operating condition (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.
   8) Run the engine at 1800 rpm.
   9) For any pump test, the pump flow, measured in liter/min at 7 kg/cm² will be larger than the pump flow at 70 kg/cm² at the same rpm.
   10) The difference between the pump flow of two operating pressure is the flow losse.
   11) Use those values in the following Formula 1.

$$\text{Formula 1: } \left(\frac{\ell \text{/min at 7 kg/cm}^2 - \ell \text{/min at 70 kg/cm}^2}{\ell \text{/min at 7 kg/cm}^2} \right) \times 100 = \text{Percent of flow less}$$

   12) If the percent of flow loss is more than 10%, pump performance is not high enough for use.

STANDARD VALUES

Item			Condition			S
Stroke	Blade lever		Center of lever knob	Neutral + Blade rise/lower/float	C	
					T	
				Neutral + Left tilt / Right tilt		
	Ripper lever		Center of lever knob	Neutral + Ripper raise/lower		
Operating power	Blade lever		Stroke end position at full engine speed	Neutral + Blade raise/lower		
				Blade lower + Float		
				Neutral + Left tilt / Right tilt		
	Ripper lever		Stroke end position at full engine speed	Neutral + Ripper raise/lower		
Oil pressure	Main relief		Oil temp. 45~55°C	Idling		13
				Full speed		13
Performance	Blade	Blade speed	• Oil temp. 45~55°C	Raise	Idling	TY 22 TS 22
					Full speed	TY 22 TS 22
			• Blade unloaded	Lower	Idling, Full speed	TY 22 TS 22
			• Ground level → Upper limit	Float	Idling, Full speed	
		Natural drop	Oil temp. 40~50°C engine stopped. Drop from height of 800 mm above ground at center of blade.			120 n
		Machine body drop	Amount by which center of idler drops when blade only			100 n
	Blade tilt	Tilt speed	• Oil temp. 45~55°C • Blade unloaded	Left tilt	Idling	
					Full speed	TY 22 TS 22
			• Oil temp. 40~50°C, blade tiltad to push down blade and engine stopped. Measure time until machine fully grounded.	Right tilt	Idling	TY 22 TS 22
					Full speed	TY 22 TS 22
		Tilt return (Tilt naturel drop)	Oil temp. 40~50°C, blade tilted to push down blade and engine stopped. Measure time until machine fully grounded.	Left tilt		1
				Right tilt		1
	Ripper	Ripper speed	• Oil temp. 45~55°C	Raise	Idling	
					Full speed	1
			• Shank high position • Ground level → Upper limit	Lower	Idling	
					Full speed	
		Natural drop	Oil temp. 40~50°C engine stopped. Drop from height of 500 mm above ground at bottom of point.			80 n
		Machine body drop	Oil temp. 40~50°C, ripper pushed down and engine stopped. Drop at center of sprocket.			
Heat balance	Operating oil temp.					1

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DISASSEMBLY AND ASSEMBLY

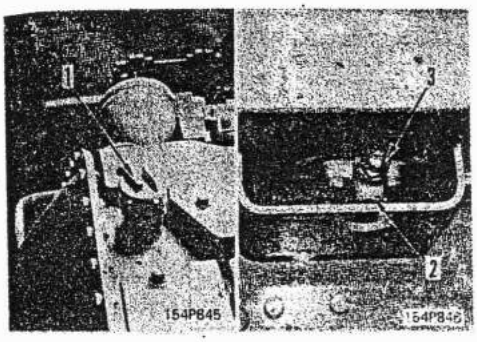
DISMOUNTING HYDRAULIC PUMP ASSEMBLY

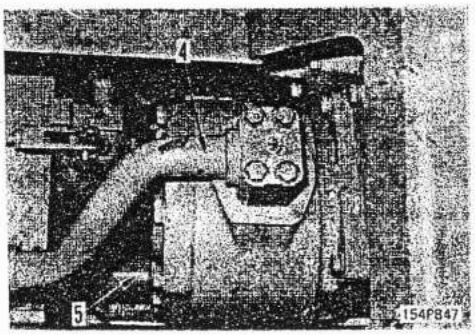
⚠ Completely lower work equipment to ground.

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).

   kg Hydraulic pump assembly: 40 kg





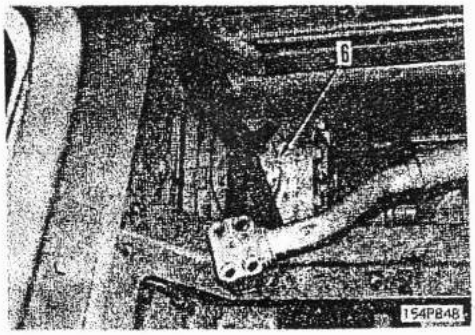
MOUNTING HYDRAULIC PUMP ASSEMBLY

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.

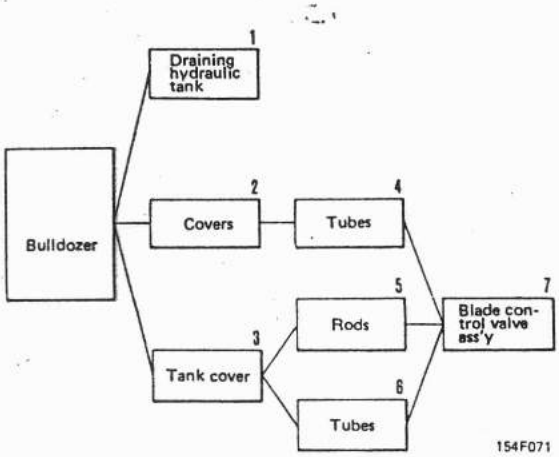
   Hydraulic tank: Approx. 70 ℓ

   ★ Start and run engine to let oil circulate in hydraulic system. Check oil level again.



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DISMOUNTING BLADE CONTROL VALVE ASSEMBLY

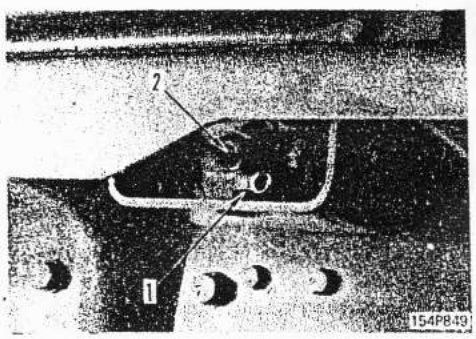


1. **Draining hydraulic tank**

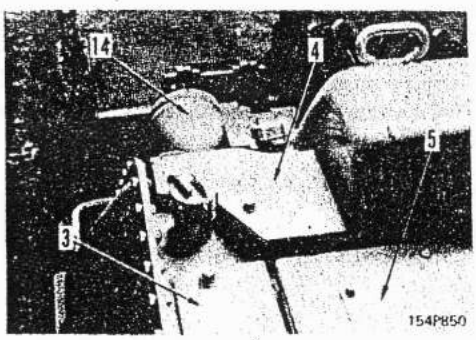
   Loosen oil filler cap to release internal pressure in tank.

   Remove drain plug (1), then open valve (2) to drain oil.

   Hydraulic tank: Approx. 70 ℓ

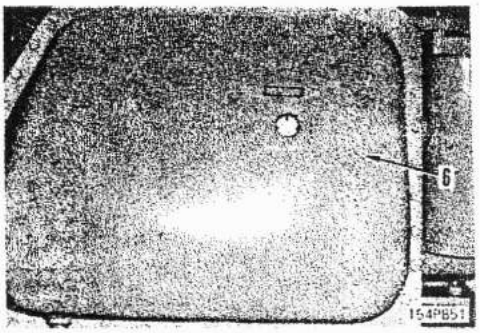


2. **Covers**
   1) Remove lamp (14).
   2) Remove covers (3), (4) and (5).



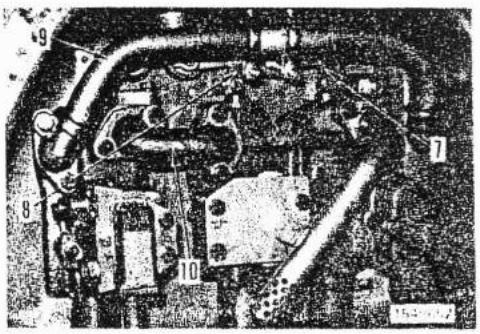
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3. **Tank cover**
   Remove tank cover (6).

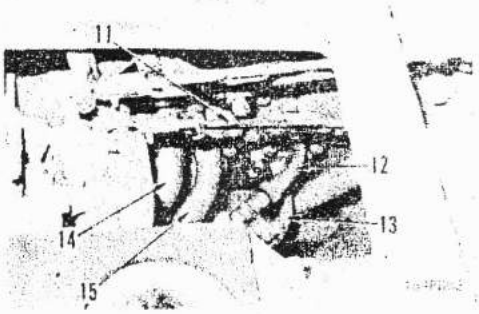


4. **Tube**
   1) Remove tube (9) between hydraulic filter and ripper control valve.
   2) Remove tube (10) between blade control valve and ripper control valve.

5. **Rods**
   Disconnect rods (7) and (8) inside tank.

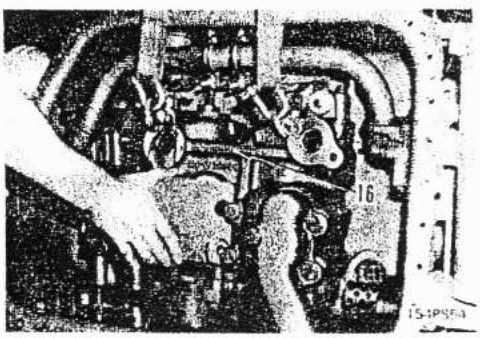


6. **Tubes**
   1) Disconnect servo valve rod (11).
   2) Remove tilt tubes (12) and (13), and lift tubes (14) and (15).



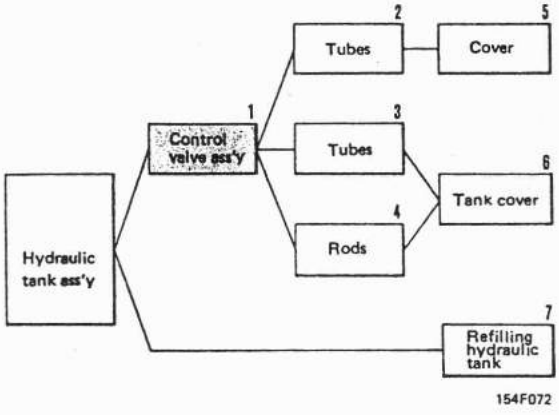
7. **Blade control valve assembly**
   Hoist control valve assembly (16) and remove.

   kg Blade control valve assembly: 78 kg



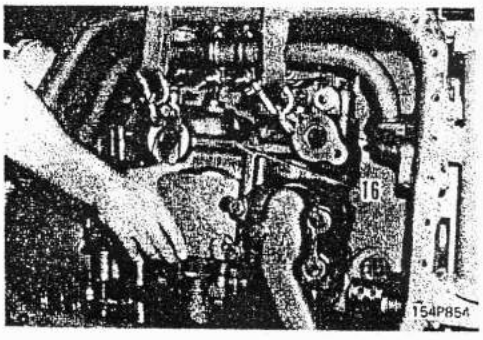
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MOUNTING BLADE CONTROL VALVE ASSEMBLY



1. Blade control valve assembly
   Fit O-ring and sling control valve assembly (16) to install.

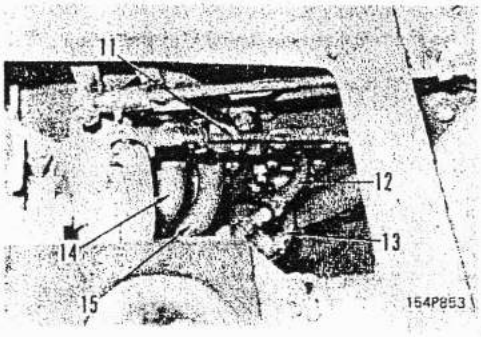
   ⊕ Fit O-ring securely in groove.



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).



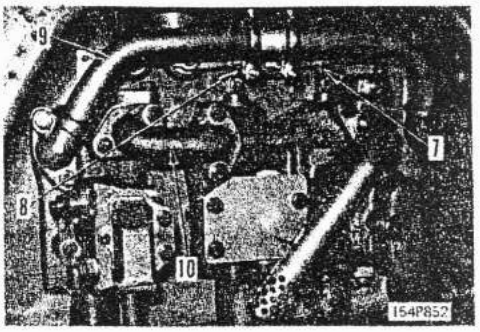
https://truckmanualshub.com/

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.

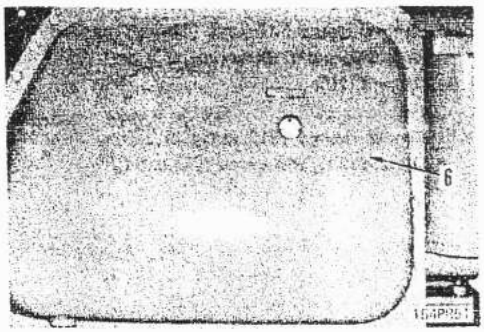
      ⊕ Fit O-ring securely in groove.



4. Rods
   Install rods (7) and (8) inside tank.

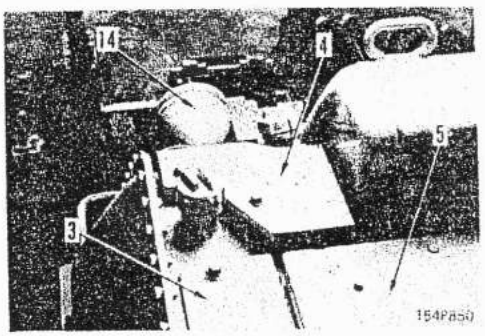
   ⊕ Bend cotter pin securely.

5. **Tank cover**
   Fit gasket and install cover (6).



6. **Covers**
   1) Install covers (3), (4) and (5).

   2) Install lamp (14).

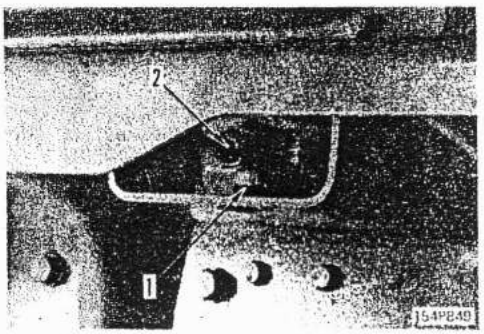


7. **Refilling hydraulic tank**
   1) Tighten drain plug (1) and close drain valve (2).

   2) Pour engine oil in through oil filler until it reaches specified level.

      Hydraulic tank: Approx. 70 ℓ

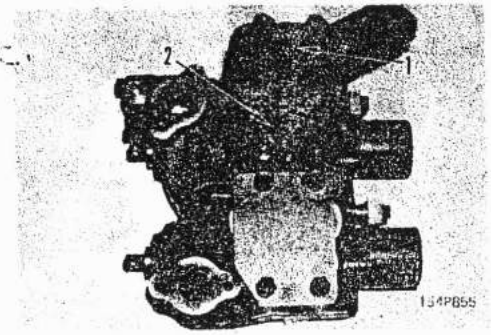
      ★ Start and run engine to let oil circulate in hydraulic system.
      Check oil level again.

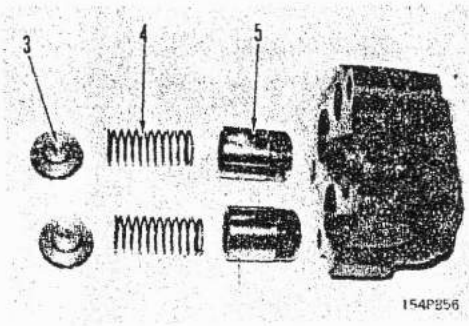


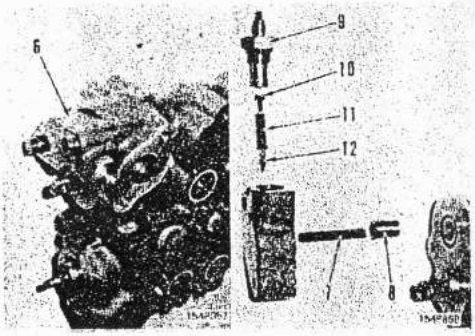
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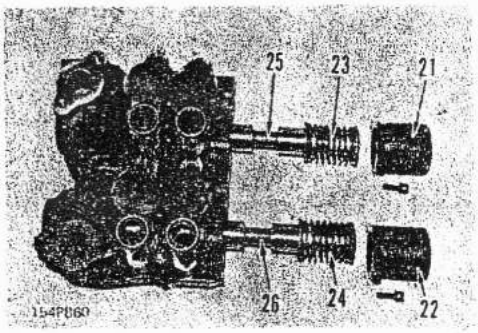
DISASSEMBLY OF BLADE CONTROL VALVE ASSEMBLY

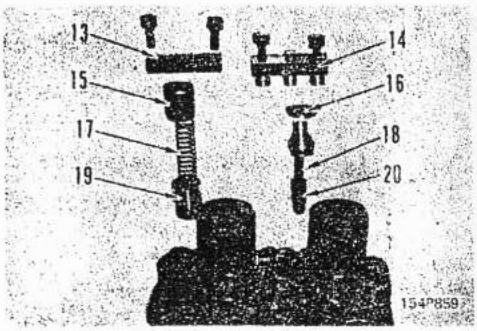
1. Remove suction valve tube (1).
2. Remove suction valve assembly (2).
3. Loosen plugs (3) and remove springs (4) and suction valves (5).
4. Remove main relief valve assembly (6). Then remove spring (7) and main relief valve (8).
5. Remove holder (9). Then remove retainer (10), spring (11) and poppet (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).











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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.

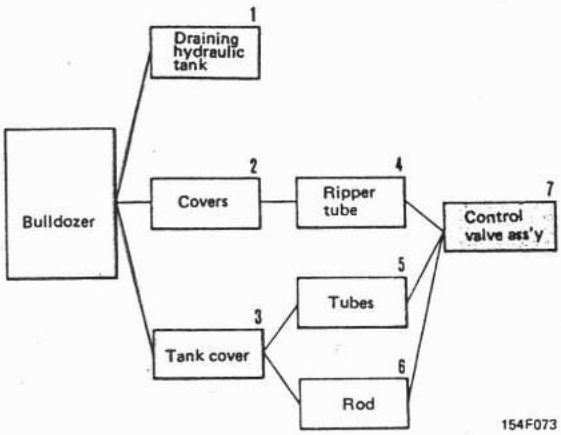
   ⊕ Fit O-ring securely in groove.
5. Assemble main relief valve (8) and spring (7). Fit O-ring and install main relief valve assembly (6).
6. Assemble suction valves (5) and springs (4). Fit O-rings to plugs (3) and install.

   ⊕ Fit O-ring securely in groove.
7. Install suction valve assembly (2).

   kgm Suction valve: 10 kg.m
8. Install suction valve tube (1).

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DISMOUNTING RIPPER CONTROL VALVE ASSEMBLY

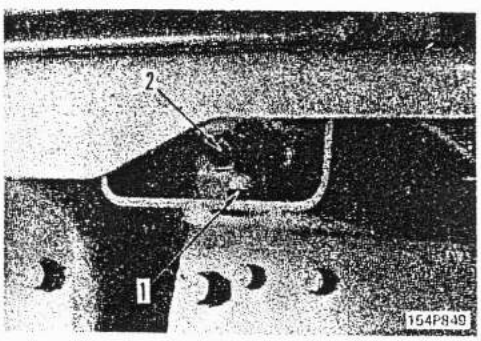


1. Draining hydraulic tank

Loosen oil filler cap to release internal pressure in tank.

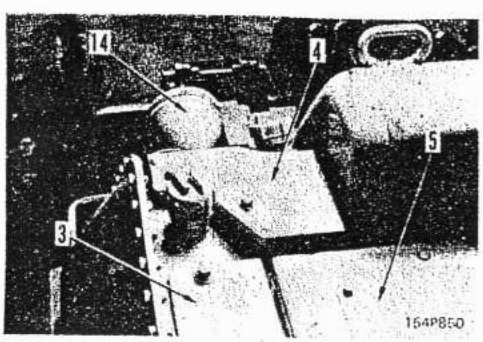
Remove drain plug (1), then open valve (2) to drain oil.

Hydraulic tank: Approx. 70ℓ



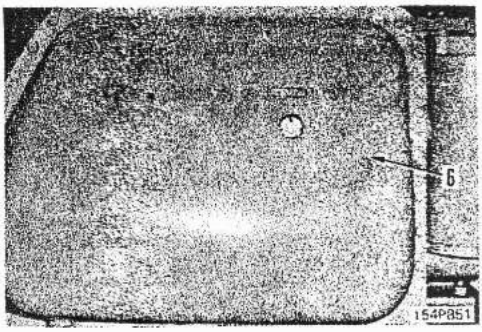
2. Covers

Remove lamp (14) and covers (3), (4) and (5).



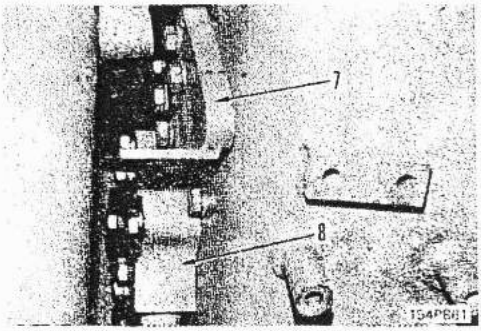
https://truckmanualshub.com/

3. **Tank cover**
Remove tank cover (6).



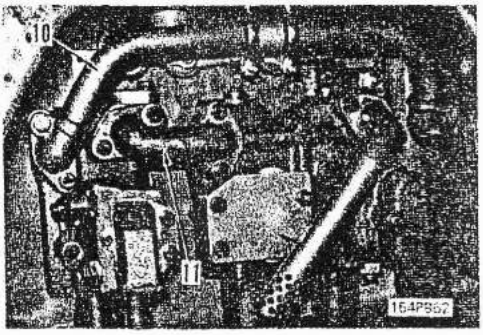
4. **Ripper tube**
1) Remove oil filler mounting bracket (7) from steering case.

2) Remove tube (8) between ripper control valve and ripper cylinder at control valve end.

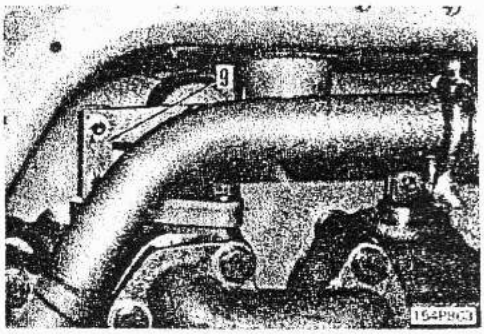


5. **Tubes**
1) Remove tube (10) between ripper control valve and hydraulic filter at control valve end.

2) Remove tube (11) between ripper control valve and lift and tilt control valves.



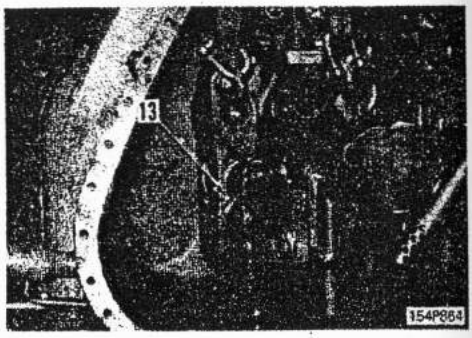
6. **Rod**
Disconnect rod (9).



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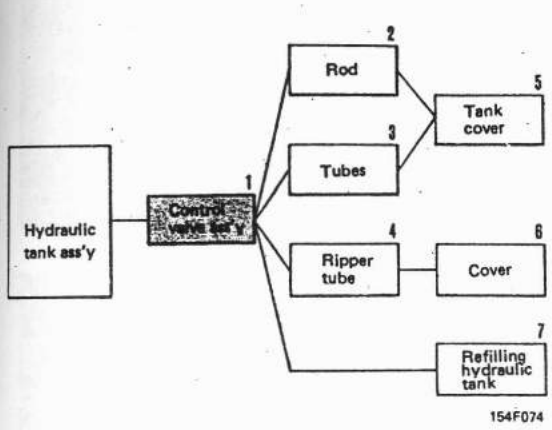
7. **Ripper control valve assembly**
   Hoist ripper control valve assembly (13) and remove.

   kg Control valve assembly: 45 kg



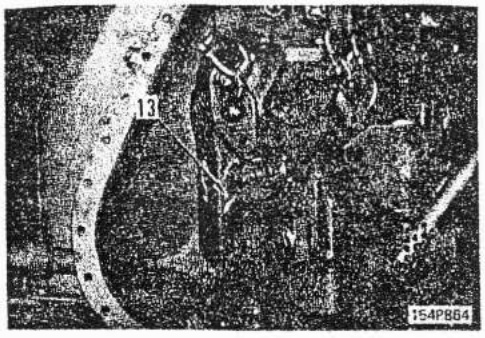
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MOUNTING RIPPER CONTROL VALVE ASSEMBLY



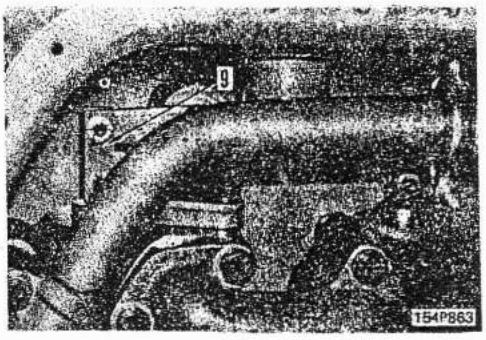
1. **Ripper control valve assembly**
   Fit O-ring. Hoist ripper control valve assembly (13) to install.

   ⊕ Fit O-ring securely in groove.



2. **Rod**
   Install rod (9).

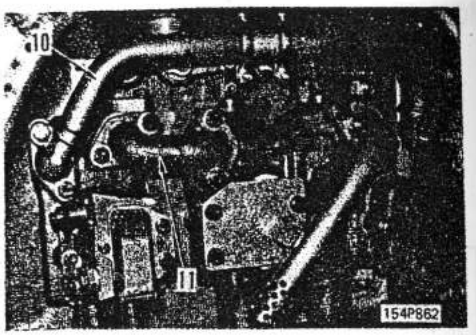
   ⊕ Bend cotter pin securely.



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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.

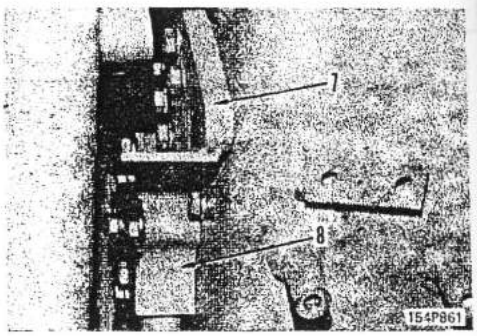
   ⊕ Fit O-ring securely in groove.



4. Ripper tube
   1) Fit O-ring and install tube (8) between ripper control valve and ripper cylinder.

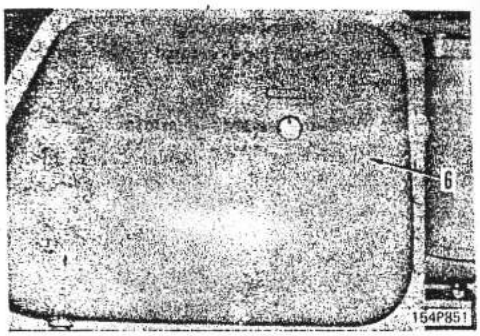
   ⊕ Fit O-ring securely in groove.

   2) Install oil filler bracket (7) to steering case.

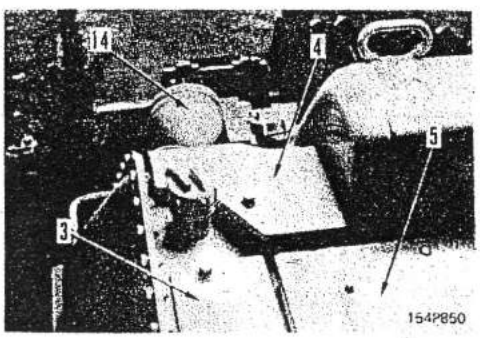


5. Tank cover
   Attach gasket, then install tank cover (6).

   Stick gasket to cover.



6. Cover
   1) Install lamp (14).
   2) Install spacer and cover (3).
   3) Install covers (4) and (5).

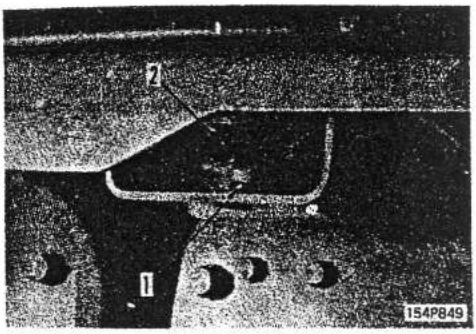


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7. **Refilling hydraulic tank**
   1) Tighten drain plug (1) and close drain valve (2).
   2) Pour engine oil in through oil filler until it reaches specified level.

      Hydraulic tank: approx. 70 ℓ

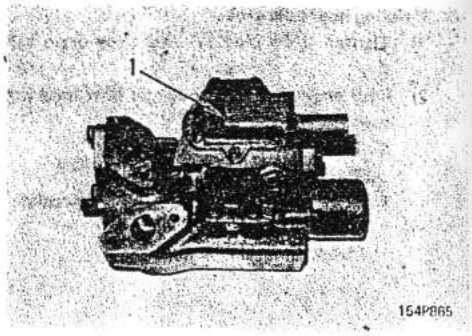
      ★ Start and run engine to let oil circulate in hydraulic system.
      Check oil level again.

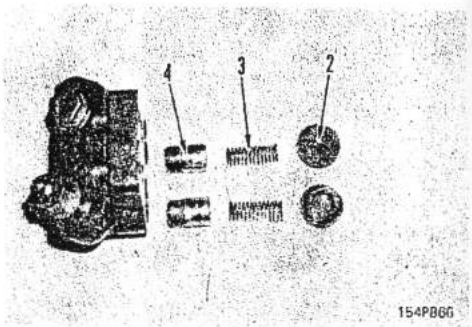


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DISASSEMBLY OF RIPPER CONTROL VALVE ASSEMBLY

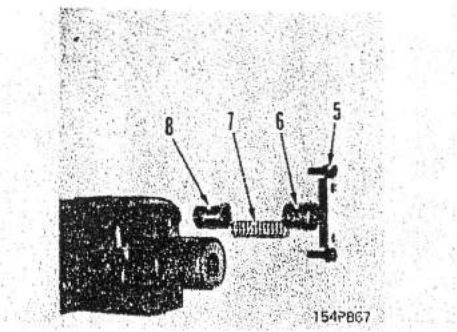
1. Remove suction valve assembly (1).
2. Loosen plugs (2) and remove springs (3) and valves (4).
3. Loosen bolts (5) and remove plug (6), spring (7) and check valve (8).
4. Remove bolts (9). Then remove spool (11) and spring (10).

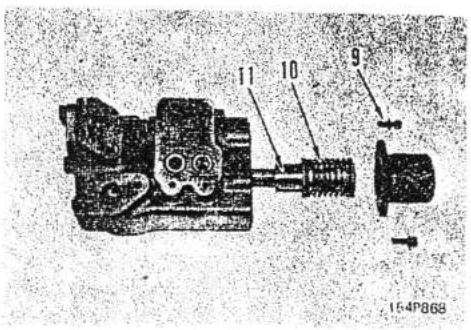




ASSEMBLY OF RIPPER CONTROL VALVE ASSEMBLY

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.
   kgm Suction valve mounting bolt: 10 kg.m

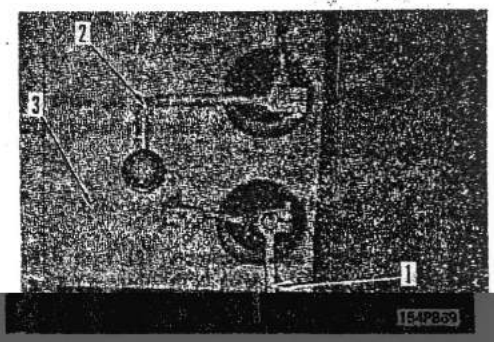




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DISMOUNTING BLADE LIFT SERVO VALVE ASSEMBLY

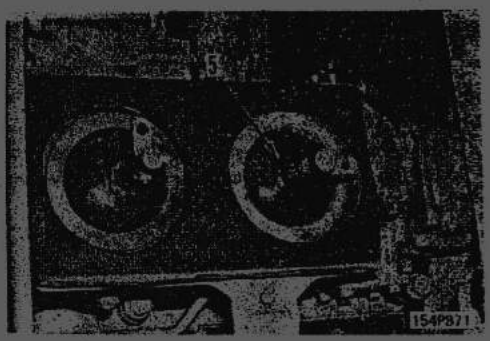
1. Disconnect blade control lever (1) and ripper control lever (2).
2. Remove upper cover (3) of servo valve.
3. Remove front cover (4) of serve valve.
4. Remove servo valve cover (5) and spring.
5. Disconnect rod (6) between servo valve and blade control lever at servo valve end.
6. Remove servo valve assembly (7).

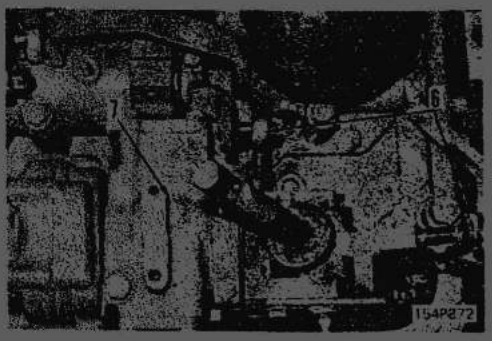




MOUNTING BLADE LIFT SERVO VALVE ASSEMBLY

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).

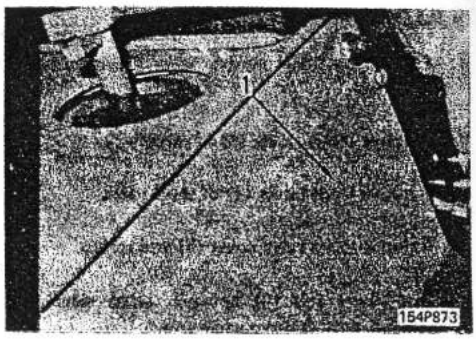


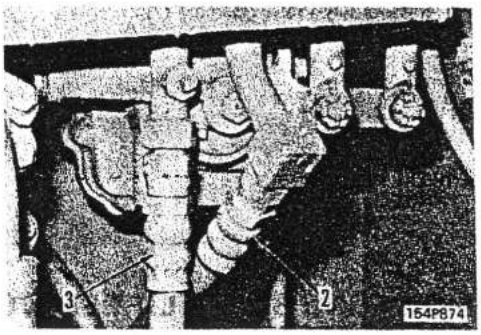


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DISMOUNTING BLADE TILT SERVO VALVE ASSEMBLY

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).

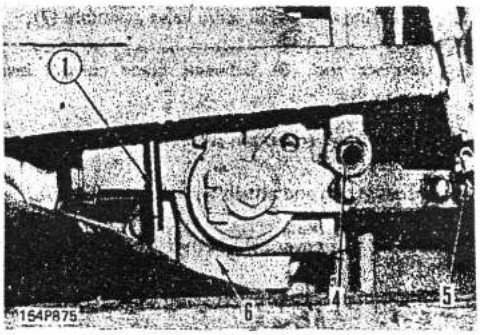




MOUNTING BLADE TILT SERVO VALVE ASSEMBLY

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.

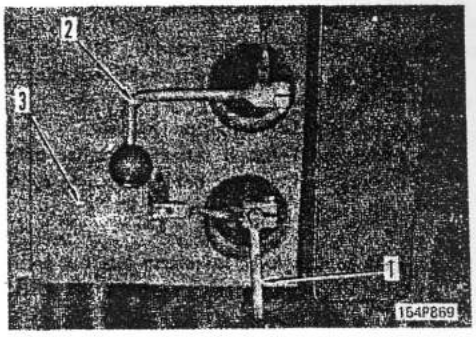
   ⊕ Fit O-ring securely in groove.
3. Install rods (4) and (5).
4. Install hose (3) between steering case and servo valve outlet, and hose (2) between steering valve and servo valve inlet.
5. Install front cover (1) of servo valve.

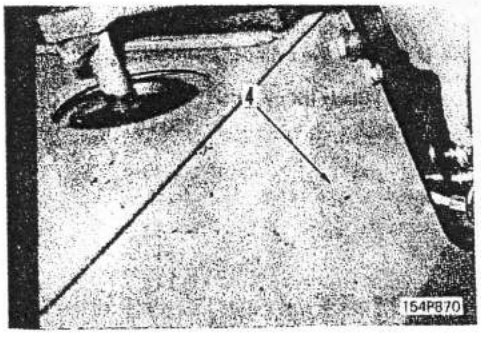


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DISMOUNTING RIPPER SERVO VALVE ASSEMBLY

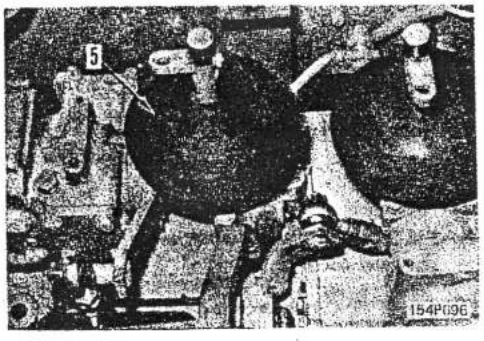
1. Disconnect blade control lever (1) and ripper control lever (2).
2. Remove upper cover (3) of servo valve.
3. Remove front cover (4) of servo valve.
4. Remove servo valve cover (5) and spring.
5. Disconnect rod (6) between servo valve and ripper control lever at servo valve end.
6. Remove servo valve assembly (7).

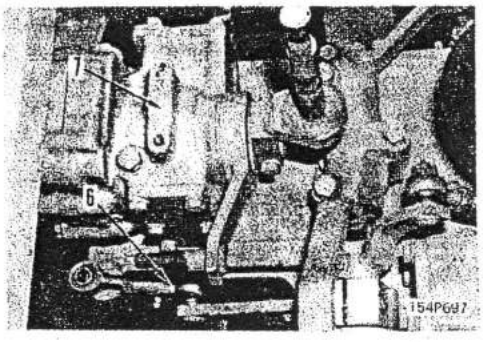




MOUNTING RIPPER SERVO VALVE ASSEMBLY

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).





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DISMOUNTING BLADE LIFT CYLINDER ASSEMBLY

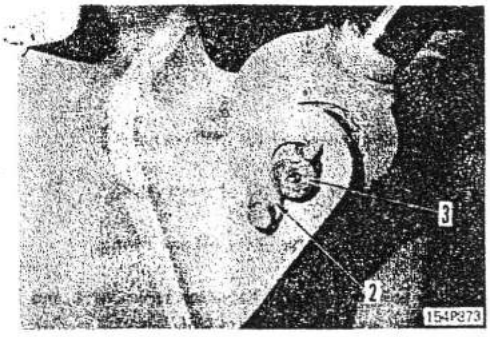
1. Hoist blade lift cylinder assembly (1), then remove lock pin (2) and pull out piston rod mounting pin (3).

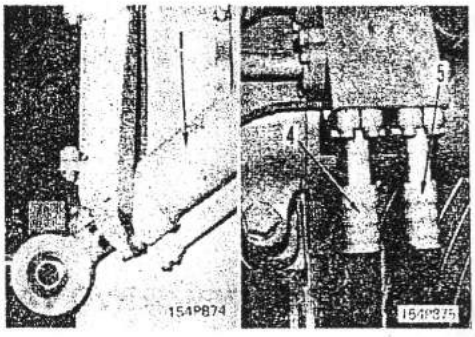
2. Start engine and retract piston rod fully.
   * When piston rod is retracted, center of gravity shifts toward cylinder bottom, causing cylinder to drop.

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.

   kg Blade lift cylinder: 150 kg (TY 220)
   160 kg (TS 220)





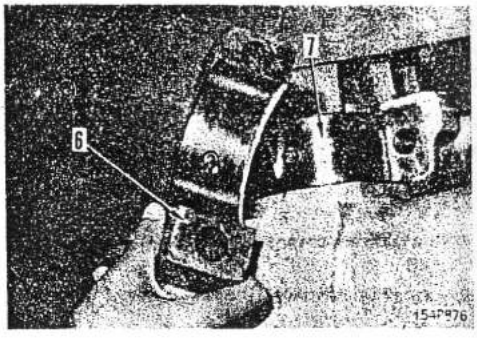
MOUNTING BLADE LIFT CYLINDER ASSEMBLY

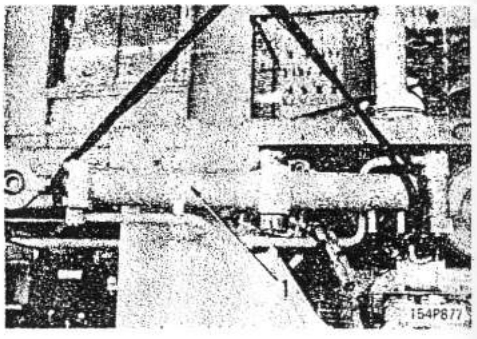
1. Hoist cylinder assembly (1) and position it at cylinder stay mount. Install bearings (7) and cylinder mounting cap (6).

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).

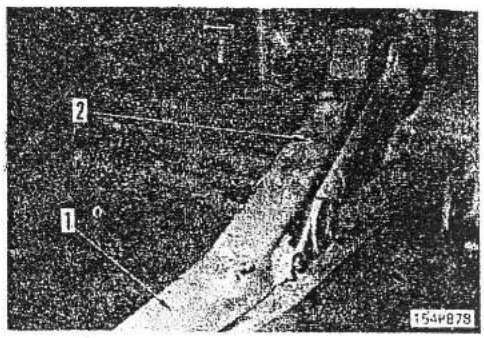


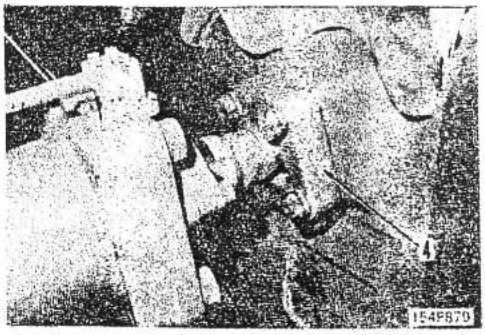


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DISMOUNTING BLADE TILT CYLINDER ASSEMBLY

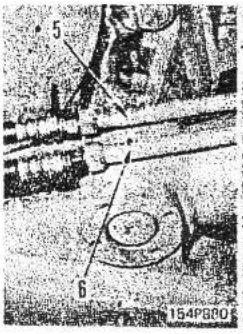
1. Remove tilt cylinder tube covers (1) and (2).
2. Hoist tilt cylinder assembly (3) and remove piston rod mounting flange (4).
   Start engine and retract cylinder rod fully.
3. Disconnecting hoses
   Stop engine and operate blade tilt control lever to release internal pressure in cylinder. Then disconnect 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.
   kg Tilt cylinder: 165 kg

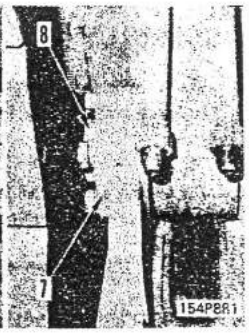


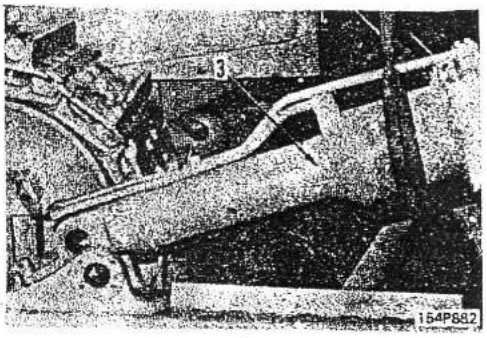


MOUNTING BLADE TILT CYLINDER ASSEMBLY

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.



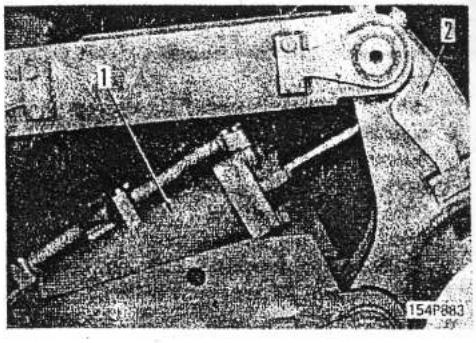


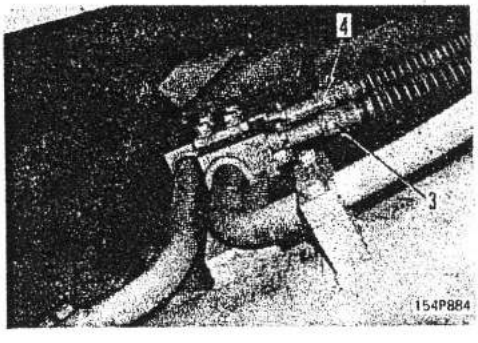


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DISMOUNTING RIPPER CYLINDER ASSEMBLY

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 (ϕ16 mm) to pull out pin (5) at bottom of cylinder.
4. Hoist cylinder assembly (1) and remove.



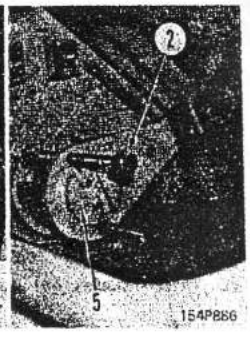


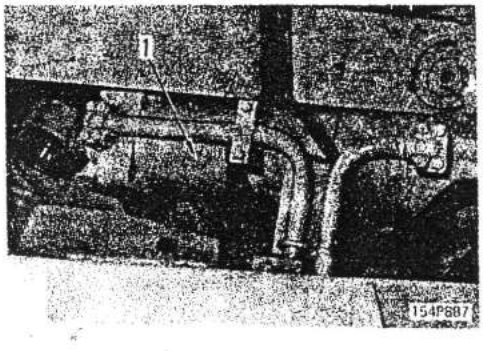
MOUNTING RIPPER CYLINDER ASSEMBLY

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.

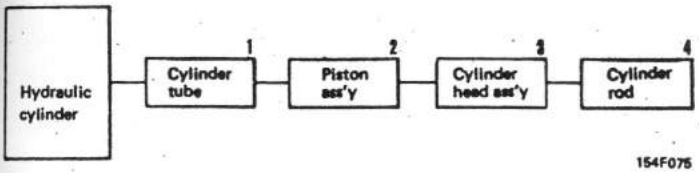






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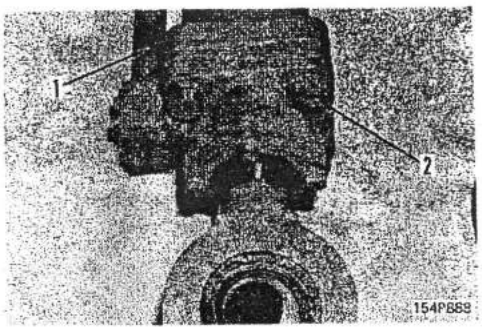
DISASSEMBLY OF CYLINDER ASSEMBLY



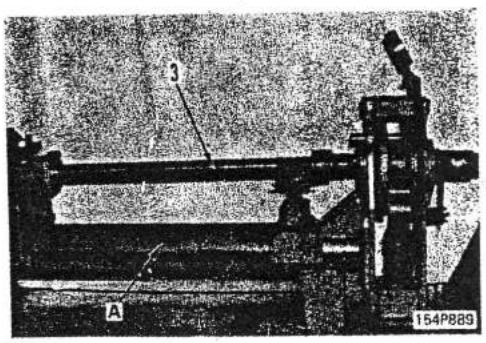
Special tools required

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.



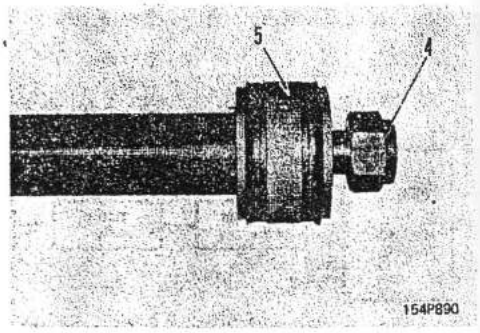
2. **Piston assembly**
   1) Set piston rod assembly (3) in cylinder overhaul stand A.



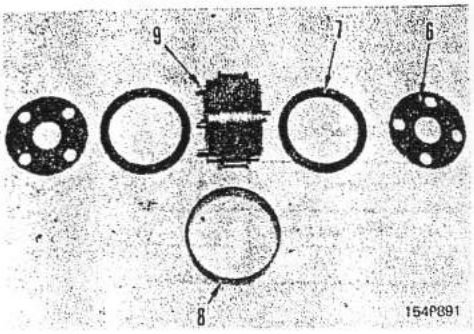
https://truckmanualshub.com/

2) Remove nut (4) with wrench.
★ Width of piston mounting nut face: 60 mm

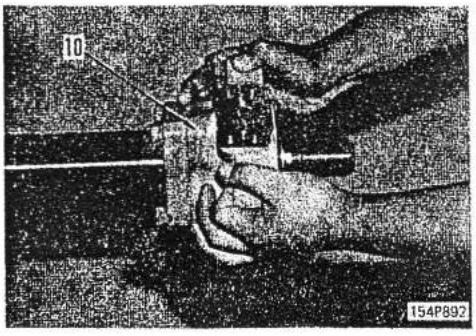
3) Remove piston assembly (5).



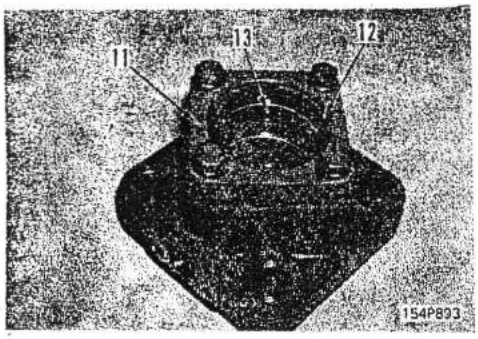
4) Remove retainer (6), U-packing (7), wear ring (8) and piston valve (9).



3. Cylinder head assembly
1) Remove cylinder head assembly (10).



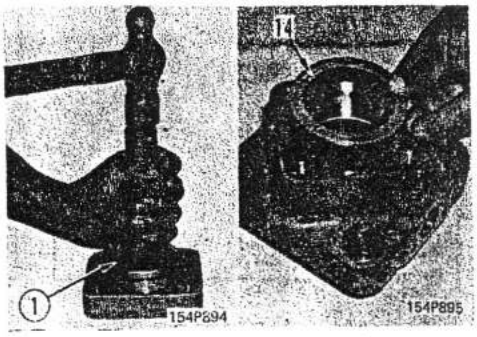
2) Remove gland (11) and dust seal (12).



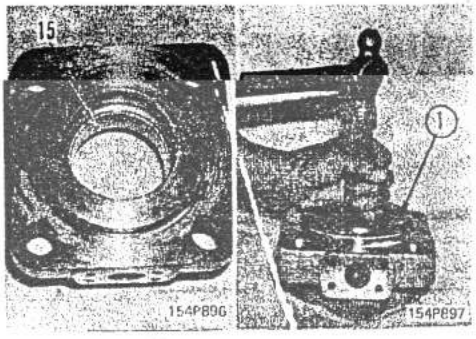
https://truckmanualshub.com/

3) Using pushing tool 1 (ϕ70 mm), remove bushing (13).

4) Remove U-ring (14).

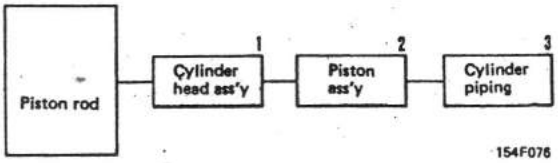


5) Using pushing tool 1 (ϕ70 mm), remove bushing (15).



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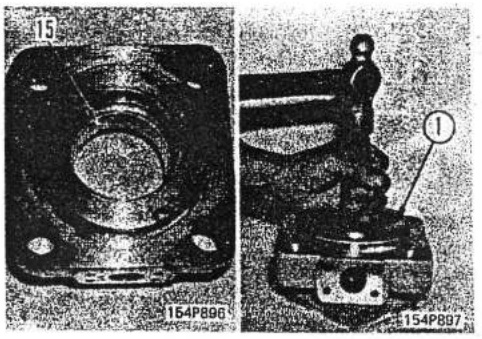
ASSEMBLY OF CYLINDER ASSEMBLY



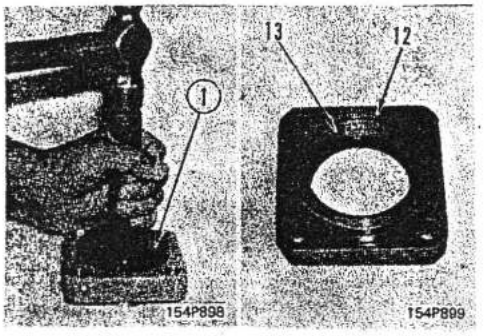
Special tools required

Part Name	A
Cylinder overhaul stand	1
Pump	1

1. **Cylinder head assembly**
   1) Using pushing tool 1 (ϕ70 mm), press-fit bushing (15).

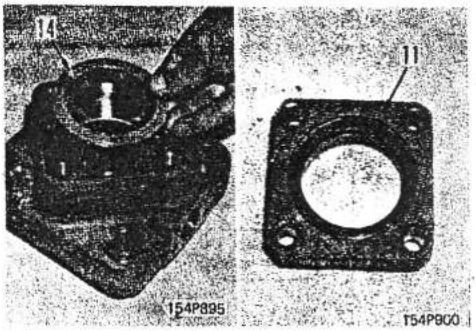


   2) Using pushing tool 1 (ϕ70 mm), press-fit bushing (13).
   3) Using pushing tool 1 (ϕ70 mm), press-fit oil seal (12).



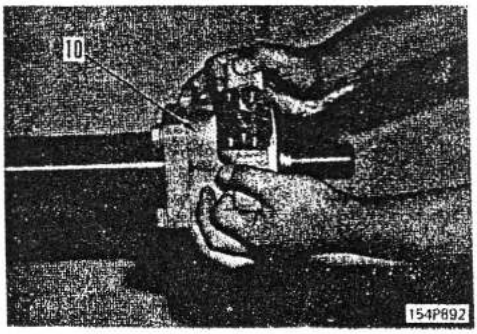
https://truckmanualshub.com/

4) Install U-ring (14) and attach gland (11).



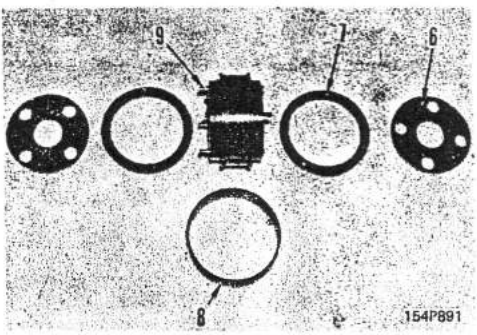
5) Fit O-ring and install cylinder head assembly (10).

⊕ Fit O-ring securely in groove.



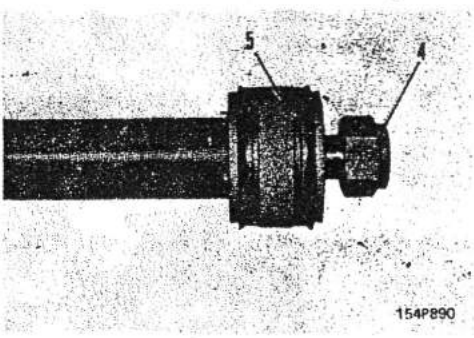
2. Piston assembly

1) Install piston valve (9), wear ring (8), U-packing (7) and retainer (6).



2) Install piston assembly (5).

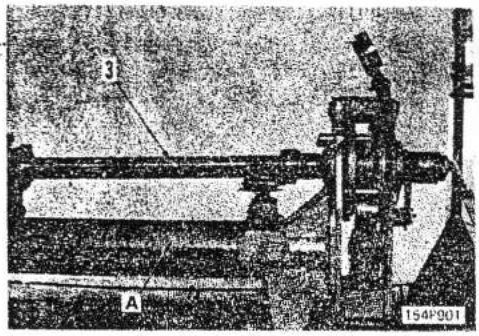
3) Temporarily tighten nut (4).
★ Width across flats: 60 mm



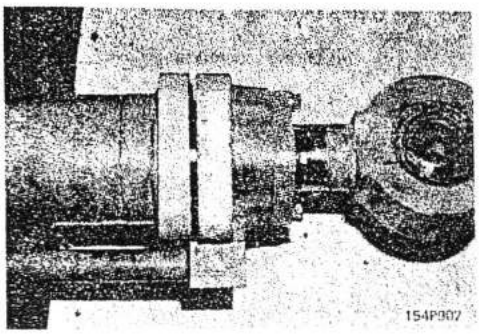
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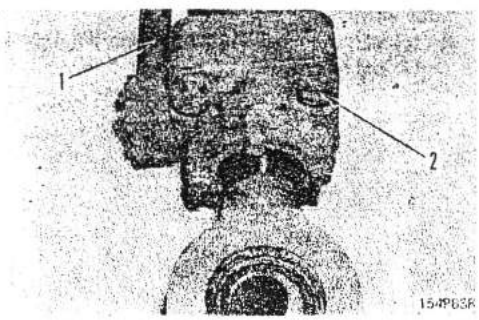
4) Set piston rod assembly (3) in cylinder overhaul stand A and tighten with wrench.

Nut: 150 ± 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.



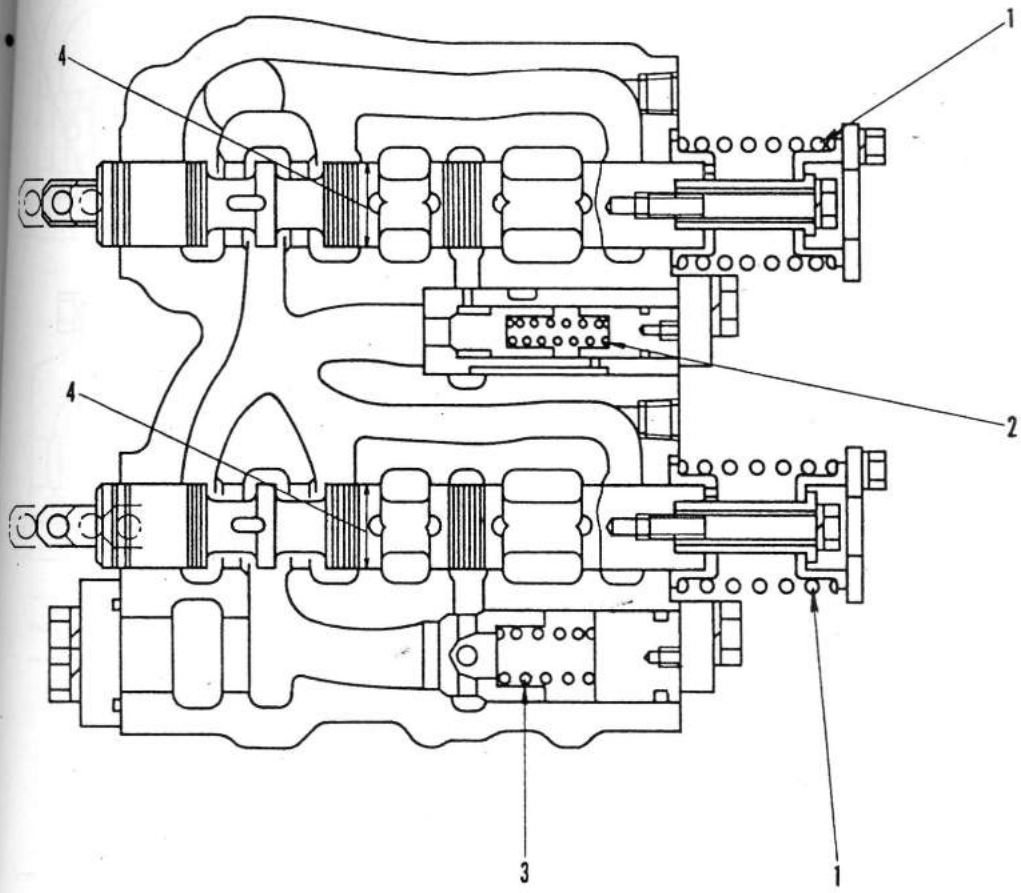


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MAINTENANCE STANDARD

ORK EQUIPMENT CONTROL VALVE

BLADE LIFT AND TILT VALVE



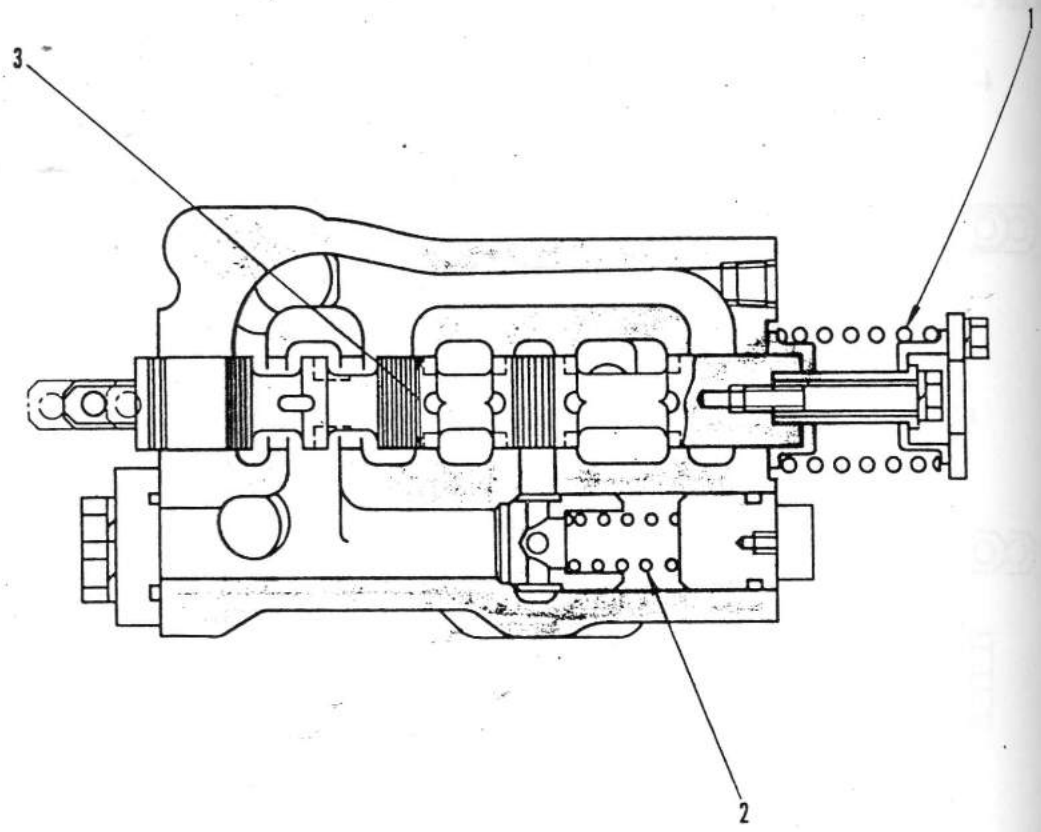
Unit : mm

No.	Check item	Criteria					Remedy
			Standard size			Repair limit	
1	Spool spring		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	555	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	

Replace

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(2) RIPPER VALVE TY 220

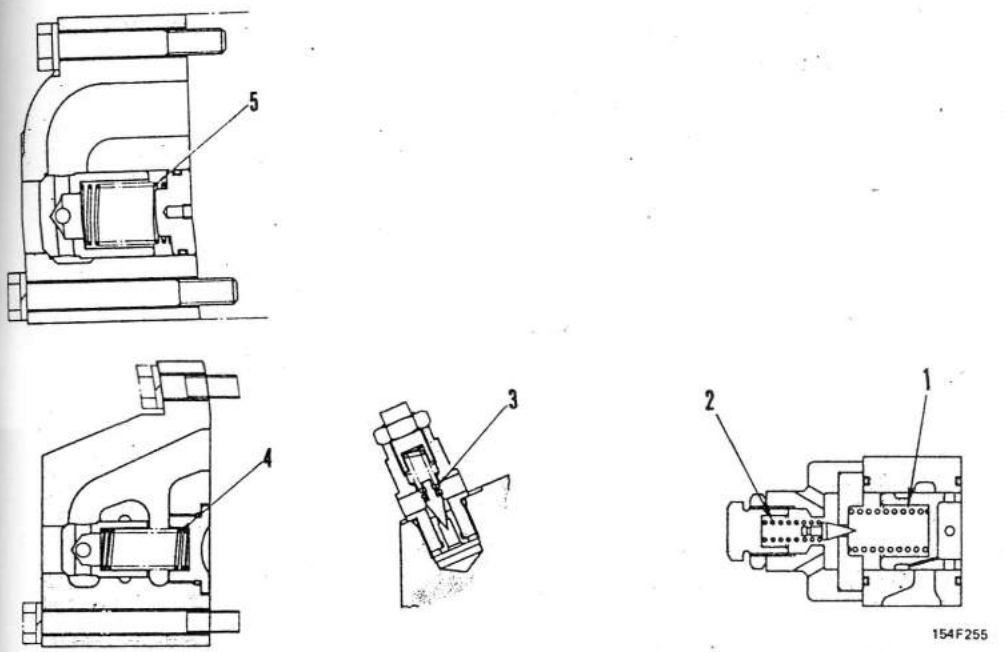


Unit : mm

No	Check item	Criteria					Remedy
1	Spool spring		Standard size			Repair limit		
			Free length X O. D	Installation length	Installation load	Free length	Installation load	
			120 x 56	72	12 kg	110	9.6 kg	
2	Check valve spring		84.7 x 26.6	47:5	1.3 kg	79	1.1 kg	Replace
3	Clearance between spool and valve body			Standard size		Standard clearance		
				40		0.018 ~ 0.023		

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MAIN RELIEF, SUCTION AND SAFETY VALVE



154F255

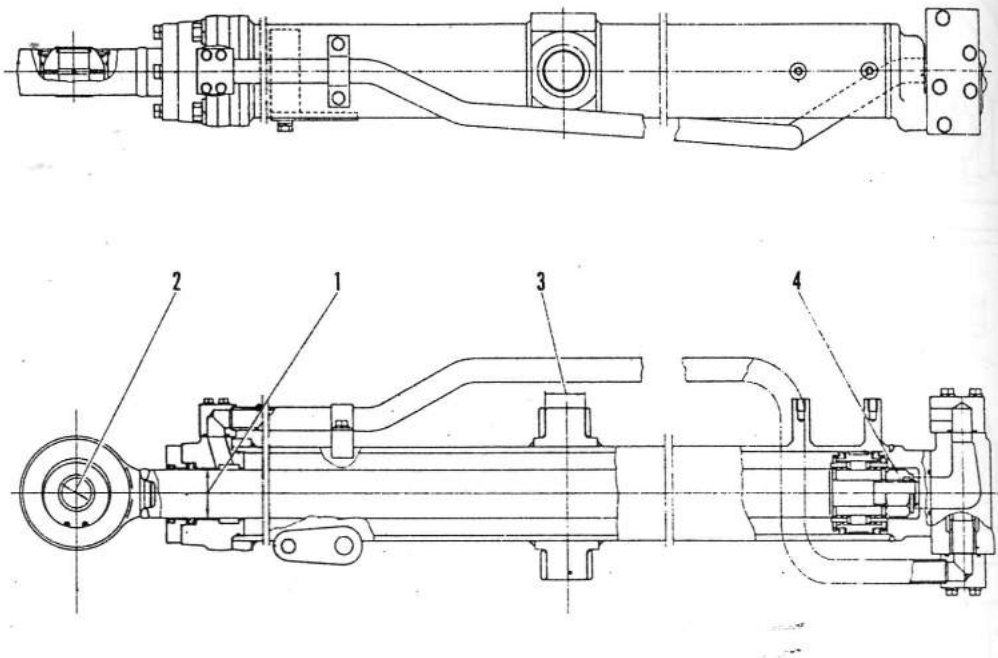
Unit: mm

No	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Flee length x O.D.	Installation length	Installation load	Free length	Installation load	
1	Main relief valve spring (Large)						
		60×22.6	43	10 kg		9Kg	
2	Main relief valve spring (Small)						
		37.1×11.3	30	27.3 kg		22kg	Replace
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/cm²					Adjust
7	Safety valve set pressure	160 kg/cm²					

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WORK EQUIPMENT CYLINDER

(1) BLADE LIFT CYLINDER



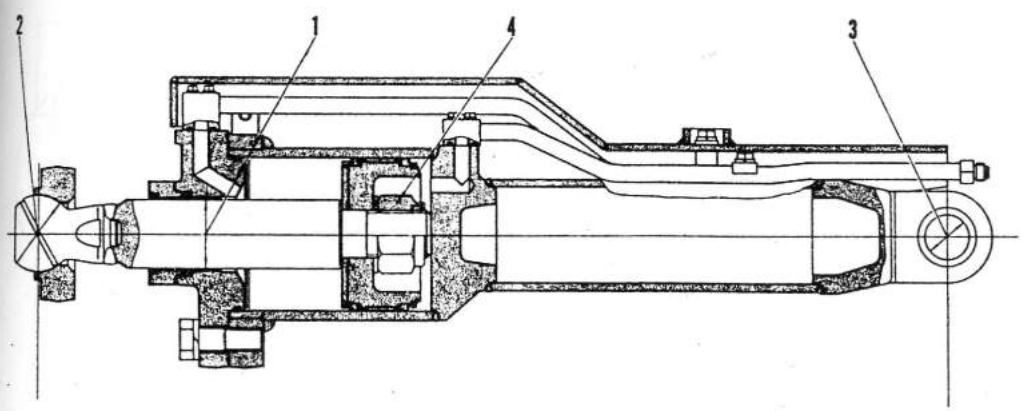
154F256

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
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 ± 18kg.m					Adjust

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(2) BLADE TILT CYLINDER



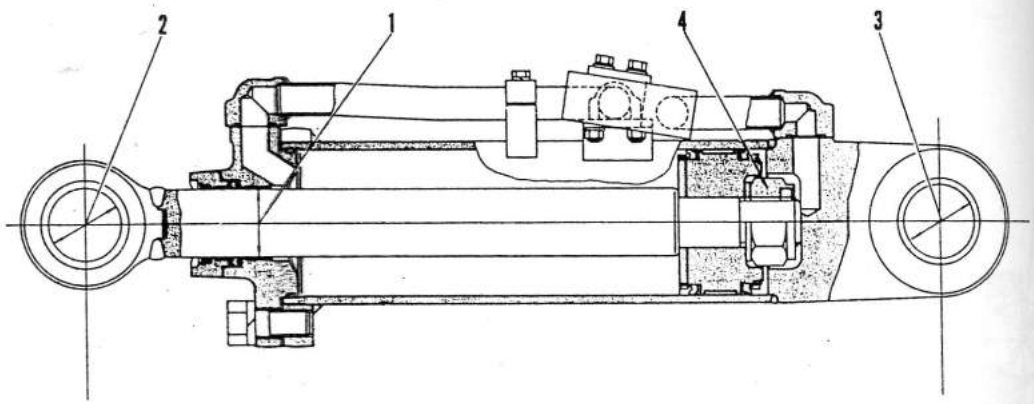
154F257

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
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 hed and cap	100	0 −0.1	+0.5 +0.2	0.200 ~ 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

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(3) RIPPER CYLINDER TY 220



154F258

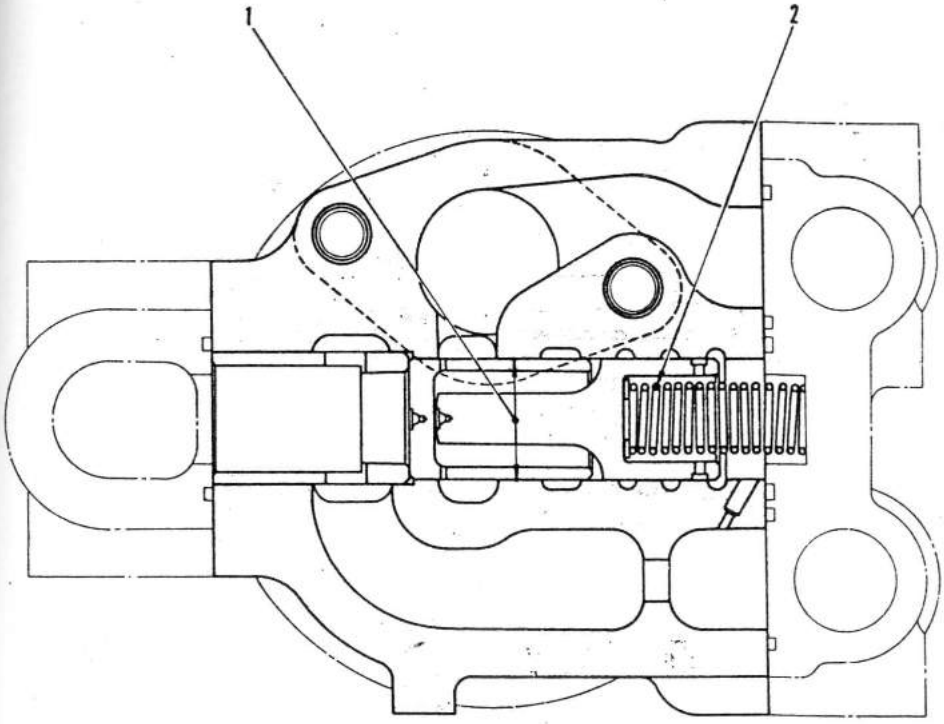
Unit: mm

No.	Check item	Clearance					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
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	+0.286 +0.184	0.214 ~ 0.364	1	
3	Clearance between cylinder bottom bushing and pin	75	−0.030 −0.076	+0.286 +0.184	0.214 ~ 0.362	1	
4	Tightening torque of piston nut	405 ± 40.5					Adjust

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QUICK DROP VALVE

TS 220



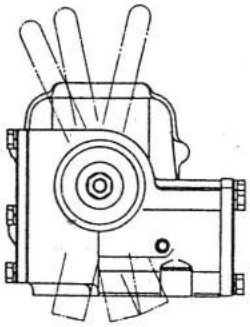
154F275

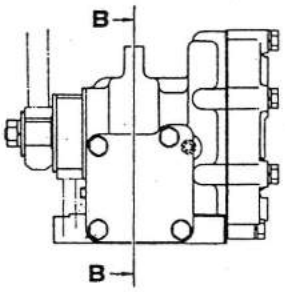
Unit: mm

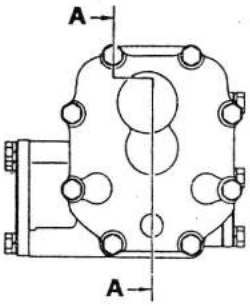
No.	Check item	Criteria					Remedy
1	Clearance between plunger and valve body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		38	−0.011 −0.016	+0.010 0	0.013 ~ 0.018	0.024	
2	Valve spring	Standard size			Repair limit		
		Free length x O.D.	Installation length	Installation load	Free length	Installation load	
			55.9	13.9			

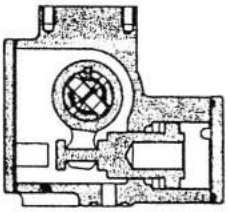
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ROTARY SERVO VALVE

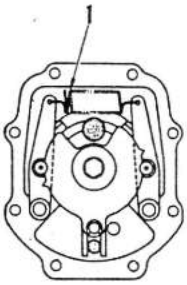




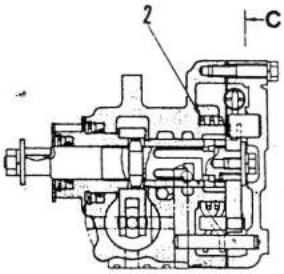




Section B - B



Section C - C



Section A - A C

154F259

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Input lever spring	Free length x O.D.	Installation length	Installation load	Free length	Installation load	Replace
2	Detent spring						

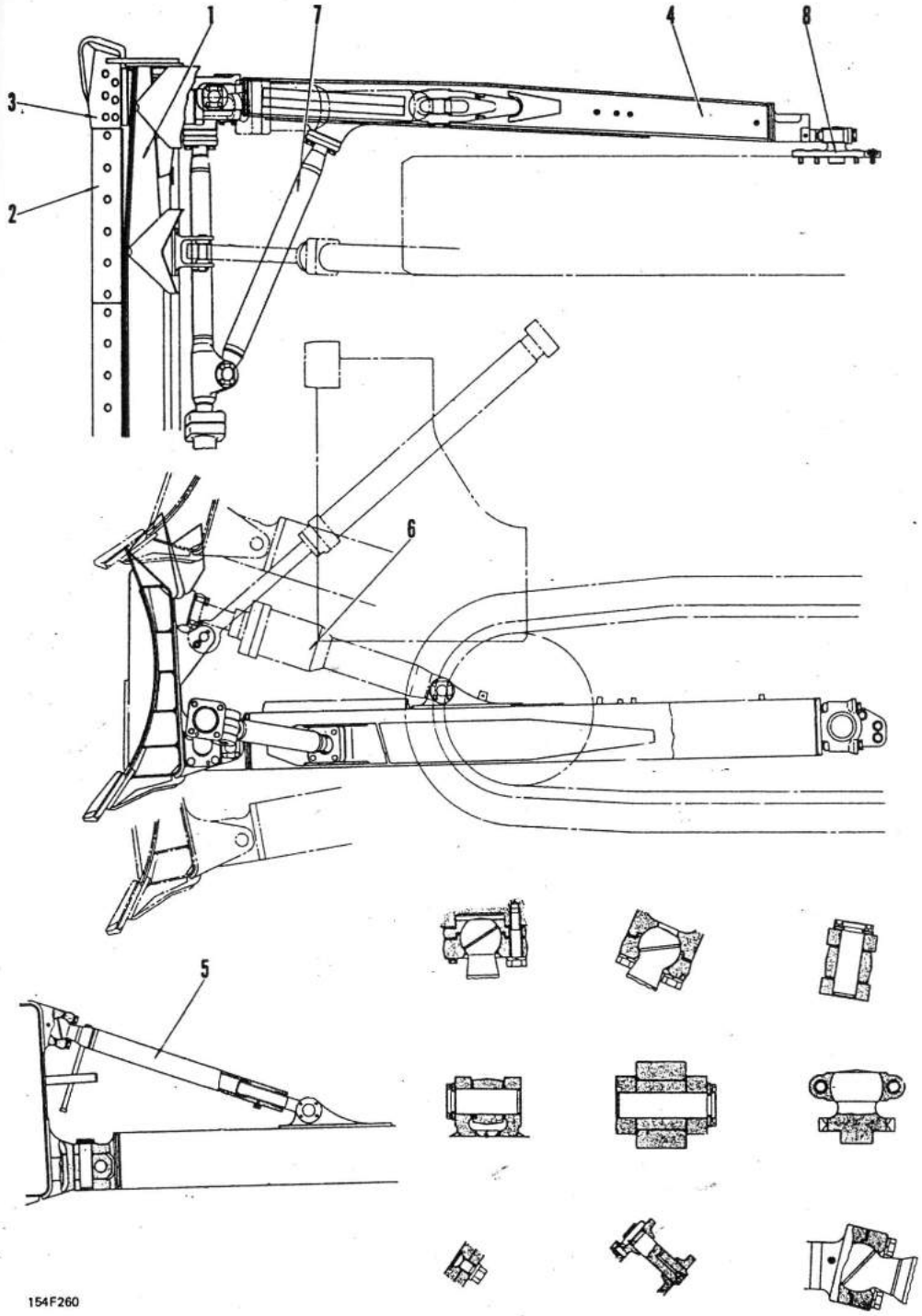
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WORK EQUIPMENT

https://truckmanualshub.com/

STRUCTURE AND FUNCTION

STRAIGHT TILTDOZER TY 220



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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.

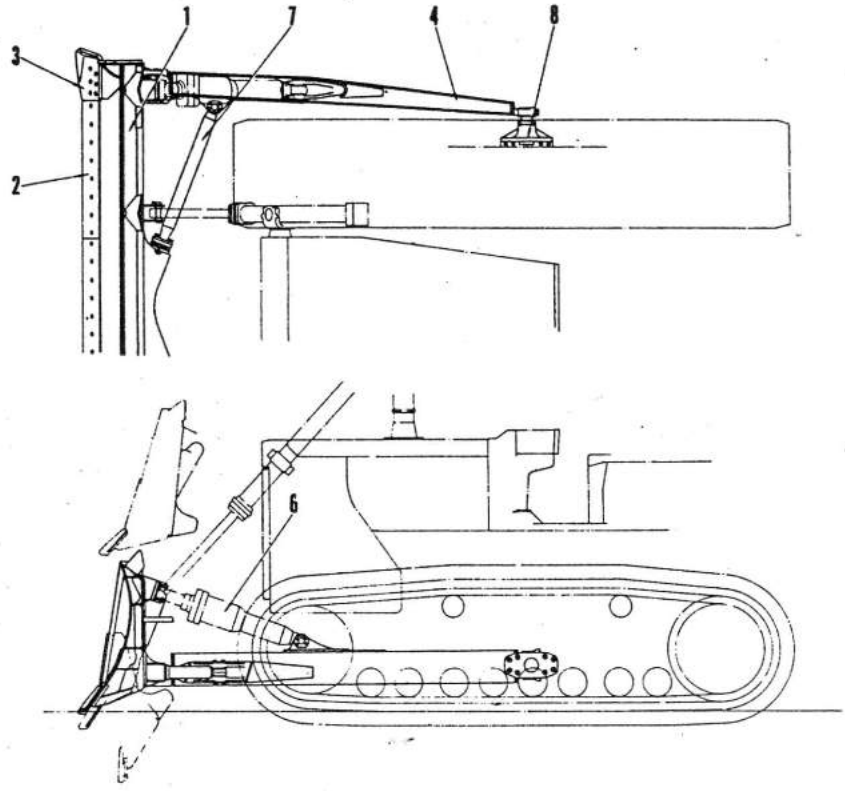
STRAIGHT-TILTDOZER

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 madeof 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 is 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.

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STRAIGHT TILTDOZER TS 220



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STRUCTURE

The work equipment system is divided into the work equipment and the hydraulic control device which controls the work equipment.
In TS220 machines, angledozer, straightdozer and straight-tiltdozer are three representative hydaulic equipments. Straight-tiltdozer is explained in this section.

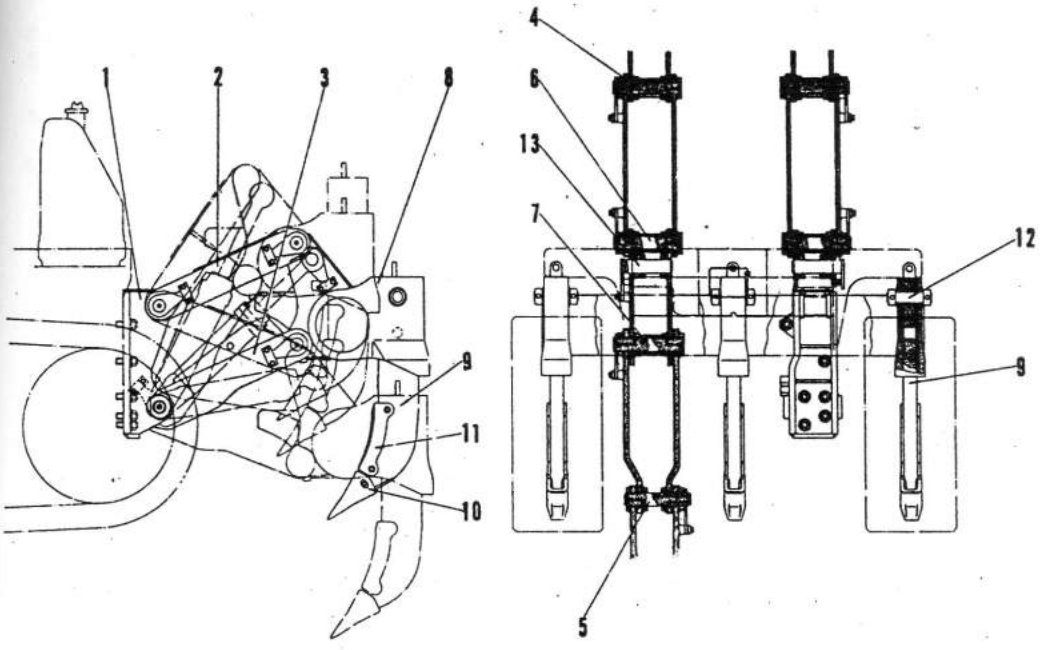
STRAIGHT-TILTDOZER

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 allov 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 (6) at their left side.
In addition, a relief mechanism for tilting is applied at the center of back side of blade.

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FIXED MULTI-SHANK RIPPER TY 220



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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.

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

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 explansion 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)).

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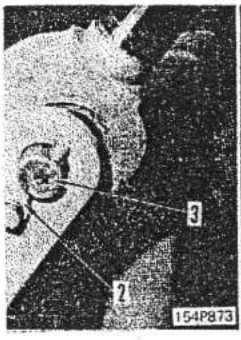
DISASSEMBLY AND ASSEMBLY

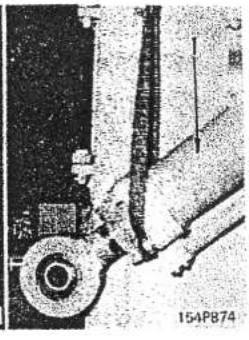
DISMOUNTING BLADE ASSEMBLY

⚠ Place blocks (height: 370 mm) under I-frames.

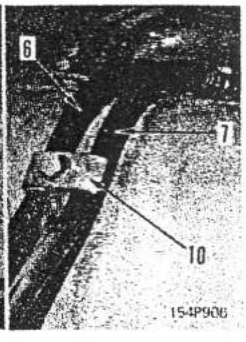
Stop engine, then operate tilt control lever two or three times to release internal pressure in piping.

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).



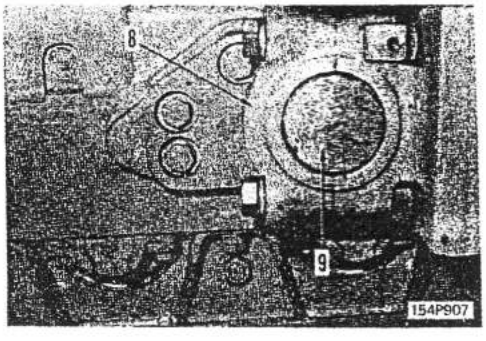


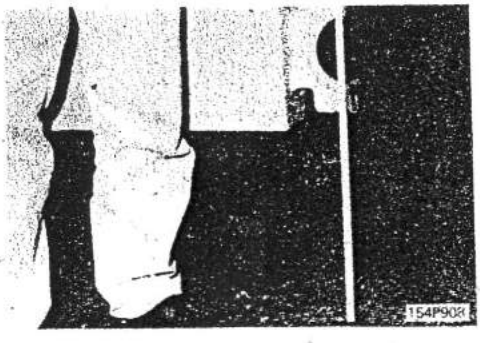


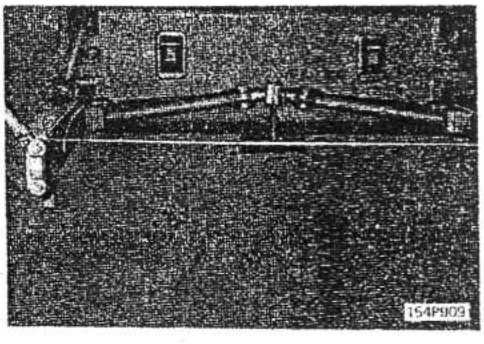


MOUNTING BLADE ASSEMBLY

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 (9).
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).

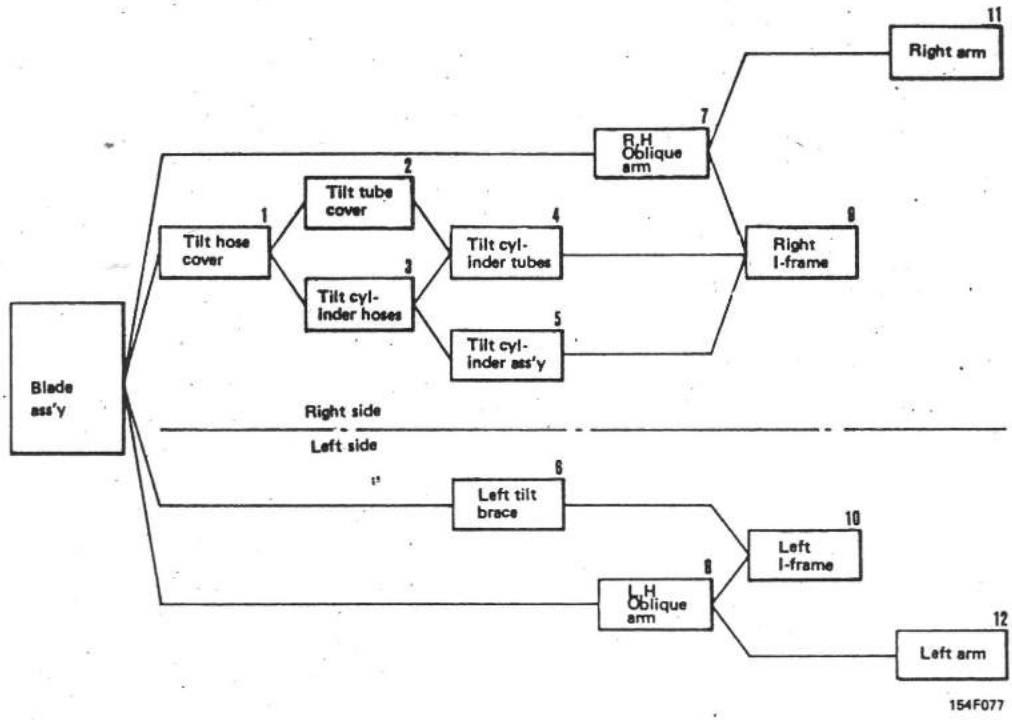






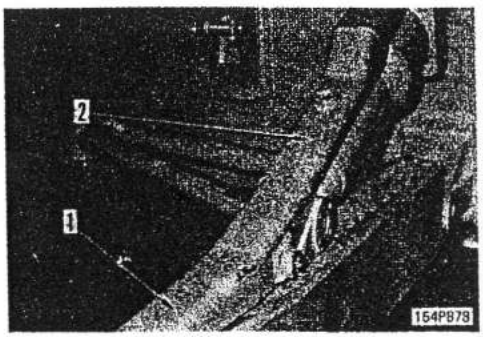
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DISASSEMBLY OF BLADE ASSEMBLY



1. **Tilt hose cover**
   Remove hose cover (1).

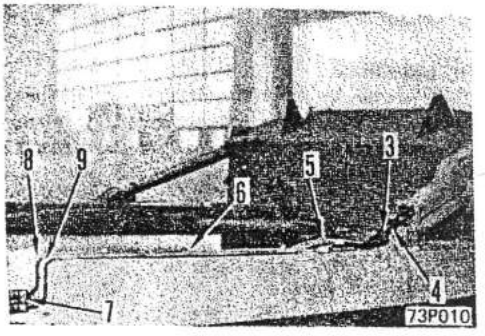
2 **Tilt tube cover**
   Remove tube cover (2).



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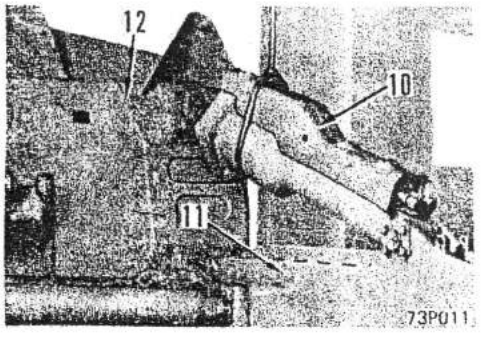
3. **Tilt cylinder hoses**
   Disconnect hoses (3) and (4).

4. **Tilt cylinder tubes**
   Release clamps (5), (6) and (7) and remove tubes (8) and (9).



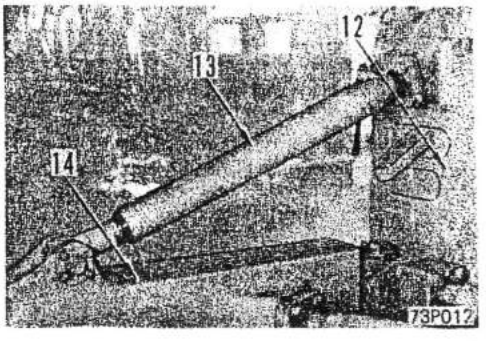
5. **Tilt cylinder assembly**
   Sling tilt cylinder assembly (10) with crane, disconnect it from I-frame (11) and blade (12), and lift away.
   ★ Note number and thickness of shims at blade ball joint for later reference.

   kg 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.

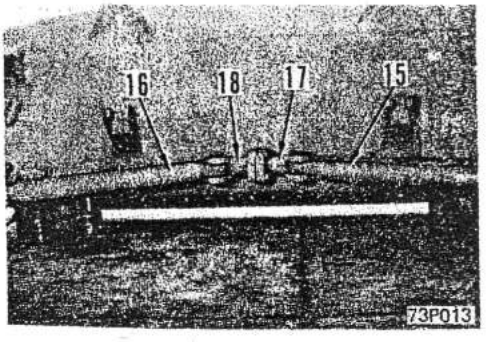
   kg Tilt brace: 65 kg



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.

   kg Oblique arm: 60 kg

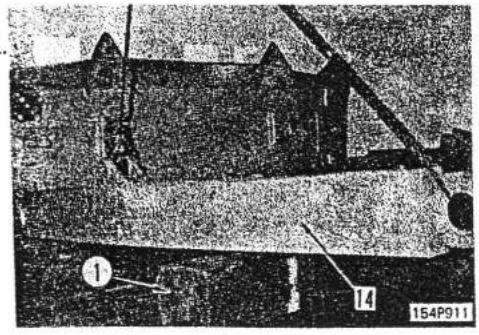


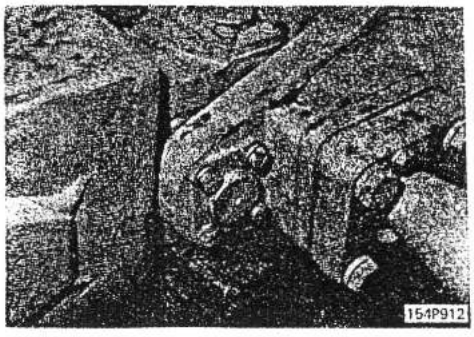
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9. Right I-frame

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.

kg I-frame: 350 kg





11. Right arm

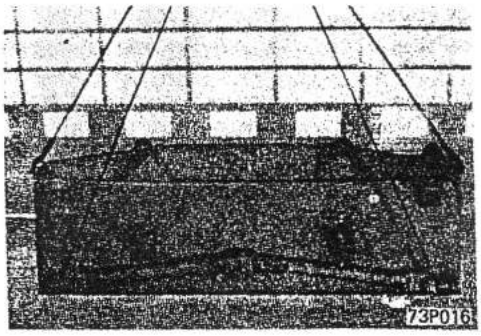
12. Left arm
1) Lower blade and lay it flat on ground.

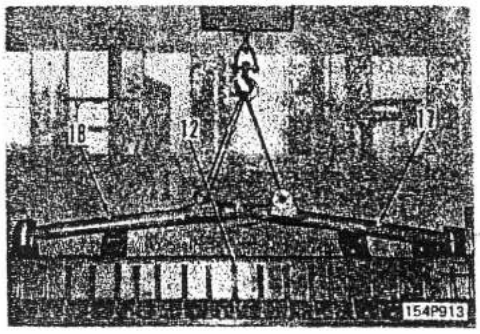
2) Sling right arm (17) and left arm (18) with crane, disconnect from blade (12) and lift away.

kg Arms: 90kg

★ Note number and thickness of shims at ball joint at both ends for later reference.

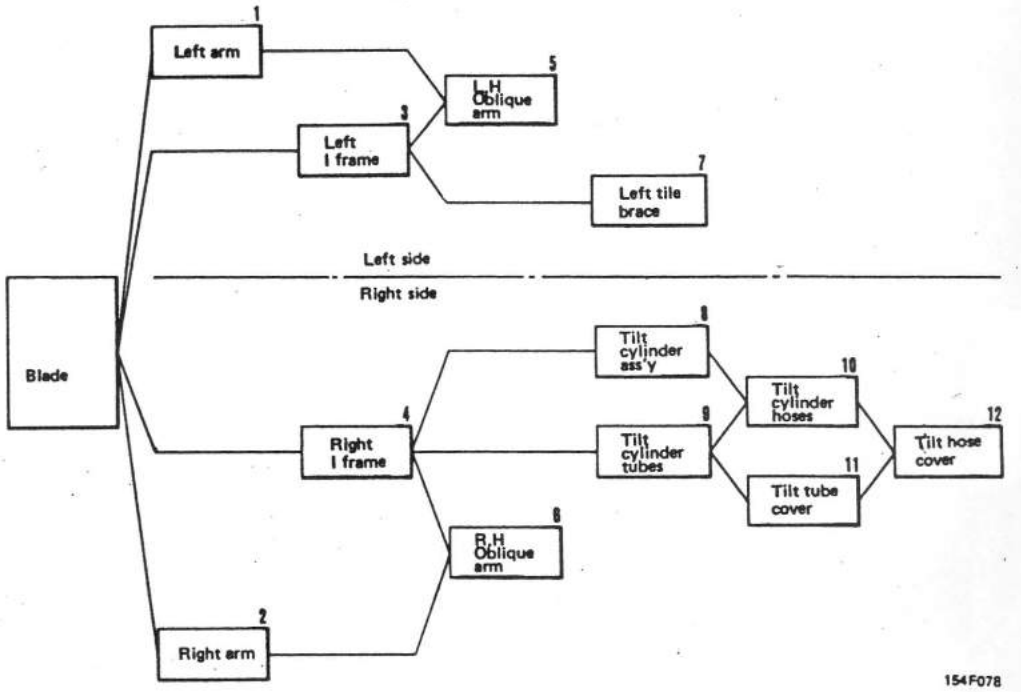
kg Blade assembly: 1,600 kg





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ASSEMBLY OF BLADE ASSEMBLY



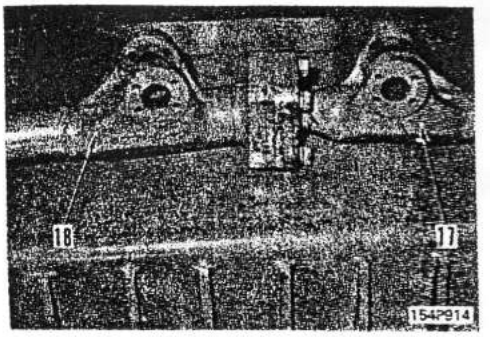
1. **Left arm**

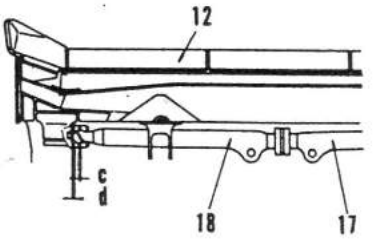
2. **Right arm**

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.

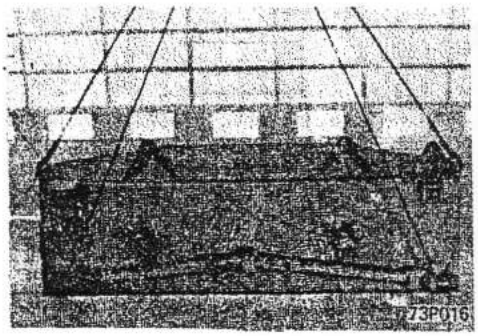


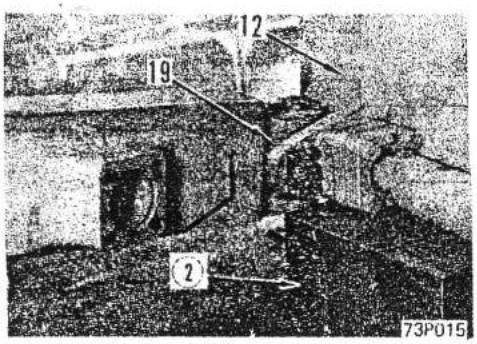


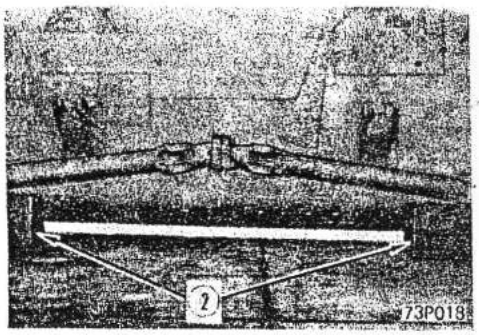
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3. **Left I-frame**
   1) Sling blade with crane, insert blocks 2 under arm mounts to keep blade in standing position.

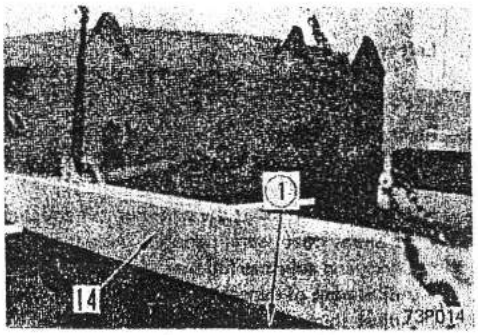
   2) Attach joint (19) to I-frame (14), lift with crane and connect to blade (12).



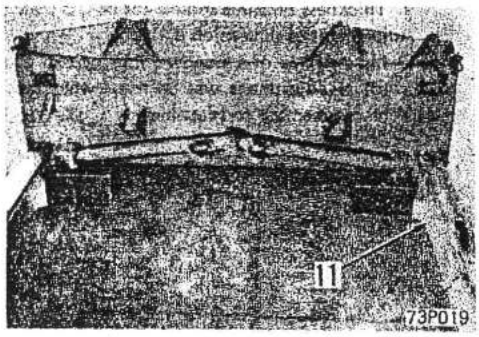




   3) Insert block 1 under I-frame so that center of I-frame trunnion mount is 442.5 mm from ground.



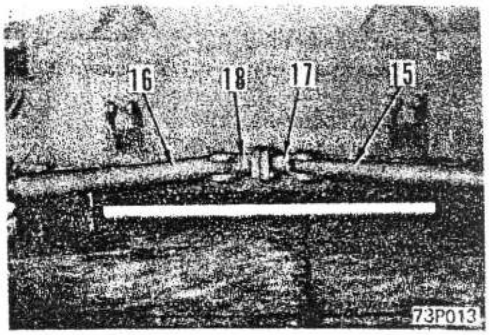
4. **Right I-frame**
   Mounting procedure for right I-frame (11) is same as for left I-frame.



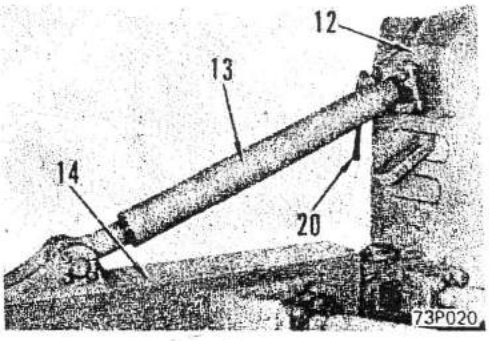
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5. **L.H Oblique arm**

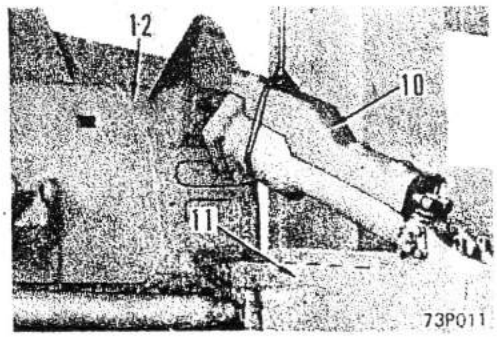
6. **R.H Oblique arm**
   Sling L.H oblique arm (16) and R.H oblique arm (15) with crane, and connect to arms (18) and (17), and I-frame (14) and (11).
   - ★ Adjust shims at ball joint so that axial play is less than 1 mm, but ball can still turn smoothly.
   - ★ Thickness of shims should not be less 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.



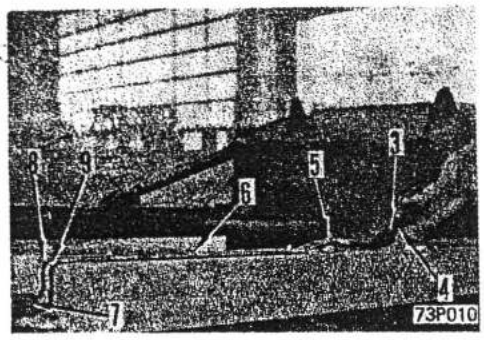
8. **Tilt cylinder assembly**
   1) Sling tilt cylinder assembly (10) with crane and connect to blade (12).
      - ★ Adjust shims at joint face so that axial play of ball is less than 1 mm, but ball can still turn smoothly.
   2) Extend cylinder with a bar to align pin hole for connection to I-frame (11), then connect.
      - ★ NOTE: Oil comes out when extending cylinder, so prepare a container.



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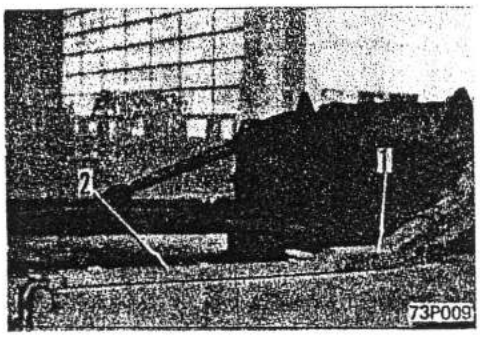
9. **Tilt cylinder tubes**
   Secure tubes (8) and (9) with clamps (5), (6) and (7).

10. **Tilt cylinder hose**
    Install hoses (3) and (4).



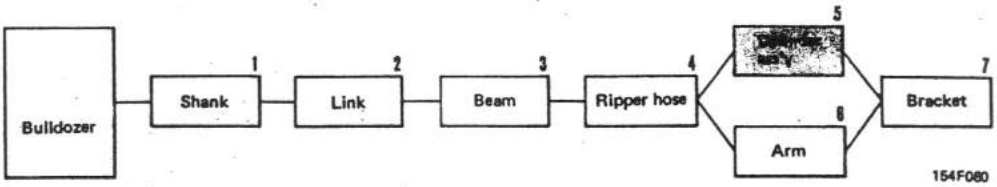
11. **Tube cover**
    Install tube cover (2).

12. **Hose cover**
    Install hose cover (1).



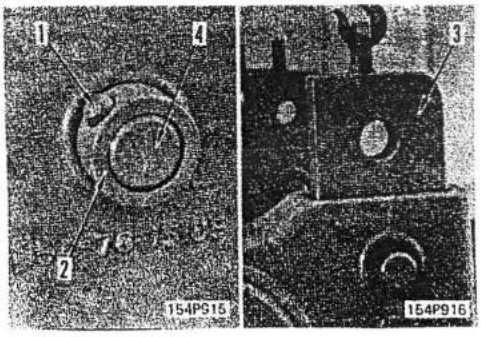
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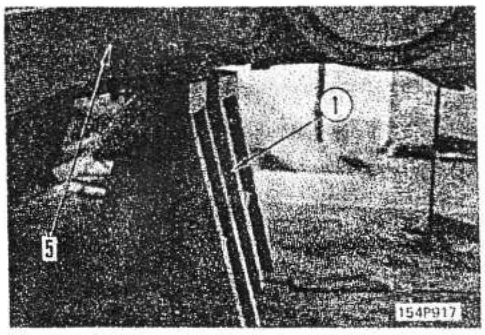
DISASSEMBLY OF RIPPER ASSEMBLY



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.

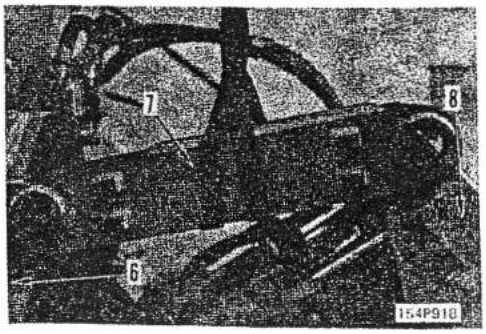
      kg Shank: 200 kg
   4) Insert block 1 (height: approx. 700 mm) under arm to keep ripper assembly (5) in position.





2. **Link**
   Hoist link (7) and remove mounting pin of bracket (6) and beam (8).

   kg Link: 93 kg

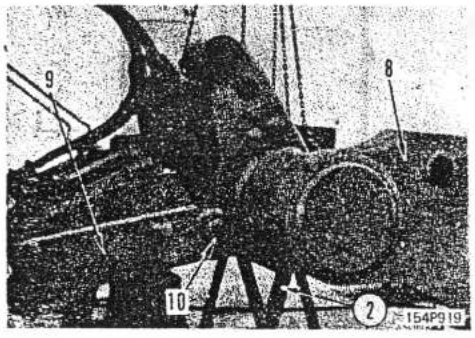


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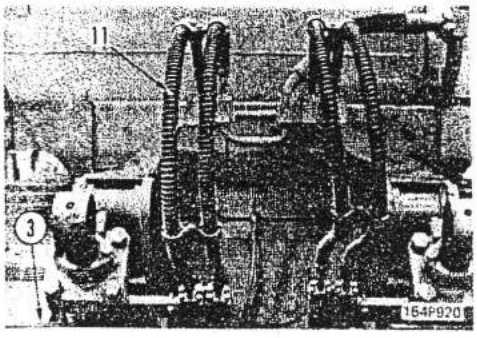
3. Beam
   1) Sling beam (8) and pull out mounting pin at cylinder head. Start engine and fully retract cylinder rod.
   2) Raise beam (8) and after inserting block 2 (height: approx. 1000 mm) under beam, lower it again.
   3) Remove mounting pin (10) connecting beam and arm (9). Lift beam and remove.

      kg Beam: 1150 kg

      ★ Insert block 3 under cylinder.



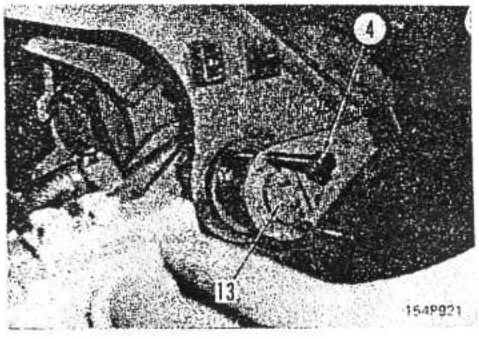
4. Ripper hose
   Remove hose (11) between ripper control valve and cylinder assembly.

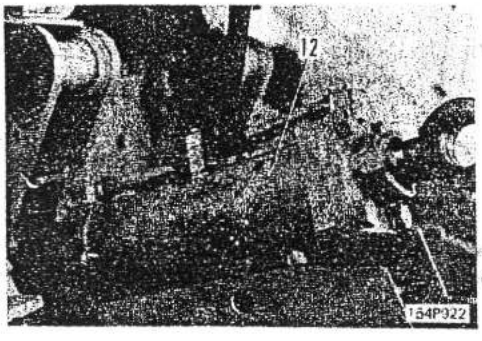


5. Cylinder assembly
   Using jack bolt (4) (ϕ16 mm, P = 1.8), pull out pin (13) connecting arm and cylinder assembly (12). Lift cylinder assembly and remove.

   kg Cylinder assembly: 115 kg

   ★ Leave mounting pin in arm.

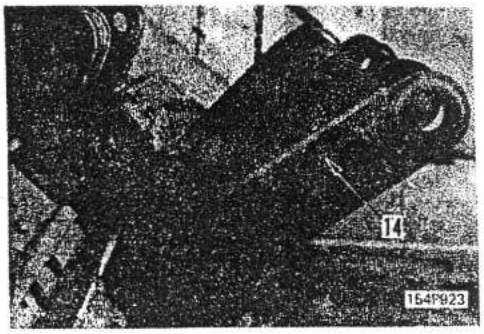




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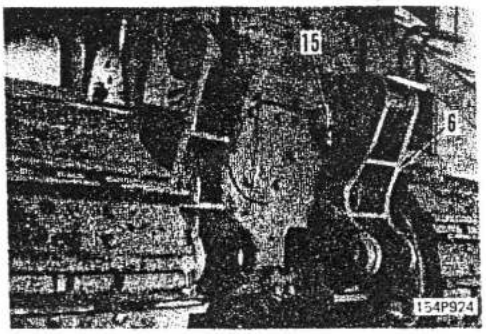
6. Arm
Hoist arm (14), pull out mounting pin and remove arm.

kg Arm: 380 kg



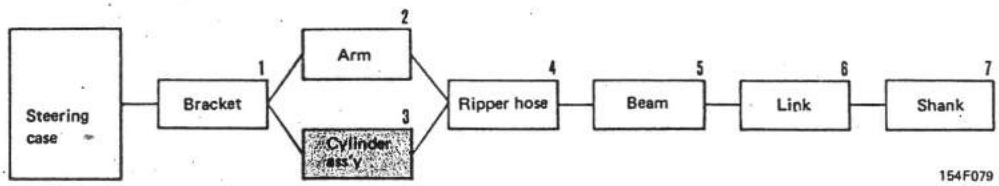
7. Bracket
Hoist bracket (6), remove mounting nut (15) and lift away bracket.

kg Bracket: 125 kg



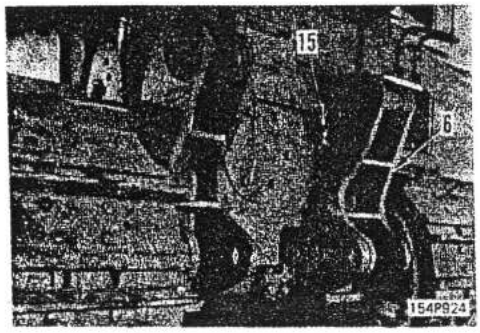
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ASSEMBLY OF RIPPER ASSEMBLY

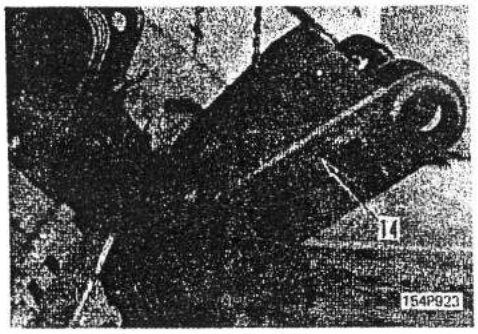


1. **Bracket**
   Lift bracket (6) and insert mounting bolt (15).

   Bracket: 225 ± 25 kg.m



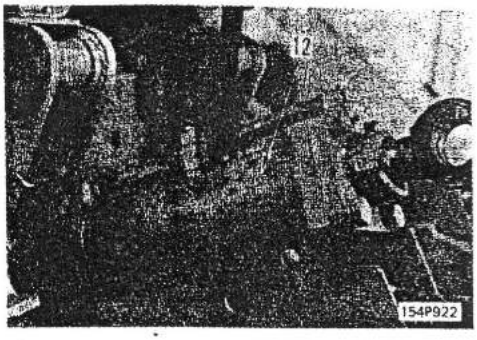
2. **Arm**
   Sling arm (14), align with bracket holes and temporari ly insert mounting pin (13).
   ★ Insert mounting pin so that bottom of cylinder can enter.

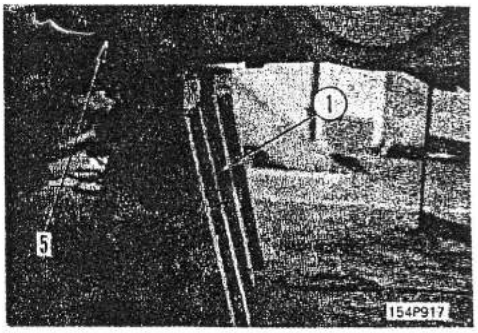




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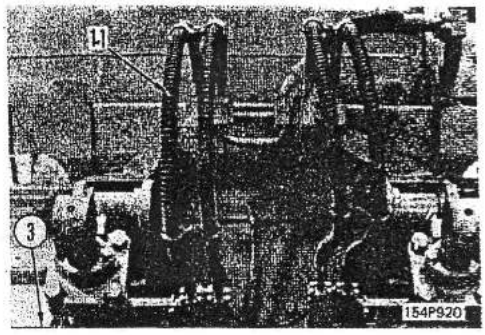
3. **Cylinder assembly**
   1) Lift cylinder assembly (12) and aligning it with holes in bracket and arm, insert and lock mounting pin (13).
   2) Insert block 1 (height: approx. 700 mm) under arm to keep it in position.
   3) Insert block 3 under head of cylinder assembly.



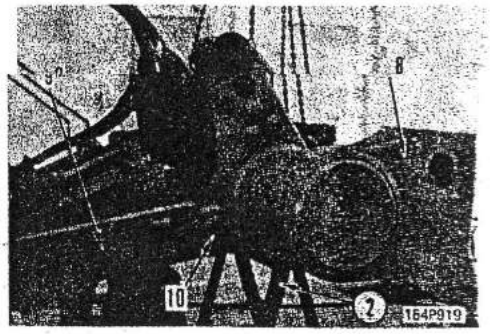


4. **Ripper hose**
   Fit O-ring and install hose (11) between ripper control valve and cylinder assembly.

   ⊕ Fit O-ring securely in groove.

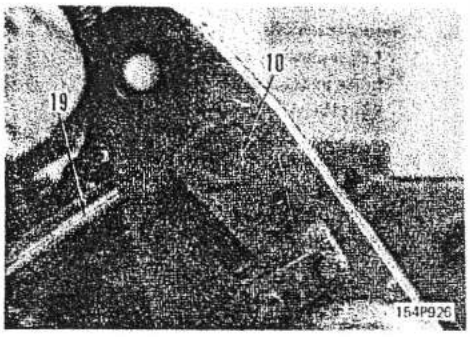


5. **Beam**
   1) Lift beam (8) and aligning it with hole in arm (9), insert and lock mounting pin (10).
   2) Lift beam and insert block 2 (height: approx. 1000 mm) under beam to keep it in position.

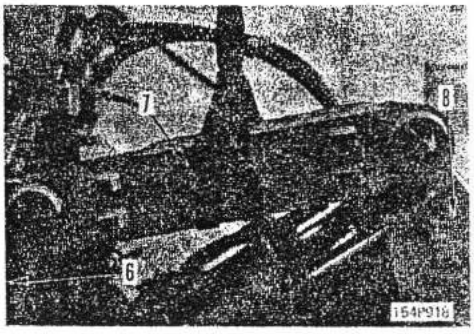


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3) Start engine and extend cylinder rod (19). Align with hole in beam and insert mounting pin (10).

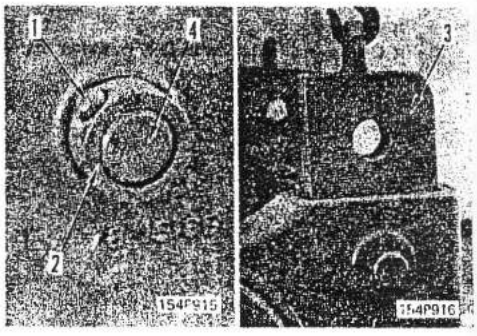


6. Link
Lift link (7) and aligning it with holes on both sides of bracket (6) and beam (8) insert and lock mounting pin.



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).

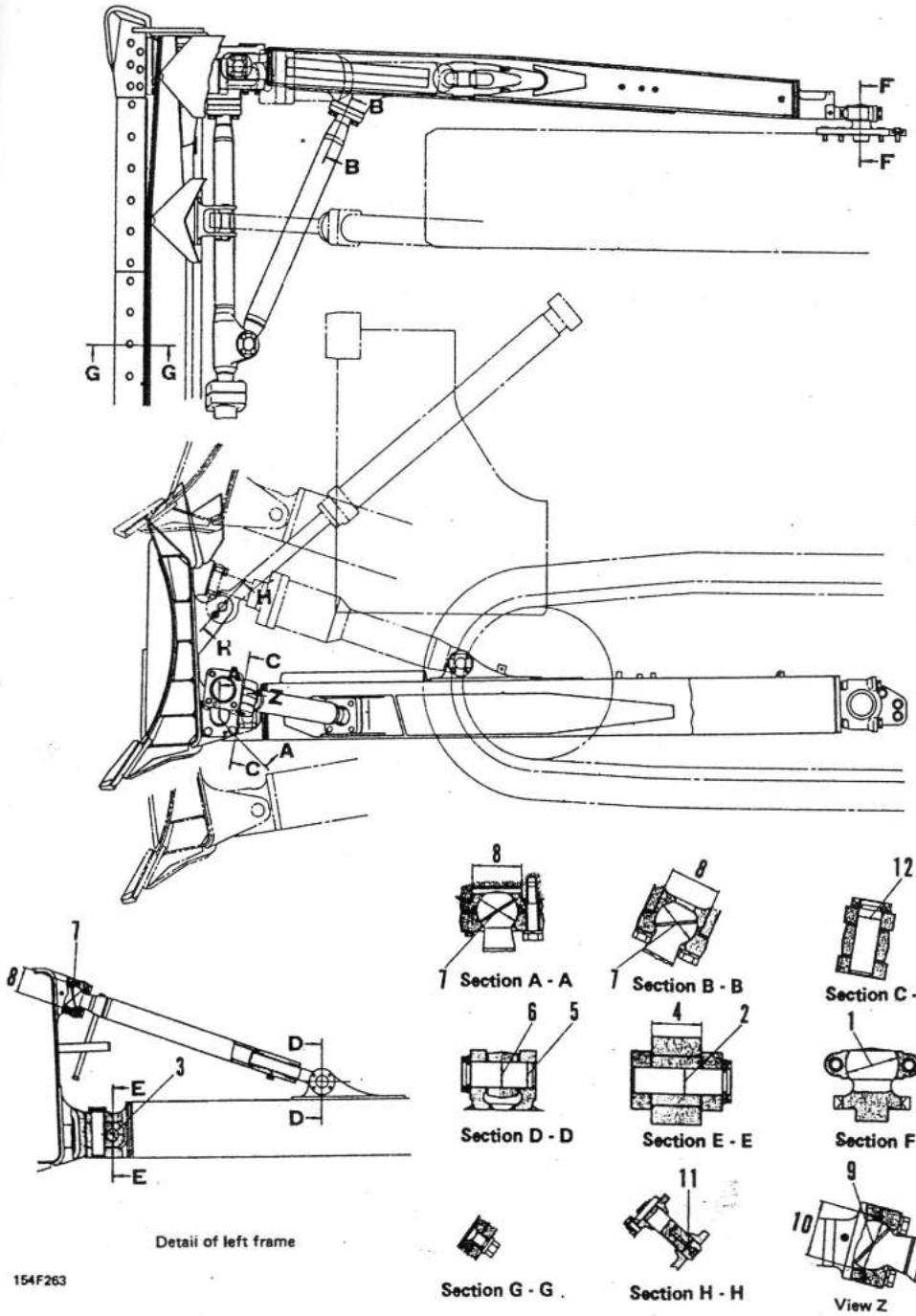


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MAINTENANCE STANDARD

STRAIGHT TILTDOZER TY 220

(1) BLADE, FRAME



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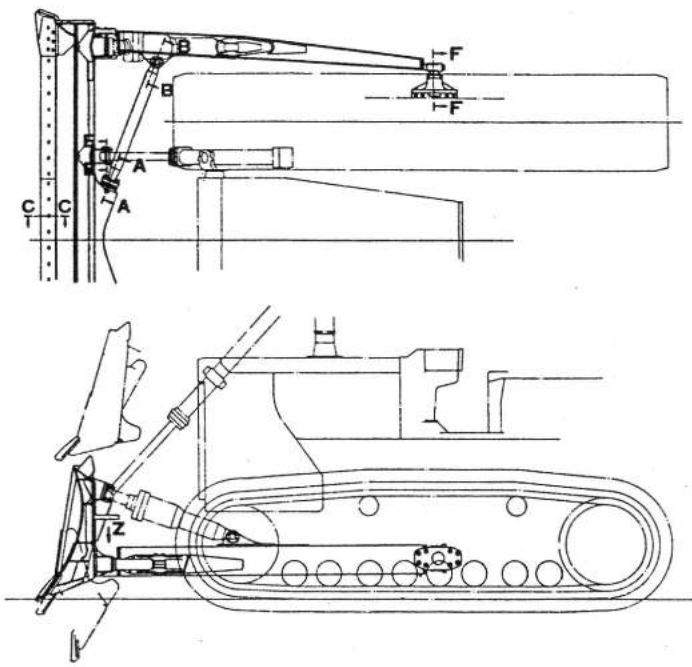
Unit: mm

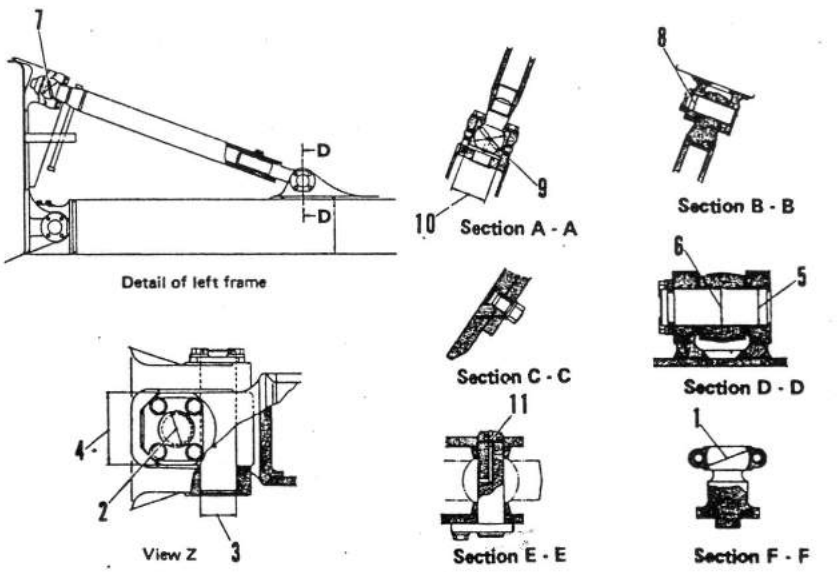
No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Spherical clearance between trunnion cap and trunnion	130 ball	−0.5 −1.0	+0.5 0	0.5 ~ 1.5	10	Replace
2	Clearance between frame pin and joint	60	−0.3 −0.5	+0.3 0	0.3 ~ 0.8	3	
3	Clearance 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	+0.2 0	0.3 ~ 0.7		

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STRAIGHT TILTDOZER TS 220

(1) BLADE AND FRAME





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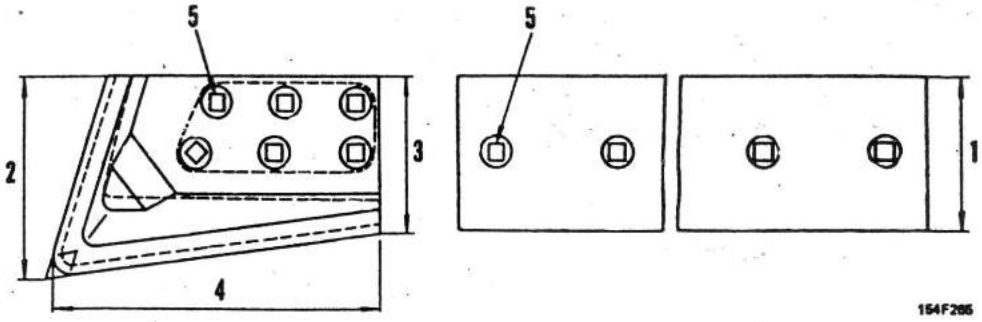
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Unit: mm

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	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 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

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(2) CUTTING EDGE AND END BIT

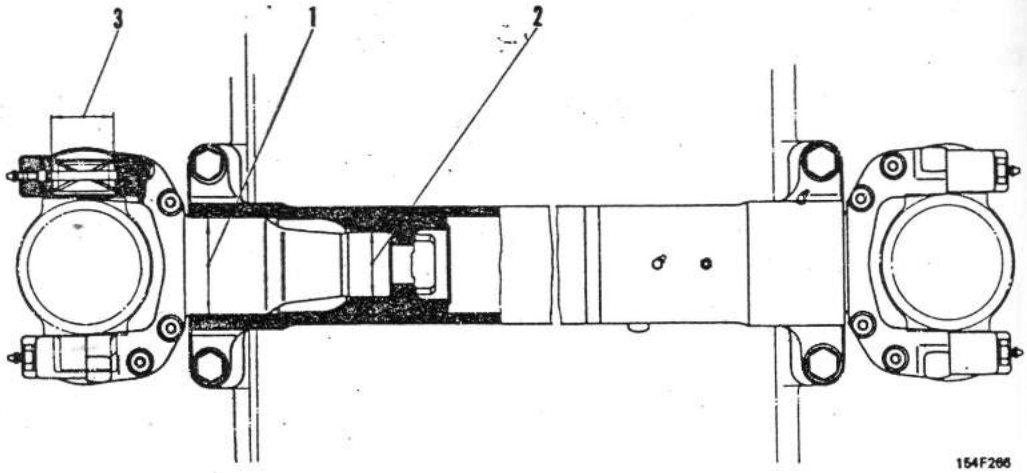


Unit: mm

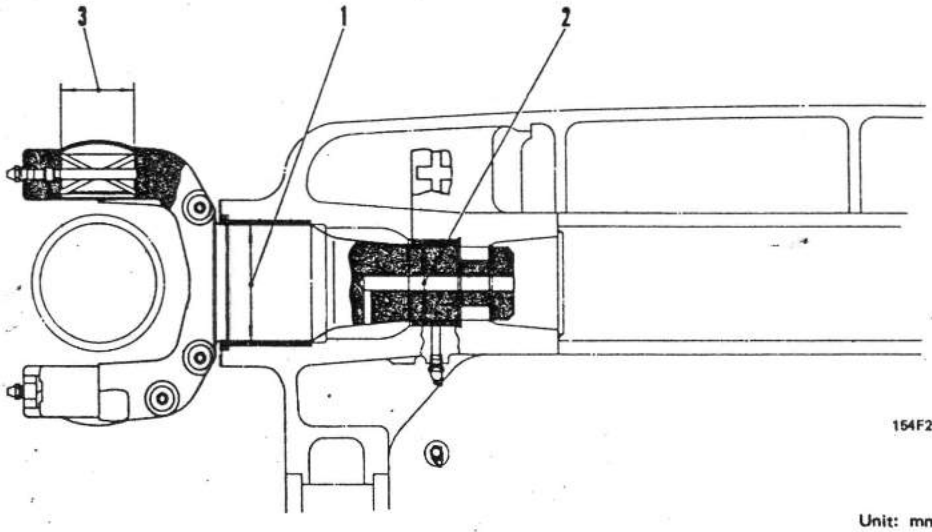
No.	Check item	Criteria			Remedy
			Standard size	Repair limit	
1	Height of cutting edge		254	213	Replace or turning (after turning 140 max.)
2	Height of end bit (outside)		292	211	Replace
3	Height of end bit (inside)		254	211	
4	Width of end bit		435	360	
5	Tightening torque mounting bolt	54 ± 8 kg.m			Adjust

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CYLINDER STAY TY 220



CYLINDER STAY TS 220

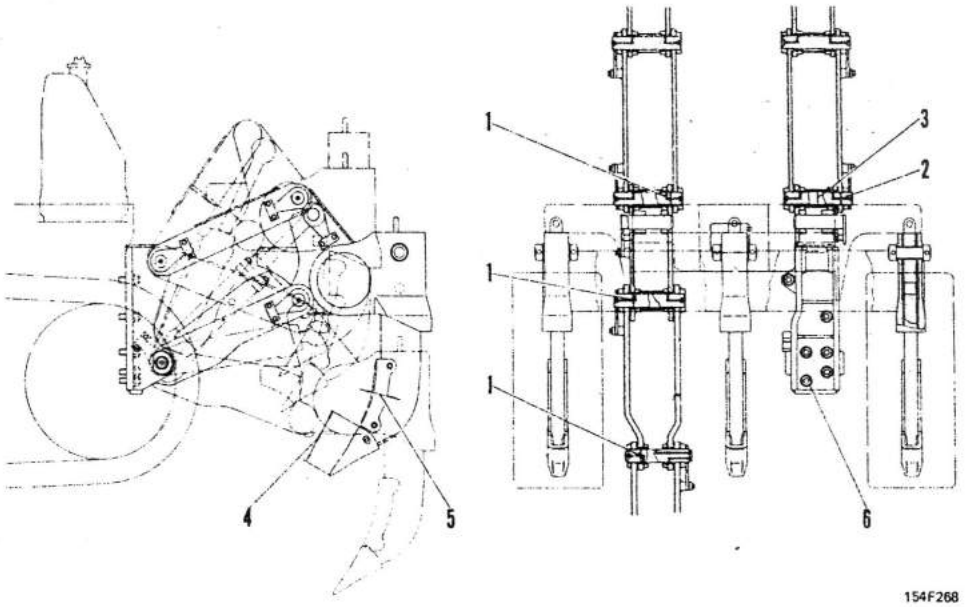


Unit: mm

No.	Check item	Criteria						Remedy
			Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between cylinder yoke and bushing		115	−0.072 −0.126	+0.054 0	0.072 ~ 0.180	0.5	Replace
2	Clearance between cylinder yoke and bushing		76	−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	

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FIXED MULTI-SHANK RIPPER GY 220



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Unit: mm

No.	Check item	Criteria					Remedy
			Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between link pin and bushing		75	−0.030 −0.076	+0.400 +0.200	0.230 ~ 0.476	1.5	Replace
2	Clearance between shank holder and shank pin		Shaft 60 Hole 62	+0.3 −0.3	+0.3 −0.3	1.4 ~ 2.6	10.0	
3	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	
				Standard size		Repair limit		
4	Wear of point			335		225		
5	Wear of protector			113		93		
6	Tightening torque of mounting nut of ripper bracket	225 ± 25 kg.m						Adjust

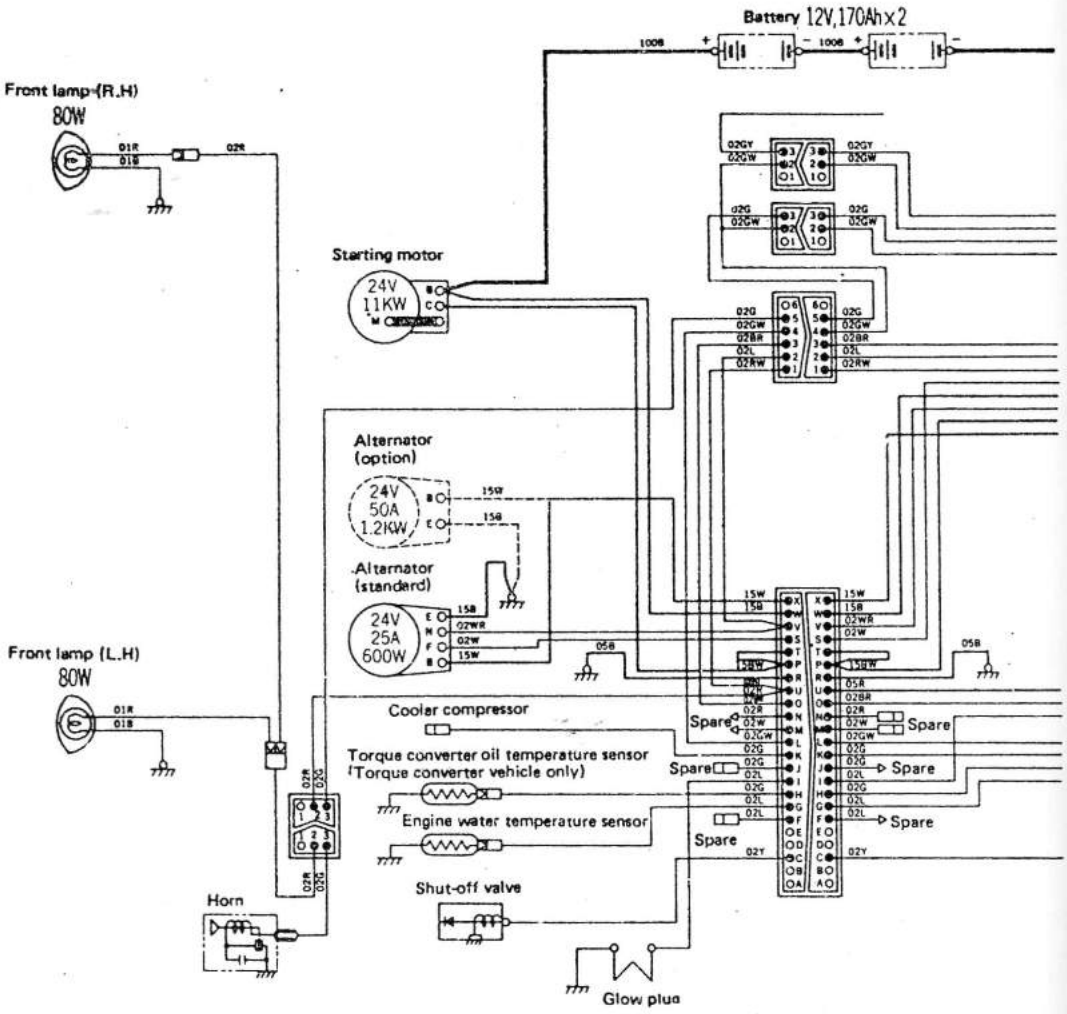
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OTHERS

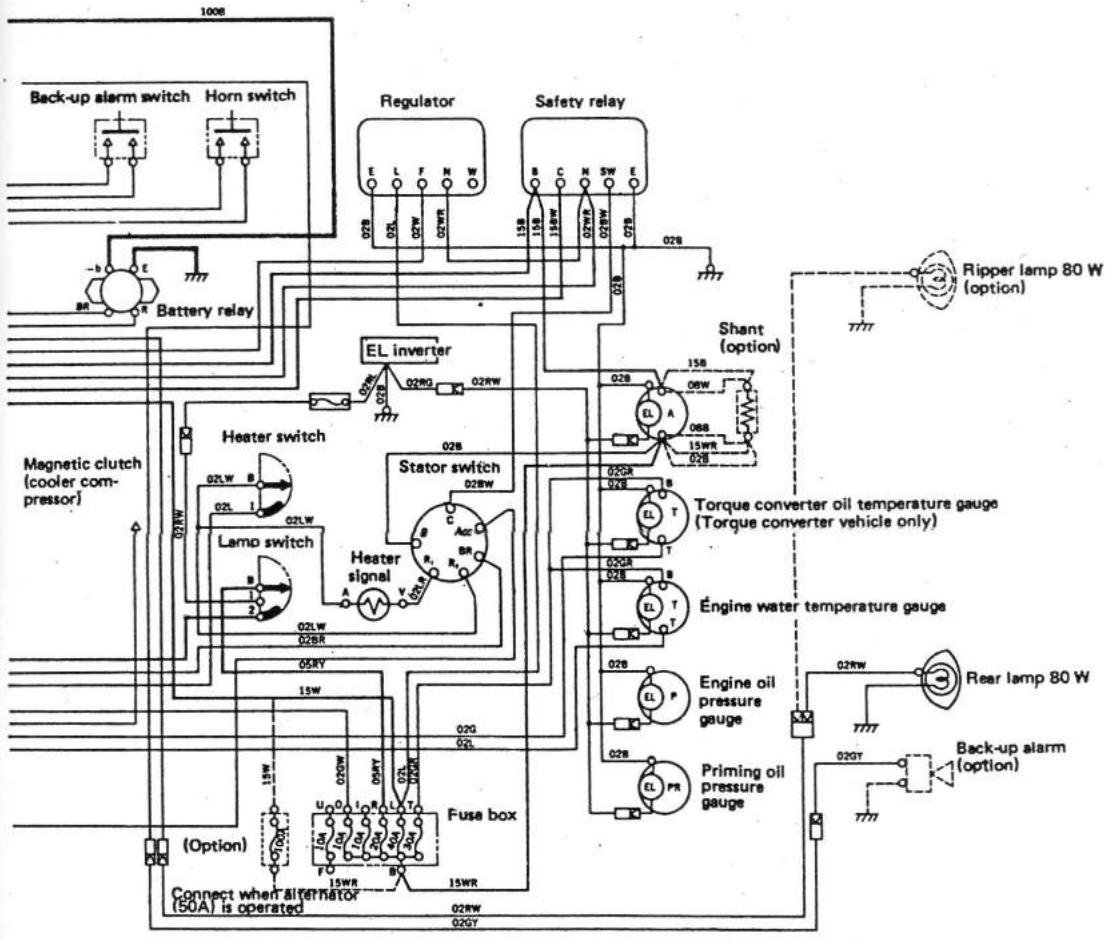
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ELECTRICAL SYSTEM

ELECTRICAL CIRCUIT



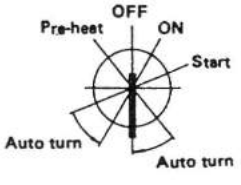
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Starting switch connecting table

Terminal / Key position	B	BR	R_1	R_2	C	Acc
Pre-heat	○	○	○			○
OFF	○					
ON	○	○				○
Start	○	○		○	○	○

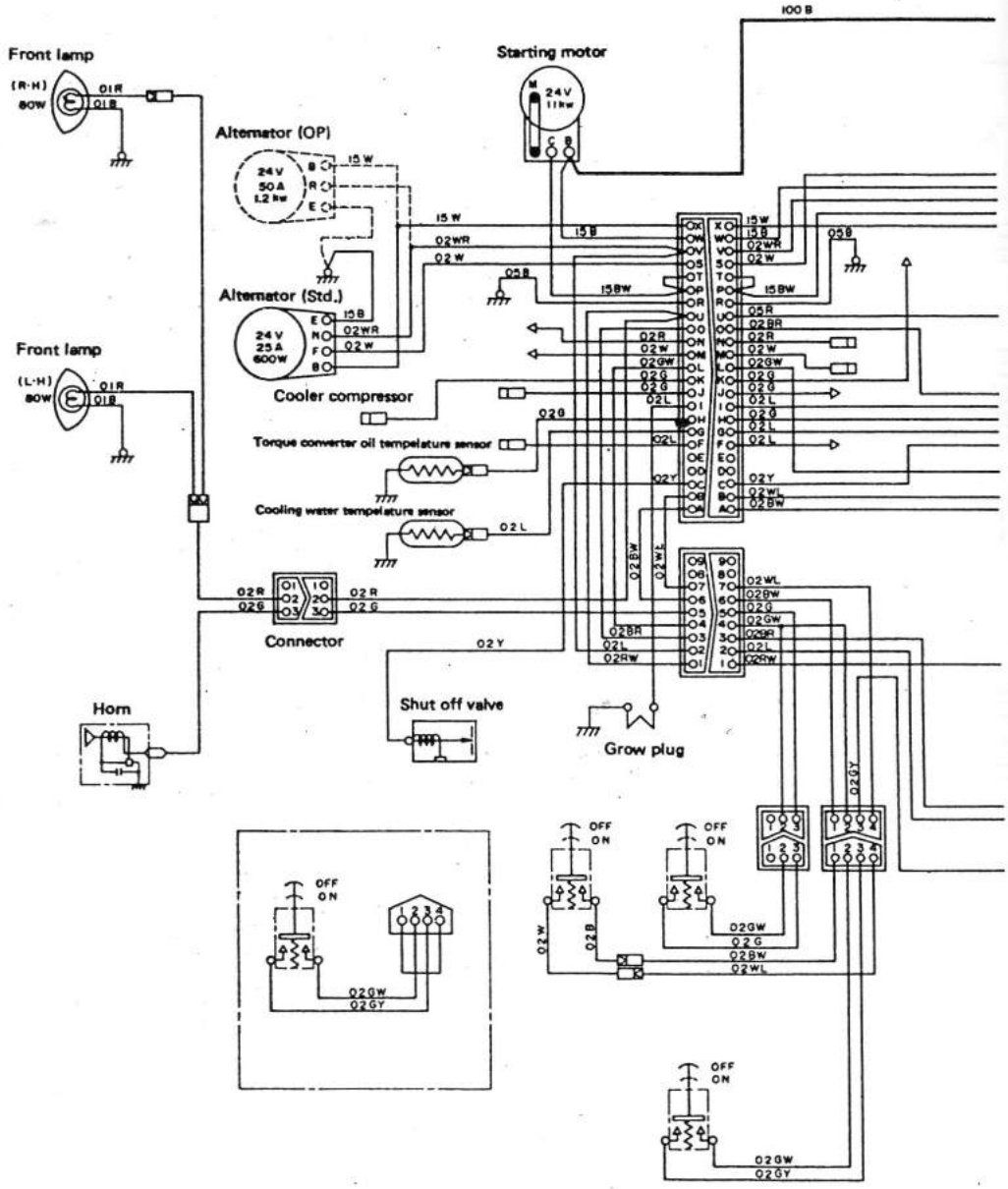
Starting switch key position



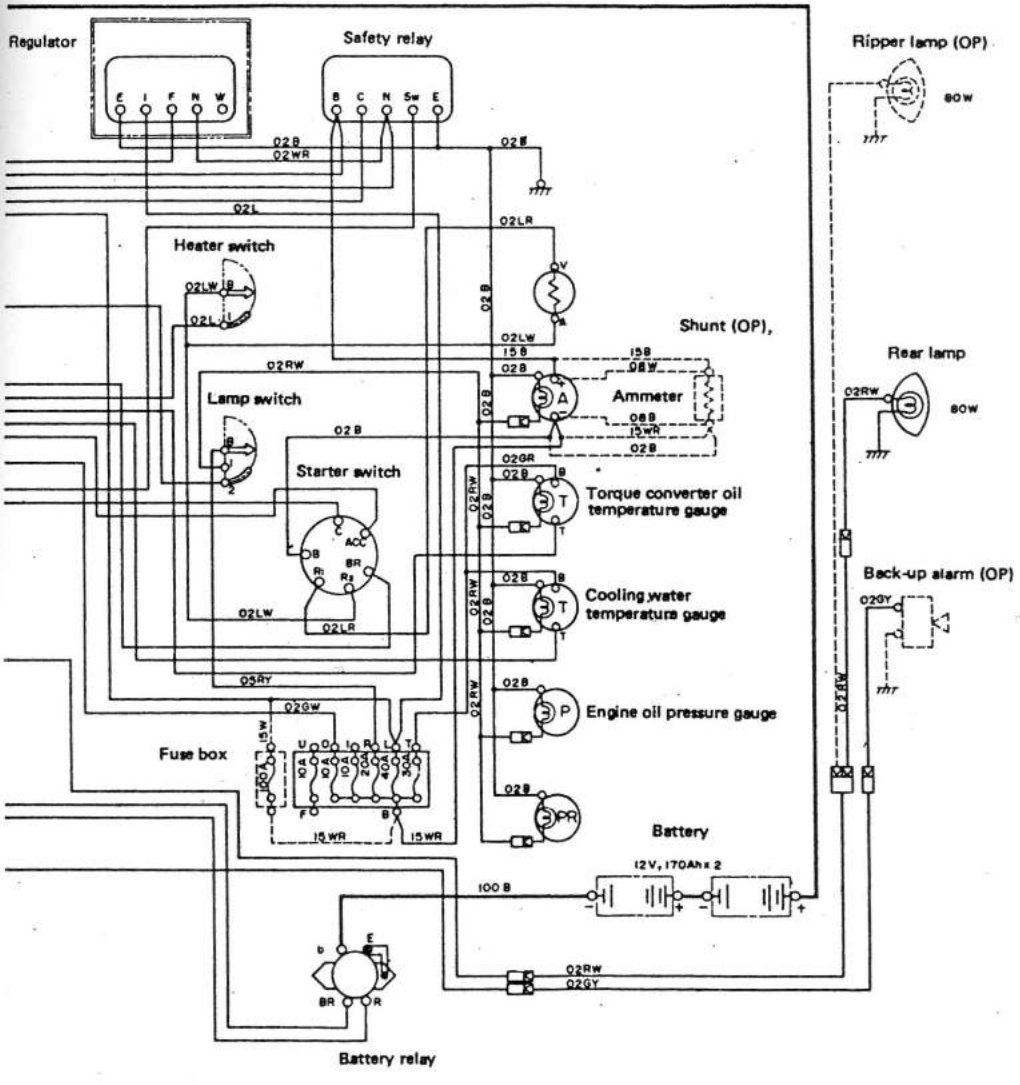
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ELECTRICAL CIRCUIT

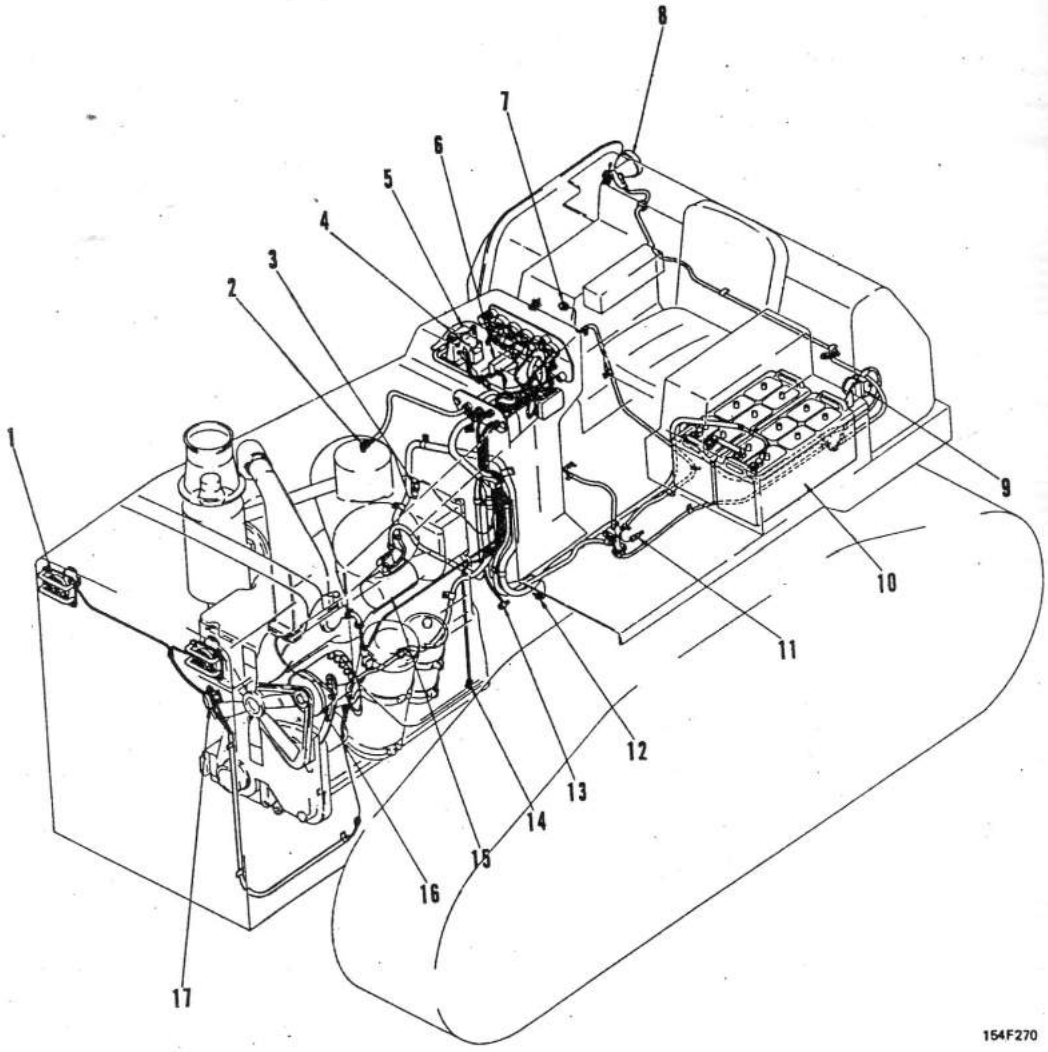


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WIRING DIAGRAM



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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. Back-up 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