110SHO3200

NEW FRONTIERS. NEW DREAMS

# SHOP MANUAL

# BD50

## BULLDOZER

**(WITH BEML BS6D105-1 ENGINE, WET CLUTCH STEERING AND STRAIGHT TILT DOZER BLADE ATTACHMENT WITH EXTERNAL MOUNTED CONTROL VALVE)**

**(FOR ENGINE DETAILS REFER ENGINE SHOP MANUAL)**

**BEML LIMITED**
**INDIA**

# BD50 BULLDOZER

The BD50 is a bulldozer, which has hydraulically-controlled dozer equipment.

The engine is the sole source of power: it drives the machine and also the gear pump for developing hydraulic power used In actuating the dozer equipment.

The tractor chassis is formed with a casing structure-the bevel gear case-and two main frames extending from this casing. The engine and drive line components are carried by the chassis. and the. weight of the whole chassis assembly is supported on the two track frames, with two diagonal braces keeping the chassis assembly and track frames in proper geometric relationship.

# FOREWORD

This MANUAL is published for the information and guidance of shop personnel entrusted with the servicing of the BD50 Bulldozer, and provides instructions to be adhered to in disassembling and re-assembling the machines of this model in the shop. The instructions are given mainly in the form of procedures, and, in each section of the MANUAL, are preceded by an outline description of each major component in respect to mechanical construction, function and other pertinent items.

**TERMINOLOGY**

Efforts have been made in the preparation of this MANUAL to use the most common shop terms in order to avoid ambiguity and equivocation. Some key terms used, however, require precise agreement in advance between the writer and the reader as to their meanings, as the clarity of what are aimed at in shop work depends largely on these terms. Throughout this MANUAL, the major key terms are used with the following meanings:

**(1) Clockwise (C.W.) and Counterclockwise (C.C.W.)**

A circular direction, C.W. or C.C.W., is in the mind of the viewer standing in front and ahead of the machine, except when a driven component is discussed. Such a component as the oil pump, the component is considered singly and as viewed from its driving side.

**(1) Terms of Servicing Criteria**

BASIC SIZE: This term is universally defined as the theoretical or nominal standard size (diameter, length, thickness, etc.) from which variations are made, and is used in this sense throughout.

**ASSEMBLY STANDARD:** This is dimensional value or a range of dimensional values to be adhered to in assembling components, as assembling is required to satisfy the assembly standard specified for it.

**STANDARD CLEARANCE:** This refers to a clearance range, within which a distance of separation occurring in a full assembly or sub-assembly of replacement parts must take its value. Such an assembly or sub-assembly is permitted to be installed or mounted in place only when this requirement is satisfied.

**CLEARANCE LIMIT** (maximum allowable clearances) : A running clearance between a shaft and its hole, for instance; will increase as the shaft or hole wears progressively. A clearance limit is provided for each critical or important clearance and, if such a clearance is found to have increased on disassembling beyond the clearance limit specified for it, the parts associated with that clearance must be corrected to take a value with in the limit.

**SERVICE LIMIT:** An extra stock is provided on some parts subject to is wear, so that these parts may be repaired on disassembling. There are, many such parts that can be re-used repeatedly until their extra stock is used up by grinding, cutting, etc. A service limit is the minimum or the maximum dimension (thickness, diameter, etc,) specified for such part. Any part found to have exceeded its service limit is not repairable; its serviceability has ended and a replacement part must be used in re-assembling.

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# SPECIFICATION

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# BD50 BULLDOZER SPECIFICATION

| | | | | |
|---|---|---|---|---|
| ENGINE | Model | | | BS6D105-1 |
| | Type | | | 6 Cylinder, Water Cooled, Turbo Charged Diesel Engine |
| | Flywheel HP | | | 90 HP (67 KW) @ 1750 rpm |
| | No. of Cylinders | | | 6 x 105 x 125 mm |
| | Piston Displacement<br>Max torque | | | 6490 cc<br>47.5 kg m @ 1100 rpm |
| | Starting Method | | | By starting Motor |
| | Dry Weight | | | 760 kgs |
| DIMENSIONS | Operating Weight | | | 11,000 kg (24,300 lbs) |
| | Overall length | | | 4,700 mm (185.0") |
| | Overall width | | | 3,350 mm (131.9") |
| | Overall height | | | 2,690 mm (113.6") (up to top of exhaust pipe) |
| | Track width | | | 400 mm (15.7") |
| | Track guage | | | 1,600 mm (63.0") |
| | Length of track on ground<br>pressure on ground | | | 2,085 mm (82.1")<br>0.65 kg/cm$^2$ |
| | Contacting area | | | 16,700 cm$^2$ |
| | Maximum Ground clearance | | Exclusive of grouser | 350 mm (13.8") (up to engine underguard) |
| | Height to drawbar | | | 595 mm (23.4") |
| | Centre of gravity | In front of Sprocket | | 1,151 mm |
| PERFORMANCES | Traveling speeds | Forward 1st | | 2.5 km/h (1.6 MPH) |
| | | Forward 2nd | | 3.5 km/h (2.2 MPH) |
| | | Forward 3rd<br>Forward 4th | | 5.5 km/h (3.4 MPH)<br>9.4 km/h (5.8 MPH) |
| | | Reverse 1st | | 3.2 km/h (2.0 MPH) |
| | | Reverse 2nd | | 5.2 km/h (3.2 MPH) |
| | | Reverse 3rd | | 3.0 km/h (5.0 MPH) |
| | Maximum Drawbar pull | | | 10,340 kg |
| | Minimum turning radius | | | 5.4 m (17.7 ft) |
| | Gradeability | | | 30$^{\circ}$ |
| POWER TRANS SYSTEM | Main Clutch | Type | | Wet, multi-plate, spring, w/hydraulic booster |
| | | Lining | | No. of lining-I.D. x O.D. x Thickness<br>=2-280 mm x 375 mm x 1.5 mm |
| | | Material | | Sintered alloy |

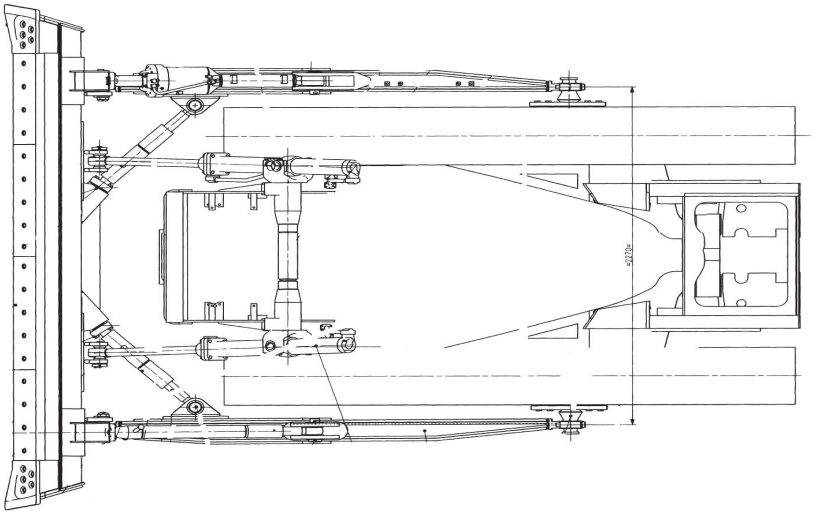
# BD50 BULLDOZER SPECIFICATION

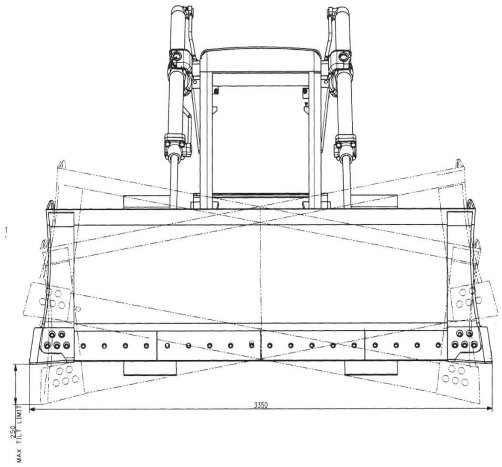
| | | | |
|---|---|---|---|
| POWER TRANSMISSION SYSTEM | Transmission | Type | spur gear, sliding mesh, manually operated splash lubricated |
| | | Speed range | 4-forward, 3-reverse |
| | | Lubrication | Splash Lubricated |
| | Steering clutch | Type | Wet, multi-plate, manually operated, with hydraulic booster |
| | | Lining | No. of lining - I.D. x O.D. X Thickness = 6 - 254 mm x 350 mm x 3 mm |
| | | Reduction ratio | 2.643 |
| | | Material | Sintered Alloy |
| | Steering brake | Type | Wet, externally contracting band, foot-and manually-operated. Interconnected with steering clutch and Hydraulic Booster |
| | Reduction ratio | Material | Special Alloy 10.07 |
| | Final drive | Type | Spur gear, double-reduction |
| | | Lubrication | By splash |
| | | Seal | Floating seal |
| UNDER CARRIAGE | Suspension | | Semi-rigid, equalizer bar |
| | No. of carrier rollers | | 2 on each side |
| | No. of track roller | | 5 on each side |
| | Seal | Type | Floating Seals Assembled, single grouser |
| | Track Shoe | Grouser height | 50 mm (2.0") |
| | | No. of Track Shoe | 38 |
| | | Pitch | 175 mm (6.9") |
| | | Width | 400 mm (15.7") |
| LOCATION OF OPERATOR'S SEAT<br>TYPE OF OPERATOR'S SEAT | | | Centre of vehicle on rear side<br>Single, fixed |
| LEVERS, PEDALS, INSTRUMENTS ETC | Lighting units | Front lights | 2 |
| | | Rear light | 1 |
| | | Instrument lamp | 1 |

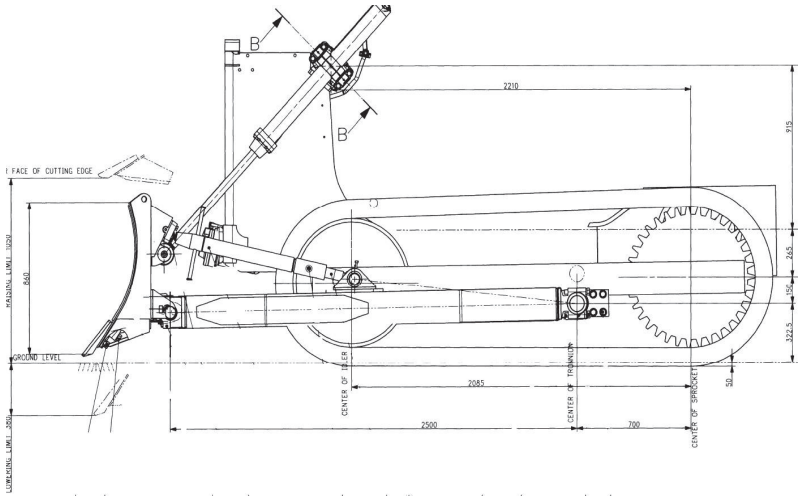
# BD50 BULLDOZER SPECIFICATION

| | | | |
|---|---|---|---|
| LEVERS, PEDALS, INSTRUMENTS ETC | Levers and pedals | Main clutch pedal | 1 |
| | | Gearshift lever | 1 |
| | | Steering clutch lever | 2 |
| | | Brake pedal | 1 |
| | | Brake lock lever | 1 |
| | | Fuel control lever | 1 |
| | | Hydraulic control lever | 1 |
| | Switches | Starting switch | 1 |
| | | Lighting switch& Auto ShutOff | 1 |
| | Instruments | Oil pressure gauge | 1 |
| | | Ammeter | 1 |
| | | Water temperature gauge<br>Service meter | 1<br>1 |
| WORK ATTACHMENT | Type | | Straight blade |
| | Operation | | Hydraulic |
| | Weight | | 1,697 kg |
| | Width x Height | | 3350 mm x 860 mm |
| | Maximum lift above ground | | 1,050 mm |
| | Maximum drop below ground | | 380 mm |
| | Maximum tilting | | 250 mm (9.8") |
| | Maximum angling | | $25^{\circ}$ |
| HYDRAULIC SYSTEM | Weight<br>Relief valve setting | | 330 kg (730 lbs)<br>140 kg/cm$^2$ (2000 PSi) |
| | Lift / Tilt cylinders | Qty-Bore x Rod-Stroke. | 2-90 x50-883mm / 1-160x70-140mm |
| | Oil pump | Capacity, Type | 80cc/rev, Gear Pump |
| | | Delivery | 170 Lpm @ 1750 rpm |
| | Control valve | Type | Two spool control |
| | | Position | LIFT-Raise, hold, lower &float: TILT- Up &Down |
| | Hydraulic Tank | Capacity | 66 liters |
| | | Location | Right hand side of operator's seat |
| | Hydraulic Oil | | SAE 10W |
| | Filtration of Hydraulic oil | | By full - flow filter |
| CAPACITIES | Main clutch | | 18 liters (SAE 30) |
| | Transmission & Steering case | | 90 liters (SAE 30) |
| | Final drive case (right &left) | | 12 Litres ( SAE 30) |

# DRIVE TRANSMITTING SYSTEM







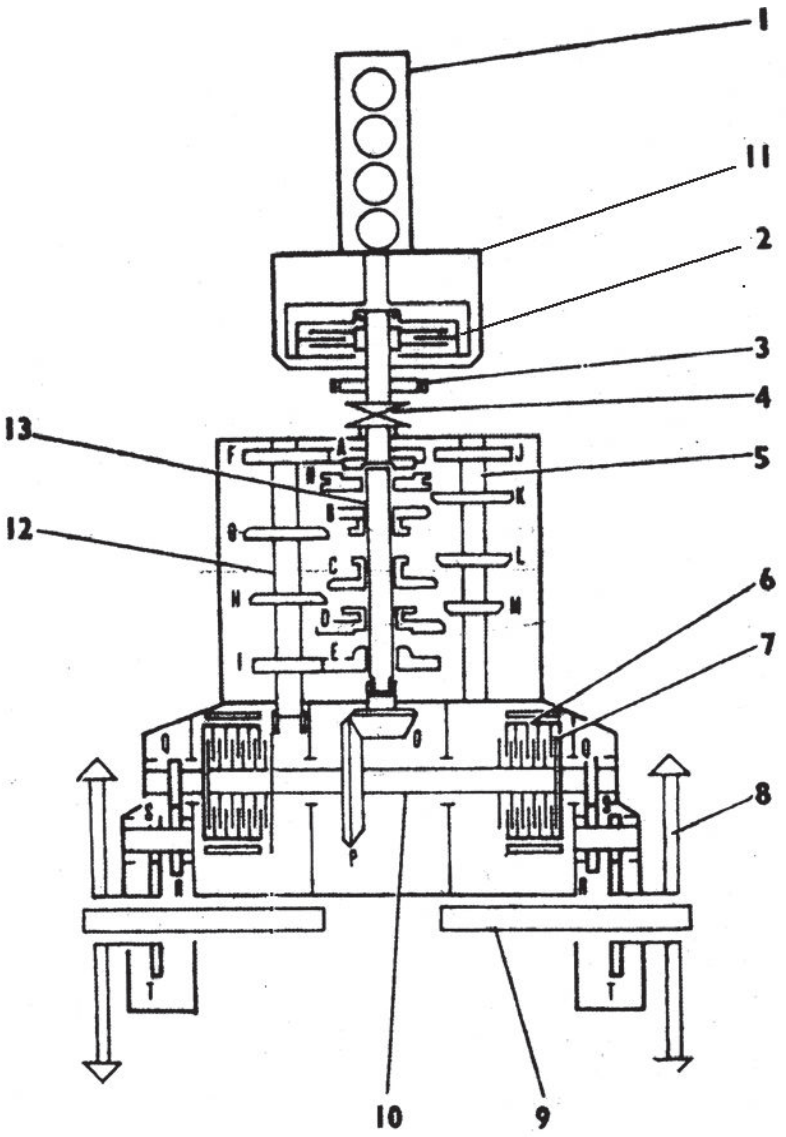

The power train, which carries power from the engine to the track, consists of the main clutch, transmission, bevel gears, steering clutches, final drives and sprockets.

The engine power is carried by and transmitted through the main-clutch to the transmission which supplies the proper ratio to suit the working conditions encountered when the bulldozer is being operated. It is then divided between the steering clutches, flowing right angle; to the final drives which provide a final gear reduction between the steering clutches and sprockets.

The interlocking feature prevents the transmission gears from jumping out of place during operation.

# SPECIFICATIONS

## DRIVE TRANSMITTING SYSTEM




1. Engine
2. Main clutch
3. Inertia brake
4. Universal joint
5. Intermediate shaft
6. Steering brake
7. Steering clutch
8. Sprocket
9. Sprocket Shaft
10. Bevel gear shaft
11. Power take off
12. Countershaft
13. Main shaft

### POWER TRANSMITTING DIAGRAM

| Direction | Speed | Power flow | Gear ratio | Transmission reduction ratio | Final Drive reduction ratio | Vehicle's speed |
|---|---|---|---|---|---|---|
| Forward | 1st | A→F→I→E | $\frac{40}{22} \times \frac{42}{20}$ | 3.83 | 101.6 | 2.45 |
| | 2nd | A→F→H→C | $\frac{40}{22} \times \frac{37}{25}$ | 2.69 | 71.6 | 3.47 |
| | 3rd | A→F→G→B | $\frac{40}{22} \times \frac{30}{32}$ | 1.704 | 45.3 | 5.48 |
| | 4th | — | — | 1.00 | 26.5 | 9.35 |
| Reverse | 1st | A→F→J→M→D | $\frac{29}{22} \times \frac{44}{20}$ | 2.90 | 77.2 | 3.22 |
| | 2nd | A→F→J→L→C | $\frac{29}{22} \times \frac{37}{27}$ | 1.805 | 48.0 | 5.18 |
| | 3rd | A→F→J→K→B | $\frac{29}{22} \times \frac{30}{34}$ | 1.163 | 30.9 | 8.04 |

### GEAR DATA

| CODE | NAME |
|---|---|
| A | Drive gear (4th rear) |
| B | Main shaft 3rd gear |
| C | Main shaft 2nd gear |
| D | Main shaft reverse 1st gear |
| E | Main shaft 1st gear |
| F | Countershaft |
| G | Countershaft 3rd gear |
| H | Countershaft 2nd gear |
| I | Countershaft 1st gear |
| J | Intermediate shaft reverse gear |
| K | Intermediate shaft reverse 3rd gear |
| L | Intermediate shaft reverse 2nd gear |
| M | Intermediate shaft reverse 1st gear |
| N | Coupling |
| O | Bevel pinion |
| P | Bevel gear |
| Q | Final drive 1st pinion |
| R | Final drive 1st gear |
| S | Final drive 2nd pinion |
| T | Final drive 2nd gear |

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# GENERAL INSTRUCTIONS

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# GENERAL INSTRUCTIONS

## INSTRUCTIONS FOR DISASSEMBLING WORK

(1) Before starting to disassemble any part of the machine, study the parts book and service manual, giving particular attention to the servicing criteria and standards indicated in these publications, to gain a full understanding of the mechanical component to be disassembled. Knowledge of the construction and functions of the component is an essential factor of successful servicing work.

(2) When draining out lubricants and hydraulic oil, be sure to take note of the colour, viscosity and cleanliness with which the oil comes out. Oil in service often suggests the condition of the parts served, particularly when the oil lubricates, gears or bearings.

(3) It is advisable and often mandatory to put match marks across mating joint lines before separating or removing parts, and to scribe identification marks on identical parts. This provision that you make at the time of disassembling will greatly facilitate your re-assembling work.

(4) During disassembly, carefully note the orientation or position of each part, as necessary, and the sequence of taking one part after another from the machine. What you have so noted at the time of disassembling will be an assurance of your restoring or re-assembling, the parts correctly.

(5) Be sure to use the special disassembling tool wherever its use is specified in the procedure. If the special tools is not available, some tool similar to it should be used. Use of a special tool is prescribed where common tools can cause damage of one type or another to the parts involved.

(6) Tapered parts or press-fitted parts are expected to be tight in place and not to yield easily to hand pulling. If such a part is noted to be loose be sure to inspect it for wear with greater care.

(7) Parts taken off on disassembling should be washed clean and set aside in an orderly manner, making proper provision to protect them against dust. Use two kinds of washing fluid, one for, removing dirt and one for clean washing. Filters, magnetic plugs and breathers are the parts that must be cleaned particularly and carefully.

(8) Make shim stock available in all thicknesses for use at the time of re-assembling.

(9) There are some components that should be serviced at specialized shops because use-of specialized equipment and instruments is necessary in servicing them.

## INSTRUCTIONS FOR RE- ASSEMBLING WORK

(1) Before starting to assemble, make sure all parts are clean. Replacement parts are usually coated with an anti-rust compound; remove the compound by wiping or washing.

(2) Installation of bearings, bushes, oil seals and the like require the use of special driving-in or forcing tool in most cases. Driving such a part into its position by directly hitting it with a hammer is a bad practice-*always, use a piece of wood or soft metal to transmit the hammer blow to the part.*

(3) Spring, plain, tongue or toothed washers, cotter pins and locking wires are highly important parts but, because of their small size, are liable to be forgotten at the time of re-assembling. When fitting such fastening parts as bolts and nuts, check to be sure whether -locking means are specified or not for the fastening parts.

(4) Use a torque wrench wherever its use is prescribed or a torque limit is specified. When securing a cover or similar part having many bolts, be sure to adhere to the

standard shop practice of tightening the securing bolts gradually to distribute the pressure evenly.

(5) Match marks are not marks for identifying mating parts: they are meant to be coincided and aligned as accurately as possible. Ignoring this fact may result in a costly major repair.

(6) Clean tools, clean work benches and tables are essential for successful assembling work. Cleanliness saves working time and promotes accurate assembling.

## INSTRUCTIONS FOR ADJUSTING WORK

(1) Most of assembling operations are completed with adjusting work. Be sure to check, your list so that none of such components, are left unadjusted. Track tension, control linkage play and oil pressures are typical items of adjustment that demand your greater attention In reassembling work.

(2) Check to be sure that components serviced at specialized shops, carry notes certifying to the effect that the components are properly adjusted and certified for re-use.

## INSTRUCTIONS FOR USE OF HAND TOOLS

(1) Use good and correct hand tools. Use of defective or wrong 'hand tools is' a sure way of 'improperly assembling or damaging the parts,

(2) Never use any special tool for other purposes than the one for which, it is intended, or you will damage the machine or the tool.

## INSTRUCTIONS FOR HANDLING BEARINGS IN DISASSEMBLING RE-ASSEMBLING WORK

(1) Dust is one of the common enemies of all bearings. Dust can often be a cause of bearing noise and accelerate deterioration of the lubricating oil in service.

(2) When replacing a bearing, unpack, the replacement bearing only when all preparatory steps for bearing installation have been completed.

(3) Installing bearing, be sure to position it properly, and force it all the way against the wall (stepped shoulder or seat).

(4) Use of a number of bearing pullers (some of which serve also as installers) is involved in general disassembling and re-assembling work. Be sure to use these tools where their use is specified. DRIVING a bearing in with a HAMMER in most cases, is the same thing as driving a sure cause to trouble into the machine.

(5) For the washing fluid to be used in cleaning bearings, benzine or benzol is recommended. Kerosene and diesel oil may be used if compressed air is available for blowing dust off, but with these oils alone fine dust entrapped within a bearing is hard to remove.

(6) After washing, and cleaning bearings, and pending their installation coat them lightly with grease.

(7) Spherical roller bearings should be installed with particular attention for positioning. Secure them correctly to eliminate excessive clearance at either end face, or the bearings will wear off prematurely in service.

## INSTRUCTIONS FOR HANDLING OIL SEALS

(1) While installing an oil seal, make sure the oil seal is so positioned as to bring its lip to the correct side.

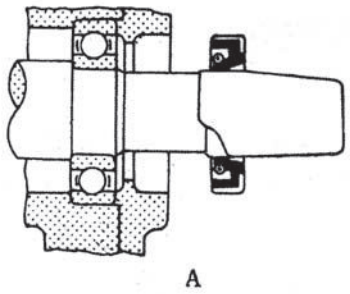
(2) The lip of an oil seal in place is required to present a sharp tip angle for satisfactory sealing action Thus, it is highly essential to handle oil seals carefully, in order

to protect their lips against damage. For instance, winding the wire of a tag around an oil seal is a bad practice and should never be attempted.

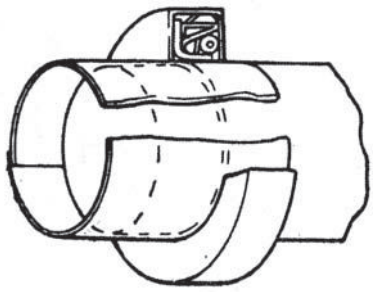
Oil the seal just before forcing it into the bore at the time of installing otherwise the seal might get scratched due to the friction of dry rubbing face during initial operation.

Use a guide to slip the seal into bore when installing it, as shown in Fig. A. If such a guide is not available, prepare a makeshift guide with a sheet of brass, as shown in Fig. B. Use of the guide is particularly necessary where the shaft has a keyway or a shoulder.

(3) Fig. C illustrates the proper way of forcing the oil seal into the bore. Note that an adapter is used to apply pressure uniformly to the end face of the seal. The forcing adapter should be 0.5 mm smaller in diameter than the bore, and its free end should be shaped to take blows from a mallet or hammer. The surface of the shaft on which the seal is mounted, must be smooth and free of any scratch mark.



A



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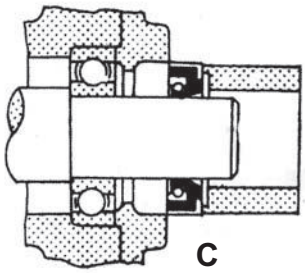

C

## INSTRUCTIONS FOR HANDLING SNAP RINGS

(1) In handling a snap ring, be careful not to twist it and deform its corners and ends. Try to preserve its springiness never expand and contract it suddenly. After fitting it to the shaft, check to be sure that the ring is properly seated.

(2) Always use the ring expander in removing and installing snap rings.

## INSTRUCTIONS FOR HANDLING GASKETS AND PACKINGS

(1) A copper packing removed from the machine should not be re-used. However, a packing of this type, found to be in good condition after it is annealed, may be re-used.

(2) Sealing sheets, packings, gaskets and the like are not to be re-used.

(3) Leather packings, before installation, should be soaked in oil so that they will become pliable.

(4) Protect the surfaces of rings and" V " packing against damage. Winding wires directly around them is a bad practice.

(5) A gasket should be fitted at the time of re-assembling, with its both surfaces coated with a bonding agent.

# TORQUE LIMIT CHART

| Material | | S45-1, SMn 40CH, SCM3 or equivalent |
|---|---|---|
| **Nominal Size (mm)** | **Pitch** | **Torque (kg. m)** |
| 6 | 1 | 1.0 ~ 1.5 |
| 8 | 1.25 | 2.5 ~ 3.5 |
| 10 | 1.5 | 5.5 ~ 7.5 |
| | 1.25 | |
| 12 | 1.75 | 9.5 ~ 12.5 |
| | 1.5 | 11.0 ~ 14.5 |
| 14 | 2 | 15.0 ~ 20.0 |
| | 1.5 | 17.0 ~ 22.5 |
| 16 | 2 | 23.5 ~ 31.5 |
| | 1.5 | 25.5 ~ 34.5 |
| 18 | 2.5 | 32.5 ~ 43.5 |
| | 1.5 | 38.5 ~ 52.0 |
| 20 | 2.5 | 45.5 ~ 62.0 |
| | 1.5 | 53.5 ~ 72.5 |
| 22 | 2.5 | 64.5 ~ 84.5 |
| | 1.5 | 71.0 ~ 96.0 |
| 24 | 3 | 79.0 ~ 105 |
| | 1.5 | 94.0 ~ 125 |
| 27 | 3 | 110 ~ 150 |
| 30 | | 145 ~ 195 |
| 33 | | 190 ~ 250 |
| 36 | | 230 ~ 310 |

SECTION : 03

# MAIN CLUTCH

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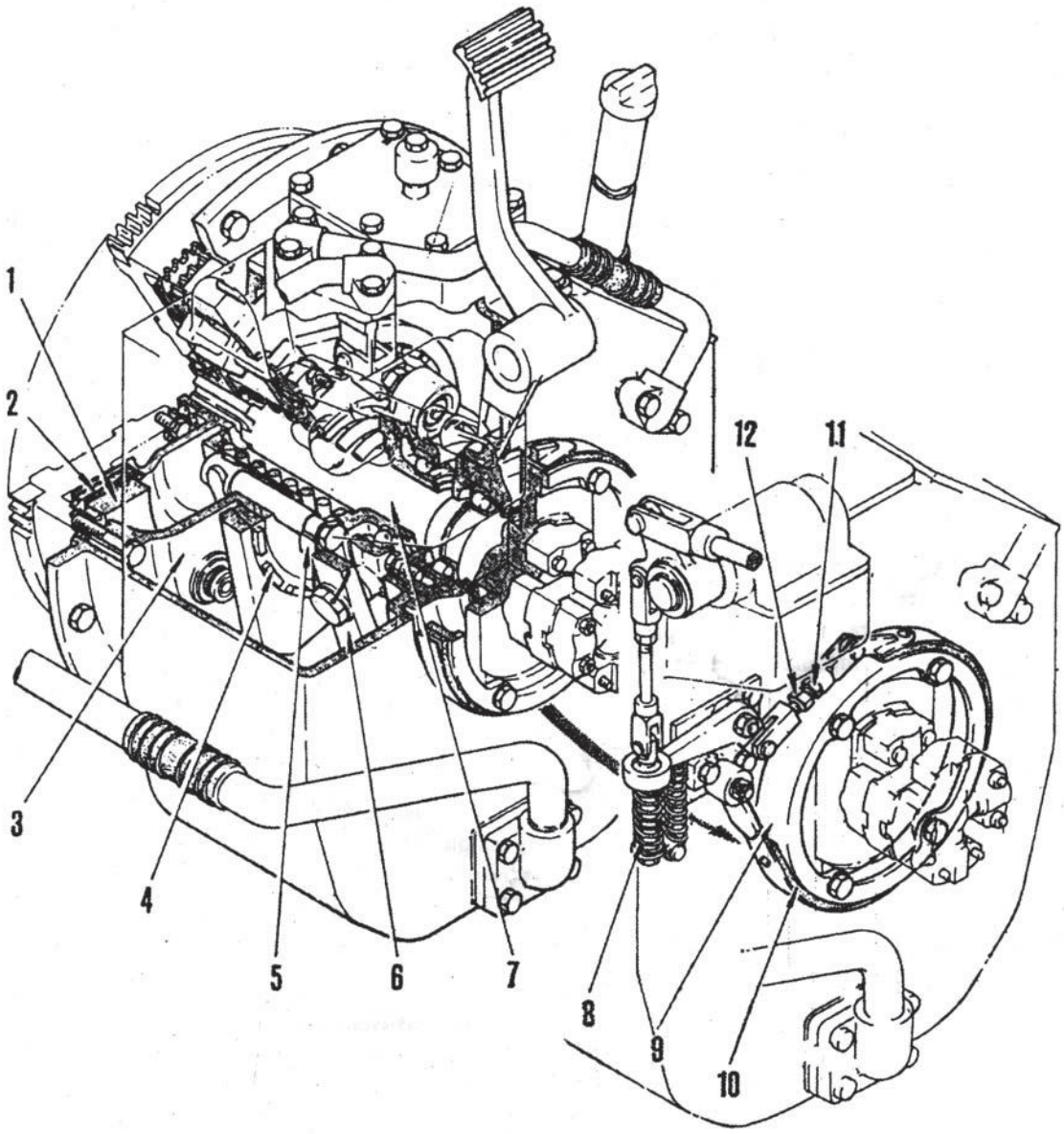
# MAIN CLUTCH

## DESCRIPTION




Main Clutch

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | Pressure plate | 4. | Adjusting ring | 7. | Clutch shaft | 10. | Lining |
| 2. | Disc | 5. | Flange | 8. | Spring | 11. | Lock nut |
| 3. | Clutch cover | 6. | Release yoke | 9. | Brake drum | 12. | Turn-buckle |

# MAIN CLUTCH

## DESCRIPTION

The main clutch is of wet type, built for serving under the severe working conditions to which main clutches are subjected in machines of this class. The clutch internal parts are constantly kept wet, cooled and lubricated with the oil supplied under pressure from a gear pump. In normal condition, the main clutch remains engaged by the force of its springs. Depressing the main clutch pedal causes the hydraulic booster to overcome this spring force and separate mating friction surfaces, thereby dis-engaging the clutch. The pedal requires only a little effort by the operator. Such accessory components as the gear pump and oil filters are so located as to permit easy removal, inspection and servicing. A universal joint is used to connect the shaft of main clutch to that of transmission, so that a slight misalignment, if any, of these shafts will not cause any damage.

### A. Clutch Internal Parts

With the clutch in engaged state, drive is transmitted from flywheel through an alternate stack; of driving and driven plates to the driven-plate guide and clutch shaft. Driving plates are engaged with flywheel, and driven plates with guide, in such a way that the plates are capable of moving in axial direction (along the axis of clutch shaft) when the clutch, is in the state of disengagement. The guide is splined to the clutch shaft. The output end of clutch shaft carries the inertia brake.

With the main clutch pedal is released clutch springs push the release bearing to pull the inner ends of release levers through rod towards transmission side, Since these levers are pivoted on the clutch cover, their outer ends push the pressure plate towards fly wheel side to hold the driven and driving plates tightly sandwiched between pressure plate and flywheel. The force developed by the hydraulic booster for disengaging the main clutch is applied to release bearing against the force of clutch springs. When this occurs, the pressure plate becomes freed from clutch springs, and its small springs pull it away from the driven and driving plates. Under this condition, driving plates spin around with flywheel but driven plates stay standstill on the guide,

### B. Hydraulic Booster

(I) The gear pump for supplying oil under pressure to the booster is located on the front left side of the engine. It is driven by the engine.

(2) The booster is a means of hydraulically moving the release bearing through shift lever (yoke) in the main clutch. The actuating force is developed out of the pressurized oil supplied from the gear pump.

The major parts of the booster are: the closed-end cylinder into whose bore, the piston (having an internal oil passage) is fitted; the spring-loaded valve spindle; and the two levers, one for moving the valve spindle and the other for transmitting the booster output to the shift lever.

Under the disengaged condition of main clutch, the internal valve (formed by the inner end of valve spindle and the inlet of ,oil passage in the piston) is open, so that the oil entering the cylinder freely flows through this passage and comes out of the other end of the piston. Practically no pressure is applied to the piston.

When the main clutch pedal is depressed, the linkage transmits the downward motion of pedal to the valve spindle, and causes the internal valve to close, thereby permitting the oil pressure to build up and exerts force against the output lever through piston. Thus, a small force applied to the pedal results in a much greater force for moving the release bearing.

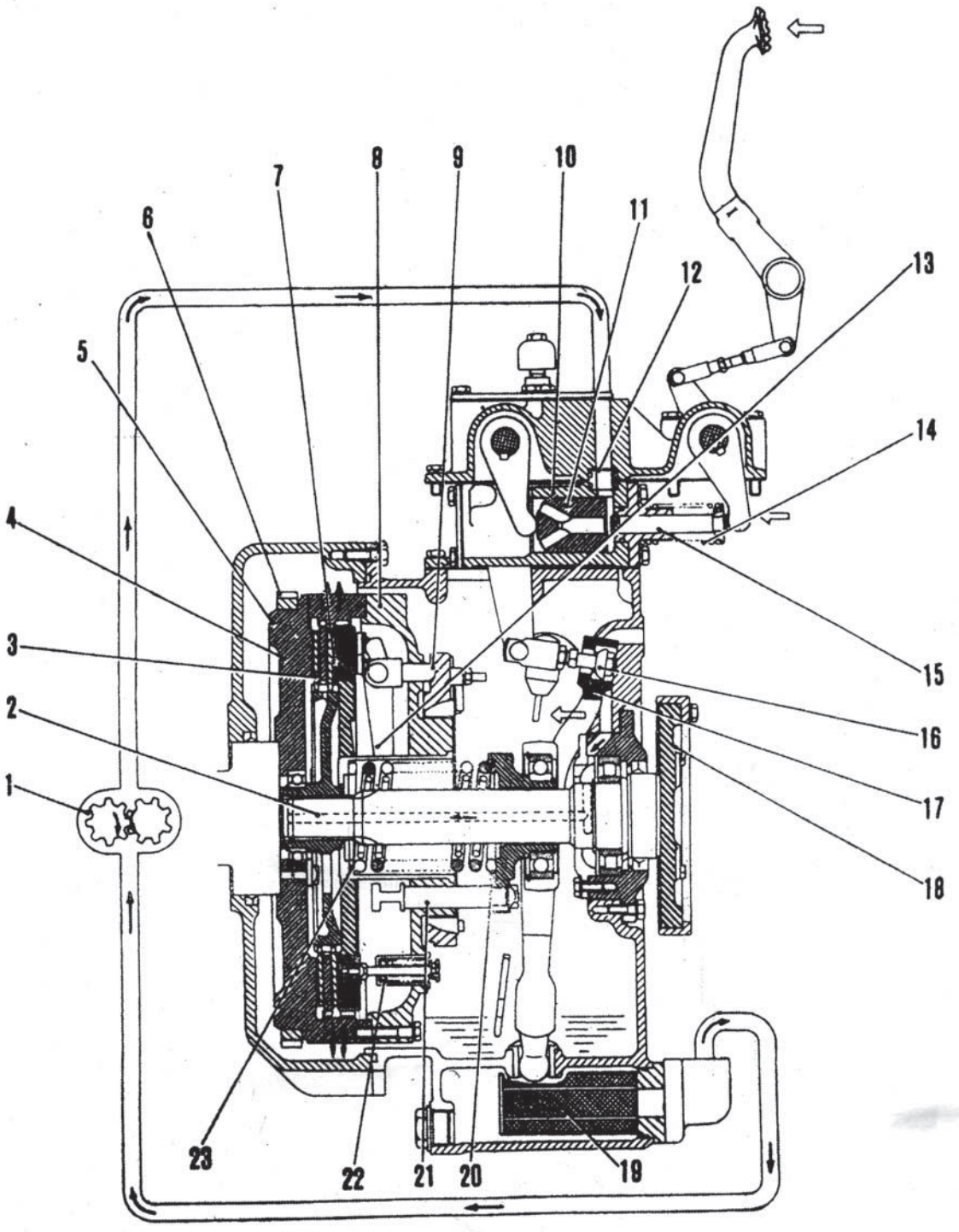
Even when the engine is down and no oil pressure is available, the main clutch can be disengaged without assistance of the booster. In this case, the downward motion of pedal is directly transmitted through valve spindle and piston in the booster cylinder.

(3) Oil circuit

An oil sump is formed at the bottom of the clutch case, from which the gear pump lifts oil through a strainer and forces it out through the line extended along the side of the engine to the hydraulic booster. On entering the booster cylinder, the pressurized oil flows through the clearance between piston and cylinder head and then

# MAIN CLUTCH






## Hydraulic Booster

1. Gear pump
2. Clutch Shaft
3. Plate
4. Disc
5. Flywheel
6. Ring gear
7. Pressure plate
8. Clutch cover
9. Adjusting ring
10. Cylinder
11. Hydraulic booster
12. Pipe
13. Lever
14. Return spring
15. Valve
16. Lock nut
17. Release yoke
18. Interia brake drum
19. Filter screen
20. Flange
21. Rod
22. Return spring
23. Main clutch springs.

through the piston, and passes into the bearing cage at the output end of main clutch shaft. From this case, the oil flows through the passage provided within clutch shaft along its axis and comes out to the back of flywheel. Thereupon, the oil flows into the oil grooves formed on the driven plates and, by centrifugal force, is flung against the bore of flywheel. Many holes are cut in the flywheel bore so that the oil splashes outward and falls down to the sump along the inside walls, of the clutch case.

While circulating through the main clutch the oil absorbs the heat of friction and lubricates clutch internal parts, thereby enabling the drive transmitting members - driving and driven plates in particular-to withstand the severe effects of even continuous disengagement and engagement of the main clutch.

**C. Inertia Brake**

This, brake is of drum-and-band type, and serves to prevent the transmission input shaft from spinning by inertia. The lever· for actuating the brake band is interconnected to the linkage between main clutch pedal and hydraulic booster. Depressing the pedal fully makes this brake, apply just when the main clutch begins to disengage. Otherwise, the operator would experience grating of gears in selecting the speeds.

**D. Universal Joint**

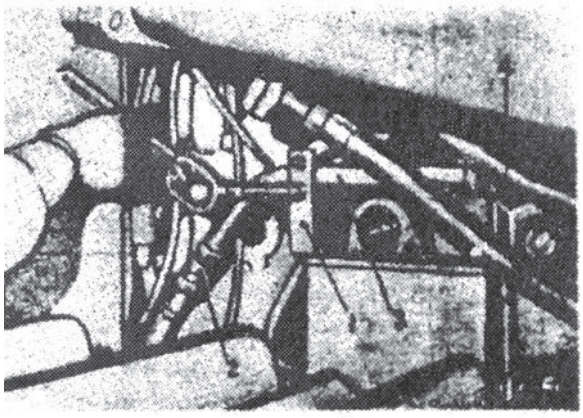
The universal joint is located behind the inertia brake. The output end of clutch shaft is connected to the transmission input shaft with this joint. These shafts are aligned with some clearance in between. With the universal joint removed, there is sufficient room for performing manual work between main clutch and transmission at the time of assembling or disassembling.

## MAIN CLUTCH W/INTERTIA BRAKE

### REMOVAL

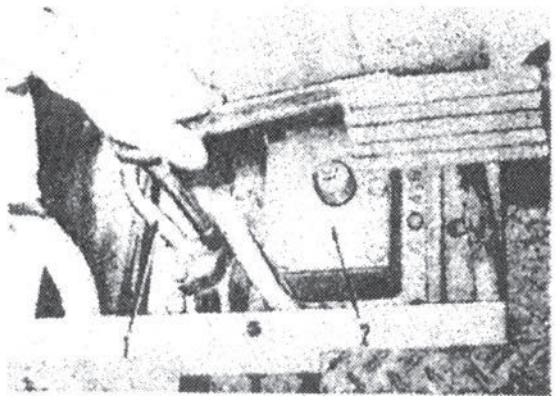
(1) Raise the tractor off the floor by placing four 350 mm thick blocks under the tracks.

(2) Remove the underguards below the engine and transmission.



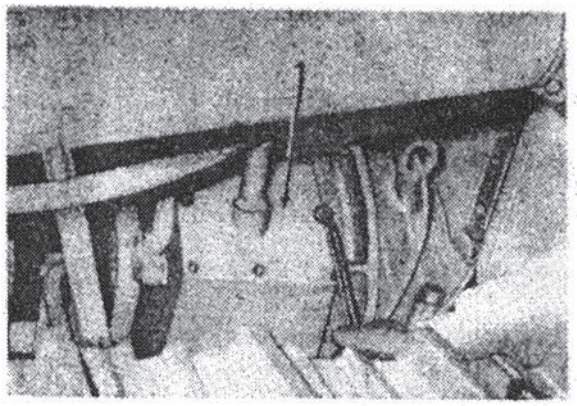
(3) Remove the floor plates and disconnect pipe (1) leading to pump. Remove clutch cover (2).

(4) Remove pipe clip(1). Disconnect joint (2), and take out pipe (3). Disconnect main clutch control link (4).

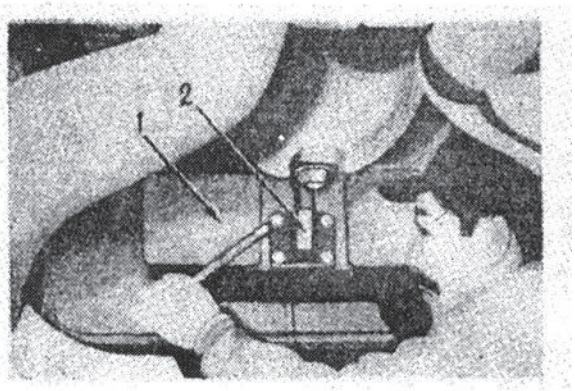


(5) Remove cover (I).

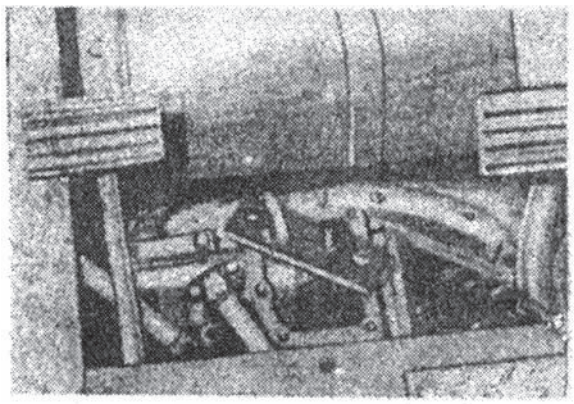
(6) Remove the universal joint.



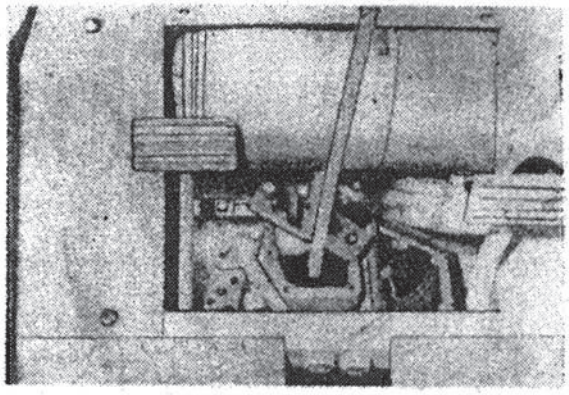
(7) Disconnect pipe (2) leading to oil pump.



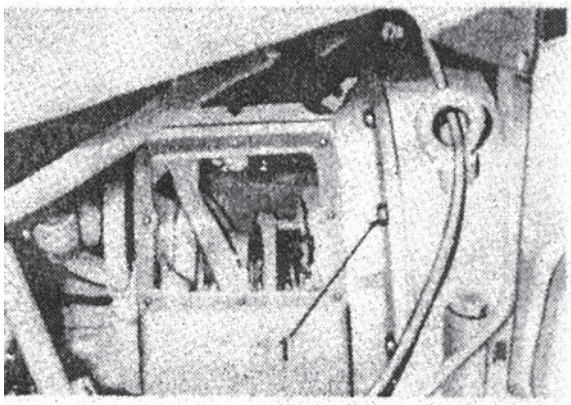

(8) Install the lifting eye fixture by screwing bolts into the holes provided for fixing cover.



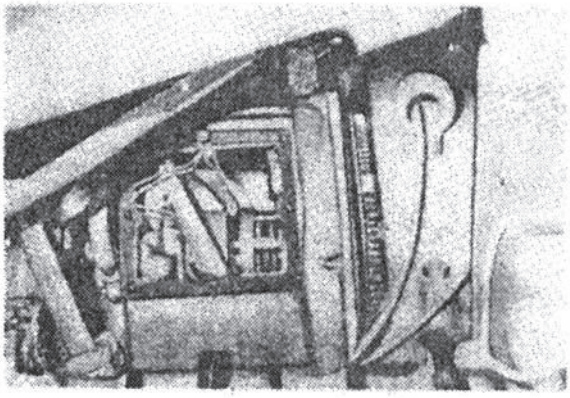
(9) Support the weight of the main clutch assemble by attaching a lifting sling to the eye fixture just installed.



(10) Remove bolts (1) securing flywheel housing to main clutch case.




(11) Tie the main clutch yoke in place with a piece of wire so that the yoke will not rock.

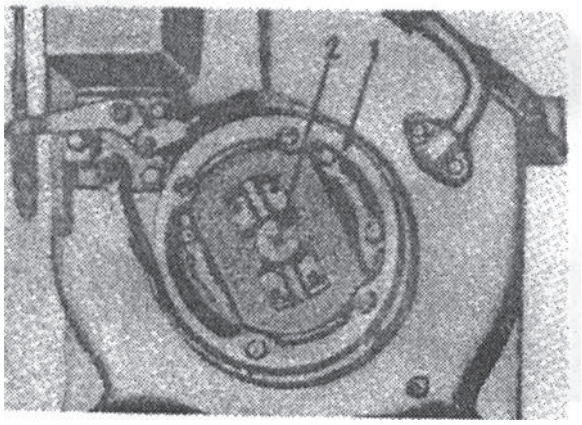


# MAIN CLUTCH

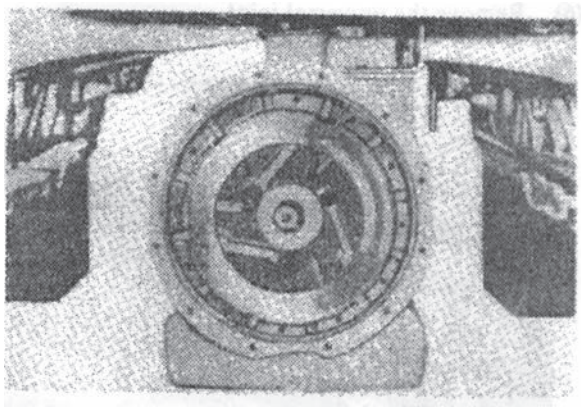
## MAIN CLUTCH W/INTERIA BRAKE

### REMOVAL

(12) Draw out inertia brake drum (1) complete with main clutch shaft (2). Hold the main clutch assembly in suspension for removal.



(13) Lower the main clutch assembly gradually.

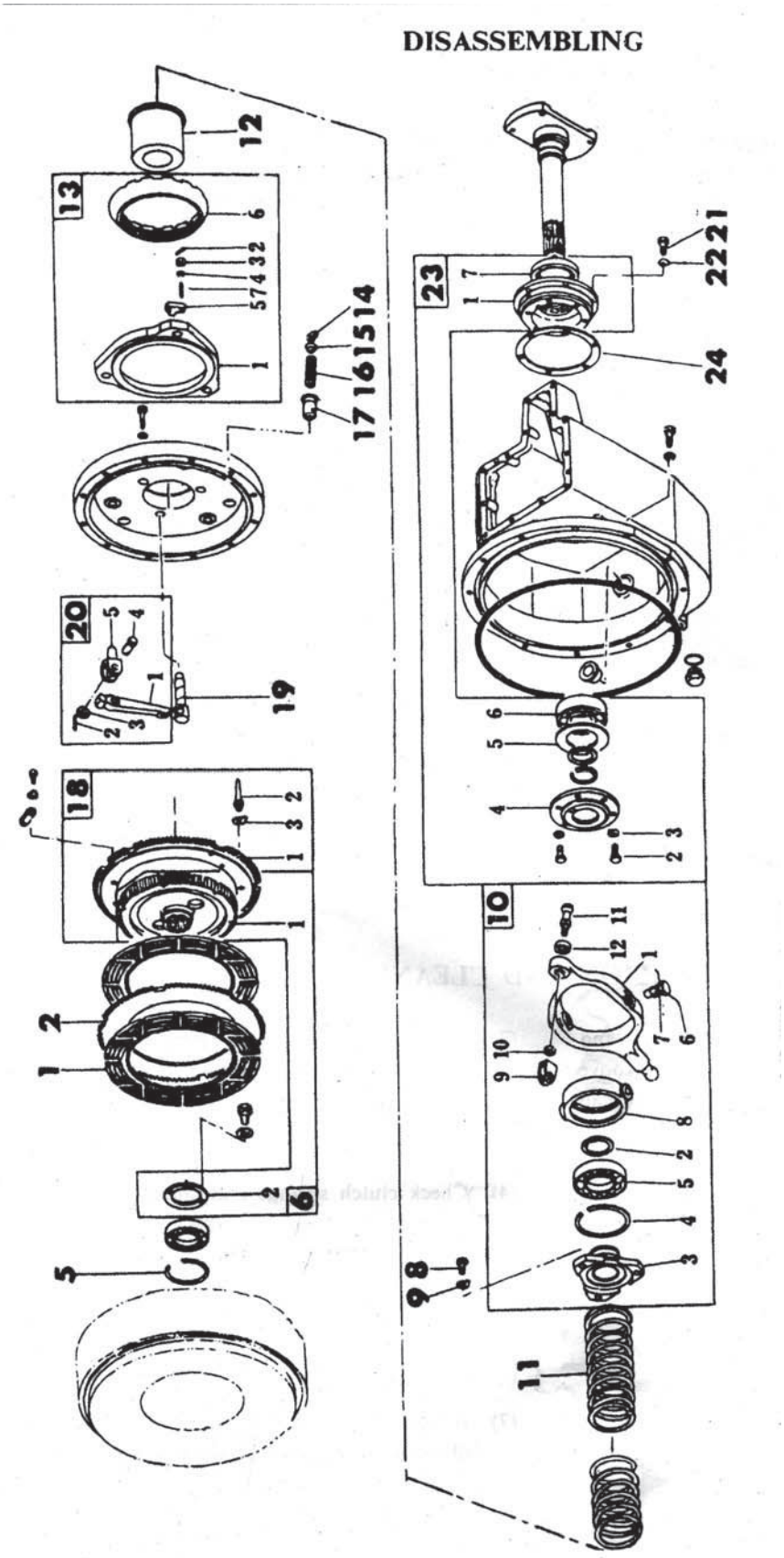


**CAUTION:** When removing the bolts securing flywheel housing to clutch case, be sure to loosen the bolts in steps and in sequence so as to relieve the pressure uniformly around the housing.

# MAIN CLUTCH

## MAIN CLUTCH W/INTERIA BRAKE

DISASSEMBLING




| | |
|---|---|
| l. | Main clutch disc |
| 2. | Main clutch plate |
| 3. | Bolt |
| 4. | Washer |
| 5. | Snap ring |
| 6-1. | Main clutch gear |
| 6-2. | Lock plate |
| 7. | Main clutch yoke pin |
| 8. | Bolt |
| 9. | Lock Washer |
| 10-1. | Yoke |
| 10-2. | Snap ring |
| 10-3. | Flange |
| 10-4. | Snap ring |
| 10-5. | Bearing |
| 10-6. | Wire |
| 10-7. | Screw |
| 10-8. | Bearing cage |
| 10-9. | Lever yoke |
| 10-10. | Nut |
| 10-11. | Joint |
| 10-12. | Bush |
| 11. | Springs |
| 12. | Holder |
| 13-1. | Ring |
| 13-2. | Cotter pin |
| 13-3. | Nut |
| 13-4. | Spring washer |
| 13-5. | Lock |
| 13-6 | Nut |
| 13-7 | Stud |
| 14. | Collar |
| 15. | Guide |
| 16. | Spring |
| 17. | Guide |
| 18-1 | Main clutch plate |
| 18-2 | Guide |
| 18-3 | Lock |
| 19. | Rod |
| 20-1 | Lever |
| 20-2 | Cotter pin |
| 20-3. | Washer |
| 20-4. | Pin |
| 20-5 | Support |
| 21. | Bolt |
| 22. | Spring washer |
| 23-1 | Bearing cage |
| 23-2. | Bolt |
| 23-3 | Lock |
| 23-4. | Bearing cap. |
| 23-5 | Plate |
| 23-6 | Bearing |
| 23-7 | Oil seal |
| 24. | Gasket |

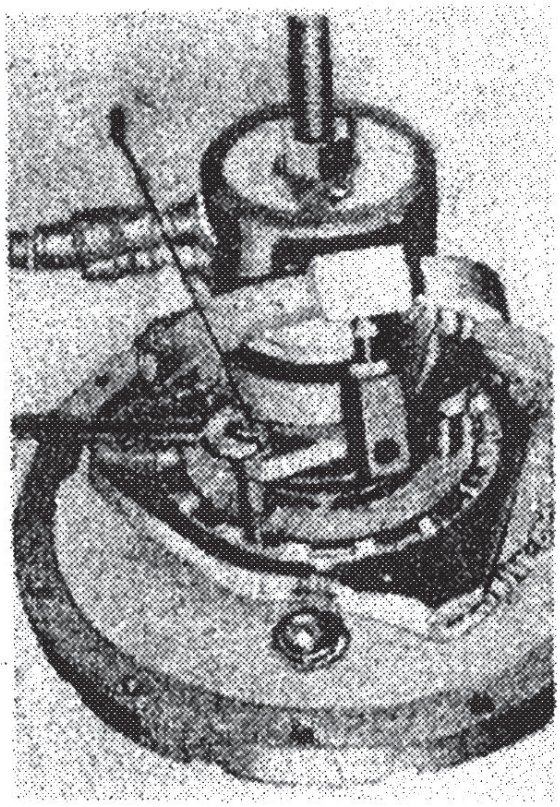
(Parts are listed in the order of sequence of removal.)

# MAIN CLUTCH

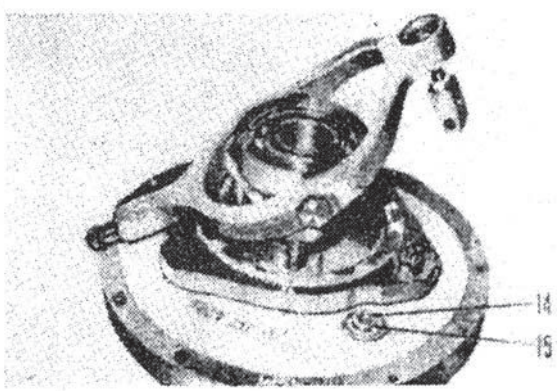
## MAIN CLUTCH W/INTERIA BRAKE

DISASSEMBLING. ETC

(1) Use of the special tool is required to remove bolts (8). This is a tightening tool for compressing the two clutch springs. After removing the bolts with the clutch springs compressed, loosen the tool gradually to release the springs.

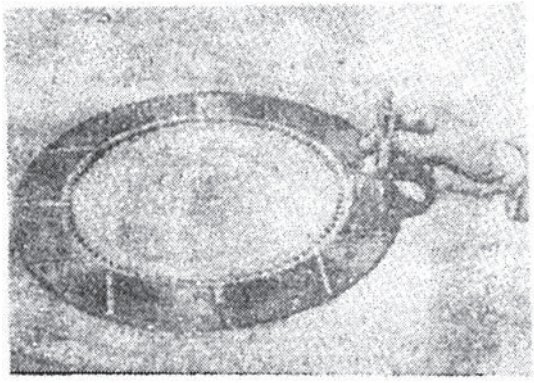


(2) To remove small springs (16) (not visible in this figure), push guide (15) against spring force and take out collar (14) to free the springs for removal.




### INSPECTION AND CLEANING

(1) Inspect the friction surfaces of clutch discs and plates for distortion, uneven wear, steps or groove marks, and check the thickness for wear. Clean all discs and plates thoroughly.



(2) Inspect the internal and external teeth of clutch discs and plates for wear or any damage.

(3) Inspect the hemispherical pivot point of the yoke for wear or any damage.

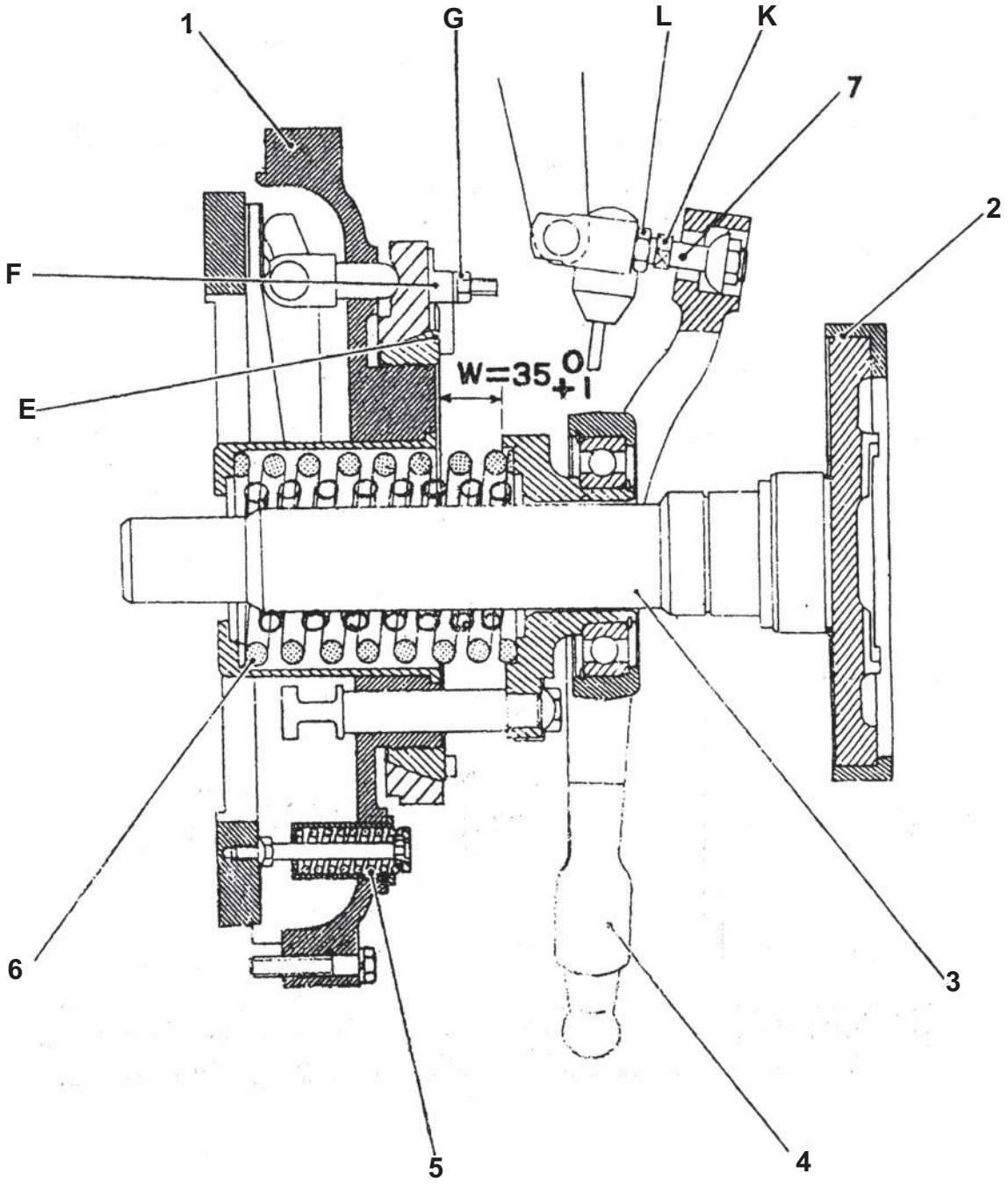
(4) Check clutch springs and clutch return springs for signs of fatigue, and inspect for damage.

(5) Inspect the bush in the seat for yoke pivot to see if the bush is excessively worn or damaged in any way.

(6) Inspect oil seals for wear or damage.

(7) Inspect the splines of clutch shaft for damage, and check the oil seal surface of shaft for wear.

## RE-ASSEMBLING




### Main Clutch

1. Clutch cover
2. Brake drum
3. Main clutch shaft
4. Yoke
5. Return spring
6. Main clutch springs

# MAIN CLUTCH

## MAIN CLUTCH W/INERTIA BRAKE

### RE-ASSEMBLING

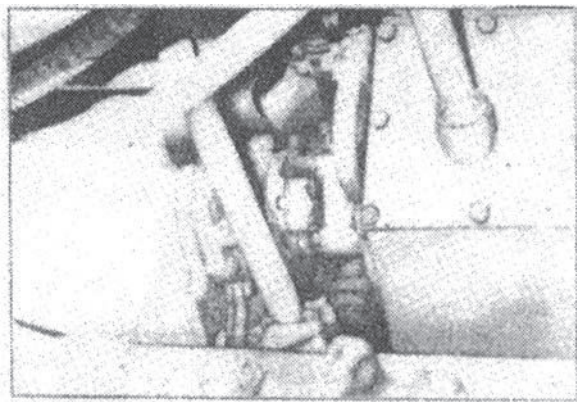
To re-assemble the main clutch, reverse the disassembling procedure and adhere to the following instructions:

(1) Apply engine oil to main clutch discs and plates before installing them in place.

(2) Apply bonding agent to the packing, and a light coating of grease to the oil seal, before fitting these parts at the time of re-mounting the bearing assembly on main clutch case. The case is to be positioned in place as governed by match marks provided across it and flywheel housing.

(3) In a properly adjusted main clutch in place, the value of dimension W is $35^{+1}$ mm. To adjust dimension W to this value, turn adjusting ring (E).

(4) Lock plate (F) and securing nut (G) must be loosened to permit the ring (E) to be turned.

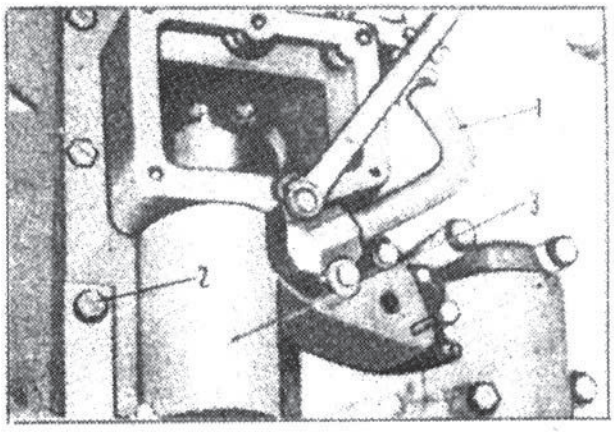


(5) When installing the inspection cover, be sure to apply a liquid sealing compound to its gasket.

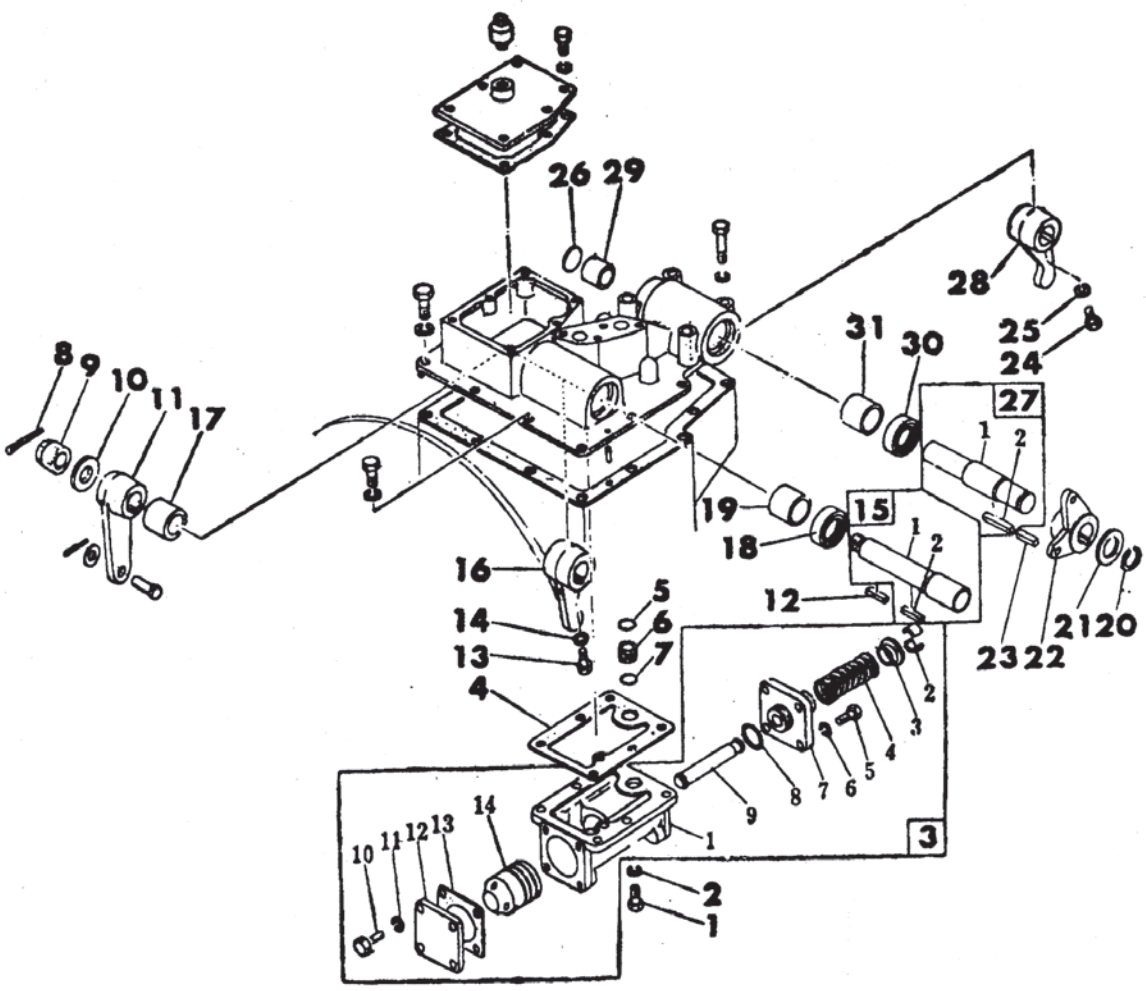
# BOOSTER

## REMOVAL

Disconnect pipe (1) and remove bolts (2) Take out the booster assembly (3).



## DISASSEMBLY




(Parts are listed in the sequential order of removal)

### Main Clutch Booster

1. Bolt
2. Spring washer
3-1 Booster cylinder
3-2 Ring
3-3. Spring seal
3-4. Spring
3-5. Bolt
3-6. Spring washer
3-7. Bush
3-8 “O” ring
3-9 Valve
3-10 Bolt
3-11. Spring washer
3-12. Cover
3-13. Gasket
3-14. Piston
4. Gasket
5. "O" ring
6. Pipe
7. "O" ring
8. Cotter pin
9. Nut
10. Washer
11. Lever
12. Key
13. Bolt
14. Spring washer
15-1 Shaft
15-2 Key
16. Lever
17. Bush
18. Oil seal
19. Bush
20. Snap ring
21. Washer
22. Lever
23. Key
24. Bolt
25. Spring washer
26. Plug
27-1 Shaft
27-2 Key
28. Lever
29. Bush
30. Oil seal
31. Bush

To remove spring (3-4), push on the spool to compress the spring and remove the ring. Removal of the ring allows the seat and spring to come off.

## INSPECTION AND CLEANING

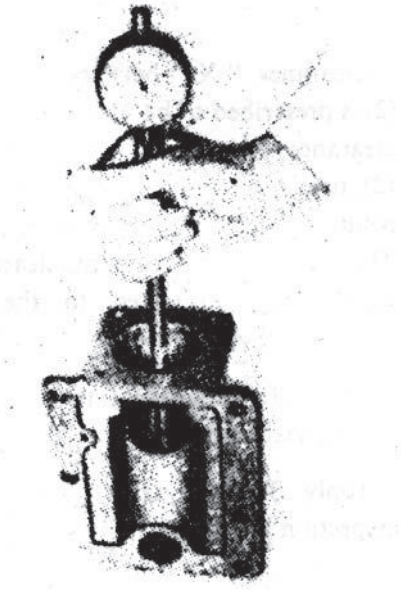
(1) Inspect the booster piston and valve for wear or damage.

(2) Check the booster spring for fatigue, and examine it for damage.

(3) Check the booster cylinder bore for wear or any damage.

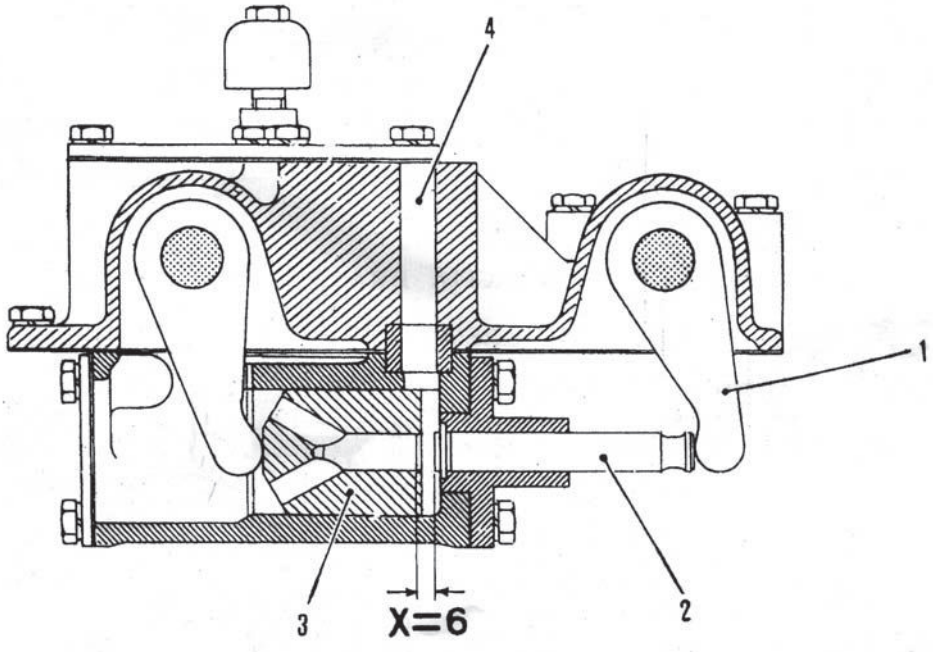
(4) Inspect the oil seals for damage.

(5) Inspect the oil seal surfaces of shafts for wear or damage.



### RE-ASSEMBLING

Reverse the disassembling procedure to re-assemble the booster.




**Main Clutch Booster**

1. Lever
2. Valve
3. Piston
4. Oil hole

# MAIN CLUTCH

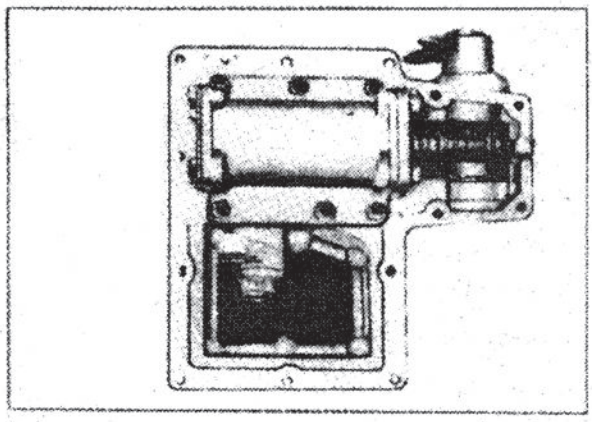
## BOOSTER INERTIA BRAKE

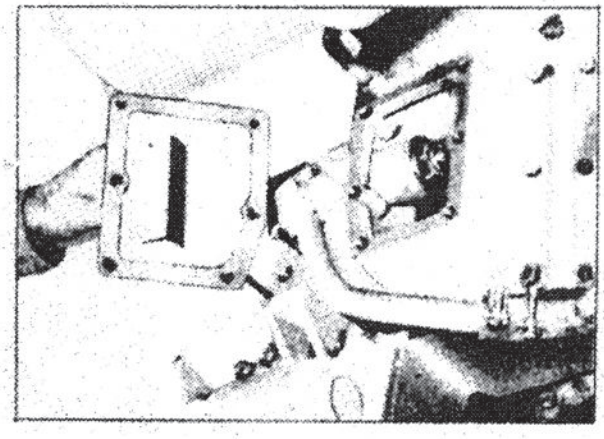
### RE-ASSEMBLING

(1) Clearance" X" between piston (3) and valve (2) is prescribed to be 6 mm. To obtain this much clearance, hold piston (3) in contact with valve (2), turn back joint K (See Main Clutch) 5½ or 6 rotations, and lock the joint in that position. This will result in a 6 mm. clearance if the clutch pedal play is adjusted to the specified value (23 mm at pedal face).

(2) Apply Bonding agent to the packing for sealing the seating joint of booster body on the case.

(3) Apply Bonding agent to the packing for the inspection lid on the booster.

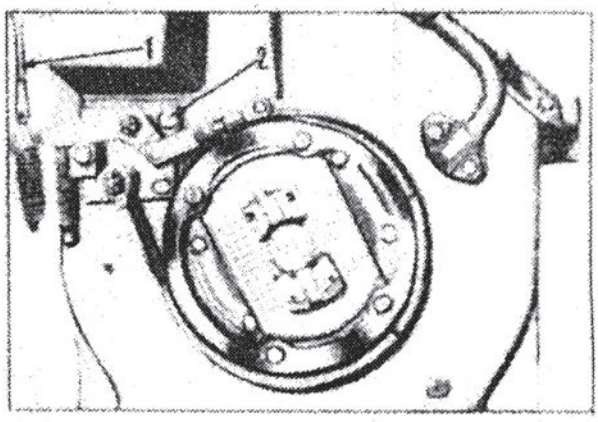




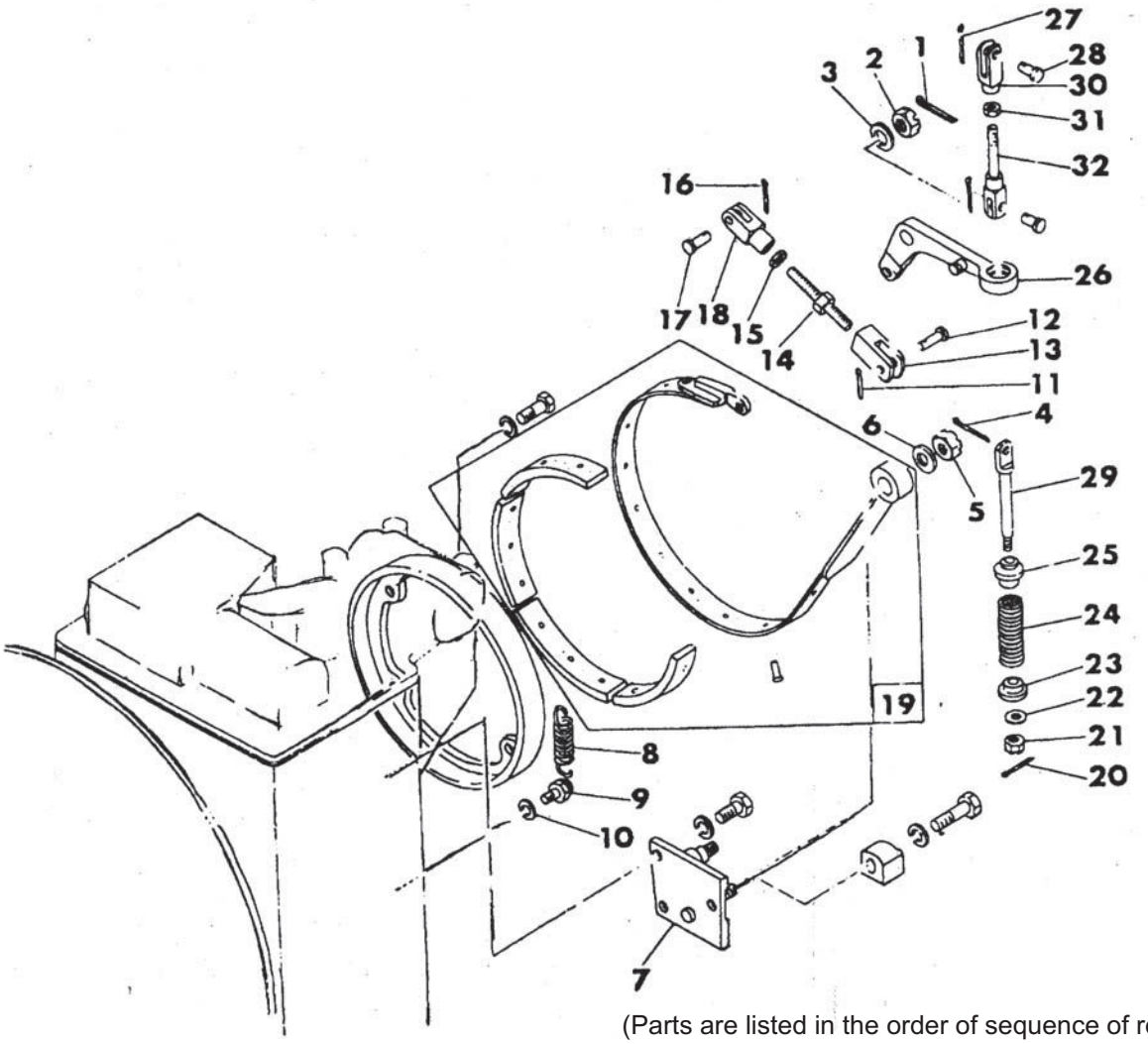
## INERTIA BRAKE

### REMOVAL

Disconnect yoke joint (1) to free the inertia brake band, from the clutch booster Remove bolts (2) securing brake bracket, and take out the brake band assembly.



## DISASSEMBLING




(Parts are listed in the order of sequence of removal)

### Inertia Brake

1. Cotter pin
2. Nut
3. Washer
4. Cotter pin
5. Nut
6. Washer
7. Bracket
8. Spring
9. Pin
10. Washer
11. Cotter pin
12. Pin
13. Yoke
14. Adjust bolt
15. Nut
16. Cotter pin
17. Pin
18. Yoke
19. Brake band
20. Cotter pin
21. Nut
22. Washer
23. Guide
21. Spring
25. Guide
26. Lever
27. Cotter pin
28. Pin
29. Rod
30. Yoke
31. Nut
32. Rod

## CLEANING AND INSPECTION

(l) Inspect the brake band for wear or damage.

(2) Check the springs for fatigue, and examine for damage.

## RE-ASSEMBLING AND RE-MOUNTING

Reverse the procedures of removal and disassembling, adhering to the following instructions :

(1) When positioning the brake band around the drum, be sure to locate it squarely to cover the full width of the drum surface.

2) Set the adjusting bolt to obtain a band-to-drum clearance of 1 mm.

# TRANSMISSION

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**GEAR SHIFT LEVER ASSEMBLY**

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**SHIFT FORK**

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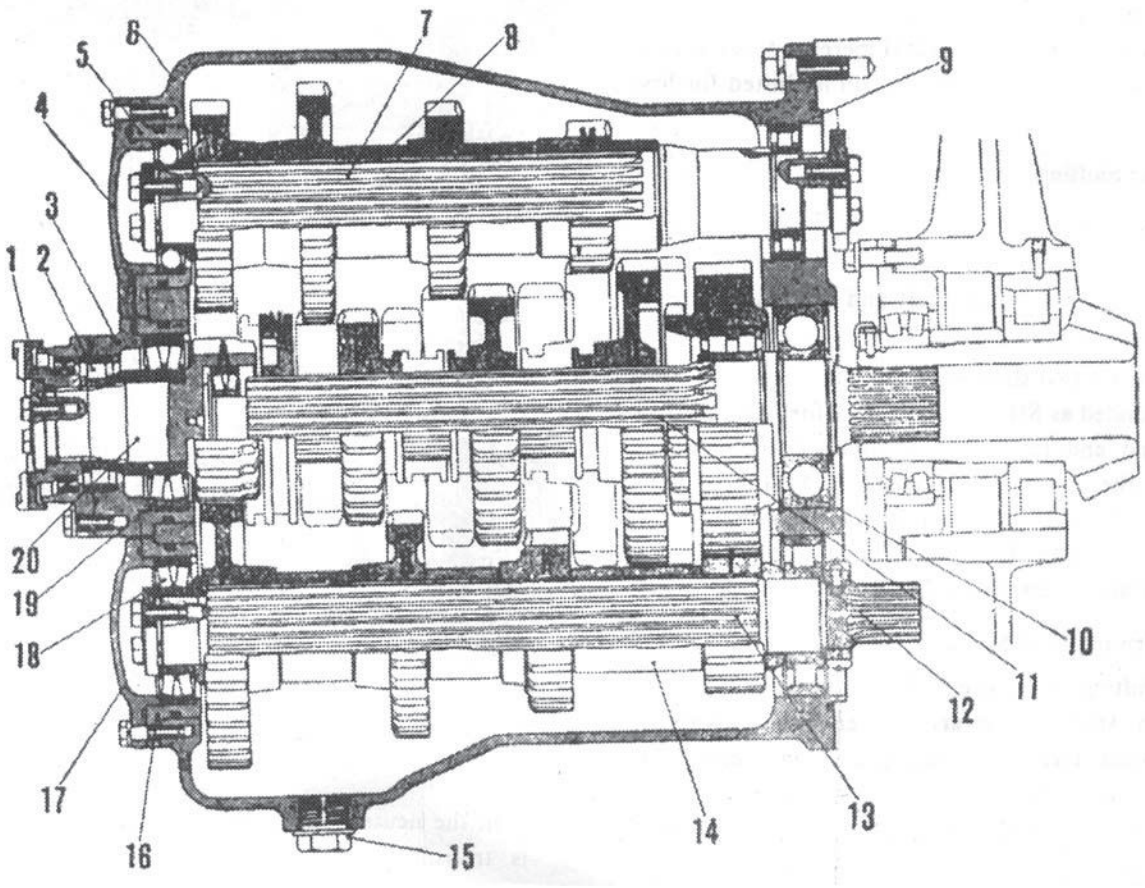
# TRANSMISSION

## DESCRIPTION




**Transmission**

1. Coupling
2. Bearing
3. Bearing holder
4. Cover
5. Bearing holder
6. Transmission housing
7. Intermediate shaft
8. Collar
9. Bearing
10. Ball bearing
11. Main shaft
12. Bearing
13. Counter shaft
14. Collar
15. Drain plug
16. Bearing holder
17. Cover
18. Bearing
19. Bearing
20. Input shaft

The transmission is of selective sliding gear type. It comprises three gear-carrying shafts-main shaft, counter shaft and intermediate shaft, all supported by rolling-contact bearings-whose gears are so related as to provide a total of 7 speeds, four forward speeds and three reverse speeds.

Gears on main shaft are splined to the shaft and are capable of sliding along the shaft. Gears on intermediate shaft and counter shaft are fixed on the shaft with collars. The output end of main shaft is splined and the bevel pinion for dividing the flow of drive into two cross paths toward the right and left steering clutches, is fitted to it.

The bottom section of transmission ·case serves as an oil sump, from which gears splash up oil to lubricate all running and sliding parts within the transmission.

# TRANSMISSION

## DESCRIPTION

The flow of drive through the transmission takes the following path: from input shaft to counter shaft through a pair of gears in constant mesh and then to main shaft directly (for forward drive) or through intermediate shaft (for reverse drive). The first speed gear on main shaft is mounted on a roller bearing of that this gear (which is in constant mesh with one of counter shaft gears) merely spins on main shaft-except when the transmissions shifted for first speed.

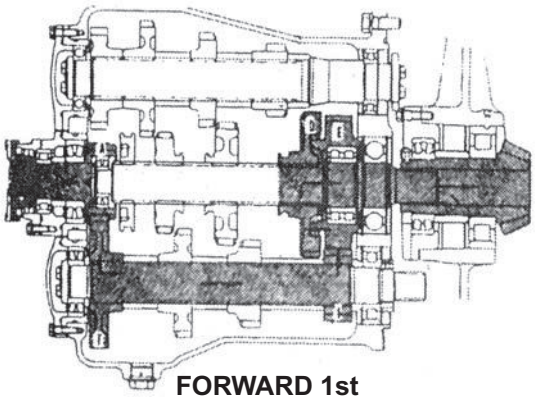
### A. Gear Shifting

Gear shifting is effected in, a conventional manner: moving the shift lever into the desired position selects the gear on main shaft and meshes it with the corresponding gear.

There are two shift levers for the operator. One, designated as SHIFT LEVER, is for selecting first, second and third speeds, forward and reverse; and the other, designated as 4TH (or TOP) LEVER, is used to shift the transmission for fourth speed., Flow of drive for each speed is illustrated diagrammatically.

#### (1) Forward First Speed

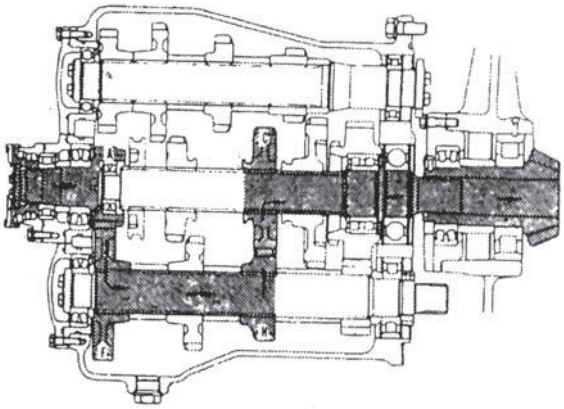
Shifting the reverse-first-speed-gear D (on main shaft) backward to engage it with the constant mesh first-speed-gear E connects main shaft to countershaft. Engagement is made by means of the dog clutch formed on these gears.



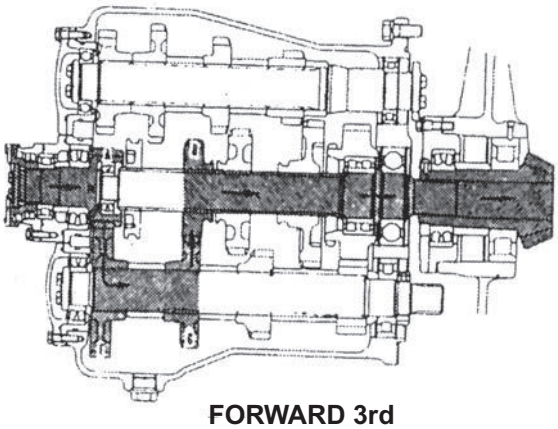
**FORWARD 1st**

(2) Forward Second and Third Speeds

These speeds are selected by sliding the respective gears C or B on main shaft to mesh them with the corresponding gears H or G on countershaft.



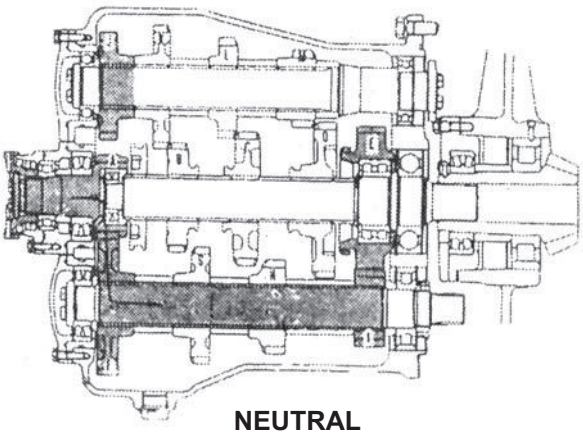
**FORWARD 2nd**



**FORWARD 3rd**

#### (3) Neutral

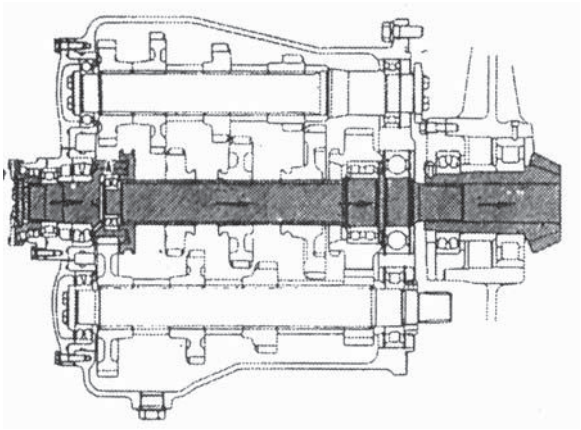
In the neutral state, the rotation of input shaft is transmitted to countershaft and intermediate shaft but not to main shaft. The only running member of main shaft in this state is the first-degree-gear E.



**NEUTRAL**

4) Forward Fourth (Top) Speed

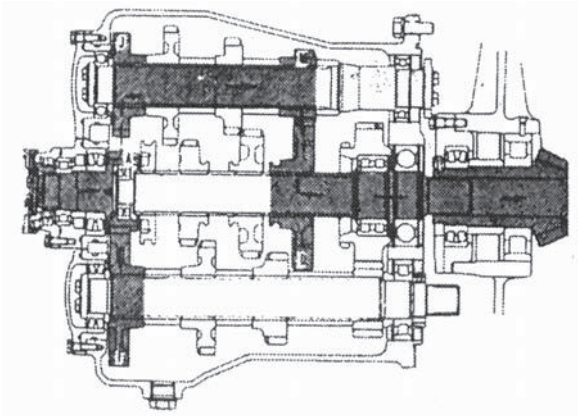
This speed is selected by sliding the 4th speed gear on main shaft into the input shaft gear.



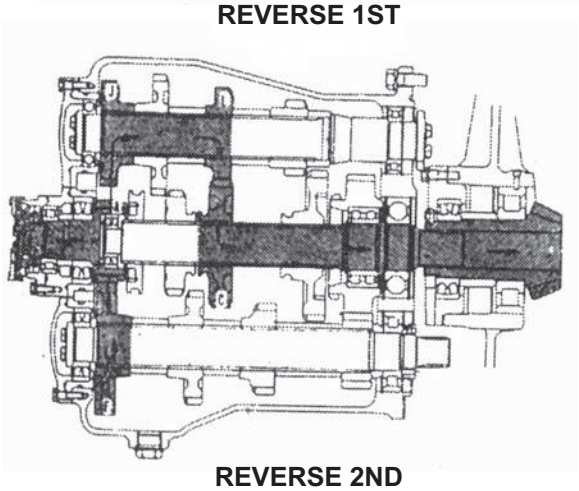
**FORWARD 4th**

With these gears engaged by their dog clutch, drive flows directly from input shaft to main shaft.

5) Point (5) should start here.



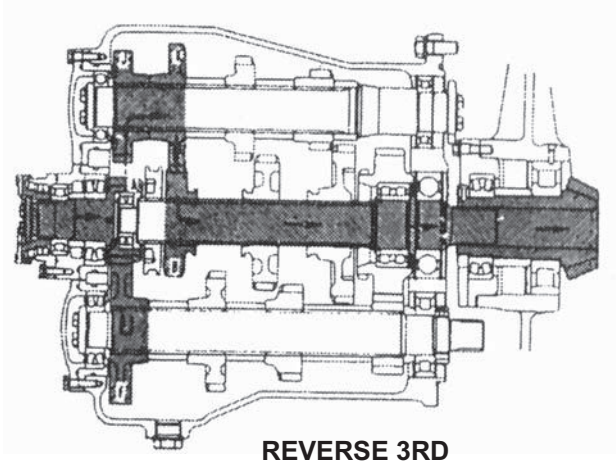
**REVERSE 1ST**



**REVERSE 2ND**

(5) Reverse First, Second and Third Speeds

For these speeds, gears on intermediate shaft come between main shaft gears and countershaft gears to reverse the direction of rotation cf main shaft.



**REVERSE 3RD**

(6) Transmission Gear Ratios

The speed of input drive is changed according to the following table of ratios. Output speed (at bevel pinion) is inversely proportional to output torque.

**POWER FLOW CHART**

| Direction | Speed | Power flow (gear combination) | Gear reduction ratio | Traveling speed km/h |
|---|---|---|---|---|
| Forward | 1st | A→F→I→E | $\frac{40}{22} \times \frac{42}{20}$ | 2.45 |
| | 2nd | A→F→H→C | $\frac{40}{22} \times \frac{37}{25}$ | 3.47 |
| | 3rd | A→F→G→B | $\frac{40}{22} \times \frac{30}{32}$ | 5.48 |
| | 4th | Direct | — | 9.35 |
| Reverse | 1st | A→F→J→M→D | $\frac{29}{22} \times \frac{44}{20}$ | 3.22 |
| | 2nd | A→F→J→L→C | $\frac{29}{22} \times \frac{37}{27}$ | 5.18 |
| | 3rd | A→F→J→K→B | $\frac{29}{22} \times \frac{30}{34}$ | 8.04 |

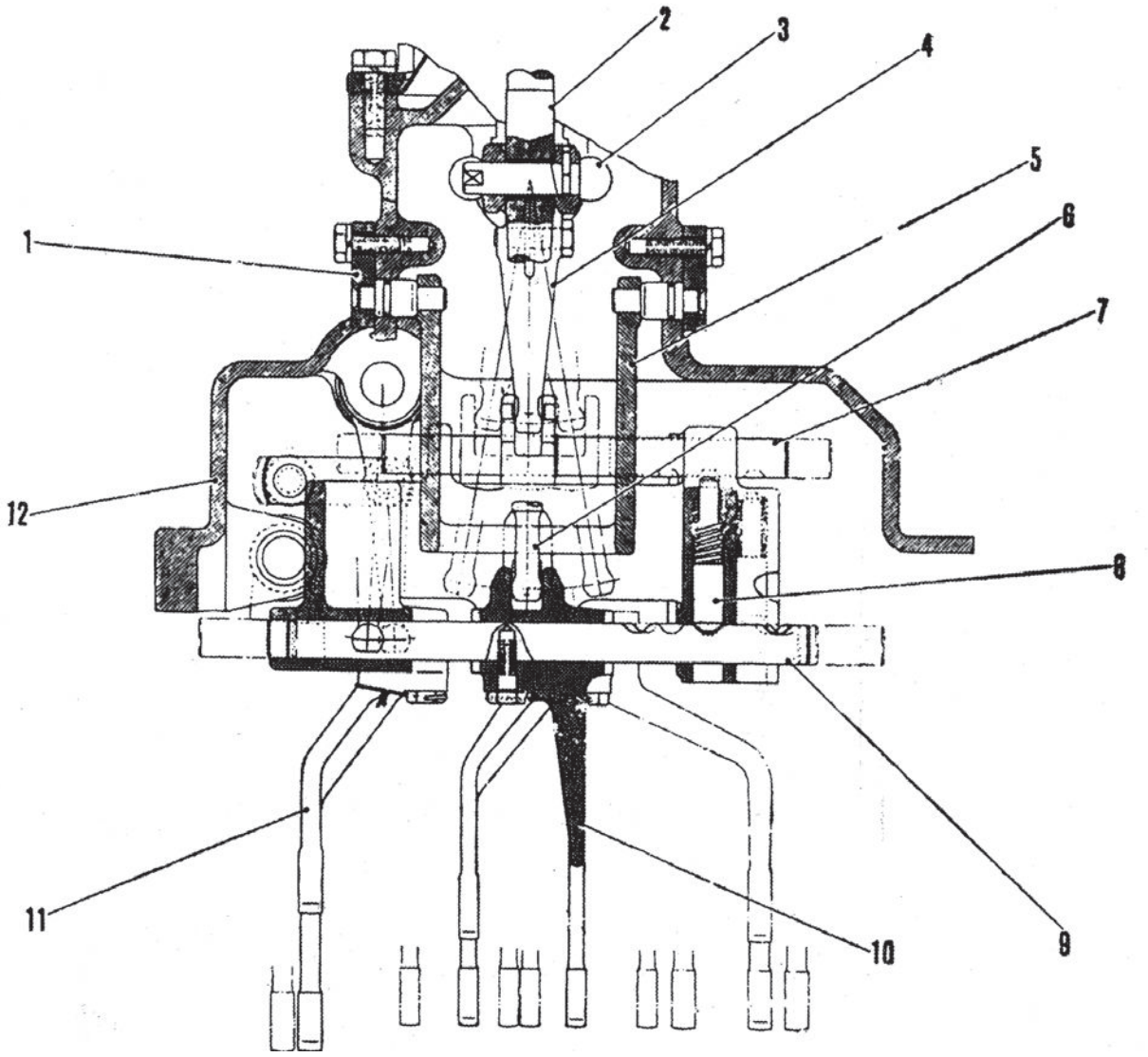
B. Gear Shift Mechanism

The shift mechanism, located in the transmission case cover, consists of two control levers (SHIFT and 4TH levers), four shifter shafts and forks. The shifter shafts carry the forks whose bottom ends are

## DESCRIPTION

engaged with gears on main shafts. These shafts can slide in the holes machined through the case cover. Spring-loaded arresting balls are provided in the cover; and each shaft has semi-spherical dents for arresting balls.

Moving the shift lever into the desired gear position swings its tip sidewise into the passage and then pushes the shaft axially, causing its fork to move the main shaft gear to mesh with the corresponding gear on counter shaft or intermediate shaft. At each position, the shifter shaft becomes arrested by the ball.

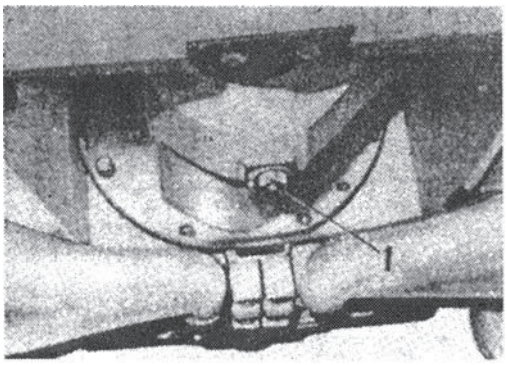



**Shifter forks.**

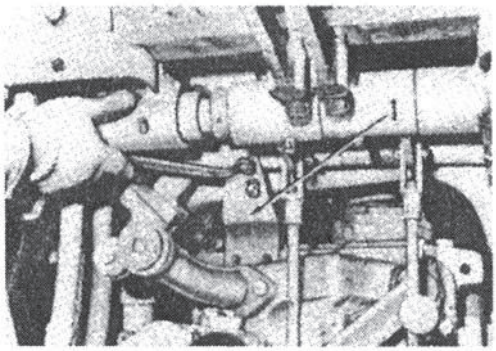
1. Bracket
2. Levee
3. Shaft
4. Lever
5. Lever bracket
6. Lever
7. Fork shaft
8. Plunger
9. Fork shaft
10. Fork
11. Fork (4th speed)
12. Bracket

## REMOVAL

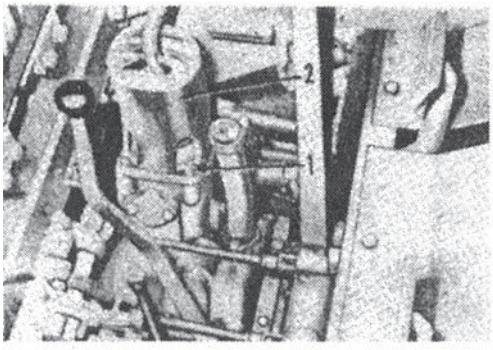
(1) Raise the tractor off the floor by placing four 350 mm thick blocks under the tracks.
(2) Remove the under guards.
(3) Remove all floor plates.
(4) Remove both side cover plates.
(5) Remove the universal joint.
(6) Loosen drain plug (1) to drain oil out.



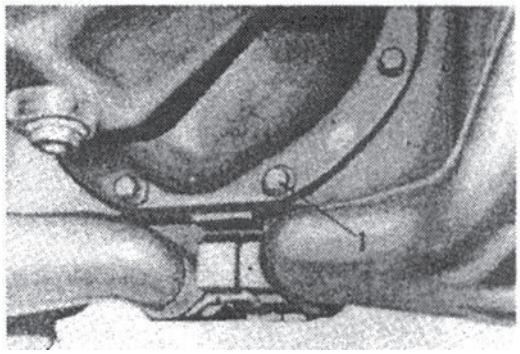

(7) Remove pipe bracket (1)



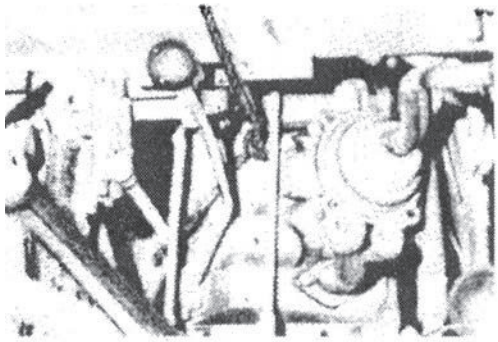

(8) Draw off the shift lever grip. Remove bolts (1) and take off guide (2).



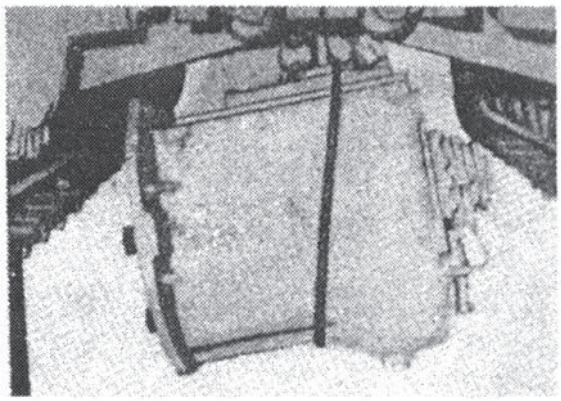

(9) Remove bolts (1) securing the transmission case to the steering case.




(10) Place a lifting sling around the transmission case, and lift the transmission off the main frame.



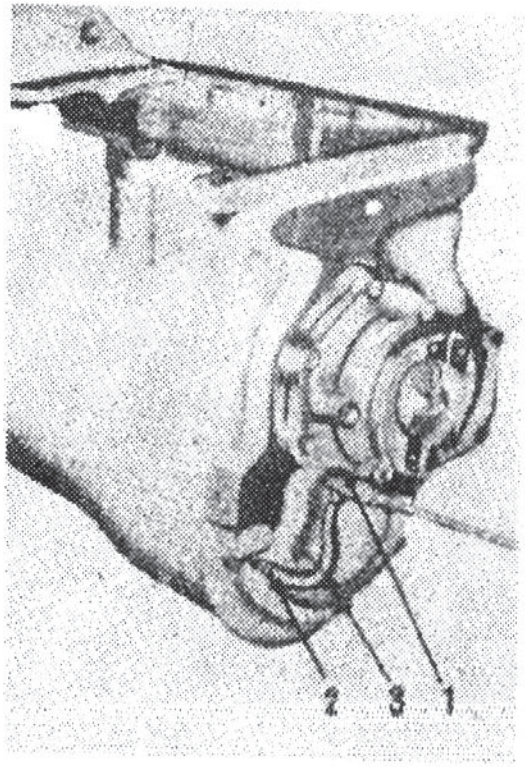
(11) Lower the transmission clear from main frame.



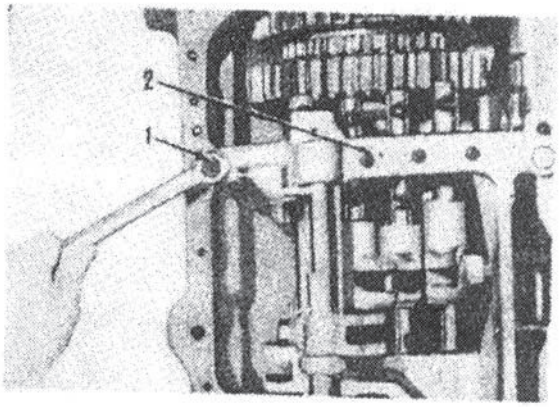
**NOTE:** Cock down the right side (as viewed from the front side) of the transmission slightly to clear the main frame when lowering it on the floor. Handle the transmission with care so as not to strike it against other parts or components.

## REMOVAL

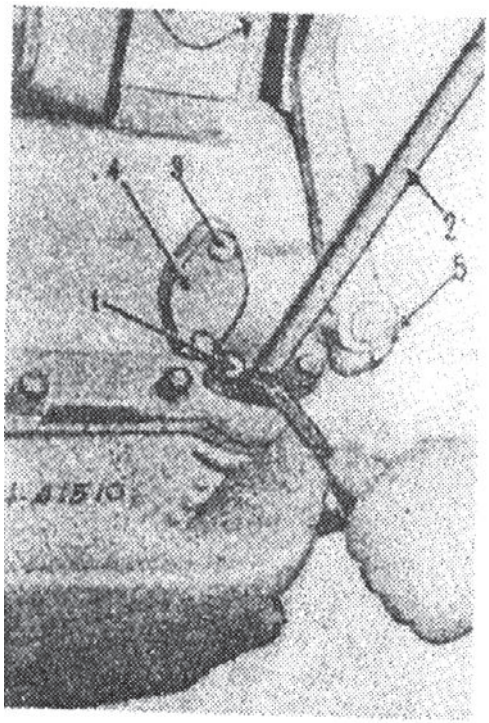
(12) With the transmission set on the floor, remove bolts (1) and draw out oil filler (2) complete with dip stick. Remove bolts (3) and take out stopper and cover (4). Remove bolts (5) and take this shift lever assembly off the transmission case.



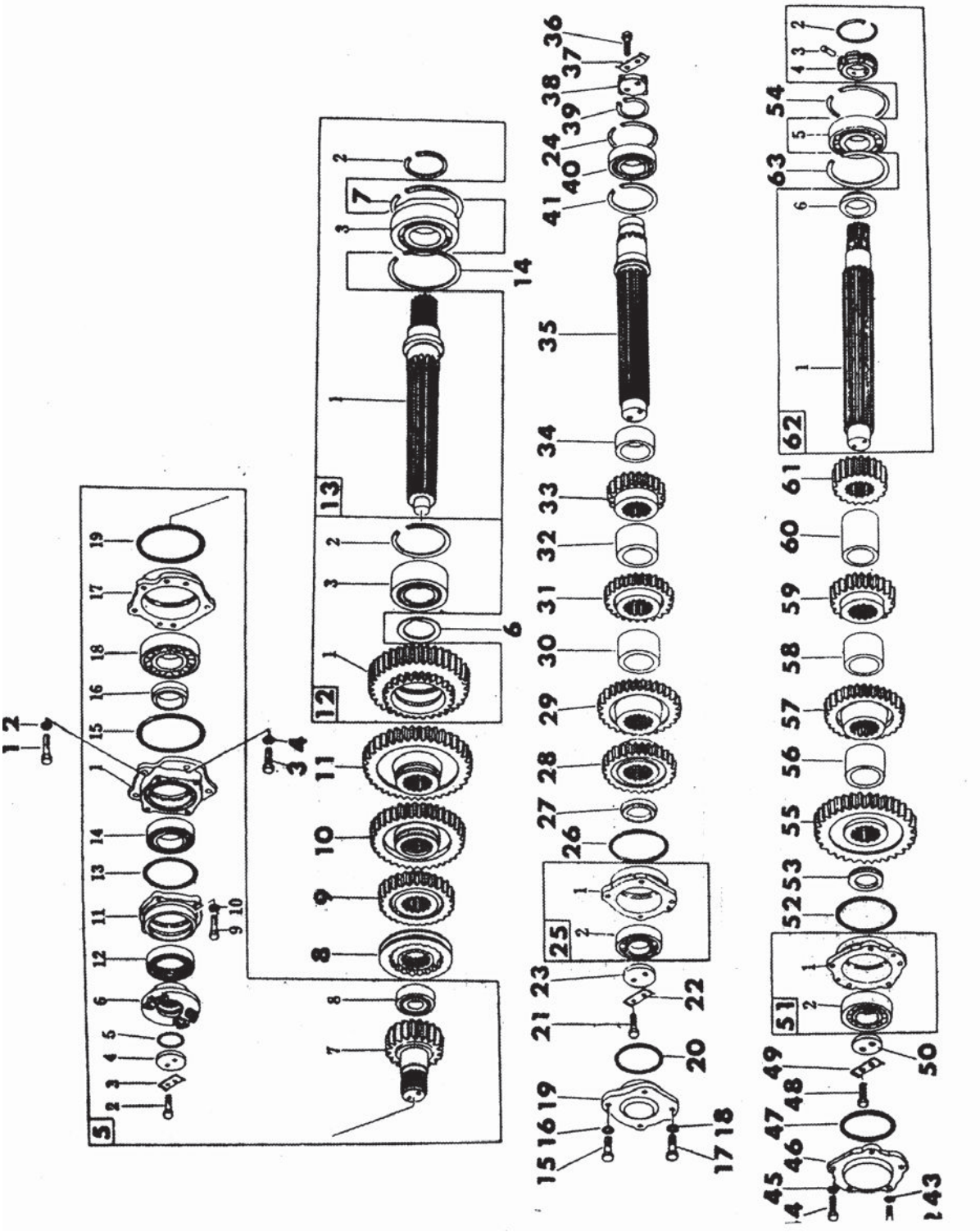

(13) Remove bolts (1) and take out shift fork assembly (2).




(14) Disconnect tube joints (1) (2) and remove lube oil tube (3).



## DISASSEMBLING



**Transmission**

**(Parts are listed in the order of sequence of removal.)**

# TRANSMISSION

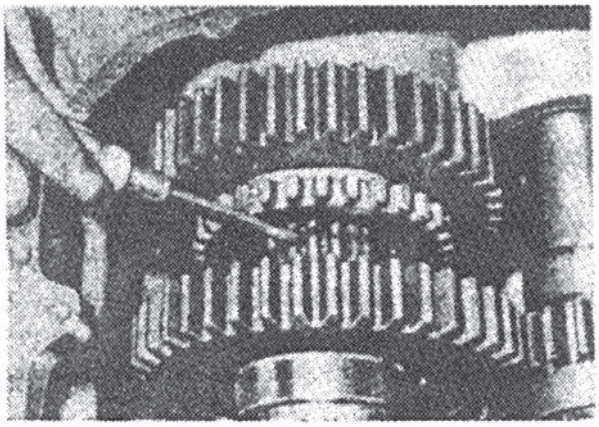
## DESCRIPTION REMOVAL

1. Bolt
2. Spring washer
3. Bolt
4. Spring washer
5-1. Bearing cage
5-2. Bolt
5-3. Lock
5-4. Holder
5-5. "O" ring
5-6. Coupling
5-7. Gear
5-8. Bearing
5-9. Bolt
5-10. Spring washer
5-11. Cover
5-12. Oil seal
5-13. "O" ring
5-14. Bearing
5-15. "O" ring
5-16. Collar
5-17. Bearing cage
5-18. It Bearing
5-19. "O" ring
6. Snap ring
7. Snap ring
8. Coupling
9. Gear
10. Gear
11. Gear
12-1. Gear
12-2. Snap ring
12-3. Bearing
13-1. Main shaft
13-2. Snap ring
13-3. Bearing
14. Snap ring
15. Bolt
16. Spring washer
17. Bolt
18. Spring washer
19. Cover
20. “O” ring
21. Bolt
22. Lock
23. Holder
24. Snap ring
25-1. Bearing cage
25-2. Bearing
26. “O” ring
27. Washer
28. Gear
29. Gear
30. Collar
31. Gear
32. Collar
33. Gear
34. Collar
35. Intermediate shaft
36. Bolt
37. Lock
38. Oil thrower
39. Snap ring
40. Bearing
41. Snap ring
42. Bolt
43. Spring washer
44. Bolt
45. Spring washer
46. Bearing cover
47. “O” ring
48. Bolt
49. Lock
50. Holder
51-1. Bearing cage
51-2. Bearing
52. “O” ring
53. Washer
54. Snap ring
55. Gear
56. Collar
57. Gear
58. Collar
59. Gear
60. Collar
61. Gear
62-1. Countershaft
62-2. Snap ring
62-3. Pin
62-4. Nut
62-5. Bearing
62-6. Washer
63. Snap ring

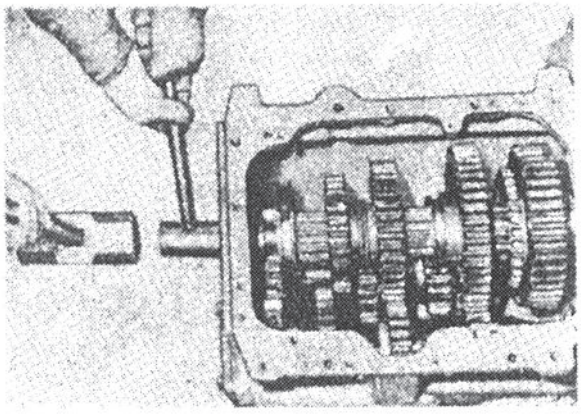
## DESCRIPTION REMOVAL DISASSEMBLING ETC

The main shaft and counter shaft are to be re-moved as follows : .

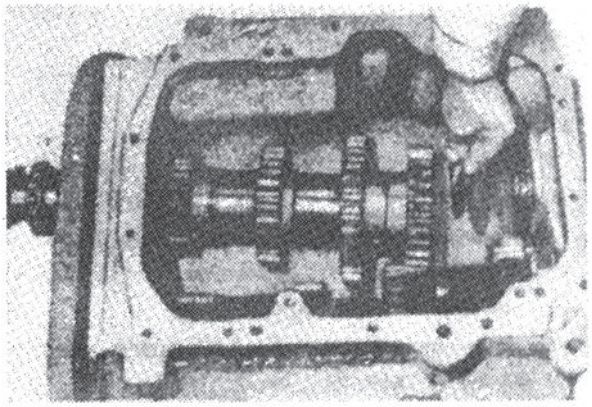
(1) Pry out snap ring (6) with a screwdriver.



(2) Take off snap ring (7) and drive the ma:n shaft out, as shown. Take out one gear after another from the shaft within the transmission case while the shaft is being driven out.



(3) Remove snap ring (24). Remove the countershaft similarly, that is, by driving with a hammer.

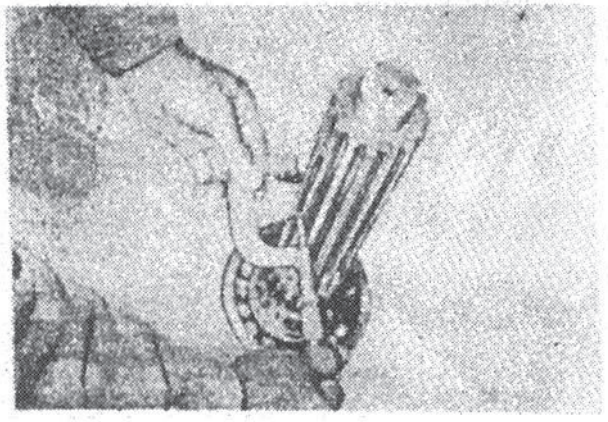


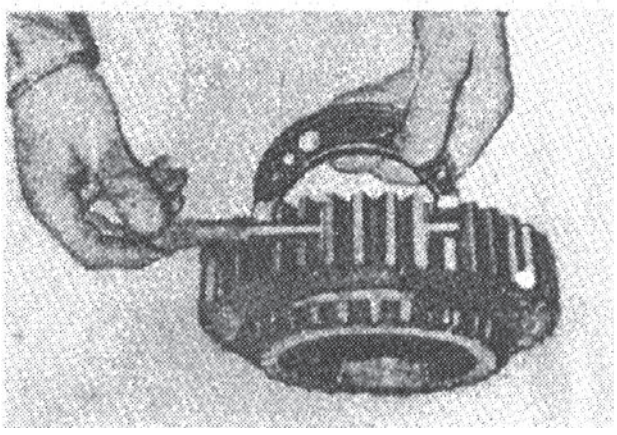
**NOTE:** Refer to exploded view on Page 04-07 and 04-08.

# INSPECTION AND CLEANING

(1) Wash all disassembled parts clean,

(2) Check the teeth and splines of gears and shafts for wear, and examine them for damage.





(3) Inspect the tips of shifter forks to, make ,sure they are in good condition, that is, free from exclusive wear or distortion.

(4) Check the oil seal surfaces of shafts for wear or damage.

(5) Inspect all oil seals for damage.

## RE-ASSEMBLING

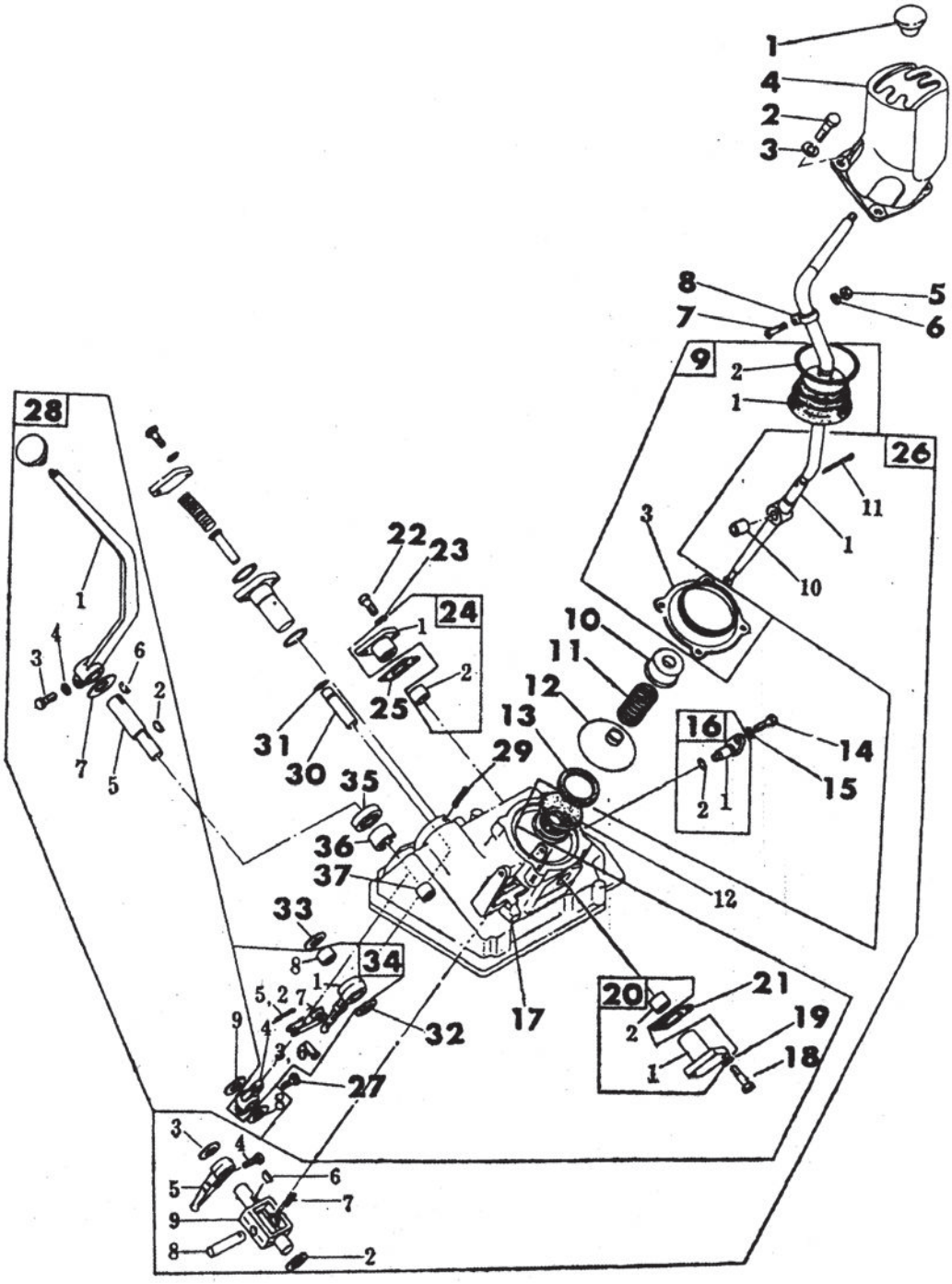
Re-assemble the transmission in the reverse order of disassembling, by adhering to the following instructions:

(1) Countershaft. Main shaft and intermediate shaft are to be inserted through the rear end of the transmission case. Mount gears onto each shaft within" the case while the shaft is being inserted.

(2) To fit the snap ring (6) in place on main shaft, turn the shaft counter-clockwise by slowly barring, while holding the snap ring in the gap. until the engaging ends of the ring fit into the shaft. Rock the ring in place with fingers to be sure it is fully seated in place.

# GEAR SHIFT LEVER ASSEMBLY

## DISASSEMBLING



**Gear Shift Lever**

**(Parts are listed in the order of sequence of removal.)**

# TRANSMISSION

## GEAR SHIFT LEVER ASSEMBLY

### DISASSEMBLY ETC.

1. Knob
2. Bolt
3. Spring washer
4. Guide
5. Nut
6. Spring washer
7. Screw
8. Clamp
9-1. Boot
9-2. “O” Ring
10. Cover
11. Spring
12. Cover
13. Seal
14. Bolt
15. Sprang washer
16-1. Bracket
16-2 “O” ring
17. Bracket
18. Bolt
19. Spring washer
20-1. Boss
20-2. Bearing
21. Gasket
22. Bolt
23. Spring washer
24-1. Boss
24-2. Bearing
25. Gasket
26-1. Lever
26-2. Washer
26-3. Washer
26-4. Bolt
26-5. lever
26-6. Key
26-7. Roll pin
26-8. Shaft
26-9. Yoke
26-10. Bush
26-11. Colter pin
26-12. Cover
27. Bolt
28-1. Lever
28-2. Key
28-3. Bolt
28-4. Spring washer
28-5. Shaft
28-6. Key
28-7. Washer
28-8. Washer
28-9. Washer
29. Roll pin
30. Shaft
31. “O” ring
32. Washer
33. Washer
34-1. Lever
34-2. Cotter pin
34-3. Pin
34-4. Lever
34-5. Cotter pin
34-6. Pin
34-7. Yoke
34-8. Bearing
35. Oil seal
36. Bearing
37. Bearing

The sub-assembly of lever (26) is to be driven out toward cover (F). Bosses (20) (24) must be removed before starting to drive out this sub-assembly.

## INSPECTION AND CLEANING

(1) Inspect the tip of shift lever for wear or damage.

(2) Inspect the boot and seats for damage.

(3) Check the springs for fatigue or damage.

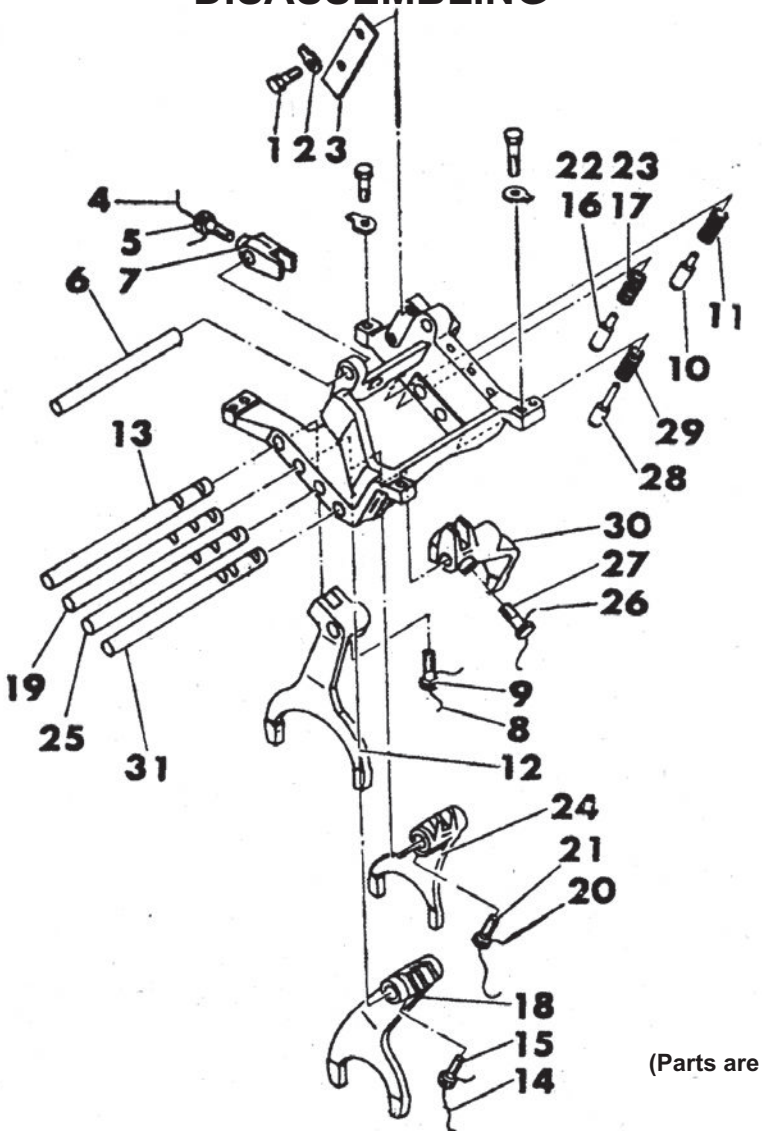
(4) Wash all. disassembled parts clean.

## RE-ASSEMBLING

Gaskets are used in the connections of oil level pipe, filler pipe, cover assembly, and shift lever bosses on transmission case. When installing these parts, be sure to coat the gaskets with Bonding Agent.

# SHIFT FORK

## DISASSEMBLING




**(Parts are listed in the order of sequence of removal.)**

**Shift Fork**

| | | | | | |
|---|---|---|---|---|---|
| 1. | Bolt | 12. | Fork | 23. | Spring |
| 2. | Lock | 13. | Shaft | 24. | Fork |
| 3. | Plate | 14. | Wire | 25. | Fork |
| 4. | Wire | 15. | Bolt | 26. | Wire |
| 5. | Bolt | 16. | Punger | 27. | Bolt |
| 6. | Shaft | 17. | Spring | 28. | Plunger |
| 7. | Lever | 18. | Yoke | 29. | Spring |
| 8. | Wire | 19. | Shaft | 30. | Fork |
| 9. | Bolt | 20. | Wire | 31. | Shaft |
| 10. | Plunger | 21. | Jolt | | |
| 11. | Spring | 22. | Plunger | | |

## INSPECTION AND CLEANING

(1) Inspect the tips of forks for wear or damage.
(2) Check the springs for fatigue or damage.
(3) Check the plungers for wear or damage.
(4) Inspect the arresting dents of shafts for wear, and check the shafts for straightness.
(5) Wash all disassembled parts clean.

## RE-ASSEMBLING

Some of bolts used in this mechanism are locked with wires. When re-assembling, be sure to identify these bolts and bind them with wires securely.

## RE-MOUNTING

After locating the transmission in its approximate position, be sure to check and correct its alignment with respect to the engine. Install the universal joint to connect the transmission input shaft to main clutch shaft only when the alignment is noted to be accurate within the specified limit.

SECTION : 05

# BEVEL GEAR

## INDEX

**BEVEL GEAR** ..... 05-01

**A. DISMOUNTING BEVEL GEAR SHAFT, BEVEL GEAR ASSEMBLY** . ..... 05-02

**B. MOUNTING BEVEL GEAR SHAFT, BEVEL GEAR ASSEMBLY** . ..... 05-07

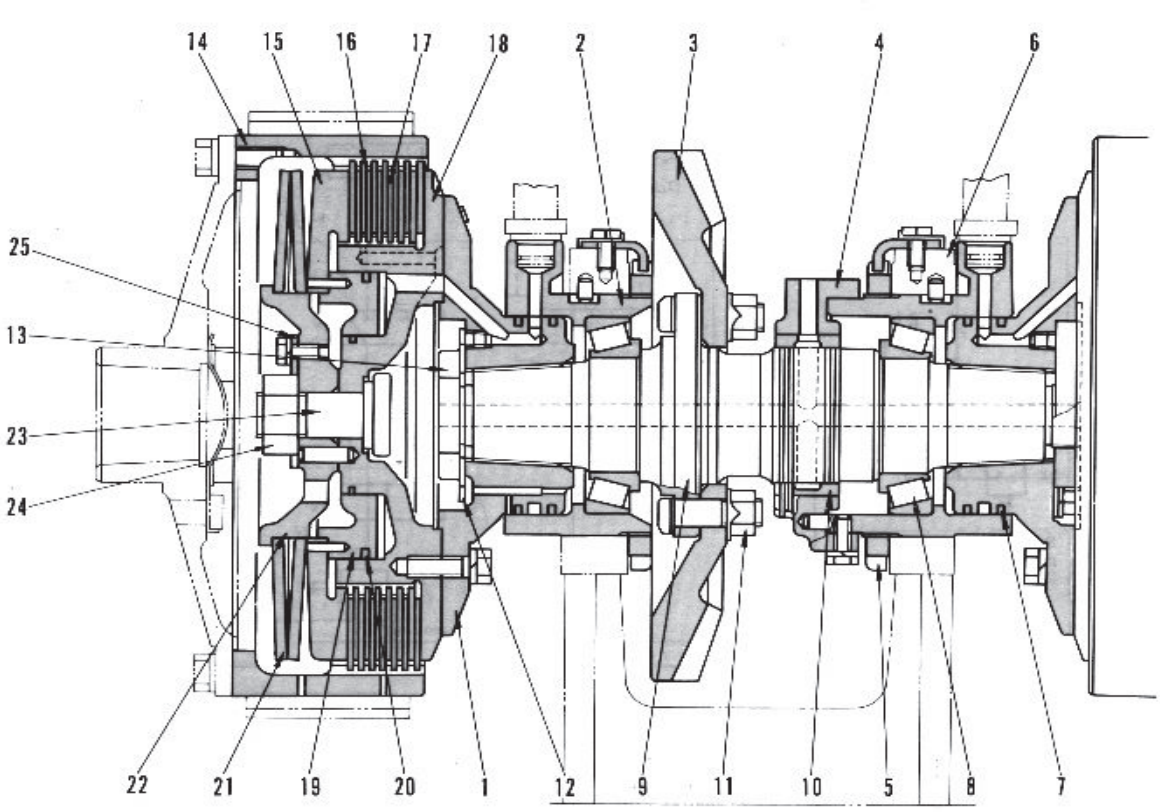
# BEVEL GEAR

The bevel pinion and gear used of a spiral bevel gear type.

Driving power from the engine is divided into two directions, right and left, through the bevel gear meshed with the bevel pinion, on the rear end of the transmission output shaft. The bevel gear is fitted to the bevel gear shaft with 8 reamer bolts and the bevel gear shaft is supported by the steering case through two taper roller bearings (8) and the bearing cages (2).

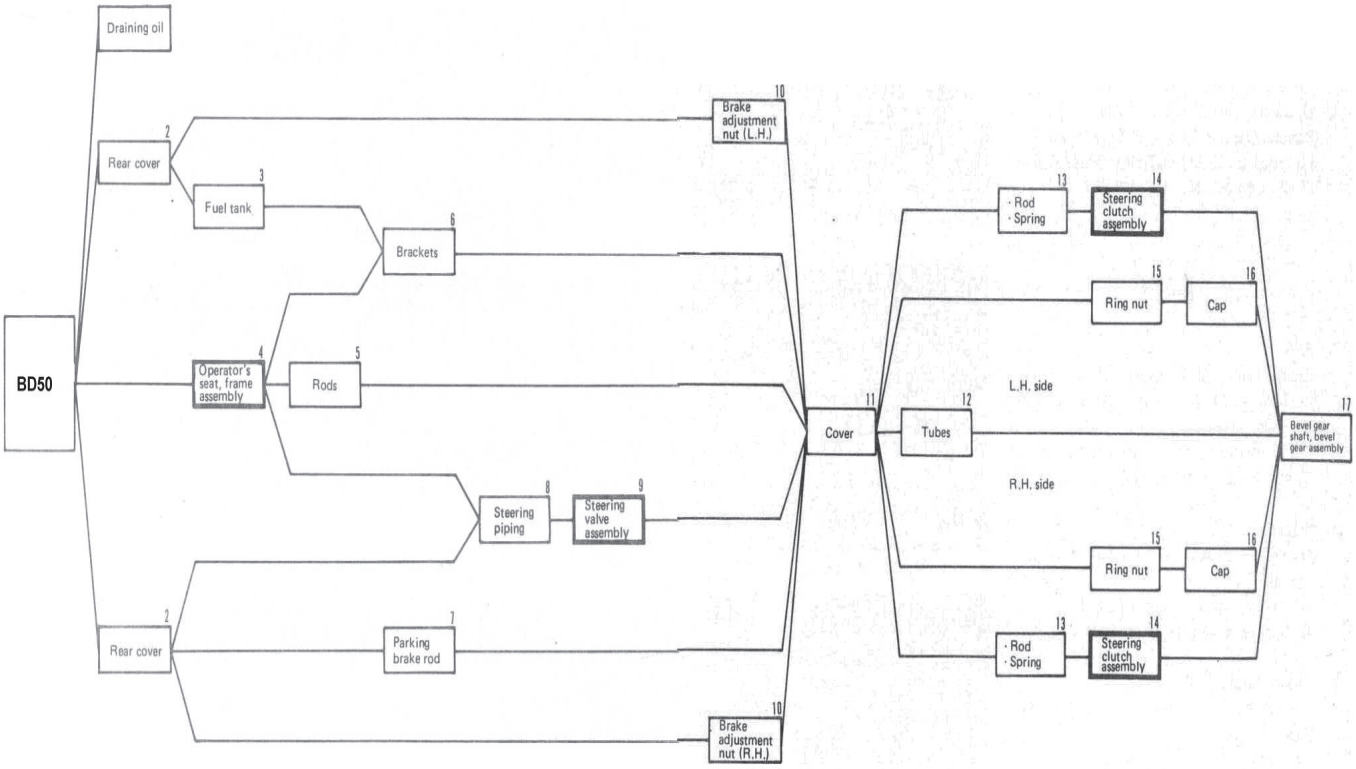
Adjusting nuts (5) are provided from moving bearing cages (2) right and left when it is necessary to readjust the bevel gear for proper tooth contact and backlash.

Bevel gear shaft hubs (1) for steering clutch are forced onto tapered splines at the end of bevel gear shaft. Steering clutches are then mounted to these hubs. A splash-lubrication is employed with the bevel gear in an oil bath.



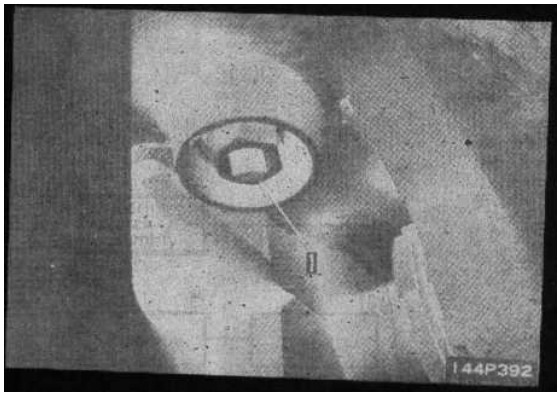

1. Bevel gear shaft hub
2. Bearing cage
3. Bevel gear
4. Flange
5. Adjusting nut
6. Cap
7. Seal ring
8. Taper roller bearing
9. Bevel gear shaft
10. Bushing
11. Nut
12. Lock plate
13. Nut
14. Brake drum
15. Pressure plate
16. Disc
17. Plate
18. Clutch drum
19. Piston
20. Seal ring
21. Spring
22. Flange
23. Bolt
24. Nut
25. Lock plate

## A. DISMOUNTING BEVEL GEAR SHAFT, BEVEL GEAR ASSEMBLY



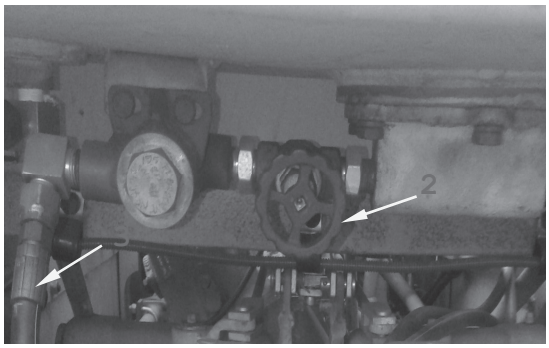

1. **Draining oil**
   Remove drain plug (1) and drain oil from case.

   **Oil: 80 ltr**




2. **Rear cover**
   Open rear cover below fuel tank.

3. **Fuel tank**
   1. Close fuel feed cock (2) and disconnect hose (3).
   2. Disconnect lamp wiring and remove cover (4)
   3. Using eye bolts (Dia = 12 mm, Pitch = 1.75 mm), remove fuel tank assembly (6).

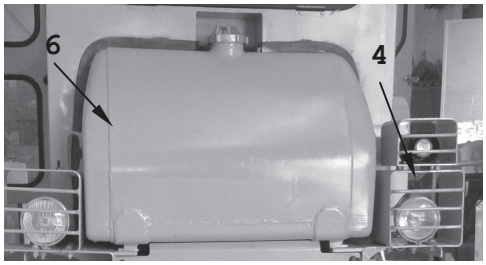



4. **Operator's seat, frame assembly**
   Remove Operator's seat and frame assembly. (For details, see 73 DISMOUNTING OPERATIOR'S SEAT AND FRAME ASSEMBLY).

**5. Rods**

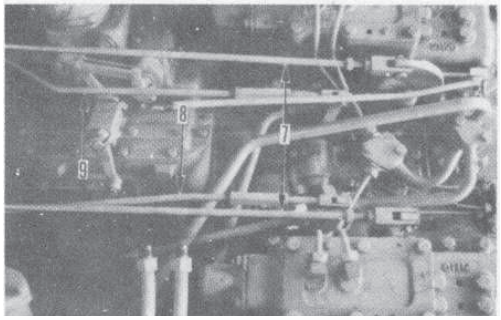
Remove brake rod (7), steering rods (8) and (9).

* Make marks (L.H., R.H., F,R) on the rods before removing.
* To remove the rods, disconnect the rods at the steering case end first.



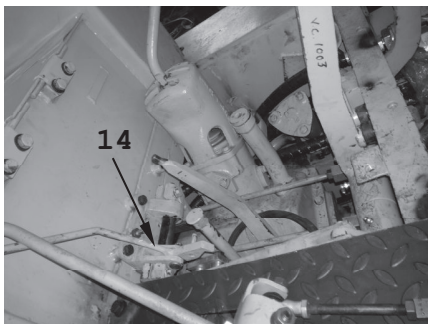

**6. Parking brake rod**

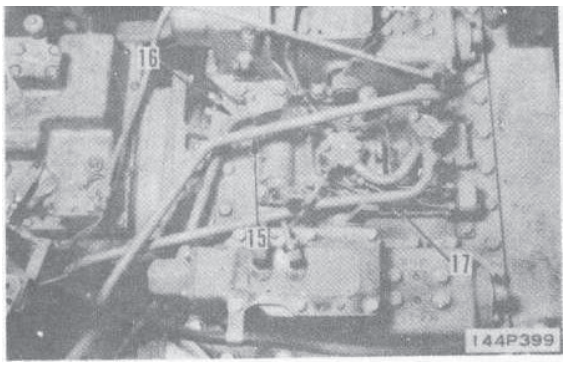
Remove spring, then remove parking brake rod (14).



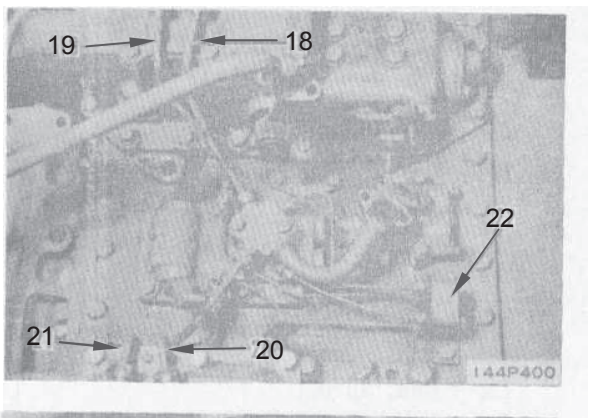

**7. Steering piping**

1) Disconnect tubes (15) and (16), then remove tube (17).
   * Remove clamp at frame end.



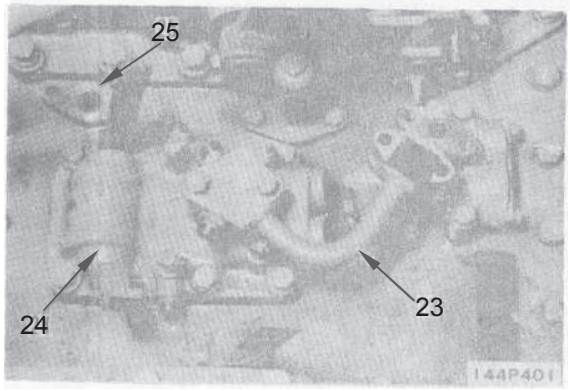




2) Remove brake control tubes (18), (19), (20) and (21).
3) Remove tube assembly (22) for oil pressure, gauge.



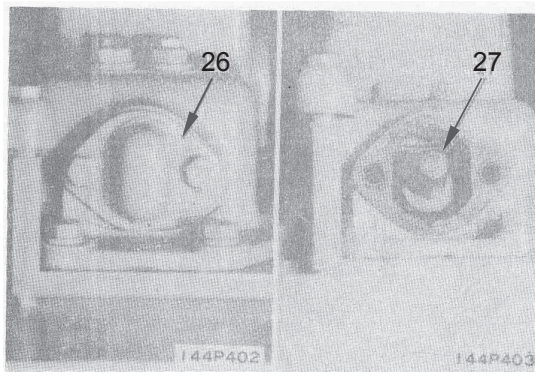

## 8. Steering valve assembly

1) Remove tube (23).
2) Remove steering control valve assembly (24).
   *The tube for the clutch may come out with the assembly, so be careful not to drop it
3) Remove spacer (25).



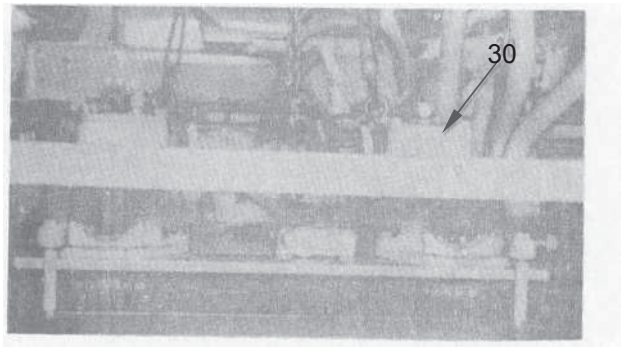
**9. Brake adjustment nut (L.H. and R.H.)**

Remove cover (26), then remove adjustment nut (27).



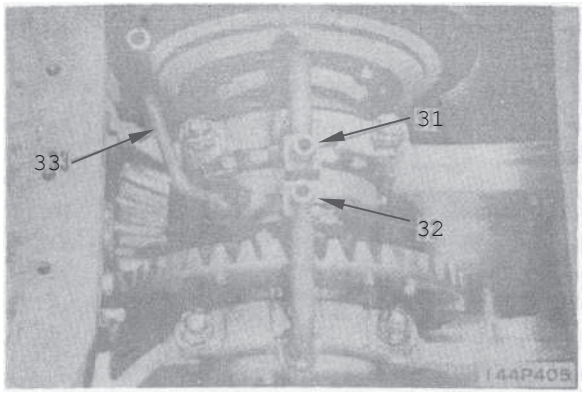

**10. Cover**

1) Remove mounting bolt.
2) Using eye bolts (Dia = 12mm, Pitch = 1.75mm) (Dia = 10 mm, Pitch =1.5 mm), remove cover (30).
   - ♦ Lift the cover, pulling the brake adjusting rod out of the lever.




**11. Tubes**

Remove tubes (31), (32) and (33).

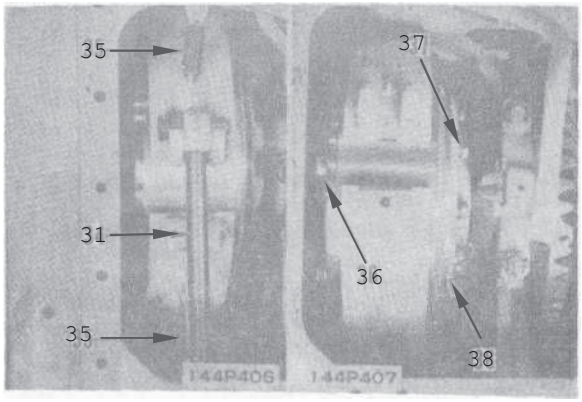



**12. Rod, spring**

Remove rod (34) and springs (35).
* Remove spring together with plate.

**13. Steering clutch assembly**

1) Remove flange bolts (36) and hub bolts (37, while turning clutch assembly (38). * Turn the clutch assembly by pressing the shoe upward with a hydraulic jack (10 ton).
2) Lift brake band with wire rope, disconnect pilot and remove steering clutch assembly (38).



**14. Ring nut**

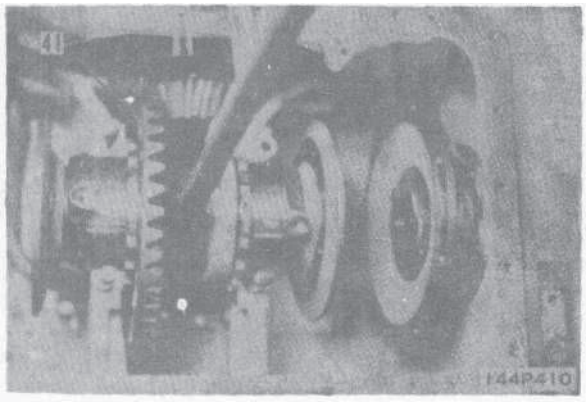
Remove lock and loosen ring nuts (40) with tool C.

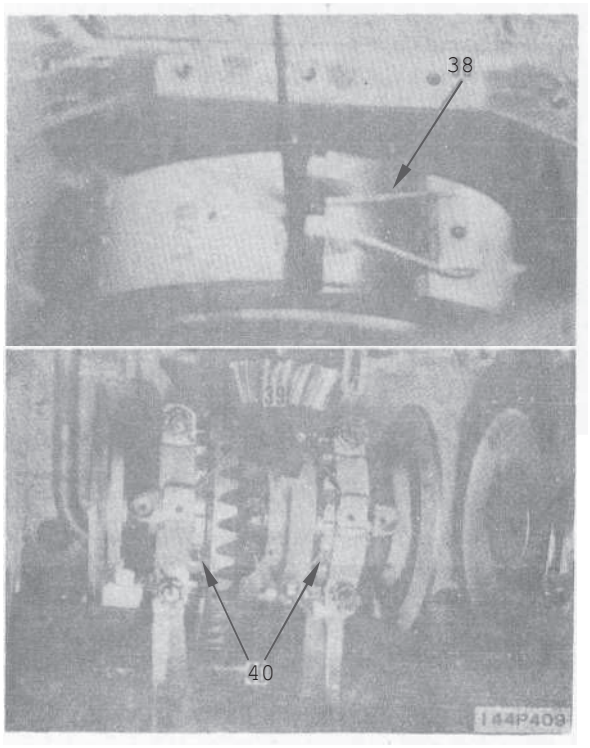
**15. Cap**

Remove nut and caps (39).

**16. Bevel gear shaft, bevel gear assembly**

1) Lift off bevel gear shaft and bevel gear assembly (41).

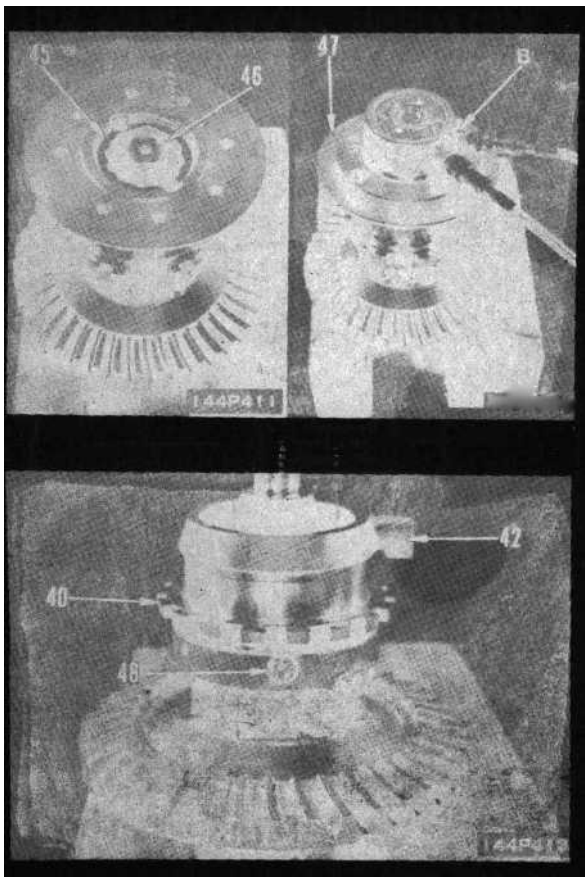



2) Disassemble bevel gear shaft and bevel gear assembly as follows.

i) Remove lock plate (45), then use tool A to remove nut (46).

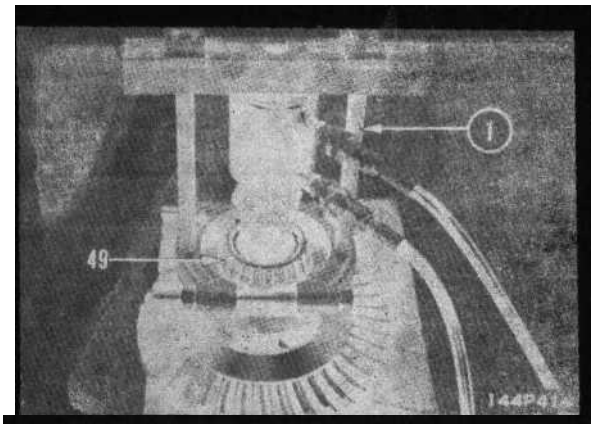
ii) Remove hub (47), with tool B.

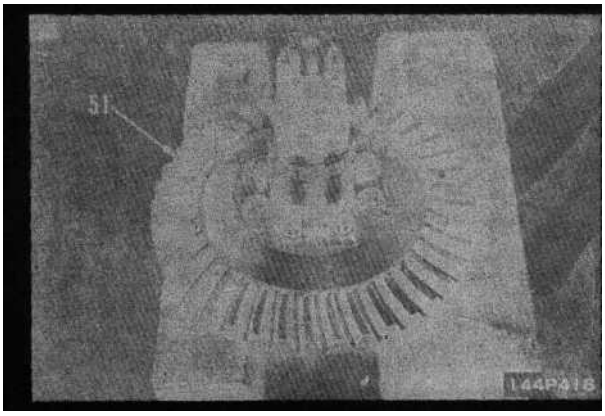


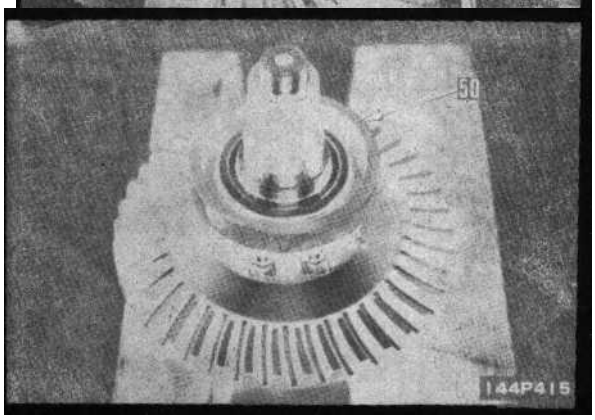

iii) Remove bolt (48), cage (42), and ring nut (40).

* There is no bolt (48) on the L.H. side.

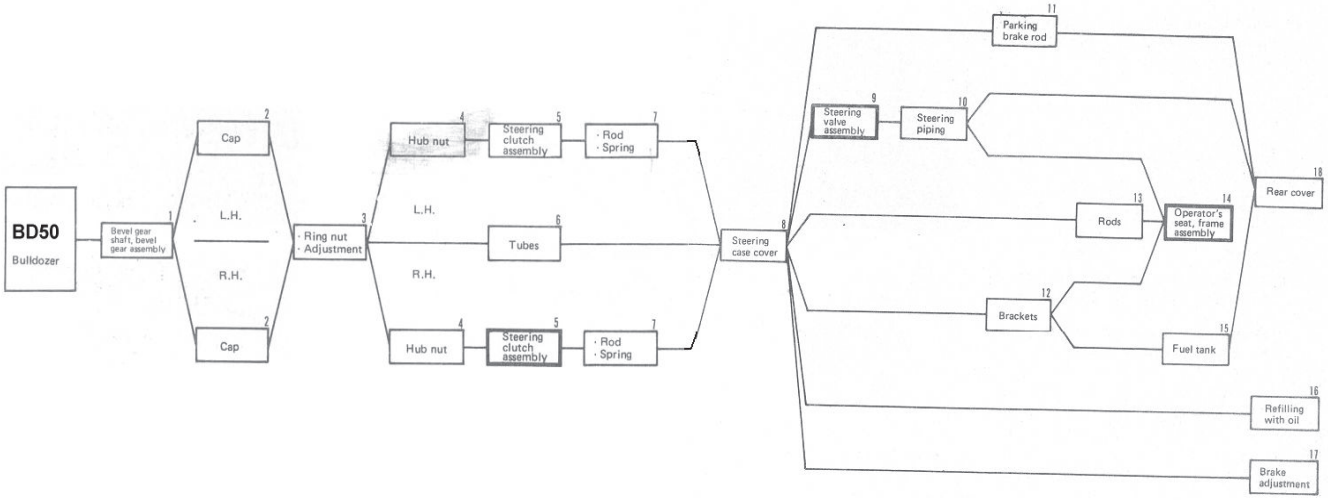
iv) Remove bearing (49) with puller (1)
v) Remove flange (50).
vi) Remove bevel gear (51).



# B.) MOUNTING BEVEL GEAR SHAFT, BEVEL GEAR ASSEMBLY



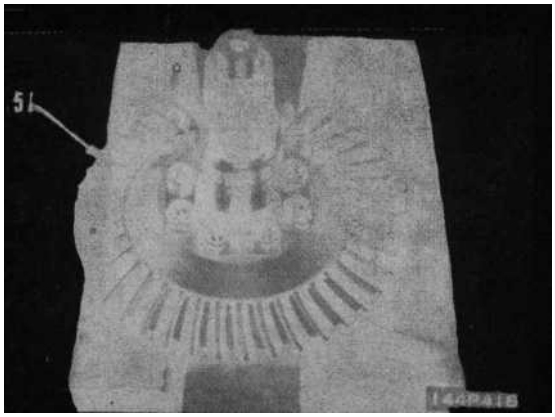

**1. Bevel gear shaft, bevel gear assembly**

1) Assemble bevel gear shaft and bevel gear assembly as follows,

i) Install bevel gear (51) on shaft

Nut; 39 ± kgm

*Bevel lock plate assembly

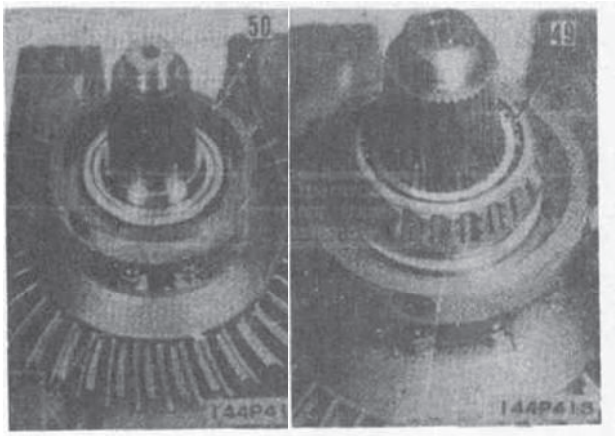



ii) Install flange (50).

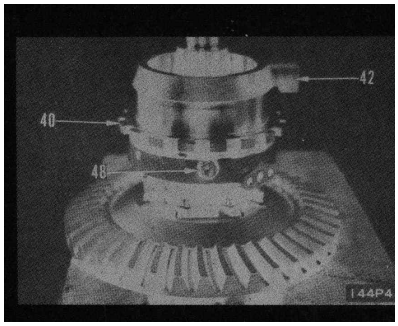
iii) Shrink-fit bearing (49).

* Temperature for shrink-fit:

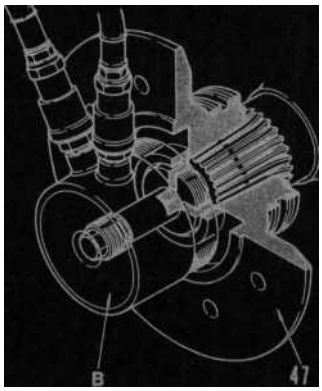
100°C for about one hour



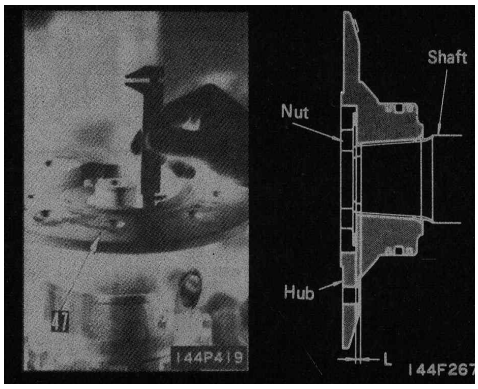

iv) Attach ring nut (40) to cage (42), align with dowel pin on flange, mount cage on shaft and tighten bolt (48).



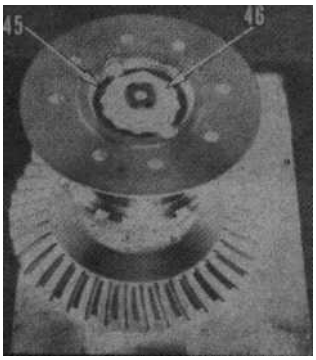
v) Press fit hub (47) with tool B.
*Pressing force on hub: 7.8 to 25 ton



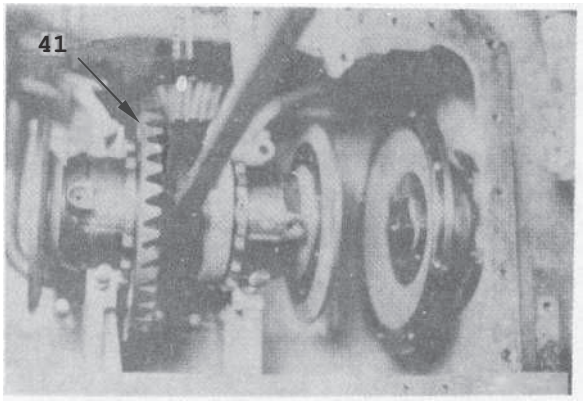

vi) Measure hub protrusion “L”.
*Standard protrusion: 4.5 ± 0.5 mm



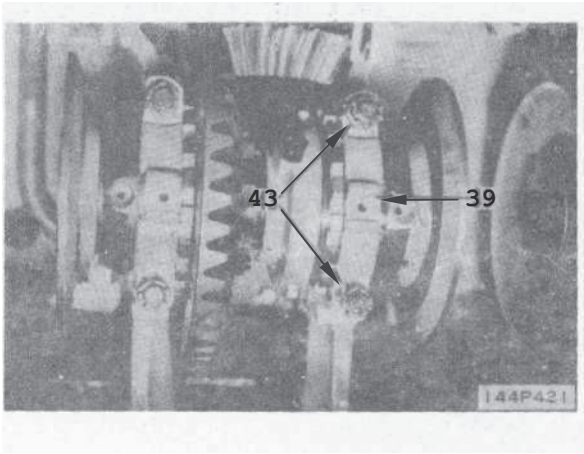

vii) Tighten nut (46) and install lock plate (45).
Nut: 60 ± 10 kgm
* If the nut cannot tightened here, tighten the nut after it is installed in the case.



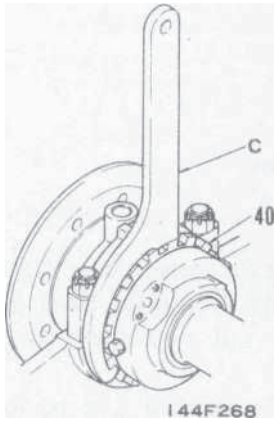

2) Raise bevel gear shaft and bevel gear assembly (41) and install.



2. **Cap**
   Align cap (39) with dowel pin on cage, and temporarily tighten nuts (43).



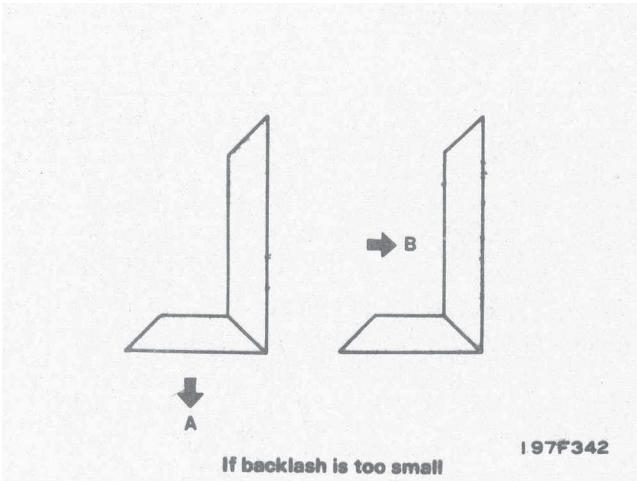

3. **Adjustment, ring nut**
   1) Using tool C, tighten ring nut (40) and adjust gear backlash and preload.
      * Tighten the ring nut to match with the lock groove.
      * Back lash: 0.25 to 0.33 mm
      * Preload: 1.5 to 2.0 kgm (with pinion engaged).
        (Addendum of gear: 9 to 12 kg)
   2) Check gear back lash with fuse or dial gauge.
   3) When bevel gear and bevel pinion are replaced, check gear contact as well.




If the result of the inspection shows that the correct backlash is not being obtained, adjust as follows:

**If backlash is too small**

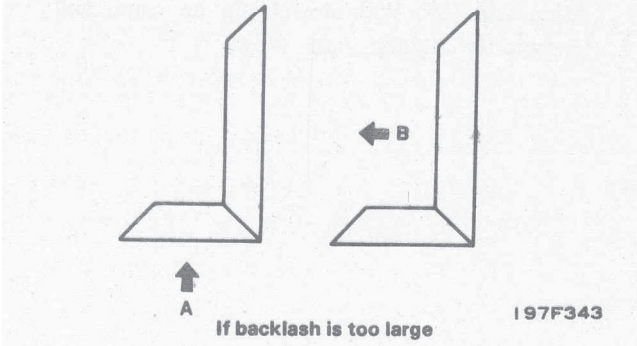
Adjust shim at bevel pinion side to move bevel pinion in direction A; or adjust ring nut at bearing cage of bevel gear shaft to move bevel gear in direction B.




**If backlash is too large**

Adjust shim at bevel pinion side to move bevel pinion is direction A; or adjust ring nut at bearing cage of bevel gear shaft to move bevel gear in direction B.

* When adjusting the ring nut at the bearing cage of the bevel gear shaft, do not change the preload of the bearing. Adjust by turning ring nut each other.




**4) Checking tooth contact**

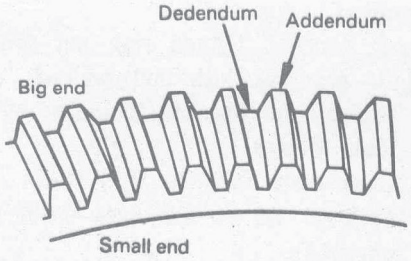
**Testing**

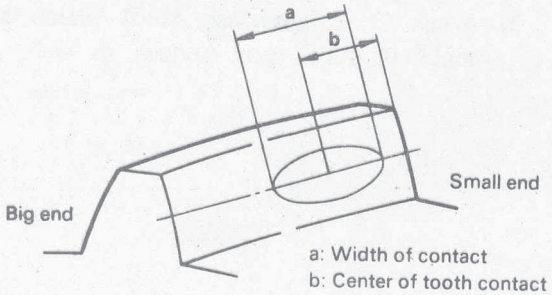
i) Coat the tooth face of the bevel pinion lightly with red lead (minimum). Rotate the bevel gear forward and backward and inspect the pattern left on the teeth.

ii) Tooth contact should be checked with no load on the bevel pinion. It should be in the center of the tooth height. The tooth contact pattern should be located 20-40% from the small end, and should cover 30-50% of the length of the tooth.

In addition, there should be no strong contact at the addendum or dedendum (tip or root of the gear teeth) or at the big and small ends.

- If the gears are adjusted to this pattern, the tooth contact will be correct when load is applied.



**Adjustment**

If the result of the inspection shows that the correct tooth contact is not being obtained, adjust again as follows:

i) If bevel pinion is too far from center line of bevel gear. Contact is at the small end of the convex tooth face of the bevel gear and at the big end of the concave tooth face.

- Procedure for adjustment Adjust the thickness of the shims at the bevel pinion to move the bevel pinion in direction A. Adjust the ring nut at the bearing cage of the bevel gear shaft to move the bevel gear in direction B. Check the tooth contact pattern and backlash again.

ii) If bevel pinion is too pinion is too close to center line of bevel gear.

Contact is at the small end of the concave tooth fact of the bevel gear and the big end of the convex tooth face.

- Procedure for adjustment Adjust the thickness of the shims at the bevel pinion to move the bevel pinion in direction A. Adjust the ring nut at the bearing cage of the bevel gear shaft to move the bevel gear in direction B. Check the tooth contact pattern and backlash again.
- When adjusting the bevel gear to the right or left, do not change the preload of the bearing. Adjust by turning ring nut each other.

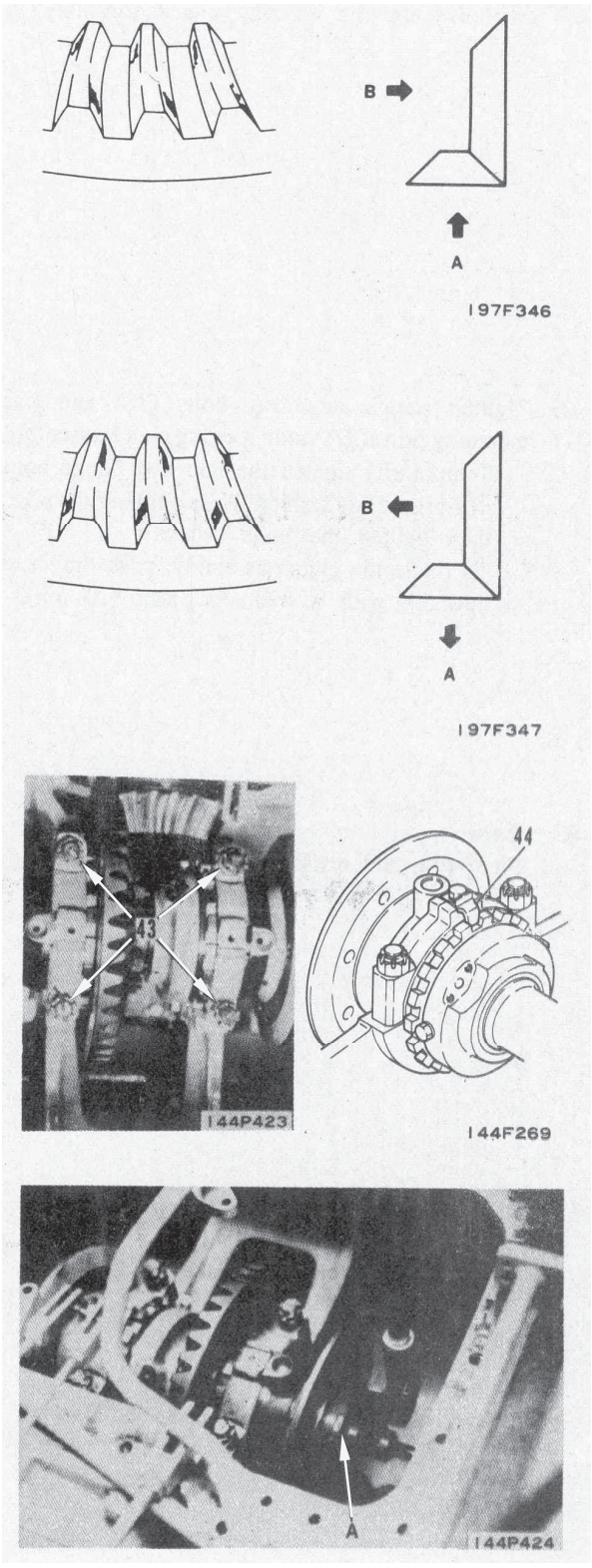
5. Tighten nuts (43) uniformly and install cotter pin.
6. Install lock (44).

**Hub nut**

If hub nut was not tightened when assembling bevel gear shaft, tighten hub nut without fail.

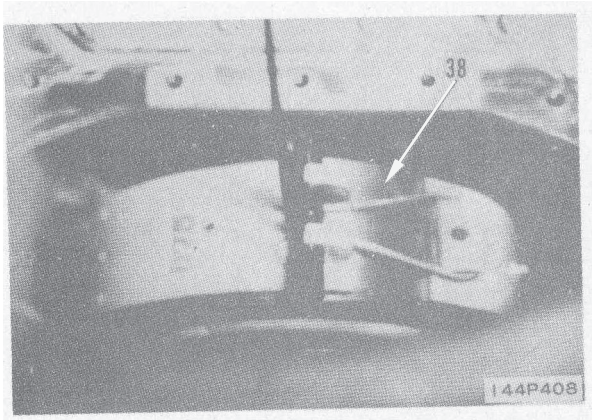
- Tighten with tool A and install lock plate.

Tightening torque: 60 ± 10 kgm



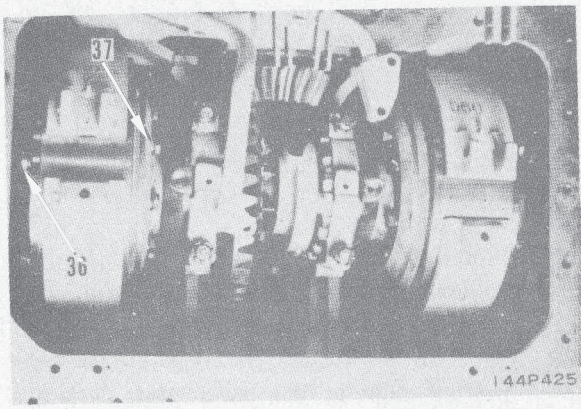
5. **Steering clutch assembly**

1. Attach wire rope to brake band and raise clutch assembly (38). Align clutch oil holes with hub oil holes and set steering clutch assembly in position.



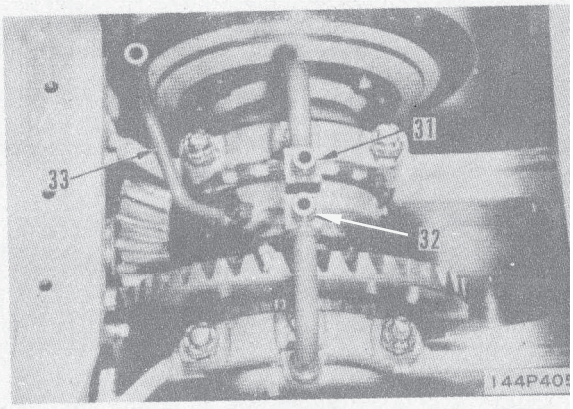

2) Tighten flange mounting bolts (36) and hub mounting bolts (37) while rotating clutch assembly.

- Temporarily tighten the hub and flange bolts in a criss-cross fashion while aligning the pilot, then tighten the bolts securely.
- To rotate the clutch assembly, push the shoes upwards with a hydraulic jack (10 ton).



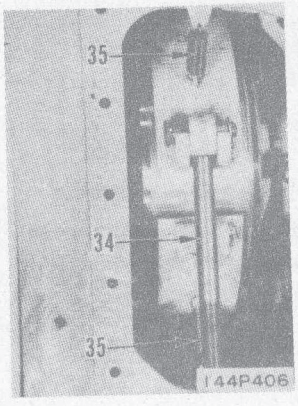

6. **Tube**

Fit O-ring and install tubes (33), (31) and (30).




7. **Rod, spring**

1. Install spring (35)
2. Align pin with claw on brake band, and install adjustment rod (34)



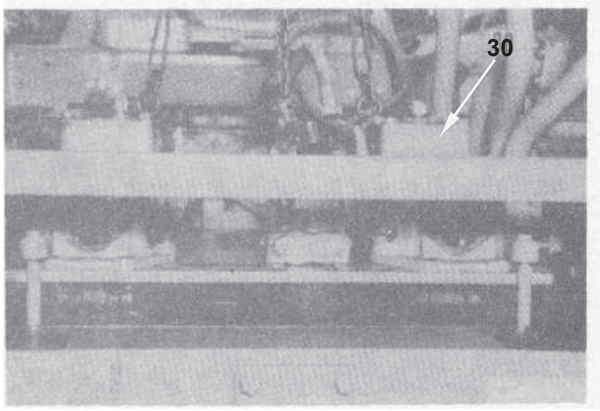
8. **Steering case cover**

1) Stick gasket to steering case.

Gasket: Gasket sealant (LG.1)

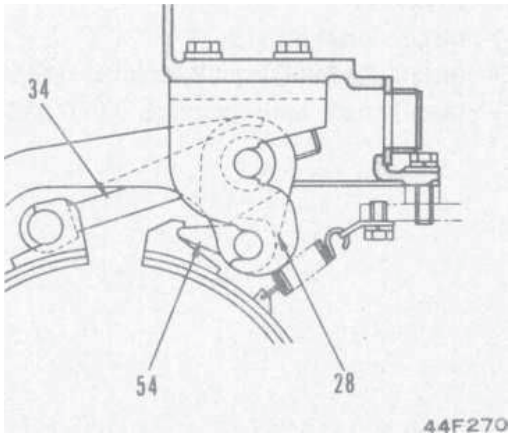
2) Using eye bolts (Dia. 12 mm, Pitch = 1.75mm) (Dia. 10mm, Pitch = 1.5mm), raise steering case cover (30).

- Raise the rear side a litde higher.




3) Connect adjustment rod (34) to lever (28). Align tip of end (54) with notch on brake band, and set cover (30) in position.

- Confirm that the adjustment rod pin is securely fitted in the brake band, then lower the cover.




4) Tighten mounting bolts.

Bolt: Gasket sealant (LG.1)

5) Push tip of lever (28) upward and tighten adjustment nut (27).

- If the lever is tightened as it is, the lever tip will not reach the catch on the brake band.

9. **Steering valve assembly**

1) Fit O-ring and install spacer (25).

Gasket: Gasket sealant (LG-1)

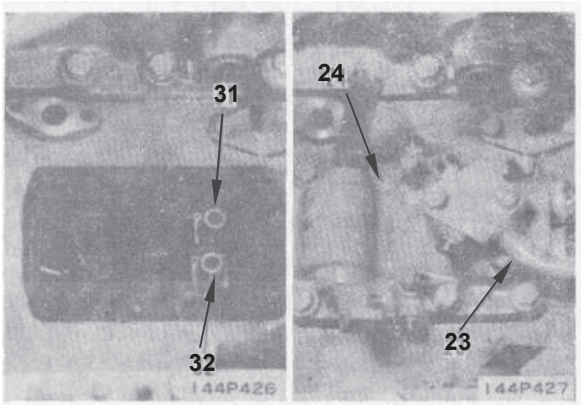
2) Adjust distance between tube (32) and tube (31)) to align with valve mounting holes.'

3) Fit gasket and install steering valve assembly (24).

Gasket: Gasket sealant (LG-1)

Mounting bolt: Gasket sealant (LG-1)

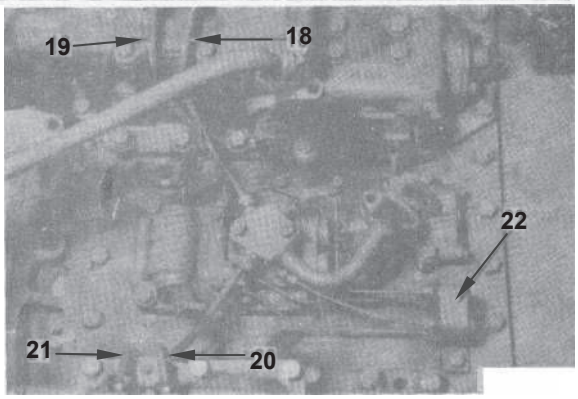
4) Fit O-ring and temporarily install tube (3).



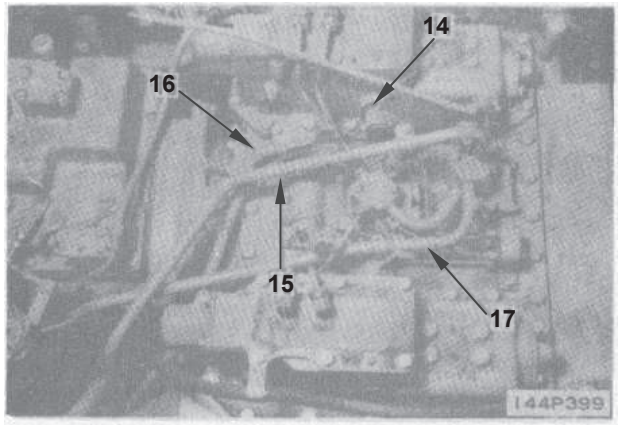

10. **Steering piping**

1) Install tube assembly (22) for oil pressure gauge.

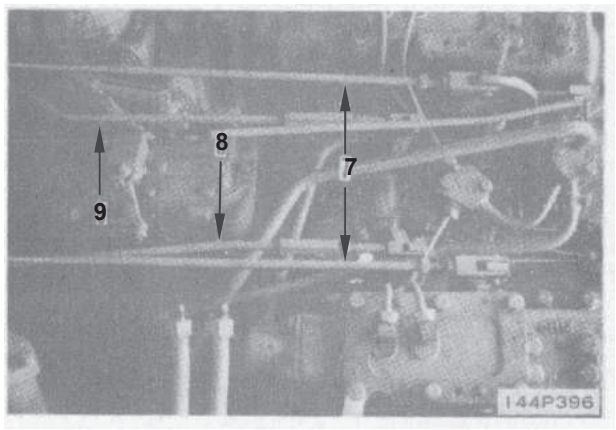
2) Install brake control tubes (18). (19), (20) and (21),



3) Fit O-ring and install tube (17), and connect tubes (16) and (15).
* Install the clamp on the frame side.

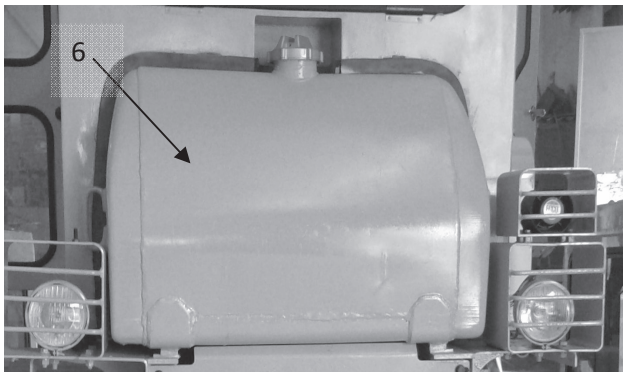



11. **Parking brake rod**
Install rod (14) and hook spring in position.
- Bend cotter pin securely.

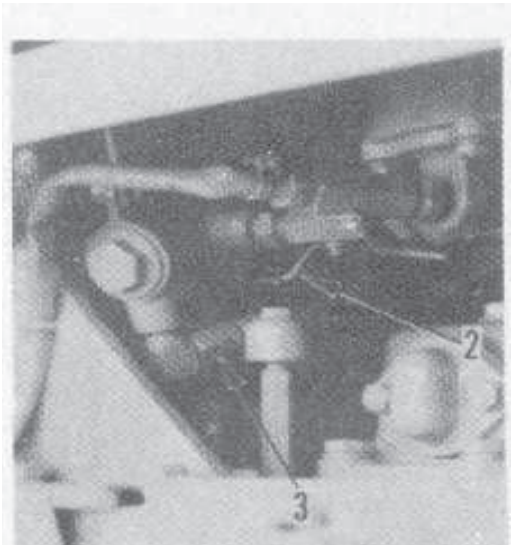



12. **Rods**
Install steering rods (9) and (8) and install brake rods (7).
- Bend cotter pin securely.

13. **Operator's seat, frame assembly**
Install operator's seat and frame assembly.
For details, see 73 MOUNTING OPERATOR'S SEAT AND FRAME ASSEMBLY.




14. **Fuel tank**
1) Using eye bolts (Dia. = 12 mm, Pitch = 1.75 mm), install fuel tank (6).
Mounting bolt: Thread tightener (LT-2)

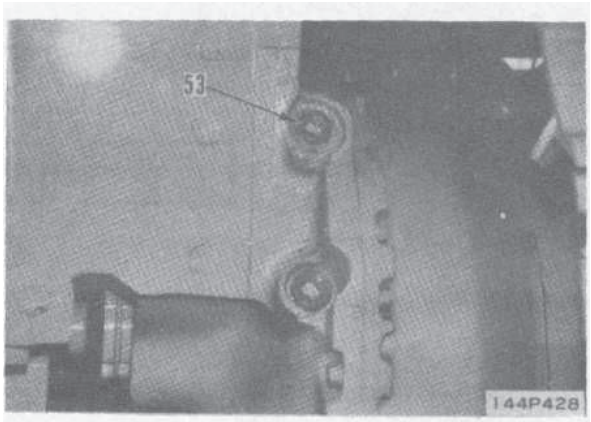



2) Connect hose (3) and open fuel supply valve (2).
3) Connect lamp wiring and install cover .

15. **Refilling with oil**

1) Tighten drain plug.
2) Add engine oil through oil filter (53) to the specified level.

- Run the engine to circulate the oil through the system. Then check the oil level again.



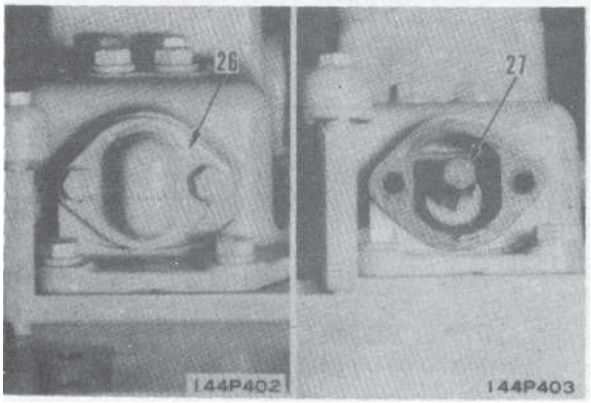

16. **Brake adjustment.**

1) Tighten adjustment nut (27) to a torque of 9 kgm and then loosen nut by 1.5/6 turn.

- The clearance between the brake lining and drum should be 0.3 mm and stroke of the brake pedal 95 to 115 mm.

2) Fit gasket and install cover (26).

Gasket : Gasket sealant (LG-1).




17. **Rear cover**

Close rear cover.

**SECTION : 06**

# WET STEERING CLUTCHES

## INDEX


1.Steering Clutch .....06-01
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# STEERING CLUTCH

**Steering clutches structure**

Steering clutches are mounted on both ends of the bevel gear shaft to control the direction the machine travels. These clutches interrupt the flow of drive from the bevel gear to the final drive, to allow changing of the direction of travel.

These are wet, multi-disc, hydraulically type clutches. Each steering clutch consists of the following parts.

- Clutch drum (18): This drum is bolted to the bevel gear shaft hub (1) which is forced into the bevel gear shaft spline. And this acts as cylinder.
- Bevel gear shaft hub (1): Th is leads oi l from the steering control valve to piston (19).
- Brake drum (14); This drum is bolted to the final drive flange.
- Plates (17): These plates are in mesh with the brake drum (14).
- Discs (16): These discs are in mesh with the clutch drum (18).
- Pressure plate (15): A pressure plate (15) is fixed to piston (19) with pins. The piston (19) and pressure plate move simultaneously.
- Springs (21): When placing the steering lever in "ENGAGED", springs (21) push pressure plate (15). discs (16) and plates (17) to clutch drum (18).

In the steering clutch, the springs (21) maintain the plates (17) and discs (16). normally in contact with each other, between the clutch drum (18) and the pressure plate (15), so that rotation of discs (16) can be frictionally transmitted to plates (17).

When a steering lever is pulled, the steering control valve acts to flow oil to piston (19). The movement of the piston (19) acts on the pressure plate (15) to release friction contact between discs (16) and plates (17).

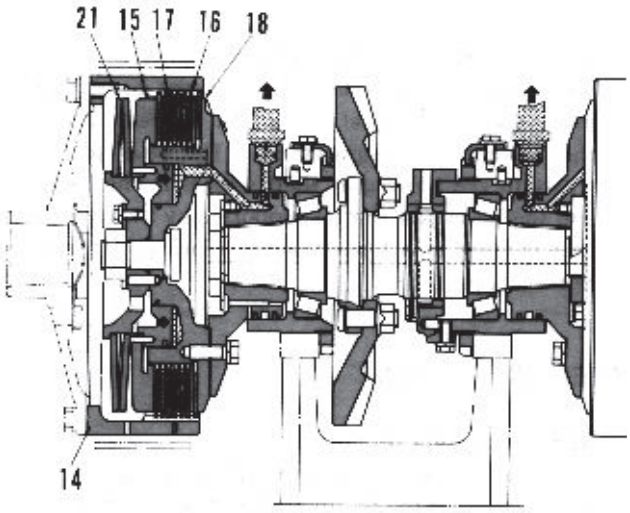
When the steering lever is released, the pressure plate (15) is returned to its original position by the springs (21). and frictional contact between discs (16) and plates (17) is recovered.

Pulling both the right and left steering levers simultaneously disengages both the right and left steering clutches. Pulling only the left steering lever will disengage only the left steering clutch leaving the right steering clutch engaged, thus permitting the machine to turn to the left.

# OPERATION

**(1) When left steering clutch is engaged;**

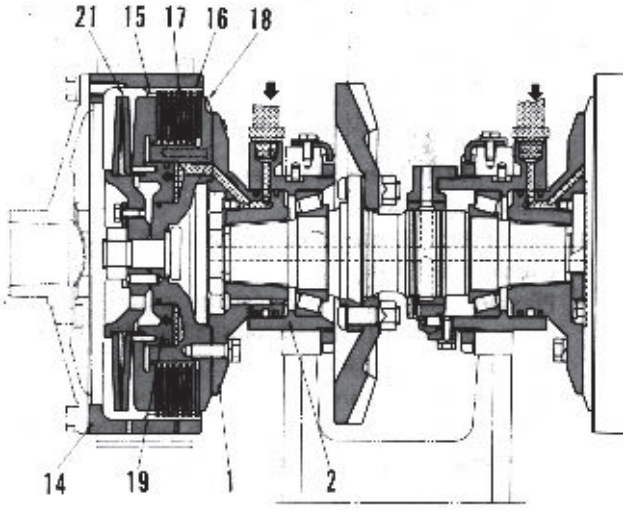
Pressure plate (15) presses plates (17) and discs (16) against clutch drum (18) by the force of springs (21). The frictional force between plates (17) and discs (16) transmits the power from clutch drum (18) to brake drum (14).




**(2) When left steering clutch is disengaged;**

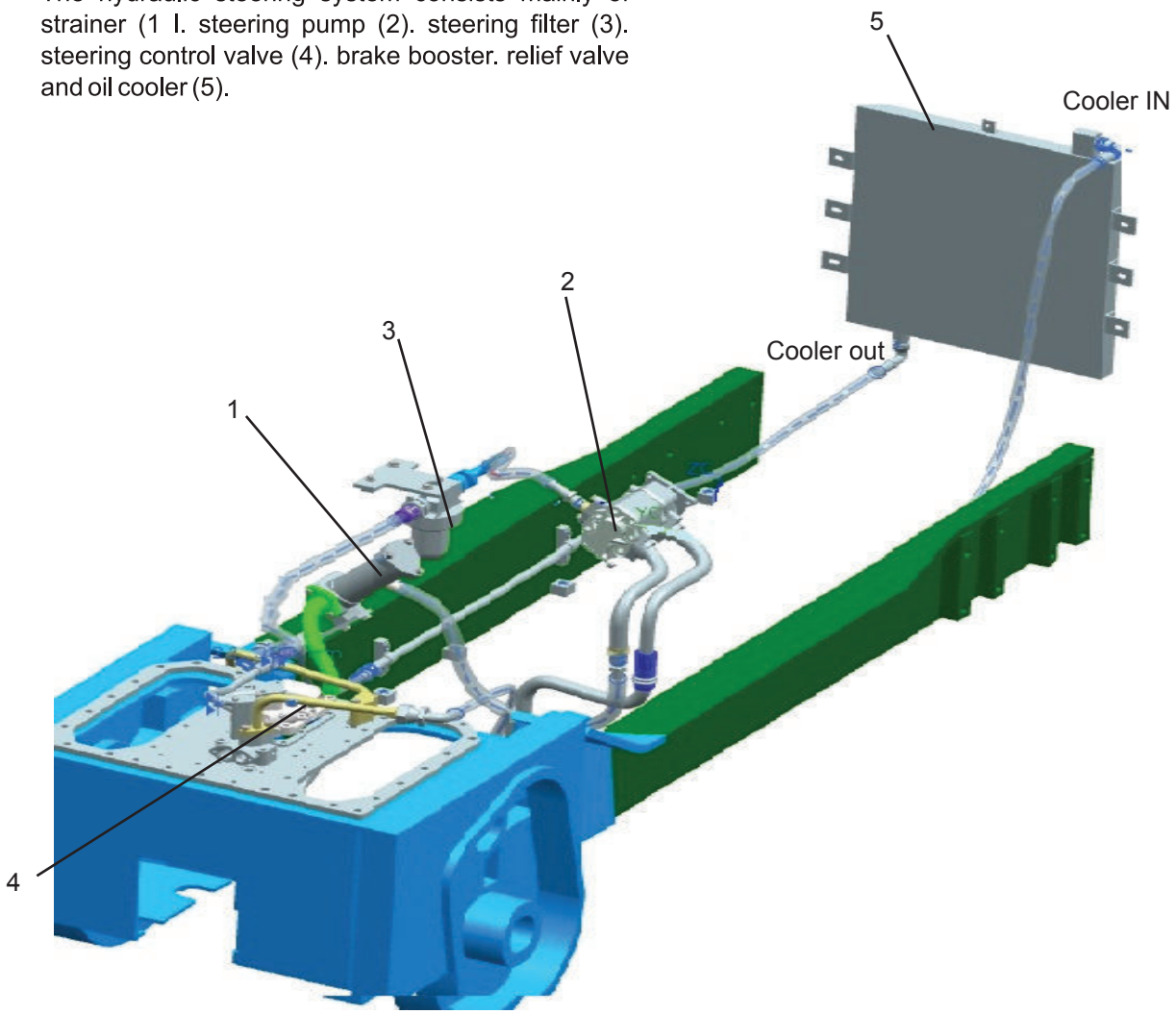
When the steering level is pulled, oil from the steering control valve flows to piston (19) through bearing cage (2) and bevel gear shaft hub (1), and pushes the piston to left, compressing springs (21). Thus, pressure plate (15) is moved left, and the pressing force between plates (17) and discs (16) is free.

As a result, the power to the final drive is disengaged. When the steering lever is released, oil of pump through the steering control valve is discontinued, and the piston (19) returns to the initial position by the force of the springs (21). Thus the clutch is engaged. When the left steering clutch is disengaged, power is transmitted only to the right steering clutch, achieving the left turn.



# STEERING CLUTCH AND BRAKE PIPING

The hydraulic steering system consists mainly of strainer (1 l. steering pump (2). steering filter (3). steering control valve (4). brake booster. relief valve and oil cooler (5).




1. Mangnetic suction strainer (for steering pump)
2. Tandem pump (main clutch & steering)
3. 10 Micron absolute Filter ( steering pump discharge )
4. Steering control valve
5. Steering oil cooler

The oil inside the steering case passes through magnet strainer (1) and is sucked up by steering pump (2). From here it passes through steering filter (3) and flows to steering control valve (4), brake booster and relief valve.

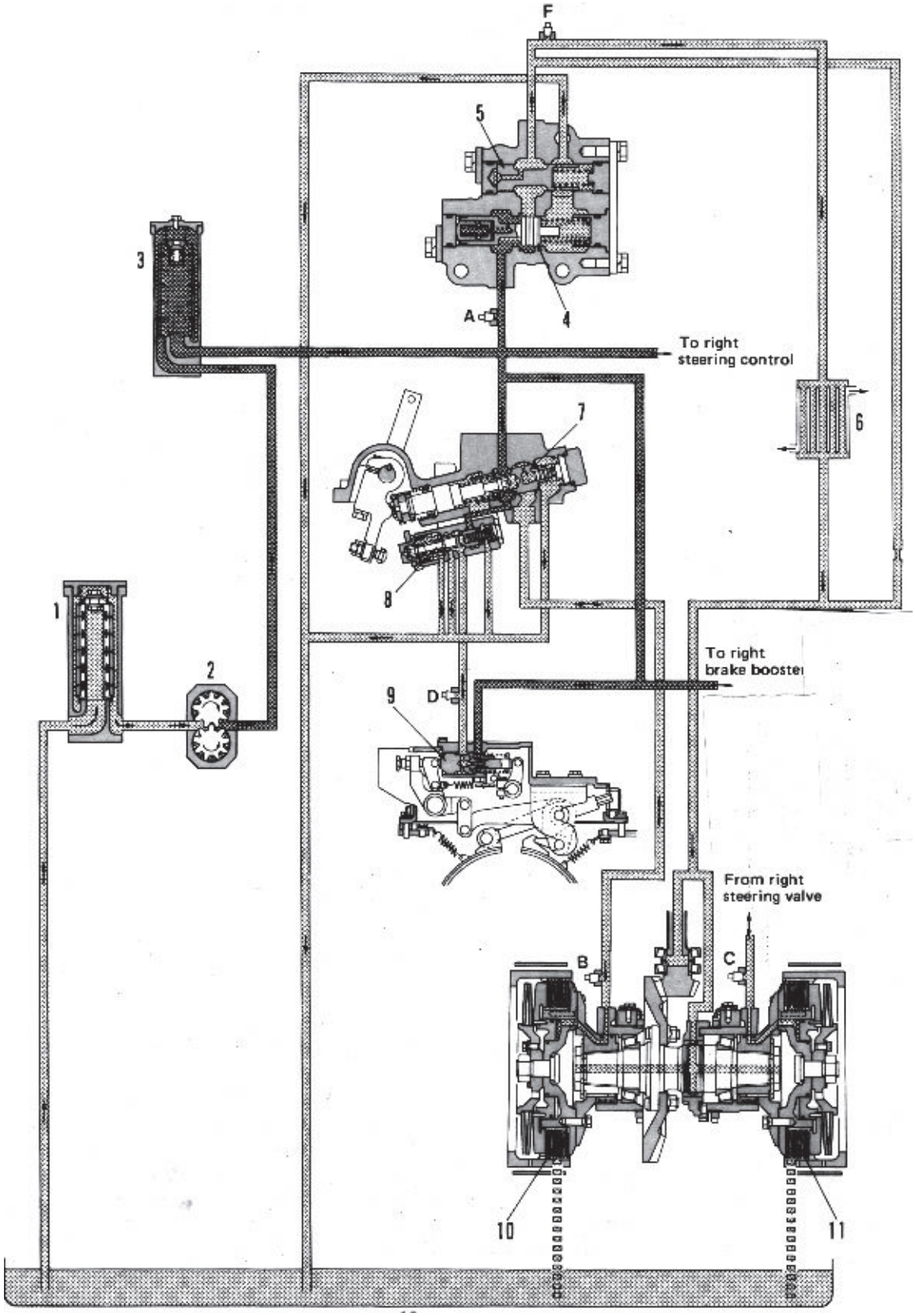
The oil relieved by relief valve (set pressure: 20 kg/cm2) flows to the oil cooler by-pass valve.

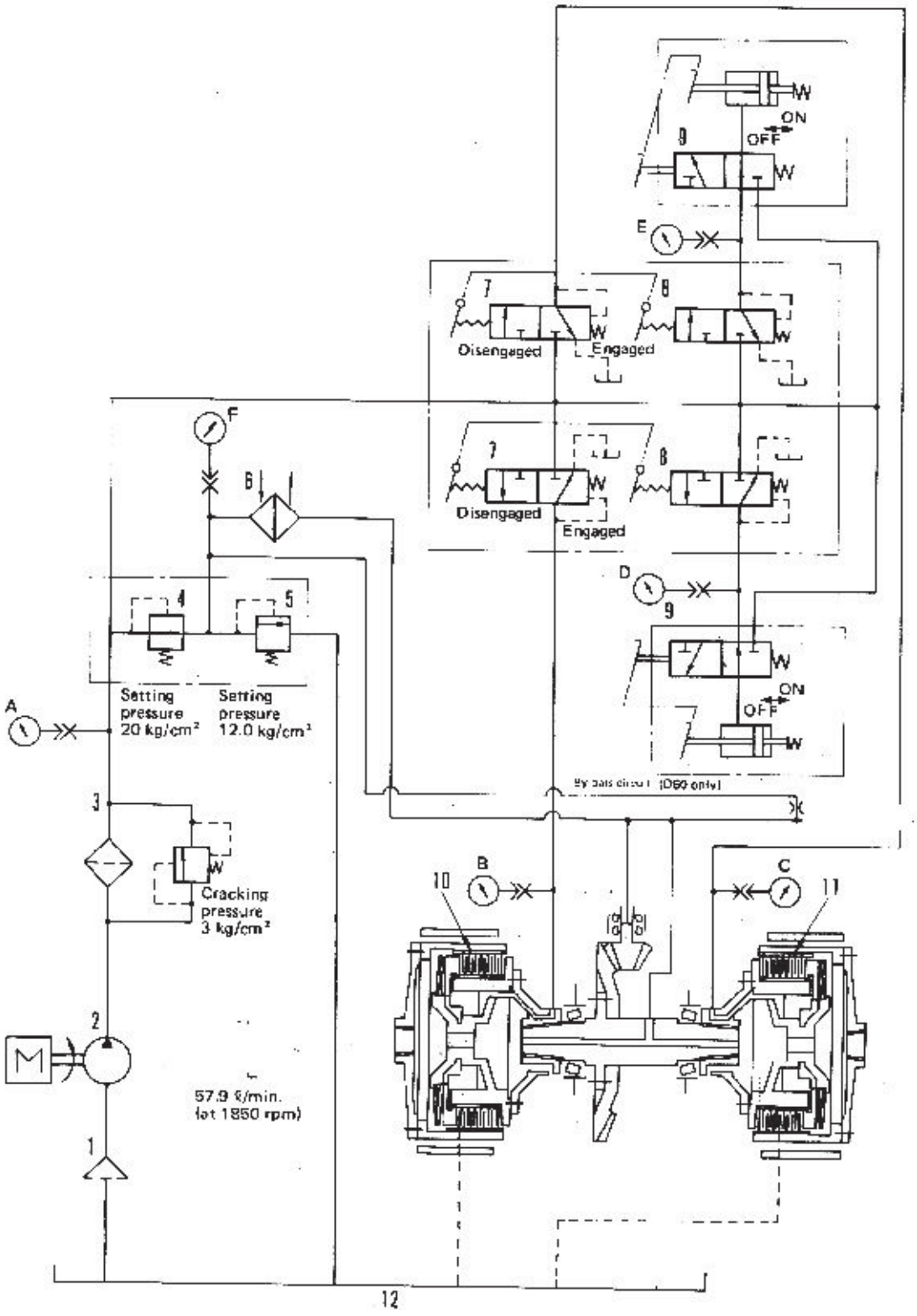
If the oil pressure in the oil cooler by-pass valve exceeds the set pressure of 12 kg/cm², due to reasons such as clogging of cooler (5) or of the lubrication system, the oil is relieved to the steering case.

When the steering lever is pulled halfway, the oil flowing to steering control valve (4) flows to the steering clutch. When the steering lever is pulled fully, the oil flows to the steering clutch and brake booster. This disengages the steering clutch and at the same time actuates the brake.

# STEERING CLUTCH AND BRAKE HYDRAULIC SYSTEM

Engine running, both steering lever are not pulled,
and both brake pedal are not depressed.



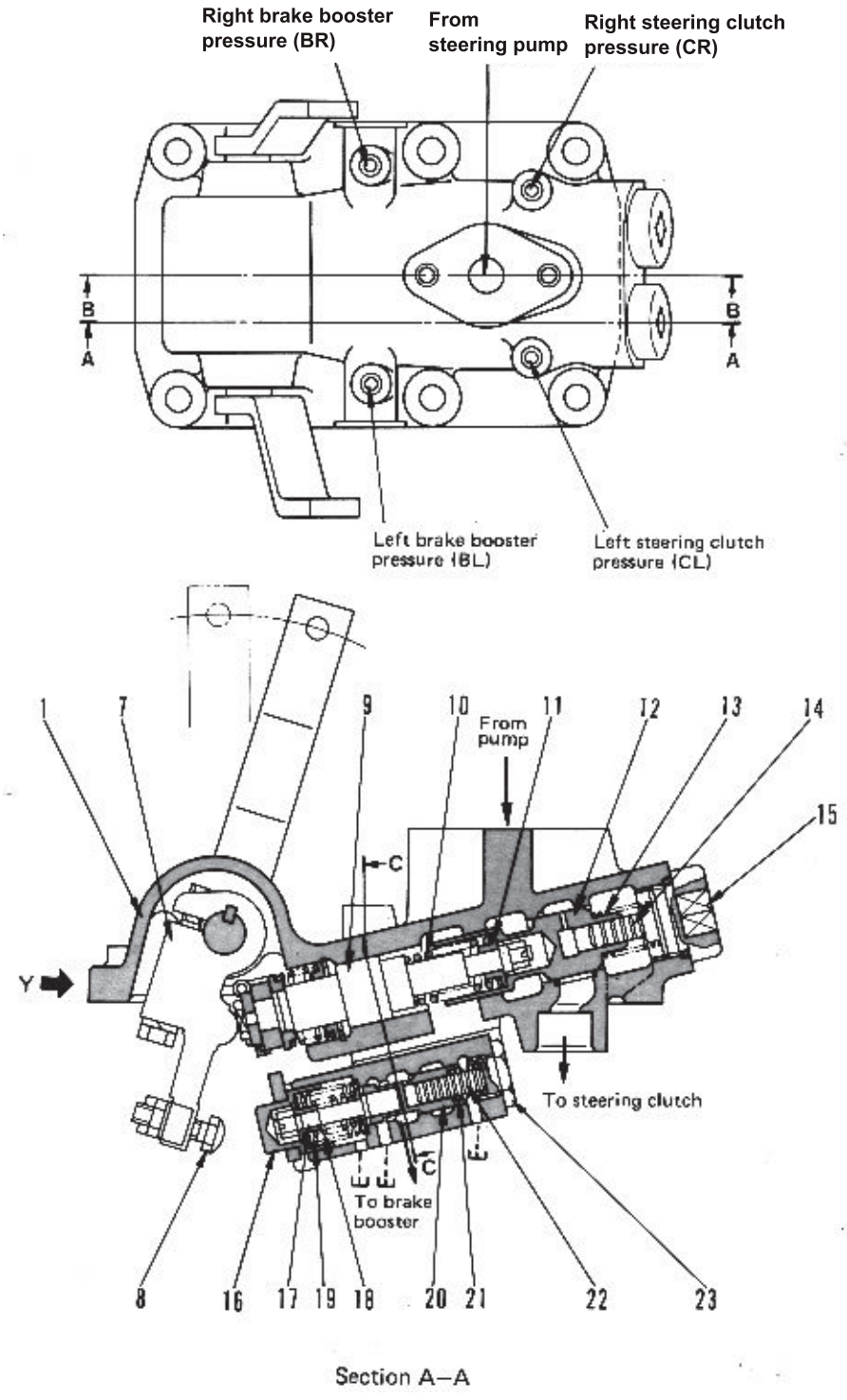



1. Steering strainer (magnet type)
2. Steering pump
3. Steering filter
4. Relief valve
5. Oil cooler by-pass valve
6. Oil cooler
7. Steering Control valve
8. Brake valve
9. Brake booster
10. Left steering clutch
11. Right steering clutch
12. Steering case

A. Plug for relief valve pressure (MS x 1.25)
B. Plug for left steering clutch pressure (PT 1/S)
C. Plug for right steering clutch pressure (PT 1/S)
D. Plug for left brake booster pressure (PT 1/S)
E. Plug for right brake booster pressure (PT 1/S)
F. Plug for by-pass valve setting pressure (M8 x 1.25)

# STEERING CONTROL VALVE

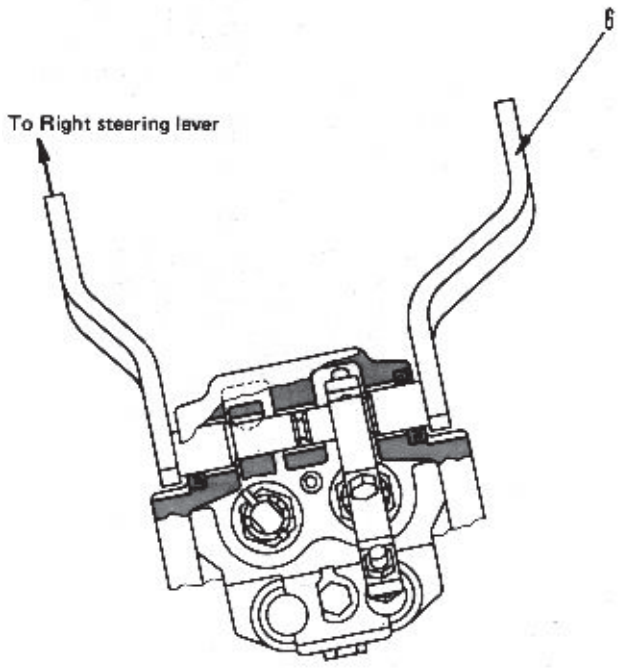
The steering control valve consists of two steering valves (12) which control the flow of oil to the left and right steering clutches, and two brake valves (20) on the left and right which control the flow of oil to the brake boosters.



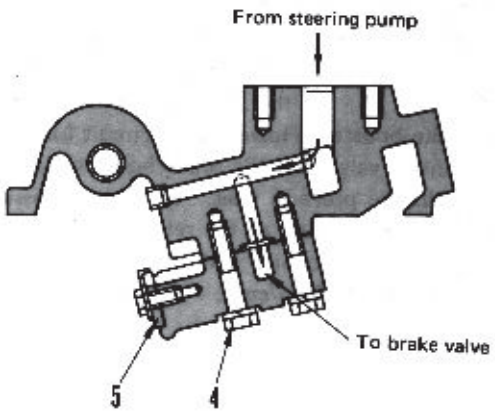

Section A–A

1. Steering valve body
7. Lever
8. Adjustment bolt
9. Shaft
10. Spring
11. Stopper
12 Steering valve
13. Spring
14. Piston
15. Plug
16. Guide
17. Shaft
18. Spring
19. Spring
20. Brake valve
21. Spring
22. Piston
23. Plug

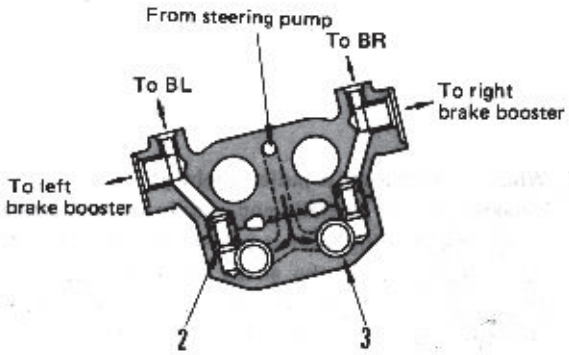
2. Tube
3. Brake valve body
4. Bolt
5. Plate
6. Lever




View Y




Section B–B




Section C–C

# Function

1. **When steering lever is not pulled : (Steering clutch engaged; brake not applied)**

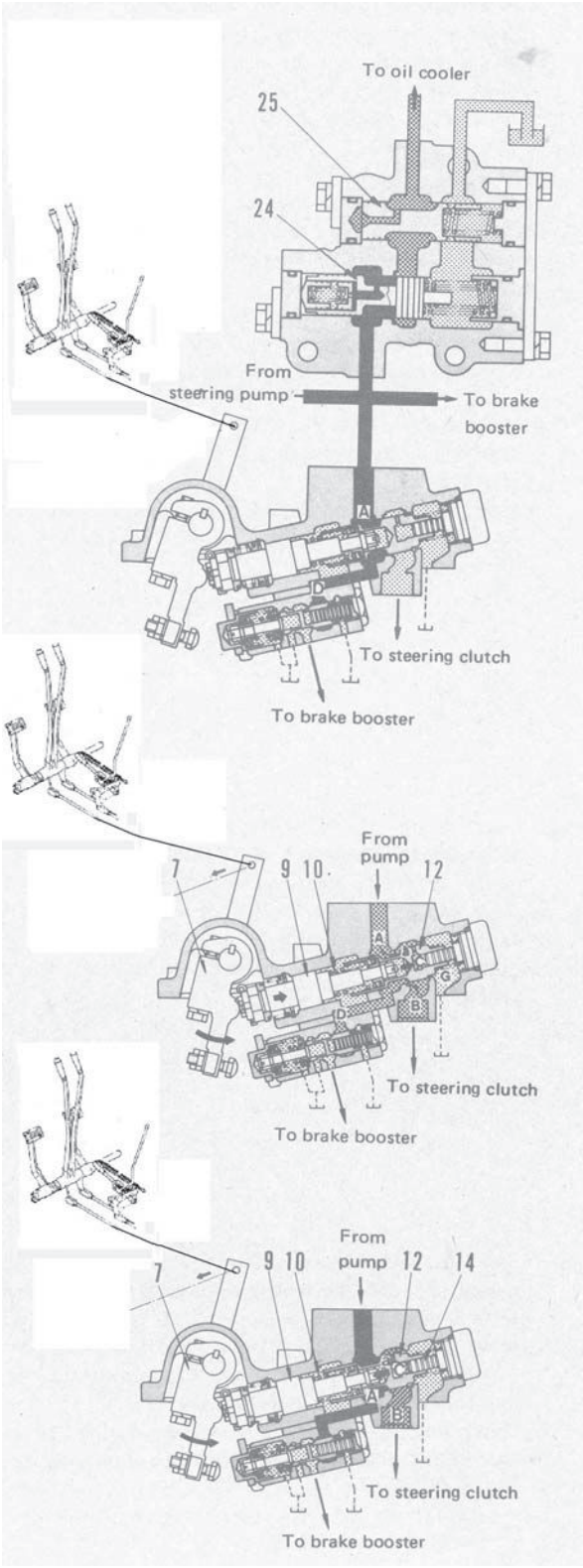
The oil from the steering pump flows to relief valve (24), port (A) of the steering control valve, and the brake booster. However, the circuit for the steering control valve and the brake booster is closed, so the hydraulic pressure rises. When the pressure exceeds the set pressure of the relief valve (24), the oil flow to the oil cooler and the hydraulic pressure is maintained at 20 kg/cm$^2$,

**2. When steering lever is pulled slightly: (Steering clutch partially engaged; brake not applied)**

When the steering lever is pulled, lever (7) is pushed in the direction of the arrow and compresses spring (10). Spring (10) then pushes steering valve (12) in the direction of the arrow. As a result, the flow of oil from port (B) to port (G) is shut off. At the same time, the flow of oil from port (A) to port (B) is connected, and it flows to the steering clutch. When the steering clutch is filled with oil, the oil pressure rises.

The oil flowing through orifice (a) to port (C) pushes piston (14) and the reaction pushes the steering valve (12) in the direction of the arrow and compresses spring (10). The steering valve (12) shuts off the flow of oil from port (A) to port (B), and the hydraulic pressure comes into balance with the force of spring **(**10**).**

If the steering lever is pulled further, spring (10) is compressed accordingly, so the force of the spring (10) and the hydraulic pressure in balance with the spring both rise. This partially engages the steering clutch.

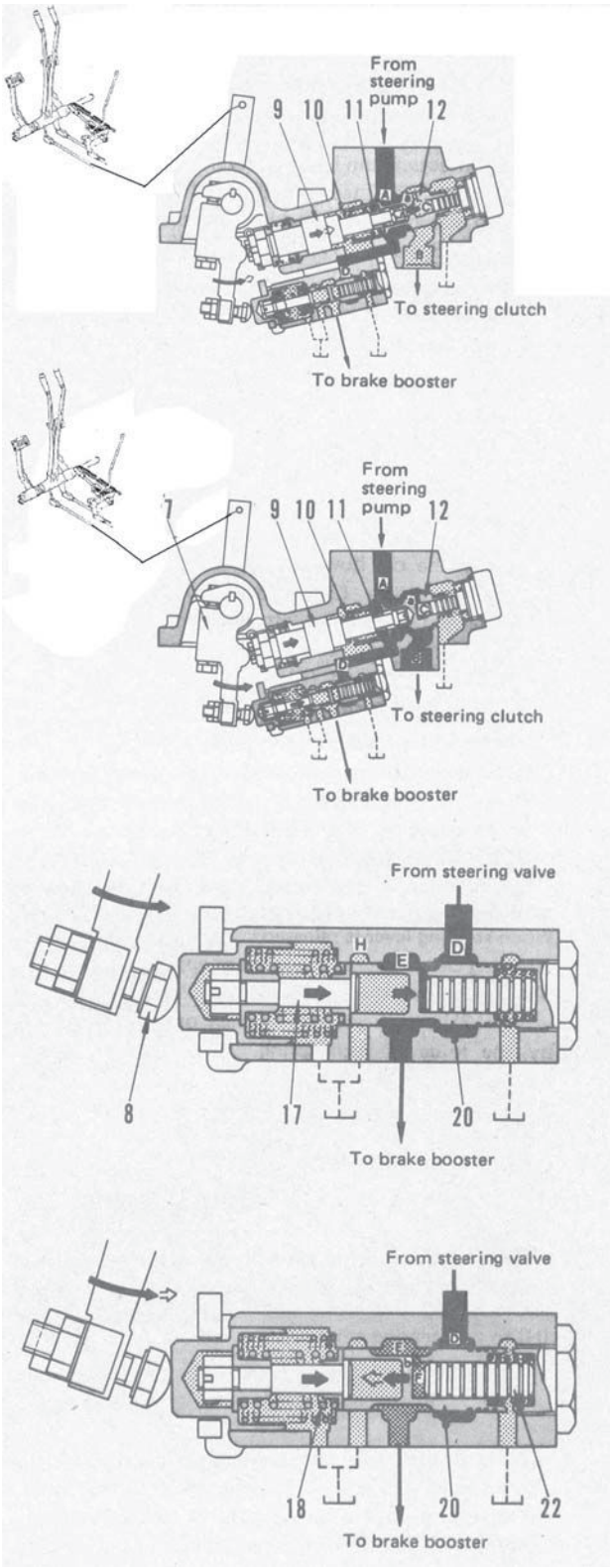


3. **When steering lever is pulled to detent :**
**(steering clutch disengaged; brake not applied)**
When the steering lever is pulled to the detent position, shaft (9) moves in the direction of the arrow and comes into contact with stopper (11). Shaft (9) pushes stopper (11), which then pushes steering valve (12), so even if the hydraulic pressure at port (B) rises, steering valve (12) cannot move to the left. Spring (10) is fully compressed and the hydraulic pressure reaches 18.9 kg/cm$^2$ (Completion of modulation).
The hydraulic pressure continues to rise to 20 kg/cm$^2$, the set pressure of the main relief valve, and the steering clutch is disengaged.

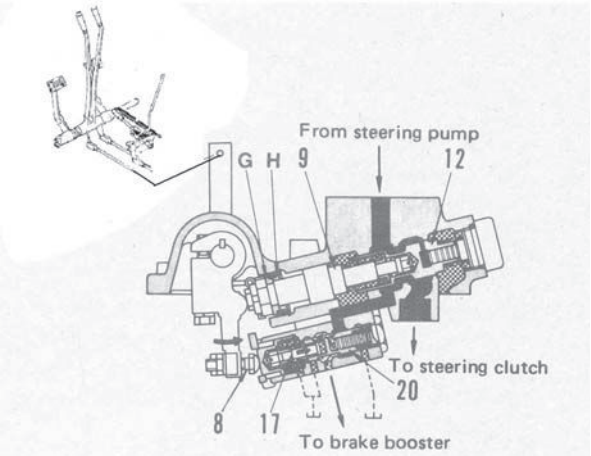
4. **When steering lever is pulled further :**
**(steering clutch disengaged; brake circuit oil pressure starts to rise)**
Shaft (9) is in contact with stopper (11), so port (A) and port (B) open the same amount that shaft (9) has moved.

Because of adjustment bolt (8), shaft (17) also moves to the right and pushes brake valve (20).
As a result, the flow of oil from port (E) to port (H) is shut off. At the same time, the flow of oil to port (D) and port (E) is connected, and it flows to the brake booster.

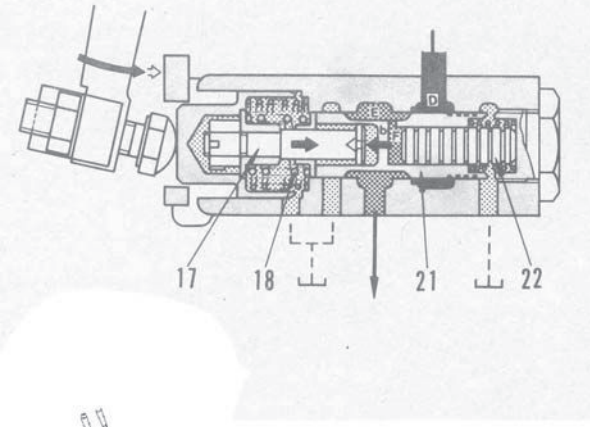
The oil flowing through orifice (b) to port (F) pushes piston (22) and the reaction pushes the brake valve (20) to the left and compresses spring (18). The brake valve (20) shuts off the flow of oil from port (D) to port (E), and the hydraulic pressure comes into balance with the force of spring (18).
If the steering lever is pulled further, spring (18) is compressed accordingly, so the force of the spring, and the hydraulic pressure, which is in balance with the spring both rise. This starts
To actuate the brake.



5. **When steering lever is pulled fully :**
(steering clutch disengaged; brake applied)
Shaft (9) moves to the right until stopper (G) and (H) are in contact. From here, the shaft (9) cannot move any further. The steering valve (12), like shaft (9) can also not move any further. Because of adjustment bolt (8), shaft (17) also moves to the right and pushes brake valve (20).



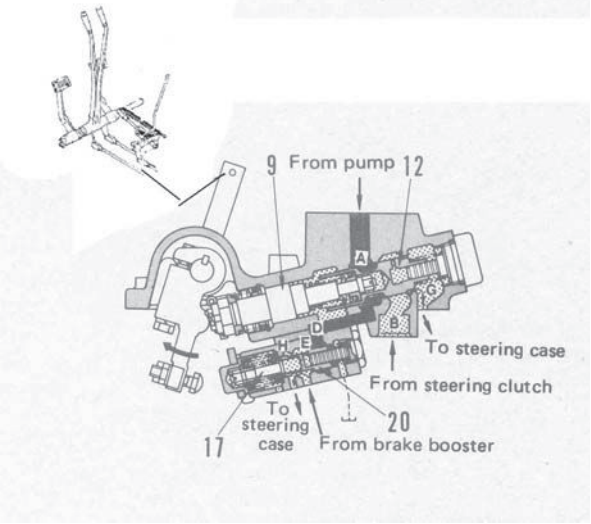

However, even when shaft (9) reaches the end of stroke, shaft (17) does not reach the end of stroke. Therefore the oil flowing from orifice (b) to port (F) pushes piston (22) and the reaction pushes brake valve (20) to the left and compresses spring (18), Brake valve (20) shuts off the flow of oil from port (D) to port (E). The hydraulic pressure and the force of spring (18) are brought into balance. When this happens, the force of spring (18) is at its maximum. The hydraulic pressure, which is in balance with the force of the spring (18) is also at its maximum (16.7 kg/cm$^2$) and the brake is therefore fully applied.




6. **When steering lever is released :**
(steering clutch engaged; brake not applied)

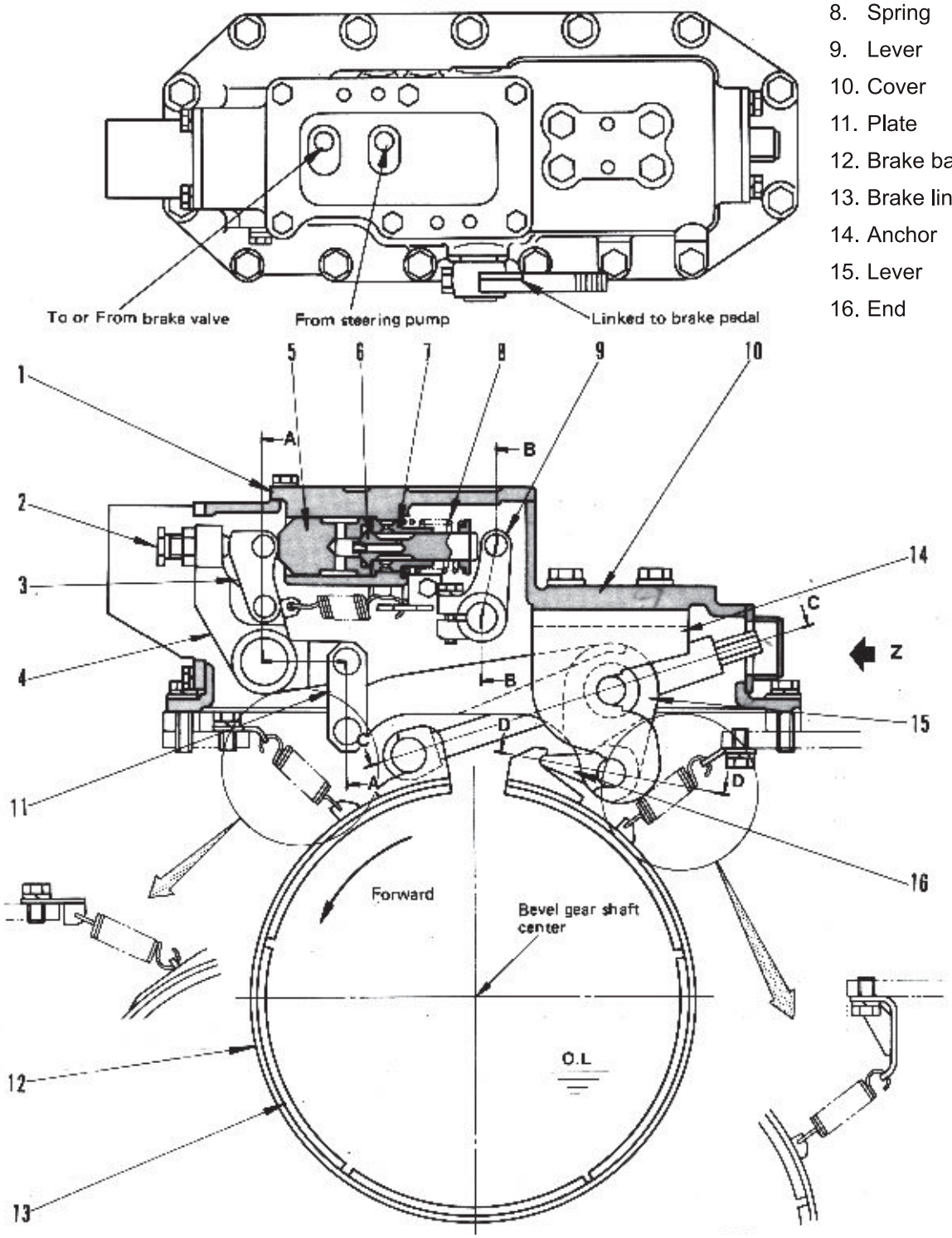
Shaft (9), shaft (17), brake valve (20) and steering valve (12) are all returned to their original positions by the force of each spring. When this happens, steering valve (12) shuts off the flow of oil from port (A) to port (B). At the same time, it connects the flow of oil at port (B) and port (G). Therefore, the oil in the steering clutch is drained from port (G) to the steering case.

In addition, brake valve (20) shuts off the flow of oil from port (D) to port (E). At the same time, it connects the flow of oil from port (E) to port (H), and the oil in the brake booster is drained from port (H) to the steering case.



# STEERING BRAKE AND BOOSTER

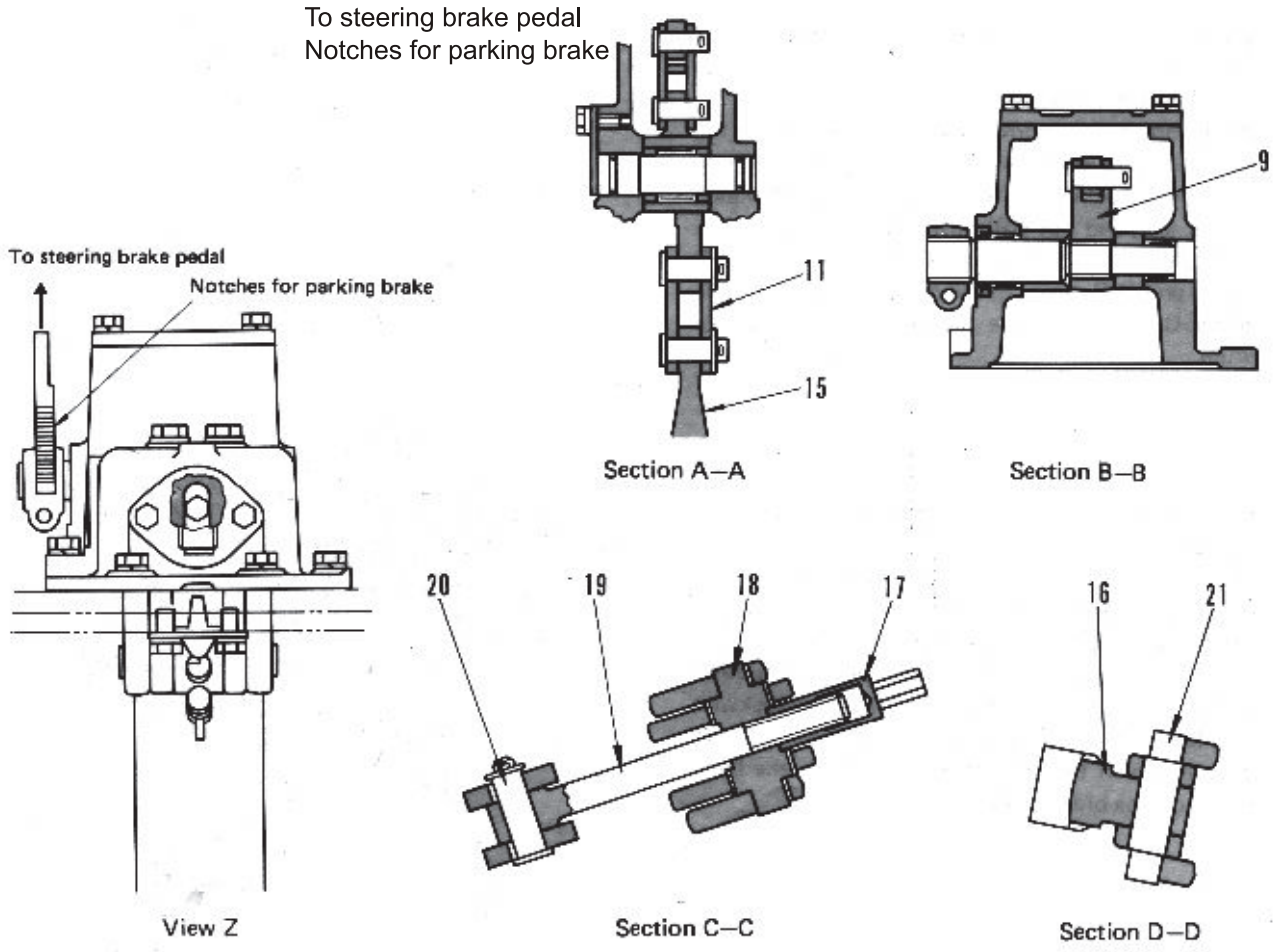
1. Brake booster body
2. Adjusting bolt
3. Lever
4. Lever
5. Piston
6. Spool
7. Sleeve
8. Spring
9. Lever
10. Cover
11. Plate
12. Brake band
13. Brake lining
14. Anchor
15. Lever
16. End



The contracting band type brake is mounted on the brake drum and immersed in the steering clutch case oil. This brake is actuated as a steering when a steering lever is pulled, and as a parking brake when the both brake pedals are depressed. When a steering lever is pulled, first a steering clutch is disengaged and then the operating force of pedal depressing is decreased by equipment of brake booster. A steering brake interrlocked with the brake pedal is actuated. When both brake pedals are depressed, both the right and left brakes actuate simultaneously to stop the machine without disengagement of steering clutches. The right pedal is provided with a locking device to keep the pedal in the depressed position.

One end of the brake band (12) is suspended from the anchor (14) through the end (16) and pin (21). While the other end is suspended from anchor (14) through rod (19), adjusting nut (17) and pin (20).

Two springs are provided for making uniform the tension of brake band (12) around the drum. The adjusting nut (17) is used for adjusting the clearance between brake lining (13) and the brake drum.




17. Adjusting nut
18. Pin
19. Rod
20. Pin
21. Pin

### Functions

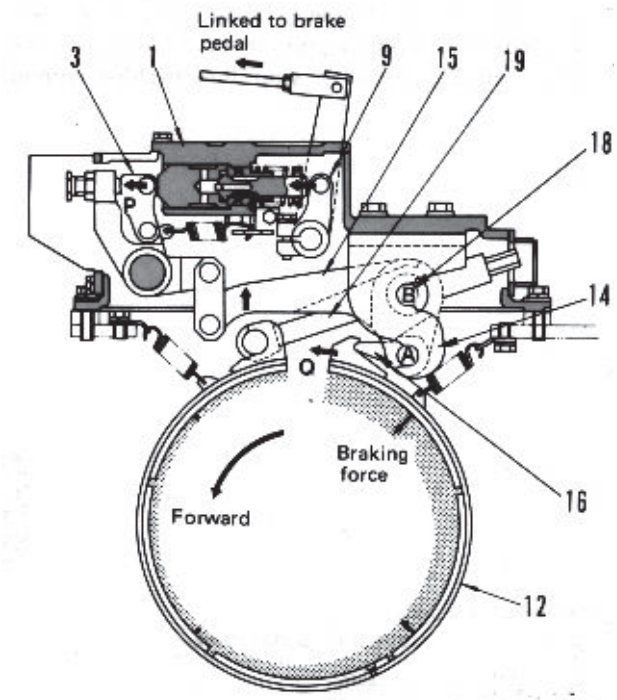
When one steering lever on the turning side of machine is pulled, the steering clutch on the same side is disengaged. Then, the track on the side where the flow of drive (power has been cut off by the steering clutch) is free from driving power. However, it is dragged somewhat by the track on the opposite side, thereby causing the machine to make a gradual turn. When the same steering lever is further pulled, the steering control valve is moved to flow into brake booster, and brake booster acts. As a result, the brake band contracts the brake drum and the track is held still, thereby causing the machine to make a sharp turn.

When brake pedal is depressed, the brake booster acts and brake band contracts the brake drum.

**1. Brake operation when the machine is traveling forward**

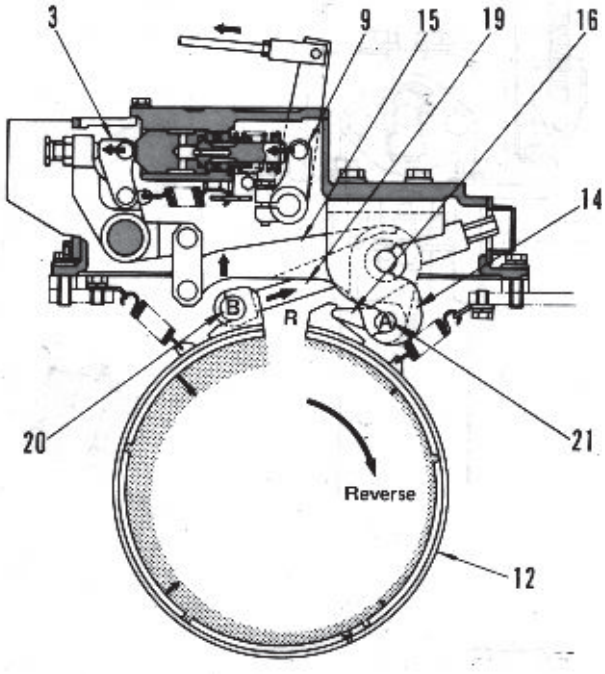
When pulling a steering lever fully, brake booster piston moves at left, and lever (3) turns in the lever (15) moves upward.

As the brake drum turns counterclockwise while the machine is traveling forward, the brake band is pulled counterclockwise. Therefore, rod (19) is pulled to the left, and pin (18) pushes anchor (14). As a result, lever (15) turns clockwise as a fulcrum of B point, end (16) moves in the direction shown by the arrow Q and the brake band contracts the brake drum.




**2. Brake operation when the machine is traveling reverse**

While the machine is traveling reverse, the brake drum is turning clockwise. Therefore, the brake band (12) is pulled clockwise. Accordingly, end (16) is pushes to the right, and pin (21) pushes anchor (14). As a result, lever (15) turns clockwise as a fulcrum of A point, pin (20) moves in the direction as shown by the arrow R and the brake band contracts the brake drum.

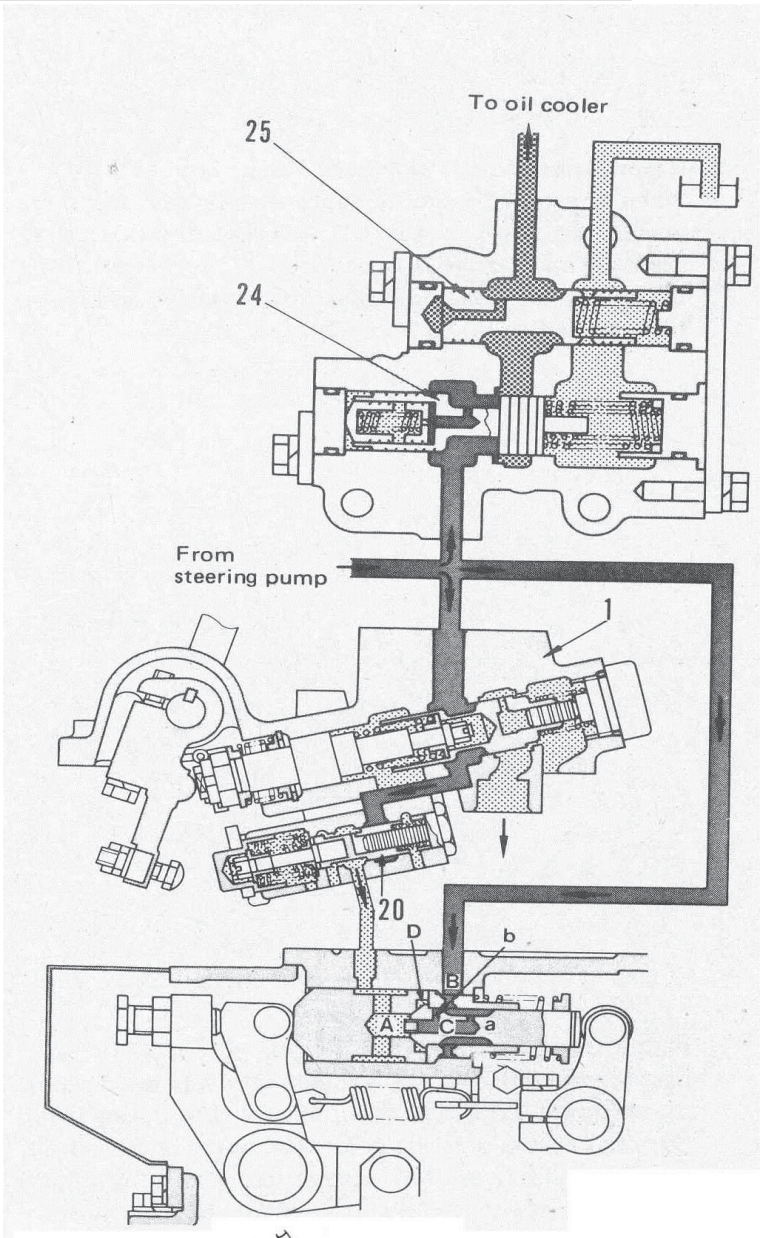


**Operation of hydraulic brake booster**

1. When brake pedal is not depressed, and steering lever is not pulled (brake not applied)

   If brake valve (20) operates, one oil line from the steering pump flows to port (A). another oil line flows directly to port (B) without passing through steering valve.

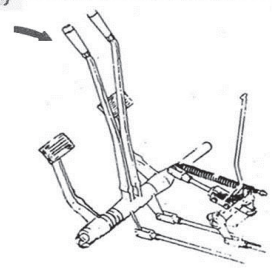
   The steering lever is not being pulled, so valve (20) does not move. The oil does not flow to port (A). but only flows to port (B). It then passes through orifice (a) and flows to port (C). However, the brake pedal is not being depressed, so the flow of oil at port (C) and port (D) is shut off. As a result, the hydraulic pressure rises, and when it exceeds the set pressure of the relief valve (24). it flows to the oil cooler, and the hydraulic pressure is maintained at 20 kg/cm².



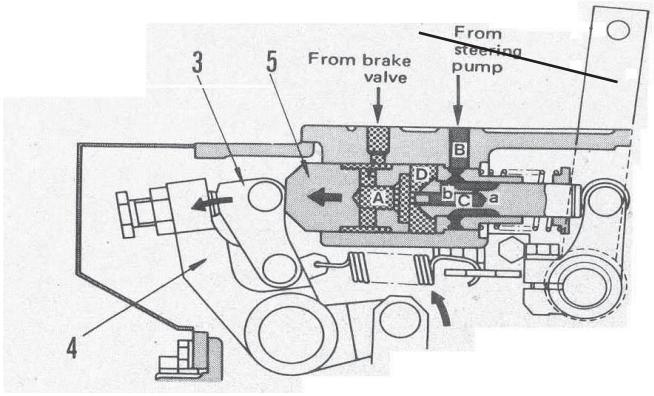

2. **When steering lever is pulled fully (brake applied)**

   Brake valve (20) operates and oil flows to port (A). When the hydraulic pressure in the circuit rises, the oi l at port (A) pushes piston (5) to the left. Levers (3). (4) move and applies the brake.

   The hydraulic pressure at this point is 16.7 kg/cm²

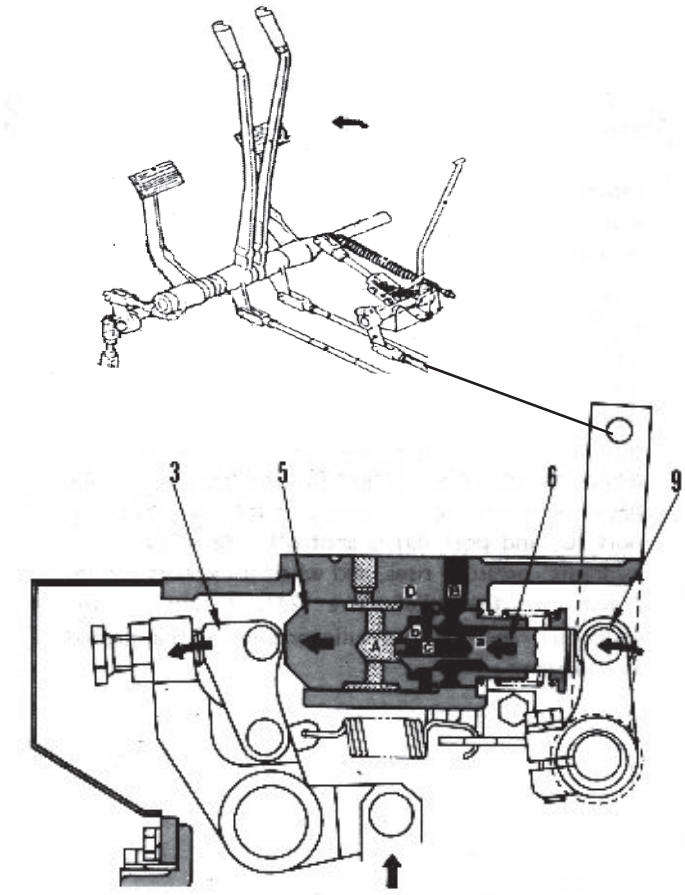


★ For details of the operation of the steering valve, see P. 21-70.

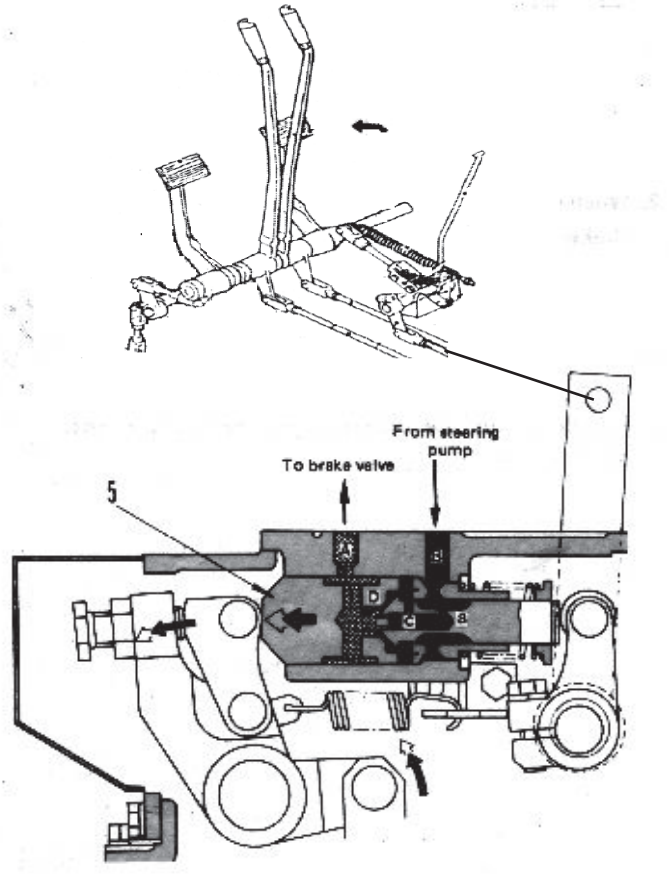


**3. When brake pedal is depressed (brake applied)**

When the brake pedal is depressed slightly, lever (9) pushes spool (6) to the left, and the flow of oil at port (C) and port (0) is connected. Because of this, the oil from the pump passes from port (B) and flows through orifice (a) to port (C).

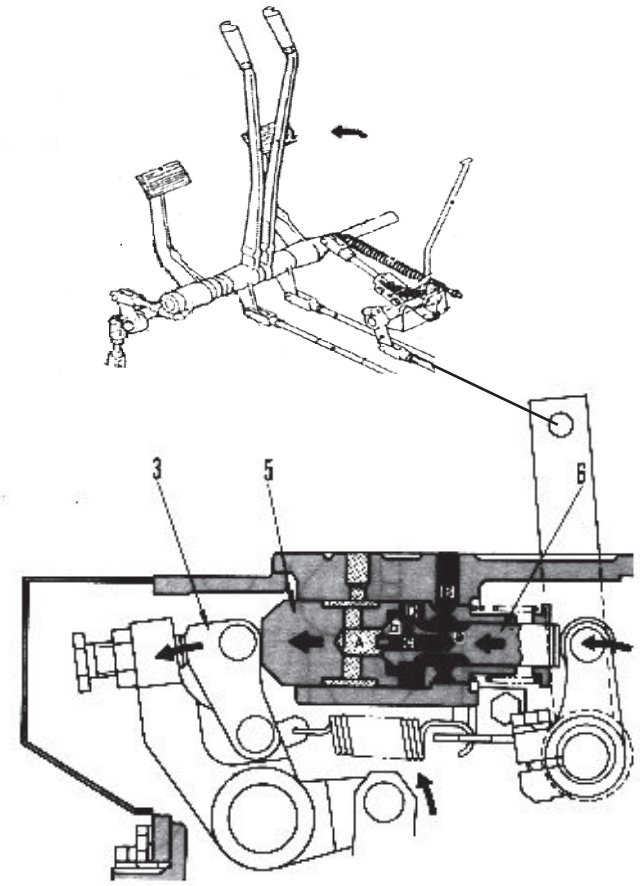



When the hydraulic pressure at port (0) rises, it pushes piston (5) to the left and connects the flow of oil at port (0) and port (A). The oil then drains from port (A) to the steering case. The brake pedal travels the same distance that piston (5) moves by slight depressing force. This movement of the position (5) and pedal, and the oil flow is repeated over a short period (follow-up movement).



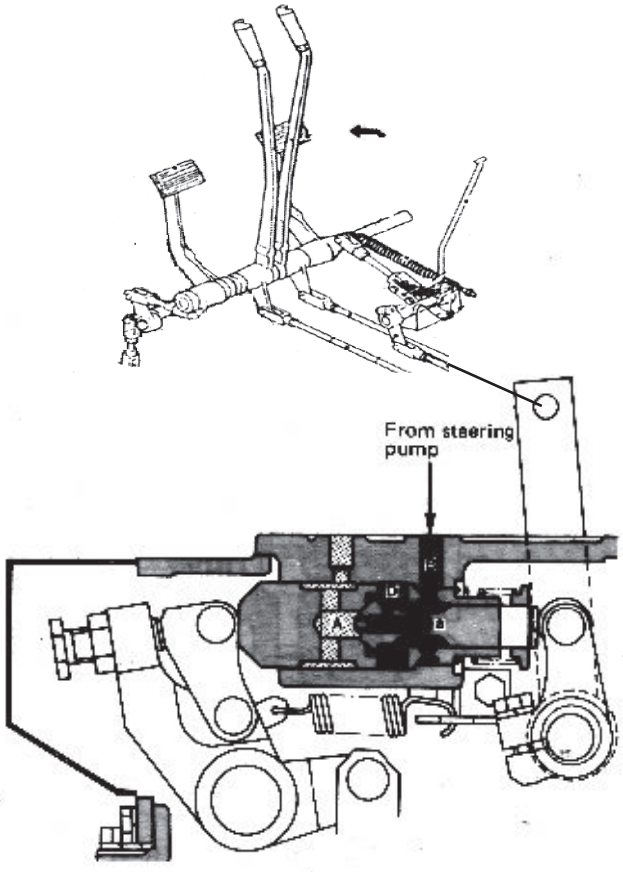
Spool (6) moves further to the left and connects the flow of oil at port (8) and port (D). The volume of oil flowing to port (0) increases and piston (5) moves faster. Piston (5) continues to push lever (3). then brake band contracts smoothly and the brake is applied.

In this way, the hydraulic pressure rises in two stages. At first, the oil pushes piston (5) lightly, and when the flow of oil at port (D) and port (8) is connected, it pushes strongly. This prevents the brake from being applied suddenly.



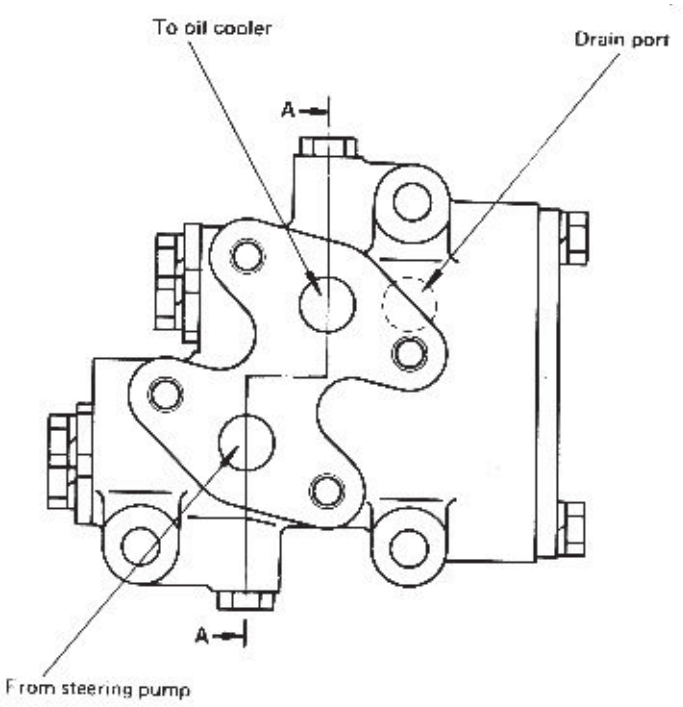

**4. When brake pedal is depressed fulley (brake applied)**

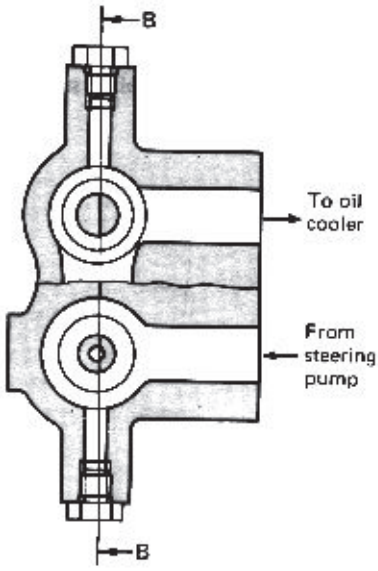
When the brake pedal reaches the end of its travel, the flow of oil at port (D) and port (A) remains shut off, and the hydraulic pressure rises further. When the pressure reaches 20 kg/cm², the main relief valve functions and the oil flows into the lubrication circuit.



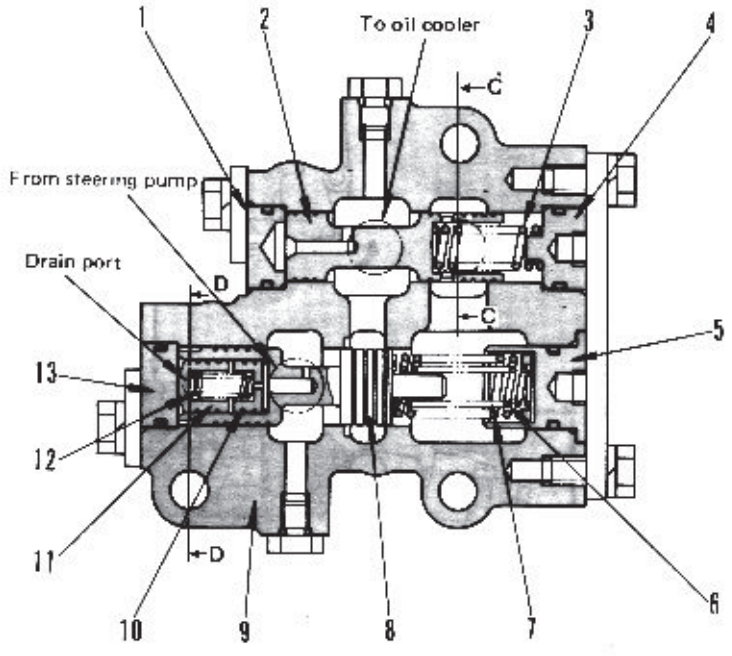
# STEERING RELIEF VALVE

The steering relief valve consists of relief valve (8) and oil cooler by-pass valve (2). Relief valve (8) adjusts the pressure in the steering circuit to 20 kg/cm²; oil cooler by-pass valve (2) prevents any abnormal high pressure due to clogging of the oil cooler or any other part. (Cooler by-pass valve set pressure: 12.0 kg/cm²)



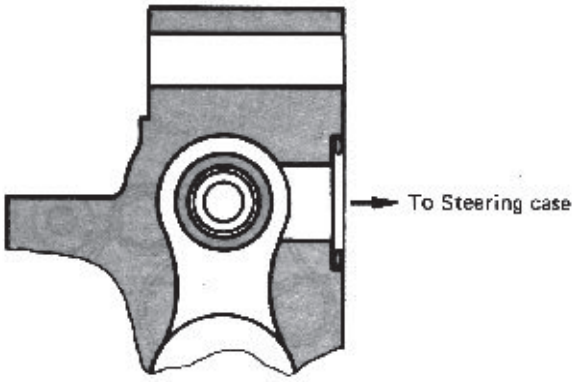




Section A–A

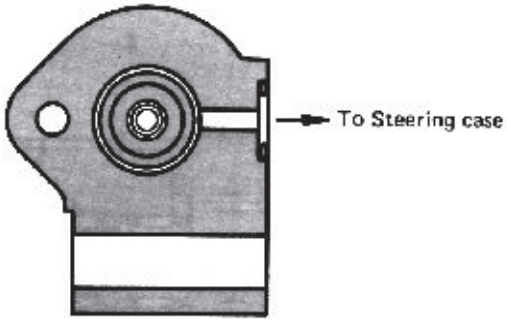



Section B–B

1. Plug
2. Cooler by-pass valve (safety valve)
3. Spring
4. Plug
5. Plug
6. Spring (small)
7. Spring (large)
8. Relief valve
9. Relief valve body
10. Piston
11. Piston
12. Spring
13. Plug




Section C–C

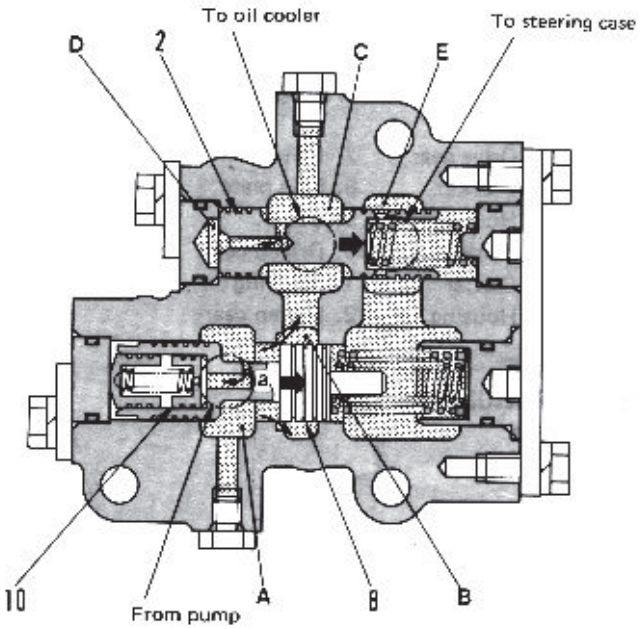



Section D–D

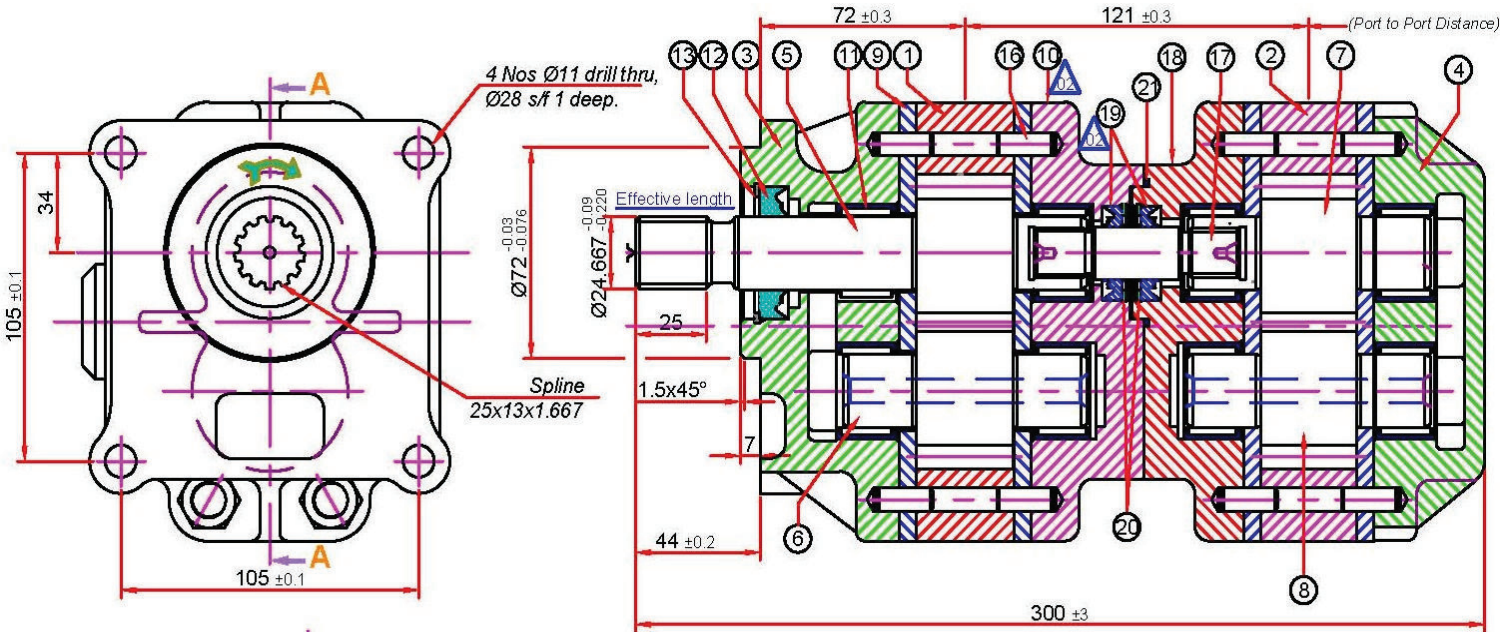
**Operation**

The oil from the steering pump flows to port (A). then passes through orifice (a) of relief valve (8) and flows to piston valve (10). When the hydraulic pressure rises, the oil pushes piston valve (10) and the reaction moves relief valve (8) to the right. As a result, port (A) and port (B) are connected, and one oil line flows to the oil cooler through port (C) of the cooler by-pass valve (2). while another oil line flows to port (D) of cooler bypass valve (2). When this happens, the hydraulic pressure is maintained at 20 kg/cm².

If, due to clogging of the oil cooler, there is a rise in the pressure of the oil flowing to the oil cooler, the oil at port (D) moves cooler bypass valve (2) in the direction of the arrow. As a result, port (C) and port (E) are connected and the oil is relieved to the tank. The hydraulic pressure becomes 12.0 kg/cm².



## TANDEM GEAR PUMP (MAIN CLUTCH & STEERING)




| Sl.No | Descrition | Qty. |
|---|---|---|
| 22 | Hex. bolts | 4 |
| 21 | 'O' Ring | 1 |
| 20 | Int.circlip | 2 |
| 19 | Oiseal | 2 |
| 18 | Spacer-II | 1 |
| 17 | Coupling | 1 |
| 16 | Dowel pin | 4 |
| 15 | Spring washer | 8 |
| 14 | Hex. bolts | 8 |
| 13 | Internal circlip | 1 |
| 12 | Oil seal | 1 |
| 11 | Bearings | 8 |
| 10 | Spacer-I | 1 |
| 9 | Thrust plate | 4 |
| 8 | Driven gear | 1 |
| 7 | Drive gear | 1 |
| 6 | Driven gear | 1 |
| 5 | Drive gear | 1 |
| 4 | Cover | 1 |
| 3 | Bracket | 1 |
| 2 | Body-II | 1 |
| 1 | Body-I | 1 |

### *Pump specifications*

*1: Maximum number of revolutions 2300*
*2:Theoritical discharge @1000 RPM of pump - I--- 31.4 cc/rev*
*3:Theoritical discharge @1000 RPM of pump - II--- 31.4 cc/rev*
*4:Actual discharge @ MAX pump RPM 72 LPM (Each pump)*
*5: Max.Working pressure 30 Kgs/cm2*
*6:Test oil temperature 50 to 55°c*
*7: Pump direction Clock wise*
*8. Pump efficiency at 30 kgcm2 -------- 87 % to 90% (Since its fixed gap)*

SECTION : 07

# F I N A L  D R I V E

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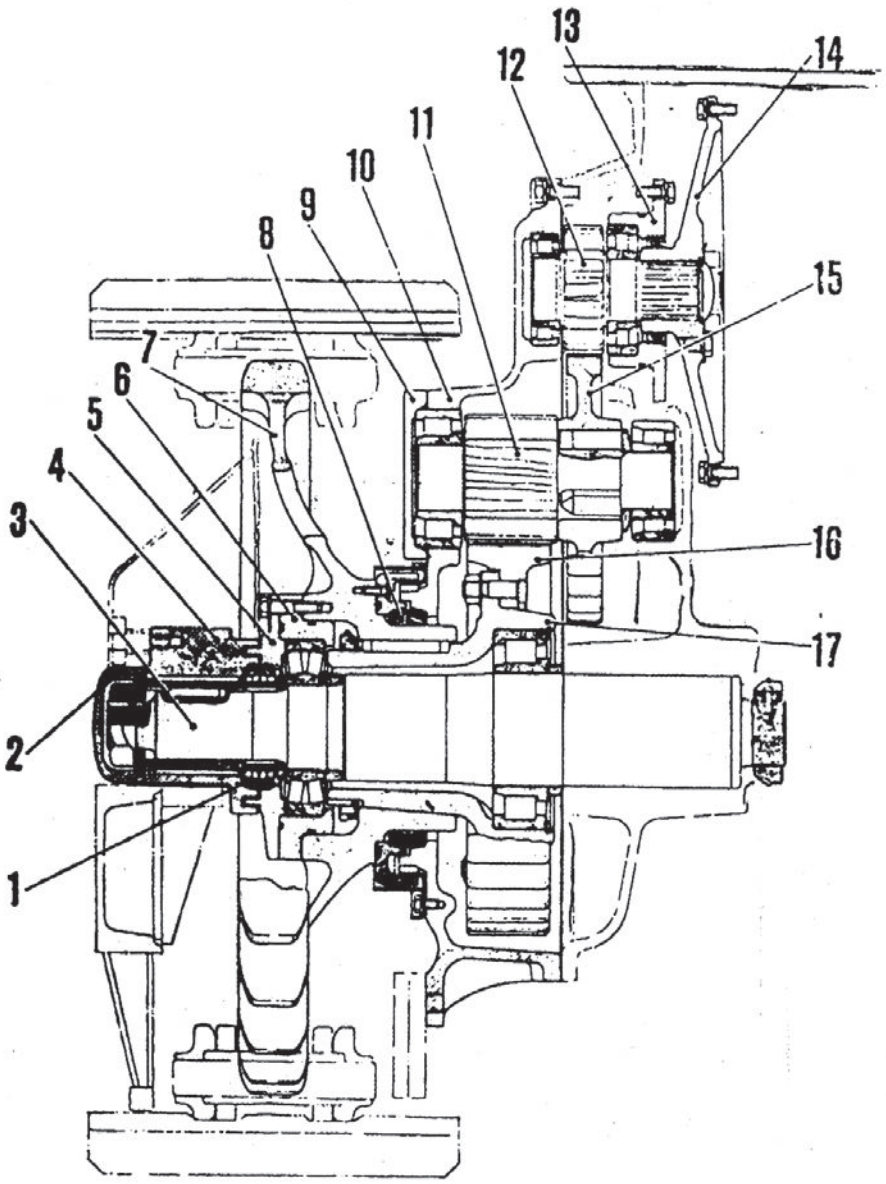
RE-MOUNTING ..... 07-08

# FINAL DRIVE

## DESCRIPTION




**FINAL DRIVE**

| | | | | | |
|---|---|---|---|---|---|
| 1. | Floating seal | 7. | Sprocket | 13. | Bearing cage |
| 2. | Cap | 8. | Floating seal | 14. | Flange |
| 3. | Sprocket shaft | 9. | Cover | 15. | 1st reduction gear |
| 4. | Bearing | 10. | Cover | 16. | 2nd reduction gear |
| 5. | Bearing retainer | 11. | 2nd pinion | 17. | Hub |
| 6. | Bearing cage | 12. | 1st pinion | | |

# FINAL DRIVE

## DESCRIPTION

The final-drive gearing, consisting of four spur gears, lowers the speed of steering clutch output pinion through two stages of reduction to drive the sprocket wheel. These gears are, first pinion integral with input shaft; first gear and 2nd ,pinion on the intermediate shaft; and 2nd gear which is bolted to the sprocket wheel boss (a sleeve-like member-enclosing the outer portion of the sprocket wheel shaft (axle) with roller bearings in between). The sprocket wheel, located outside the final-drive case, is rigidly mounted on the same boss, The sprocket shaft extends through the case and its inner end is rigidly secured to the underside of bevel gear case.

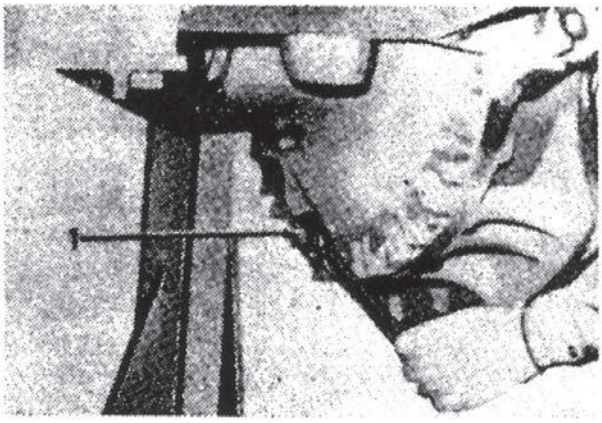
The running clearance between final-drive case and rotating members (sprocket and hub) is tightly sealed by means of seal rings of floating type. A similar sealing arrangement is provided at the outer end of sprocket shaft to seal the clearance between shaft (stationary) and rotating member. Lubricating oil in the final drive case provides splash lubrication to all gears and bearings, including those bearings between sprocket hub and sprocket shaft.

# REMOVAL

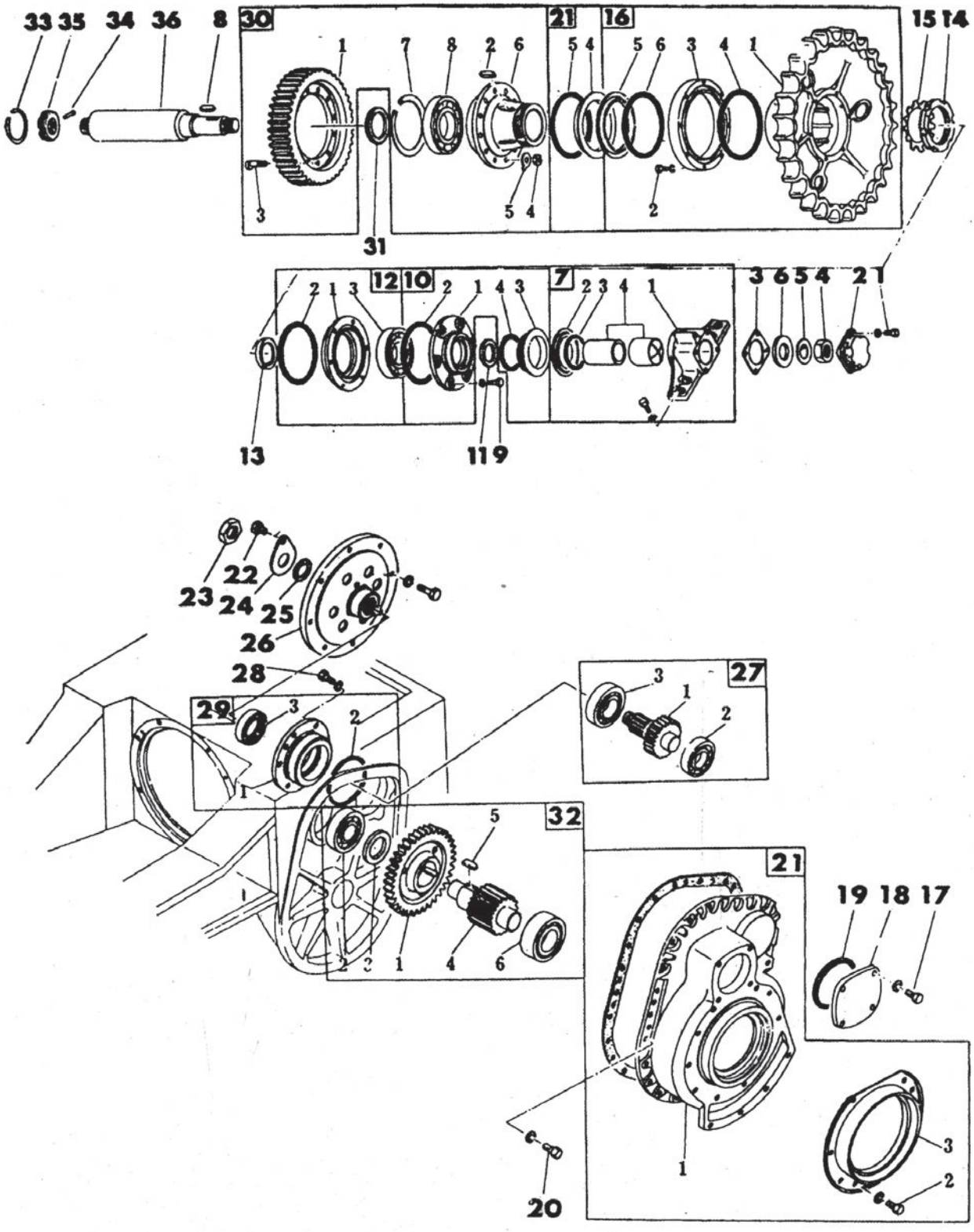
(1) Remove the track-frame groups from the chassis. (Refer to TRACK REMOVAL and TRACK-GROUP REMOVAL.)

(2) Remove the bevel gear shaft group including steering clutch assemblies. (Refer to REMOVAL OF BEVEL GEAR SHAFT GROUP:)

(3) Drain oil from each final-drive case by loosening its drain plug (1).



# DISASSEMBLING




**(The Parts are enumerated in the order of sequence of removal.)**

**Final-drive Group**

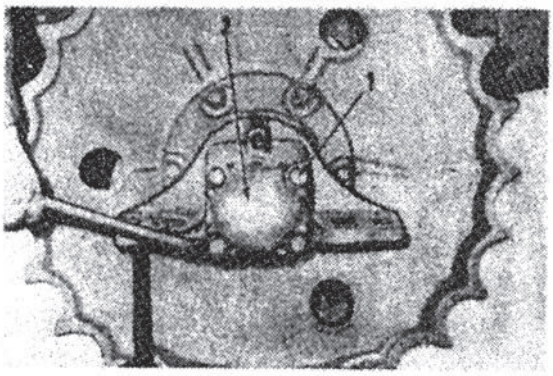
# FINAL DRIVE

## DISASSEMBLING

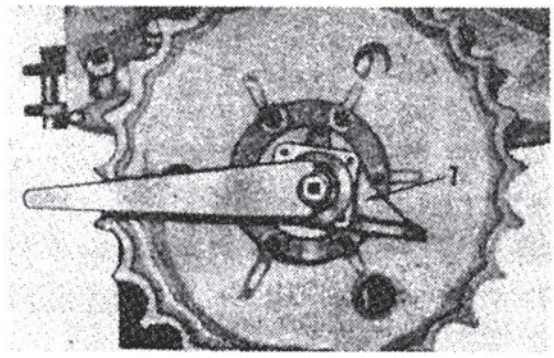
1. Bolt
2. Bearing cap
3. Gasket
4. Nut
5. Lock
6. Washer
7-1. Bearing
7-2. Seal
7-3. “O” ring
7-4. Bush
8. Key
9. Bolt
10-1. Bearing retainer
10-2. “O” ring
10-3. Seal
10-4. “O” ring
11. Collar
12-1. Bearing cage
12-2. “O” ring
12-3. Bearing
13. Collar
14. Nut
15. Lock
16-1. Sprocket
16-2. Bolt
16-3. Guard
16-4. “O” ring
16-5. Floating seal
16-6. “O” ring
17. Bolt
18. Retainer
19. “O” ring
20. Bolt
21-1. Case
21-2. Bolt
21-3. Guard
21-4. Floating seal
21-5. “O” ring
22. Bolt
23. Nut
24. Lock
25. Packing
26. Flange
27-1. Pinion
27-2. Outer bearing
27-3. Inner bearing
28. Bolt
29-1. Bearing cage
29-2. “O” ring
29-3. Oil seal
30-1. Gear
30-2. Key
30-3. Bolt
30-4. Nut
30-5. Lock
30-6. Hub
30-7. Snap ring
30-8. Bearing outer race
31. Collar
32-1. Gear
32-2. Bearing inner race
32-3. Spacer
32-4. Pinion
32-5. Key
32-6. Bearing
33. Ring
34. Pin
35. Nut
36. Shaft

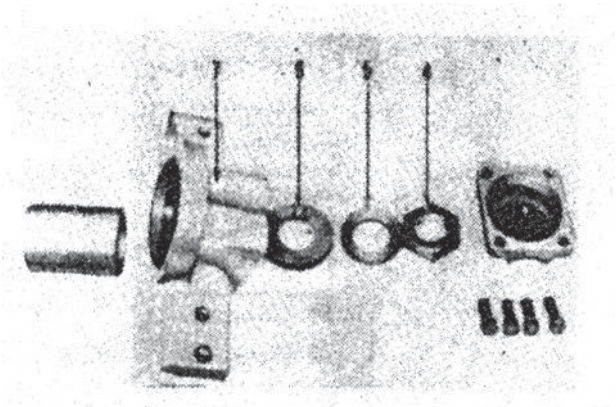
## DISASSEMBLING

(1) Remove bolts (1) and remove bearing cap (2). Take out gasket.

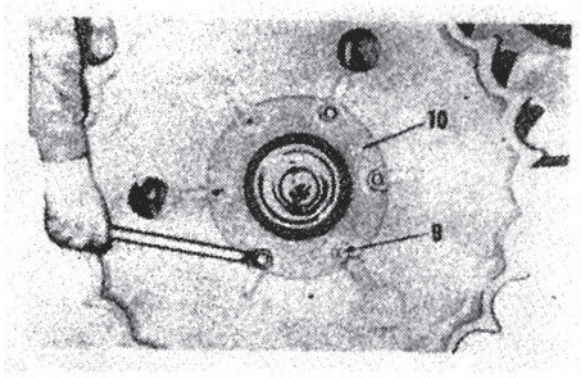


(2) Remove nut (4), take off lock (5) and washer (6) and draw off sprocket bearing (7). This removal involves parts 7-1 through -4.

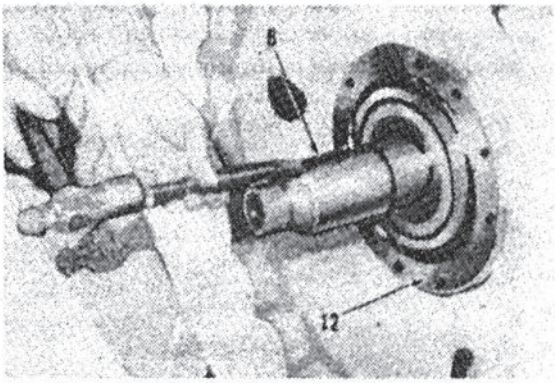




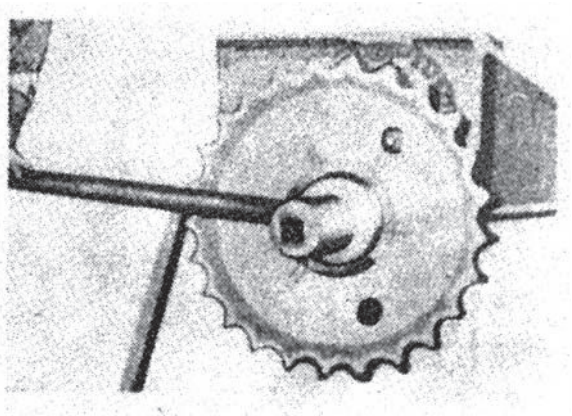
(3) Remove bolts (9) and detach bearing retainer (10) by removing parts 10-1 through -4.



(4) Force key (8) out of place and jack out bearing cage (12) by screwing jacking bolts into the cage. Parts 12-1 through -3 come out in this operation.

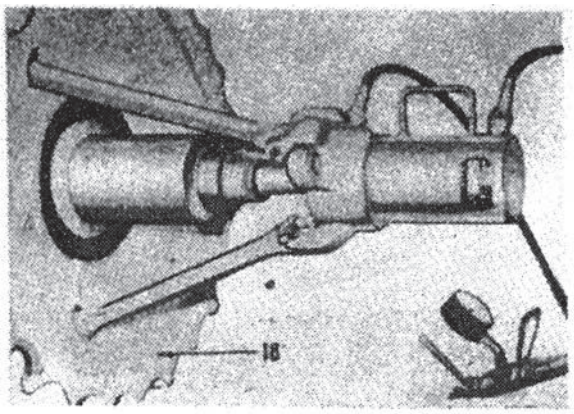


(5) Using the special wrench, loosen and remove sprocket nut (14).

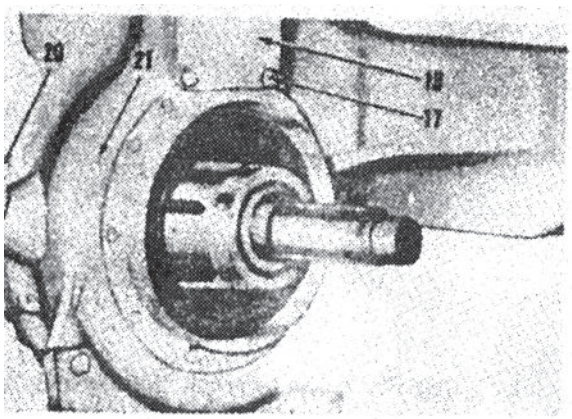


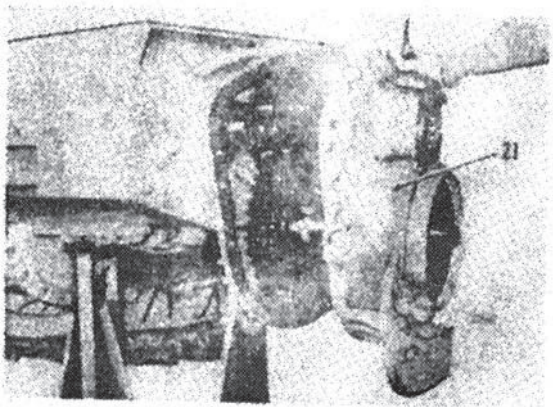
## DISASSEMBLING

(6) Draw sprocket (16) off the hub with the use of the special tool. Parts 16-1 through -6 are to be removed.

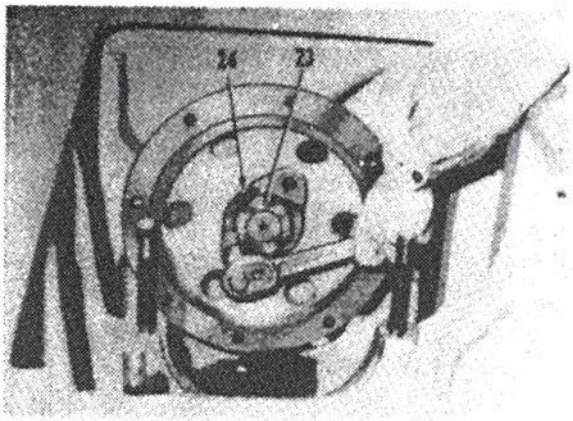



(7) Remove bolts (17) and remove retainer (18). Remove bolts (20) and detach case (21). Parts 21-1 through-5 are to be removed. Suspend the case from above by taking a hitch to a bolt screwed into one of retainer bolt holes, and remove the case, when it is still in suspension as shown in Fig,

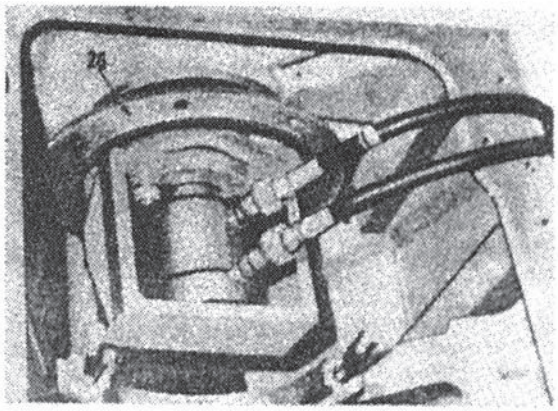


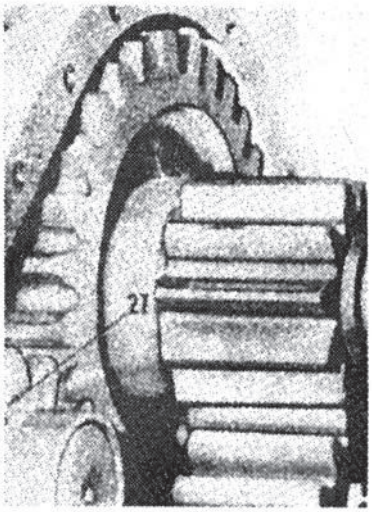

(8) Remove bolts (22), remove nut (23) and lock (24), and take out packing (25).




(9) Using the special tool, draw the flange (26) off the input shaft.

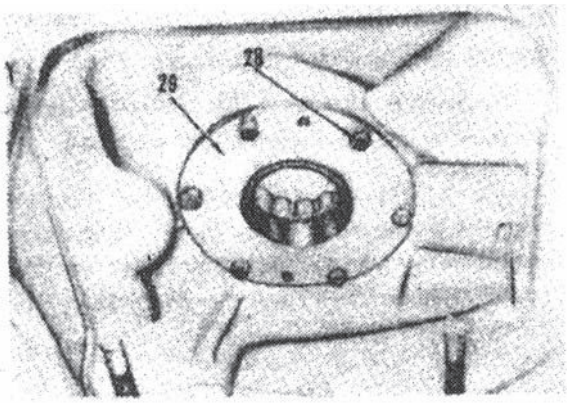



(10) Draw out pinion, (27). This operation involves removal of parts 27·1 through 3.

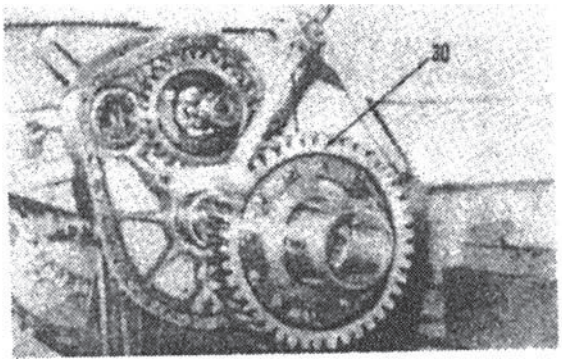


## DISASSEMBLING

(11) Remove bolts (28) and draw bearing cage (29) out by using jacking screws. Parts 29-1 through -3 come out in this operation.

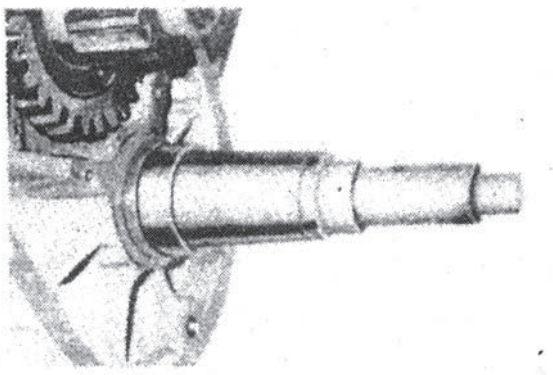



(12) Draw out gear (30), removing parts 30-1 through -8. The inner races of two roller bearings will remain on the sprocket shaft.

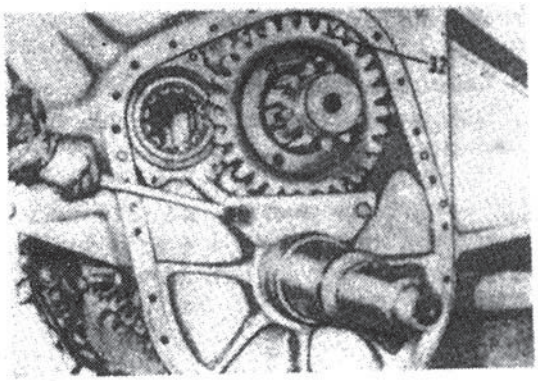



(13) Draw each bearing inner race off the sprocket shaft.

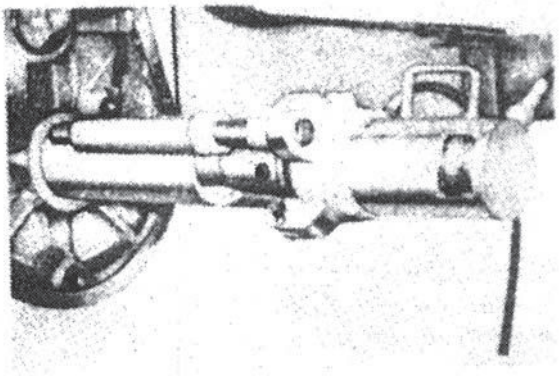
NOTE; Pour hot oil over the inner race while pulling it.



(14) Remove the plate, by which an oil bath is formed for gear (32). Draw out gear (32) removing parts 32-1 through 6.




(15) Using the spacial tool, draw out sprocket Shaft (36). (Normally this shift need not be removed.)



# CLEANING AND INSPECTION

(1) Wash all removed parts clean, and dry them with compressed air.

(2) Inspect each final-drive case for cracks or any other damage. Repair or replace the case as necessary.

(3) Check the gear teeth for wear, and measure gear backlash in each mesh of teeth in final-drive gear train. Inspect the gear teeth for contact pattern.

(4) Check for wear of the reamer bolts, with which the last gear is secured to the sprocket hub, and inspect the bolts and holes for damage.

(5) Check the sprocket shaft for straightness. Repair or replace the shaft as necessary.

(6) Check the teeth of sprocket wheel for radial wear by using the contour gauge. Measure the tooth width to determine the extent of lateral wear. Repair the teeth, or replace the sprocket wheel, as necessary.

# RE-MOUNTING

Instructions to be followed in re-assembling and re-mounting the final-drive groups are as follows:

(1) Before installing the final-drive case in place, make sure that the gasket between this case and steering case is of the prescribed thickness. Never use too thin or too thick gaskets.

(2) Where a replacement final-drive case is to be installed, tentatively build the final-drive gear train with the replacement case in place, making sure each gear is properly aligned, and then fix the position of the final-drive case anew with respect to the steering case by doweling.

3) When re-mounting sprockets, centre the sprockets relative to sprocket shaft and push the wheel slowly over the sprocket hub so as not to disturb the sealing rings in place.

(4) Before fitting the sealing rings (between sprocket and final-drive case and at the outer end of sprocket hub), make sure that rings are all clean. Apply oil to the lapped faces of rings just before putting them in place.

(5) Apply grease to oil seals and "O" rings before fitting them in place.

(6) The surfaces of shafts, whether they are splined or not, must be coated lightly with MOLYCOTE or its equivalent if the surface are to make with bore surfaces in press-fit. The parts to be so coated are:

a) The splined end of input shaft (1st pinion) onto which the hub of the connecting flange is fitted.

b) The shaft of 2nd pinion onto which 1st gear is fitted.

c) That part of sprocket hub carrying sprocket.

d) Those parts of sprocket shaft fitting to bores provided in the case.

(7) The connecting flange (splined to the input shaft) must be secured by tightening its nut to a torque of 40 to 70 kg-m and its face and radialrunouts (at the flanged peripheral part) must be kept within 0.15 mm (face) and 0.2 mm (radial).

SECTION : 08

# UNDERCARRIAGE

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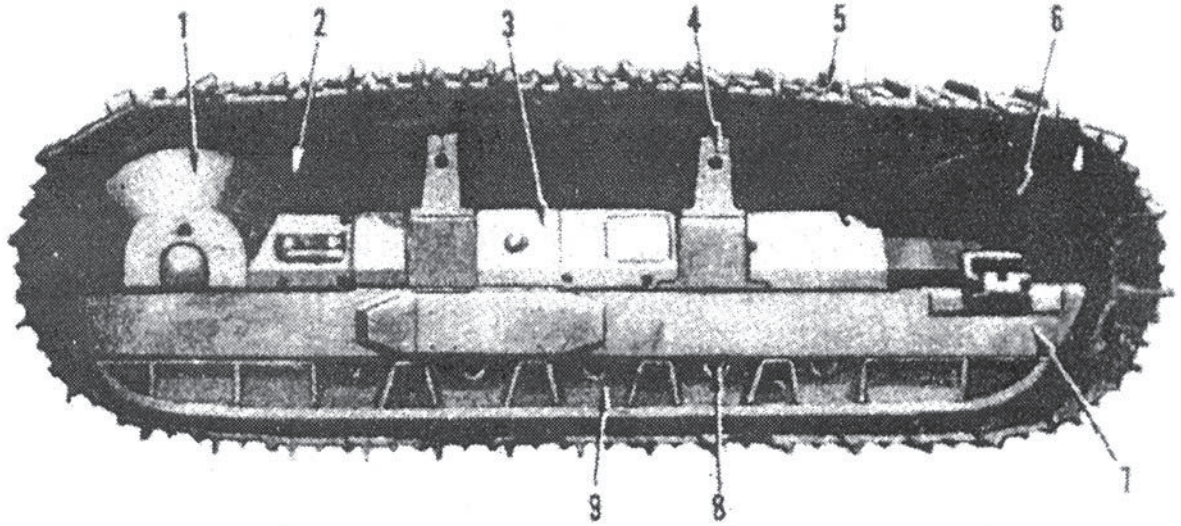
# UNDER CARRIAGE

## GENERAL




1. Sprocket cover
2. Sprocket
3. Recoil spring cover
4. Carrier roller
5. Track
6. Idler
7. Track frame
8. Track roller
9. Roller guard

By the term “undercarriage (crawler)" is meant the right and left track frame groups, each consisting of an endless track chain and a frame structure on which rollers are mounted. The track chain is laid forward by the front idler, and the machine rides on the track with the track rollers, with the drive being transmitted from the sprocket. The front idler is held by a recoil spring (compression spring) whose compression can be varied to adjust the track tension. During operation, the front idler yield back and recoils forward when the track rides over an obstruction, thereby preventing excessive shock stresses from occurring in the track chain and the frame.

# TRACK FRAME

### A. Description

The frame is a welded steel structure, fabricated with channels and plates and designed strong enough to withstand the large, dynamic stresses encountered by it in heavy-duty earthmoving work.

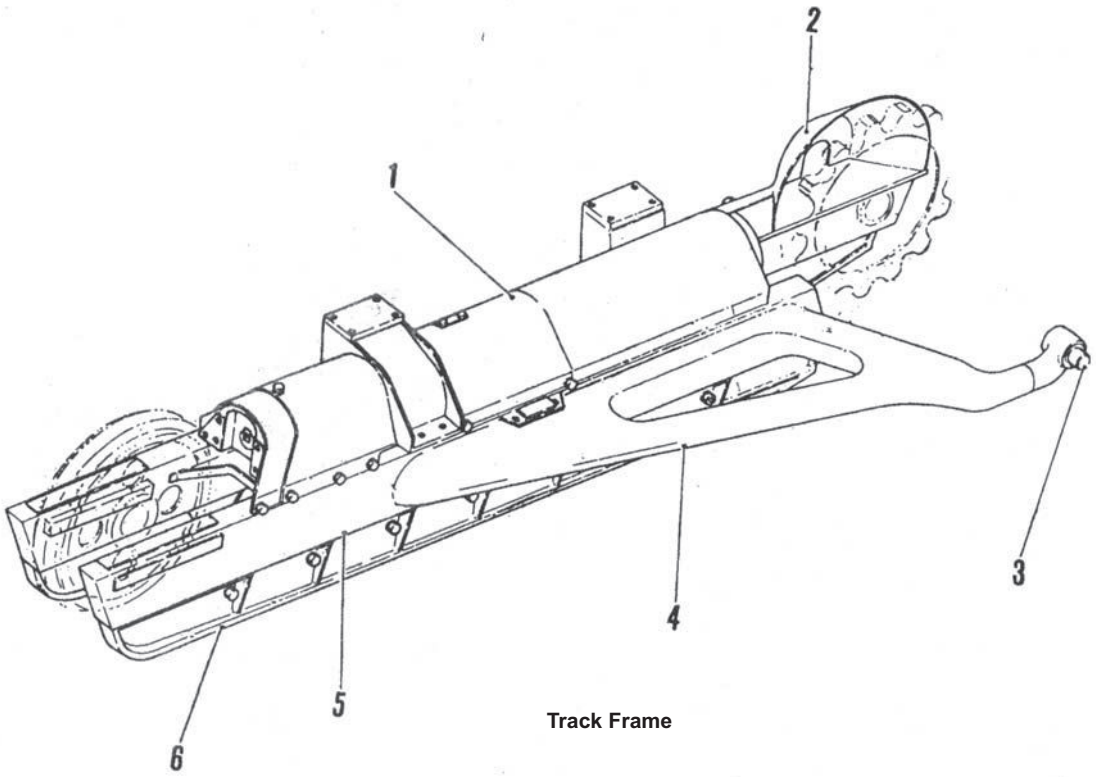
The diagonal brace, a solid steel casting triangular in shape, has its one side-end welded to the track frame and other end secured freely to the pivot shaft under bevel gear case. This end is capable of turning up and down on the axis of the sprocket shaft, such that the track frame is kept parallel to the chassis but is allowed to present a rocking motion around the sprocket shaft.

On the top of track frame are mounted the carrier rollers, recoil spring, front idler and bearing for supporting the sprocket shaft. Under the track frame are mounted the track rollers and roller guard.

# UNDER CARRIAGE

## TRACK FRAME

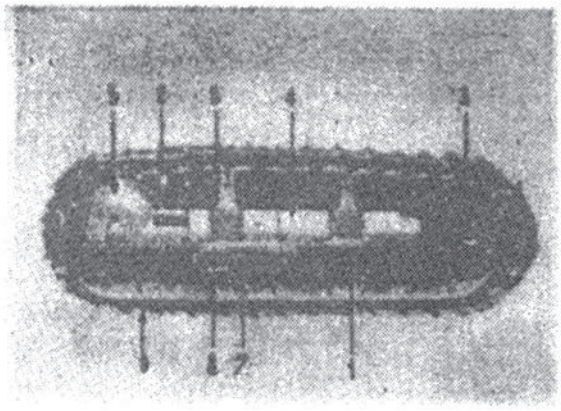
### REMOVAL




Track Frame

1. Recoil spring cover
2. Sprocket cover
3. Diagonal brace pivot shaft
4. Diagonal brace
5. Track frame
6. Roller guard

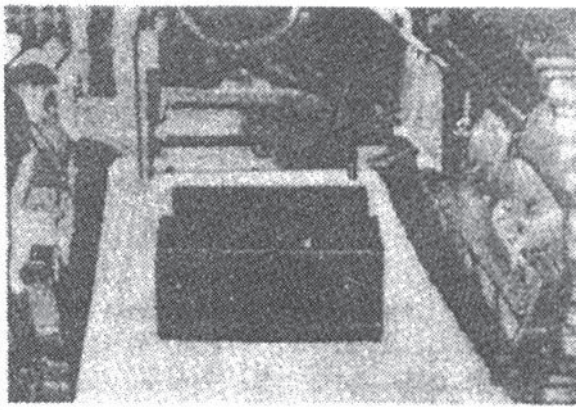
**B. Removal**



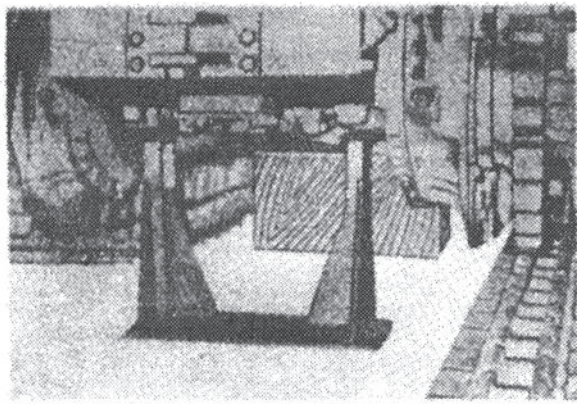
1. Track frame
2. Sprocket
3. Front idler
4. Recoil-spring cover
5. Sprocket side cover
6. Carrier roller
7. Track rollers
8. Guard
9. Track chain

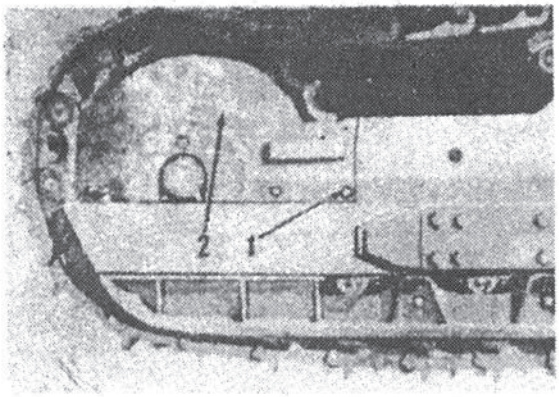
(1) Open the tracks. (Refer to TRACK REMOVAL)

(2) Lift the chassis off the floor with hydraulic jacks or an overhead crane, and block up the chassis. The blocks are to be placed under the equalizer bar to hold up the front end and under

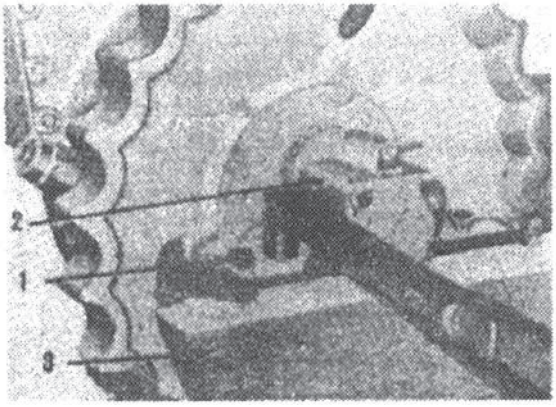


the embossed parts of steering case through which sprocket shafts extended (rear end). Use of such a supporting stand as is shown in the Fig. is recommended for supporting the rear end. Remove bolts (1) and remove sprocket side cover (2).

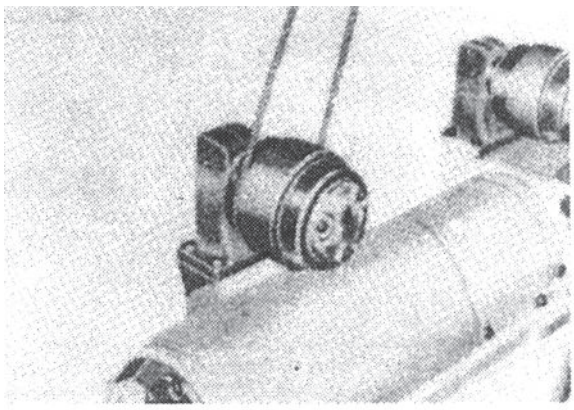




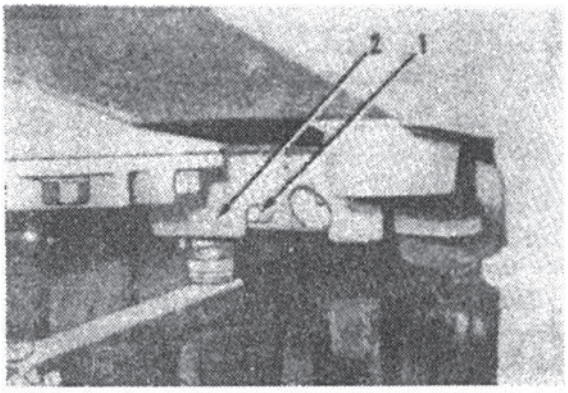

(3) Remove bolts (1) to detach sprocket shaft bearing (2) from track frame (3).




(4) Suspend the track frame from above by hitching a lifting tool to the carrier roller.



(5) Remove bolts (1) and remove diagonal brace cap (2). The track frame assembly is now ready to be carried away in suspension.



## DESCRIPTION

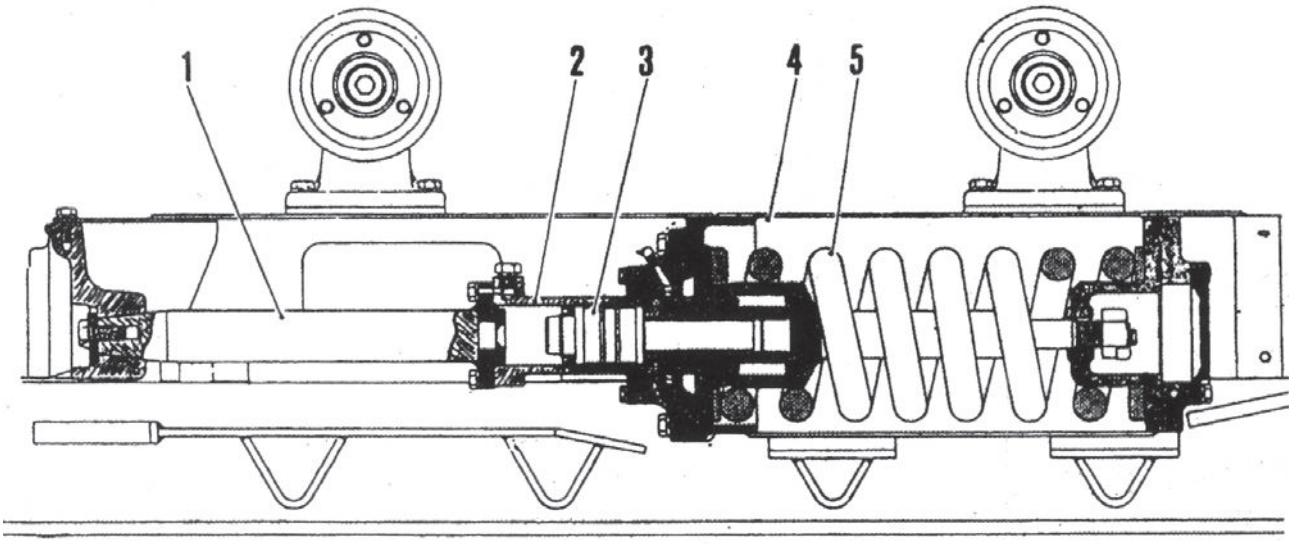
### C. Re-Mounting

To re-connect the track-frame groups to the chassis, reverse the removal procedure and adhere to the following instructions :

(1) Torque limits are specified for the bolts securing the diagonal brace pivot shaft caps to steering case and the sprocket shaft bearings to track frames. Be sure to torque these bolts up to the specified limits.

(2) Before securing the sprocket shaft bearings in place, check to be sure the center-to-center distance between front idlers is 1600±11 mm.

## RECOIL SPRING




**Recoil Spring**

1. Rod
2. Idler adjusting cylinder
3. Piston
4. Recoil spring cylinder
5. Recoil spring

### A. Description

Each recoil spring is a part of the system and provides cushioning to the front idler whose supports are mounted on the track frame and slide over it. The spring is fitted around a pilot bolt whose forward end which is in yoke shape, would slide over grease cylinder. The cylinder is in turn connected to push rod whose forward end is connected to the idler support, so that the horizontal movement of the idler on and along the frame is restrained by the track chain on the front side and by the pilot bolt on the rear side.

The spring compression can be increased or decreased, as desired, to tension the track chain more or less, by pumping in or taking out the grease to or from the cylinder (2).

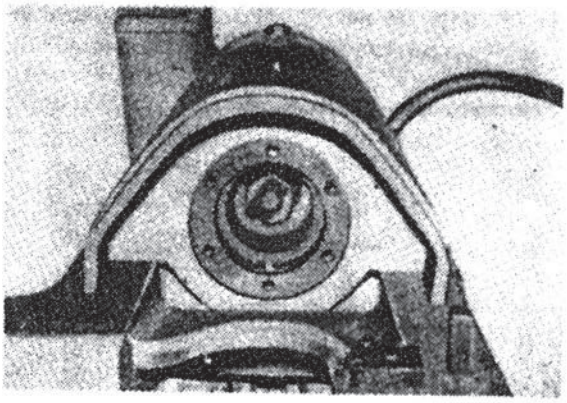
**B. Removal**

(1) Open the tracks. (Refer to TRACK REMOVAL.)

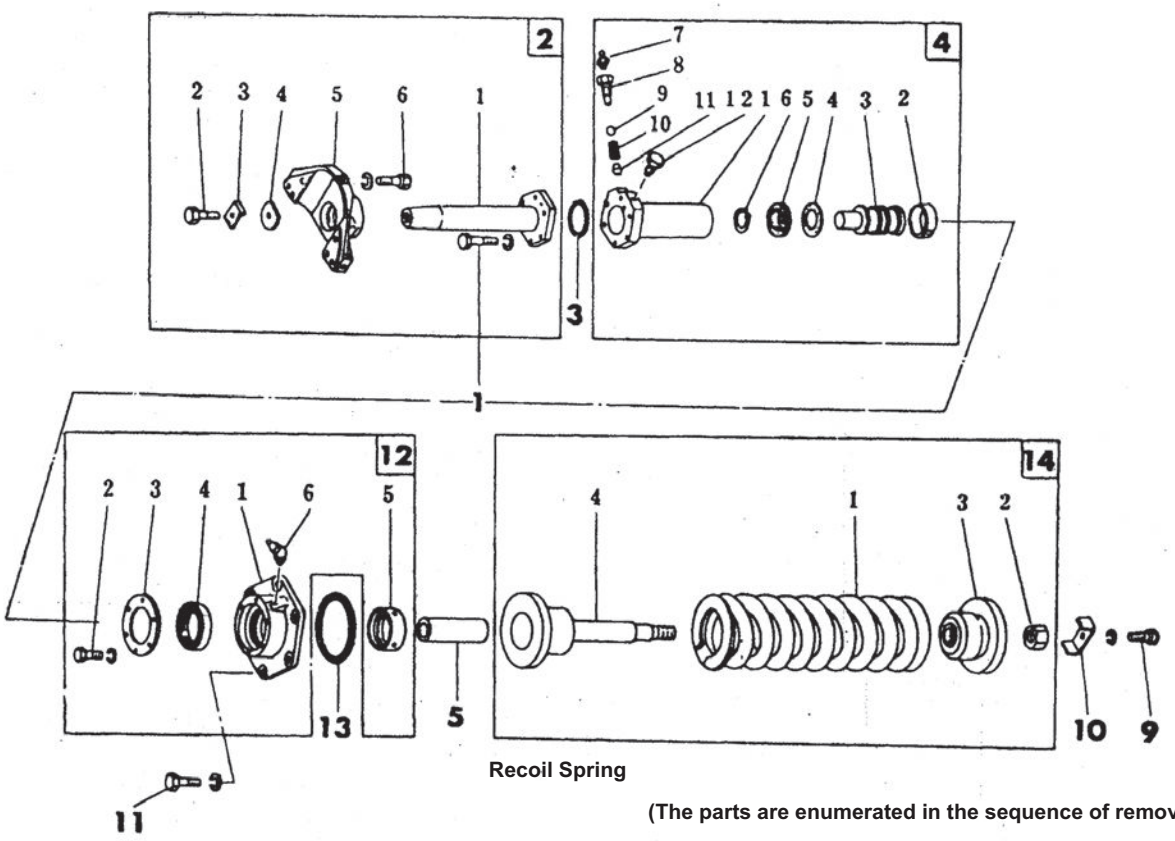
(2) Separate the track-frame groups from the chassis (Refer to REMOVAL OF TRACK FRAME GROUPS.)

(3) Take down the front idler assembly from each track frame.

(4) Remove the plug, and pump-out the oil in the recoil spring Chamber.



**c. Disassembling**



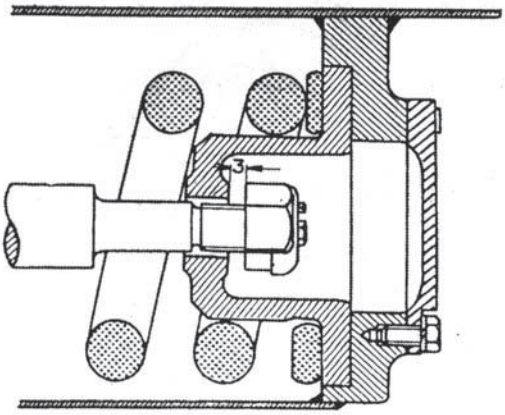

**Recoil Spring**

**(The parts are enumerated in the sequence of removal)**

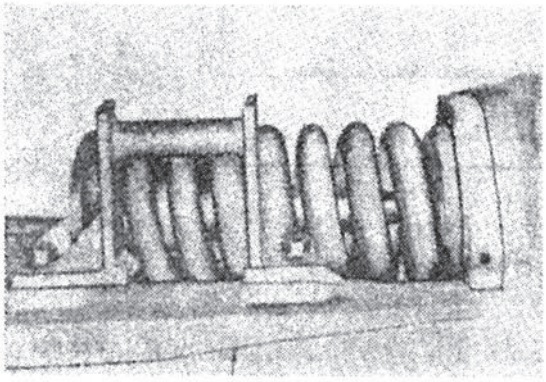
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | Bolt | 4-4. | Gasket | 6. | Bolt (not shown) | 12-5. | Bush |
| 2-1. | Rod | 4-5. | Gasket | 7. | Cover (not shown) | 12-6. | Grease fitting |
| 2-2. | Bolt | 4-6. | Snap ring | 8. | Gasket | 13. | "O" ring |
| 2.3. | Lock | 4-7. | Grease fitting | 9. | Bolt | 14-1. | Spring |
| 2-4. | Washer | 4-8. | Seat | 10. | Lock | 14-2. | Nut |
| 2-5 | Yoke | 4-9. | Steel ball | 11. | Bolt | 14-3. | Pilot |
| 3. | "O" ring | 4-10. | Spring | 12-1. | Cover | 14-4. | Bolt (pilot) |
| 4-1. | Cylinder | 4-11. | Plunger | 12-2. | Bolt | | |
| 4-2. | Snap ring | 4-12. | Plug | 12-3. | Cover | | |
| 4-3. | Piston | 5. | Collar | 12-4. | Oil seal | | |

## DISASSEMBLING ETC.

(1) Turn in the nut (14-2) to obtain a clearance of 3 mm between it and recoil spring pilot (14-3).




(2) Remove cover (12-1), and push on the spring from rear end with a rod or bar to force it out forward.



(3) To detach recoil spring front pilot, use a press to compress the spring, remove the nut, and slacken the press gradually to free spring from pilot.

### D. Inspection

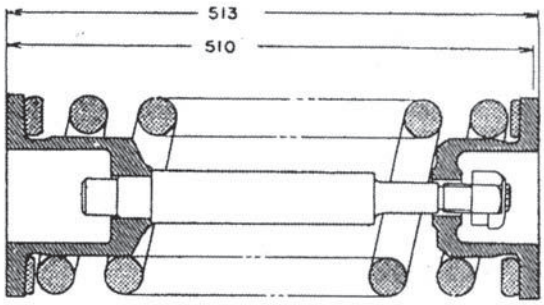
(1) Inspect each recoil spring for damage, and check its free length, as-installed preload and squareness to determine the extent of fatigue in the spring.

(2) Inspect the grease cylinder for wear or damage on its internal and external surfaces. Check the bush inside recoil cover for wear.

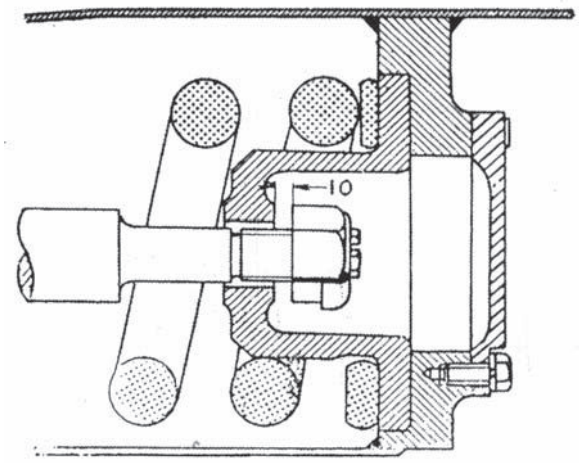
### E. Re-Assembling

Build the recoil spring assemblies on track frames according to the following instructions :

(1) Use a press to assemble together the recoil spring and seat With the spring compressed to a length of 513 mm (as against the specified spring length of 510




mm) by means of the press, tighten the nut until it bears against the seat, and insert the assembly into the recoil spring cylinder. After the cylinder cover is put on, turn back the nut until it becomes flush with the end face of the rod. This will introduce the specified clearance of 10 mm between seat and nut.




(2) Before inserting the piston into the bore of grease cylinder, have the cylinder stuffed with a proper amount of grease and apply grease to the sliding face of piston and to the cylinder bore. The piston rings in place must be so positioned as to stagger ring gaps.

(3) When positioning the grease fitting on grease cylinder, be sure to point its nipple toward the inspection opening provided in the cover, so as to make the nipple accessible to a charging nozzle through the opening.

(4) After the recoil spring has been re-assembled in place on the track frame, add 4 to 6 litres of engine oil into its spring housing formed by the cover. The oil serves to prevent the spring from rusting.

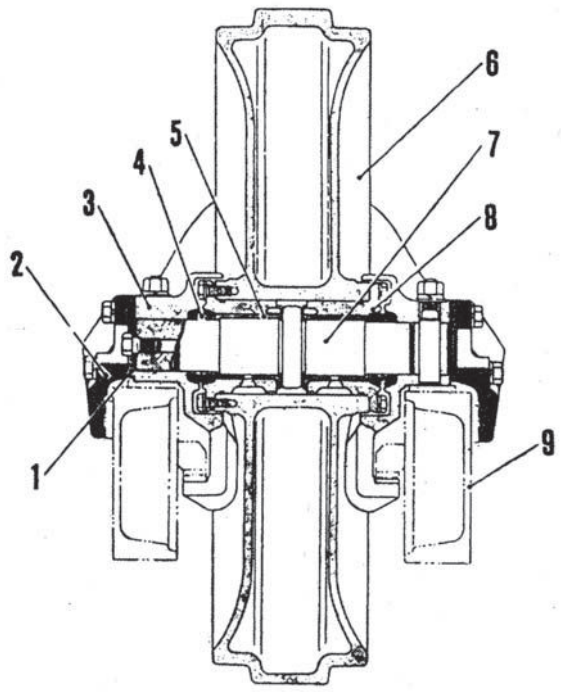
*Note:* Instead of oil, grease can be applied over the recoil spring and inner face of the housing, before re-assembling if they are originally applied with grease.

# FRONT IDLERS

## A. Description

The supports (or bearings) on both sides of each front idler are so constructed that they are capable of sliding, properly guided, in fore-aft direction on the frame without jumping out of the forward ends of the track frame.

The shaft on which the front idler rotates is held rigidly by the supports, and the running clearance between the bore of idler hub and this shaft is filled with lubricant, there being sealing rings of floating type fitted to both ends of this bore to contain the lubricant hermetically.



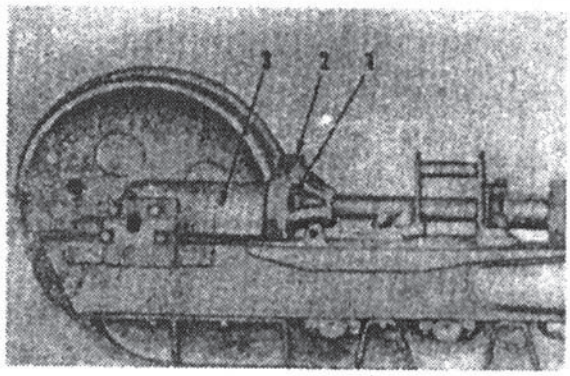

**Idler**

1. Shim
2. Guide
3. Idler shaft bearing
4. Floating seal
5. Bushing
6. Idler
7. Idler shaft
8. Bushing
9. Track frame

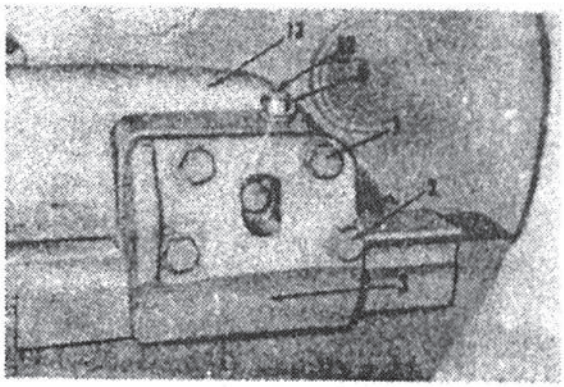
## B. Removal

(1) Open the tracks. (Refer to TRACK RE-MOVAL.)

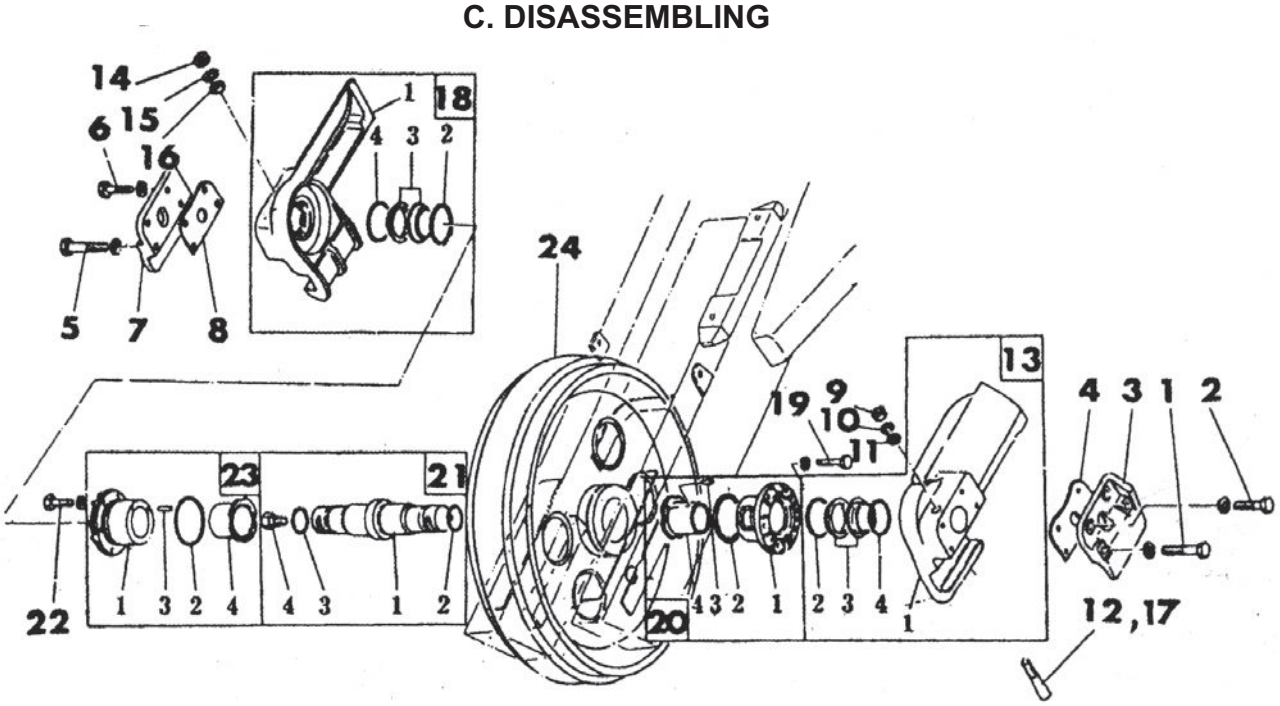
(2) Remove bolts (1) and take off cover (2).




3) Remove bolts (1) and disconnect idler shaft bearing (3) from yoke (2). Take out the idler assembly from the track frame.



## C. DISASSEMBLING

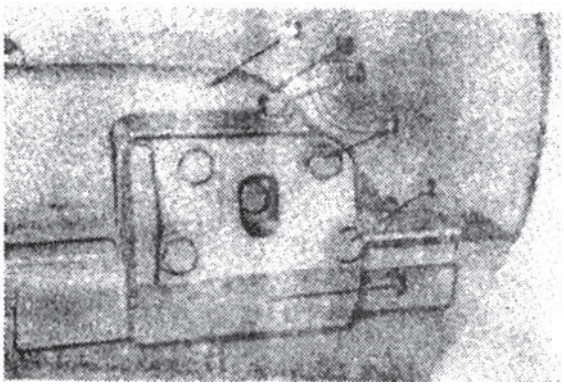



**(The parts are enumerated in the order of sequence of removal)**

**Front Idler**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | Bolt | 11. | Washer | 18-1. | Bearing | 21-2. | "O" ring |
| 2. | Bolt | 12. | Bolt | 18-2. | "O" ring | 21-3. | "O" ring |
| 3. | Guide | 13.1. | Bearing | 18-3. | Seal ring | 21-4. | Plug |
| 4. | Shim | 13-2. | "O" ring | 18-4. | "O" ring | 22. | Bolt |
| 5. | Bolt | 13-3. | Seal ring | 19. | Bolt | 23-1. | Bush |
| 6. | Bolt | 13-4. | "O" ring | 20-1. | Bush | 23-2. | "O" ring |
| 7. | Guide | 14. | Nut | 20-2. | "O" ring | 23-3. | Roll pin |
| 8. | Shim | 15. | Spring washer | 20-3. | Roll pin | 23-4. | Bush |
| 9. | Nut | 16. | Washer | 20-4. | Bush | 24. | Idler |
| 10. | Spring washer | 17. | Bolt (same as 12) | 21-1. | Shaft | | |

(1) Remove bolts (1) & (2) and remove guide (3). Remove nut (9). Remove, bolt (12), and take out bearing (13).



(2) Remove bolts (19) and drive out shaft (21) toward bush (20). The bush will come out together with the shaft.

### D. Cleaning and Inspection

(1) Inspect the idler for cracks or any other damage. Check its O.D. and the width of its peripheral land to determine the amount of wear.

(2) Check shaft O.D. and bush I.D. to determine the amount of wear. Check shaft for runout (deflection). Clean and clear the oil ways and grooves of the shaft by blowing with compressed air.

**E. Re-Assembling**

To re-assemble the front idlers, reverse the disassembling procedure and adhere to the following instructions

(1) The bushes of front idlers and track rollers are to be forced into the bore with the use of the same press. When fitting the idler bushes, first position each bush with its bolt holes aligned to those in the idler and then start pushing it into the bore. Of the two bushes for each idler, one is to be forced in from outer side and the other from inner side.

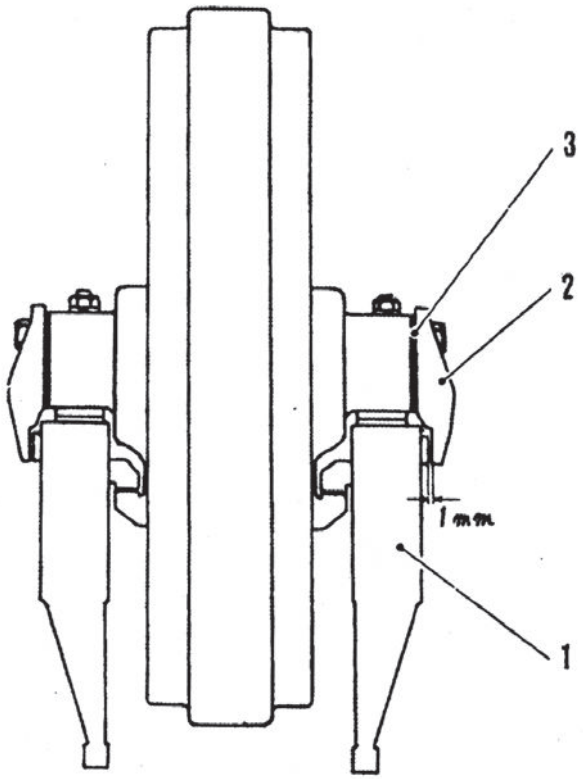
(2) Before installing the idler shaft set bolts, apply LOCKTIGHT to these bolts, and tighten them to a 25-28 kg-m torque.

**F. Re-Mounting**

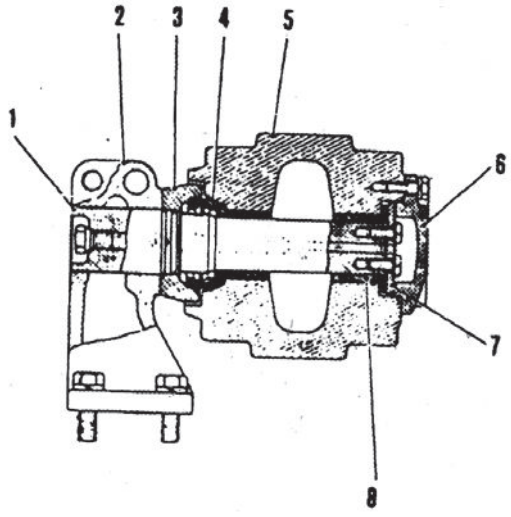
Reverse the removal procedure to re-mount the front idlers, adhering to the following instructions :

(1) Adjust the thickness of shim (3) to obtain a clearance of not more than 1mm between idler shaft guide (2) and track frame (1).

(2) Each idler shaft is to be so positioned as to bring its lubricant-charging end to outer side.




# CARRIER ROLLER




1. Carrier roller shaft
2. Support
3. Retainer
4. Floating seal
5. Carrier roller
6. Cover
7. Retainer
8. Bushing

**A. Description**

Two carrier rollers are employed in each track frame group. The carrier roller is a chilled casting in material. It is mounted on a shaft which is press-fitted to the supporting structure. The shaft support is bolted to the top face of track frame. Sealing rings of floating type are fitted to the inner end of each carrier roller in order to hermetically contain the lubricant with which the running clearance around the shaft in the roller bore is filled.

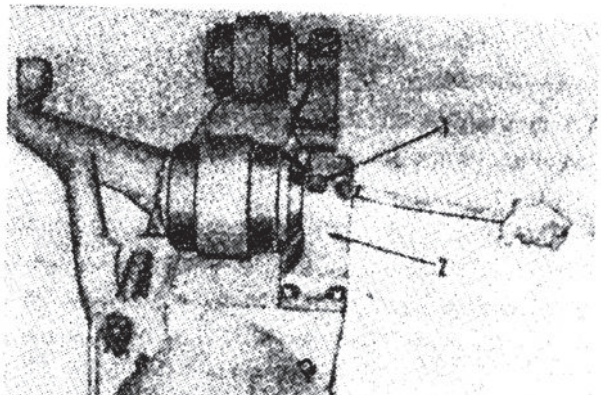
**8. Removal**

(1) Open the tracks. (Refer to TRACK REMOVAL.)

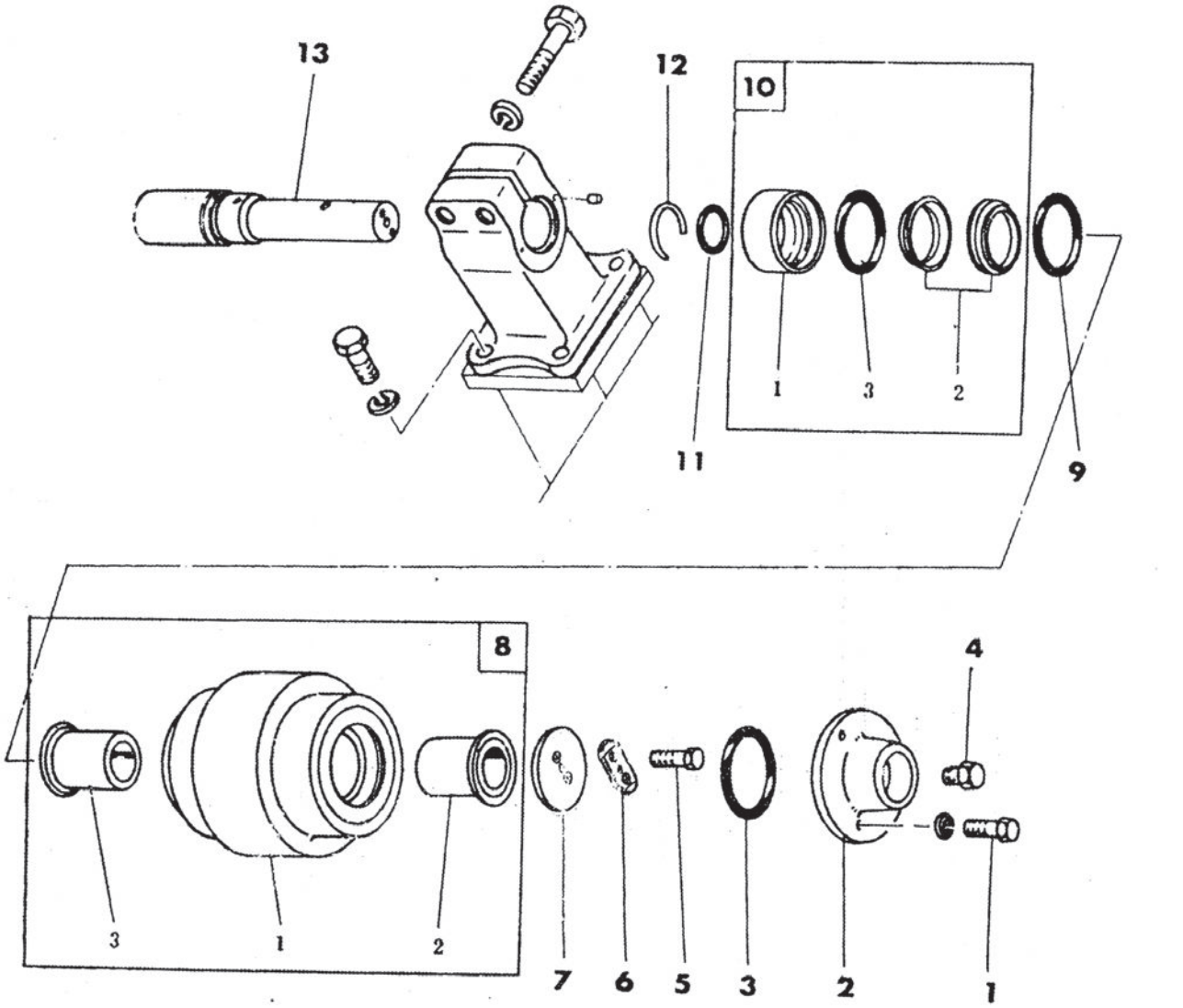
(2) Remove bolts (1) securing the roller shaft, and remove the roller assembly from support (2). If the shaft will not come off the support, lightly tap on the bearing side to shake the shaft loose.

## DISASSEMBLING

(3) The carrier roller can be removed without opening the track chain. This can be accomplished by slackening the track as much as possible, and by jacking up the upper span of track from underside with an oil jack set on the recoil spring cover.



### C. Disassembling




**(The parts are enumerated in the order of sequence of removal)**

**Carrier Roller**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | Bolt | 6. | Lock. | 8-3. | Bush | 10-3. | "O" ring |
| 2. | Shaft cover | 7. | Plate | 9. | "O" ring | 11. | Snap |
| 3. | "O" ring | 8-1. | Roller | 10-1. | Coller | 12. | Snap ring |
| 4. | Plug | 8-2. | Bush | 10-2. | Seal ring | 13. | Shaft |
| 5. | Bolt | | | | | | |

**D. Cleaning and Inspection**

(1) Check the riding faces and land width of each carrier roller for wear.

(2) Measure roller shaft O.D. and bush I.D. to determine the amount of wear, and clean the shaft with compressed air, making its oil ways and grooves perfectly free from any dirt.

(3) Inspect the thrust faces of collar and bushes for wear.

(4) Inspect the support for cracks, distortion or any other malcondition.

**E. Re-Assembling and Re-Mounting**

Reverse the removal and disasembling procedures.

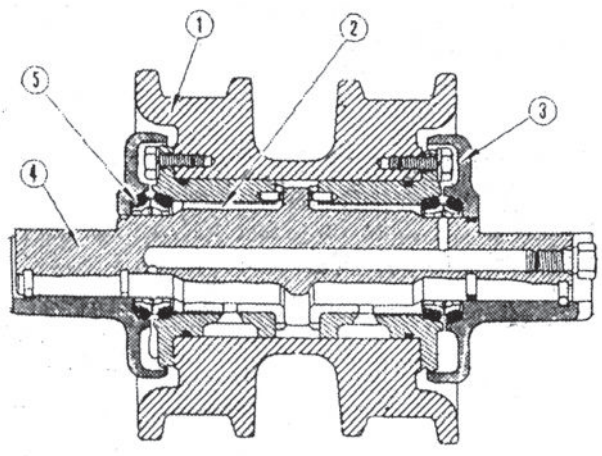
When mounting the carrier roller on the support, position the roller shaft to make the engraved line on its end face points upward, and tighten the bolts on the support with the roller shaft held in that position.

# TRACK ROLLERS

**A. Description**

The track roller is a special steel casting in material.

It rotates on its shaft, and the track frame rests on both ends of this shaft. The weight of the machine is supported by a total of 10 track ·rollers. In other words, the machine rolls on two tracks, right and left, with these rollers located under the track frame:. As counted from the front side, 2nd and 4th rollers are of double-flange type, while 1st, 3rd and last rollers are of single-flange type: the two kinds of rollers are used to prevent them from getting off the track during turning, particularly pivot-turning. Sealing rings of floating type are fitted on both ends of each track roller, in order to hermetically retain the lubricant with which the running clearance around the shaft in the roller bore is filled.



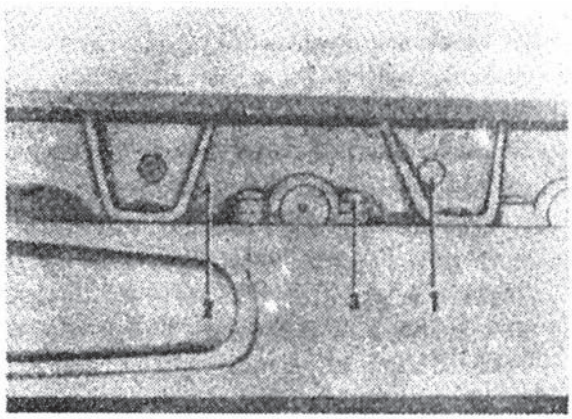

**Track Rollers**

1. Roller
2. Bushing
3. Collar
4. Shaft
5. Floating seal

**B. Removal**

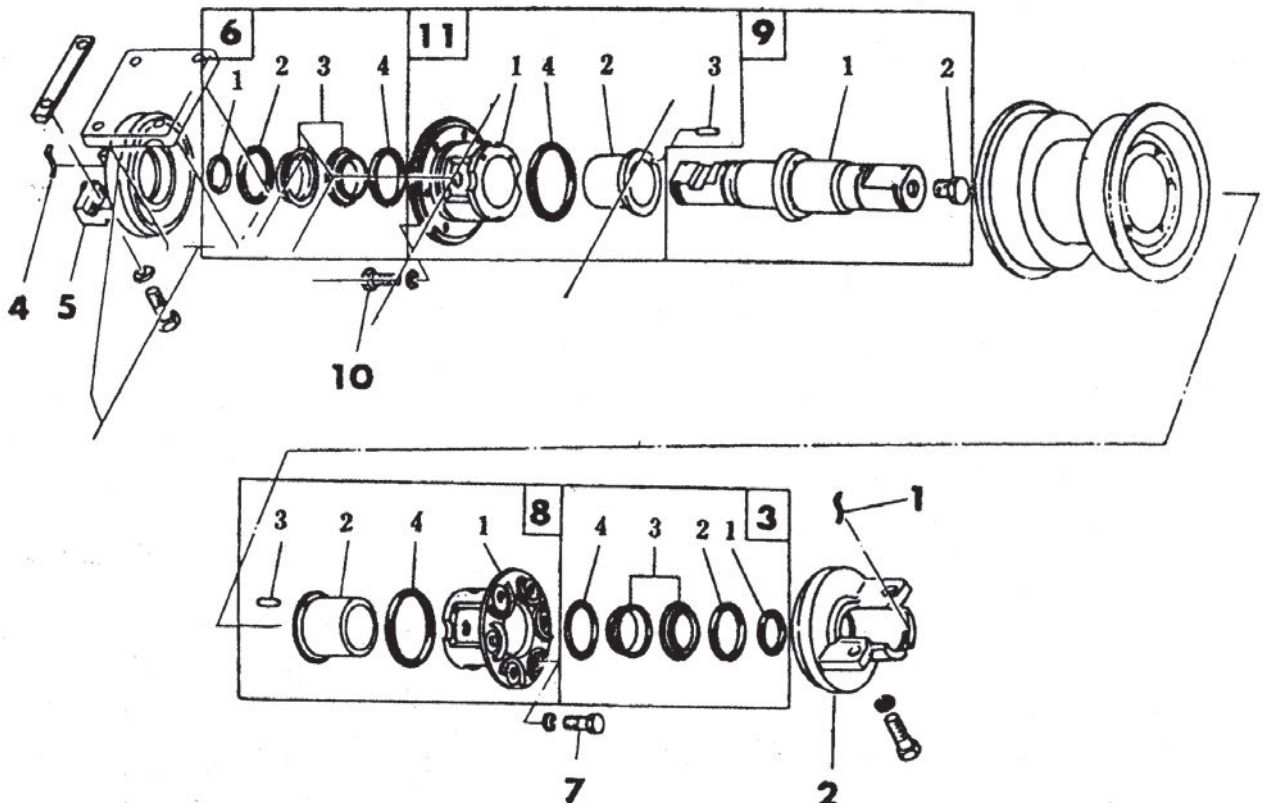
(1) Open the tracks, and detach each track-frame group from the chassis. Place the removed track-frame group upside down on the floor.

(2) Remove the bolts (1) and remove guard (2) Remove each track roller assembly from the track frame by removing its securing bolts (3).



## DISASSEMBLING ETC.

### C. Disassembling




(The parts are enumerated in the order of sequence of removal)

**Track Rollers**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | Ring | 4. | Ring | 7. | Bolt | 9-2. | Plus |
| 2. | Collar | 5. | Collar | 8-1. | Bush | 10. | Bolt |
| 3-1. | "O" Ting | 6-1. | "O" ring | 8-2. | Bush | 11-1. | Bush |
| 3-2. | "O" ring | 6-2. | "O" ring | 8-3. | Roll pin | 11-2. | Bush |
| 3-3. | Seal ring | 6-3. | Seal ring | 8-4. | "O" ring | 11-3. | Roll pin |
| 3-4. | "O" ring | 6-4. | "O" ring | 9-1. | Shaft | 11-4. | "O" ring |

### D. Cleaning inspection

(1) Check the wear of .each track roller by measuring roller O.D. at the riding faces and flange thickness.

(2) Inspect the track roller shaft for damage, and check its run out (deflection).

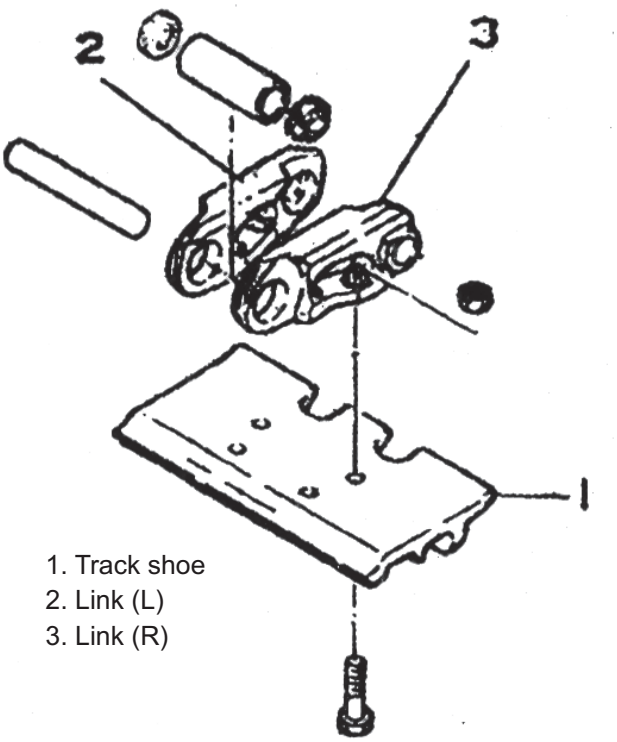
(3) Measure shaft O.D., bush I.D. and thickness of the centre flange (of the shaft) to determine the amount of wear. Clean the shaft and roller, and clear the oil passage through shaft with compressed air.

(4) Inspect roller-shaft collars for damage.

### E. Re-Assembling and Re-Mounting

Reverse the removal and disassembling procedures outlined above. Use the press to install the bushes in the roller as outlined for carrier rollers.

# TRACKS




1. Track shoe
2. Link (L)
3. Link (R)

## A. Description

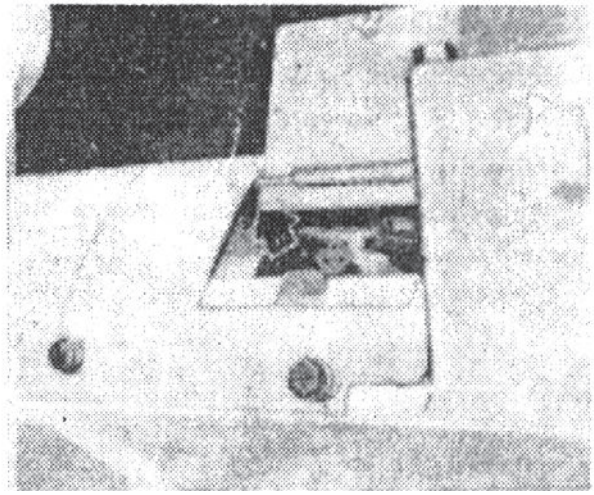
A Single loop of track is composed of 38 segments. It is built up type.

The built-up segment consists of a shoe, two parallel-links, a pin and a bush. The leading ends of two parallel links for each segment are press-fitted on the bush and the trailing ends of the two links of the preceding segment are press-fitted on the pin inserted through that bush, such that, in the end-to-end connection of two segments in a row, each end of the pin extends through two overlapped link ends. The shoe is bolted to the two parallel links to form a complete segment. A dust seal is fitted to each end of the bush in place in order to keep foreign matters off the clearance between pin and bush. Two segments in each track chain are provided with master pins, which are special pins designed for easier installation and removal. The loop of track is to be made (closed) or unmade (opened) by inserting or withdrawing these pins. Shoes are available in different types in regard to the grouser. The most commonly used shoes are single-grouser and semi-double-grouser shoes.

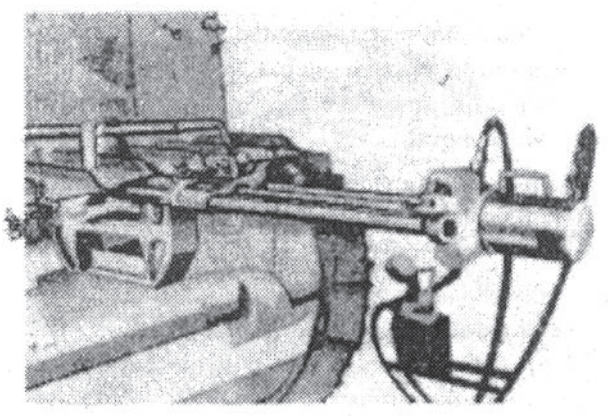
## B. Removal

(1) Removal plug to relieve the pressure (grease) in the grease cylinder in order to slacken the track chain.

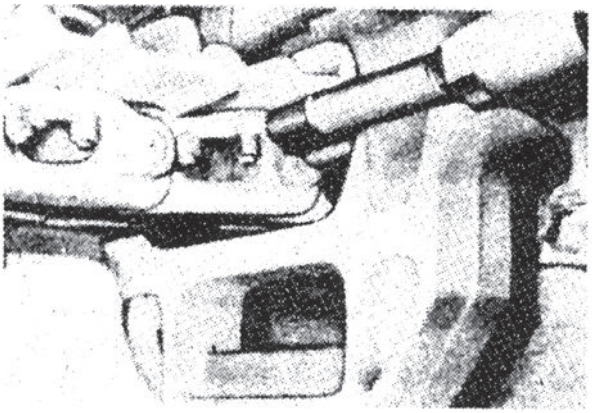
NOTE : If no grease bleeds out, drive the machine back and forth with jerk. This will force some grease out and slacken the track chains.

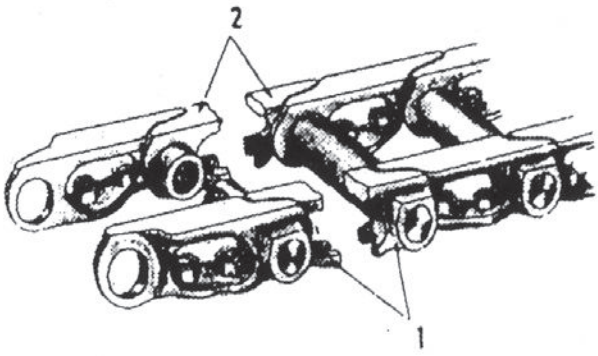


(2) Using a hydraulic cylinder, force the master pin out to disconnect the chain there. After both track chains have been opened, drive the machine backward to lay the tracks down on the floor.



## DISASSEMBLING ETC.



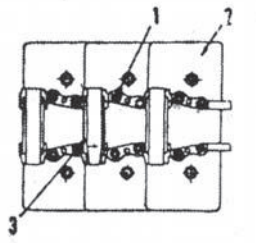



(3) Where the existing tracks are to be replaced with another set of tracks, lay new tracks on the floor in line with the old tracks to be replaced, to form extensions and drive the machine over to the new tracks.

**C. Disassembling**

(1) Remove shoe bolts (1) and remove shoe (2). Repeat this process to remove all shoes.

(2) Using the press, force out one pin after another, starting from the end where master bush (3) is located.




NOTES:

(1) Before pushing each pin out, make sure it will slide out without galling the bore in the link. If the pin in place is noted to have stepped wear indication, smoothen the worn surface to insure easy removal.

(2) If press equipment for disassembling tracks is not available, the track may be cut with a cutting torch to remove any portion of the track for renewal.

The flame-cutting procedure is as follows :

(i) Cut the pair of links in the middle. (This produces four half links.)

(ii) Remove a 15-cm long mid-portion of each bush and the pin by flame-cutting.

(iii) To remove the half pin from the preceding link, apply flame to the embossed end of the link and drive the half pin out.

(iv) Remove other half links (1) & (2) from the following links.

(v) When connecting new links to take the place of the pair removed by flame cutting, be sure to use dust seals at both ends of each new bush.

**D. Inspection**

(1) Inspect each track shoe for cracks or wear of its grouser and ground-bearing face.

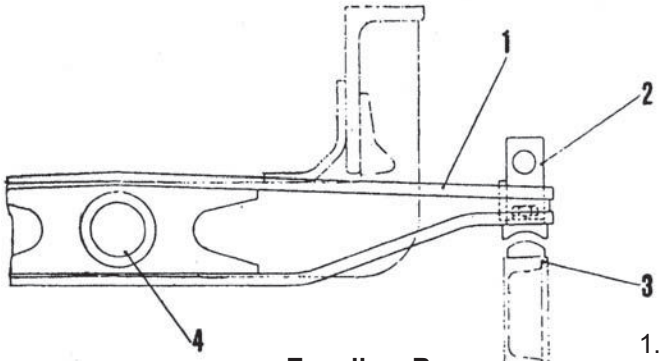
(2) Inspect the links, bushes and dust seals for wear, and check the link height and bush O.D. Also check the overall stretch, if any, in each track chain.

(3) Check the bolts, for tightness. Replace exclusively worn bolts.

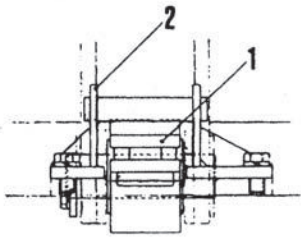
**E. Re-Assembling**

Reverse the disassembling procedure. Apply oil to bushes and pins before press-fitting them into links.

# SUSPENSION




Equalizer Bar




1. Equalizer bar
2. Bracket
3. Main frame
4. Centre pivot pin

## A. Description

The rear end of the chassis is rigidly supported on the track frames with sprocket shafts, but the front end is suspended, that is, freely supported. "The front-end suspension is formed with the equalizer bar, whose centre point is supported through a pin on the chassis and whose ends are supported and held by brackets built on the track frames. This arrangement allows the forward part of each track frame to move vertically, independent of the other track frame, without so much raising or lowering the chassis. If one of the tracks rides over an obstruction on the ground, that track frame will turn up around the sprocket shaft and the equalizer bar will rock on its pivot, thereby transferring some of the load to the other track frame. This is an equalizing action calculated to prevent occurrence of excessive stress in the load carrying members. An added advantage of this. arrangement is that the rolling and pitching motion of the chassis is reduced for increased operator's riding comfort.

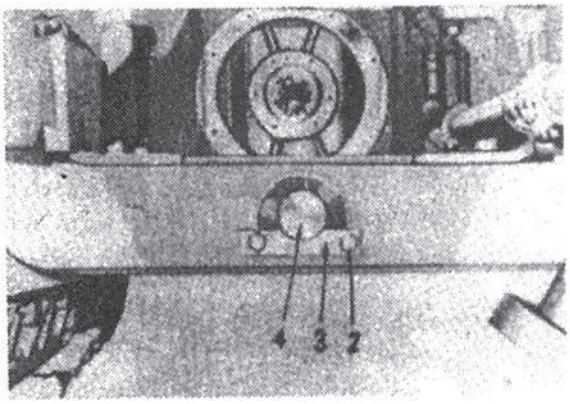
## B. Removal

(1) Remove the underguards below engine and transmission.

(2) Open the tracks, and separate one track-frame group from the chassis. (Refer to TRACK RE MOVAL and REMOVAL OF TRACK-FRAME GROUPS.)

Block up the main frame under the radiator to hold the front end raised above the floor and thereby permit the equalizer bar to rock in place.

(3) Suspend one end of equalizer bar (I) with a sling; remove bolts (2) ; remove 'plate key (3); and draw out pivot pin (4). Lower the hanging end of equalizer bar and carry it out of the machine' for removal.




# INSPECTION AND REMOUNTING

## C. Inspection

(1) Inspect equalizer bar for cracks, damage or any signs of fatigue.

(2) Check the bush (in which the pivot pin is held) for wear,

(3) Inspect the resting end face at each end of equalizer bar for wear or galling.

## D. Re-Mounting

Reverse the removal procedure to re-mount the equalizer bar. Note that the pivot pin is to be inserted into the bush from rear side.

**SECTION : 09**

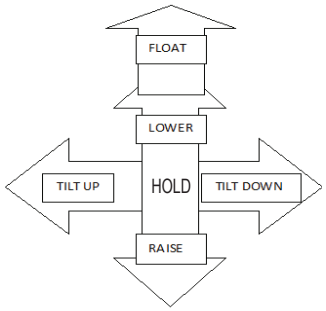
# HYDRAULIC CONTROL SYSTEM

## INDEX


1. Hydraulic System ..... 09-01
2. Hydraulic Circuit Diagram for BD50.....09-02
3. Hydraulic Oil Flow Schematic.....09-03
4. Hydraulic Oil Filter, Filler Etc.....09-04
5. Hydraulic Pump.....09-05
6. Hydraulic Oil Lines.....09-06
7. Hydraulic Control Valve.....09-07
8. Hydraulic Cylinders.....09-011

## HYDRAULIC SYSTEM

Hydraulic power for operating the dozer blade is developed by hydraulic pump. The hydraulic pump is driven by engine through PTO gear. The pressurised oil delivered by the pump is admitted into hydraulic cylinders through hydraulic direction control valve. The hydraulic direction control valve has two spools such as blade lift spool and tilt spool. The blade lift spool has four positions designated as Blade Raise, Hold, Lower and Float. The Blade tilt spool has three positions, designated as Blade tilt Up, Hold and Tilt down. The Hydraulic Control valve has built in Primary Relief valve to control maximum operating system pressure of 140kg/cm2. The Blade lift spool has built-in Secondary relief with anti cavitations valve on both ports set to 160kg/cm2. These secondary relief cum anti cavitations valves protect the lift cylinder circuit system from cavitations and controls maximum operating pressure of 160kg/cm2. The hydraulic control valve mounted on RH fender, in front of operator right side. The oil discharged from the pump passed through the control valve to tank through the return line filter. When blade raise, lower, float and tilting operation is performed oil flows to respective cylinders and returns to the hyd tank via control valve and filter.

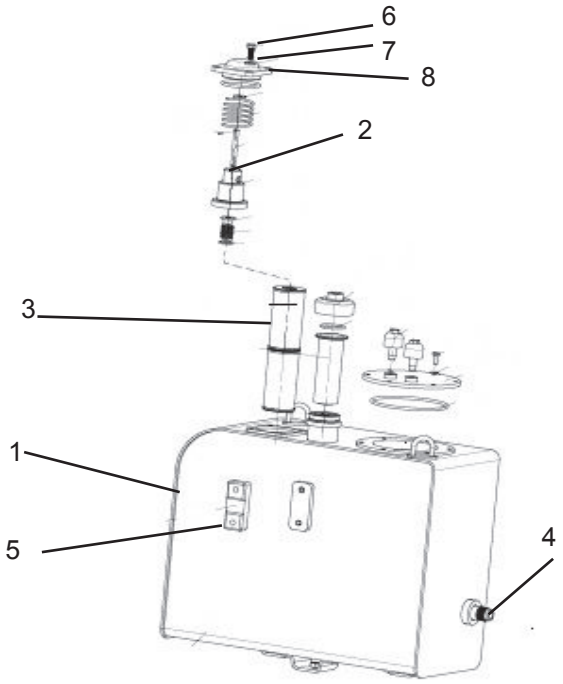



CONTROL LEVER POSITIONS

The hydraulic control valve spools are actuated by hydraulic control lever mounted in front of operator right hand side. The lever pushed forward away from operator, makes blade lower and further forward blade will be in float condition and lever struck in float detent position, lever pulled back towards operator, the blade lifts above ground. The lever operation in towards LH make blade tilt UP and towards RH blade tilt down. The control valve lever operation should be as shown above.

The hydraulic tank is located on the right hand side of the operator. The oil filter is fitted inside the tank and equipped with a strainer and a dip stick, a sight gauge is provided to maintain the oil level in the hydraulic tank.

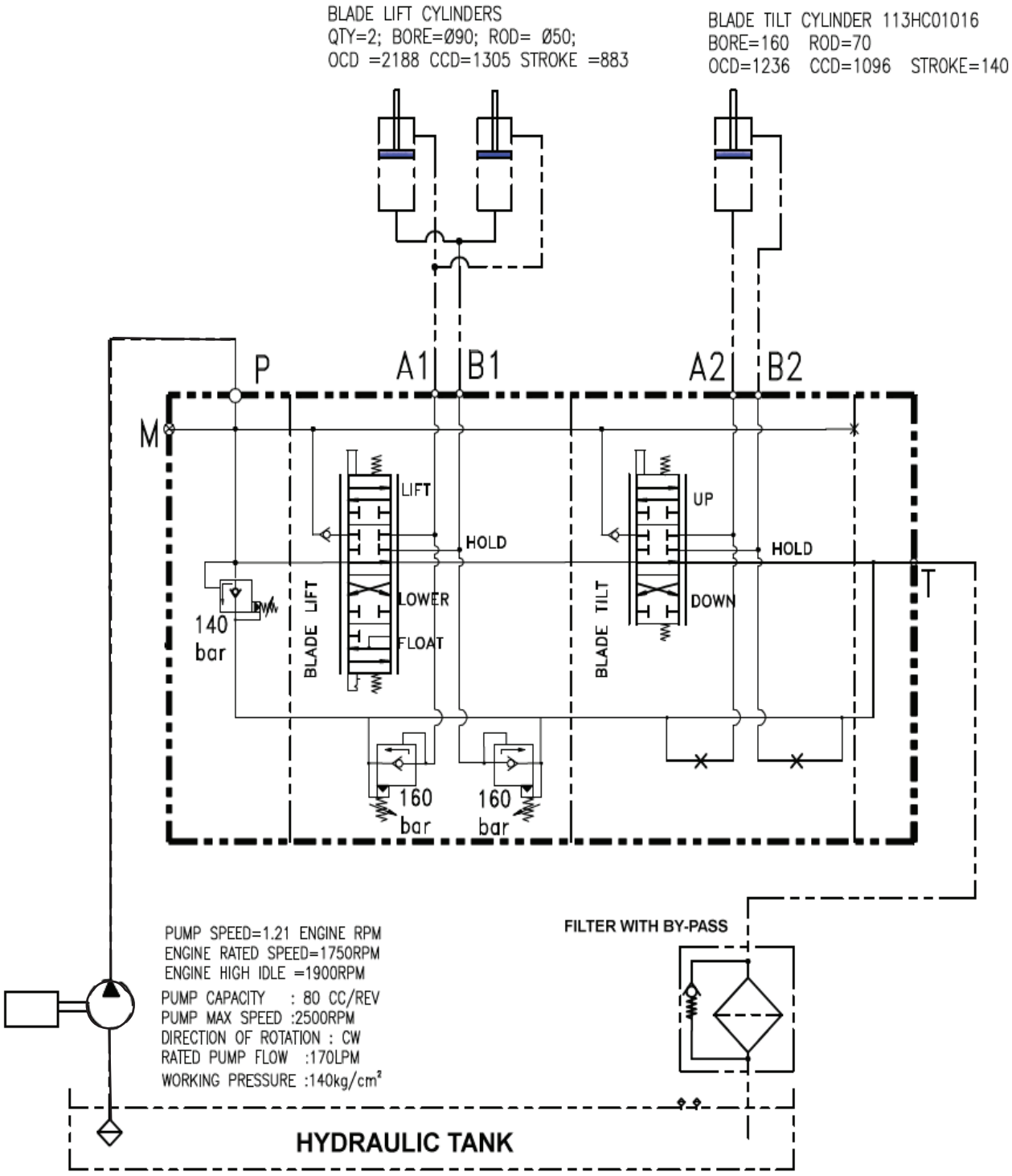
1. Hydraulic Tank
2. Safety valve
3. Filter element
4. Return line
5. Oil level Sight Gauge
6. Screw
7. Washer
8. Cover




**HYDRAULIC TANK**

# HYDRAULIC CIRCUIT DIAGRAM FOR BD50

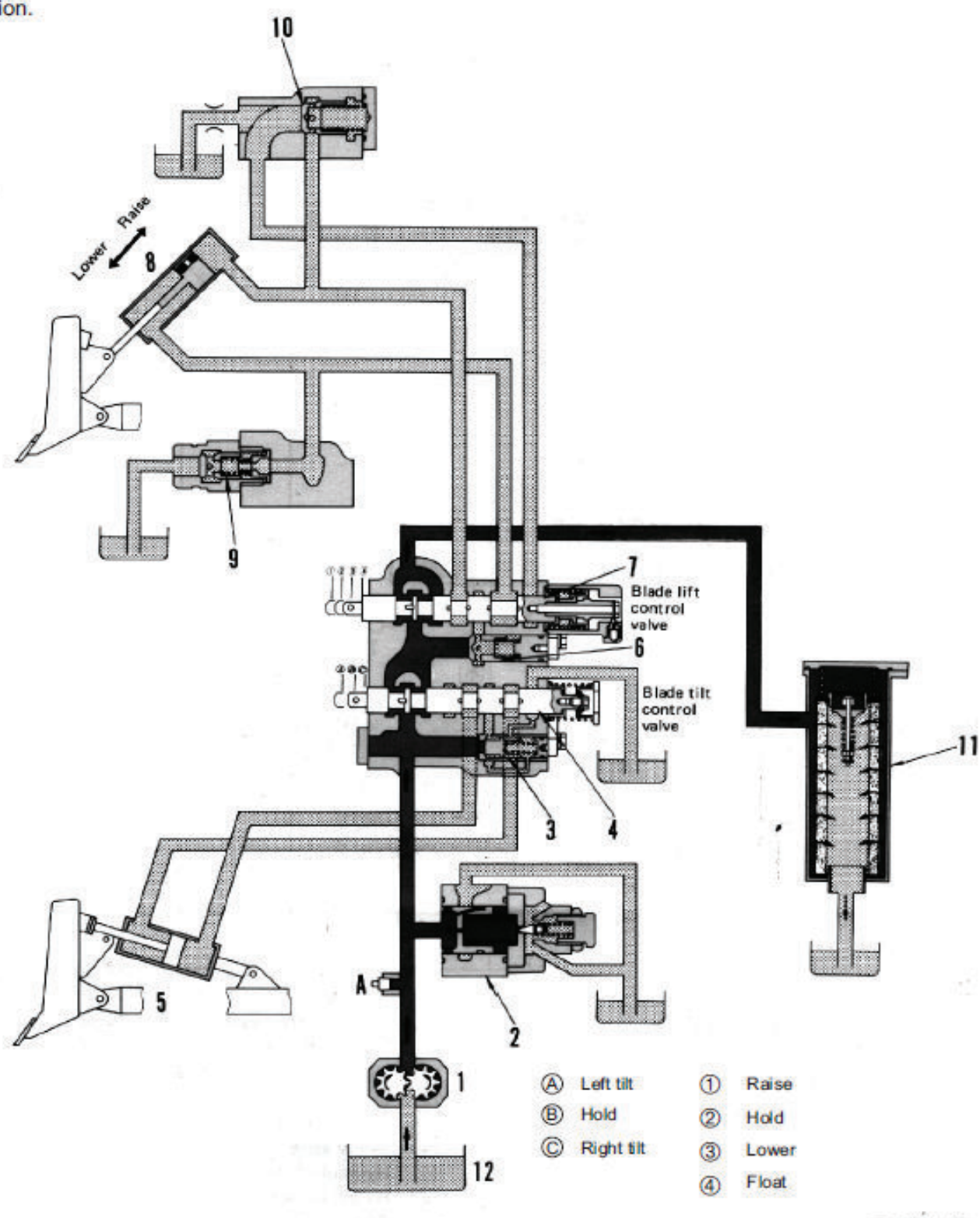
## STRAIGHT TILT DOZER ATTACHMENT



## HYDRAULIC CONTROL SYSTEM

- **Straight-tiltdozer**

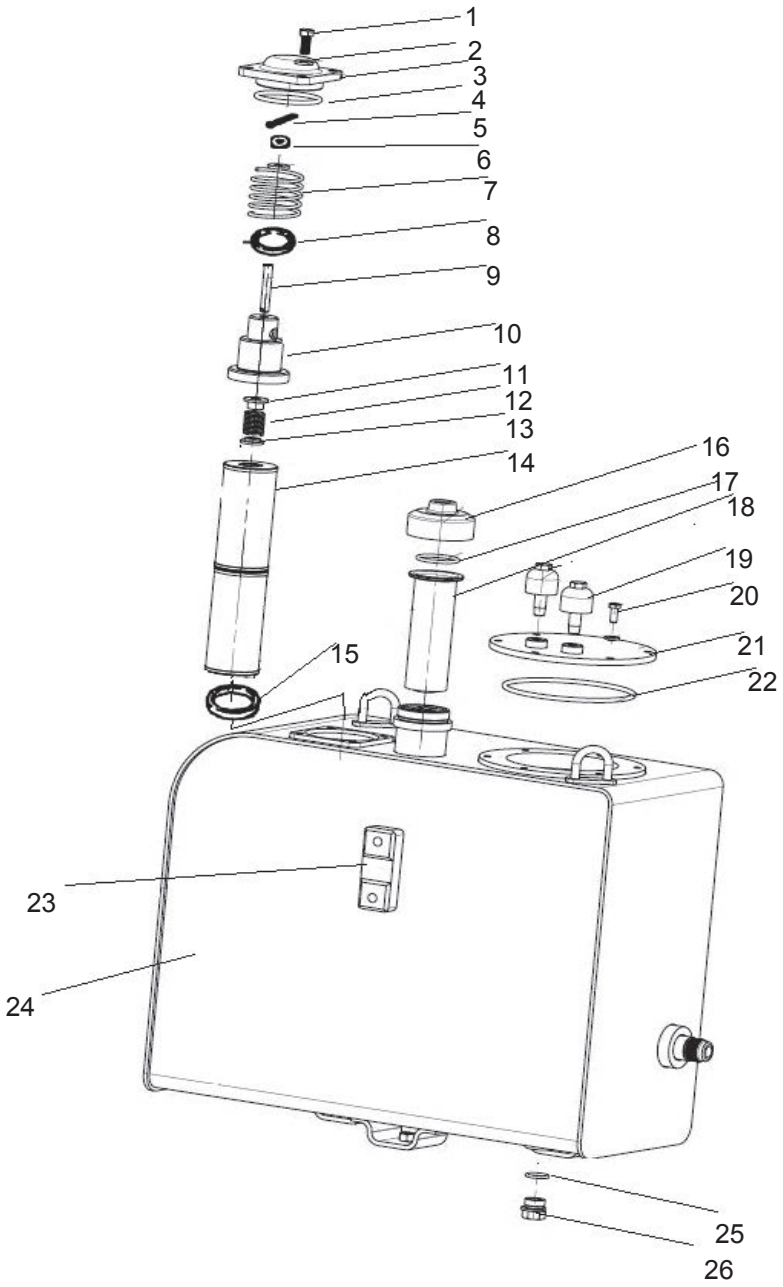
Engine running, two blade control levers in "HOLD" position.



# HYDRAULIC OIL FILTER, FILLER Etc.

## DISASSEMBLING AND RE-ASSEMBLING

## HYDRAULIC TANK, OIL FILTER, FILLER etc.




1.Screw
2.Washer
3. Cover
4.O.Ring
5.Cotter pin
6.Plate
7.Spring
8.Spacer
9.Rod
10.Seat
11.Valve
12.Spring
13. Valve
14. Filter Element
15. Support
16. Filler Cap
17. O-ring
18. Filler Strainer
19. Breather
20. Screw
21. Inspection cover
22. O-ring
23. Oil Lever Indicator
24. Hydraulic oil tank
25. O-ring
26. Drain Plug

## CLEANING AND INSPECTION

(1) Wash the filter element and clean.

(2) Inspect the safety valve internal parts for rusting, and examine the sliding surface and seating face of the valve piston or disc for any signs of irregular contact.

(3) Check the filter cover plate 'O' ring for any damage. Replace if necessary.

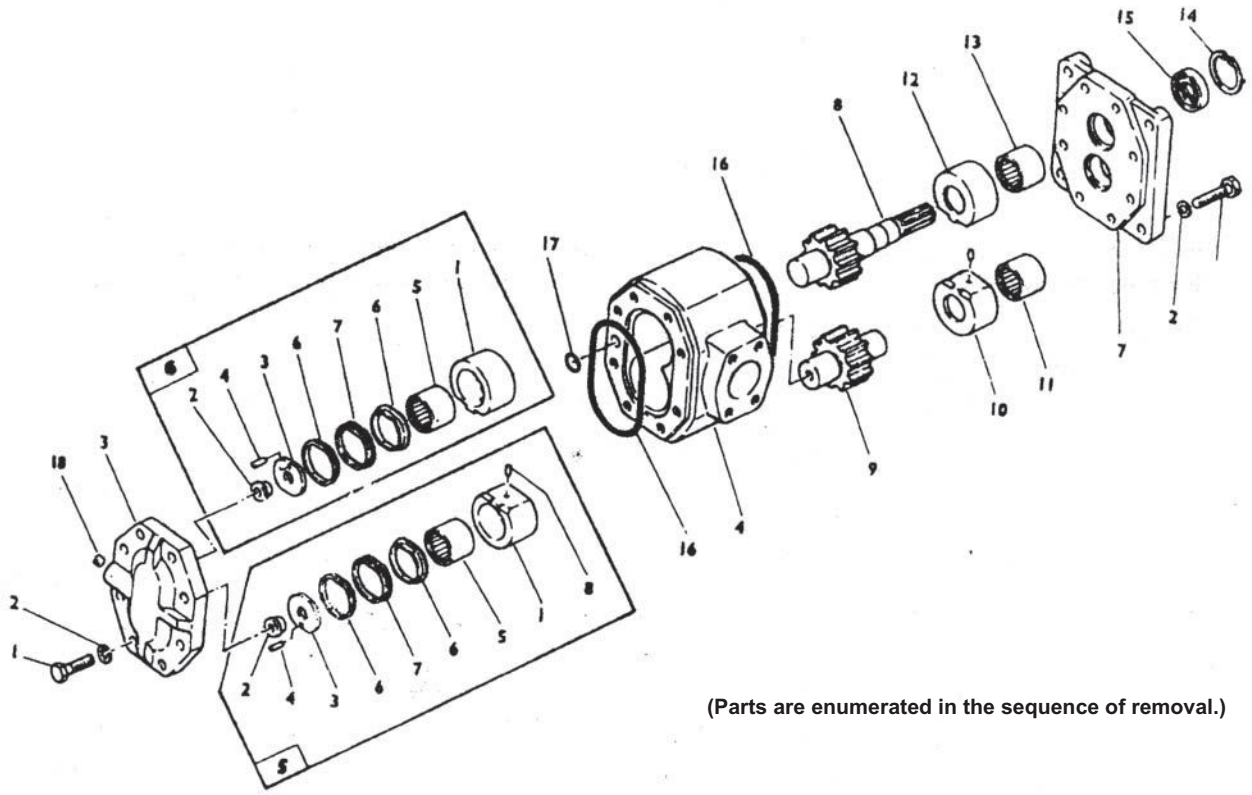
## RE-ASSEMBLING

Reverse the disassembling procedure, and observe the following instructions.

(1) Before putting back the filter cover plate, grease the "O'' ring and safety valve assembly.

2. Assemble the serviced filter with the components in sequence as shown in the fig. carefully before fixing the cover screws.

## HYDRAULIC PUMP



**(Parts are enumerated in the sequence of removal.)**

1. Bolt
2. Spring Washer
3. Cover housing
4. Housing Pump
5-1. Bushing
5-2. Collar
5-3. Plate Seal
5-4. Pin
5-5. Bearing needle
5-6. Ring, back up
5-7. 'U' Ring
6-1. Bushing
6-2. Collar
6-3. Plate Seal
6-4. Pin
6-5. Bearing needle
6-6. Ring, back up
6-7. 'U' Ring
7. Bracket mounting
8. Gear drive
9. Gear driven
10. Bushing
11. Bearing needle
12. Bushing
13. Bearing needle
14. Ring snap
15. Seal Oil
16. 'O' Ring
17. 'O' Ring
18. Plug

The hydraulic pump, which is a gear pump located on the lower front part of the engine and driven by engine crankshaft through gears, draws oil from the hydraulic oil tank and delivers pressurized oil to the control valve Located on the RH fender, in front of operator seat.

The pump is a precision-machined device and requires a high degree of skill and experience to overrhaul. It is recommended that the pump should be overhauled only by the specialist at a BEML authorized service shop.

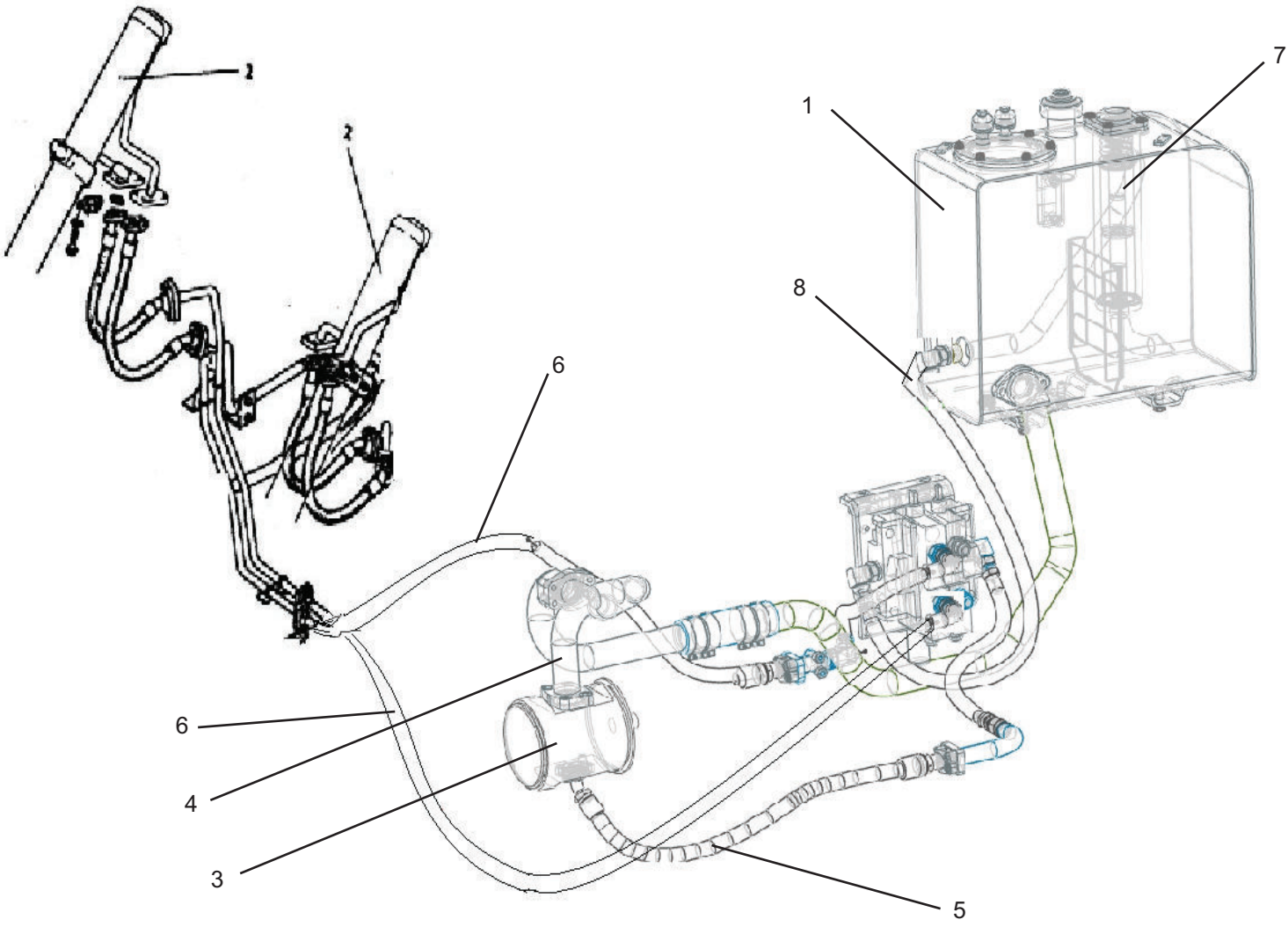
A built-in self-aligning feature is included in the pump design for extended service life and reliable performance : the discharge pressure is utilized to secure the minimum journal clearance in the bushes on both sides of pump gears and to hold them in correct alignment at all times regardless of the progressive increase of running clearance due to normal wear.

The details of the parts of the pump shown in figure.

# HYDRAULIC OIL LINES

## HYDRAULIC OIL LINES

The hydraulic oil lines between hydraulic pump, tank and cylinders are indicated in the figure below.




**Hydraulic Oil Line**

1. Hydraulic Tank
2. Hydraulic Cylinders
3. Pump Hydraulic
4. Pump Inlet line
5. Pump outlet line
6. Piping to Blade Lift Hydraulic Cylinders
7. Oil filter
8. Control Valve to Tank line

# HYDRAULIC CONTROL VALVE

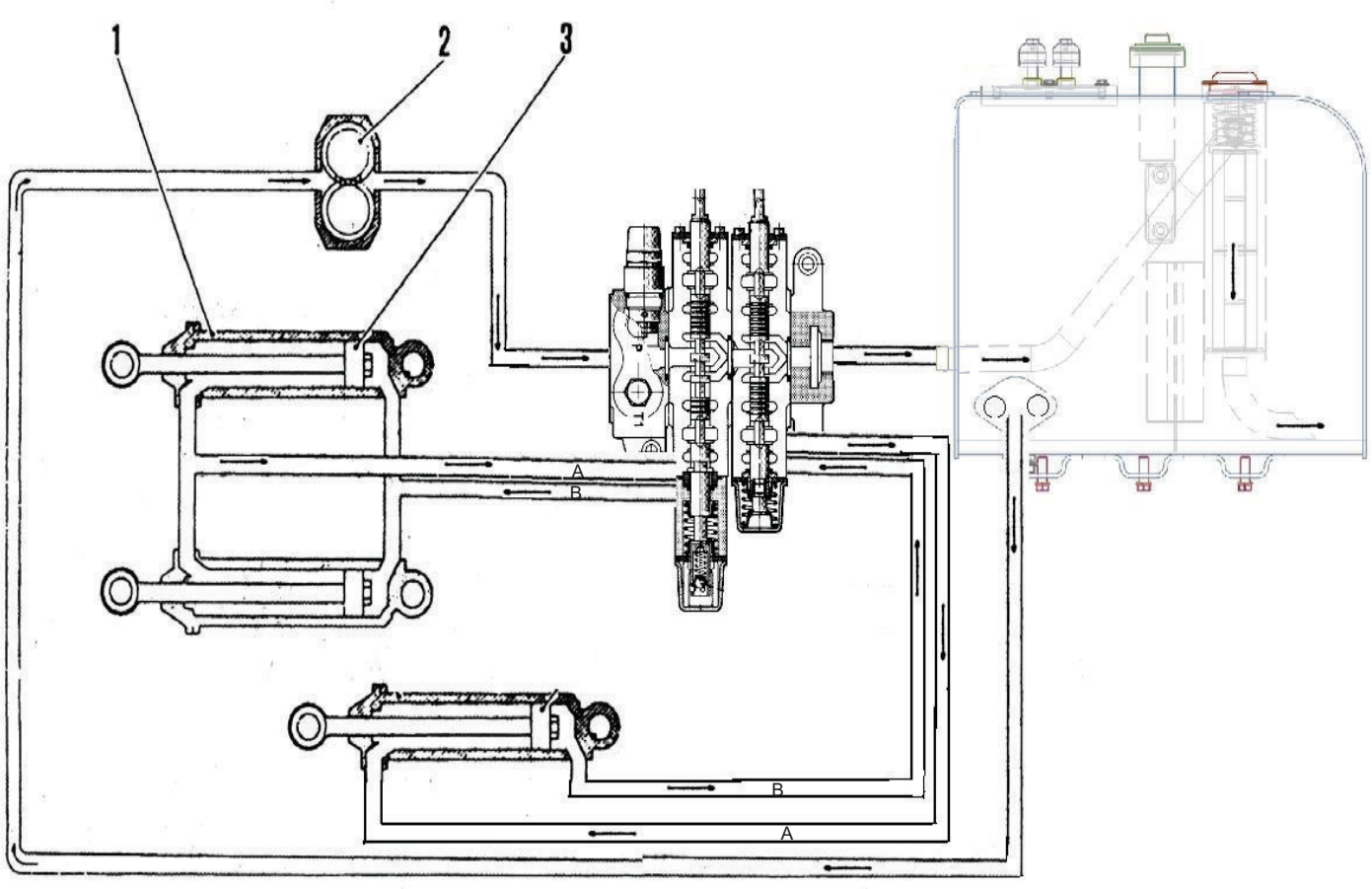
## CONTROL VALVE

The control valve is a two spool type, in which spool is moved by the control lever through a precisely-machined bore to close and open a particular oil port as selected and thus passes the high-pressure oil through respective oil lines to the hydraulic cylinders.

The control lever, located by the side of operators seat to be moved from its neutral position (HOLD position) into RAISE, LOWER, FLOAT or TILT position for raising, lowering or freeing the dozer blade.
The spool is spring loaded which causes the lever to return to HOLD position automatically, when the lever is released.

With the control lever in HOLD position, the oil in the hydraulic cylinders is trapped to hold the dozer blade at its current position.

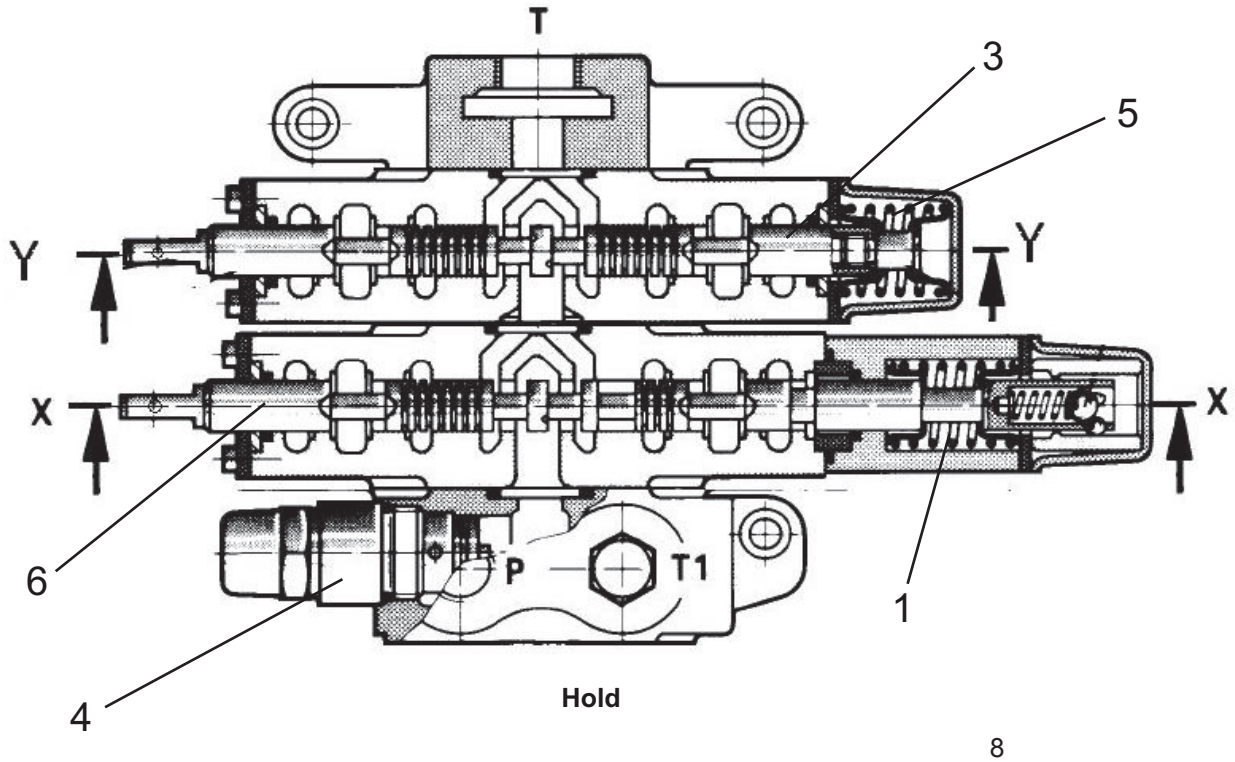
Moving the control lever into FLOAT position connects all internal passages of the hydraulic cylinders to the low-pressure side of the system, so that the cylinders cease to hold the dozer blade.



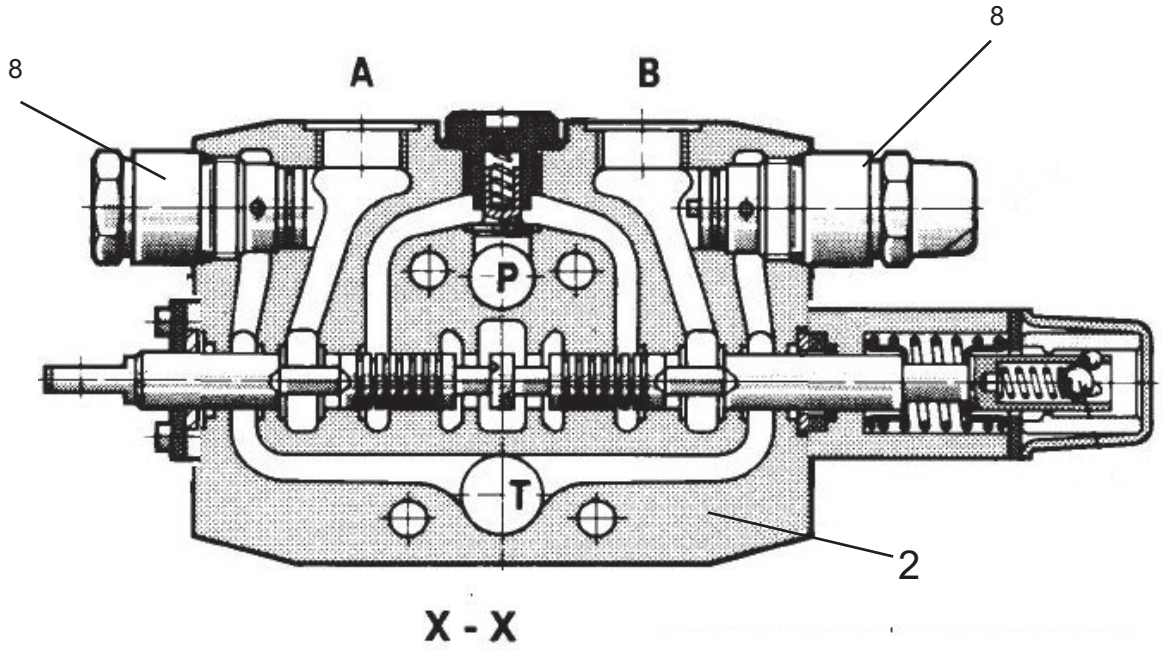

**Oil Lines**

1.Blade Lift Cylinders 2. Hydraulic pump 3 Hydraulic cylinder Piston

# HYDRAULIC CONTROL VALVE




**Hold**

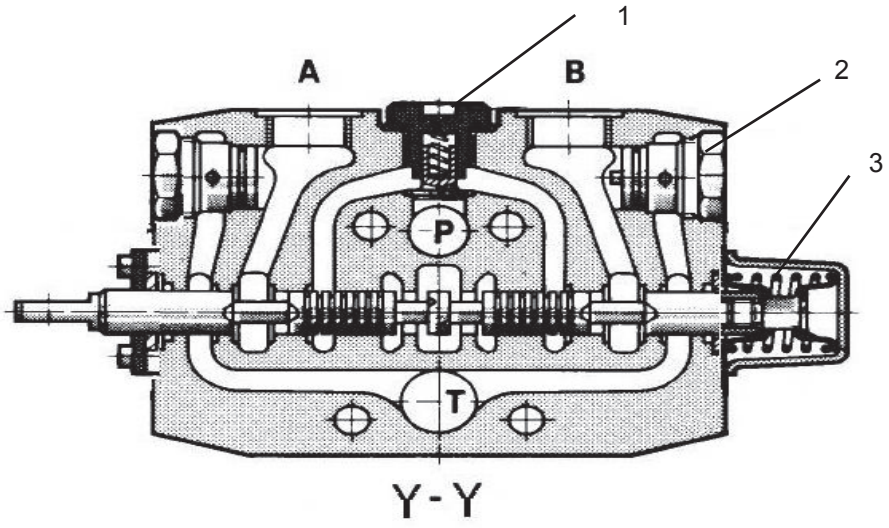



**X - X**

1. Spring
2. Valve housing
3 Blade Spool tilt
4. main relief valve
5. Spring
6.Blade Spool lift
7. Check vave
8.. Secondary reilef valve with anti cavitation

The spool position within the bore is illustrated above for HOLD, RAISE, LOWER and FLOAT. Included in the control valve assembly are; a relief valve for limiting the supply pressure to 140 $kg/cm^2$ and a suction valve for allowing the cylinders to suck oil in during the lowering of the dozer blade and thereby prevent occurrence of vacuum on top side of the piston in each cylinder.

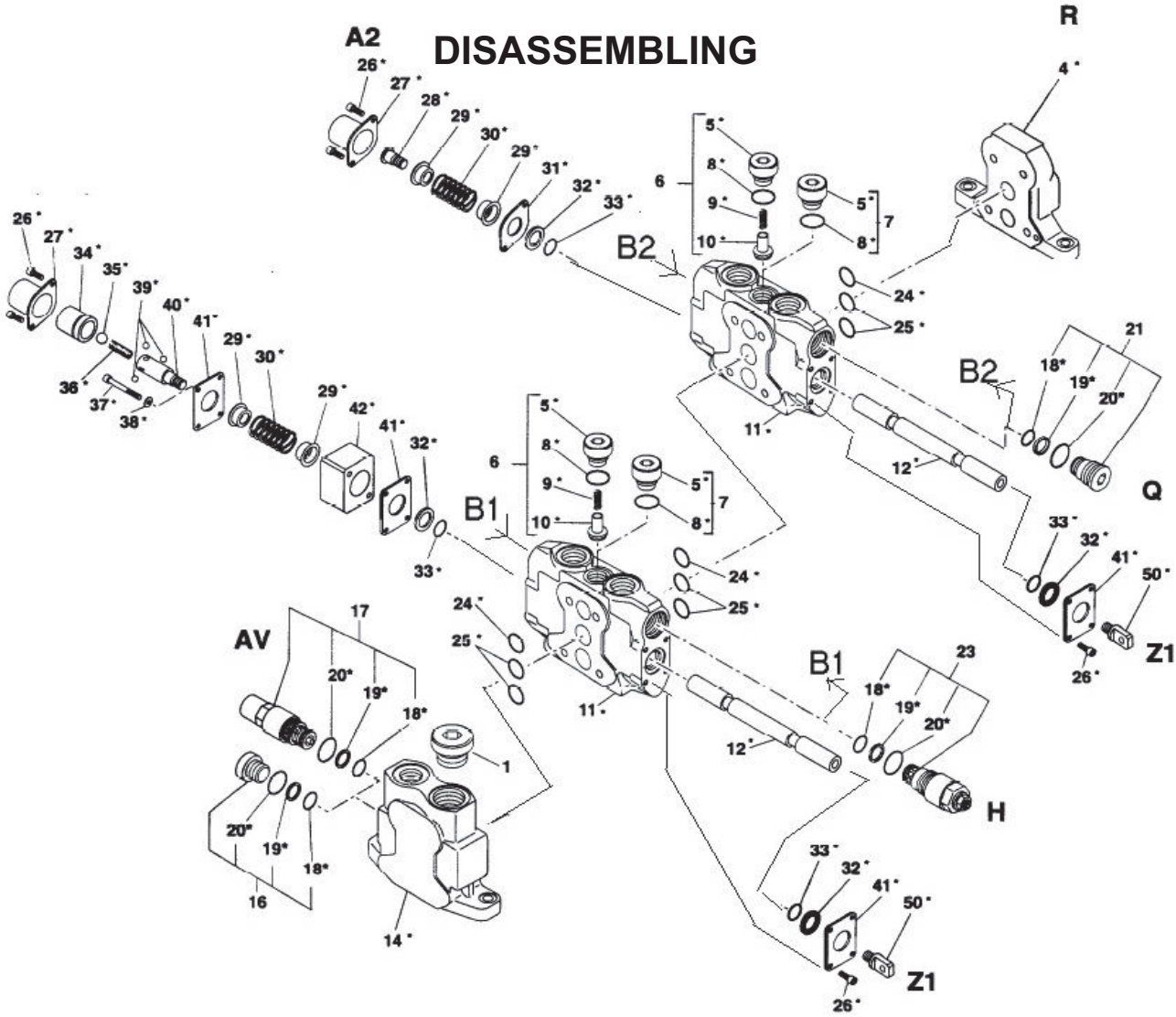
# HYDRAULIC CONTROL VALVE




1. Load hold check valve
2. Plug
3. Spring spool return

The spool position within the bore is illustrated above for TILT. Included in the control valve assembl.

# HYDRAULIC CONTROL VALVE

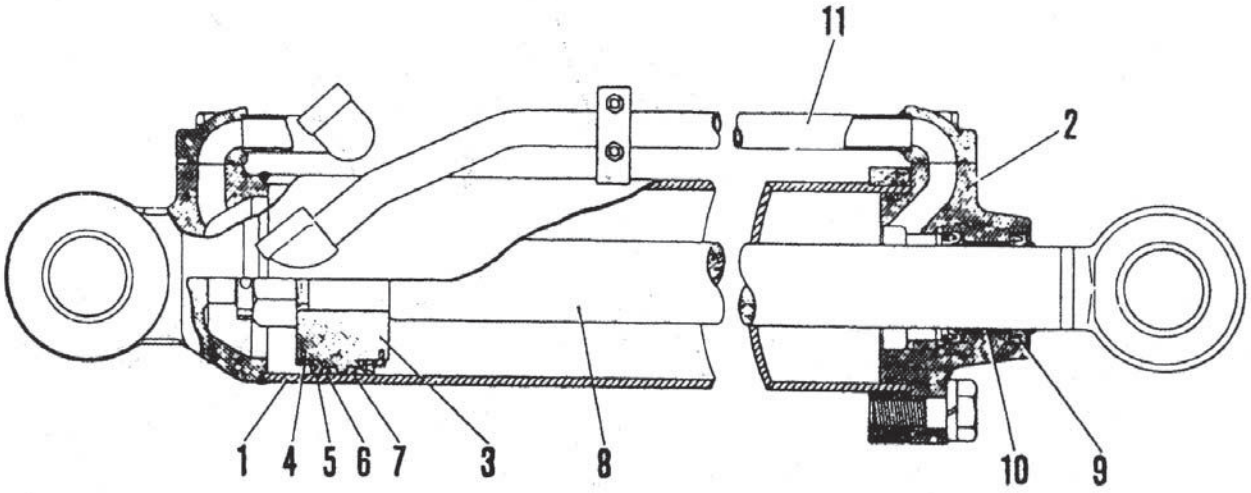



**Control Valve**

1 SCREW PLUG 1
4 OUTPUT ELEMENT 1
5 SCREW PLUG 3
6 NON RETURN VALVE 2
7 PLUG 2
8 O RING 3
9 SPRING 2
10 POPPET 2
11 DIRECTIONAL VALVE ELE 2
12 SPOOL 2
14 INLET ELEMENT 1
16 SCREW PLUG 1
17 MAIN RELIEF VALVE 1
18 O RING 6
19 SEAL
20 O RING 6
21 O PLUG 2
23 PORT RELIEF VALVE 2
24 O RING 3
25 O RING 6
26 SCREW 12
27 COVER 2
28 ADAPTER 1
29 SPRING RETAINER 4
30 SPRING 2
31 FLANGE 2
32 WIPER RING 4
33 O RING 4
34 GUIDE BUSHING 1
35 BALL 1
36 SPRING 1
37 SCREW 4
38 WASHER 4
39 BALL 3
40 LOCKING PIN 1
41 FLANGE 4
42 SPACER 1
50 TONGUE 2

# HYDRAULIC CYLINDERS

## BLADE LIFT CYLINDERS




**Hydraulic Cylinder**

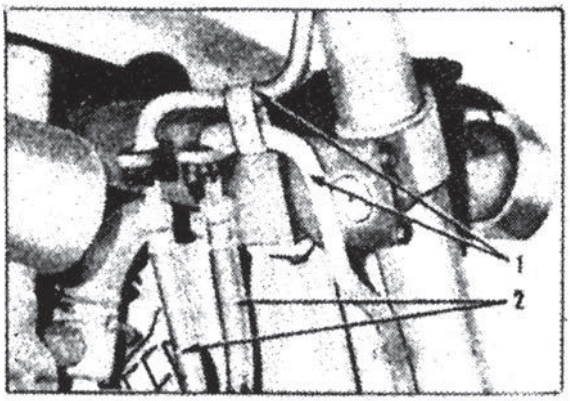
1. Cylinder
2. Cylinder cover
3. Piston
4. "U" ring retainer
5. "U" ring
6. Nylon
7. Piston ring
8. Piston rod
9. Oil seal
10. Bearing
11. Pipe

The two hydraulic cylinders are of double-acting type built rugged and durable. The piston reciprocates within the precisely-finished bore of the cylinder, and is fitted with piston rings and sealing rings which provide an oil-tight sliding contact with the bore of the cylinder.

The piston rod moving through the packed end bore is chrome-plated for increased resistance to abrasive wear.

## REMOVAL

(1) Disconnect flexible hoses (2) from the pipes (1) of each lift cylinder.




(3) insert pin (2) into pin hole (1) to hitch the cylinder in place to the frame. Lock the pin (2) with a cotter pin to prevent it from slipping off,

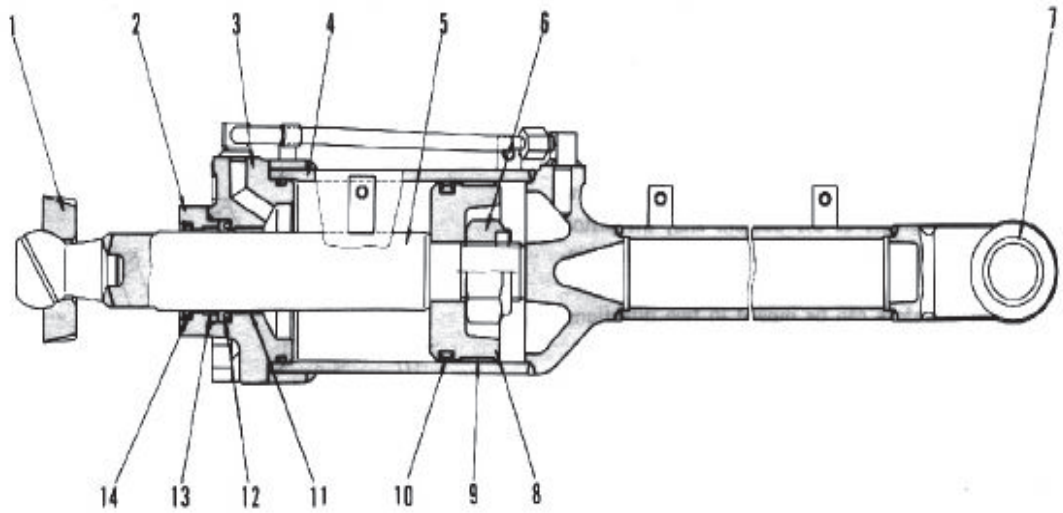
(2) Pull off cotter pin (1) ; draw out locking pin (2) ; and remove shaft (3) to disconnect the piston rod from the" side frames

(4) Loosen bolts (1) and remove cap (2).

(5) Hitch a lifting sling to the lift cylinder and carry it away in suspended condition.

## BLADE TILT CYLINDER

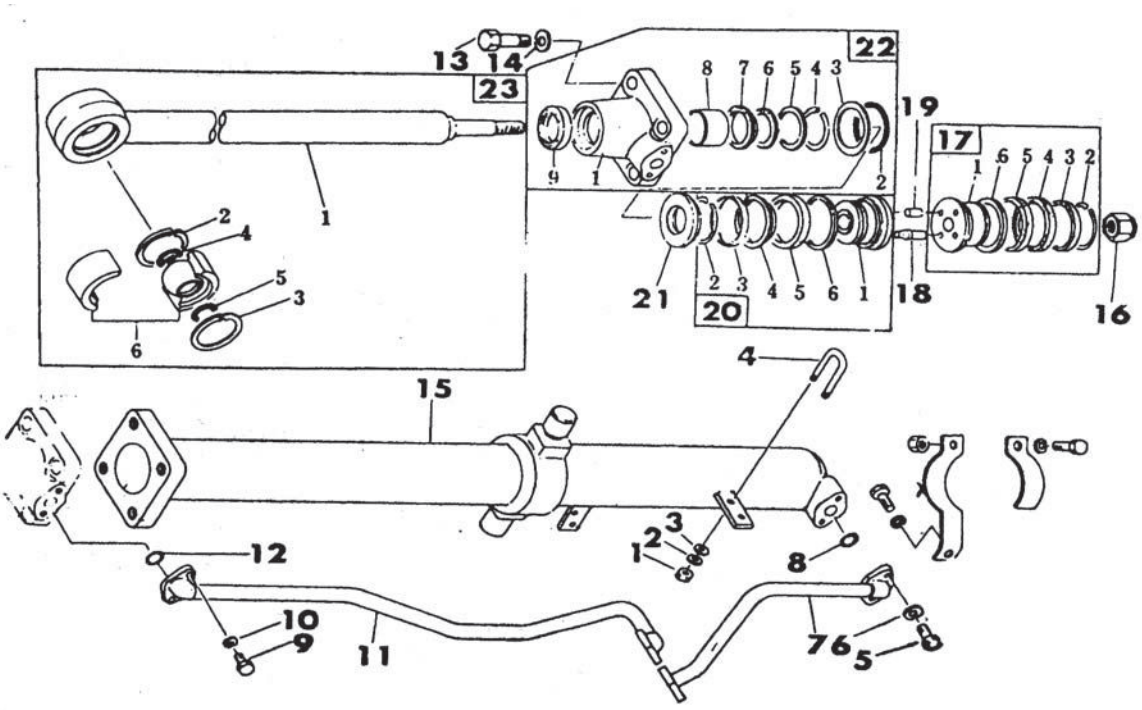
- **Straight-tiltdozer**




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

# HYDRAULIC CYLINDERS

## DISASSEMBLING




**(The parts are enumerated in the sequence of removal.)**

**Hydraulic Cylinder**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | Nut | 13. | Bolt | 20-1. | Piston | 22-6. | "U" ring |
| 2. | Spring washer | 14. | Spring washer | 20-2. | Stopper | 22-7. | Nylon heel |
| 3. | Washer | 15. | Cylinder | 20-3. | "U" ring holder | 22-8. | Bushing |
| 4. | Bolt | 16. | Nut | 20-4. | "U" ring | 22-9. | Wiper ring |
| 5. | Bolt | 17-1. | Piston | 20-5. | Nylon heel | 23-1. | Piston rod |
| 6. | Spring washer | 17-2. | Stopper | 20-6. | Piston ring | 23-2. | Snap ring |
| 7. | Tube | 17-3. | "U" ring holder | 21. | Spacer | 23-3. | Snap ring |
| 8. | "O" ring | 17-4. | "U" ring | 22-1. | Cylinder head | 23-4. | "O" ring |
| 9. | Bolt | 17-5. | Nylon heel | 22-2. | "O" ring | 23-5. | "O" ring |
| 10. | Spring washer | 17-6. | Piston ring | 22-3. | Ring | 23-6. | Bearing |
| 11. | Tube | 18. | Valve | 22-4. | Snap ring | | |
| 12. | "O" ring | 19. | Stopper | 22-5 | Packing | | |

## INSPECTION AND CLEANING

(1) Clean the cylinder bore, piston and piston rod.

(2) Inspect the piston, piston rod, and packings for wear or any damage.

(3) Check the cylinder bore for any abnormal wear or score marks.

## RE-ASSEMBLING

Instructions for re-assembling hydraulic cylinders are as follows:

(1) When fixing the piston to the rod, be sure to lock the securing nut by inserting a cotter pin through the nut hole and bending the pin legs around, Over the nut faces.

(2) Wet the piston with hydraulic oil before pushing it into the cylinder bore, and, just when the piston enters the bore, make sure the surfaces of "U" packing on the piston would not fold back.

# DOZER EQUIPMENT

**(WORK ATTACHMENT)**

## INDEX

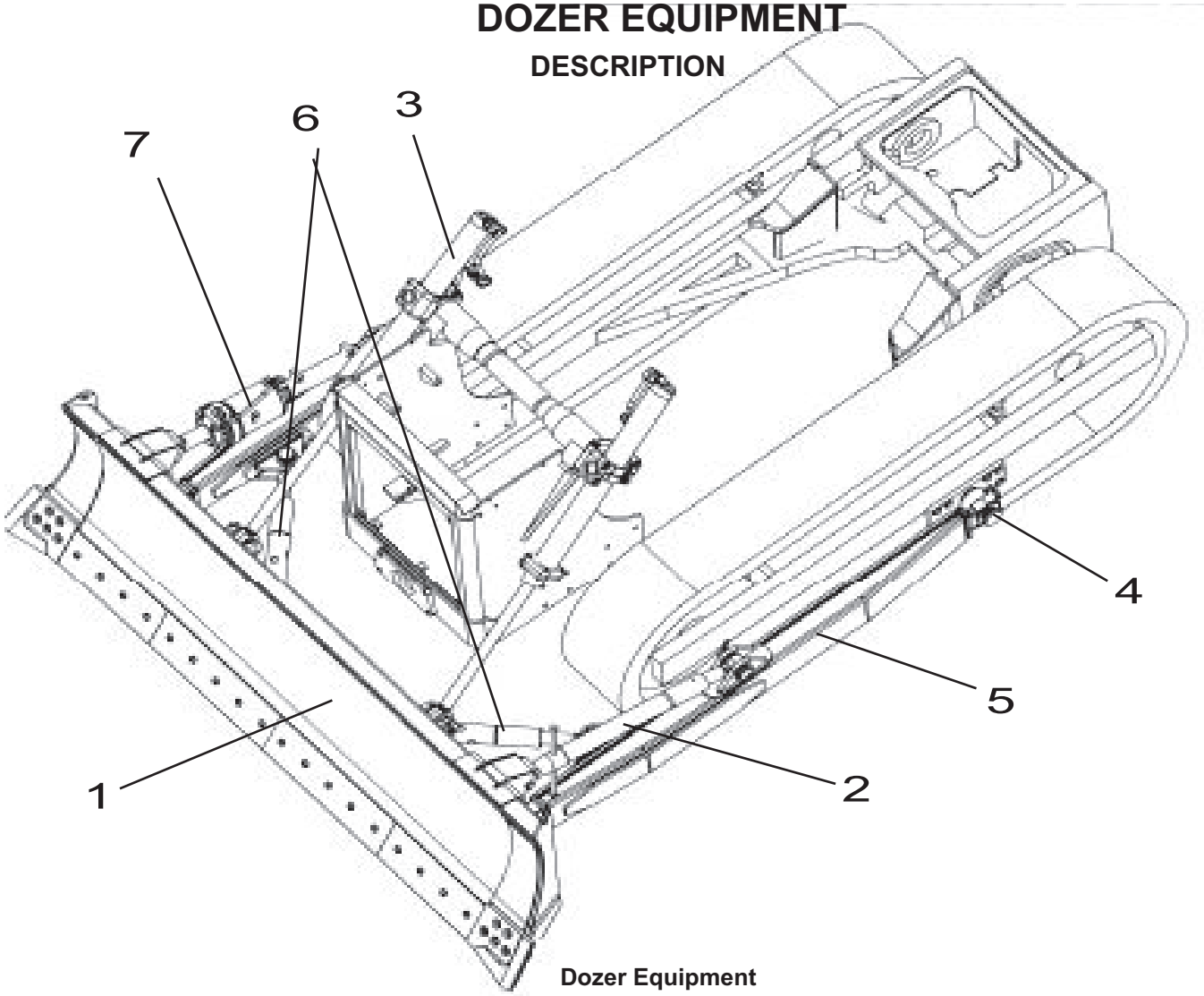
1. WORK EQUIPMENT .....10-01

2. STRAIGHT TILT DOZER.....10-02

3. HYDRAULIC SYSTEM TESTING AND ADJUSTING...10-03

## DOZER EQUIPMENT

### DESCRIPTION




**Dozer Equipment**

1. Dozer Blade
2. Brace
3. Hydraulic cylinder
4. Trunnion
5. Side frame
6. Side Brace
7. Tilt Cylinder

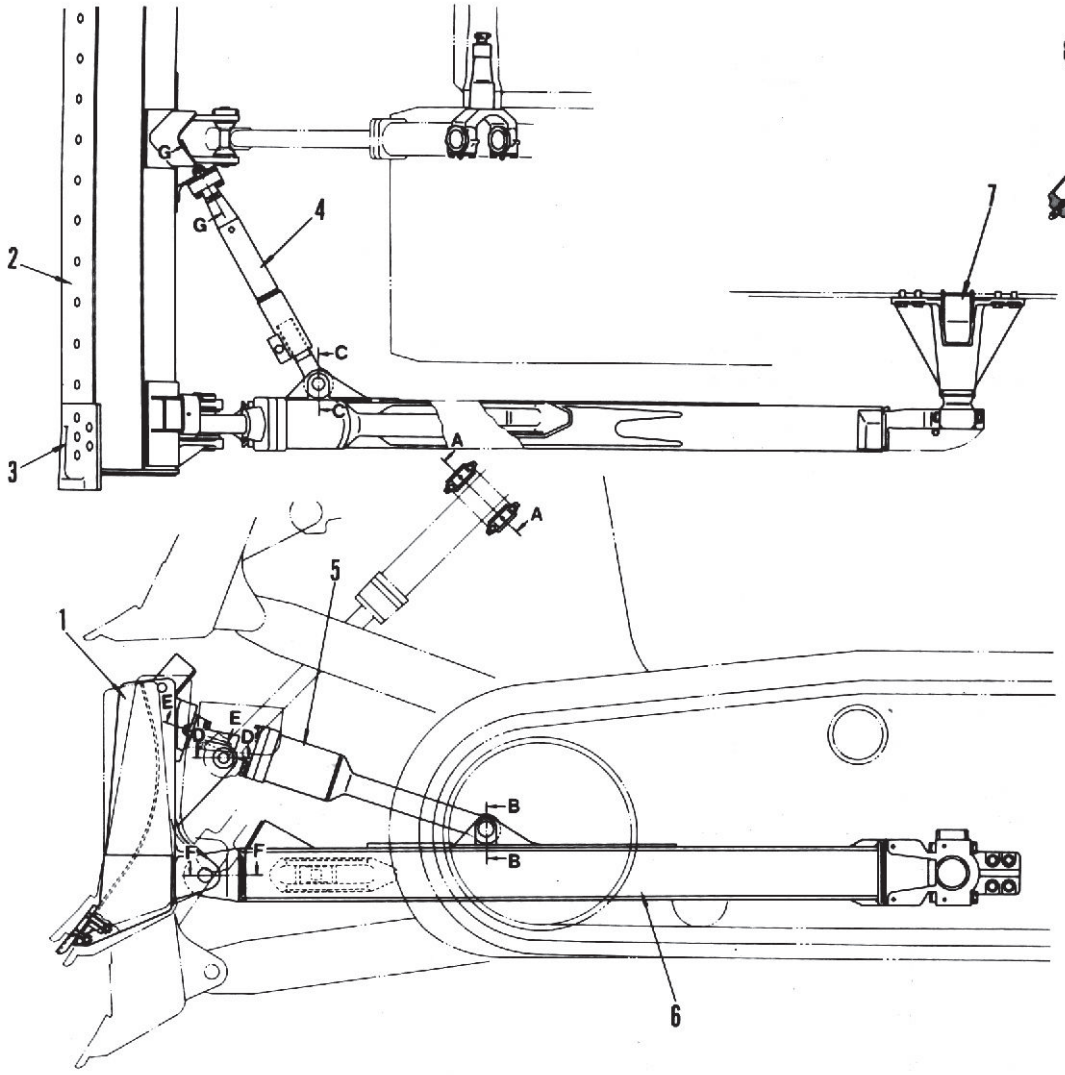
The straight tilt dozer which is a attachment on D50 Dozer consists of the blade (bowl), push arms, braces and Side frame.

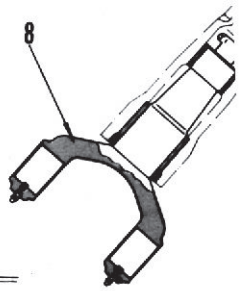
The blade is supported by the Side frame through arms, braces and centre shaft ; and the side frames are connected to the tractor by its bearing ends mounted on the trunnions (provided on track frames). All these are built-up components, fabricated with steel channels, castings and plates by welding. The blade is reinforced with webs, backing plates and an extra mass of metal given to each connecting point. Its cutting edge consists of two short pieces (end bits) and a long strip (cutting edge), all made of an extra-hard carbon steel.

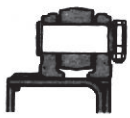
These parts are fitted to the blade properly, by means of bolts and nuts. The long cutting edge can be turned up-side-down to double its usable life. The hydraulic cylinders, mounted on the radiator, hold the blade from above ,by their piston rods.

The arms and braces have their .ends shaped for pin connection. The connection of each arm with track frame and blade are connecting bracket to another, that, by shifting one arm toward rear and the other arm toward front. Each brace is an assembly of parts joined together by screw

## STRAIGHT-TILTDOZER





Section A–A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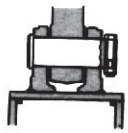
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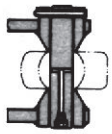
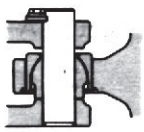
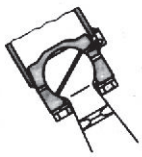

Section D–D


Section E–E


Section F–F


Section G–G

The blade (1) with the front plate made of high tensile steel is tough enough to endure severe works. The cutting edge (2) is made of carbon steel, and is of splitting type so that the edge can easily be reversed. The end bit (3) is made of cast steel having good wear resistance with excellent strength. The straight frame (6) made also of high tensile steel is constructed to be box-type, the front of which is stationed to the blade via joint bracket, and the rear of which is fixed to the track frame by means of trunnion (7). The straight frame is moved up and down by the action of the brade lift cylinder.

The brace supports both blade and straight frame on their right side, and the tilt cylinder supports them on their left side.

The blade is supported by straight frames (6), tilt cylinder (5) on left side and tilt brace on right side.

1. Blade
2. Cutting edge
3. End bit
4. Brace
5. Tilt cylinder (left side), brace (right side)
6. Straight frame
7. Trunnion
8. Yoke

## INSTALLATION AND ADJUSTMENT OF STRAIGHT-TILT DOZER

1. Assemble the blade and install it to the machine.

**2. Confrim the horizontalness of the blade**

1) Set the distance between the installation pin and shims for the tilt cylinder (1).

1

2) If the blade is still not horizontal after the distance between the mounting pins is set, rotate the brace until the blade is horizontal.

★ Adjust shims (2) so that the play of the brace in the axial direction is less than 0.5 mm.

Standard thickness of shims: 4 mm

**3. Confirm the parallelism of the straight frame**

1) Set distance between the mounting pin and shims for L.H. and R.H. braces (3).

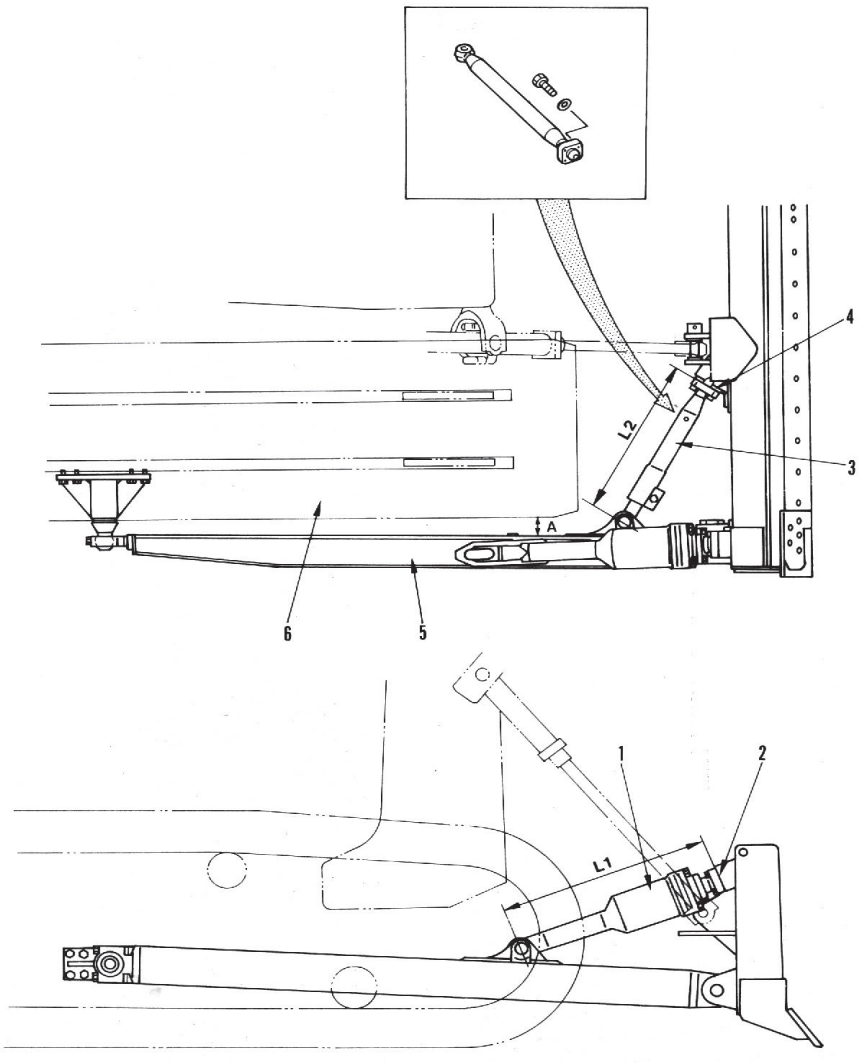
★ Adjust shims (4) so that the play of the brace in the axial direction is less than 0.5 mm.

Standard thickness of shims: 2 mm

2) Raise the blade about 400 mm above the ground and adjust braces (3) so that clearance A between straight frame (5) and track (6) is equal on left and right.

3) To minimize the sideways movement of the braces, tense the braces to a torque of 3.75 ± 1.25 kgm.

Brace securing bolts: **45 ± 5 kgm**



## PREVENTING RECURRENCE OF THE SAME TROUBLE

- The diagnostic tables are useful for locating damaged or otherwise faulty parts, but useless for tracing the sources from which damage and faults resulted.
- Also, diagnostic tables indicate only the correction of damaged or faulty parts; no indication is made about the measures to be taken to remove the source Troubles.
- To prevent recurrence of the same trouble therefore, it is necessary to detect the source of a trouble by carefully referring to the matters described below.

### HYDRAULIC SYSTEM

**1. CHECKING OIL**

Most hydraulic system troubles are attributed to water, air or foreign matter in the oil. Check the oil for foreign matter and locate the place of entry.

**1) Checking oil**

- Mixing with water

  Check with an diesel engine oil checker or with a hot plate.

- Mixing with foreign matter

  Remove the drain plug and filter. Check for foreign matter accumulated on the bottom of tank and in the filter. Also, check the degree of contamination with the **contamination checker.**

- **Viscosity**

  Check viscosity of oil with a **viscosimeter** to see whether proper viscosity oil is used or not.

**2) Locating the point of entry.**

When water or other foreign matter is noticed, locate the point of entry.

Water oil tank, breather, etc.

Earth... oil refilling and changing methods

Rubber..Cylinder packings, etc.

Metal particles... worn or damaged hydraulic pump or hydraulic motor.

**3) Cleaning or changing oil**

When metal particles or other foreign matter is excessive clean the oil with **oil refresher** or change oil.

★ Oil refresher is useless for removing water mixed in oil.

★ Wash or replace the strainer and replace the filter when cleaning the oil.

**2. REMOVING PIECES OF BROKEN PARTS**

If damage to a part is found, clean the oil to remove pieces of damage part which may circulate in the oil circuit.

If necessary, disassemble and clean the valves, cylinders and other devices in which pieces of the broken part or other foreign matter are liable to accumulate, so that recurrence of trouble can be prevented.

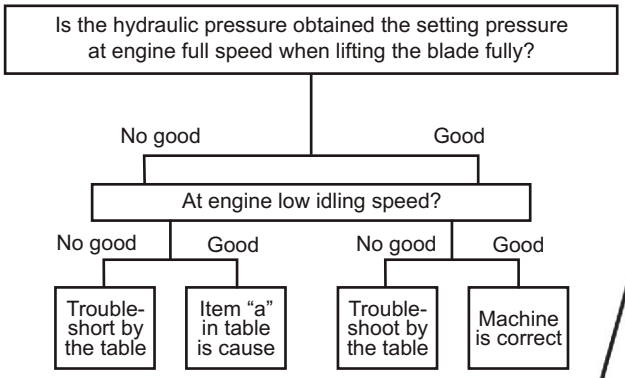
## DIAGNOSTIC TABLES

**1. Blade lifting force lacks and lifting speed is slow.**

**Check before troubleshooting**

- Is oil quantity in hydraulic tank proper?
- Are the travels of hydraulic control lever and valve spool proper?

**Check the trouble**




| No. | Problems \ Remedy / Cause | Strainer clogged. | Hydraulic pump sucking air. | Hydraulic pump defective. | Oil leakage from piping between pump and control valve. | Acting of check valve defective. | Drop of main relief valve setting pressure, blocked orifice and valve defective. | Suction valve on the raise side defective. | Oil leakage from piping between control valve and lift cylinder head. | Packing on the lift cylinder head defective. | Piston valve on the lift cylinder defective. | Quick-drop valve defective. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | a | b | c | d | e | f | g | h | i | j | k |
| | | Tank to pump | | | Hydraulic control valve | | | | | Control valve to cylinder | | |
| | | C △ X | | X | △ X | △ X | A C X | △ X | △ X | X | C X | C X |
| 1 | Hydraulic pressure is low at engine full speed when tilting the blade fully. | ○ | ○ | ○ | | ○ | | | | ○ | | |
| 2 | Item 1 is correct. (Hydraulic pressure is proper ) | | | | | | ○ | | | ○ | | |
| 3 | An unusual noise is maked from hydraulic pump. | ○ | | | | | | | | | | |
| 4 | The hydraulic drift of lift cylinder is large even if the circuit of lift cylinder head is plugged. | | | | | | | | | ○ | | |
| 5 | Discharge of pump is lack. | ○ | ○ | | | | | | | | | |
| 6 | Oil leakage outside the hydraulic control valve is more. (Check after removing the tank cover ) | | | | | | ○ | | | | | |
| 7 | Work equipment operating speed is slow when operating the control lever, but hydraulic pressure is higher. | | | | ○ | | | | | | | |

★ In case of problems item 1 when no tilt cylinder machine measure the hydraulic pressure with blocking the one side of lift cylinder circuit.

★ Causes item "i" to "k" for problems item 1 are applicable to no tilt cylinder machines.

★ Causes item "d" and "h" indicate that oil leakage is from the mounting surface between control valve and tank.

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X : Replace △ : Repair
A : Adjust A : Clean

**2. Blade does not lift.**

**Ask the operator the following questions**

- Didn't the blade move off suddenly?

  Seizure and damage to various units.
- In this time, was an unusual noise produced? (where did it emanate from?)

  → Damage to various units.
- Was the blade lifting speed slower than any speed has been obtained so far.

  → Wear of parts or flattening of spring.

**Check before troubleshooting**

- Is oil quantity in hydraulic tank proper?
- Are the travels of hydraulic control lever and control valve spool proper?

| No. | Problems \ Remedy | Cause: No turning of pump. (PTO unit defective) | Pump defective. | Oil leakage from piping between pump and control valve. | Drop of main relief valve setting pressure, blocked orifice a and valve defective. | Suction valve on the raise side defective. | Oil leakage from piping between control valve and lift cylinder head. | Packing on the lift cylinder defective. | Piston valve on the lift cylinder defective. | Quick-drop valve defective. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | a | b | c | d | e | f | g | h | i |
| | | Hydraulic pump | | Hydraulic control valve | | | Hydraulic control valve to hydraulic cylinder | | | |
| | | △ X | X | △ X | A C X | C X | △ X | X | C X | C X |
| 1 | The oil does not issue from the pressure take-off removed plug even if engine is cranking. | ○ | | | | | | | | |
| 2 | Hydraulic pressure does not raise at engine full speed in blade lift raising circuit. | | ○ | ○ | | ○ | | | ○ | |
| 3 | Hydraulic pressure does not raise at engine full speed with tilting fully in blade lift raising circuit. | | ○ | ○ | | | | | ○ | |
| 4 | Hydraulic pressure raises at item 3. | | | | | ○ | | | ○ | |
| 5 | The oil issues from cylinder without moving cylinder rod when the blade control lever is moved to RAISE position at engine low idling speed after removing the piping from lift cylinder bottom. | | | | | | | | ○ | |
| 6 | There is not almost discharge of hydraulic pump with loading. | ○ | ○ | | | | | | | |

★ In case of problems item 3 when no tilt cylinder machine, measure the hydraulic pressure with blocking the one side of lift cylinder circuit.

★ Causes item "g" to "i" for problems item 3 are applicable to no tilt cylinder machines. In this case, the damage of lift cylinder bottom is mostly considered as a same time.

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X : Replace △ : Repair
A : Adjust A : Clean

**3. The front of machine cannot be raised off ground by the blade.**

**Check before troubleshooting**

- Is oil quantity in hydraulic tank proper?
- Are the travels of hydraulic control lever and valve spool proper.

| No. | Problems \ Remedy / Cause | Suction valve on the lower side defective. (a) | Blocked orifice of control valve. (b) | Oil leakage from piping between control valve and cylinder bottom. (c) | Packing on lift cylinder bottom defective. (d) | Piston valve on lift cylinder bottom defective. (e) | Quick-drop valve defective. (f) |
|---|---|---|---|---|---|---|---|
| | | Control valve | | | Control valve to cylinder | | |
| 1 | Hydraulic pressure is low at engine full speed when lifting the blade fully. | | | | | | |
| 2 | Hydraulic pressure is low at engine low idling speed when lifting the blade fully. | | | | | | |
| 3 | Hydraulic pressure on lift cylinder lower side is low at engine full speed. | ○ | | ○ | ○ | | |
| 4 | The acting pressure of lift cylinder lower side is higher at engine full speed. | | ○ | | | | |
| 5 | The oil issues from the cylinder without moving cylinder when the blade control lever is moved to LOWER position at engine low idling speed after removing the piping from lift cylinder head. | | | | ○ | | |
| 6 | Oil leakage outside the hydraulic control valve is more. (Check after removing the tank cover.) | ○ | | ○ | | | |
| | Remedy | C X | C X | Δ X | X | C X | C X |

Problems as "1 blade lifting force lacks and lifting speed is slow".
Problems as "1. Blade lifting force lacks and lifting speed is slow"

★ Cause item "c" indicates that oil leakage is from the mounting surface between control valve and tank.

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X : Replace △ : Repair
A : Adjust A : Clean

**4. Hydraulic drift of lift cylinder is large.**

**Ask the operator the following questions**

- Did the hydraulic drift of lift cylinder suddenly become large?
  → Logged dirt in valve or damaged parts.
- Did the hydraulic drift of lift cylinder gradually
  → Worn parts.

**Check before troubleshooting**

- If the rod of control lever is disconnected from the control valve spool, is the hydraulic drift of lift cylinder proper? → Bend of rod or seizure of rod
  → Bend of rod or seizure of rod bushing or faulty of servo oil circuit.

| No. | Problems / Remedy | Cause a: Oil leakage from lift spool. (by damaged spool) | b: Suction valve on the raise side defective. | c: Oil leakage from piping between control valve and lift cylinder head. | d: Packing on lift cylinder head defective. | e: Piston valve on lift cylinder defective. | f: Quick-drop valve defective. |
|---|---|---|---|---|---|---|---|
| | | Hydraulic control valve | | | Control valve to cylinder | | |
| | | △ X | C X | △ X | X | C X | C X |
| 1 | Hydraulic drift of lift cylinder is large even if the piping from lift cylinder head is blocked. | | | | ○ | | |
| 2 | Oil leakage outside the control valve is more. (Check after removing the tank cover.) | | ○ | ○ | | | |
| 3 | There is oil leakage from control valve drain tube. (Check after removing the tank cover.) | ○ | | | | | |

★ Cause item "c" indicates that oil leakage is from the mounting surface between control valve and tank.

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X : Replace △ : Repair
A : Adjust A : Clean

**5. Blade moves unsteadily when leveling the ground (Control lever in "HOLD").**

**Problems and cause**

- When checking the hydraulic drift of lift cylinder

  It is excessive the standard value → Problems as "4. Hydraulic drift of lift cylinder is large"

  It is within the standard value → Forming an vaccum in cylinder → It is corrected in accordance with raising the machine by lift cylinder and lowering the machine slowly.

  ★ But if it is frequent → Suction valve in head side defective.

**6. Blade lowers under the following conditions**

**1.** Blade lowers momentarily when control lever is changed from "HOLD" position to "RAISE" position.

**2.** Blade lowers gradually when placing control lever in "RAISE" position with engine stopped.

| | | Remedy |
|---|---|---|
| Cause: Check valve for lift control valve defective | → | C.X |

**7. Travel of the piston rods in the right and left lift cylinders is different. (Applicable to straight-tilt dozer only)**

| | | Remedy |
|---|---|---|
| Cause: Large clearance of blade mounting parts or adjustment (by shims) defective | → | C.△ |

The following symbols are used to indicate the action to be taken when a cause of failure is located.

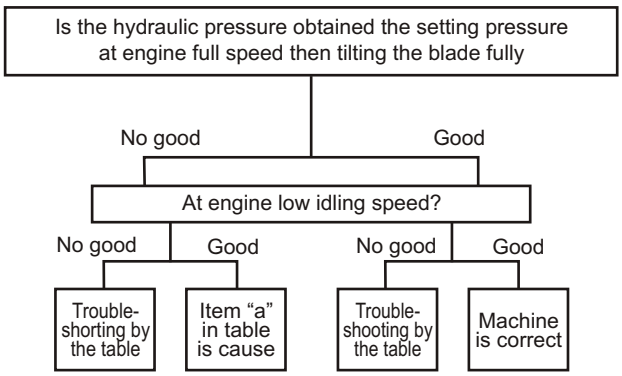
X : Replace △ : Repair
A : Adjust A : Clean

**8. Blade tilting force is lack, blade tilting speed is slow, the machine cannot be raised off ground by blade tilting force.**

**Check before troubleshooting**

- Is oil quantity in hydraulic tank proper?
- Are the travels of control lever and control valve spool proper?

**Check the trouble**




| No. | Problems \ Remedy | C | △ X | X | △ X | △ X | A C X | C X | △ X | X |
|---|---|---|---|---|---|---|---|---|---|---|
| | Cause | Strainer clogged. | Hydraulic pump sucking air. | Hydraulic pump defective. | Oil leakage from piping between pump and control valve. | Acting of check valve defective. | Drop of main relief valve setting pressure, and valve defective. | Blocked orifice on flow control valve. | Oil leakage from piping between control valve and tilt cylinder. | Tilt cylinder packing defective. |
| | | a | b | c | d | e | f | g | h | i |
| | | Tank to pump | | | Hydraulic control valve | | | | | Tilt cylinder |
| 1 | Hydraulic pressure is low at engine full speed when lifting the blade fully. | ○ | ○ | ○ | | ○ | ○ | | | |
| 2 | Item 1 is correct. (Hydraulic pressure is proper ) | | | | | | | ○ | ○ | |
| 3 | The lifting speed of blade is variable. | ○ | | | | | | | | |
| 4 | Oil leakage occurs when removing the piping from tilt cylinder head. | | | | | | | | ○ | |
| 5 | Hydraulic drift of tilt cylinder is large even if the circuit of tilt cylinder head is blocked. | | | | | | | | ○ | |
| 6 | Discharge of hydraulic pump is lack. | ○ | ○ | | | | | | | |
| 7 | There is oil leakage to outside the control valve. (Check after removing the tank cover ) | | | | | | | ○ | | |
| 8 | Work equipment operating speed is slow when operating the control lever, but hydraulic pressure in circuit is higher. | | | | ○ | | | | | |

★ Causes item "d" and "h" indicate that oil leakage is from the mounting surface between control valve and tank.

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X : Replace △ : Repair
A : Adjust A : Clean

**9. Tilt cylinder does not move off. (Tilting is impossible)**

**Ask the operator the following questions**

- Didn't the tilt cylinder move off suddenly?
  → Seizure and damage to various units.
- In this time, was an unusual noise produced? (where did it emanate from?)
  → Wear of parts or flattening of spring.
- Was the blade tilting speed slower than any speed has been obtained so far.

**Check before troubleshooting**

- Is oil quantity in hydraulic tank proper?
- Are the travel of hydraulic control lever and control valve spool proper?

| No. | Problems \ Remedy | Cause: No turning pump. (PTO unit defective) | Hydraulic pump defective. | Oil leakage from piping between pump and control valve. | Drop of main relief valve setting pressure, blocked orifice and valve defective. | Blocked orifice on flow control valve. | Oil leakage from piping between control valve and cylinder. | Packing on the tilt cylinder bottom defective. | Packing on the tilt cylinder head defective. |
|---|---|---|---|---|---|---|---|---|---|
| | | a | b | c | d | e | f | g | h |
| | | Hydraulic pump | | Hydraulic control valve | | | | Tilt cylinder | |
| | | △ X | X | △ X | A C X | C X | △ X | X | X |
| 1 | The oil does not issue from the pressure take-off removed plug even if engine is cranking. | ○ | | | | | | | |
| 2 | Hydraulic pressure does not raise at engine full speed with keeping to place in TILT position. | | ○ | ○ | ○ | ○ | ○ | ○ | |
| 3 | Hydraulic pressure does not raise at engine full speed when tilting the blade with lifting fully. | | ○ | ○ | ○ | | | | |
| 4 | Hydraulic pressure raises at item 3. | | | | | ○ | ○ | ○ | |
| 5 | When blade control lever is placed in the no-raising tilt side after removing the outlet piping of no-rising tilt side, cylinder does not move off but oil issues. | | | | | | ○ | ○ | |
| 6 | There is not almost discharge of hydraulic pump with loading. | ○ | ○ | | | | | | |

★ Causes item "c " and "f" indicate that oil leakage is from the mounting surface between control valve and tank.

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X : Replace △ : Repair
A : Adjust A : Clean

**10. Hydraulic drift of tilt cylinder is large.**

**Ask the operator the following questions**

- Did the hydraulic drift of tilt cylinder suddenly become large? → Damaged parts.
- Did the hydraulic drift of tilt cylinder gradually become large? → Worn parts.

**Check before troubleshooting**

- If the rod of control lever is disconnected from the control valve spool, is the hydraulic drift of tilt cylinder proper?

  → Bend of rod or seizure of rod bushing or faulty of servo oil circuit.

**Confirmation of trouble**

- Check for the amount of hydraulic drift compared with "standard value table" when tilting.

| No. | Problems / Remedy | Cause a: Oil leakage from tilt spool (by damaged spool) — Hydraulic control valve: Δ X | Cause b: Oil leakage from piping between control valve and tilt cylinder — Hydraulic control valve: Δ X | Cause c: Packing on the tilt cylinder defective — Tilt cylinder: X |
|---|---|---|---|---|
| 1 | Oil does not issues when removing the piping from tilt cylinder head. | | | ○ |
| 2 | Hydraulic drift of tilt cylinder is large even if the piping of tilt cylinder head is blocked. | | | ○ |
| 3 | Oil leakage outside of control valve is more. (Check after removing the tank cover ) | | ○ | |
| 4 | There is oil leakage from the drain tube on control valve. (Check after removing the tank cover ) | ○ | | |

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X : Replace △ : Repair
A : Adjust A : Clean

SECTION : 11

# MISCELLANEOUS MOUNTINGS

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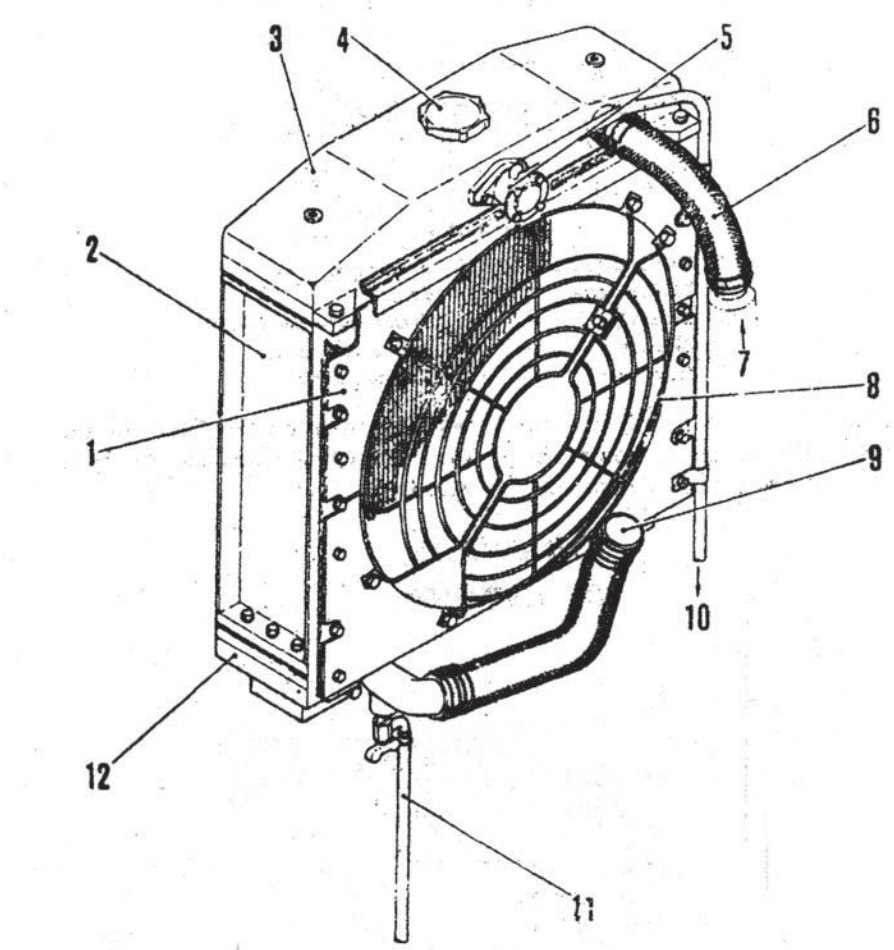
# MISCELLANEOUS MOUNTINGS

## RADIATOR

### DESCRIPTION




**Radiator**

1. Shroud
2. Support
3. Upper tank
4. Cap
5. Pressure valve
6. Rubber hose
7. From water manifold
8. Guard
9. To radiator
10. Overflow tube
11. Drain hose
12. Lower tank

The radiator is mounted on the main frame and stands in front of the cooling fan. It consists of upper and lower tanks and a core which consists copper tubes and fins. A masking structure, protecting the front race of the radiator, is provided. The water filler is on the upper Tank and contains a strainer. An overflow tube is connected to the pressure valve. The cock for draining the radiator is located below the lower tank. The rear face of the radiator carries a baffler designed to guide all of air from the fan through the radiator core.

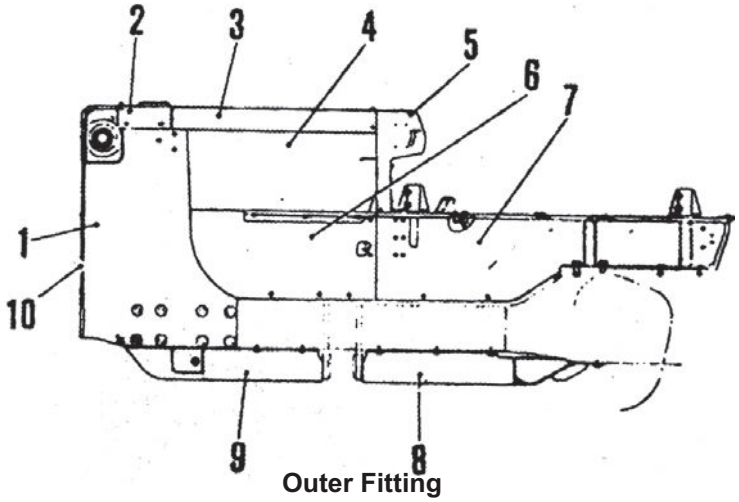
# MISCELLANEOUS MOUNTING

## COVERING

### DESCRIPTION

## COVERINGS

### DESCRIPTION



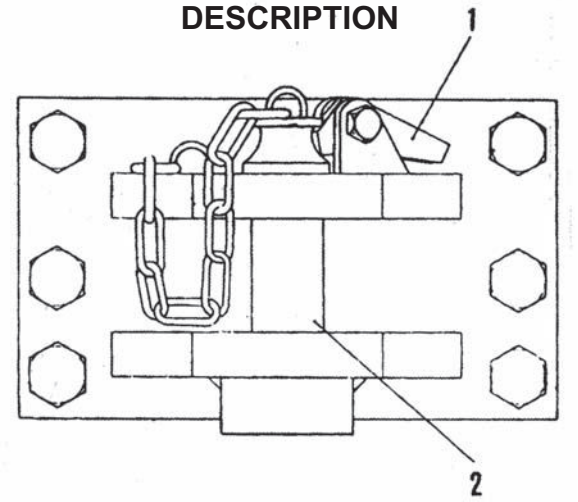

**Outer Fitting**

1. Radiator guard
2. Radiator cover
3. Engine hood
4. Side cover
5. Dash board
6. Engine side cover
7. Fender
8. Transmission underguard
9. Engine underguard
10. Radiator mask

The bottom portion of the chassis is fully covered with a plate structure. The engine is housed in an enclosure covered with the bonnet on the top and side-plates on the sides and the front end by the radiator mask and on the back by the dash board.

## DRAWBAR

### DESCRIPTION



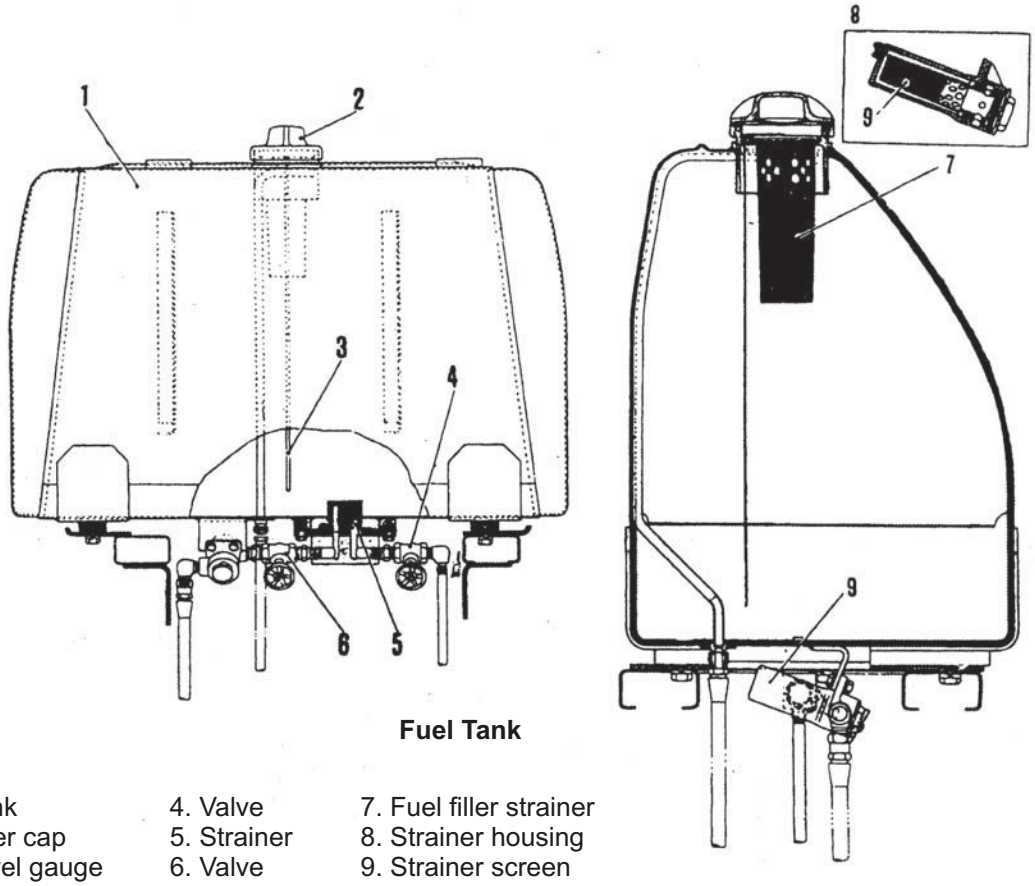

**Drawbar**

1. Latch
2. Pin

A fixed type drawbar is attached to the outer face of the bevel gear shaft case. A latch provided on the drawbar engages a flanged head of the drawbar and side-plates on the sides and the front end by the radiator mask and on the back by the dash board pin to hold the pin in place so that it will not accidently slip out during operation.

# FUEL TANK

## DESCRIPTION




**Fuel Tank**

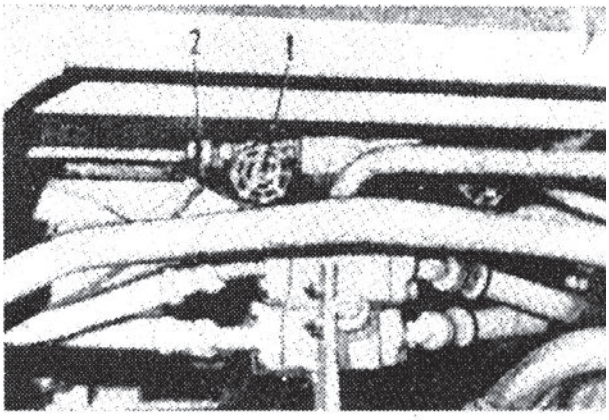
1. Fuel tank
2. Fuel filler cap
3. Fuel level gauge
4. Valve
5. Strainer
6. Valve
7. Fuel filler strainer
8. Strainer housing
9. Strainer screen

The tank is situated just behind the operator's seat, and fitted to a supporting fixtures mounted on the right and left stepboards Two clocks are provided under the tank: one is the shut-off valve of the fuel line leading to the engine and the other is the tank drain valve. The filler, located on the top of that tank, is provided with a strainer and a graduated dip stick.

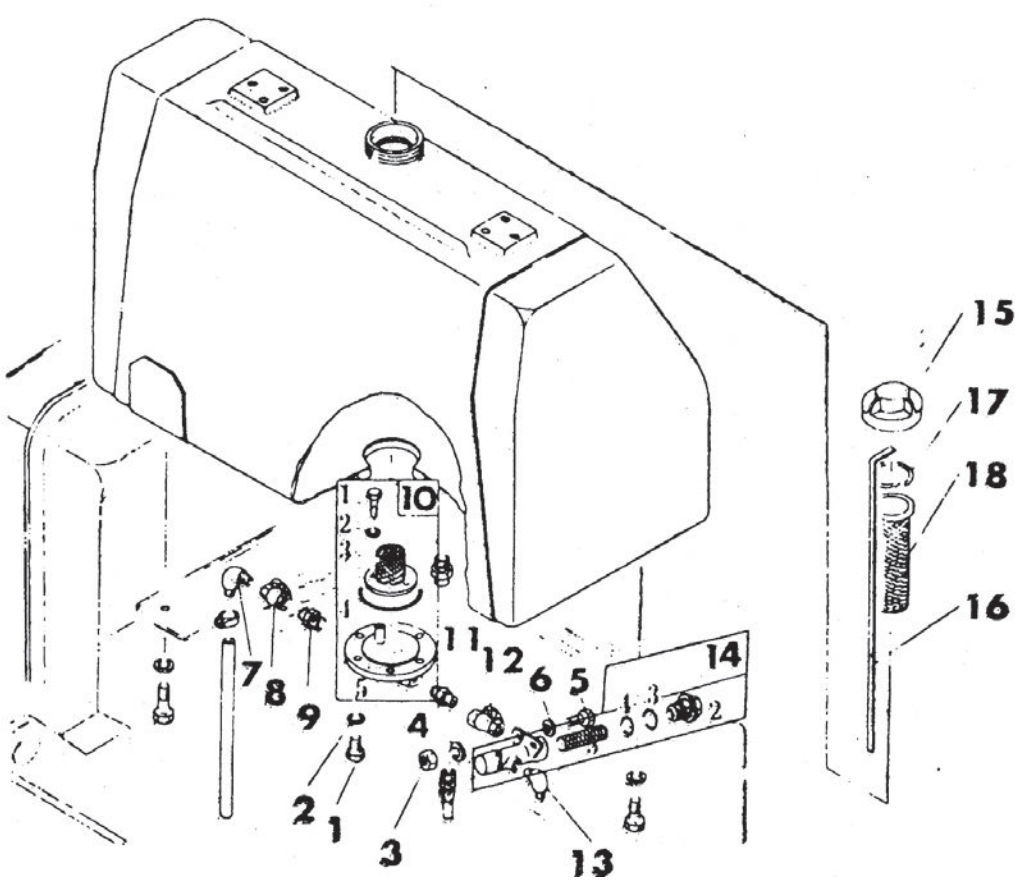
## REMOVAL

(1) Close valve (1) under the tank. Loosen joint (2) to disconnect the pipe from this valve.

(2) Loosen joint (3) on return (from engine) line, remove bolts (4) and take down fuel tank assembly (5).



### DISASSEMBLING




**(The parts are enumarated in the sequence of removal)**

### Fuel Tank

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | Bolt | 8. | Valve | 11. | Nipple | 14-5. | Stainer screen |
| 2. | Spring washer | 9. | Nipple | 12. | Valve | 15. | Cap |
| 3. | Nut | 10-1. | Bolt | 13. | Elbow | 16. | Gauge |
| 4. | Washer | 10-2. | Spring washer | 14-1. | Stainer case | 17. | Ring |
| 5. | Bolt | 10-3. | Stainer | 14-2. | Cap | 18. | Strainer |
| 6. | Spring washer | 10-4. | 'O' ring | 14-3. | Gasket | | |
| 7. | Elbow | 10-5. | Flange | 14-4. | "O" ring | | |

## INSPECTION AND CLEANING

(1) Inspect the tank for cracks or any other damage, and clean its interior, surface.

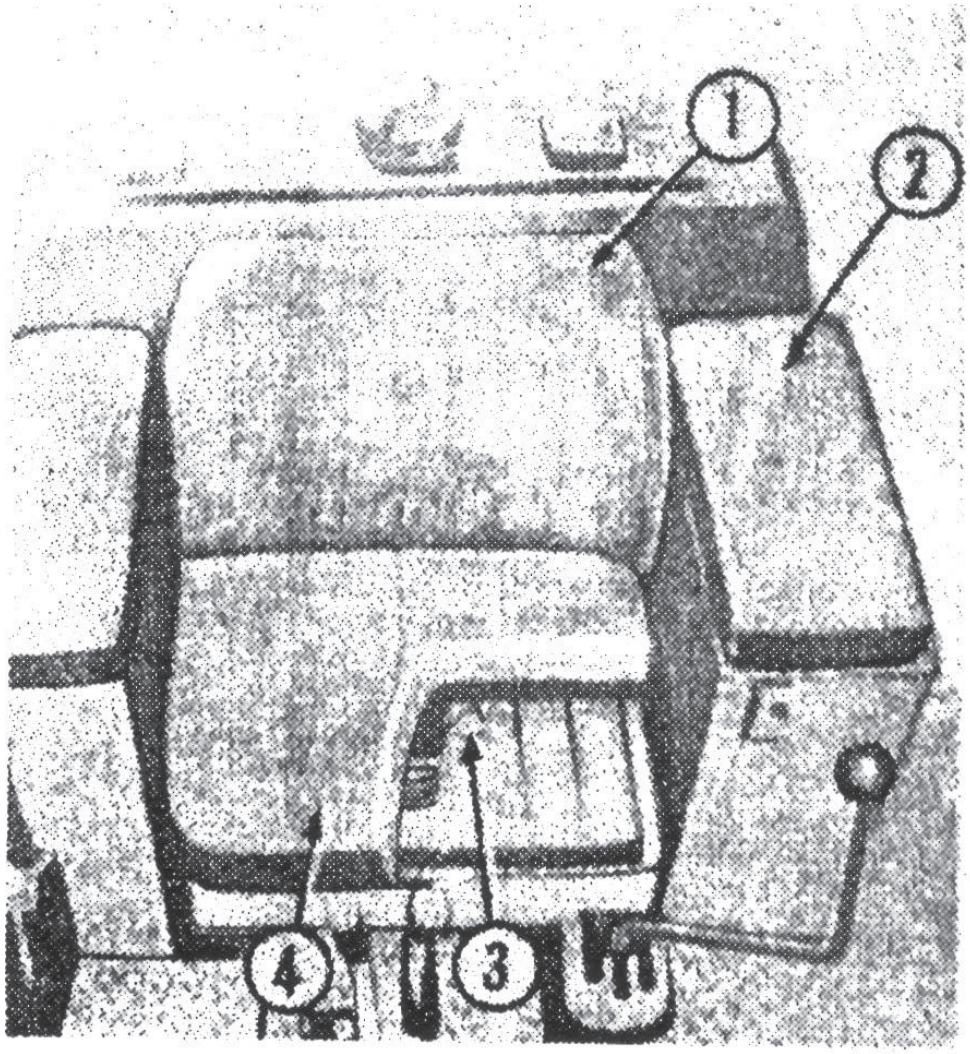
2. Wash the strainers clean.

## RE-ASSEMBLING

Do not re-use the gaskets and "O" rings removed while re-assembling the fuel tank, Before installing strainers and making flange connections, make sure these parts are perfectly clean and free from any dirt.

# OPERATOR'S SEAT

## DESCRIPTION




**Operator Seat**

1. Back seat
2. Arm rest
3. Bolt
4. Seat cushion

The seat is located on the centre line of the tractor, over the bevel gear and steering clutch compartment. It is for single seating and can be repositioned within 75 cm fore or aft of the standard position, the total range being 150 cm.

A cushioned seat pad, arm rests and back rest constitute the seat. Provisions are made over the side fenders for mounting an awning to give a shade and for erecting a cabin to give weather protection for the operator.

Section: 12

# ENGINE DISASSEMBLY AND INSTALLATION

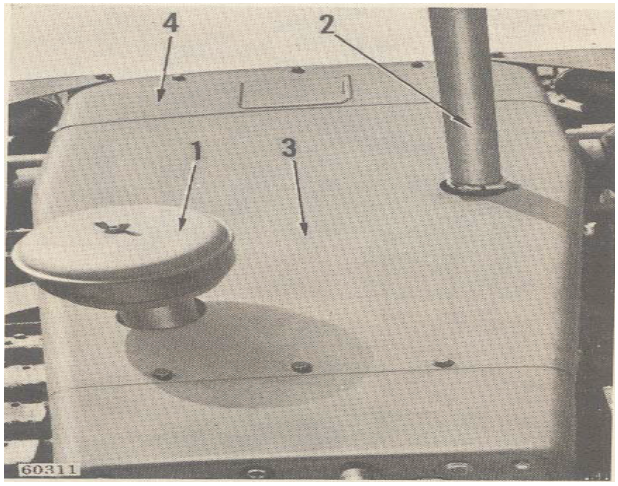
## INDEX


| | |
|---|---|
| ENGINE DISASSEMBLY | 12-01 |
| ENGINE INSTALLATION | 12-04 |
| ENGINE CENTERING | 12-04 |

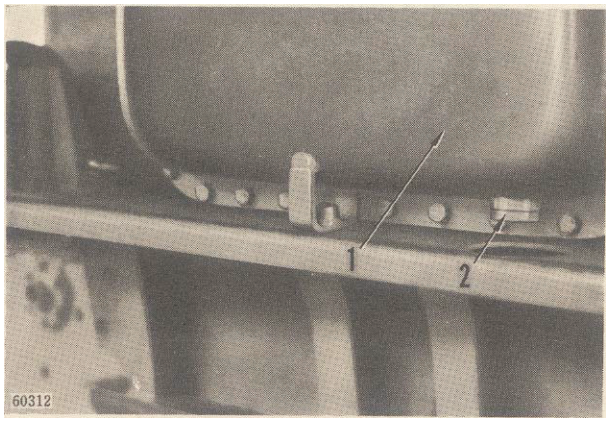
## Engine Disassembly & Installation:

### Disassembly:

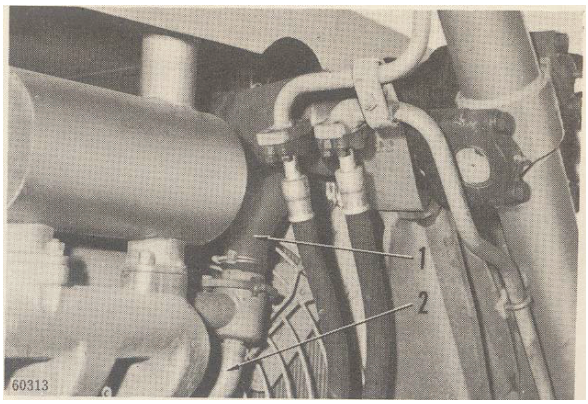
1. Remove the angle-dozer equipment from the tractor, as outlined in STRAIGHT TILT-DOZER EQUIPMENT REMOVAL.
2. Take off air cleaner (1), exhaust pipe (2), engine hood (3), radiator cover (4) and side cover plates



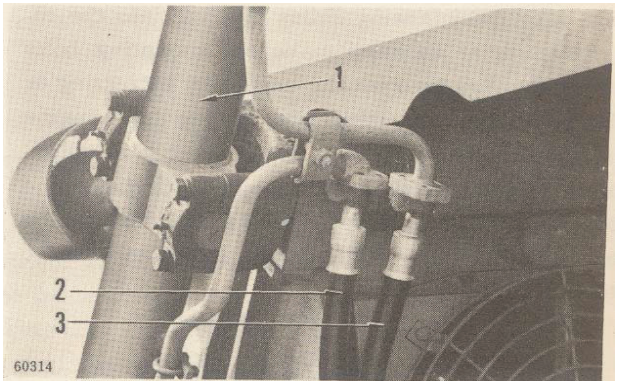

3. Loosen plug (2) to drain the hydraulic oil tank (1). Remove engine under guard, and drain the cooling system by opening the radiator drain cock.



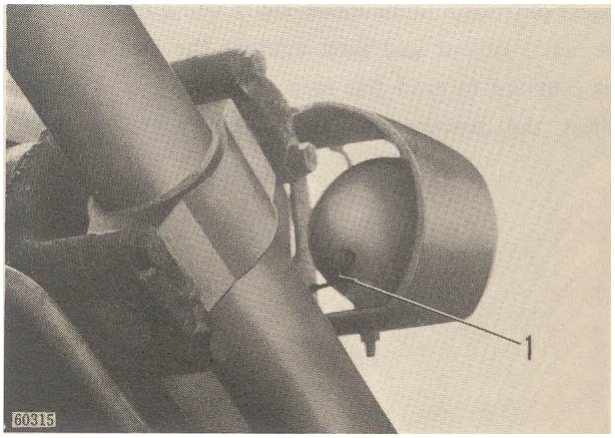

4. Draw rubber hoses (1) & (2) off the engine to sever radiator from engine.



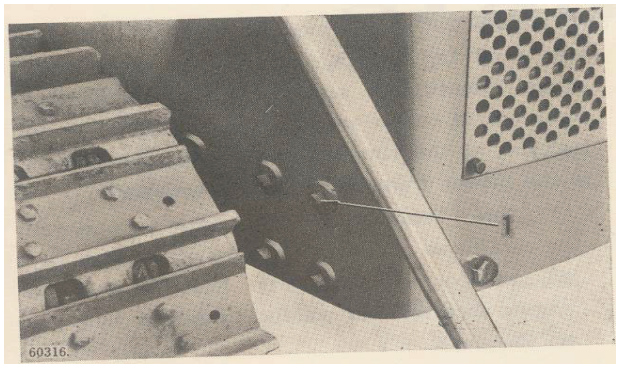

5. Disconnect the high-pressure lines from pipes (2) (3) of each hydraulic cylinder (1). Remove fan guard.



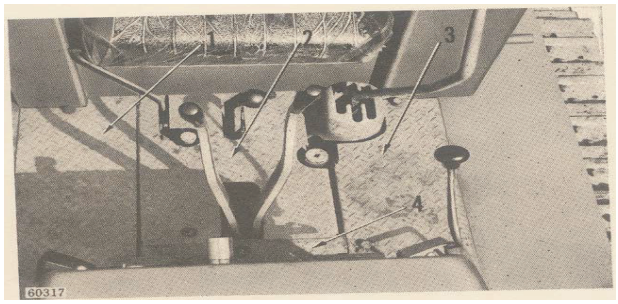

6. Disconnect electrical cord (1) from each head-light.



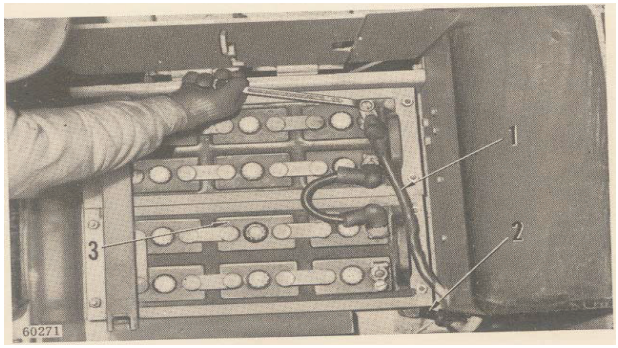
7. Loosen bolts (1) securing the radiator guards and remove the assembly of radiator and stays by lifting with a hoist.



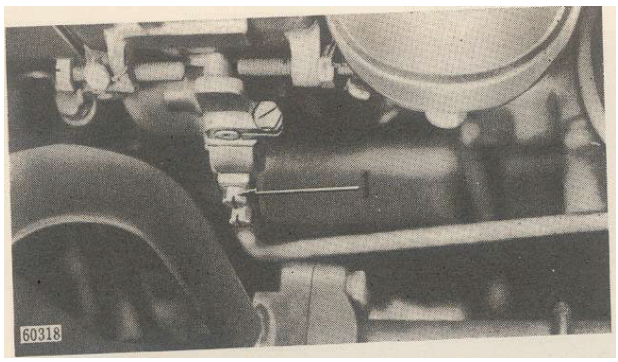

8. Remove all floor boards (1) (2) (3) (4)



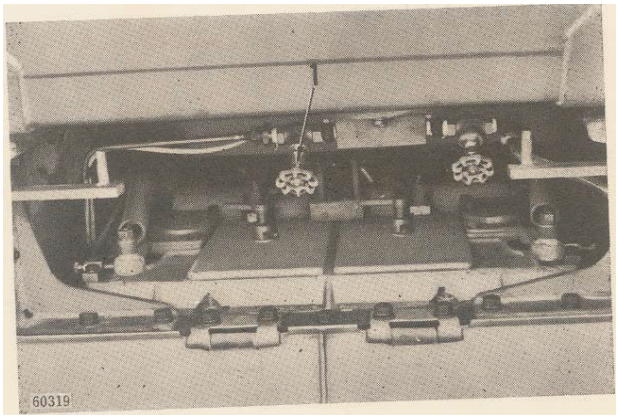

9. Disconnect battery cords (1) (2) from battery (3).




10. Disconnect lever (1) from control valve.




11. Disconnect the decompression

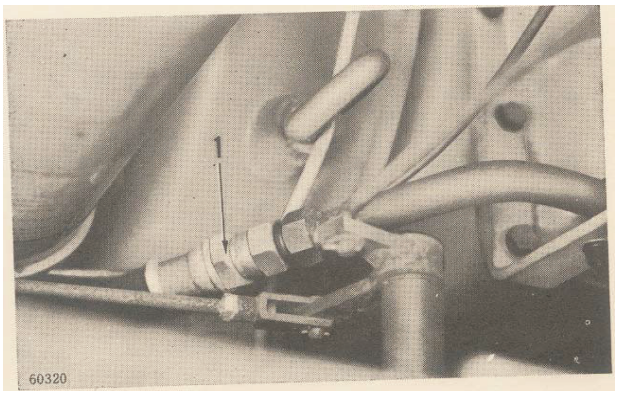



12. Close valve (1) and undo the joint of engine fuel control valve.

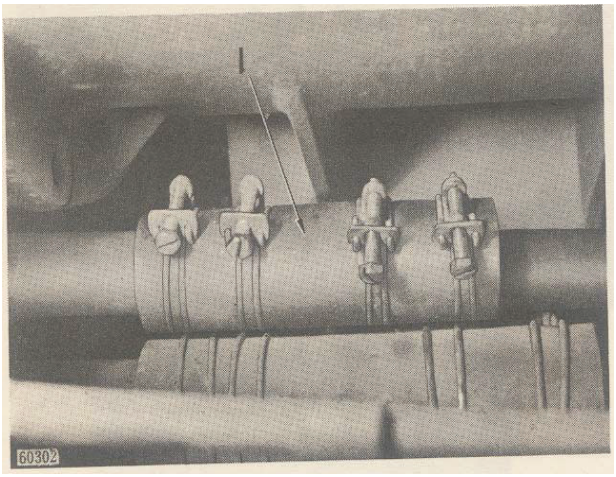
13. Disconnect the temperature gauge cord from manifold.

14. From the left side of the engine, disconnect the oil pressure gauge tube.

15. undo joint (1) in the oil line leading from main clutch to pump.



16. Undo joint (1) in the line from main clutch filter to pump.




17. Disconnect the main clutch control valve lever link- age at the clutch case.

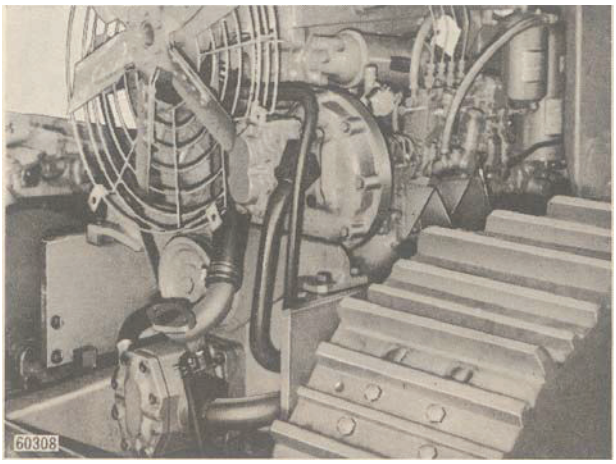
18. Disconnect electrical wires from generator and starting motor.

19. Remove the Universal joint.

20. Loosen the engine mounting bolts, and lift the engine off the chassis with a hoist and lifting slings. Identify the sets of adjusting shims that come out of engine mounts, as each set is to be restored, at the time of remounting the engine, to the mount from which it was removed.

CAUTION: When lifting the engine for removal, be careful so as not to bounce it against any adjacent component or part. Rest the removed engine securely and solidly on blocks laid out on the floor.

The engine is to be remounted by reversing the foregoing removal procedure. Before securing the engine in place, it is necessary to true it up with respect to the transmission input shaft, as follows.



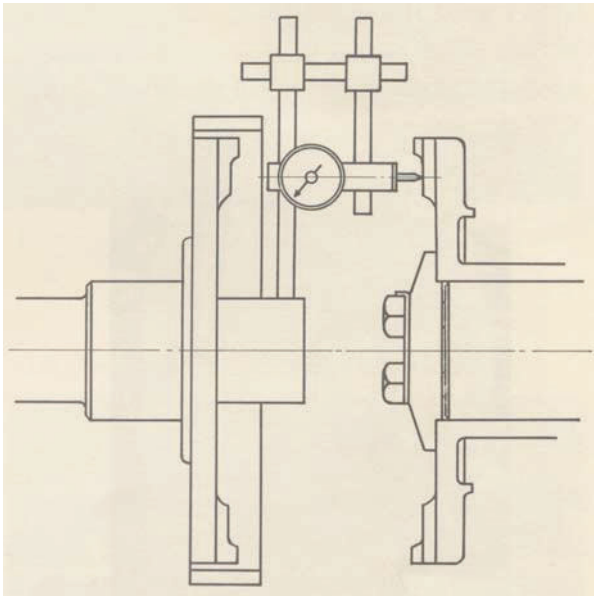

**Securing the Engine:**
After placing the engine in its approximate position, with the adjusting shims inserted into the respective engine mounts, make the mounting bolts snug-tight, and turn up the engine by increasing or decreasing the shim thickness at the four engine mounts, in order to reduce the amount of misalignment to within the limit (0.25mm). With the engine properly centered, apply LOCKTIGHT "B" to the mounting bolts and tighten them alternately to the torque limits:

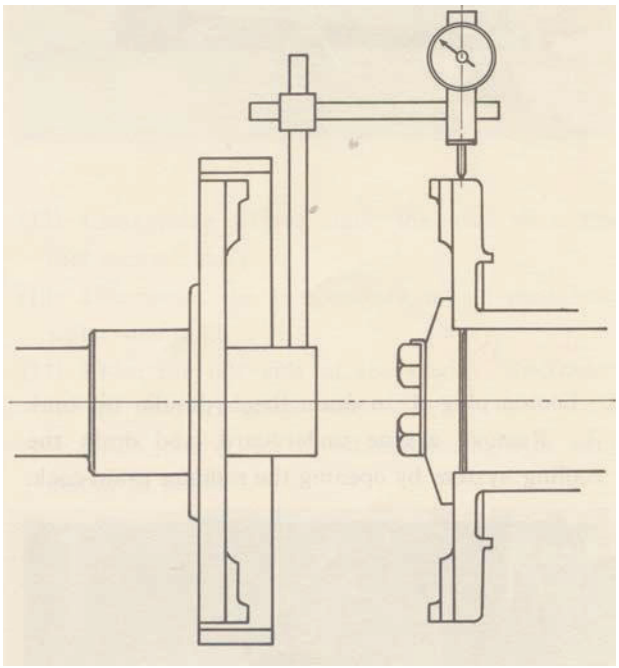
| | |
|---|---|
| Front mounts | 25 ~ 28 kg-m. |
| Rear mounts | 33.5 ~ 37 kg-m. |

## ENGINE CENTERING

Mount a dial gauge on the end of main clutch shaft and point the gauge spindle against the periphery of transmission input shaft coupling to read the radial run out and next against the end face of this coupling to read the face run out.

Adjust the position of the engine, as outlined above, so that either run out reading will not exceed 0.25mm.





SECTION : 13

# MAINTENANCE STANDARDS

# MAINTENANCE STANDARDS

Unit : mm

| Unit | Items to be Inspected | | Basic Size | Standard Clearance | Clearance limit or re-use limit | Service limit | Remaks |
|---|---|---|---|---|---|---|---|
| MAIN CLUTCH | Pressure plate | Thickness | 22 | | | 20 | M = 3<br>Z = 131<br>(20 teeth eliminated)<br>Chordal measurement :<br>88.793 $^{-0.15}_{-0.35}$ (10) |
| | | Transverse warpage | | 0.3 | 0.5 | | |
| | Plate | Thickness | 7 | | | | M = 3<br>Z = 131<br>(23 teeth eliminated)<br>Chordal measurement :<br>88.793 $^{-0.15}_{-0.35}$ (10) |
| | | Transverse warpage | | 9.15 | 0.3 | | |
| | Disc | Thickness | 7 | | | 5.5 | M = 3<br>Z = 87 |
| | | Transverse warpage | | 0.3 | 0.5 | | |
| | Flywheel-to-pressure plate backlash | | | 0.4 ~ 0.55 | | 1 | |
| | Inner drum-to-main shaft clearance (splines) | | 45 | 0.005 ~ 0.19 | | 0.3 | M = 2.5 Z = 16<br>Chordal measurement :<br>20.379 $^{-0.097}_{-0.145}$ (3) |
| | Disc-to-inner drum gear backlash | | | 0.52 ~ 0.63 | | 1 | M = 3 Z = 87<br>Chordal measurement :<br>69.836 $^{-0.22}_{-0.28}$ (8) |
| | Yoke screw-to-throwout bearing cage clearance | | 20 | 0.05 ~ 0.103 | | 0.5 | |
| | Lever Support-to-clutch cover clearance | | 18 | 0.095 ~ 0.165 | | 1 | |
| | Lever rod to-clutch cover clearance | | 22 | 0.1 ~ 0.163 | | 1 | |
| | Yoke ball-to-bushing clearance | | 30 | 0.13 ~ 0.3 | | 2.5 | |
| | Main clutch spring | Free length | 263 | | | | |
| | | As-installed length | 148 | | | | |
| | | As-installed tension (kg) | 325 | ± 16 | | 294 | |
| | Main clutch cover-to-fiange clearance | | 35 | 0 ~ 1.0 | | | |
| | Clutch return spring | Free length | 85 | | | | |
| | | As-installed length | 56 | | | | |
| | | As-installed tension (kg) | 31.2 | ± 3 | | | |
| | Shaft and oil seals | | 85 | | | 84.5 | |

# MAINTENANCE STANDARDS

Unit : mm

| Unit | Items to be Inspected | | | | Basic Size | Standard Clearance | Clearance limit or re-use limit | Service limit | Remaks |
|---|---|---|---|---|---|---|---|---|---|
| MAIN CLUTCH | Bearing 06120-03520 | | | Pedal | 42 | | | | |
| | | | | Shaft | 35 | | | | |
| | Inertia brake | Thickness of brake and brand lining | | | 7.6 | | | 5.8 | |
| | | Brake drum-to-lining clearance | | | 1 | | | | |
| | | Spring | Large | Free length | 98.5 | | | | |
| | | | | As-installed length | 110 | | | | |
| | | | | As-installed tension (kg) | 5.4 | ± 0.5 | | | |
| | | Spring | Small | Free length | 85.5 | | | | |
| | | | | As-installed length | 65 | | | | |
| | | | | As-installed tension (kg) | 6 | ± 0.6 | | | |
| | Booster cylinder-to-piston clearance | | | | 55 | | | | |
| | Booster valve-to-bushing clearance | | | | 18 | 0.025 ~ 0.042 | | | |
| | Booster shaft-to-bushing clearance | | | A | 28 | 0.045 ~ 0.125 | | | |
| | | | | B | 28 | 0.045 ~ 0.117 | | | |
| | Booster spring | | | Free length | 116 | | | | |
| | | | | As-installed length | 81.5 | | | | |
| | | | | As-installed tension (kg) | 8 | ± 0.8 | | 6.5 | |
| | Booster piston-to-valve clearance | | | | 6 | | | | |
| | Gear pump | | | | | | | | Refer to BEML for Service. |
| | Bearing 06030-06012 | | | Flywheel | 95 | | | | |
| | | | | Inner drum gear | 60 | | | | |
| | Bearing 06030-08214 | | | Cage | 125 | | | | |
| | | | | Flange | 70 | | | | |
| | Bearing 06042-00213 | | | Cage | 120 | | | | |
| | | | | Flange | 65 | | | | |
| | Backlash in gears | | | | | 0.17 ~ 0.49 | | 0.75 | |
| | O.D. of coupling oil seal | | | | 75 | + 0 – 0.074 | 74.8 | 74.5 | |
| | Shifter fork-to-fork groove clearance | | | | 10 12 | 0.2 ~ 0.4 | | 1 | |

# MAINTENANCE STANDARDS

Unit : mm

| Unit | Items to be Inspected | | Basic size | Variation | | Standard clearance | Clearance limit or re-use limit | Service limit | Remarks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Hole | Shaft | | | | Part Name | No. of teeth | Chordal measurement |
| TRANSMISSION | Bearing 06030-21310 | Count-ershaft | 50 | 0<br>–0.012 | +0.017<br>+0.033 | | | | 131-14-45550 | 40 | $68.59^{-0.08}_{-0.18}$ (5) |
| | | Cage | 110 | –0.010<br>–0.045 | 0<br>–0.015 | | | | 131-14-45570 | 32 | $53.83^{-0.08}_{-0.18}$ (4) |
| | Bearing 06041-00311 | Count-ershaft | 55 | 0<br>+0.015 | +0.015<br>+0.034 | | | | 131-14-45580 | 25 | $39.07^{-0.08}_{-0.18}$ (3) |
| | | Cage | 120 | 70<br>–0.035 | 0<br>–0.015 | | | | 131-14-45610 | 20 | $39.07^{-0.07}_{-0.16}$ (3) |
| | Bearing 06040-06314 | Main Shaft | 70 | 0<br>+0.015 | +0.011<br>+0.030 | | | | 131-14-44540 | 22 | $39.07^{-0.08}_{-0.18}$ (3) |
| | | Conflict | 150 | 0<br>–0.040 | 0<br>–0.018 | | | | 131-14-44630 | 30 | $53.83^{-0.08}_{-0.18}$ (3) |
| | Bearing 130-09-13413 | Drive gear | 80 | –0.021<br>–0.051 | 0<br>–0.013 | | | | 131-14-44640 | 37 | $53.83^{-0.08}_{-0.18}$ (4) |
| | | Main shaft | 35 | 01<br>–0.012 | 0<br>–0.016 | | | | 131-14-44650 | 44 | $68.66^{-0.09}_{-0.21}$ (5) |
| | Bearing 130-09-34110 | Drive gear | 60 | 0<br>–0.015 | +0.030<br>+0.011 | | | | 131-14-44660 | 42 | $54.39^{-0.08}_{-0.24}$ (4) |
| | | Cage | 130 | –0.012<br>–0.052 | 0<br>–0.018 | | | | | | |
| | Bearing 130-09-31160 | Drive gear | 55 | 0<br>–0.015 | +0.034<br>+0.015 | | | | | | |
| | | Cage | 100 | 0<br>–0.035 | 0<br>–0.015 | | | | | | |
| | Bearing 06040-06211 | Inter-mediate shaft | 55 | 0<br>–0.015 | +0.020<br>+0.039 | | | | 131-14-46570 | 20 | $39.14^{-0.07}_{-0.16}$ (3) |
| | | Cage | 100 | –0.010<br>–0.045 | 0<br>–0.015 | | | | 131-14-46560 | 27 | $53.97^{-0.08}_{-0.18}$ (4) |
| | Bearing 06041-00211 | Inter-mediate shaft | 55 | 0<br>–0.015 | +0.015<br>+0.034 | | | | 131-14-46550 | 34 | $53.97^{-0.08}_{-0.18}$ (4) |
| | | Case | 100 | 0<br>–0.035 | 0<br>–0.015 | | | | 131-14-46540 | 29 | $54.32^{-0.08}_{-0.18}$ (4) |
| | Bearing 130-09-13210 | 1st driven gear | 120 | –0.029<br>–0.059 | 0<br>–0.015 | | | | | | |
| | | Main shaft | 70 | 0<br>–0.015 | +0.020<br>+0.039 | | | | | | |
| BEVEL GEAR SHAFT | Bearing 130-09-31180 | Main shaft | 90 | 0<br>–0.020 | +0.040<br>+0.018 | | | | | | |
| | | Case | 190 | 0<br>–0.046 | 0<br>–0.030 | | | | | | |
| | Bearing 130-09-34120 | Main shaft | 185 | 0<br>–0.020 | +0.045<br>+0.025 | | | | | | |
| | | Cage | 150 | –0.012<br>–0.052 | 0<br>–0.018 | | | | | | |
| | Bearing 06000-32215 | Bevel gear shaft | 75 | 0<br>–0.015 | +0.039<br>+0.020 | | | | | | |
| | | Cage | 130 | –0.012<br>–0.052 | 0<br>–0.018 | | | | | | |
| STEERING CLUTCH | Bearing 06001-07217 | Pressure | 85 | 0<br>–0.020 | +0.013<br>–0.009 | | | | | | |
| | | Cage OE | 150 | +0.012<br>–0.028 | 0<br>–0.018 | | | | | | |

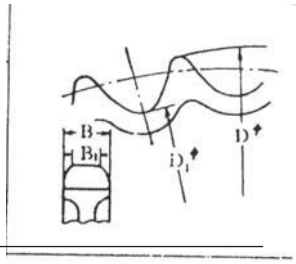
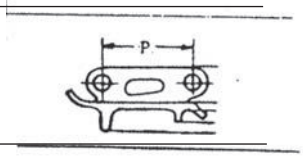
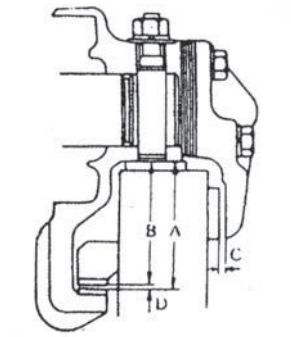
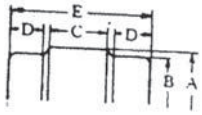
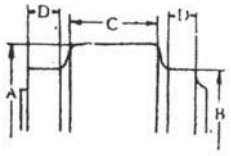
# MAINTENANCE STANDARDS

Unit : mm

| Unit | Items to be Inspected | | Basic Size | Standard clearance | Clearance limit or re-use limit | Service limit | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| FINAL DRIVE | Back-lash to pinion | | | 1st :<br>0.25 ~ 0.82<br>2nd :<br>0.27 ~ 0.89 | 1.5 | | Module : 10<br>No. of teeth : 11<br>Module : 10<br>No. of teeth : 29<br>Module : 10<br>No. of teeth : 42 |
| | Roller bearing 06043-00313 | Pinion | 65 | | | | |
| | | Cage | 140 | | | | |
| | Roller bearing 06043-02213 | Pinion | 65 | | | | |
| | | Case | 120 | | | | |
| | Roller bearing 130-09-13340 | Pinion | 60 | | | | |
| | | Case | 130 | | | | |
| | Roller bearing 06043-02314 | Pinion | 70 | | | | |
| | | Case | 150 | | | | |
| | Roller bearing 06043-02224 | Shaft | 120 | | | | |
| | | Hub | 215 | | | | |

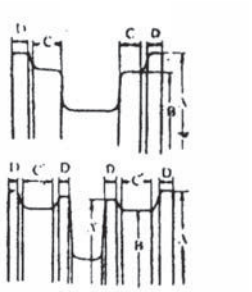
# MAINTENANCE STANDARDS

Unit : mm

| Unit | Items to be Inspected | | | | Basic Size | Standard clearance | Clearance limit or re-use limit | Service limit | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| FINAL DRIVE | Roller bearing 06030 - 21310 | Shaft | | | 90 | | | | |
| | | Cage | | | 190 | | | | |
| | Sprocket shaft bending | | | | | 0 ~ 0.06 | 2 | | |
| | Bearing collar-to-bushing clearance | | | | 95 | 0.12 ~ 0.228 | 0.5 | | |
| | Sprocket | O.D. | | D | 794 | | Wear on teeth 6 | |  |
| | | Root diameter | | $D_1$ | | | | | |
| | | Width | Tip | B | | | | | |
| | | | Root | $B_1$ | 75 | | | | |
| | Track | Pitch | | P | 175 | | | |  |
| | | Bushing-to-link-fit | | | 55 | 0.214 ~ 0.11 | | | |
| UNDERCARRIAGE | Track guage | | | | 1600 | | | |  |
| | Bearing (idler shaft support) guide width | | | A | 96 | | | 100 | |
| | Exide plate width | | | B | 94 | | | 90 | |
| | Cover-to-plate clearance | | | C | | 1 | 3 | | |
| | Bearing (idler shaft support)-to-plate clearance | | | D | | 2 | 5 | | |
| | Idler | O.D. (ridged part) | | A | 720 | | | | |
| | | Tread diameter | | B | 680 | | 670 | 665 | |
| | | Width | Ridged part | C | 80 | | 72 | 68 |  |
| | | | Tread | D | 39.5 | | 43.5 | 45.5 | |
| | | | Overall width | E | 164 | | | 154 | |
| | Idler shaft-to-bushing clearance | | | | 60 | 0.25 ~ 0.364 | 1.5 | | |
| | Idler shaft flange width | | | | 20 | | | 18.5 | |
| | Idler shaft end play | | | | | 0.35 ~ 0.80 | 1.5 | | |
| | Carrier roller | O.D. of ridged part | | A | 190 | | | | |
| | | Tread O.D. | | B | 165 | | 144 | 135 |  |
| | | Width of ridged part | | C | 80 | | 74 | | |
| | | Tread width | | D | 43 | | 46 | 58 | |
| | Carrier roller shaft-to-bushing clearance | | | | 45 | 0.150 ~ 0.239 | 1 | | |
| | Carrier roller shaft end play | | | | | 0.100 ~ 0.275 | | | |

# MAINTENANCE STANDARDS

Unit : mm

| Unit | Items to be Inspected | | | | Basic Size | Standard clearance | Clearance limit or re-use limit | Service limit | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| UNDER CARRIAGE | Track roller | O.D. (ridged part) | | A | 233 | | | 220 |  |
| | | | | A | 227 | | | 215 | |
| | | Tread O.D. | | B | 200 | | 190 | 185 | |
| | | Tread width | | C | 47 | | 52 | 53 | |
| | | | | C | 43.5 | | 48.5 | 49.5 | |
| | | Flange width | | D | 19 | | 14 | 11 | |
| | | | | D | 18 | | 13 | 10 | |
| | Track roller shaft-to-bushing Clearance | | | | 60 | 0.25 ~ 0.364 | 1 | | |
| | Track roller shaft end play | | | | | 0.25 ~ 0.90 | 1.5 | | |
| | Track roller shaft flange width | | | | 16 | | | | |
| | Recoil spring | Free length | | | 648 | | | | |
| | | As-installed length | | | 510 | | | | |
| | | As-installed tension (kg) | | | 8700 | | | | |
| | Idler adjusting cylinder-to-bushing clearance | | | | 90 | 0.250 ~ 0.372 | | | |
| | Idler-to-idler distance | | | | 1600 | ± 8 | | | |
| | Track | Pitch | | | 175 | | 178 | 183 | |
| | | Link height | | | 101.5 | | 96.5 | | |
| | | Grouser height | Height of single grouser | | 50 | | 25 | 15 |  |
| | | | Semi-double grouser | A | 50 | | 25 | | |
| | | | | B | 45 | | | 20 | |
| | Idler-to-idler distance | | | | 1600 | ± 8 | | | |

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