LeTOURNEAU
WESTINGHOUSE

MODEL B TOURNAPULL®

MAINTENANCE AND REPAIR MANUAL

LeTOURNEAU-WESTINGHOUSE COMPANY
A Subsidiary of Westinghouse Air Brake Company
Peoria, Illinois, U.S.A.

FOREWORD

The Maintenance and Repair Manual is especially designed for use by mechanics. The material is arranged for easy reference and logical sequence of detail. The first section contains brief instructions on how to operate the machine, its specifications, and torque chart. (For a more complete explanation, refer to the Operator's Manual.)

The greater portion of the manual pertains to disassembly, service, and reassembly. Each major mechanical division is dealt with individually. For example: The disassembly, service, and reassembly of the radiator group is discussed as a unit. The same is true of the engine and engine accessories, the final drives and so on throughout the entire mechanical detail of the machine. Thus, if you have a repair problem on your machine, all material pertaining to that part or parts will be grouped together in one section, ready for your quick reference and use.

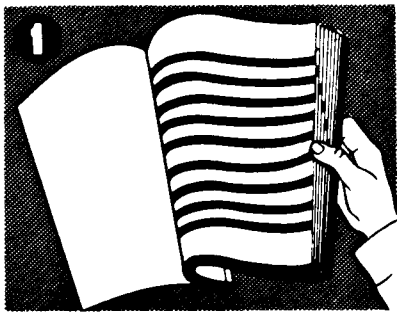
The illustrations used in this manual are typical of the component shown and do not necessarily refer to any one particular machine.

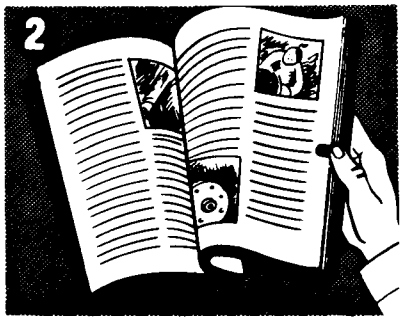
How to use Table of Contents

To save you time and also make it easy for you to find the information needed, each section in this manual has been indicated with a tab.

To quickly find each section, follow these two steps:

1. Hold manual in your right hand . . . flex book (as illustrated in figure 1) so you can see corresponding black tabs printed down right hand edges of inside pages.
2. Slide thumb down edge of manual to section desired . . . and open (see figure 2.)





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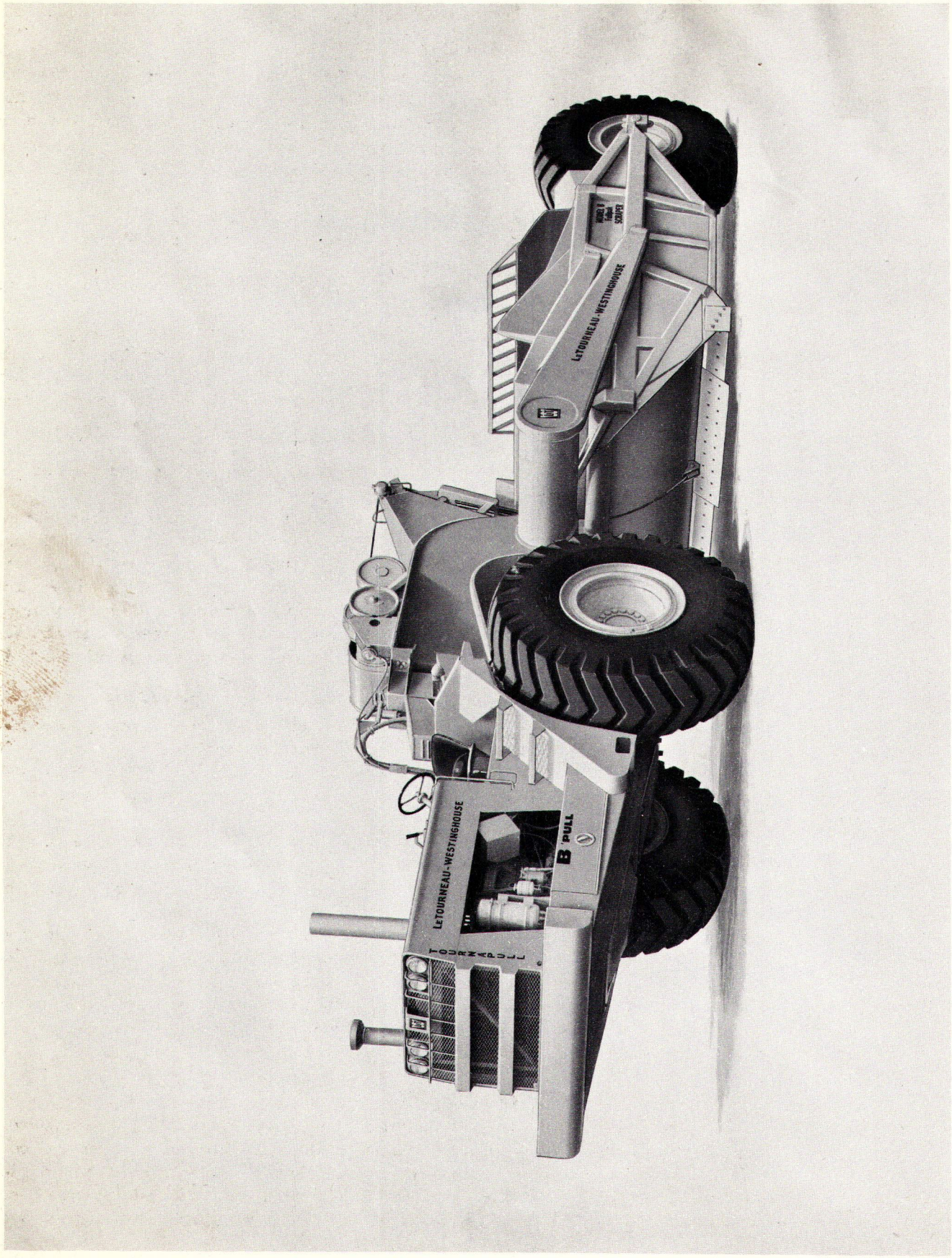


FIGURE A-1. MODEL B TOURNAPULL AND SCRAPER

MODEL B TOURNAPULL

GENERAL INFORMATION

The Model B Tournapull is a two wheeled prime mover which becomes a highly versatile and efficient tool when connected to one of the interchangeable trail units.

The Tournapull may be powered by one of two full diesel engines: GM 6-110, 6 cylinder, 2 cycle, maximum brake horsepower of 325 at 2000 RPM; or Cummins NRTO-6-BI, 6 cylinder, 4 cycle, maximum brake horsepower of 335 at 2100 RPM.

An alternating current generator, mounted in line with and driven by the engine provides electrical power for the operation of the steering motor and trail unit control motors. The generator is a 3 phase, 120 cycle type and develops 300 volts of alternating current at 1800 RPM.

Large 27.00-33, tapered bead, pneumatic tires provide maximum flotation and traction. The tapered beads grip the wheel rims with almost double the contact surface of the conventional flat bead tires.

A torque proportioning differential distributes the engine power to the best tractive advantage. The design of this differential keeps driving force at the wheel having the best traction.

The power shift transmission is hydraulic and combines a torque converter with planetary range gearing. Four speeds forward and two speeds reverse are obtained by moving the selector lever in the cockpit.

Although the shifts are manually controlled, lockup occurs automatically in 2nd, 3rd, and 4th speeds forward. This automatic lockup eliminates converter slippage at hauling speeds. With the engine RPM's above 1850 and the transmission in 2nd, 3rd, or 4th range, when torque multiplication is not needed, the unit is automatically put in direct drive. When the RPM's drop below 1850, the lockup automatically disengages, bringing the torque converter into use.

Also included in the transmission is a hydraulic retarder for constant braking power on down hill hauls. The hydraulic retarder develops up to six times the braking force obtained by using the engine alone. Caution should be exercised, however, not to let the engine overspeed in any range. The planetary gearing is a compound planetary gear train which is in constant mesh. The gear train is controlled by 6 multiple disc, oil cooled, friction clutches. These clutches are hydraulic applied and spring released. The clutch discs automatically compensate for wear and no adjustment is necessary.

A heavy duty step gear transmission is also available.

The step gear transmission and auxiliary transmission provide 10 speeds forward and 2 speeds in reverse. The auxiliary has two positions, high range, and low range. These positions provide "half steps" between the transmission gear ranges. The flywheel clutch is a heavy duty, double disc type and is located between the generator and the transmission.

The steering, and the movement of the trail unit components is accomplished by reversible a.c. electric motors. The motors are operated by control switches in the Tournapull cockpit. These motors are instantly reversible and are equipped with automatic, spring engaged, disc brakes which hold the load in whatever position it is in when the motor is stopped.

The Tournapull has electrically controlled steering, using an electric motor and gear reduction box to turn the machine through arcs of 90 degrees right or left from the straight ahead position. The motor is controlled by the steering wheel in the cockpit.

The wheels are equipped with multiple disc, air actuated, spring released brakes. Operation of the brakes is controlled by a foot application valve located on the cockpit floor.

The instrument panel is in the cockpit in front of the operator's seat. All switches, gauges, and instruments necessary for the operation of the Tournapull and trail unit are located on the instrument panel.

DRIVE SYSTEM

POWER SHIFT TRANSMISSION

The rotating engine flywheel is attached to and drives the generator rotor and the secondary flywheel which is attached to the rear of the generator rotor. The flexible drive disc of the transmission is fastened to and is driven by the secondary flywheel. This drive disc drives the torque converter pump. Here the rotation is transferred to the oil in the converter that drives the converter turbine. The converter output shaft carries the rotation to the various planetary range gears and clutches. Here, by shifting to the desired gear range, the rotation is transferred to the transmission output shaft, through the drive shaft and

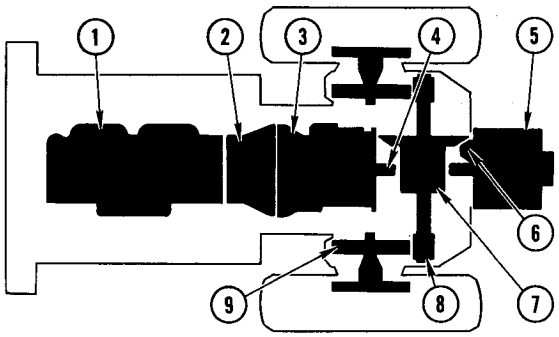


FIGURE A-2. POWER SHIFT TRANSMISSION DRIVE SYSTEM

1. Engine
2. Generator
3. Transmission
4. Drive Shaft
5. Transfer Case
6. Output Pinion
7. Differential
8. Final Drive Pinion
9. Final Drive Gear

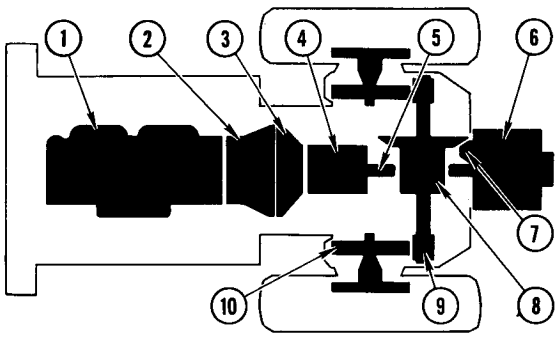


FIGURE A-3. STEP GEAR TRANSMISSION DRIVE SYSTEM

1. Engine
2. Generator
3. Flywheel Clutch
4. Transmission
5. Drive Shaft
6. Auxiliary Transmission
7. Output Pinion
8. Differential
9. Final Drive Pinion
10. Final Drive Gear

transfer case to the pinion. The output pinion is in mesh with the ring gear on the differential. The rotation is carried from the output pinion through the ring gear and differential to the final drive pinions and final drive gears to the axles and wheels.

STEP GEAR TRANSMISSION

The rotating engine flywheel is attached to and drives the generator rotor and the secondary flywheel which is attached to the rear of the generator rotor. The transmission clutch is attached to and driven by this flywheel.

Power is transferred from the secondary flywheel, through the engaged clutch to the transmission. From the transmission, power goes to the auxiliary transmission at the rear of the machine by means of a drive shaft.

The spiral bevel pinion on the auxiliary transmission output shaft drives the spiral bevel ring gear and differential assembly. The differential assembly drives the final drive pinions which in turn rotate the final drive gears. The final drive gears are splined to the final drive axles and transfer the rotation and power to the drive wheels.

ELECTRICAL SYSTEM

When a control switch on the instrument panel is closed, or when the steering wheel is turned, the main switch (in the circuit between the generator and the motor controlled by the closed circuit) is closed and the motor operates.

While the motor is operating the motor brakes are automatically released. As soon as the operation ceases the brakes are automatically engaged, thereby holding the load. Electric current is always available when the engine is running and the generator is excited. (D.C. main switch on.)

Keep the engine operating at as near idle as possible when operating any of the a.c. electric motors. This assures that maximum efficiency is being obtained.

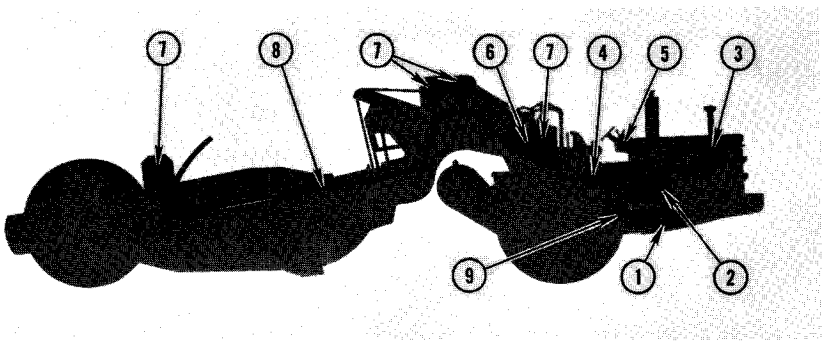


FIGURE A-4. ELECTRICAL SYSTEM

1. Batteries
2. Generator
3. Rectifiers
4. Transformer
5. Instrument Panel
6. Switch Panel
7. Motor
8. Conductor
9. D.C. Field Breaker Switch

PREPARING NEW UNIT FOR OPERATION

GENERAL

Inspect machine thoroughly for external appearance and possible damage or theft during shipment. Report any damage or shortage to railroad or carrier.

Remove all processing, protective material or packing used to condition the machine for shipment. Detach tools or bundles wired to the machine. Check condition and amount of tools against packing list.

Check all lubrication points.

Check level of fuel oil in supply tank.

ENGINE AND ACCESSORIES

Fill radiator, check coolant. (Anti-freeze in winter.)

Check drive belt adjustments.

Drain off small amount of fuel from the fuel filters to remove water or sludge.

Check oil level in air cleaners.

Check for water, oil, fuel or air leaks, before starting and during operation of engine.

Refer to engine manufacturer's manual for initial starting instructions.

Check engine shut-off control (if equipped).

Start engine, observe operation. Check for any unusual noise or abnormal engine performance.

Check engine oil pressure at pressure gauge on instrument panel.

Check temperature of coolant at temperature gauge.

TRANSMISSION

Check power shift transmission oil level. Refer to Section "K" for correct procedure.

Check flywheel clutch adjustment (step gear transmission only).

Check oil level of step gear transmission.

Check transmission for correct operation at all speeds.

Check temperature and pressure of oil in the power shift transmission.

FINAL DRIVES

Check oil level in final drive and ring gear compartments.

BRAKES

Check for air leaks in air brake lines.

Check brakes for proper operation.

WHEELS AND TIRES

Check tire pressure (at atmospheric temperature). See Section "H" for correct tire pressures.

Check wheel bolts for tightness. Check each shift for first few days of operation and then intermittently thereafter.

ELECTRICAL SYSTEM

Check all electrical connections for tightness.

Check level of electrolyte in batteries.

Check specific gravity of battery electrolyte.

Check operation of lights and accessories.

Check ammeter on instrument panel. The ammeter should show a charge with no load on the electrical system and the engine at high idle (D.C. main switch on).

Check operation of limit switches and A.C. electric motors.

MISCELLANEOUS

Check air pressure gauge on dash panel. For proper operation the air pressure should be from 90 to 120 pounds per square inch for the Tournapull with scraper, and between 130 and 145 pounds per square inch for the Tournapull with rear dump.

Hook up wire ropes to trail units.

Check trail unit hitch bolts for tightness. Check each shift of operation for the first few days and then intermittently thereafter.

OPERATING INSTRUCTIONS

The instructions which follow are intended to acquaint the mechanic with the instruments and controls and their proper use in operating the Model B Tournapull and trail units.

It is imperative that the mechanic understands the function and operation of each of the instruments and controls. This knowledge is essential for the proper maintenance and safe operation of the machine, which will give longer machine life with less unproductive down time.

Instrument Panel

CRANKING MOTOR SWITCH

The cranking motor switch (1) opens and closes the circuit to the cranking motor solenoid. Press the switch to operate the cranking motor. The cranking motor delivers the initial momentum to the engine necessary for its starting.

For machines with Cummins engines, the cranking motor switch also closes the circuit to the fuel shut-off solenoid which controls the flow of fuel to the engine injectors.

FRONT LIGHT SWITCH

The front light switch (2) controls the front

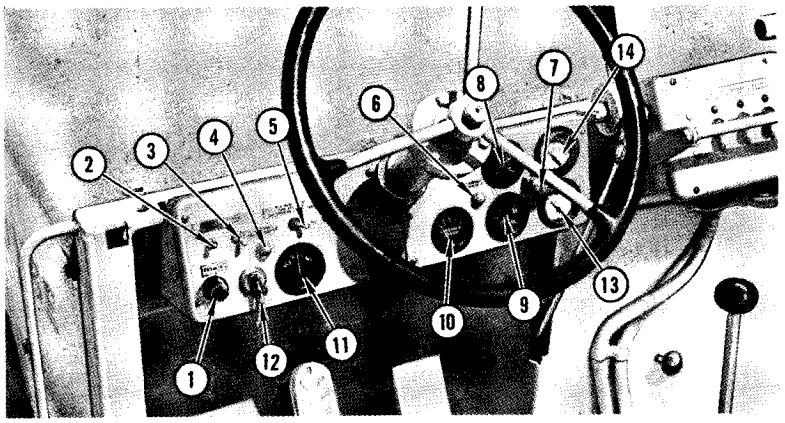


FIGURE A-5. INSTRUMENT PANEL

1. Cranking Motor Switch
2. Front Light Switch
3. D.C. Main Switch
4. D.C. Main Switch Warning Light
5. Rear Light Switch
6. Steering Motor Warning Light
7. Air Horn Control Valve
8. Engine Temperature Gauge
9. Air Pressure Gauge
10. Engine Oil Pressure Gauge
11. Ammeter
12. Key Switch
13. Transmission Temperature Gauge
14. Transmission Oil Pressure Gauge

lights. The light switch is a three position, toggle type switch. The switch is off when toggle is centered. The lights are of the double filament type with a high and a low beam. Move the toggle up for high beam and down for low beam.

D.C. MAIN SWITCH

The D.C. main switch (3) opens and closes the 24 volt basic excitation circuit to the a.c. generator. When the toggle is to the left, the circuit is closed (on), when the toggle is to the right the circuit is open (off). The switch must be on before any of the a.c. electric motors can be operated. Open the switch when idling the engine for long periods to prevent unnecessary drain on the storage batteries.

D.C. MAIN SWITCH WARNING LIGHT

The D.C. main switch warning light (4) remains on at all times when the D.C. main switch is on.

REAR LIGHT SWITCH

The right light switch (5) controls the light on the trail unit. Lift the toggle up to turn on the light, push the toggle down to turn off the light.

STEERING MOTOR WARNING LIGHT

The steering motor warning light (6) remains on at all times unless the temperature of the steering motor exceeds the safe operating range. Should the light go off, allow a short interval for the motor to cool and the light to come on again before resuming operation. Should the light continue to go off at short intervals, the trouble should be located and corrected.

AIR HORN CONTROL VALVE

The air horn control valve (7) operates the air horns which are located under the hood. Press in on the valve to operate the horns.

ENGINE TEMPERATURE GAUGE

The engine temperature gauge (8) indicates the temperature of the coolant in the engine's cooling system. The temperature range after the engine has been warmed up and is operating under normal conditions should be from 160 to 185° F.

AIR PRESSURE GAUGE

The air pressure gauge (9) indicates the amount of compressed air in the air supply tank, in pounds per square inch. Correct operating pressure for the Tournapull with scraper is 90 to 120 p.s.i., and 130 to 145 p.s.i. for Tournapull with rear dump.

ENGINE OIL PRESSURE GAUGE

The engine oil pressure gauge (10) indicates the pressure, in pounds per square inch, of the oil in the engine's pressure lubricating system. Normal operating pressure, after engine warm up, and at operating speed is as follows:

GM 6-110 ..... 25 p.s.i.
Cummins NRTO-6-BI .. 30 to 50 p.s.i.

AMMETER

The ammeter (11) indicates the rate of charge or discharge of the storage batteries. At high idle with no load on the electrical system the ammeter should register a charge, when the D.C. main switch is closed.

KEY SWITCH

The key switch (12) opens and closes the 24 volt circuit to the cranking motor switch. Also the basic excitation circuit to the D.C. main switch. To start engine turn the switch to the on position, completing the circuit to the cranking motor switch.

For machines with Cummins engines only, turn key switch to the off position to stop the engine. This opens the circuit to the fuel shut-off solenoid, stopping the flow of fuel to the engine.

TRANSMISSION TEMPERATURE GAUGE

The transmission temperature gauge (13) indicates the temperature of the hydraulic fluid in the power shift transmission. Normal operating range is from 100 to 250° F.

TRANSMISSION OIL PRESSURE GAUGE

The transmission oil pressure gauge (14) indicates the pressure of the hydraulic fluid in the power shift transmission. Normal operating range is from 100 to 225 pounds per square inch.

HOURMETER

The hourmeter (Fig. A-6) indicates the number of hours of engine operation. Instructions on how to use are as follows:

Example:

1st digit, 10,000 hour track

Short hand is pointing between 1 and 2. The first digit will be 1.

2nd digit, 1,000 hour track

The next longer hand is pointing between 2 and 3. The second digit will be 2.

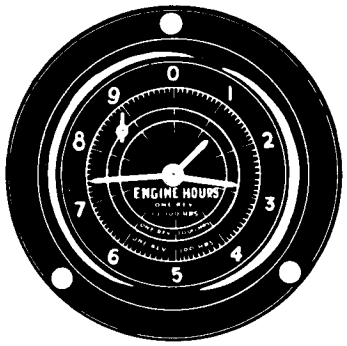


FIGURE A-6. HOURMETER

3rd digit, 100 hour track

The longest hand is pointing between 7 and 8. The third digit will be 7.

4th digit, 100 hour track.

In order to get the last digit the outer track has ten graduations between any two numbers. Each graduation is equal to one hour. Again reading the longest hand, it will be noted that it is 4 graduations past the number 7. The last digit will be 4. The total then recorded on the hourmeter will be 1,274 hours.

Cockpit

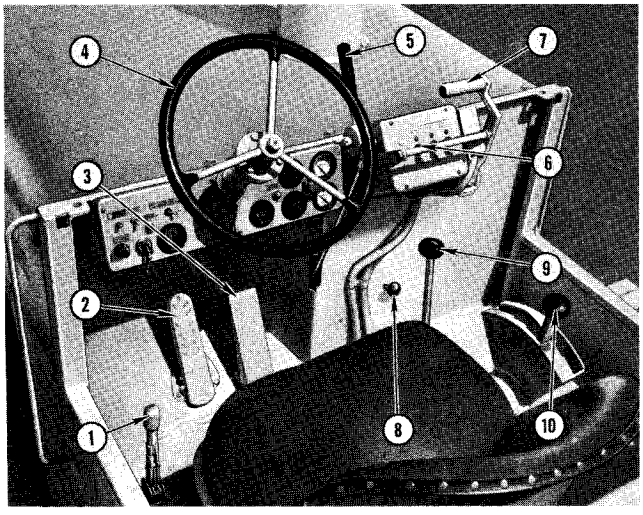


FIGURE A-7. POWER SHIFT COCKPIT

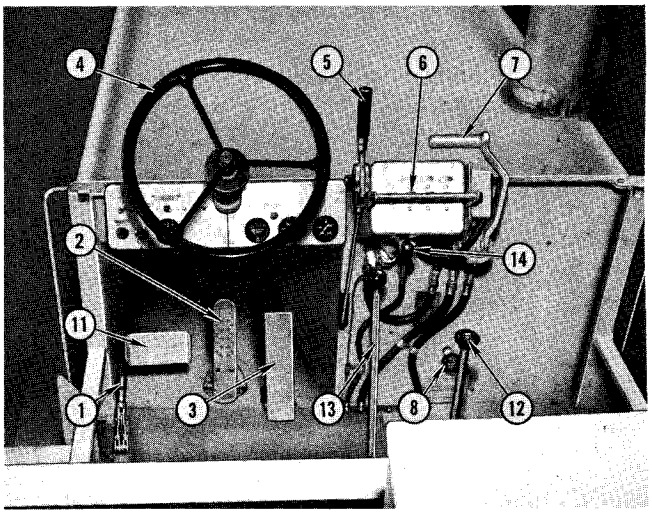


FIGURE A-8. STEP GEAR COCKPIT

1. Parking Brake Lever
2. Brake Pedal
3. Accelerator
4. Steering Wheel
5. Hand Throttle
6. Motor Control Switches
7. Quick Release Lever
8. Cold Weather Starting Aid
9. Hydraulic Retarder Control
10. Transmission Control Lever
11. Clutch Pedal
12. Transmission Shift Lever
13. Auxiliary Shift Lever
14. Clutch Brake Pre-Select Valve

PARKING BRAKE LEVER

The parking brake lever (1) operates a cable operated, band type brake over a drum that is attached to, and revolves with, the auxiliary transmission or the transfer case input shaft. To apply brake, pull lever back. To release the brake, push lever forward.

BRAKE PEDAL

The brake pedal (2) operates a metering type air valve controlling air flow to the wheel brakes for slowing and stopping the machine.

ACCELERATOR

The accelerator (3) controls the rate of flow of fuel oil to the diesel engine. To increase engine speed, press the accelerator pedal down. To decrease the engine speed, release the pressure on the accelerator pedal.

STEERING WHEEL

The steering wheel (4) operates the switches which control the reversible a.c. electric motor,

which turns the Tournapull. To turn either right or left turn the steering wheel in the direction of the turn desired. The Tournapull will not automatically return to the "straight ahead" position when the wheel is released. The wheel must be turned in the opposite direction to bring the Tournapull back in line with the trail unit. To stop the turning action of the Tournapull, stop turning the wheel. The steering motor will continue to operate, up to the limit of turn, as long as the steering wheel is held in the turning position.

HAND THROTTLE

The hand throttle (5) is connected to the accelerator linkage and may be used to maintain a fixed engine speed without use of the accelerator.

MOTOR CONTROL SWITCHES

The motor control switches (6) control the operation of the electric motors which in turn control the operation of the trail unit. Pushing the switch up results in an upward or forward movement. Pushing the switch down results in a downward or rearward movement.

QUICK RELEASE LEVER

The quick release lever (7) operates the quick drop assembly on the scraper body cable drum. The lever is interconnected with the hoist motor control switch. Pushing the lever forward releases the quick drop permitting the scraper body to drop free. Pulling the lever back closes a control switch and completes the circuit to the hoist motor, which raises the bowl. To lower the body slowly use the hoist control switch on the control panel. The hoist control switch can also be used to raise and lower the body, independently of the quick release lever.

COLD WEATHER STARTING AID

The cold weather starting aid (8) is a tank type primer for cold weather starting.

HYDRAULIC RETARDER CONTROL

The hydraulic retarder control (9) applies the retarder when pulled back, and releases it when pushed forward.

TRANSMISSION CONTROL LEVER

The transmission control lever (10) is used for gear range selection on machines equipped with power shift transmissions.

CLUTCH PEDAL

The clutch pedal (11) is a foot operated pedal which disengages or engages the flywheel clutch on machines with step gear transmission. Depressing the pedal disengages the clutch, releasing the pedal engages the clutch.

TRANSMISSION SHIFT LEVER

The transmission shift lever (12) extends upward from the deck of the cockpit to the right of the operator. The shift lever is used in conjunction with the flywheel clutch to select the various transmission gear ratios.

AUXILIARY SHIFT LEVER

The auxiliary shift lever (13) extends upward through the cockpit deck to the right and forward of the operator. The lever is used to select the desired auxiliary gear range. When the lever is forward the auxiliary is in the low range. Move the lever to the rear for high range. See "Changing Speeds" for correct procedure.

CLUTCH BRAKE PRE-SELECT VALVE

The pre-select valve (14) delivers air pressure to the clutch brake interlock valve to aid in up shifting the transmission from one gear to another.

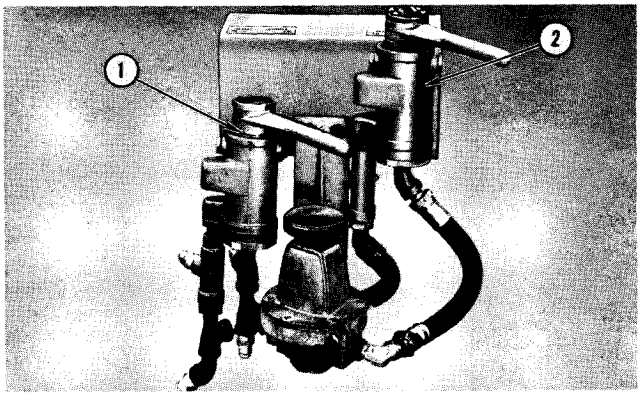


FIGURE A-9. REAR DUMP HAND BRAKE VALVES
1. Tournapull Brake Valve 2. Rear Dump Brake Valve

HAND BRAKE VALVES

The hand brake valves (Fig. A-9) control the flow of air to the Tournapull and trail unit wheel brakes, independently of the foot pedal. By moving the left valve handle to the left (on) the Tournapull brakes are applied independently of the trail unit. By moving the right valve handle to the left (on) the trail unit brakes are applied independently of the Tournapull. With both valve handles moved to the right (off) the foot valve controls all four brakes.

Starting the Engine

Read and follow carefully the instructions outlined in the engine manufacturer's manual.

Check to be sure emergency shut off control is pushed all the way in (if machine is so equipped).

Shift transmission lever into the neutral position. Turn on the key switch. Push left on the d.c. main switch—press accelerator about half way down, and press the cranking motor switch.

NOTE: Do not operate the cranking motor more than 30 seconds at one time.

Pushing the d.c. main switch to the "on" position is not necessary for the starting of the engine. However, if the machine is to be moved immediately after starting it is advisable to turn the d.c. main switch on before starting. The d.c. main switch controls the basic excitation circuit to the generator, without which the steering and control motors will not operate. When idling the engine for long periods it is advisable to turn the switch off to prevent unnecessary drain on the storage batteries. Be sure switch is turned off when the machine is not operating. Run engine at a speed as near 1800 RPM as possible when operating any of the electric motors.

As soon as the engine starts, release the cranking motor switch and throttle the engine down to idling speed until the engine temperature reaches approximately 160° F.

Do not move machine until correct air pressure has been built up in the air supply tank. Turn the d.c. main switch on before attempting to move the machine, the steering motor will be inoperative until the a.c. generator is producing current.

COLD WEATHER CONDITIONS

Read and follow carefully the instructions outlined in the engine manufacturer's manual.

Check to be sure emergency shut off control is pushed all the way in (if machine is so equipped).

Shift transmission lever into the neutral position.

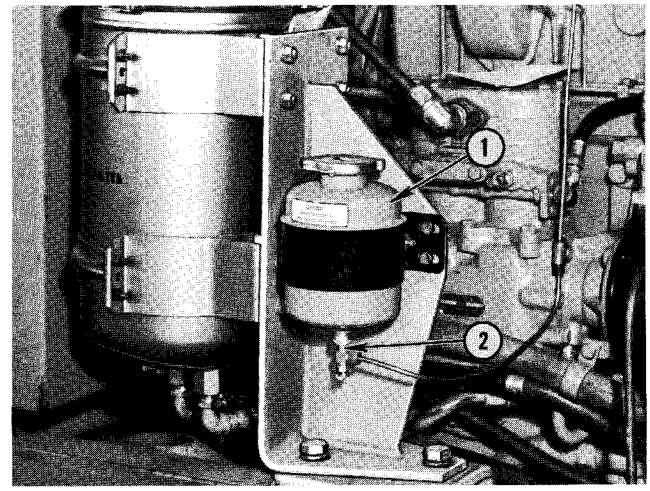


FIGURE A-10. COLD WEATHER STARTING AID TANK
1. Tank 2. Shut Off Valve

Open the valve at the bottom of the starting fluid tank. This tank is located next to the Luber-Finer lubricating oil filter.

Turn on the key switch. Push left on the d.c. main switch. Press accelerator about half way down and press the cranking motor switch. When the cranking motor has become engaged, pull back on the pump plunger and then push the plunger in slowly until the engine starts. If the plunger is not all the way in when the engine starts, push it in very slowly until it locks in. Close the valve at the bottom of the supply tank.

Stopping the Engine

For Cummins engines, throttle engine down to idling speed for a few moments to cool it before stopping. Turn the key switch to the off position. Turn off the d.c. main switch.

For GM engine, throttle the engine down to idling speed for a few moments to reduce engine temperature. Push the hand throttle forward as far as it will go, or press down on the rear of the accelerator pedal with heel until engine stops running. USE ENGINE SHUT OFF CONTROL IN EMERGENCY ONLY. Push right on the d.c. main switch to break the excitation circuit to the a.c. generator. Turn off key switch.

Steering and Braking

The Tournapull is steered by a reversible a.c. electric motor. This motor is controlled by the main switches which are activated by turning the steering wheel.

The steering system is independent of the drive wheels and includes a steering wheel, a.c. electric motor, gear reduction box, and pinion mounted on the steering kingpin housing. A ring gear which is attached to the Tournapull is driven by the gear box pinion, turning the Tournapull to the right or left with respect to the kingpin housing and trail unit. Since steering clutches are not used, there is no reduction of power to either of the drive wheels in turning. Instead, the independent steering permits the differential to proportion full power to the drive wheels.

The Tournapull and trail units are equipped with disc type air brakes. Two types of discs are used in the brake—internally splined steel discs secured to the stationary brake hub, and externally splined, lined discs which turn with the wheels.

With the air applied, the discs are forced together and the friction created between the discs slows up or stops the rotation of the wheels. The amount of pressure applied against the brake pedal determines the amount of pressure applied against the brake discs and thus the abruptness of

the stop. Springs release the brake after the foot is removed from the brake pedal and the air pressure is released.

Machines equipped with power shift transmissions have a hydraulic retarder brake included as part of the torque converter and transmission. A torque limiting valve protects the transmission from absorbing excessive brake horsepower. However, machine speed on downgrades should not be permitted to become so great as to overspeed the engine in any of the gear ranges. The retarding force developed by the brake is up to 6 times greater than that available by using the engine alone.

Changing Speeds

POWER SHIFT TRANSMISSION

The power shift transmission may be up shifted or down shifted with the engine at high idle regardless of the load. However, a down shift should not be made if the MACHINE SPEED exceeds the MAXIMUM SPEED that can be attained in the next lower range. Down shifting under this condition will overspeed the engine and cause serious damage.

The transmission control lever has seven positions, 4 positions forward, neutral, and 2 positions reverse. The positions are clearly marked on the shifting quadrant.

To select a gear range, move the control lever to the desired position marked on the quadrant.

For smoother operation of the machine, progressive shifting is recommended. Do not skip positions when up shifting or down shifting.

STEP GEAR TRANSMISSION

Following are some suggested practices for the operator when shifting from one gear ratio to another. The actual shifting procedure to be followed depends upon the operator's technique which will improve with practice.

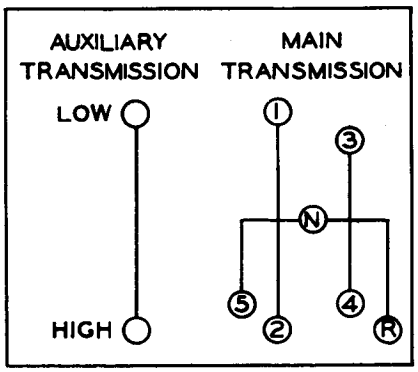


FIGURE A-11. SHIFTING DIAGRAM (STEP GEAR)

The auxiliary transmission provides intermediate gear ratios between the transmission gear ranges. For example: transmission in first speed, auxiliary in high range, obtains a speed between first speed (transmission), low range (auxiliary), and second speed (transmission), low range (auxiliary). These intermediate steps in speed range can be obtained through all five transmission speed ranges by combination shifting of the transmission and auxiliary.

Always disengage the clutch completely before changing gears.

A clutch brake is mounted on the transmission countershaft to aid in shifting gears. This clutch brake is to be used only when shifting the transmission into a higher gear. Do not use when down shifting.

To shift out of neutral into 1st speed forward or reverse use the following procedure. Depress the clutch pedal to disengage the flywheel clutch. Push in on the clutch brake pre-select button. Shift the transmission into 1st or reverse immediately after pushing in on the pre-select button. This is necessary as the clutch brake is only applied momentarily while the transmission is in neutral.

To up shift into a higher travel speed use the following procedure. Push in on the clutch brake pre-select button. Depress clutch pedal. Shift the transmission shift lever or auxiliary shift lever into the desired position.

To down shift to a lower travel speed it is necessary to "double clutch".

To "double clutch" when shifting to a lower gear range, depress the clutch pedal and shift the transmission into neutral. Engage the clutch (with transmission still in neutral), accelerate the engine to a speed which corresponds to road speed in the lower gear. Disengage the clutch, shift transmission into the lower gear range, then engage the clutch and accelerate the engine simultaneously.

Drive down grades! Keep the transmission in gear and the clutch engaged. Coasting with the transmission in neutral will cause the countershaft to spin at excessive speed far beyond the speeds encountered during normal operation. The countershaft gears move at such a low speed in comparison to the mainshaft that they are unable to provide an oil circulating pump action adequate enough to supply the lubrication necessary for the mainshaft gear bushings. Bushing failure will probably result.

For smoother operation of the machine progres-

sive shifting is recommended. Do not skip gears when up shifting or down shifting.

If the clutch is disengaged with the transmission in gear while the machine is coasting downgrade, and then re-engaged again it will cause a sudden slow down resulting in a shock load on the transmission gears, thus causing abnormal strain. Ultimate failure will result.

The shifting diagram (Fig. A-11) shows the various positions of the gear shift lever and auxiliary shift lever used to obtain the different gear ratios.

TOOLS

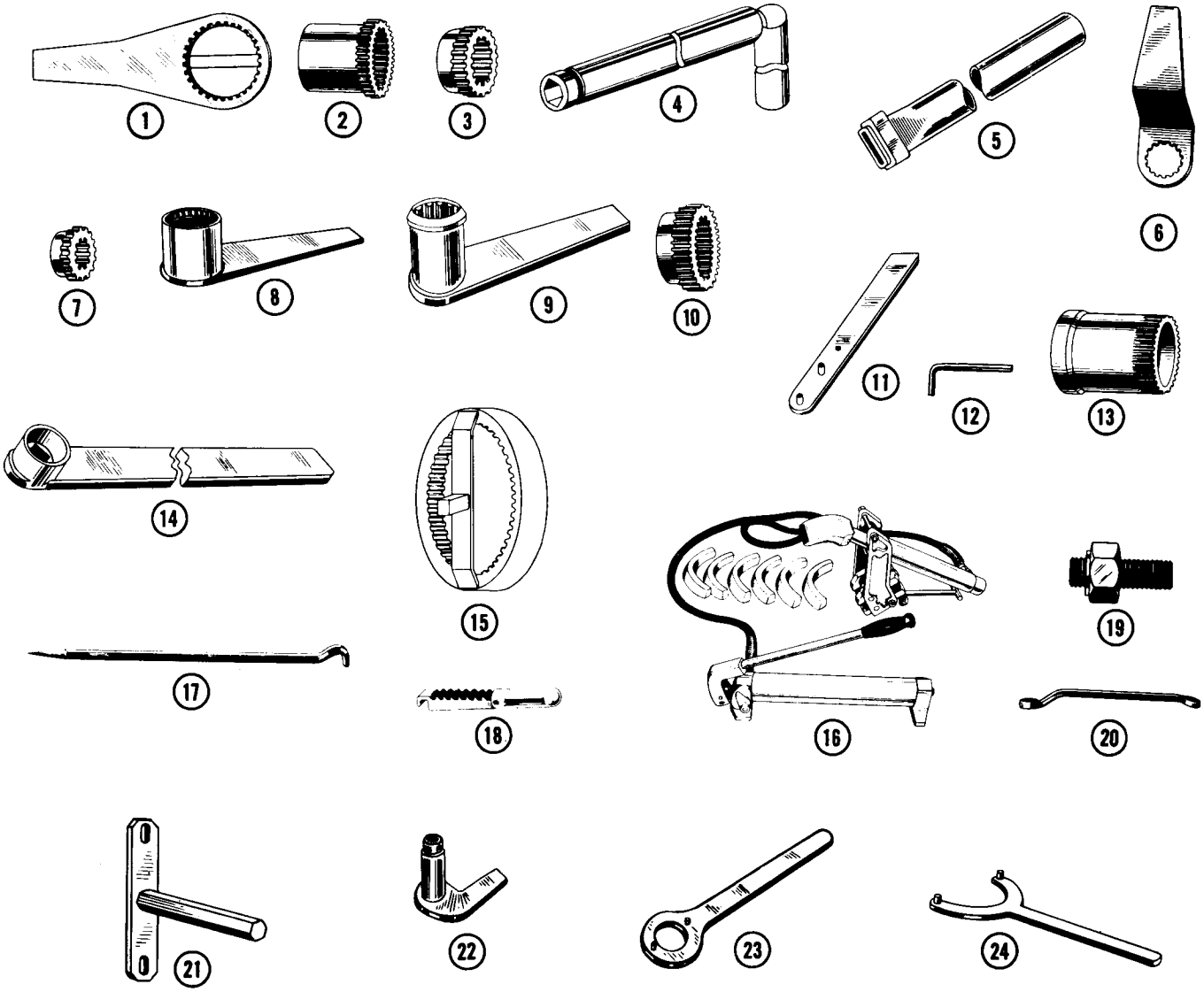


FIGURE A-12. TOOLS

1. Wrench—30 Tooth Spline (For Axle Nut, Bevel Pinion, Generator Nut and #3 Gear Box Output Shaft Nut)
2. Adaptor—30 Tooth Male and 25 Tooth Female Spline (For Axle Nut)
3. Adaptor—25 Tooth Male and 14 Tooth Female Spline (For Motor Retainer and Brake Hub Nut)
4. Wrench—1¾" Hex (For Wheel Bolt)
5. Wrench Extension
6. Wrench Handle—19 Tooth Spline (For #3 Gear Box 1st Reduction Gear Nut
7. Adaptor—16 Tooth Male and 11 Tooth Female (Use With #6)
8. Wrench—42 Tooth Spline (For Differential Adjusting Nut)
9. Wrench—19 Tooth Spline (For Bevel Pinion and #3 Gear Box 1st Reduction Gear Nut)
10. Adaptor—30 Tooth Male and 22 Tooth Female Spline (For Generator Nut)
11. Spanner Wrench (For #3 Gear Box Bearing Retainer)
12. Allen Wrench—½"
13. Adaptor—30 Tooth Male and 30 Tooth Female Spline (For Bevel Pinion and #3 Gear Box Output Shaft Nut)
14. Wrench—1⅝" Socket (For Kingpin Ball Cap)
15. Wrench—42 Tooth Spline (For Kingpin Top Nut)
16. Hydraulic Tire Removal Tool
17. Tire Removal Bar
18. Tire Removal Ratchet
19. Adaptor—Valve Stem
20. Box Wrench—12 Point, ⅞" x 1" (For Generator To Primary Flywheel)
21. Wrench—(For Electric Motor Brake)
22. Steering Mechanism Taperhead Wrench (Left and Right Hand)
23. Transmission Clutch Shaft Locknut Wrench
24. Quick Release Drum Locknut Wrench

TORQUE CHART

LOCATION	TORQUE
A.C. Motor Bearing Retainer Nut	350 Ft. Lbs.
A.C. Motor Hub Locknut	300 Ft. Lbs.
Air Brake Mounting Capscrews	190 Ft. Lbs.
Air Brake Retainer Ring To Backing Plate Capscrews	30 Ft. Lbs.
Differential Cage Capscrews	285 Ft. Lbs.
Differential Carrier To Housing Bolts	870 Ft. Lbs.
Differential Bearing Cage Capscrews	285 Ft. Lbs.
Drive Shaft Retainer Nut (Castellated)	580 Ft. Lbs.
Final Drive Axle Locknut	2000 Ft. Lbs.
Generator Adaptor Locknut	1200 Ft. Lbs.
Generator Stator To Flywheel Housing Capscrews	40 Ft. Lbs.
#2 Gear Box Output Gear Locknut	2000 Ft. Lbs.
1st Reduction Gear Locknut	100 Ft. Lbs.
2nd Reduction Gear Locknut	200 Ft. Lbs.
#3 Gear Box Output Gear Locknut	2000 Ft. Lbs.
1st Reduction Gear Locknut	100 Ft. Lbs.
2nd Reduction Gear Locknut	200 Ft. Lbs.
Bearing Plugs	400 Ft. Lbs.
Bearing Retainer Capscrews	60-110 Ft. Lbs.
#6 Gear Unit Axle Nut	8000 Ft. Lbs.
Bearing Retainer Nut	200 Ft. Lbs.
Ring Gear to Differential Carrier Bolts	285 Ft. Lbs.
Rear Dump Axle Locknut	450 Ft. Lbs.
Steering Circle Gear Taperhead Capscrews	540 Ft. Lbs.
Steering Circle Gear Flathead Capscrews	360 Ft. Lbs.
Steering Trunnion Ball and Socket Capscrews	580 Ft. Lbs.
Transmission Mainshaft Rear Locknut	500 Ft. Lbs.
Transmission Clutch Shaft and Drive Gear Locknut	100 Ft. Lbs.
Trail Unit Hitch Bolts	1400 Ft. Lbs.
Trail Unit Ball and Socket Capscrews	360 Ft. Lbs.
Scraper Blade Bolts	265 Ft. Lbs.
Scraper Quick Release Drum Internal Gear Locknut	2000 Ft. Lbs.
Scraper Quick Release Drum Sun Gear Locknut	750 Ft. Lbs.
Wheel Mounting Capscrews	870 Ft. Lbs.

Capscrews and Nuts

Size	Flat Head	Taperhead
1/4"	8 Ft. Lbs.	12 Ft. Lbs.
5/16"	15 Ft. Lbs.	25 Ft. Lbs.
3/8"	30 Ft. Lbs.	45 Ft. Lbs.
7/16"	50 Ft. Lbs.	75 Ft. Lbs.
1/2"	70 Ft. Lbs.	105 Ft. Lbs.
9/16"	90 Ft. Lbs.	135 Ft. Lbs.
5/8"	125 Ft. Lbs.	190 Ft. Lbs.
3/4"	190 Ft. Lbs.	285 Ft. Lbs.
7/8"	265 Ft. Lbs.	400 Ft. Lbs.
1"	360 Ft. Lbs.	540 Ft. Lbs.
1 1/8"	450 Ft. Lbs.	675 Ft. Lbs.
1 1/4"	580 Ft. Lbs.	870 Ft. Lbs.
1 3/8"	690 Ft. Lbs.	1000 Ft. Lbs.
1 1/2"	850 Ft. Lbs.	1275 Ft. Lbs.

SPECIFICATIONS

LeTOURNEAU-WESTINGHOUSE COMPANY, whose policy is one of continuous improvement, reserves the right to change specifications or equipment without incurring obligation as to units previously sold.

TOURNAPULL

ENGINE (DIESEL)	CUMMINS NRTO-6-BI	GM 6-110
Number of Cylinders	6	6
Operating Cycle	4 Stroke	2 Stroke
Max. Brake Horsepower	335 HP at 2100 RPM	325 HP at 2000 RPM
HP Rated at	Below 5,000′	1,500′ at 90°
Maximum Torque	900 Ft. Lbs. at 1500 RPM	875 Ft. Lbs. at 1,600 RPM
Bore	5⅛″	5″
Stroke	6″	5.6″
Displacement	743 cubic inches	660 cubic inches

CLUTCH, Power Shift Transmission ..... Allison (Lock up type) Torque Converter
Step Gear Transmission ..... Rockford double plate 16″; air assist clutch release

TRANSMISSION, Optional
Power Shift Type ..... Allison CBT 5640, 4 speed Torqmatic with Torqmatic Brake
Step Gear Type ..... Fuller L-1520 with LeTourneau-Westinghouse two-speed Transfer Case

SPEED in MPH

	Power Shift Transmission	Step Gear Transmission at 2100 RPM	
	Speed	Low Range Speed	High Range Speed
1st, Forward	0 - 4.8	2.8	4.0
2nd	0 - 10.6	4.9	7.1
3rd	0 - 21.2	9.6	14.0
4th	0 - 31.7	16.8	24.5
5th		20.7	30.1
1st, Reverse	3.7	2.8	4.1
2nd	5.6		

DIFFERENTIAL ..... Power transfer, automatic friction type no-slip differential

SERVICE CAPACITIES (U.S. Standard Measurement)	CUMMINS NRTO-6-BI	GM 6-110
Cooling System	25 gals.	19¾ gals.
Crankcase	12 gals.	9 gals.
Fuel Tank	147 gals.	147 gals.
Final Drive (Main Case)	70 gals.	70 gals.
Step Gear Transmission	4 gals.	4 gals.
Allison Power Shift Transmission & Torque Converter	16 gals.	———
Transfer Case	1½ gals.	1½ gals.

SCRAPER

CAPACITY
Cubic Yards, heaped 28
Cubic Yards, struck 21
Tons 32.5

SCRAPER OPERATING DATA

Apron opening	7′ 1″
Depth of cut, maximum	Unlimited
Depth of spread, maximum	20″
Type of ejection	forward, positive
Cutting edge, length (three-piece)	10′ 0″
Center section	1⅛″ x 16″ x 60″
Each end section (interchangeable)	1″ x 13″ x 30″

CONTROLS — Apron, bowl and tailgate controlled by individual electric motors. Finger-tip control.

OVERALL MEASUREMENTS (With Tournapull)

Length	44′ 2″
Width	11′ 9″
Height	12′ 2″
Wheelbase	26′ 10″
Gauge, center to center tires, Tournapull	8′ 0″
Gauge, center to center tires, scraper	7′ 9″
Ground clearance, Tournapull	24″
Ground clearance, scraper maximum	19″

TIRES

Standard	27.00-33, 24 ply rating, Rock Service
Optional	27.00-33, 30 ply rating, Rock Service

STEERING — Positive power steer, electric control

Maximum turning angle	90° left and right
Width required for 180° turn	39′ 10″

BRAKES — Multiple disc air brakes on all four wheels

Square inches of braking surface	6,552
Torqmatic Brake for Torqmatic Transmission	Standard
Electrotarder	Optional
Parking Brake	standard, mechanical

WEIGHTS

Shipping weight, approximate		
Power shift transmission, lbs.	69,800	
Step gear transmission, lbs.	68,900	
Distribution	Empty	Loaded
Drive Axle	69%	53%
Rear Axle	31%	47%

REAR DUMP

CAPACITY

	Tons	Cu. Yds. Struck	Cubic Yards, Heaped 1:1	Cubic Yards, Heaped 2:1
Standard	35	23	31	27
With Tailgate*	35	24	33	30

*Note: Recommended only on installation where material permits a larger cu. yd. capacity without exceeding the maximum tonnage capacity.

REAR DUMP MEASUREMENTS

Length	22' 8"
Width, outside yoke	12' 0"
Height, empty	14' 0"
Height, extreme dump position	20' 4"
Loading height, average	10' 9"
Angle of dump	58°

BOWL MEASUREMENTS

Length	16' 3"
Width	10' 2"
Depth, Maximum	7' 0"

BODY CONSTRUCTION

Bottom	3 layer: ¾" steel bottom; 1½" steel reinforcing strips; ¾" steel wear plate.
Sides	½" plate with ¾" wear plate.
Front	¾" plate with ¾" wear plate.

HOIST ..... Dumping controlled by LeTourneau-Westinghouse electric motor, gear box and cable. Positive power up and down.

OVERALL MEASUREMENTS (With Tournapull)

Length	36' 7"
Length, dump position	31' 6"
Width	12' 6"
Height	14' 0"
Height, dump position	20' 4"
Wheelbase	20' 8"
Wheelbase, dump position	12' 4"
Gauge, center to center tires, Tournapull	8' 0"
Gauge, center to center tires, rear dump	10' 0"
Ground clearance, Tournapull	24"
Ground clearance, rear dump	34"

TIRES

Tournapull, standard	27.00-33, 24 ply rating, Rock Service
Tournapull, optional	27.00-33, 30 ply rating, Rock Service
Rear Dump, standard	27.00-33, 30 ply rating, Rock Service

STEERING ..... Positive power steer, electric control

Maximum turning angle	90° left and right
Width required for 180° turn	35'
Width required for 180° turn, dump position	27'

BRAKES ..... Multiple disc air brakes on all four wheels

Square inches of braking surface	7,488
Electrotarder	Standard
Parking brake	Mechanical, standard
Automatic emergency braking system	Standard
Torqmatic brake for torqmatic transmission	Standard

WEIGHTS

Shipping weight, approximate

Allison power shift transmission	76,200 lbs.
Step gear transmission	75,300 lbs.

	Empty	Loaded
Drive Axle	64%	45%
Rear Axle	36%	55%

CRANE

OVERALL MEASUREMENTS (With Tournapull)

Length, Maximum	67' 4"
Length, Minimum	46' 8"
Width	13' 9"
Height, Maximum	29' 9"
Height, Minimum	15' 0"
Wheelbase	29' 4"
Gauge, center to center tires, Tournapull	8' 0"
Gauge, center to center tires, crane	11' 1"
Ground clearance, Tournapull	24"
Ground clearance, crane	28"

TIRES

Standard	27.00-33, 30 ply rating, Rock Service

STEERING	Positive power steer, electric control
Maximum turning angle	90° left and right
Width required for 180° turn	44' 6"

BRAKES	Multiple disc air brakes on all four wheels
Square inches of braking surface	7,956
Parking brake	Mechanical, standard
Torqmatic brake for torqmatic transmission	Standard

WEIGHTS

Shipping weight, approximate	59,400 lbs.

LIFT AND REACH

Maximum lift under movable hook	24' 9"
Maximum lift under fixed hook	27' 11"
Maximum reach	25' 5"

CAPACITY

Reach and lifting capacity, behind centerline of crane wheels

Lifting Capacity	Reach	Lifting Height
60,000 lbs.	0' to 9' 6"	24' 9"
47,500 lbs.	12'	22' 6"
38,000 lbs.	15'	20' 11"
28,500 lbs.	20'	16' 2"
22,800 lbs.	25'	4' 3"

LIFTING CONTROL	Three way positive control for lifting, spotting and placing load. Each action accurately controlled by individual L-W electric motor. Finger tip control.
Hoist block and swivel hook	controllable up and down
Boom	extendable and retractable
Elevator track	Adjustable to any angle from horizontal to 17° forward of vertical

COOLING, AIR AND FUEL SYSTEMS

INDEX

COOLING, AIR, AND FUEL SYSTEMS

COOLING SYSTEM

The cooling system includes the fan and fan belts, radiator, thermostats, and water pump. Water is circulated by a centrifugal pump which pumps the water out of the radiator into the water inlet manifold, where it circulates around an oil cooler and passes into the engine water jacket and then into the water inlet manifold at the top of the cylinder head.

There is a set of thermostats in the water outlet manifold which controls the flow of water. Before the temperature of the water reaches 165° F., the thermostats stay closed and the water by-passes the radiator. When the temperature of the circulating water is approximately 165° F., the thermostats allow the water to flow through the water by-pass line into the inlet side of the water pump. When the temperature of the circulating water exceeds approximately 185° F., the thermostats open and permit the flow of water into the radiator. Under normal operating conditions, the water temperature should range from approximately 165° to 185° F.

Water from the engine cooling system is also circulated through the air compressor head and the block. Water lines are connected to the compressor from the engine.

If the machine is equipped with the power shift transmission a heat exchanger is mounted across the top of the engine. The coolant from the radiator is circulated through this exchanger to cool the transmission hydraulic fluid. Thermostats in the cooler housings maintain the transmission fluid within the correct heat range.

The pressure type radiator type permits any overflow by water expansion within the radiator to flow out through the overflow type.

RADIATOR

Removal

Drain the coolant from the radiator and engine block. Disconnect the hoses at the radiator.

Remove the capscrews fastening the hood to the radiator shell. Prop up the hood, using blocks of wood between the underside of the hood and the top of the engine. The hood may be removed if desired (see section "C").

Disconnect the leads to the headlights. Connectors are provided for easy disconnection. Slide back the insulating tubes, move one half of the connector 90° out of line with the other half, and separate the two halves as shown in Figure B-1.

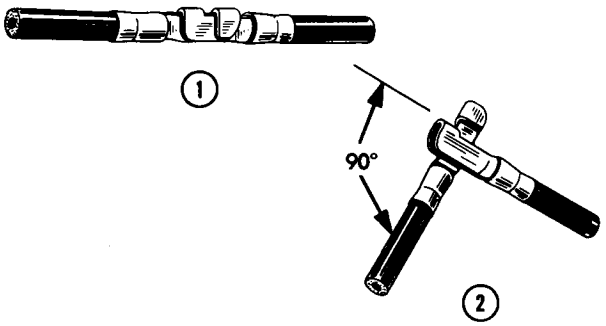


FIGURE B-1. KNIFE CONNECTOR
1. Connected 2. Disconnected

The connectors are located at the left headlight near the radiator end of the conduit carrying the headlight leads.

Loosen the bracket securing the conduit to the radiator.

Remove capscrews and lockwashers securing fan to fan hub. Remove fan from fan hub and position inside of radiator shroud.

Remove capscrews and lockwashers securing the radiator grille to case. Lift off grille.

Attach hoist to radiator. Remove the four mounting capscrews and lockwashers (one at each bottom corner of radiator). Hoist radiator from case.

Some radiators have removable lower portions of the grille. Follow the above instructions up to removing mounting bolts, then substitute the following.

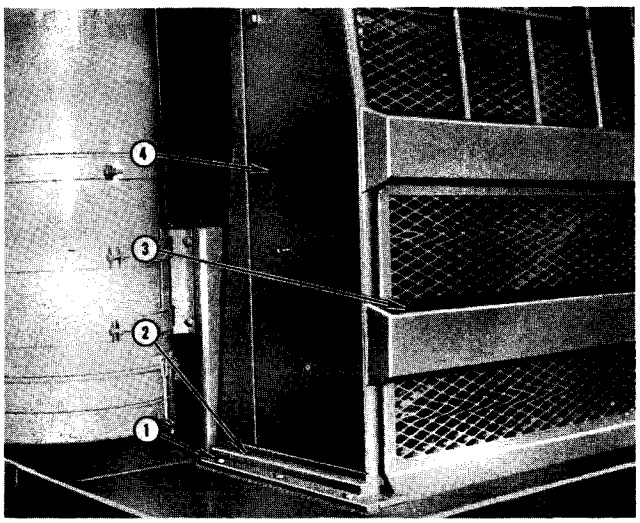


FIGURE B-2. RADIATOR ASSEMBLY
1. Capscrews 2. Cover Plates 3. Lower Grille 4. Grille

Remove capscrews and lockwashers securing the lower part of radiator grille to the radiator side sheets and remove lower part of grille (Fig. B-2).

Remove the capscrews fastening the radiator mounting bolt cover plates to the Tournapull case. Remove mounting capscrews (two on each side). Attach hoist to radiator and grille and hoist from machine. Separate grille and radiator.

Disassembly

Slide rubber hose from overflow pipe of radiator shroud.

Remove capscrews and lockwashers securing shroud to radiator and remove shroud.

Loosen jam nuts and setscrews on each side of radiator.

Remove the two nuts (one on each end) from the tie bars, and the nut and washer from the bolts holding the tie bars together.

Remove the left and right side plates by removing the four capscrews securing each to the top tank and the four capscrews securing each side plate to the bottom tank.

To separate cores from top and bottom tanks, remove the capscrews securing the clamps to their respective tanks.

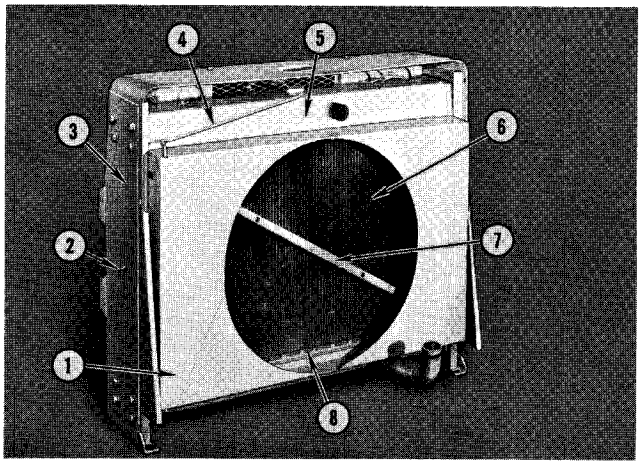


FIGURE B-3. RADIATOR SHROUD

1. Shroud
2. Setscrew
3. Side Plate
4. Overflow Pipe
5. Top Tank
6. Core
7. Tie Bar
8. Bottom Tank

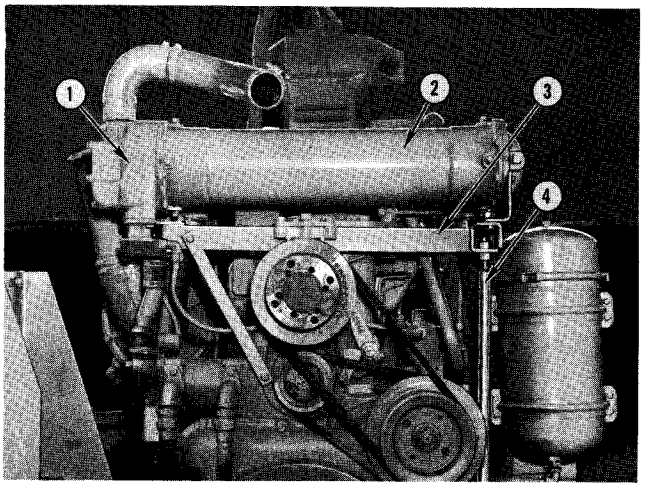


FIGURE B-4. HEAT EXCHANGER

1. Thermostat Housing
2. Heat Exchanger
3. Mounting Bar
4. Brace

Reassembly

Scrape all gasket material and seal from the clamps and the two radiator tanks. Clean inside of tanks thoroughly to remove all foreign material.

Replace gasket material and sealer.

Replace the capscrews securing the headers to the tanks. Replace side plates and tie bars.

Secure tie bars with capscrews, lockwashers and bolts.

Test for leaks by plugging hose connections and filling radiator with water. Apply four pounds of air pressure to the filled radiator and inspect for leaks.

Replace shroud.

Position fan blades inside shroud. Replace radiator on machine, install capscrews and lockwashers securing it to the main case.

Replace fan blades on fan hub and secure with capscrews and lockwashers. Replace radiator grille and secure to case. Replace overflow hose. Reconnect light wires. Connect hoses and close all drain cocks. Replace hood. Refill cooling system. Check entire system for leaks.

HEAT EXCHANGER

Removal

Drain coolant from radiator and engine block. Disconnect coolant hoses from body of heat exchanger. See Figure B-4.

Drain lubricant from power shift transmission and heat exchanger. Disconnect oil lines from heat exchanger body.

Remove capscrew, lockwashers and nuts securing heat exchanger mounting brackets to mounting bar across front of engine. Lift heat exchanger from engine.

Position on bench for further disassembly or service.

THERMOSTATS

Before installing thermostats, examine for corrosion and replace if excessively corroded or if the frame is bent or damaged. Check for holes in the bellows. To test thermostats, place them in a vessel containing hot water with a thermometer and gradually raise the temperature of the water. They should begin to open at the temperature corresponding with the marking on the thermostats. The degree difference between the start and the fully opened point is about 10° F. If the thermostats do not function as above, replace.

Check the condition of the neoprene seal and spring which prevents water from leaking to radiator when the thermostat is closed (if present). Check by-pass vent holes.

Insert thermostats in water outlet manifold. Install housing, and tighten the holding nuts and lockwasher.

AIR CLEANERS

The air intake to the engine's manifold is connected to the discharge side of the air cleaners.

The dust laden air is drawn into the inlet cap through the openings around the outside of the bottom of the cap.

The inlet cap keeps fibrous materials such as chaff or lint from entering the main body of the air cleaner assembly. Air is combined with the oil, forming a spray, and drawn upward through the filter element in the cleaner body. Oil and dust particles are separated from the air in the filter element and drain back into the oil cup. The air then goes to the intake side of the dry type air cleaner where it is further cleaned. The cleaned air is then drawn into the engine's intake manifold.

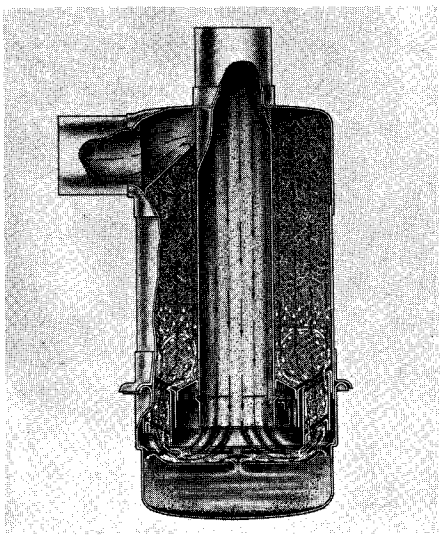


FIGURE B-5. FLOW OF AIR THROUGH AIR CLEANER

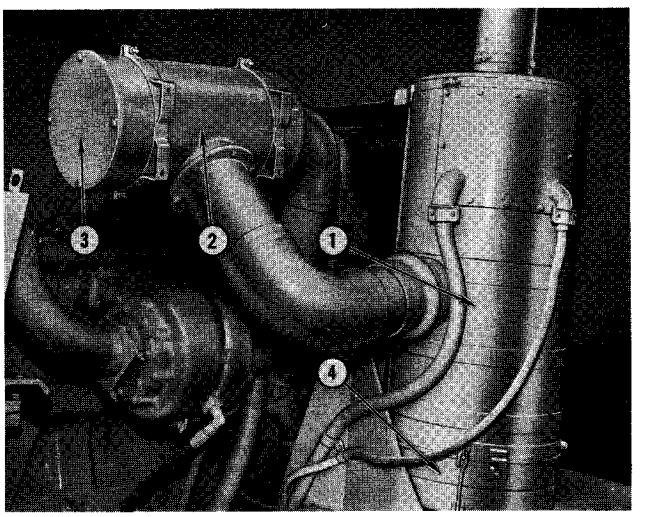


FIGURE B-6. AIR CLEANERS
1. Oil Bath Type 2. Dry Type 3. Cover and Gasket 4. Oil Cup

Oil Bath Type

REMOVAL

Loosen the wing nuts at the bottom of the air cleaner assembly and remove the oil cup and disc. Loosen the hose clamps on the discharge pipe. Remove rectifiers from housing above air cleaner (see section "D"). Remove the screws and nuts from the two air cleaner mounting bands and the upper band around the rectifier housing.

Remove air cleaner and rectifier housing from machine. Place air cleaner on bench for further disassembly.

Remove the prefilter by pushing up slightly and turning to the left, then pull down. Loosen the clamp securing the rectifier housing to the air

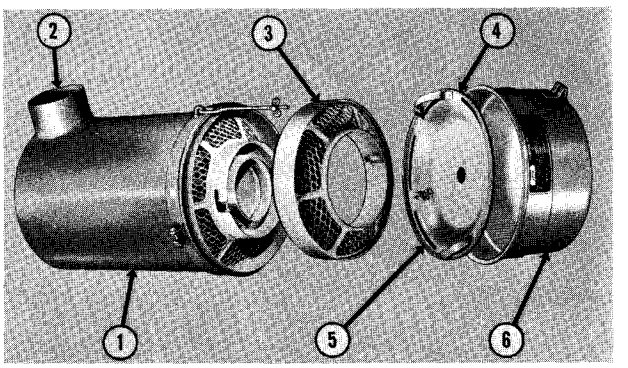


FIGURE B-7. AIR CLEANER, EXPLODED
1. Body
2. Discharge
3. Pre-filter
4. Gasket
5. Disc
6. Oil Cup

cleaner body and remove rectifier housing.

SERVICE

After the unit has been disassembled, all parts can be cleaned and defective parts replaced. Empty the oil cup, clean and refill when the oil becomes too thick to spray readily or when sediment in bottom of cup is in excess of ½".

Daily inspection is necessary to determine when any of these conditions have been reached.

Check the oil level at the beginning of each shift. Change oil every 50 hours of operation (more often if necessary in extreme dusty conditions). Use SAE 20 in summer and SAE 10 or lighter in winter. The oil should be up to the oil level mark on the disc. Raising the oil above this mark does not increase the efficiency, and this practice must be avoided.

Refer to section "K" for maintenance of air cleaner.

Dry Type

REMOVAL

Loosen hose clamps on inlet and discharge hoses.

Remove the four capscrews and nuts securing the two pieces of the mounting bands together. Remove air cleaner (see Fig. B-6).

Refer to section "K" for maintenance and element changing instructions.

AIR COMPRESSOR

Description

The compressor is of the two cylinder, single acting, reciprocating type. The Tu-Flo 500 has a rated capacity of 12 cubic feet per minute, the Tu-Flo 400 has a rated capacity of 7¼ cubic feet per minute, based on piston displacement when running at a speed of 1250 RPM.

Both the cylinder head and the cylinder block are water cooled by the engine's cooling system.

Oil under pressure from the engine enters the compressor through a passage in the crankcase and is fed to the connecting rod bearings through drilled holes in the crankshaft and to the wrist pin bearings through drilled holes in the connecting rods. The main bearings are ball bearings and are splash lubricated. Surplus oil returns to the crankcase through a line from the compressor base.

Air is supplied to the compressor by a line to the engine's intake manifold. Since the air is already cleaned, the compressor does not have a separate air cleaner.

Operation

The compressor runs continuously while the engine is operating. However, the actual compression of air is controlled by a governor which, acting in conjunction with the unloading mechanism in the compressor cylinder block, starts or stops the compression of air by loading or unloading the compressor when the air pressure in the system reaches the desired minimum (90 pounds or maximum 120 pounds for scraper equipped machines, and 120 to 145 pounds for machines with rear dumps).

COMPRESSING AIR

During the downstroke of each piston, a partial vacuum is created above the piston which unseats the inlet valves. Air then enters the cylinders above the piston after passing through the air cleaner, the intake manifold, and the intake ports.

As each piston begins its upstroke the air pressure on top of the inlet valve, plus the inlet valve return spring force, closes the inlet valve and air which has entered the cylinder is trapped above the piston. As the piston continues its upstroke, the air above the piston is compressed until the pressure lifts the discharge valve and the compressed air is discharged through the discharge line into the air tank.

As each piston starts its downstroke, the discharge valve above it returns to its seat preventing the compressed air from returning to the cylinder, and the same cycle is repeated.

NOT COMPRESSING AIR

When the air pressure in the air tank reaches the maximum setting of the governor, compressed air from the air tank passes through the governor into the cavity under the unloading pistons in the compressor cylinder block. This air pressure lifts the unloading pistons which in turn lift the inlet valves off their seats.

With the inlet valves held off their seats, the unloading cavity forms a passage between the cylinders above the pistons. Thus during the upstroke of each piston air merely passes back and forth through this passage and compression of air is stopped. When the air pressure in the tank drops

to the minimum setting of the governor, the governor releases the air pressure from beneath the unloading pistons. The unloading piston return springs then force the pistons down and the inlet valve springs return the inlet valves to their seats and compression is resumed.

Removal

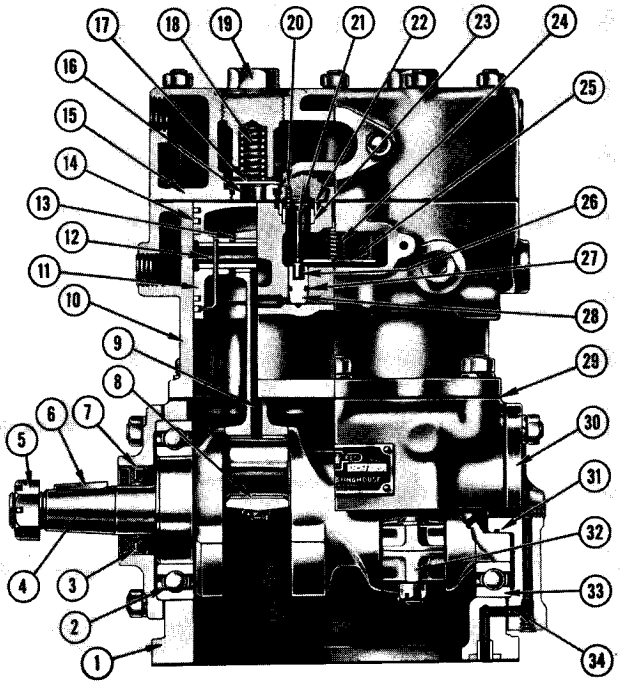


FIGURE B-8. AIR COMPRESSOR

1. Crankcase
2. Bearing
3. Oil Seal
4. Crankshaft
5. Nut
6. Key
7. Front End Cover
8. Bearing Insert
9. Connecting Rod
10. Cylinder Block
11. Piston
12. Wrist Pin
13. Bushing
14. Piston Ring
15. Cylinder Head
16. Discharge Valve Seat
17. Discharge Valve
18. Discharge Valve Spring
19. Discharge Valve Cap Nut
20. Inlet Valve Spring
21. Inlet Valve
22. Inlet Valve Guide
23. Inlet Valve Seat
24. Unloader Spring
25. Unloader Spring Saddle
26. Unloader Plunger
27. Grommet
28. Unloader Piston
29. Gasket
30. End Cover
31. Oil Seal Ring
32. Cap
33. Bearing
34. Lube Oil Passage

Drain the air system completely by opening the bleeder valve on the air supply tank. The air tank is located inside the right nose section of the Tournapull.

Drain engine cooling system, compressor cylinder head and compressor block.

Disconnect air, water, and oil lines connected to the compressor. Disconnect fuel lines to P.T. fuel pump and lead to the P.T. solenoid. Disconnect throttle linkage at P.T. fuel pump.

Remove water pump drive pulley.

Remove the mounting capscrews and lockwashers securing compressor and fuel pump to engine, and the ones securing compressor to timing gear housing. Slide the compressor and fuel pump back to disengage the drive gear, and remove the two assemblies from engine.

Separate fuel pump and compressor.

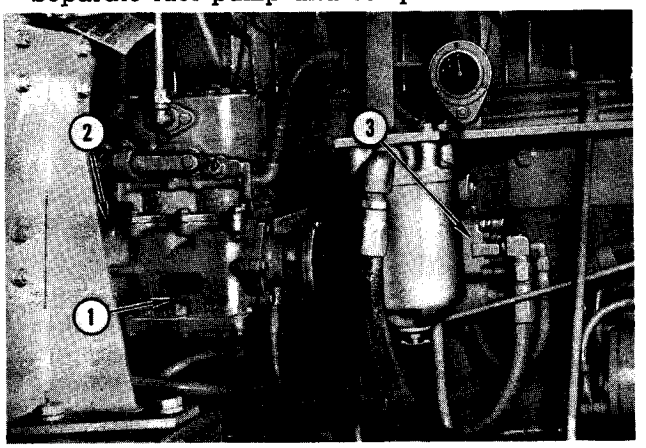


FIGURE B-9. AIR COMPRESSOR MOUNTING

1. Compressor 2. Timing Gear Housing 3. P.T. Fuel Pump

Disassembly

Remove all grease or dirt from the outside of the compressor by scraping. If necessary use cleaning solvent and a stiff bristle brush.

The cylinder head, cylinder block and crankshaft of many compressors are designed so that the compressor can be assembled in several different ways to meet the installation requirements. In order to insure correct reassembly, such parts should be marked before disassembly where necessary to show their correct position in relation to each other. This can be done best by making center punch marks in the related parts to act as guides during assembly.

It is suggested that the following parts be marked:

Position of cylinder head in relation to cylinder block.

Position of air intake fitting in relation to cylinder block.

Position of cylinder block in relation to the crankcase.

Position of front end cover (drive end of crankcase) in relation to the crankcase. (Make one punch mark on each.)

Position of rear end cover in relation to the crankcase. (Make two punch marks on each.)

Marking the crankcase with one punch mark at the drive end will permit the crankshaft to be po-

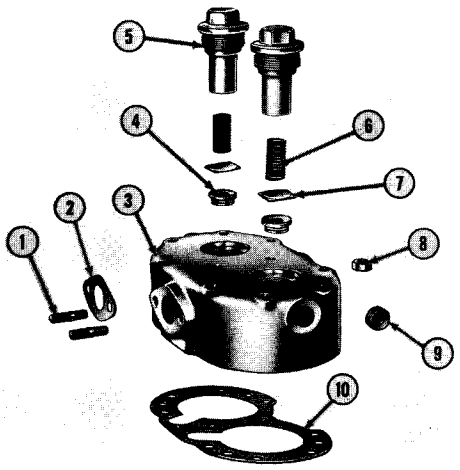


FIGURE B-10. CYLINDER HEAD, EXPLODED

1. Stud
2. Gasket
3. Cylinder Head
4. Discharge Valve Seat
5. Discharge Valve Cap Nut
6. Discharge Valve Spring
7. Discharge Valve
8. Nut
9. Pipe Plug
10. Head Gasket

sitioned properly in the crankcase during assembly.

Remove nuts from all cylinder head studs and lift off cylinder head. The cylinder head may have to be tapped slightly with a rawhide hammer to break the gasket seal.

Scrape cylinder head gasket off cylinder head and block.

Remove discharge valve cap nuts and lift out discharge valve springs and discharge valves.

Remove cotter pins and slotted nuts from the bolts securing connecting rod bearing caps to the connecting rods. Lift out connecting rod bearing caps. Then push pistons, with connecting rods attached, out the top of the cylinder block. Replace caps on each connecting rod. They are already marked with center punch marks to show the proper position of the caps.

Remove piston rings from each piston. If the pistons are to be removed from connecting rods, remove wrist pin lockwires from each wrist pin and press wrist pins from pistons and connecting rods.

Remove nuts from studs securing front or drive end cover to crankcase. Remove end cover with oil seal and gasket. If oil seal needs replacing, remove it from end cover.

Remove nuts from studs securing rear end cover to crankcase. Remove end cover, oil seal ring and gasket.

Some crankcases are fitted with a shoulder. This positions the crankshaft in the crankcase. In such cases the crankshaft may be removed only through one end of the crankcase. Press crankshaft and ball bearings out of the crankcase, then press ball bearings off crankshaft.

When cylinder head is removed from cylinder block, the inlet valve springs and inlet valves should be removed.

Remove nuts securing cylinder block to crankcase and remove cylinder block and gasket.

Remove unloader spring and the unloader spring seat.

Remove unloader spring saddle, unloader plunger, and unloading pistons. Remove unloader piston grommets. Remove inlet valve seat bushing only if they are worn or damaged.

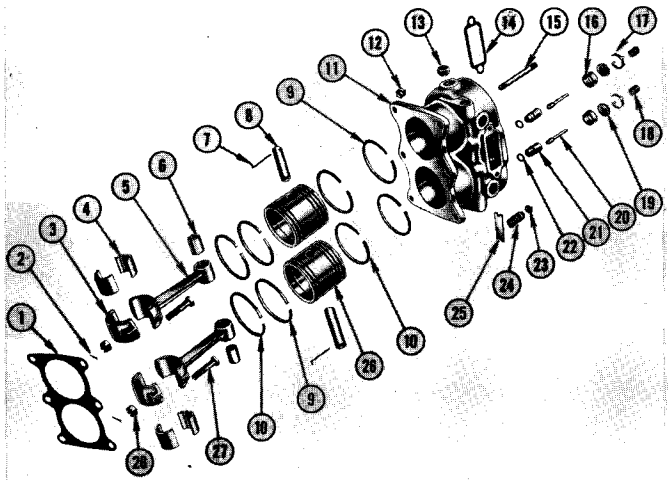


FIGURE B-11. CYLINDER BLOCK, EXPLODED

1. Gasket
2. Cotter
3. Rod Bearing Cap
4. Bearing Insert
5. Connecting Rod
6. Bushing
7. Lockwire
8. Wrist Pin
9. Piston Ring (Narrow)
10. Piston Ring (wide)
11. Cylinder Block
12. Nut
13. Pipe Plug
14. Gasket
15. Stud
16. Inlet Valve Body
17. Inlet Valve Guide
18. Inlet Valve Spring
19. Inlet Valve
20. Unloader Plunger
21. Unloader Piston
22. Grommet
23. Unloader Spring Seat
24. Unloader Spring
25. Unloader Spring Saddle
26. Piston
27. Bolt
28. Nut

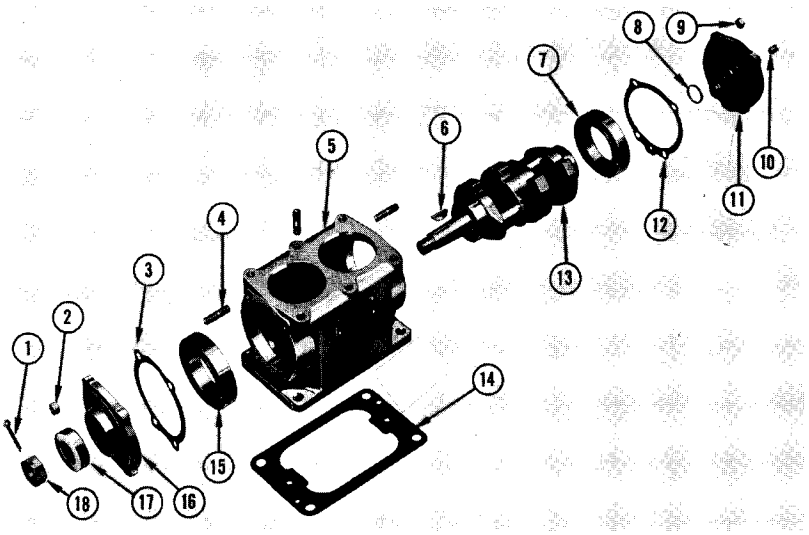


FIGURE B-12. CRANKCASE, EXPLODED

1. Cotter	4. Stud	7. Bearing	10. Pipe Plug	13. Crankshaft	16. End Cover (Front)
2. Nut	5. Crankcase	8. Oil Seal Ring	11. End Cover (Rear)	14. Gasket	17. Oil Seal
3. Gasket	6. Key	9. Nut	12. Gasket	15. Bearing	18. Nut

Cleaning and Inspection of Parts

Clean all parts thoroughly using cleaning solvent to remove all traces of dirt, oil and grease before inspection.

Put cylinder head body and cylinder block through a cleaning solution to remove all carbon from discharge valve cavity and to remove all rust and scale from water cavity. Use air pressure to blow dirt out of all cavities. Scrape carbon, dirt, and particles of old gaskets from all surfaces.

Clean discharge and inlet valves (not worn excessively or damaged) by lapping them on a piece of crocus cloth on a flat surface.

All bearings must be washed thoroughly in cleaning solvent. Inspect cylinder head body for cracks or breaks. Replace if any are found.

Thoroughly clean all oil passages through crankshaft, connecting rods, crankcase, and end covers. If necessary prod oil passages with wire and flush with cleaning solvent.

Test water jacket after cleaning for leakage, using air pressure. This must be done by assembling the cylinder head to the cylinder block. The water jackets in both parts are checked at the same time. Replace cylinder head body or the cylinder block if any leakage is found.

Discard all used discharge valve springs and replace with new ones.

Inspect condition of discharge valves and discharge valve seats. If discharge valves are grooved deeper than 0.003" where they contact the seats, they must be replaced. If the discharge valve seats are worn excessively so there is no longer sufficient metal left to reclaim the seat by using a lapping stone, the cylinder head body should be replaced.

Check crankcase and end covers for cracks and broken lugs. Replace if any are found.

Check fit of oil seal ring in the ring groove. Ring must be a neat fit in the ring groove and have 0.008" to 0.015" clearance at the gap when placed in the end bore of the crankshaft. Check lip of seal for wear. If worn thin or damaged, the oil seal must be replaced.

Inspect oil ring groove in end cover. If ring wear has formed a step pattern in the groove, replace end cover or machine groove for next oversize oil seal ring.

Check fit of ball bearings in crankcase. Bearings must be a finger press fit. If the crankcase bearing bores are worn or damaged, the crankcase should be replaced.

A cylinder block with broken lugs or with cracks of any kind must be replaced.

Check fit of unloading pistons and piston grommets in cylinder block for excessive wear. New grommets should be installed, after which the unloading pistons should be a neat sliding fit in their bores.

The bores must not be scratched or damaged in any way which might accelerate grommet wear. Check the unloading piston return spring for permanent set. If the spring does not have sufficient tension to return the unloader piston to the unloaded position, replace the spring.

Inspect condition of inlet valve and seats. If inlet valves are grooved deeper than 0.003" where

they contact the seat they should be replaced. If the inlet valve seats are worn or damaged so that they cannot be reclaimed by lapping or facing, seats should be replaced.

Check cylinder bores for evidence of excessive wear, out-of-round, or scoring. Cylinder bores which are scored or out-of-round more than 0.002" or tapered more than 0.003" should be rebored or honed oversize. Oversize pistons are available 0.010", 0.020", or 0.030" oversize. Cylinder bores must be smooth, straight, and round and must be finished with a 320 grit hone. Clearance between pistons and cylinder walls must be 0.002" minimum and 0.004" maximum.

Inspect pistons for scores, cracks or damage of any kind. If scores or cracks are found, replace the piston. Check each piston with a micrometer in relation to the cylinder bore diameter to be sure the clearance is between the 0.002" minimum and 0.004" maximum.

Check fit of piston rings in the ring grooves. Refer to Figure B-13 for correct gap and ring clearance for the Tu-Flo 400. Refer to Figure B-14 for this information on the Tu-Flo 500.

Check fit of wrist pins in pistons and connecting rods. Wrist pins must be a light press fit in the pistons. Check the fit of wrist pin in connecting rod bushing by rocking the piston. Clearance of wrist pin to connecting rod bushing should not exceed 0.0015". If excessive clearance is apparent, replace wrist pin bushings in connecting rod. Wrist pin bushings should be reamed after being pressed in place. Discard all used wrist pin lock wires.

Inspect connecting rod bearings for proper fit on crankshaft journals. Also check connecting rod bearings for wear. If worn, cracked or broken, the inserts must be replaced.

Connecting rod caps are not interchangeable. Position the caps so that the two locking slots are both located adjacent to the same capscrew.

Clearance between the connecting rod journals and the connecting rod bearing must be not less than 0.0003" or more than 0.0021" after rebuilding compressor.

Crankshaft journals which are more than 0.001" out-of-round or bruised must be reground. When regrinding, the fillets at the ends of the journals must be maintained. Connecting rods 0.010", 0.020", and 0.030" undersize are made for reground crankshafts. Screw threads, keyways, tapered ends and all ground and machined surfaces of the crankshaft must not be mutilated or excessively worn. Main bearing journals must not be worn too much to prevent the ball bearings from being a tight press fit. The oil seal ring groove in the crankshaft must not be worn so as to prevent a good fit of the oil seal ring. Walls of the oil seal ring grooves must be square and have a good finish.

Check the ball bearings for wear of flat spots. If found, the bearings must be replaced.

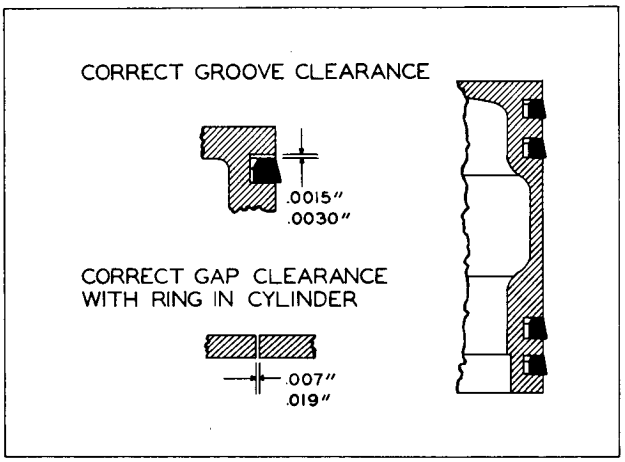


FIGURE B-13. TU-FLO 400 RING GAP AND CLEARANCE

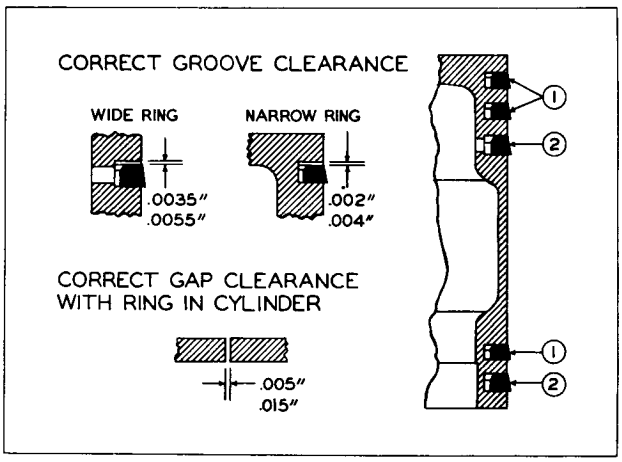


FIGURE B-14. TU-FLO 500 RING GAP AND CLEARANCE

1. Narrow Ring 2. Wide Ring

Repairs

DISCHARGE VALVES AND SEATS

If discharge valve seats merely show signs of slight scratches, they can be reclaimed by using a lapping stone, grinding compound, lapping disc, grinding tool and driver. If seats cannot be reclaimed, install new seats. After installing new discharge valves, discharge valve springs and discharge valve cap nuts, the discharge valve travel should be between 0.036" and 0.058" for Tu-Flo 400 and 0.056" and 0.070" for Tu-flo 500.

To test for leakage apply 100 pounds of air pressure through the discharge port of the cylinder head and apply soap suds to the discharge valve openings in the floor of the cylinder head. Leakage should not exceed a one inch soap bubble in not less than five seconds.

If excessive leakage is found, leave the air pressure applied and using a fibre or hardwood dowel and light hammer, tap the discharge valve off their seats several times to improve the seal between the valves and their seats. If the valves and valve seats have been reconditioned properly this will reduce the leakage.

Leakage tests must also be made by applying soap suds around the discharge valve cap nuts, with air pressure applied as above. Leakage at cap nuts is not permissible.

INLET VALVES AND SEATS

If inlet valve seats show signs of slight scratches or wear they can be reclaimed by using a lapping stone, grinding compound, lapping disc, and valve grinding tool. If the seats cannot be reclaimed in this manner, they should be replaced. The dimensions from the top of the cylinder block to the inlet valve seat should not exceed 0.145". After installing new seats, the dimension should be 0.101" to 0.113".

Inlet valves not worn excessively or damaged, can be reclaimed by lapping them on a piece of crocus cloth on a flat surface.

UNLOADER PISTONS

The grommet or "O" ring in the unloader piston should be replaced. Be careful in reinstalling the unloader piston in the bore so that the grommet is not damaged or cut. When reinstalled the piston should be a neat sliding fit in its bore. It may be necessary to use air pressure, WITH CAUTION, at the governor port of the cylinder block to remove the unloader piston for inspection, after removing the unloader plunger and associated parts.

After assembly, unloader pistons should be tested by application of 100 pounds air pressure through governor line port. Then coat unloader pistons with soap suds, leakage should not exceed a ½" soap bubble in not less than five seconds.

Assembly

INSTALLING CYLINDER BLOCK

Place new cylinder block gasket in position over crankcase studs. Position cylinder block on crankcase in accordance with markings made before disassembly. Install nuts securing block to crankcase.

INSTALLING CRANKSHAFT

If the crankshaft is fitted with oil seals, install seal rings.

Position ball bearings and crankshaft in the crankcase. Be sure the drive end of the crankshaft is positioned at the end of the crankcase which was marked with one punch mark before disassembly. If one end of the crankcase is counterbored for holding bearing, be sure the crankshaft is entered through the correct end of the crankcase. Carefully press crankshaft and bearings into crankcase.

Install oil seal ring. Then position rear end cover over studs on rear of crankcase being sure that the oil hole in the rear end cover lines up with the oil hole in the gasket and crankcase. Install nuts securing the end cover in place. Install pipe plugs in end cover oil openings which are not in use.

If front end cover oil seal has been removed from the end cover, press a new oil seal into the end cover. Install a new gasket. Carefully position the front end cover so as not to damage the oil seal and install nuts securing end cover in place.

ASSEMBLING PISTONS AND CONNECTING RODS

If wrist pin bushings have been removed from connecting rods, press new bushings into place making sure that the oil holes in the bushings line up with the oil holes in the connecting rods. Bushings must then be reamed, honed, or bored to provide between 0.0001" to 0.0006" clearance on the wrist pin. Position connecting rod in piston and press wrist pin into position. See Fig. B-15 for lockwire position. Keep lockwire hole in pin aligned with lockwire in wrist pin so that the end of the wire engages the hole in the piston. Do not use pistons in which the wrist pin is loose.

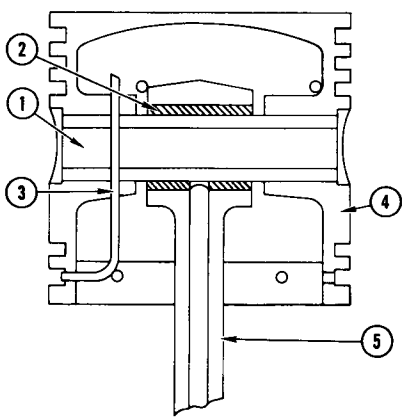


FIGURE B-15. WRIST PIN LOCKWIRE POSITION

1. Wrist Pin
2. Rod Bearing
3. Lockwire
4. Piston
5. Connecting Rod

Install piston rings by hand. Four rings are used in each piston and they must be installed in their proper location. The rings can be identified by their width and should be installed with bevel or pip mark toward top of the piston. See Figures B-13 and B-14 for proper location of piston rings. Stagger the position of the gaps in the rings.

Before installing pistons and connecting rods, thoroughly lubricate pistons, piston rings, wrist pin bearings, and connecting rod bearings with clean engine oil.

Turn crankshaft until number one crankshaft journal is down. Remove bearing cap from number one connecting rod leaving connecting rod bolts in the rod. Connecting rods are installed so that the center punch markings on the connecting rods face the same side of the compressor as when disassembled.

Insert number one connecting rod and piston through top of number one cylinder making sure the connecting rod bearing engages the connecting rod journal in the same position as that in which it was fitted.

Position and attach lower bearing cap to connecting rod. The cap is in the correct position when the two locking slots in the inserts and in the rod and cap are both located adjacent to the same connecting rod. Install two slotted nuts and cotters.

Install other piston and connecting rod in the same manner.

ASSEMBLING AND INSTALLING UNLOADER PISTON

Lubricate the unloader piston cavity in the cylinder block and also the unloader piston and unloader piston grommet with clean engine oil. Install unloader piston grommet back up ring and grommet on unloader piston. Install unloader pistons and unloader plungers through the top of the cylinder block taking care to avoid cutting the unloading piston grommets on the block. Install unloader spring saddle on unloader plungers. Install spring seat in top of cylinder block strainer opening and place unloader spring between spring guide and spring saddle. Install inlet valve guides if they have been previously removed.

ASSEMBLING AND INSTALLING CYLINDER HEAD

Install discharge valves in the cylinder head. Install discharge valve spring and discharge valve cap nut.

Install inlet valves and inlet valve springs in cylinder block. Place new cylinder head gasket on block. Carefully align inlet valve springs with inlet valve guides in cylinder head and secure head to block by tightening cylinder head nuts evenly.

INSPECTION OF REBUILT UNIT

Check to be sure all threaded openings to oil passages, such as may be found in the end covers or base plate, are properly plugged.

Run the rebuilt compressor for one half hour at 1750 RPM with discharge port open to atmosphere. Check during this run for oil leaks, overheated bearings, and excessive noise.

If the compressor is not to be installed immediately on a machine, plug the air connection to the unloading mechanism and the water connection to the cylinder head and cylinder block. Protect the discharge port against the entrance of dirt by fitting it with a temporary blanking cover.

Fit the ends of all the crankshafts with cotter pins, nuts and keys when such parts are required and then protect against damage during handling by wrapping with friction tape or some other similar material.

The unloading lever and valve mechanism must be well lubricated with lubricating oil.

Protect the open bottom against the entrance of dirt during handling or storage by installing a temporary cover.

Installation

Clean oil supply line to compressor and, if possible, run engine a few seconds to be sure the oil supply to compressor is flowing freely.

Clean oil return line and passage to be sure oil can return from the compressor to the engine crankcase.

Lubricate compressor cylinder walls and bearings with lubricating oil before replacing compressor in position.

Since the fuel pump is driven from the air compressor shaft, the compressor drive must be correctly timed to the camshaft gear.

Crank the engine until number one cylinder is on valve-set position. In this position, two center punched marks will appear on the face of the camshaft gear and both intake and exhaust valves will be closed.

Mesh the compressor gear with the camshaft gear by indexing the one punch marked on the compressor gear between the two punched marked teeth on the camshaft gear.

NOTE: This can be checked through the front of the gear housing by putting chalk marks on the top of the two teeth on the camshaft gear and a chalk

mark on the tooth of the compressor gear.

Attach the compressor and fuel pump securely to the engine with capscrews and lockwashers.

Replace water pump drive pulley. Reconnect air, fuel, oil and water lines; throttle linkage and PT solenoid lead.

Clean or replace any dirty air or water lines before connecting them to the compressor. Always use a new discharge fitting gasket.

With compressor running, check for noisy operation and oil, water or air leaks. Check the unloading valve for clearance. Test air system for serviceability.

NOTE: When connecting air inlet line to compressor, care should be taken not to crush fiber washer. Damage to washer may result in compressor pumping oil into the air supply tank.

AIR COMPRESSOR GOVERNOR

The air compressor governor has been inserted into the air supply system to control the amount of air contained in the reservoir tank.

Although the compressor runs continuously during engine operation, actual compression of air takes place only when the air tank pressure falls below minimum requirement. After pressure has again been built up to the maximum setting, the governor acting in conjunction with the compressor unloading mechanism halts further compression of air.

Removal and Disassembly

Bleed the air from the air supply tank. Disconnect line at side of governor. Unscrew the governor from the fitting under the right front of cockpit.

Release the nut which locks the adjusting screw in place and then back out screw from the sleeve (Fig. B-16).

Lift spring and plunger from sleeve (Fig. B-17).

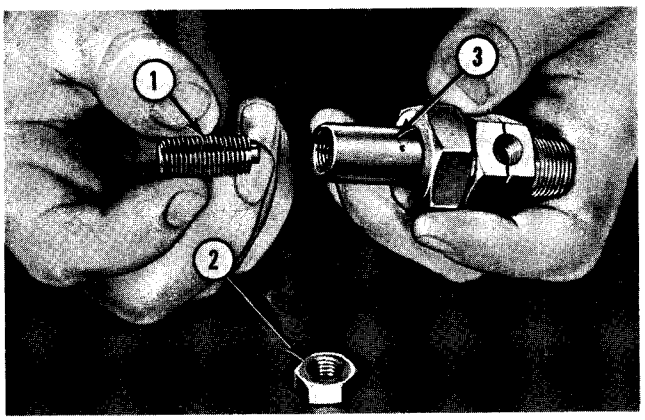


FIGURE B-16. REMOVING ADJUSTING SCREW
1. Adjusting Screw 2. Locknut 3. Sleeve

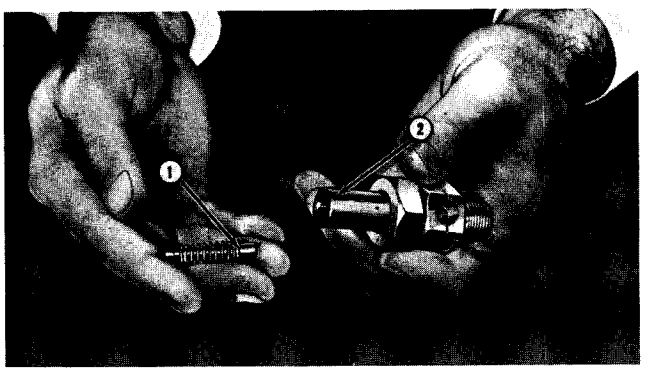


FIGURE B-17. REMOVING SPRING AND PLUNGER
1. Spring and Plunger 2. Sleeve

Loosen the sleeve collar until it is entirely free of the governor body, permitting removal of sleeve (Fig. B-18).

The end of the sleeve is a snug fit in the governor body but can be removed by hand. Sleeve must not be pried or forced free of its seat. After sleeve has been removed, exposed ball check and shim(s) may be removed (Fig. B-19).

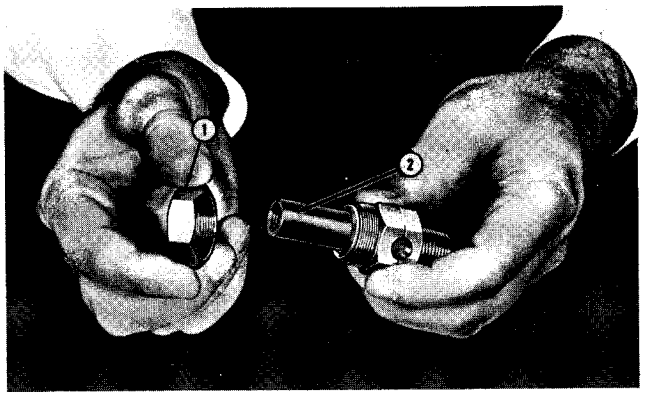


FIGURE B-18. REMOVING COLLAR
1. Collar 2. Sleeve

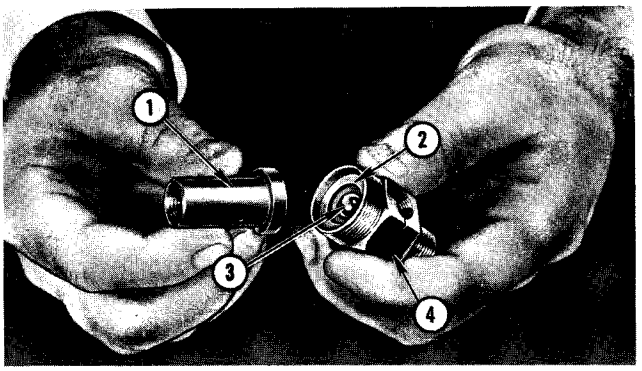


FIGURE B-19. SLEEVE REMOVED
1. Sleeve 2. Shim 3. Ball Check 4. Body

Reassembly

Replace ball check and shim(s) in governor body.

Fit sleeve into governor body.

Place collar over sleeve and screw down on the governor body.

Replace spring and plunger into sleeve with the largest end of the plunger toward the ball check.

Replace adjusting screw and locknut.

Adjustment

Re-install the governor on the machine. Do not connect line to the compressor unloader. Operate the engine until the air pressure in the supply tank reaches the maximum setting. Refer to air pressure gauge on instrument panel for air pressure. The valve should open at this point and exhaust air through the port in the side of the governor body.

If air should exhaust before the limit is reached, loosen locknut and screw in the adjusting screw. If air exhausts after the proper pressure is reached, screw the adjusting screw out, releasing some of the spring pressure against the ball. When the proper adjustment has been obtained, lock the adjusting screw into place with the locknut. See Figure B-20.

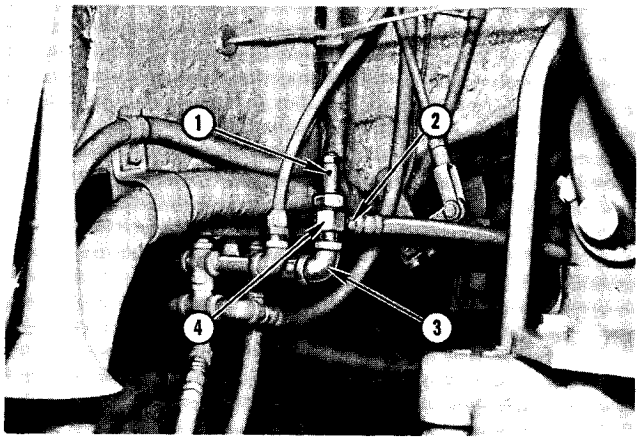


FIGURE B-20. AIR COMPRESSOR GOVERNOR
1. Exhaust 2. Inlet 3. Outlet 4. Governor

QUICK RELEASE VALVE

The purpose of the quick release valve is to reduce the time required to release the brakes by hastening the exhaust of air pressure from the brake diaphragm.

The valve consists of a body containing a spring loaded diaphragm so arranged as to permit air pressure to flow through the valve in one direction but, when the supply pressure is reduced, the air which has passed through the valve is permitted to escape through the exhaust port.

The quick release valve assumes three positions during normal operation. The three positions are the applying position, when air pressure is passing through the valve into the brake; the holding position, when pressure is held in the brake; and the releasing position, when the brake is being exhausted.

When air pressure from the brake enters the top connections of the valve, the diaphragm moves down and closes the exhaust port. Air pressure then deflects the outer edges of the diaphragm downward and flows out the side connections to the brakes.

As soon as the brake chamber pressure below the diaphragm equals the brake valve pressure above the diaphragm, the force of the spring below the diaphragm forces the outer edge of the diaphragm back up against the body, although the center of the diaphragm keeps the exhaust port closed. This is the holding position.

If the brake valve pressure on top of the diaphragm is released, the brake chamber pressure below the center of the diaphragm raises it, then opens the exhaust port and permits the brake air pressure to be released through the exhaust port.

If the brake valve pressure on top of the diaphragm is only partially released, the diaphragm assumes its holding position as soon as the pressures above and below it are equalized.

In this manner, the quick release valve reacts to pass any increased brake valve pressure through it to the brakes, or quickly releases the brake air pressure when the brake valve pressure is reduced and thus maintain the same pressure in the brakes as the brake valve is delivering.

Removal and Disassembly

The machine is equipped with a quick release valve for each wheel brake.

On the Tournapull the valves are mounted on the main case. The trail unit valves are mounted on the frame near the wheels.

NOTE: As a safety precaution it is wise to bleed

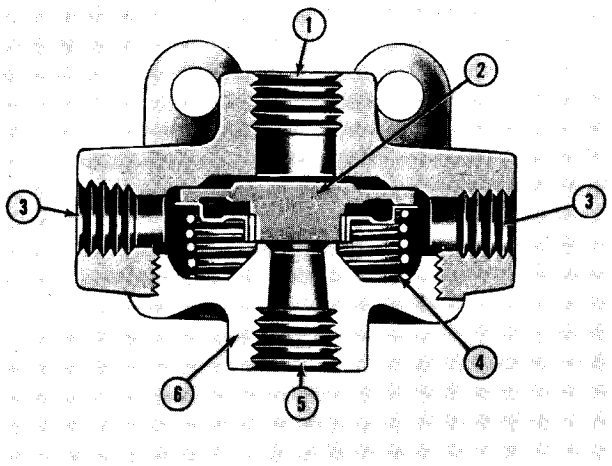


FIGURE B-21. QUICK RELEASE VALVE, SECTIONAL

1. Inlet Port
2. Diaphragm
3. Outlet
4. Spring
5. Exhaust
6. Cover

the air system before disconnecting any air lines.

To remove the quick release valve, disconnect the tubing, remove the two capscrews and remove the valve from the machine.

Remove all dirt and grease from exterior of the valve using cleaning solvent and a brush.

Unscrew the cover, lift out diaphragm spring, diaphragm spring seat, and diaphragm.

Inspect exterior of valve for broken or damaged parts. All broken or damaged parts must be replaced.

Examine all metal parts and wash in cleaning solvent.

Examine diaphragm for signs of cracking, wear, or damage. Carefully examine the lower face of the diaphragm which contacts the exhaust port seat in the cover for signs of pitting or grooving. Replace diaphragm if any of these conditions are found.

Reassembly

To reassemble quick release valve, install diaphragm into diaphragm spring seat. Replace the diaphragm spring and seat into body.

Install valve on machine, reconnect air lines.

With brake applied, coat the exhaust port with soap suds to detect leakage. Leakage in excess of a one inch soap bubble in one second is not permissible.

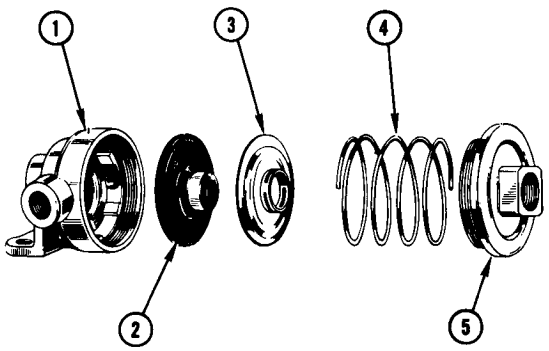


FIGURE B-22. QUICK RELEASE VALVE, EXPLODED

1. Body
2. Diaphragm
3. Spring Seat
4. Spring
5. Cover

AIR TANK

The air tank is located in the right side of the Tournapull nose section.

A bleeder valve is located on the bottom of the tank. Air pressure forces any moisture present out through the bleeder valve. The air tank should be drained of all collected condensation as part of the daily preventive maintenance program.

The tank itself requires little attention because of the all welded, sheet steel construction. Care should be exercised, however, to prevent bending or breaking the inlet and outlet lines and fittings.

A safety valve is mounted on the air junction block under the right front of the cockpit. The

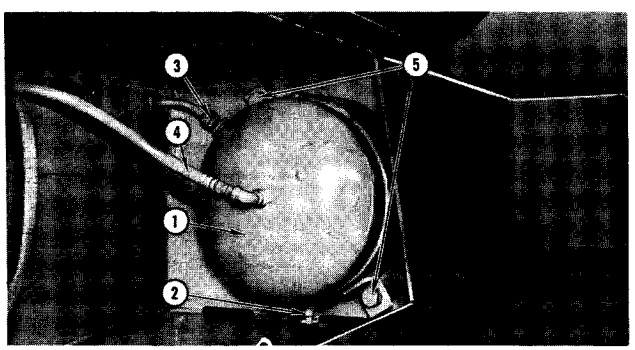


FIGURE B-23. AIR TANK

1. Tank
2. Bleeder Valve
3. Inlet Line
4. Outlet Line
5. Mounting Capscrews

safety valve is set to open at 150 pounds per square inch.

Should air pressure in the air supply tank rise to a point above the setting of the safety valve, the pressure will force the ball, against spring pressure, from its seat and allow the air to flow around the ball and out through the exhaust port. As soon as the pressure is reduced to the setting of the valve, the spring forces the ball back on its seat, stopping the exhaust.

Removal

Open the bleeder valve to completely bleed the air system.

Disconnect the inlet and outlet lines from the tank.

Remove capscrews and lockwashers securing tank to case and pull tank from opening in case.

Take care when removing tank to prevent damaging bleeder valve on bottom of tank.

Remove bushing, strainer screen and spring from from air inlet opening. Clean screen in cleaning solvent and blow dry with compressed air.

AIR BRAKE APPLICATION VALVE

Operation

As the operator depresses the treadle, pressure is exerted on the top of the pressure regulating spring and piston. As the piston moves downward, the exhaust valve seat moves downward against the combined inlet-exhaust valve and closes the exhaust opening in the piston stem. Continued movement of the piston downward pushes the combined inlet-exhaust valve off its seat. The air pressure from the air supply tank then flows through the inlet valve and out the outlet to the brake, applying the brake.

When the air pressure being delivered to the brake from the cavity below the piston overcomes the mechanical force being exerted on top of the piston, the piston lifts and the inlet valve closes, cutting off further supply of air pressure to the brake. The exhaust valve remains closed, preventing any escape of air pressure through the exhaust port. Should the operator depress the treadle further and put additional force on top of the piston, a corresponding increase in the air pressure being delivered to the brake results.

If the operator permits the treadle to partially return toward its fully released position, thus reducing the mechanical force on top of the piston, the air pressure below the piston overcomes the mechanical force on top of it and the piston lifts still further. When this happens, the inlet valve remains closed but the exhaust valve opens to exhaust air pressure from the brake until the air pressure below the piston again balances the mechanical force on top of it.

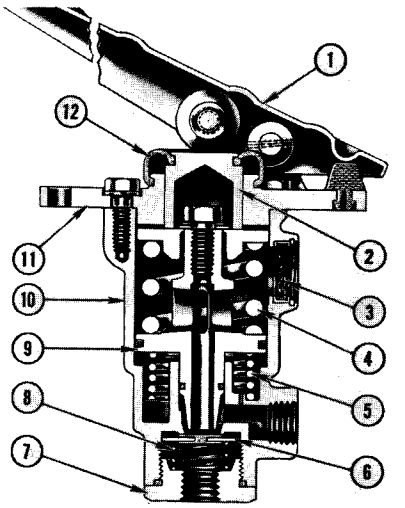


FIGURE B-24. TREADLE VALVE, SECTIONAL

1. Treadle	5. Return Spring	9. Piston
2. Plunger	6. Inlet Valve	10. Body
3. Filter Screen	7. Inlet Nut	11. Mounting Plate
4. Graduating Spring	8. Inlet Valve Spring	12. Boot

Releasing the treadle to its fully released position, the exhaust valve remains open and all the air pressure from the brake is exhausted and the brakes are fully released.

Depressing the treadle fully, compresses the pressure regulating spring and the piston strikes the shoulder in the body. Under these conditions, the inlet valve is held open, permitting full air pressure to pass into the valve and on to the brake.

Removal and Disassembly

Drain the air tank and bleed the air system. Disconnect the air lines to the brake valve.

Remove the mounting bolts from the mounting plate and lift valve, mount plate and treadle from the cockpit.

Clean exterior of valve with cleaning solvent

and a brush. Blow dry with compressed air. Remove the cotter from end of treadle pin. Drive out the treadle pin and remove treadle.

Drive out the treadle roller pin with drift pin and remove roller and retaining ring. Remove rubber boot from top of valve. Remove the capscrews and lockwashers attaching the mounting plate to the body.

Remove piston and spring assembly from body. Remove rubber grommets from piston.

Do not disassemble the pressure regulating spring and piston assembly unless the exhaust seat has been damaged and has to be replaced.

Remove piston return spring from body. Remove inlet nut from body. Pull the inlet valve spring and valve from inside the body.

Reassembly

If the piston graduating spring, or graduating spring seat is damaged or broken, they must be replaced.

Care should be exercised not to damage the exhaust seat which is a part of the piston. Replace all grommets with new ones. If the exhaust seat is slightly damaged, it may be lapped flat with a piece of crocus cloth on a flat surface.

If inlet seat is nicked or worn excessively, replace the body. Inlet and exhaust valve must be replaced with new one.

Wash all metal parts in cleaning solvent. Carefully inspect the exhaust seat. If seat is worn slightly, lap on a piece of crocus cloth on a flat surface. If seat is worn excessively, or damaged in any way, the piston and pressure regulating spring assembly must be replaced. If pressure regulating spring is damaged in any way it must be replaced.

Replace rubber grommets with new ones.

Check fit of treadle pin in treadle and mounting plate. Pin must be a free fit. If mounting holes are worn excessively, the plate should be replaced. Inspect treadle roller for fit on roller pin, also for flat spots. Roller must be a free rolling fit on pin. If excessive wear is found or if the roller has any flat spots, the pin, the roller, or both must be replaced. Check to be sure the stop at the heel of the treadle is in good condition. If not, this treadle stop should be replaced.

Check for cracks or breakage of the mounting plate. Replace if necessary. Replace stop button. Replace boot if cracked or deteriorated.

Inspect body for scores and excessive wear where the piston grommets make contact with the body. If excessive wear or grooves are found, the body should be replaced. Inspect small bleed hole leading to outlet port in body to be sure it is open and not obstructed.

Inspect inlet seat for excessive nicks. If nicked excessively, replace body. Replace inlet and exhaust valve if worn or damaged.

Install new grommets on piston. Lubricate the piston grommets and the surfaces they slide against with barium grease. Install piston return spring and piston and spring assembly in body.

Install mounting plate and secure in place with three capscrews and lockwashers. Install the

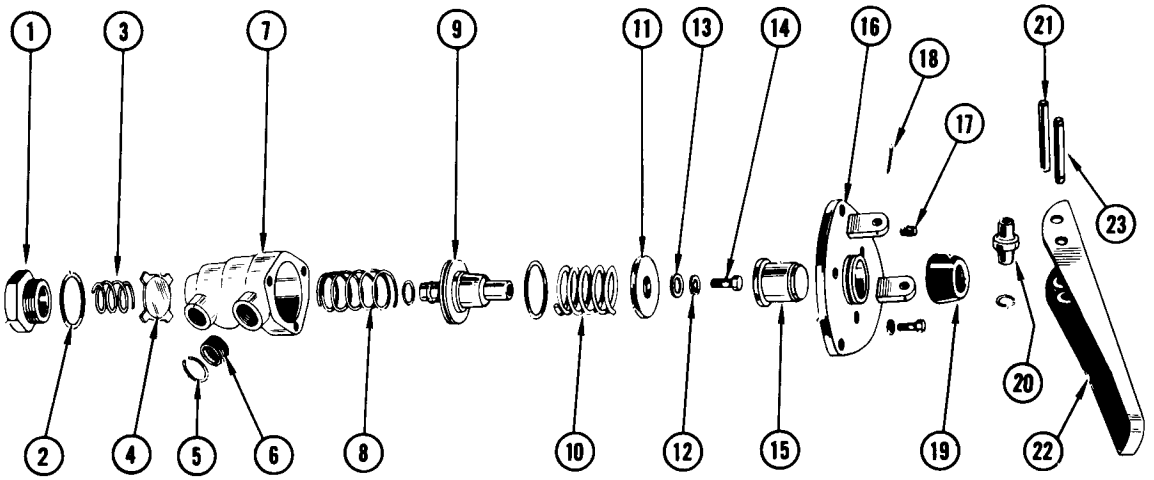


FIGURE B-25. TREADLE VALVE, EXPLODED

1. Inlet Nut
2. Grommet
3. Inlet Valve Spring
4. Inlet Valve
5. Retaining Ring
6. Filter Screen
7. Body
8. Piston Return Spring
9. Piston
10. Graduating Spring
11. Spring Seat
12. Lockwasher
13. Washer
14. Capscrew
15. Plunger
16. Mount Plate
17. Stop Button
18. Cotter
19. Boot
20. Roller
21. Treadle Pin
22. Treadle
23. Roller Pin

plunger and boot in the mounting plate.

Position the treadle or lever on mounting plate and install treadle pin being sure the cotter pin hole in the pin lines up with the hole in the mounting plate, then install cotter pin.

To install roller, place the retaining ring in the recessed end of the roller and place the roller and retaining ring in the treadle. Then drive the roller pin in from either side of the treadle to the position where the pin is locked in place by the retaining pin.

Install inlet and exhaust valve and position inlet valve spring in the body. Position grommet on inlet nut and install in the body.

Replace unit on machine and reconnect the air lines.

Adjustment

With the valve in the fully applied or fully released position, cover the exhaust port with soap suds. Leakage must not exceed a one inch soap bubble in one second.

No leakage is permissible at any other point on the brake valve with the treadle in the depressed position.

Install an air gauge on the application side of the system. When the brakes are fully applied, the instrument panel pressure gauge and the gauge in the application side of the system should have approximately the same reading.

Use the test gauge on the application side of the system to check the valve for reaction or balance. Partially open the valve and hold it in this position. Observe the two air gauges which should show different unchanging air pressures. The pressure differential should remain constant until further application or release of the brake pedal.

If the brake does not release promptly, it indicates exhaust valve is not opening sufficiently. This can be caused by the filling plate being installed upside down or by insufficient shims being used between the air inlet valve seat and the body of the valve.

If the brake does not fully release, check clearance between treadle roller and button on top of the spring cage. Clearance must be 1/16". If clearance is correct, add additional shims between inlet valve seat and body of valve to increase exhaust valve opening.

If the brake valve does not apply promptly, check for excessive clearance between exhaust valve and exhaust valve seat. Remove shims between inlet valve and exhaust valve seat. Remove shims between inlet valve seat and body of valve to decrease exhaust valve clearance. This will increase inlet valve openings.

If brake valve does not graduate the delivered pressure properly, check to be sure bleed hole to cavity immediately below the diaphragm is not restricted. The bleed hole should be 1/16" in diameter.

HAND APPLICATION VALVE

The hand application type valves are used for two purposes; controlling the rear dump brakes, and operating the scraper quick drop assembly. Although the method of applying pressure to the valve is different, the operation of the valve is the same. The valve used for scraper quick drop control is operated by a lever pressing against a button on the cam. The valves used for brake control on the rear dump are applied by moving the application handle.

As the application handle is moved in a clockwise direction (or pushed forward), the actuating cam moves downward carrying with it the spring retainer, metering spring, and the metering piston assembly thereby seating the metering piston assembly on the exhaust valve insert and closing the exhaust to atmosphere. As further movement takes place, the valve stem moves downward, unseats the inlet valve insert and allows air pressure to enter the application side of the brake system.

When the desired rate of deceleration has been reached and the movement of the application handle is stopped, reaction or balance occurs in the valve mechanism. That is, the applied air pressure below the metering piston assembly forces the assembly upward, compresses the metering spring and allows the intake valve to close. Thus both inlet and exhaust valves are closed and the applied air pressure is held constant until the application handle is moved to the released position or until additional air pressure is admitted to the application side of the valve by further clockwise movement of the application handle.

Disassembly

Remove the valve from the machine and clamp in a vise. Remove the inlet plug, plug gasket, inlet cap and cap gasket. The metering piston return spring may then be removed from the valve housing.

Place the inlet cap in a vise and remove the small hex nut which locks the inlet body to the exhaust valve body and stem. Insert the bit of a small screw driver between inlet valve body and the wall of the inlet cap. Unscrew the stem from the inlet valve body. The inlet and exhaust valve spring may be removed. Remove the screw which retains the insert. Remove the inserts.

Remove application handle retaining nut and handle (or actuating button). Insert a drift through the lower opening in the valve housing. The metering spring, metering spring retainer and the metering spring washer may be removed. Insert a suitable drift through the exhaust holes in the piston rod and a piece of flat bar stock through the slots in the piston cup spreader and unscrew the two parts. Leave the bar stock in position. Engage the two slots in the piston and unscrew the two parts. The piston cup may now be removed.

Remove the actuating cam pins from the valve housing and push the actuating cam from the valve housing.

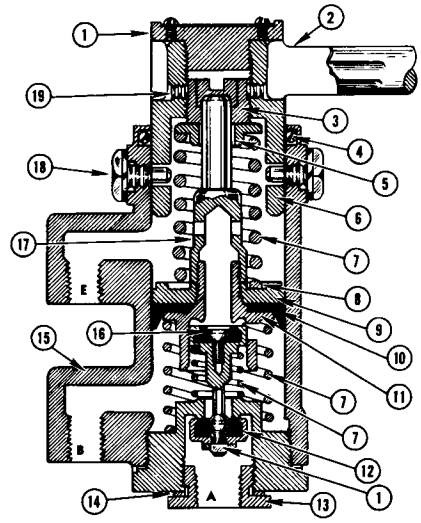


FIGURE B-26. HAND METERING VALVE, SECTIONAL

1. Nut
2. Handle
3. Guide
4. Grommet
5. Retainer
6. Cam
7. Spring
8. Washer
9. Piston
10. Cup
11. Spreader
12. Stem
13. Cap
14. Gasket
15. Body
16. Screw
17. Rod
18. Pin
19. Setscrew

Remove the "O" ring. Remove the adjusting set screws and unscrew the adjusting nut from the actuating cam.

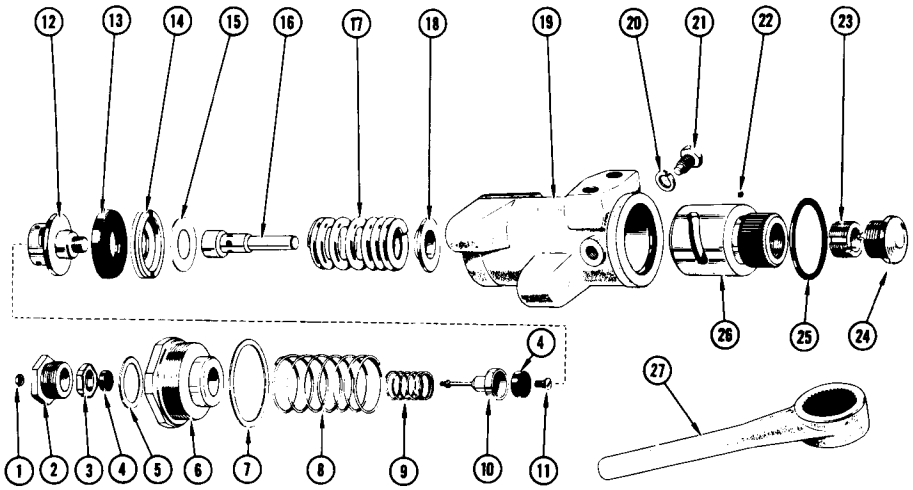


FIGURE B-27. METERING VALVE, EXPLODED

1. Nut
2. Plug
3. Body
4. Insert
5. Gasket
6. Cap
7. Gasket
8. Spring
9. Spring
10. Stem
11. Screw
12. Spreader
13. Cup
14. Piston
15. Washer
16. Rod
17. Spring
18. Retainer
19. Housing
20. Lockwasher
21. Pin
22. Setscrew
23. Guide
24. Button
25. "O" Ring
26. Cam
27. Handle

Adjusting and Testing

Reassemble the valve by reversing the disassembly procedure.

The valve may be adjusted either on or off the machine. In either case air pressure must be available. See Figure B-26.

Remove the application handle retainer nut and

application handle. Be sure application handle is in released position before removal.

Loosen adjustment setscrews until the adjusting nut and piston guide can be rotated.

Disconnect application line at port "B".

Apply air pressure at port "A".

Using a broad blade screwdriver or other suitable tool, move the adjusting nut and piston guide downward until an air leak develops at port "B".

Turn adjusting nut and piston rod guide in opposite direction 1½ turns. Tighten adjustment setscrews. Make sure setscrews contact flats on the adjusting nut and piston rod guide. Replace application handle and handle retainer nut.

With the application handle in the released position and air pressure at port "A", there should be no leakage through ports "B" and "E". A leak at either of these ports indicates leakage at the valve insert caused by dirt, damaged or worn insert, damaged or worn insert seat, or a bent exhaust valve stem.

With the application handle in the applied position, air pressure present at port "A", and with port "B" plugged, there should be no leakage at port "E". A leak at port "E" indicates leakage at the exhaust valve insert caused by dirt, damaged or worn insert, damaged or worn insert seat, or a bent exhaust valve stem. This could also be caused by a damaged or worn piston cup.

PILOTAIR VALVE

Disassembly

Remove the cotter from one end of cam roller lever pin and remove pin and roller from valve body. See Figure B-28.

Remove snap ring securing the plunger guide into body. Entire assembly may now be removed.

Individual parts may now be separated and inspected.

Reassembly

Wash all metal parts in cleaning solvent. Wash all rubber parts in soap and water. Dry all parts with low pressure air jet.

Lubricate all friction surfaces, including packing rings with a wide temperature range grease.

Replace parts back into body in reverse order of removal. Secure with snap ring.

Replace roller and lever pin—secure with cotter.

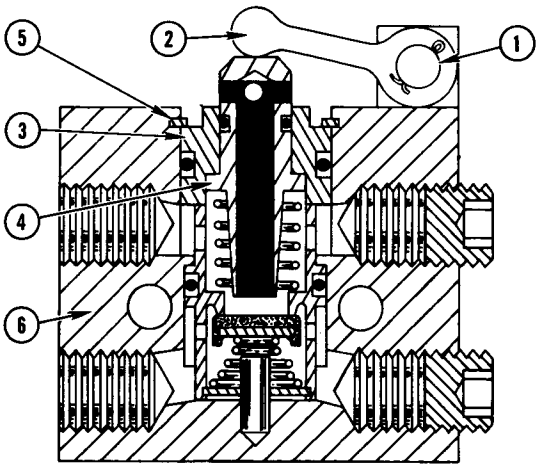


FIGURE B-28. PILOTAIR VALVE, SECTIONAL

1. Cotter
2. Cam Roller
3. Plunger Guide
4. Plunger
5. Snap Ring
6. Body

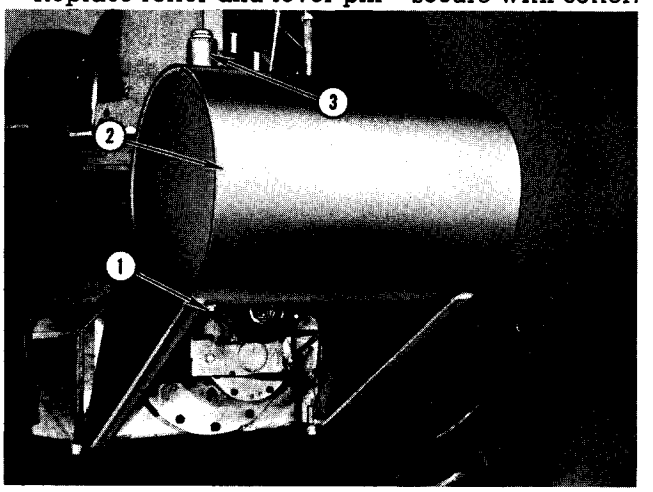


FIGURE B-29. FUEL TANK

1. Drain Plug
2. Fuel Tank
3. Filler Cap

FUEL TANK

The fuel supply system cleans, contains, prepares and controls the flow of fuel to the engine. The use of a good grade of fuel oil and proper care of the filters are some of the most important factors of engine care and maintenance. Dirty fuel may contain solid material which is abrasive. If some of this material reaches the fuel injection system the finely finished surfaces will become damaged and the fuel injection equipment will no longer function properly.

Under such circumstances, the engine will begin to show symptoms of loss of power, incomplete

combustion, hard starting, missing and other forms of erratic operation.

Keep all fuel lines tight and free from leaks. Replace fuel oil filters periodically. Drain sediment from fuel tank before each shift. Refer to section "K" for maintenance and lubrication instructions.

Removal

Disconnect fuel lines to fuel tank at connections on rear of main case.

Remove capscrews and lockwashers securing the auxiliary transmission guard plate to fuel tank bracket and remove plate.

Attach hoist to fuel tank and remove the three mounting bolts which secure the tank bracket to the main case.

TROUBLE SHOOTING

TROUBLE: Compressor fails to maintain adequate pressure in air system.

CAUSE: Dirty air cleaner.
REMEDY: Remove air cleaner. Clean all parts in cleaning solvent. Refill cup and replace in machine.

CAUSE: Excessive carbon in compressor cylinder head or discharge line.
REMEDY: Clean head and line of carbon and replace if necessary.

CAUSE: Discharge valve leaking.
REMEDY: Repair or replace compressor cylinder head if excessive leakage is found.

CAUSE: Inlet valve stuck open.
REMEDY: Check condition of inlet valve. If there is excessive clearance between the inlet valve bushings and the inlet valves, both may have to be replaced.

CAUSE: Excessive leakage of inlet valves.
REMEDY: Inlet valves pitted or worn. Must be ground to their seats. If valve seats are too badly pitted or worn, inlet valve and seats must be replaced.

TROUBLE: Compressor passes excessive oil.

CAUSE: Excessive wear.
REMEDY: Replace compressor or worn parts.

CAUSE: Oil return line to engine crankcase plugged.
REMEDY: Remove line and clean.

CAUSE: Compressor crankcase flooded.
REMEDY: Remove oil return line and clean.

CAUSE: Piston ring improperly installed.
REMEDY: Remove pistons and reinstall rings. Be sure to stagger ring gaps.

TROUBLE: Noisy operation.

CAUSE: Loose drive pulley.
REMEDY: Tighten pulley.

CAUSE: Excessive carbon in cylinder head or discharge line.
REMEDY: Clean head and line of carbon. Replace if necessary.

CAUSE: Worn or burned out bearings.
REMEDY: Replace bearings.

CAUSE: Excessive wear.
REMEDY: Replace compressor or worn parts.

TROUBLE: Compressor does not unload.

CAUSE: Defective unloading piston grommet.
REMEDY: Replace grommet.

CAUSE: Unloading cavity plugged with carbon.
REMEDY: Remove cylinder head, disassemble and clean.

CAUSE: Unloading mechanism binding or stuck.
REMEDY: Disassemble and clean all parts with a cleaning solvent. Replace all worn parts.

Treadle Valve

TROUBLE: Brakes do not release or release slowly when foot pressure is removed.

CAUSE: Improper adjustment prevents or limits exhaust valve opening.
REMEDY: Readjust exhaust valve.

CAUSE: Piston sticking in valve body.
REMEDY: Clean and lubricate piston and springs.

TROUBLE: Valve will not meter applied air pressure properly.

CAUSE: Weak or broken metering spring.
REMEDY: Replace metering spring.

TROUBLE: Brakes apply with valve in released position.

CAUSE: Improper adjusting holding inlet valve open.
REMEDY: Readjust valve.

TROUBLE: Air brake not functioning properly.

CAUSE: Leaks in air system.
REMEDY: Check entire system for leaks.

CAUSE: Clogged air line.
REMEDY: Locate clogged line and remove obstruction.

COCKPIT AND ENGINE

INDEX

COCKPIT AND ENGINE

COCKPIT

Removal

STEP GEAR TRANSMISSION

Remove battery ground cable from battery post and fasten it away from post to prevent accidently shorting out battery.

Open air tank bleeder valve and completely bleed the air system.

Remove capscrews and lockwashers securing exhaust shield flange to hood. Remove clamp fastening exhaust pipe to exhaust side of turbocharger. Lift exhaust pipe and shield from hood. Remove the four bolts fastening dry type air cleaner mounting bracket to the hood. Block under air cleaner to keep it from falling. (Dry type air cleaner may be removed if desired).

Remove the two bolts fastening oil bath air cleaner and rectifier housing to hood.

Remove the capscrews fastening the hood to the cockpit, side sheets, and to radiator grille. Lift off hood. Remove side sheets.

Loosen the capscrews in the cockpit deck plate mounting clips. Turn clips and remove cockpit deck plate.

Disconnect headlight wires at left head light and pull cable through the conduit. Unscrew conduit locking nut from under instrument panel and remove conduit.

Disconnect air lines to transmission pre-select valve.

Remove cover and disconnect leads from steering main switches.

Disconnect cable from instrument panel to cranking motor solenoid.

Disconnect cable from instrument panel to P. T. fuel pump solenoid.

Remove cover from parking brake sheave inspection port on left side of cockpit and disconnect parking valve wire rope from handle. Loosen jam nut and back out adjusting screw. This screw is to prevent the cockpit side sheets from pulling in when parking brake is applied.

Support fender with hoist; remove mounting capscrews and lockwashers and remove fender. Both fenders are to be removed.

Remove coolant temperature bulb from engine block.

Disconnect throttle linkage.

Disconnect air lines to clutch assist air valve and air chamber.

Disconnect tubing from cold weather starting aid pump.

Remove knobs from transmission and auxiliary transmission shift levers. Disconnect flywheel clutch pedal linkage.

Disconnect air compressor to governor air line at the compressor.

Remove treadle valve to rear junction block air line from clips under cockpit and disconnect line from treadle valve.

Disconnect the main cable from switches and from clips securing it to the under side of the cockpit. Also disconnect the cable that goes from the D.C. field switch to the panel, at the panel.

Disconnect the engine oil pressure line from the fitting on the cockpit fire wall.

Disconnect the air lines from the air tank to the junction block and from the junction block to the trail unit brakes.

Remove the four mounting bolts securing the cockpit to the case. Attach hoist to cockpit and raise slightly. Check for any wires, hoses, tubing, or controls which may have been overlooked and left connected.

Lift off cockpit and lower to floor. Lower carefully and place on blocks to prevent damaging wires, hoses, cables, tubing or controls.

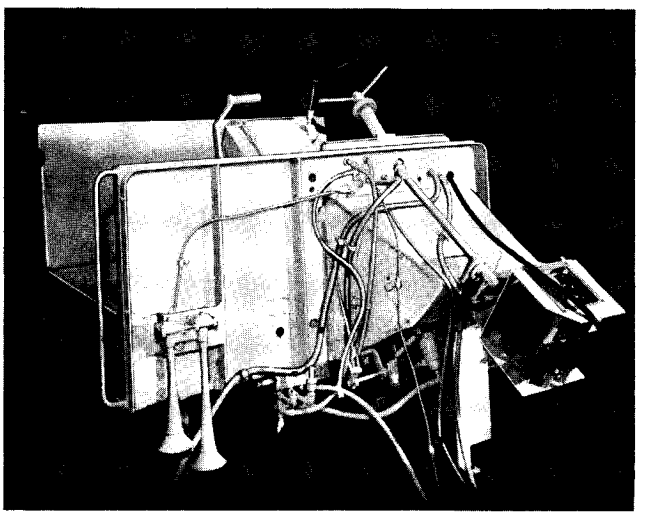


FIGURE C-1. POWER SHIFT COCKPIT, REMOVED

POWER SHIFT TRANSMISSION

Follow the above instructions and include the following steps.

Remove transmission oil pressure line, and transmission oil temperature bulb from transmission.

Remove cotter and pin securing transmission selector linkage to selector control valve lever on transmission.

Remove cotter and pin securing hydraulic retarder lever linkage to retarder control valve on transmission.

Disconnect transmission filler pipe at connection under cockpit floor plate.

Disconnect tachometer cable (if equipped).

Lift off cockpit and place on blocks as described above.

ENGINE

Removal

STEP GEAR TRANSMISSION

Remove hood, radiator, cockpit and dry type air cleaner.

Remove tubing from starting aid tank. Be sure valve is closed before removing tubing.

Drain lubricating oil from Luber-Finer oil filter. Disconnect all lines from bottom of filter. Remove capscrews and lockwashers fastening filter bracket to Tournapull case and lift filter and bracket from case.

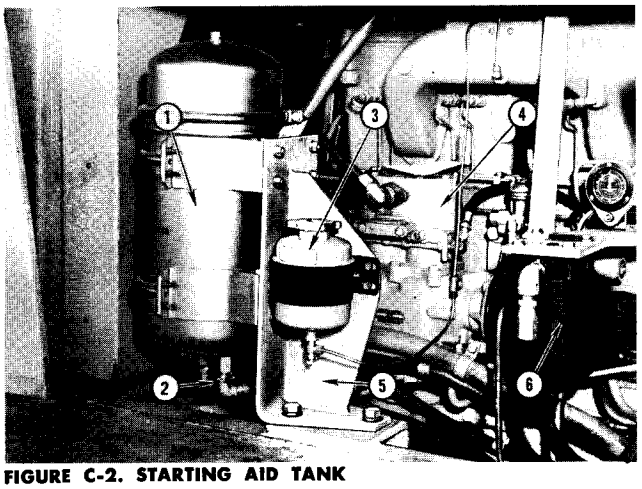


FIGURE C-2. STARTING AID TANK

1. Luber-Finer
2. Oil Lines
3. Starting Aid Tank
4. Air Compressor
5. Bracket
6. Fuel Filter

Disconnect air line that goes from compressor head to air supply tank.

Disconnect fuel lines from fuel filter, fuel pump, and fuel return manifold at the engine.

Loosen nut on the clip holding the generator grease tube against the case and remove grease tube from under clip (if so equipped).

Disconnect generator to transformer leads at the generator terminal strip. Also remove the cable from the cable clamp securing it to the generator end bell.

Remove Tournapull rear belly pan.

Remove cotter, nut, and washer from rear of drive shaft and pull the parking brake drum and key from shaft. Remove bearing retainer and shims.

Remove the snap ring from inside the spacer. Pull out on drive shaft as far as possible (approximately 15 inches or until it hits a stop).

Attach hoist to engine and transmission and take up any slack.

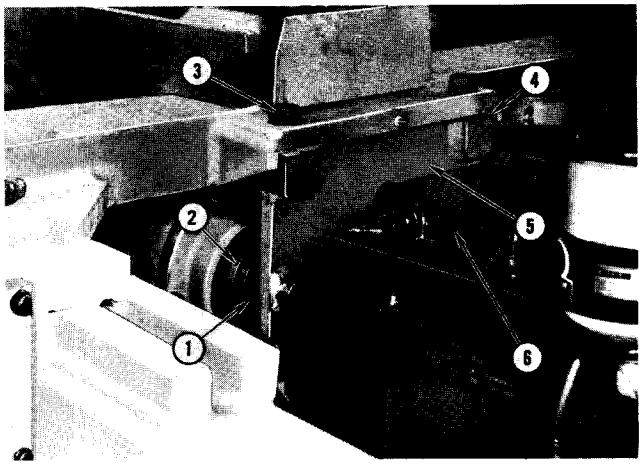


FIGURE C-3. TRANSMISSION HANGER AND ADAPTOR

1. Adaptor Boot
2. Hose Clamps
3. Hanger Bolts
4. Shims
5. Hanger
6. Transmission

Loosen lockscrews in hose clamp holding the transmission adaptor boot to the adaptors (Fig. C-3).

Remove engine front mounting bolts, engine rear mounting bolts, and transmission hanger bolts. Hoist engine very slightly and remove shims from all mounting pads. Keep shims grouped together as they MUST be replaced in the same position from which they were removed.

If engine, generator and transmission are mounted in cradle type mount, remove engine front mounting bolts and the bolts securing the cradle mount to the Tournapull case (Fig. C-6).

Recheck around engine, generator, and transmission to see if any cables, controls, hoses, or tubes have been left connected.

Hoist engine, generator and transmission and pull forward out of case. Place on stand or blocks for service or further disassembly.

POWER SHIFT TRANSMISSION

Remove hood, radiator, cockpit and dry type air cleaner.

Disconnect tubing from starting aid tank. Be sure valve is closed before removing tubing.

Drain oil from Luber-Finer lubricating oil filter. Disconnect all lines from bottom of filter. Remove capscrews and lockwashers fastening filter bracket to Tournapull case and lift filter and bracket

from case. See Figure C-2.

Disconnect air line that goes from compressor head to air supply tank. Disconnect fuel lines from fuel filter, fuel pump and fuel return manifold at the engine.

Loosen nut on the clip holding the generator grease tube against the main case and remove grease tube from under clip (if so equipped).

Pull parking brake wire rope (from rear of machine) through sheave and guide tube. Remove the capscrews and lockwashers at each end of the guide tube and remove guide tube from transmission.

Disconnect generator to transformer leads at the generator terminal strip. Also remove the cable from the cable clamp securing it to the generator end bell.

Remove hose from "out" side of transmission to heat exchanger from clamps securing it to the left side of main case.

Remove hose from "in" side of transmission to heat exchanger from clamps securing it to the right side of main case.

Remove Tournapull rear belly pan.

Remove cotter, nut, and washer from rear of drive shaft and pull parking brake drum and key from shaft. Remove bearing retainer and shims.

Remove snap ring from the spacer. Pull out on drive shaft as far as possible (approximately 15 inches or until it hits a stop).

Remove capscrews and lockwashers fastening transmission adaptor to the rear case.

Attach hoist to engine end transmission and take up any slack.

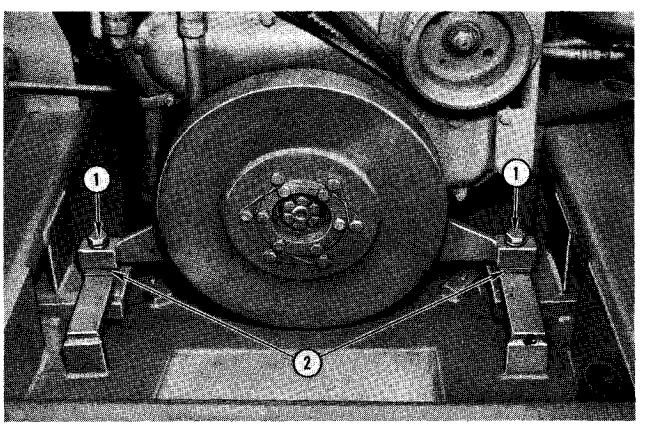


FIGURE C-4. FRONT ENGINE MOUNT
1. Mounting Bolts 2. Shims

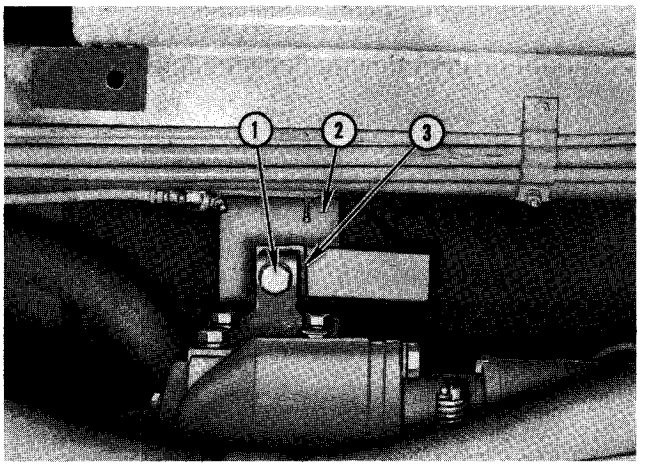


FIGURE C-5. REAR ENGINE MOUNT
1. Mounting Bolt 2. Mount 3. Shims

Remove engine front mounting bolts, engine rear mounting bolts, and transmission hanger bolts. Hoist engine very slightly and remove shims from all mounting pads. Keep shims grouped together as they MUST be replaced in the same position from which they were removed.

If engine, generator and transmission are mounted in a cradle type mount, remove front engine mounting bolts and the bolts securing the cradle mount to the transmission case. Use figure C-6 for reference.

Recheck around engine, generator, and transmission to see if any cables, controls, hoses or tubes have been left connected.

Hoist engine, generator and transmission from case. Place on stand for service or further disassembly.

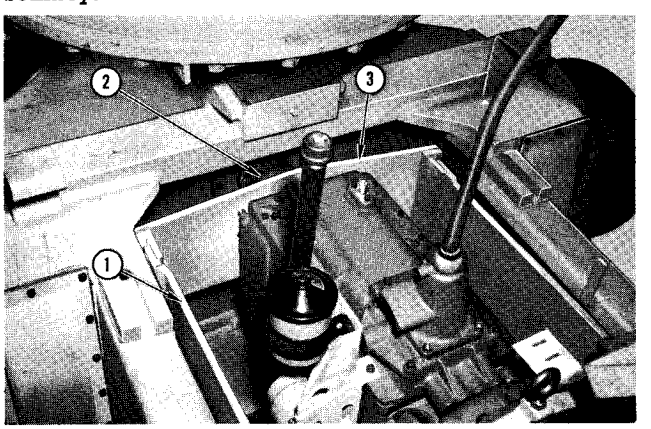


FIGURE C-6. CRADLE TYPE MOUNT
1. Side Sheet 2. Adaptor 3. Rear Plate

Installation

STEP GEAR TRANSMISSION

Engine, generator, clutch and transmission are to be installed in the case as a single unit. Refer to other sections of this manual for instructions on assembling the individual components to each other.

Clean the outside of the engine thoroughly to remove the accumulated coating of grease and

dirt. Clean the inside of the Tournapull case to remove any accumulation of dirt, grease or other foreign material present.

Attach hoist to engine, generator and transmission and position unit into main case.

Replace the engine and transmission mounting bolts (with shims) in the positions from which they were removed. Tighten the mounting bolts securely.

Mount a dial indicator on the transmission mainshaft splined adaptor sleeve. It must be mounted so that it will indicate the inside diameter of the transmission adaptor bore in the main case.

Rotate the transmission mainshaft to indicate the ID of the adaptor bore. The indicator readings must be within a total of at least 0.040" out of round in relation to the center of the adaptor bore.

Change position of indicator so that it will indicate the machined adaptor mounting face around the bore of the transmission in a 10" diameter circle.

Transmission output shaft must be at right angles to the machined face on the case within 0.010" total indicator reading. Indicate the machined surface and note readings at top, bottom and each side.

Due to the weight of the generator and transmission, the output shaft of the transmission will, when the rear of the transmission is unsupported drop 0.042" below the center line of the engine crankshaft, and 0.011" out of square with relation to the adaptor mounting face. The transmission will be 0.033" low at the rear transmission hanger.

In order to bring the generator and transmission in line with the engine crankshaft when aligning these components in relation to the bore in the case, allowance will have to be made for this droop and out of square condition.

Align the engine, generator and transmission assembly to the bore in the case, by means of the engine mounting shims and by shifting the assembly from side to side. CHECK BORE CONTINUALLY WITH A DIAL INDICATOR DURING ALIGNING PROCEDURE.

When the indicator reads 0.042" low at the bottom of the ID of the bore, but equally spaced in relation to the sides of the bore, measure the distance between the top of the rear transmission hanger and the block where it butts up against the main case. Add shims between the hanger and the main case in the amount of the measured gap between the hanger and the main case **less** 0.033".

Install transmission hanger capscrews and pull hanger into place.

Indicate case bore ID and machined face. Indicator should read no more than a total of 0.040" in the bore ID, or more than a total of 0.010" on the face. If readings do not come within these requirements, re-shim.

If engine, generator and transmission are equipped with cradle type mount the engine, generator and transmission must be assembled together as a complete unit and the mounting cradle installed. Hoist entire assembly into case and lower onto the mounting pads. Mount dial indicator on transmission mainshaft and indicate the ID of the adaptor bore in the Tournapull rear case. Indicator readings between any two points around the bore must not vary over 0.040" total indicator reading between any two points. Make note of readings. Position the indicator pad so that it will indicate the machined boss of main case around the adaptor bore, in a 10" diameter circle. Take readings all around the machined boss. Readings must not vary over 0.010" total indicator reading. If readings are not within the specified limits, shift the entire engine, generator, transmission and mounting cradle assembly up or down; or shift from side to side, until the correct readings are obtained. Tighten engine and transmission mounting bolts to correct torque and recheck by again indicating diameter of adaptor bore in case, and the machined surface of the case.

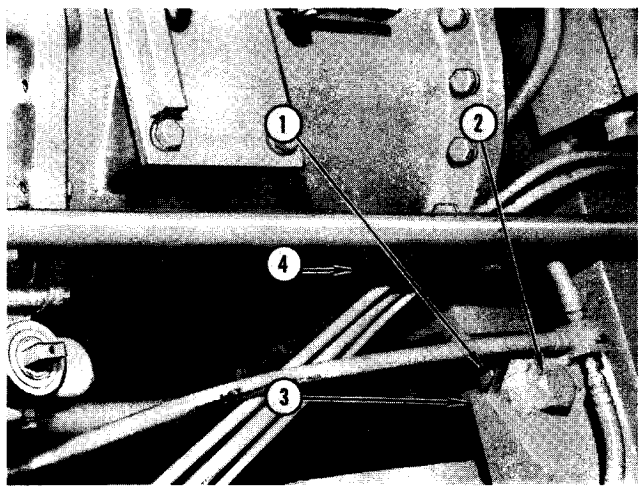


FIGURE C-7. TRANSMISSION REAR MOUNT
1. Bracket 2. Bolt 3. Nut 4. Transmission

Replace the transmission adaptor between main case and transmission. Coat the mating surfaces with a thin coating of Permatex. Engage the internal splines of the drive shaft hub with the external splines on transmission mainshaft splined adaptor sleeve. Replace adaptor boot and secure with hose clamps. See Figure C-8.

Replace spacer and snap ring into bore of the

auxiliary transmission. Replace shims, bearing retainer and oil seal, and secure with capscrews. Install key into keyway on drive shaft and replace parking brake drum. Secure with flat washer, castellated nut and cotter. See section "H" for procedure on readjusting the parking brake.

Reconnect all controls, cable, hoses and tubing. Complete installation of all assemblies removed.

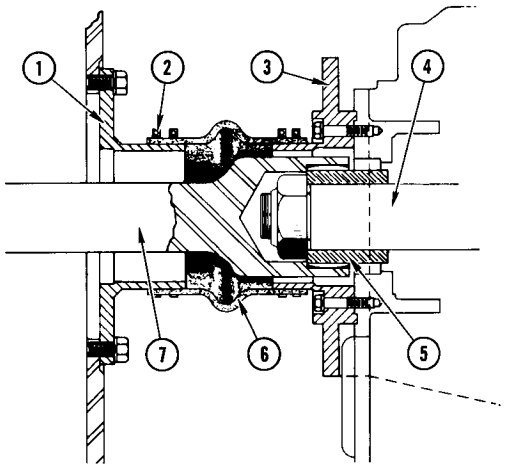


FIGURE C-8. TRANSMISSION ADAPTOR

1. Boot Adaptor
2. Hose Clamp
3. Transmission Adaptor
4. Transmission Mainshaft
5. Adaptor Hub
6. Boot
7. Drive Shaft

POWER SHIFT TRANSMISSION

Engine, generator and transmission are to be installed in the case as a single unit. Refer to other sections of this manual for instructions on assembling the individual components to each other.

Clean the outside of the engine thoroughly to remove the accumulated coating of grease and dirt. Clean the inside of the Tournapull case to remove any accumulation of dirt, grease or other foreign material present.

Attach hoist to engine and transmission and position unit into main case.

Replace the engine and transmission mounting bolts (with shims) in the position from which they were removed. Tighten the mounting bolts securely.

Mount a dial indicator on the transmission mainshaft splined adaptor sleeve. It must be mounted so that it will indicate the diameter of the transmission adaptor bore in the main case.

Indicate the inside diameter of the adaptor bore. The indicator readings between any two points around the bore must NOT vary over 0.040" total reading.

Add or subtract shims at mounting points to obtain the correct indicator readings. Continue checking the bore measurement as shims are removed or added.

Now reposition the dial indicator pad so that it will indicate the machined boss of the main case around the adaptor bore, in a 10" diameter circle.

Take readings all around the machined boss. Readings must not vary over 0.010" total indicator reading. If readings are not within the 0.010" limit, shift the assembly up or down by adding or removing shims to the engine mounts and the transmission mounts; or shift the assembly to one side or the other, until the correct readings are obtained, add necessary shims. Tighten engine and transmission mounting bolts to correct torque and recheck by again indicating the diameter of adaptor bore in case, and the machined surface of the case.

If engine, generator and transmission are in the cradle type mount, they must be assembled into the mount before placing into case.

Position unit into case and replace shims and mounting bolts into positions from which they were removed. Tighten mounting bolts securely and then proceed as described above.

Remove mounting bolts and shims and slide assembly far enough forward to position the transmission adaptor between main case and transmission. Position gasket between adaptor and transmission and between adaptor and rear main case. Secure to transmission with capscrews and lockwashers. Slide engine and transmission back and replace mounting shims and bolt. Replace capscrews and lockwashers securing adaptor to main case.

Engage the internal splines of the drive shaft hub with the external splines on transmission mainshaft splined adaptor.

Replace spacer and snap ring into bore of the auxiliary transmission. Replace shims, bearing retainer and oil seal, and secure with capscrews. Install key into keyway or drive shaft and replace parking brake drum. Secure with flat washer, castellated nut and cotter. See section "H" for procedure on readjusting the parking brake.

Reconnect all controls, cable, hoses and tubing. Complete installation of all assemblies removed.

SHIFT QUADRANT

Removal and Disassembly

Remove the cotter and pin securing the clevis on the shift linkage to the shift lever crank.

Remove capscrews and lockwashers securing the shift quadrant to the mounting bracket and

remove quadrant.

Remove cotter and nut from the lever pivot bolt which secures lever to end of shaft structure and then withdraw the capscrew. When the bolt is removed the plunger reactor is freed and permits the removal of the lever plunger and spring.

Raise the lever straight out of quadrant until it is free of shaft.

Reassembly

Slide shifting lever down through quadrant and into shaft.

Place spring and plunger into bore of block on shifting lever. Position plunger reactor against plunger. Press in on plunger reactor until pivot bolt can be inserted through reactor, shaft and shift lever. Fasten into place with nut and cotter.

Replace quadrant on mounting bracket and secure with capscrews, and lockwashers.

Reconnect shift linkage clevis to crank and secure with pin and cotter.

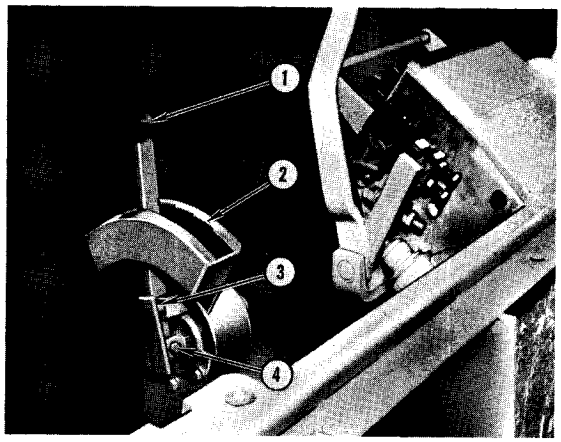


FIGURE C-9. SHIFT QUADRANT (POWER SHIFT)

1. Lever 2. Quadrant 3. Plunger and Spring 4. Pivot Bolt

A.C. GENERATOR

INDEX

A.C. GENERATOR

REMOVAL AND DISASSEMBLY

STEP GEAR TRANSMISSION

Remove engine, generator, transmission and flywheel clutch from the case as a unit. Refer to Section "C" for instructions on removing these units. Separate transmission and generator end bell.

Remove the clutch and secondary flywheel from the generator end bell (refer to section "E").

Disconnect the two leads to the generator brush holders. Disconnect one at the end bell and the other at the generator terminal strip.

Remove the socket head locking setscrew from the generator locknut (Fig. D-1). Now remove the generator locknut with a special wrench and extension handle.

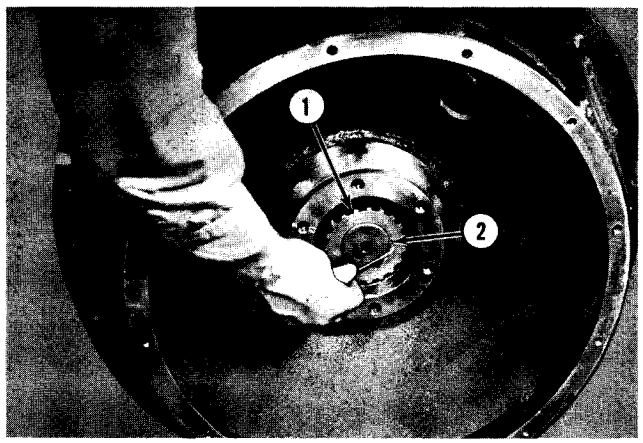


FIGURE D-1. REMOVING LOCKNUT SETSCREW
1. Locknut 2. Setscrew

Remove the capscrews securing the generator end bell to the generator stator and separate the two units (Fig. D-2). Press out the adaptor, bearing, piston rings and retainer from the bore of the end bell as a complete unit (Fig. D-3).

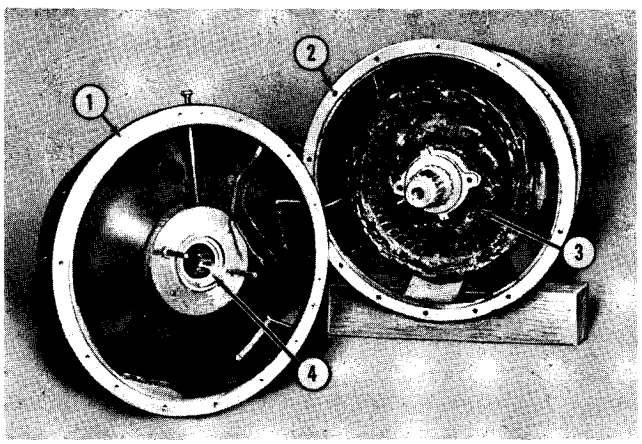


FIGURE D-2. END BELL AND STATOR, SEPARATED
1. End Bell 2. Stator 3. Rotor 4. Adaptor

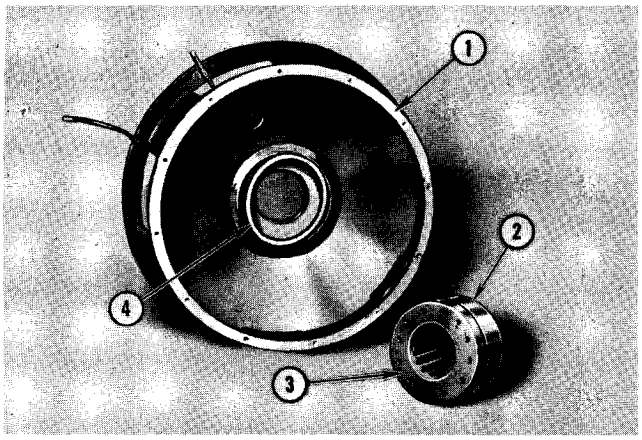


FIGURE D-3. ADAPTOR, REMOVED
1. End Bell 2. Bearing 3. Adaptor 4. Shims

Remove piston rings from grooves in the adaptor hub and slide retainer ring and bearing from hub.

Remove capscrews holding stator to engine. Pull stator straight away from rotor, taking care not to damage windings (Fig. D-4).

Remove rotor by backing out capscrews after cutting lockwires. To prevent damage to rotor windings, sling rotor to keep it from dropping to the floor when capscrews are removed. Take capscrews only half way out, pull on rotor, then take the capscrews completely out. CAUTION: Tape threads on ends of rotor shaft to prevent damage to them.

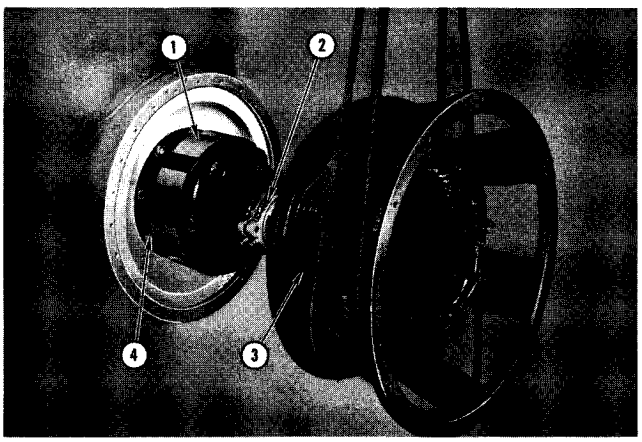


FIGURE D-4. REMOVING STATOR
1. Rotor 2. Brush Assembly 3. Stator 4. Capscrews

POWER SHIFT TRANSMISSION

Remove engine, generator and transmission from case as a unit. Refer to section "C" for removal instructions.

Place unit on stand or floor and block securely

to prevent movement. Attach chain hoist to lifting eyes on transmission and take up slack.

Remove capscrews and lockwashers securing cover plates and gaskets to inside of generator end bell (Fig. D-5). Remove plates and gaskets.

With a socket wrench reach in through the hand holes in the generator end bell and remove the capscrews securing the flexible flywheel to the transmission flywheel. It will be necessary to put the transmission in neutral and bar the engine over to bring all of these capscrews in line with the hand holes in the end bell.

Remove the capscrews and lockwashers securing the transmission case to the generator end bell. Separate by pulling the transmission straight to the rear.

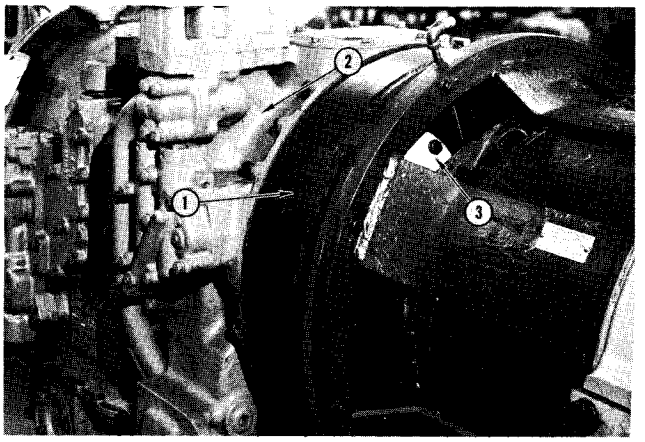


FIGURE D-5. GENERATOR END BELL
1. End Bell 2. Transmission 3. Cover Plates

Remove capscrews securing flexible flywheel to generator adaptor structure and remove flywheel and hub disc from adaptor.

Proceed to disassemble generator and adaptor as described for the step gear transmission.

BRUSH ASSEMBLY

Remove the socket head capscrews holding the two pairs of brush holder half-rings together. Remove the half-rings, brush segments and springs from around the rotor shaft (Fig. D-7).

The brush segments, tension springs, half-rings, clips and bushings may now be separated.

Check for grounds or shorts between brush holders or between brush holder and the frame of the machine. Be sure the insulated bushings are not crushed or broken.

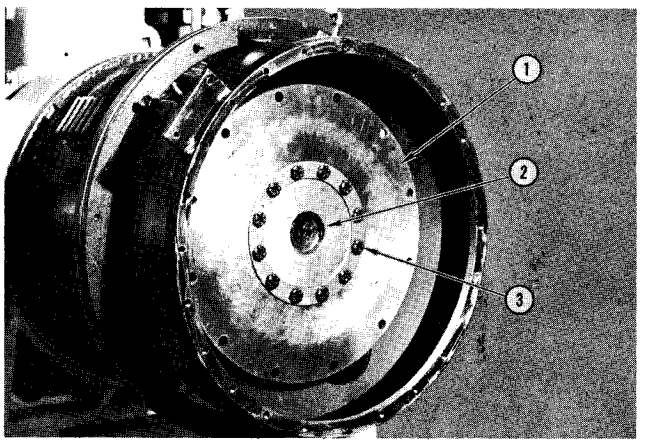


FIGURE D-6. SECONDARY FLYWHEEL
1. Flywheel 2. Adaptor 3. Capscrews

REASSEMBLY

BRUSH ASSEMBLY

Assemble the two top half-rings, brush segments, insulated bushings and tension spring. Compress spring by squeezing half-rings together and place over rotor shaft between the rotor slip rings, and separated by the center insulating washer.

Assemble bottom half-rings in the same manner. Place clips on bottom half-rings, compress spring and place over bottom of rotor shaft.

Replace socket head capscrews and lockwashers.

STEP GEAR TRANSMISSION

Inspect the stator windings. Remove any accumulation of grease and dirt with a low pressure siphon hose and a cleaning fluid, such as carbon tetrachloride. After the windings have been washed down with the cleaning fluid, blow off the excess with compressed air.

Install rotor on engine flywheel and secure with capscrews and lockwires. Replace the stator over the rotor and secure to flywheel housing with cap-

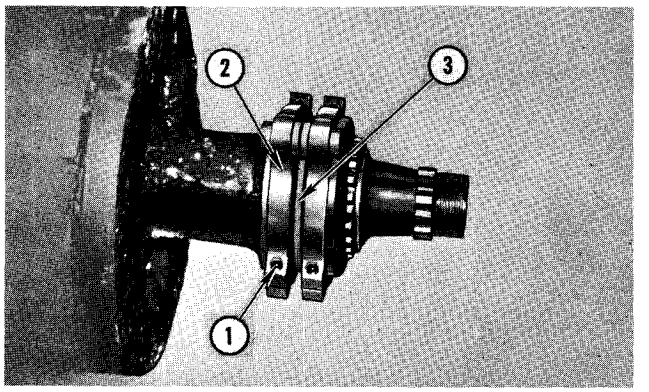


FIGURE D-7. GENERATOR BRUSH ASSEMBLY
1. Capscrew 2. Half Ring 3. Insulating Washer

screws and lockwashers. Torque capscrews to 40 ft. lbs. Reconnect leads to generator brush holders.

Install and secure end bell to generator stator with capscrews and lockwashers. Repack ball bearings with high temperature ball bearing grease.

Install the ball bearing onto the hub of the

adaptor structure. Slide the retainer ring onto the hub until it has passed the piston ring grooves (beveled edge of ring away from adaptor). Place the two piston rings in the grooves of the hub. Compress the rings and position the retainer ring over them, thus holding them in the compressed position.

Now start the adaptor hub into the bore of the end bell. This will force the retainer ring back. Freeing the piston rings in the bore of the end bell.

Assemble the adaptor and torque the locknut to 1200 ft. lbs. Replace socket head setscrew.

To determine the amount of shims required (if any) between the generator rear bearing and the bottom of the bearing bore in the end bell, first check the engine crankshaft end play with an indicator. Record the amount of end play for future reference.

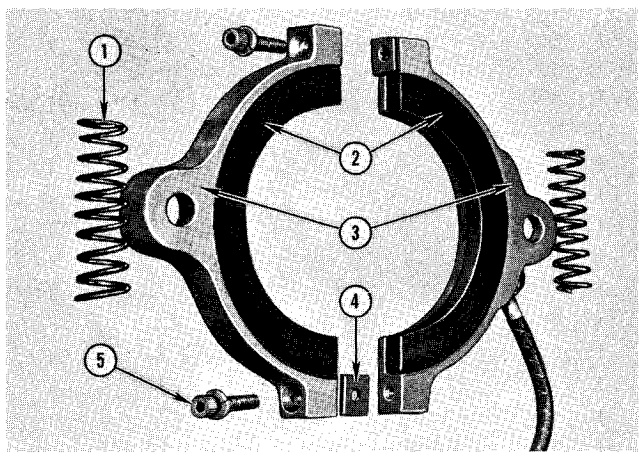


FIGURE D-8. BRUSH AND HOLDER

1. Spring
2. Brush Segments
3. Half Ring
4. Capscrew
5. Clip

Move the engine crankshaft as far forward as possible and hold in this position. Move the bearing forward until it bottoms in the bore.

Check the distance between the inner race of the bearing and the shoulder of the adaptor with a feeler gauge.

Add 0.001" to the distance between the bearing and shoulder. Insert shims equal to this total distance, between the bearing and bottom of the bore.

Recheck the crankshaft end play. The amount of end play should be reduced to approximately 0.001" to 0.002".

Complete reassembly of unit.

POWER SHIFT TRANSMISSION

Assemble unit as described for step gear transmission. Place hub disc into adaptor bore. Position flexible flywheel onto adaptor and hub disc. Secure with capscrews torqued to 70 ft. lbs.

Position gasket on transmission mounting face of end bell. Hoist transmission case against end bell and secure with capscrews. The three top capscrews securing the transmission to the generator end bell must be lock wired. These capscrews are installed through the inspection port at the top of the converter housing.

By reaching in through hand holes in end bell replace the capscrews securing the flexible flywheel to the transmission flywheel. Torque the capscrews to 70 ft. lbs. It will be necessary to bar the engine over to reach all the capscrews.

Replace hand hole gaskets and covers.

Complete reassembly of unit.

RECTIFIERS

The rectifiers are mounted above the engine air cleaner. They are enclosed in an extension to the air cleaner body so that air entering the air cleaner passes across the rectifier plates before reaching the air cleaner. This flow of air across the rectifiers keeps them from overheating.

The rectifier assembly consists of two separate rectifiers. They are the battery charging and compensating rectifier, and the booster rectifier.

Removal and Disassembly

Remove capscrews and lockwashers fastening cover plate to rectifier housing.

Pull cover plate and gasket, with rectifiers attached from housing.

Disconnect the wires to the rectifier terminals. Mark them as they are removed to facilitate reassembly.

Loosen cable clamps on cover and pull cables from cover plate.

Loosen nuts on each end of rectifier mounting bolt and slide rectifier from between mounting bracket ears.

Reassembly

The rectifiers should never be interchanged. Replacement must always be made with a rectifier with the same number of plates and stacked in the same way as the one being replaced.

Replace rectifiers between the mounting bracket ears and tighten nuts on mounting bolts. Use the following guide for reconnecting the leads to the rectifier terminals.

The a.c. terminals are color coded yellow and are not connected by a terminal bar.

The d.c. positive terminal is color coded red and is always connected to the brass collector ring on one end of the rectifier. It is in between the three a.c. terminals and the d.c. negative terminal.

The d.c. negative terminal is color coded black and is on the opposite side of the a.c. terminals, across from the d.c. positive terminal.

Slide rectifiers into housing. Secure cover and gasket to housing with capscrews and lockwashers.

Later rectifiers are coded with symbols: A.C. for alternating current; + for positive d.c.; and — for negative d.c.

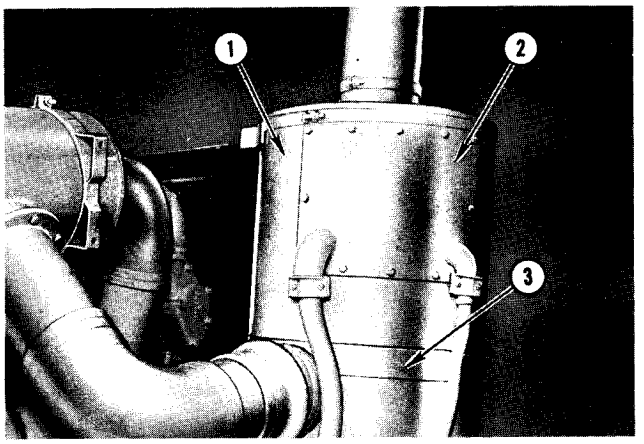


FIGURE D-9. RECTIFIER HOUSING

1. Housing
2. Cover Plate
3. Air Cleaner

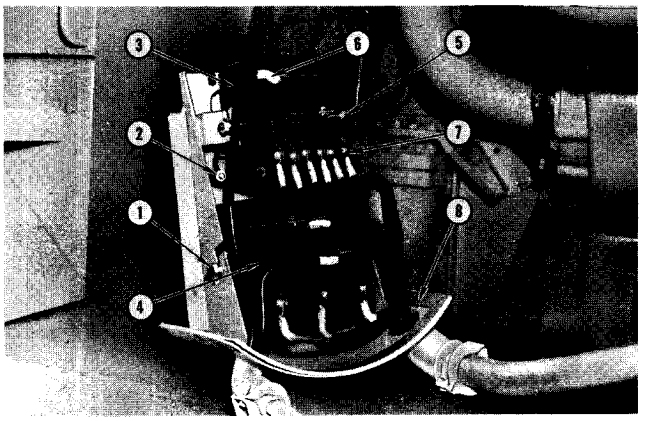


FIGURE D-10. RECTIFIERS

1. Mounting Bolts
2. Resistor
3. Battery Charging and Compensating Rectifier
4. Booster Rectifier
5. Positive Terminal (+)
6. Negative Terminal (—)
7. A.C. Terminal
8. Gasket

TRANSFORMERS

The transformer assembly consists of two transformers. They are the flux bridge transformer (or main transformer) and the voltage control transformer.

The transformers are mounted under the cockpit floor plate against the right hand side of the cockpit wall.

Removal

Remove right hand cockpit floor plate. Disconnect leads from terminal strip on transformer to be replaced.

Remove mounting bolts and lift transformer from cockpit.

Replacement

Secure replacement transformer to cockpit wall with mounting bolts.

Reconnect leads to terminal strips.

Replace cockpit floor plate.

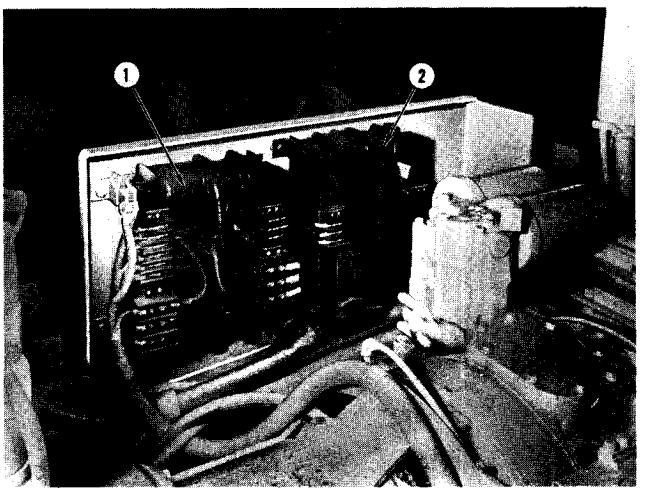


FIGURE D-11. TRANSFORMERS

1. Voltage Control Transformer
2. Flux Bridge (Main) Transformer

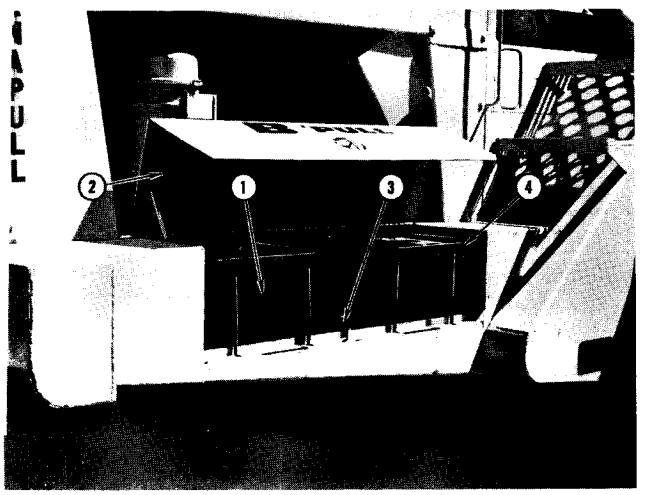


FIGURE D-12. BATTERIES

1. Battery
2. Cover
3. Spacer
4. Hold Down Plate

BATTERIES

The Model B Tournapull is equipped with two 12 volt batteries connected in series to provide 24 volts D.C. The batteries are mounted in the battery box on the left side of the Tournapull nose section.

The batteries provide the necessary direct current for the operation of the cranking motor, instruments, lights and the initial excitation of the A.C. generator.

Always operate the batteries at or near full charge and keep the electrolyte at the proper level. A battery half charged or less cannot be depended upon for starting and wears out rapidly. A low battery usually indicates that the charging system is out of adjustment. The charge rate can be varied by adding or removing shims under the flux bridge. Adding shims increases the charge rate and removing shims decreases it.

Keep the electrolyte above the plates so the battery can produce its full capacity and not be damaged by overheating. Maintain battery water level from the top of the plates to 3/8" above the plates.

Distilled water (never boiled or filtered) or water from local sources approved by the battery manufacturer should be used for filling storage batteries.

The best time to add water is just prior to operation. This insures a good mixture between the water and electrolyte. The water will stay on top in cold weather and freeze at about 32° F., unless it is thoroughly mixed.

The batteries should be kept clean and dry. Dirt and dampness furnish a path for electricity to leak away. Connections must be clean and tight to reduce resistance to the flow of current.

Dirt should be brushed off with a stiff bristle (non-metallic) brush. Wipe with a cloth wet with ammonia or bicarbonate of soda (one pound of soda to a gallon of water). Wash off with water. Examine vent plugs to see if the gas escape holes are clean afterwards.

Corrosion should be removed by scraping off with a stiff bristle (non-metallic) brush. Wash with ammonia or soda solution. After rinsing with clear water and drying, a thin coating of terminal grease or vaseline should be applied to the terminals. Do not apply grease between battery post and battery cable clamp.

Refer to section "K" of this manual for maintenance and instructions.

FLYWHEEL CLUTCH AND LINKAGE

INDEX

FLYWHEEL CLUTCH AND LINKAGE

The flywheel clutch serves as a connecting link between the generator rotor shaft and the transmission, by means of which flow of power from the engine to the transmission can be interrupted for the purpose of shifting gears, starting and stopping.

The flywheel clutch is a heavy duty, double disc clutch, controlled by the clutch pedal in the cockpit. It is mounted to the secondary flywheel and is enclosed within the generator end bell and the transmission bell housing.

The clutch is normally in the engaged position, and the flow of power passes from the engine through the generator rotor and clutch to the transmission. To break this flow of power to the transmission, the clutch is disengaged by depressing the clutch pedal.

When the operator presses down on the clutch pedal, the pedal moves forward and, through the action of the clutch pedal air valve, chamber and linkage rotates the clutch release shaft and turns the release yoke, disengaging the clutch.

FLYWHEEL CLUTCH

Removal and Disassembly

Disconnect and remove transmission as described in section "F".

Attach hoist or sling about the clutch assembly and take up the slack. Place four 3/8" x 16 hold down bolts through the holes in the back plate and thread them into the tapped holes of the pressure plate. These bolts should be approximately 5" in length and with sufficient washers on each one to permit their being drawn down snug to the back plate.

Remove the capscrews and lockwashers securing the clutch assembly to the secondary flywheel and remove clutch. As the clutch is separated from the flywheel, the front clutch plate will fall free. Place clutch assembly on bench for further disassembly (with back plate up). See Figure E-1.

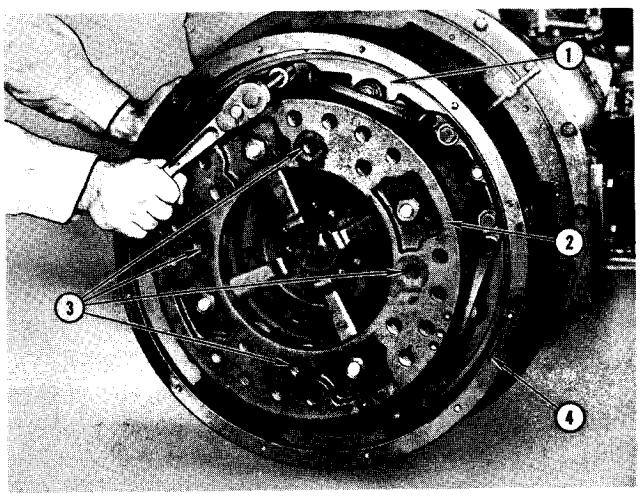


FIGURE E-1. CLUTCH REMOVAL

1. Adaptor
2. Back Plate
3. Hold Down Bolts Go Here
4. End Bell

To assure correct reassembly, paint mark the clutch cover, center plate, pressure plate and the adaptor. Remove the capscrews and lockwashers securing the back plate to the adaptor.

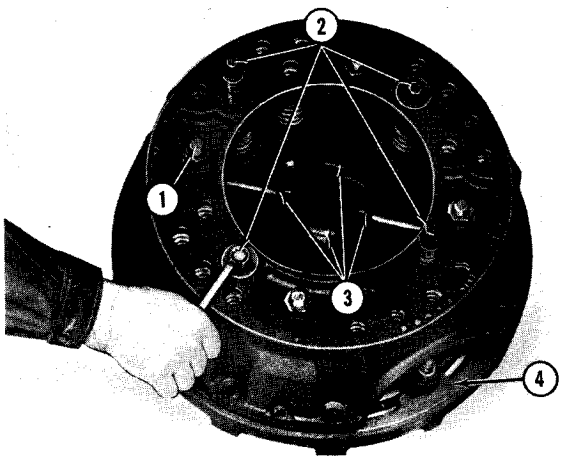


FIGURE E-2. REMOVING BACK PLATE

1. Adjusting Nut
2. Hold Down Bolts
3. Release Levers
4. Back Plate

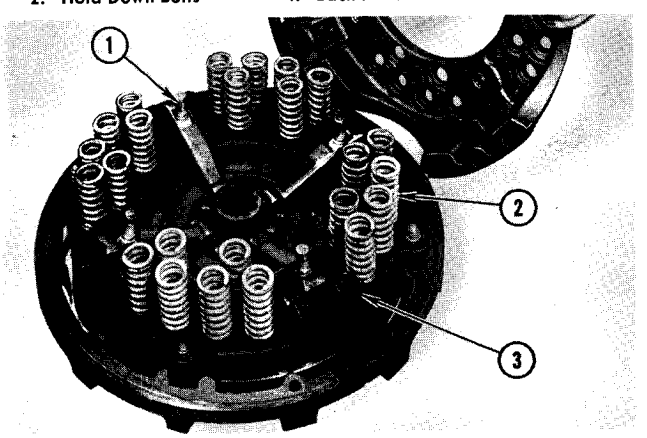


FIGURE E-3. REMOVING SPRINGS

1. Eyebolts
2. Springs
3. Pressure Plate

Place the clutch in an arbor press or clutch overhaul machine and remove the hold down bolts from the back plate. Should a press not be available, proceed as follows:

By alternately removing and replacing two of the four hold down bolts and using a decreasing

number of washers each time, the back plate may be completely released from the spring tension (Fig. E-2).

Back off the clutch adjusting nuts from the clutch release lever eyebolts. Lift the back plate from the clutch assembly and remove the springs from the pressure plate (Fig. E-3).

Remove cotter and washer from each lever pin and withdraw pins. Lift lever assemblies from between the mounting ears (Fig. E-4).

The needle bearings located in the mounting ears of the lever assemblies may be removed if necessary by pressing or tapping them from their position.

Remove the lever pivot pin holding the eyebolt and spring into place in each lever. Remove the eyebolts and springs, noting position of springs in order to reassemble correctly. Tap or press needle bearings from eyebolts if necessary.

Remove the four locknuts, return screw bushings and the anti-rattle springs from each of the center plate return screws which secure the pressure plate to the center plate.

Raise the pressure plate and the rear clutch plate from the center plate.

Remove the two flat washers and the plate separator springs from each return screw (Fig. E-5).

Lift adaptor from center plate. Remove the four return screws from the studs in the center plate.

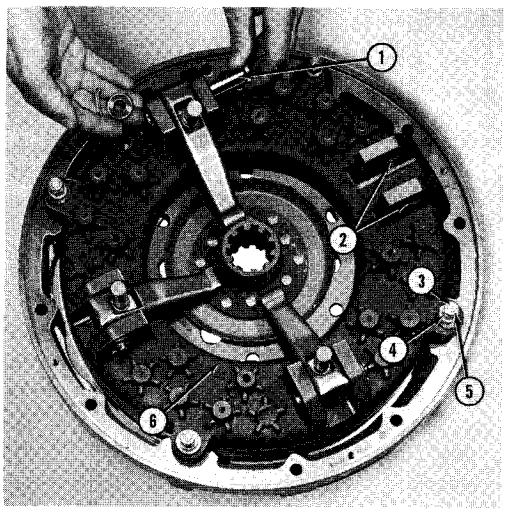


FIGURE E-4. REMOVING RELEASE LEVER

1. Lever Pin
2. Needle Bearing
3. Locknut
4. Bushing
5. Anti-rattle Spring
6. Pressure Plate

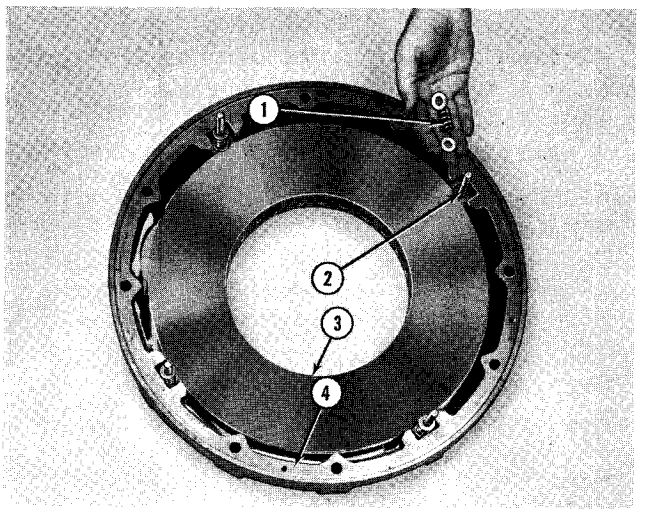


FIGURE E-5. REMOVING SEPARATOR SPRINGS

1. Plate Separator Spring
2. Return Screw
3. Center Plate
4. Adaptor

Reassembly

Place the center plate on a flat surface with the rear side up (rear side has countersunk holes in the drive lugs). Insert the four center plate return springs into the plate from the bottom. On each of these screws, place in the following order: washer, plate separator spring (4 coils), another washer and then the anti-rattle spring (5 coils).

Position the front clutch plate on top of the center plate with the hub face up, or toward the rear of the clutch. Position the pressure plate over the rear clutch plate so the four return screws and anti-rattle springs enter the holes in the pressure plate. Place the bushings over the return screws with the small end of the bushing into the pressure plate hole and secure into place with the self locking nuts.

NOTE: These return screw bushings must be adjusted to a specific clearance after the clutch is installed.

Replace the spring and eyebolt in each lever and secure in place with the lever pivot pin. (Flat on eyebolt toward the mounting lever pin.)

Place the clutch thus far assembled in an arbor press or clutch overhaul machine. Position the release lever assemblies between the mounting ears and fasten into place with the lever pins. Secure pins with the washers and cotters.

Before replacing the clutch pressure springs they may be tested in the following manner. First compress spring to 1 15/16" with no reading being taken. Release pressure on spring and then compress again to 2⅛". For a new spring, it should take 190 to 200 lbs. to compress the spring to the 2⅛" measurement; for a used spring it should take a minimum of 185 pounds. Springs not meeting these requirements should be replaced.

Place the 18 clutch springs on the pressure plate and then position back plate on top of

springs. Springs must be lined up with the depressions in the under side of the back plate. Compress the clutch with the press and start the adjusting nuts on the eyebolts.

Assemble adaptor ring to back plate and secure with the four capscrews.

Move the assembled clutch on to a flat smooth surface. Place two or more long parallel bars on this surface and then position the front clutch plate on top of the bars. These bars must have sufficient height to prevent the clutch hub from touching the flat surface. Now place the clutch on top of the clutch plate. Set a dial indicator or similar device, on the protruding part of the parallel bar. A specific distance of 4 5/8" is required between the bottom (or flywheel) surface of the front clutch plate and the top surface of each release lever, measured at the tip. Turn the adjusting nuts in or out as required, until this specific distance is obtained at each of the release levers.

Place the clutch assembly in the press again and compress the clutch until the hold down bolts and washers can be installed and tightened into place.

Place the front clutch plate against the secondary flywheel and hold in position with the aligning bar. Now place clutch assembly on secondary flywheel and secure with capscrews. Remove the hold down bolts and aligning bar.

After clutch has been secured to the secondary flywheel, hand crank the engine to such a position as to bring one of the center plate screws adjacent to the opening in the clutch housing. Engage the clutch and check for a 1/16" gap between the lip of the return screw bushing and the pressure plate. Tighten or loosen the locknut, whichever is necessary, until the correct gap has been obtained. Repeat this procedure for each of the four bushings.

The clutch assembly release levers are properly adjusted at the factory before the equipment has been shipped. They should not require any further adjustment until the clutch plates have become worn, or if for some reason, the clutch has been disassembled. However, before installing a new or reassembled clutch, it would be advisable to check this adjustment as a precautionary measure. This check is a simple operation and requires only a straight edge and a small accurate machinist type steel rule.

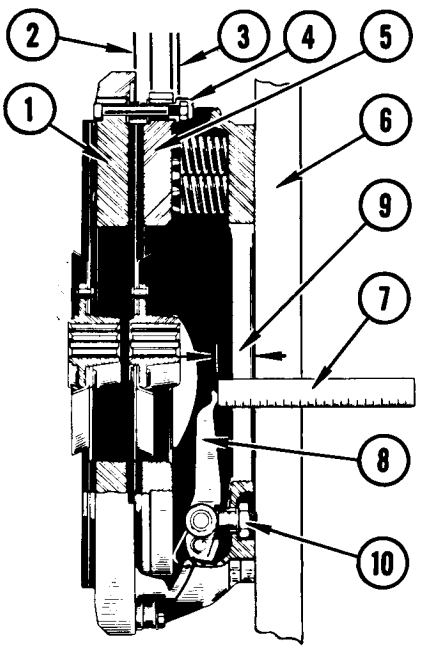


FIGURE E-6. CLUTCH ADJUSTMENTS

1. Center Plate
2. .175" Clearance
3. 1/16" Clearance
4. Return Screw Bushing
5. Pressure Plate
6. Straight Edge
7. Steel Rule
8. Release Lever
9. 1 3/16" Distance
10. Adjusting Nut

After the clutch assembly has been installed on the flywheel and the hold down bolts have been removed, place the straight edge across the back of the clutch assembly, and measure the distance from the bottom of the straight edge to the top of the free end of each of the release levers, as shown in Fig. E-6. The distance should be 1 3/16" on each release lever. If necessary, adjust the levers with the adjusting nuts on the eyebolts. Make certain all levers measure the same.

Replace the transmission and complete the reassembly of the machine as outlined in section "F".

CLUTCH LINKAGE

To enable the operator to more easily disengage the clutch, an air valve and air chamber have been incorporated into the clutch linkage. These units act as an air assist to the mechanical clutch linkage. There is also a clutch brake which slows down the transmission gears to aid in shifting the transmission.

As the clutch pedal is depressed the pull rod is moved out from the valve and the actuating lever in the brake valve is pulled with it. The end of the actuating lever contacts the piston spring seat and forces the piston assembly to move forward. The exhaust valve seat in the piston assembly contacts the exhaust valve, closing it. Continued movement of the piston after the exhaust valve is closed, forces the inlet valve off its seat, opening

it. Air pressure then flows through the open inlet valve to the cavity beside the piston. This cavity is connected to the air chamber. The air pressure applied to the air chamber disengages the flywheel clutch by rotating the clutch release shaft.

Releasing the clutch pedal allows the air to exhaust from the air chamber and air valve. As the air is exhausted the clutch springs engage the clutch.

CLUTCH RELEASE AIR VALVE

Removal and Disassembly

Disconnect air lines from valve.

Remove clevis pin securing linkage to clutch pedal lever. Remove air valve from machine.

Remove capscrews and lockwashers securing the cover to valve body. Separate cover and body.

Pull cotter pin holding fulcrum pin into body. Hold lever in body (against spring pressure) and drive out fulcrum pin with small drift. Remove lever, pull rod, washer and spring from inside body.

As lever is being removed spring pressure will force out the spring seat, shims, piston and piston return spring.

Remove inlet cap from other end of valve body. Remove spring, wear washer, valve assembly and grommet from inside body.

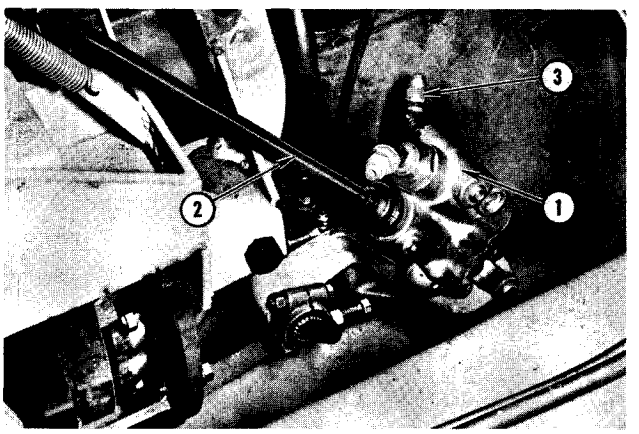


FIGURE E-7. CLUTCH RELEASE AIR VALVE

1. Air Valve
2. To Clutch Pedal
3. Air Line to Air Chamber

Reassembly

Clean all metal parts in cleaning solvent. Inspect all parts for signs of damage, replace parts when necessary.

Replace grommets and oiler felt.

Install valve grommet, valve, wear washer and spring (in that order) into valve body. Replace inlet cap and grommet.

Install piston return spring, piston, shims and spring seat into other end of valve body.

Replace pull rod spring, washer and pull rod into valve body. Engage lever pin in lever into slot in pull rod and install fulcrum pin. Turn fulcrum pin with small screw driver until cotter can be inserted through body and through hole in fulcrum pin.

Replace cover and secure with capscrews and lockwashers.

Replace unit on machine. Refer to section "K" for adjustment procedure.

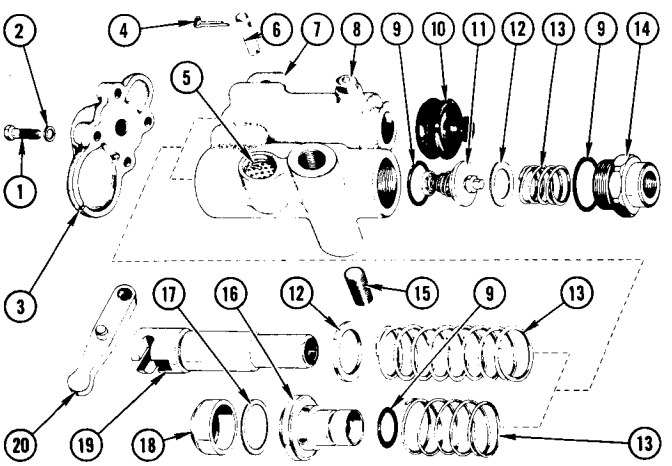


FIGURE E-8. CLUTCH RELEASE AIR VALVE, EXPLODED

1. Capscrew
2. Lockwasher
3. Cover
4. Cotter
5. Strainer
6. Fulcrum Pin
7. Body
8. Oiler
9. Grommet
10. Boot
11. Inlet and Exhaust Valve
12. Washer
13. Spring
14. Inlet Cap
15. Pipe Plug
16. Piston
17. Shim
18. Spring Seat
19. Pull Rod
20. Lever

CLUTCH RELEASE AIR CHAMBER

Removal and Disassembly

Disconnect the air line and push rod. Remove nuts from the mounting studs and remove the brake chamber.

Loosen the locknut, then unscrew the locknut from the push rod.

Remove the rubber boot from the cover and push rod. Unscrew the hex head capscrews that hold the cover to the body. They are located on the outside diameter of the body near the mounting surface.

Remove the cover and release spring.

Unscrew the nuts holding the outer clamp to the body. These are located at the air inlet end of the air chamber.

Push on the push rod and the entire assembly consisting of push rod, push plate, diaphragm guide, diaphragm; the inner and outer diaphragm clamps should ease out of body.

Straighten the rolled diaphragm. Remove outer diaphragm clamp.

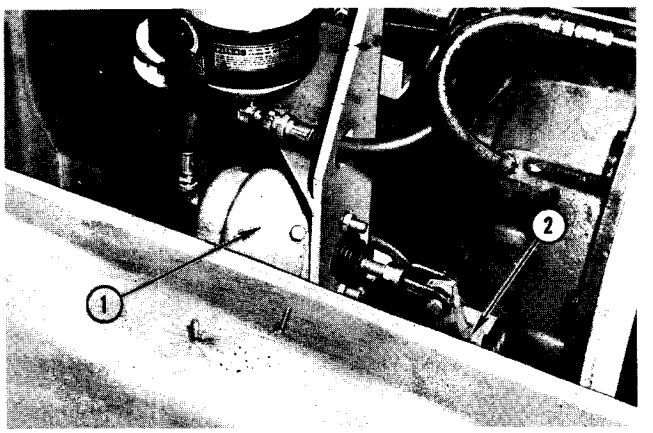


FIGURE E-9. CLUTCH RELEASE AIR CHAMBER

1. Air Chamber
2. Clutch Release Shaft

Unscrew the nuts inside the diaphragm guide. Disassemble inner diaphragm clamp, diaphragm and push plate-push rod assembly from the diaphragm guide.

Reassembly

Clean all metal parts in cleaning solvent. Inspect the body, inner and outer diaphragm clamps and diaphragm guide, for cracks or damage. If found cracked or damaged they should be replaced. Inspect the push plate-push rod assembly. Be sure the push rod is not bent, cracked or damaged. If either of these conditions are found, replace the entire assembly. Replace the diaphragm and rubber boot. Inspect release spring. If damaged or cracked, replace with correct release spring.

Stand the tubular diaphragm on end in the inner diaphragm clamp. The small diameter end of the diaphragm should be against the inner diaphragm clamp. Position and install the diaphragm guide within the diaphragm and over the inner diaphragm clamp studs. Install the push plate-push rod assembly within the diaphragm guide and over the inner diaphragm clamp studs.

Install nuts on the inner diaphragm clamp studs and tighten securely. Place the assembly consisting of the push rod, push plate, diaphragm guide,

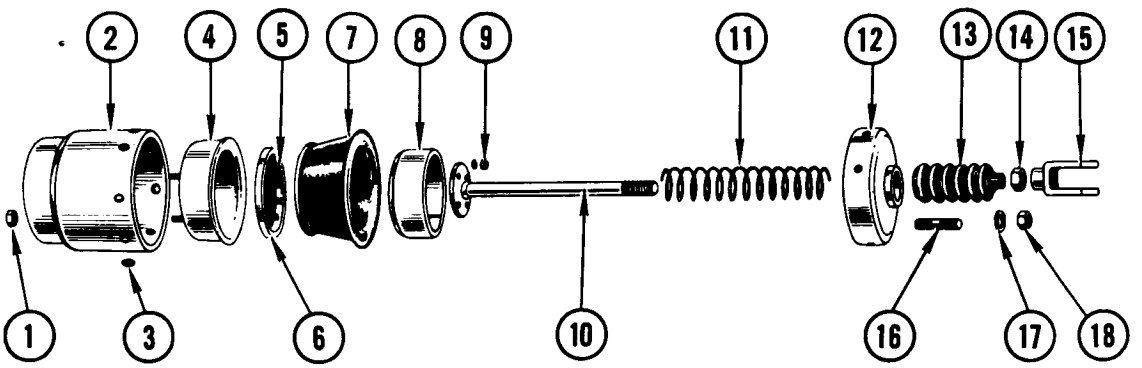


FIGURE E-10. CLUTCH RELEASE AIR CHAMBER, EXPLODED

1. Nut
2. Body
3. Lockwasher
4. Outer Diaphragm Clamp
5. Bolt
6. Inner Diaphragm Clamp
7. Diaphragm
8. Diaphragm
9. Nut
10. Push Rod
11. Spring
12. Cover
13. Boot
14. Nut
15. Yoke
16. Stud
17. Lockwasher
18. Nut

diaphragm, and inner clamp inside of the outer clamp. Roll the free end of the diaphragm back and over the end of the outer diaphragm clamp.

The inside wall of the body should be given a light application of a good grade of air brake cylinder grease. The rolled surface of the diaphragm also should be given a light application of grease.

Slide the above completed assembly into the body, making sure the end of the diaphragm fits snugly against the shoulder in the body by positioning the outer diaphragm clamp studs through the holes at the end of the body. Install nuts on the outer diaphragm clamp studs and tighten securely. Install release spring over the push rod and against the push plate. Install cover over push rod and into body. Attach cover to body with capscrews. Install rubber boot over the push rod and attach to cover. Install yoke lock nut and yoke on push rod.

Replace unit on mounting bracket. Reconnect air line and linkage.

Refer to section "K" for adjustment procedure.

TESTING

Apply air pressure and observe that the push rod moves out promptly and without binding. Release the air pressure and observe that the push rod returns to the released position promptly and without binding.

With the air pressure fully applied, check for leakage through the diaphragm by checking the clearance hole around the push rod in the cover. This may be done by removing the rubber boot from the cover and coating this place with soap suds. No leakage is permissible. If leakage is found, the diaphragm must be replaced.

TRANSMISSION

INDEX

TRANSMISSION

POWER SHIFT TRANSMISSION

Removal instructions are included in Section "C" of this manual. Refer to transmission manufacturer's manual for disassembly, service and reassembly instructions.

STEP GEAR TRANSMISSION

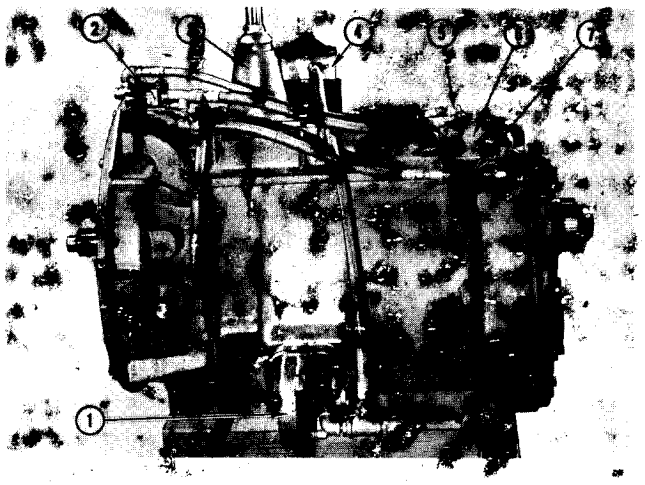


FIGURE F-1. STEP GEAR TRANSMISSION

1. Oil Pump
2. Pilot Air Valve
3. Shift Lever Housing
4. Oil Filter
5. Trigger Valve
6. Plunger Guide Cover
7. Surge Chamber

This transmission is a selective gear type, that when coupled with the LeTourneau-Westinghouse auxiliary transmission provides 10 speeds forward and two speeds in reverse.

Working in conjunction with the main and auxiliary transmissions is an air operated, semi-automatic, pre-select clutch brake. This brake when applied, permits easier and faster shifting without the loss of machine momentum. Operation of this air actuated brake is controlled by a pre-select button located immediately below the trail unit motor control switches.

When button is pressed in, air is admitted to a trigger valve located on top of the transmission. This valve is normally in the closed position. As shift lever is moved into the neutral position, the shifter yoke bars open the trigger valve releasing air to and applying the clutch brake. The clutch brake is mounted on the transmission countershaft. Applying the clutch brake slows down the speed of the countershaft to allow shifting of gears without clashing.

Application time of the brake is regulated automatically by a tripping valve and surge chamber located in the air lines between the trigger valve and the clutch brake. As air enters the surge chamber and air lines leading to the tripping valve and air is built up to line pressure, the tripping valve closes the pre-select valve cutting off any further flow of air to the clutch brake.

If by chance the tripping valve fails to close the pre-select valve, air to the brake is automatically cut off by the trigger valve as the transmission is shifted into gear.

Refer to "Changing Speeds" in section "A" of this manual for procedure to use when shifting to either a higher or lower gear range.

Removal

Remove capscrews and lockwashers securing the rear belly plate to underside of Tournapull main case and remove plate. Remove parking brake drum from rear of auxiliary transmission. Remove bearing retainer and shims. Remove snap ring from inside seal ring in cluster gear. Pull drive shaft out approximately 1½ inches, or until it hits a stop.

Remove the cockpit floor plate, exposing generator, clutch and transmission.

Remove transmission gear shift lever, see page F-3.

Disconnect clutch release shaft linkage at clutch release air cylinder and at clutch release air valve. Disconnect lubrication lines for clutch release shaft and bearing.

Drain lubricant from transmission and remove fill pipe.

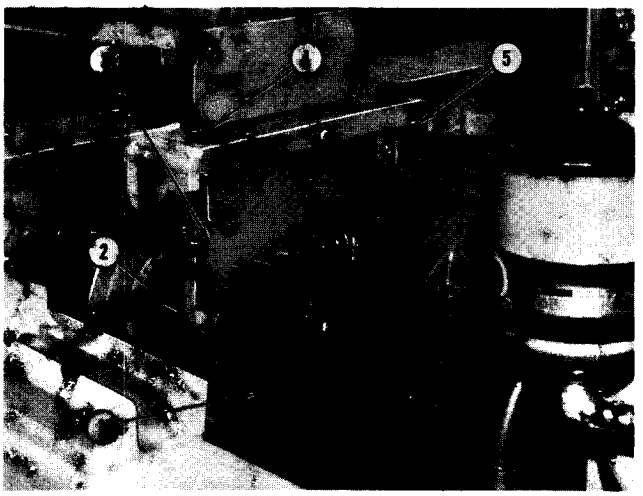


FIGURE F-2. TRANSMISSION MOUNTING BRACKET

1. Transmission
2. Adaptor Boot
3. Bracket
4. Capscrew
5. Shims

Disconnect oil lines from oil filter to transmission case and oil pump at the pump. Remove the capscrews and lockwashers securing the oil filter and clutch release air cylinder to the transmission case. Lift off bracket, oil filter and air cylinder.

Remove capscrews and lockwashers fastening transmission oil pump to transmission case and remove pump and gasket.

Disconnect air line to pilot air valve mounted on transmission bell housing.

Loosen lock screws in hose clamps on adaptor boot and remove clamps. Remove capscrews and lockwashers securing the transmission adaptor to the transmission, and the case adaptor to the rear case. Remove adaptor assembly.

Attach sling to transmission and take up the slack. Remove bolts from transmission brackets at both the transmission and Tournapull case. Remove bracket and shims (if present) from the case. Keep shims together as they are to be replaced when replacing transmission. See Fig. F-2.

Remove the capscrews and lockwashers securing the transmission bell housing to the generator end bell. If any shims are present between these two parts, retain them for use when reassembling. Slide transmission to the rear to free mainshaft from the splined clutch hub.

Maneuver transmission through opening in bottom case. Lower unit onto skid or pallet. Place on stand or work bench for further service or disassembly.

For machines equipped with carrier type engine mount, removal is the same with the following exceptions.

Remove the adaptor boot, transmission adaptor, and case adaptor. Sling the transmission and take up slack to relieve any tension on the transmission mounting bolts. Remove the capscrews and lockwashers fastening the transmission carrier back plate to the side plates. Lift back plate from around mainshaft. Two dowel pins align back plate with side plates, be sure back plate has cleared dowels before removing.

Remove the capscrews and lockwashers fastening the transmission bell housing to the mounting adaptor ring. Mount will remain fastened to generator end bell by two studs.

Move transmission to the rear and remove from case as described above.

Disassembly

Before beginning disassembly, the transmission must be drained and the exterior thoroughly cleaned. It is important that no dirt or other foreign matter be allowed to enter the case or get into the air and oil lines. Dirt is particularly harmful to the bearings, sleeves and bushings, and will greatly accelerate the wear of these and related parts.

SHIFT LEVER

Remove nuts and lockwashers from the studs by which the shift lever housing is attached to the shifting bar housing. Lift the lever housing assembly and gasket from the transmission.

Remove machine screw and lockwasher securing the dust bell to the shift lever. Unscrew lever knob from lever and raise dust bell over the end of lever.

Place the shift lever assembly upside down in a vise. Twist a heavy screw driver between the shift lever tension spring and the housing. The spring will be forced from under the retaining lugs cast into the housing. Remove spring and washer from inside housing. Pull shift lever from housing. Remove pivot pin from inside housing.

SHIFTING BAR HOUSING

Shift transmission into neutral position. This may be identified by alignment of the lever slots in the yokes and blocks.

Remove the capscrews securing the clutch brake trigger valve to the transmission case. Remove valve and actuating plunger. Remove the capscrews that secure the housing to the transmission case and lift housing and gasket from case. Lift the assembly straight up to prevent binding.

Keep the shifting bar housing in the neutral position.

Remove the tension spring cover and remove poppet springs. Turn the assembly with yokes up-

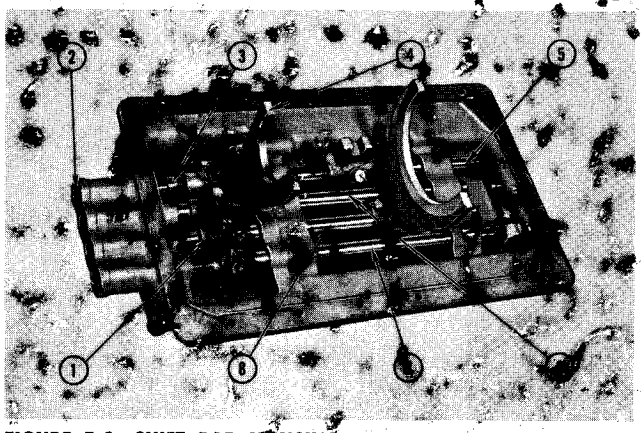


FIGURE F-3. SHIFT BAR HOUSING

1. Shift Block
2. Welch Plugs
3. Spacers
4. Shift Yoke
5. Reverse Yoke Bar
6. 3rd and 4th Yoke Bar
7. Overdrive Yoke Bar
8. 1st and 2nd Yoke Bar

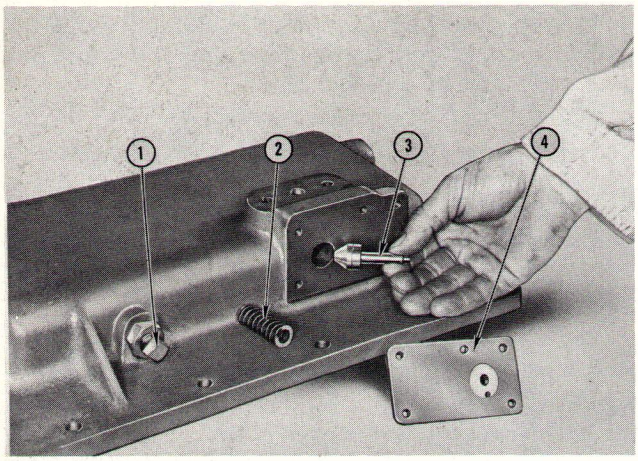


FIGURE F-4. REMOVING ACTUATING PLUNGER

1. Reverse Shift Block Setscrew
2. Spring
3. Plunger
4. Cover and Gasket

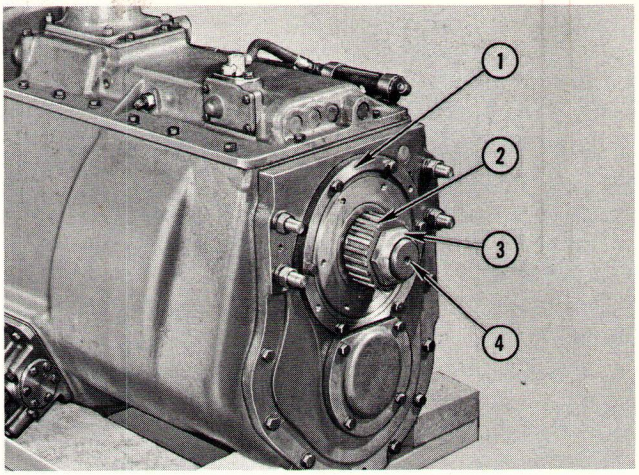


FIGURE F-5. MAINSHAFT BEARING COVER

1. Bearing Cover
2. Adaptor
3. Locknut
4. Mainshaft

ward and jar slightly to remove the steel balls assembled under the poppet springs.

Mount assembly in a vise with the left side of housing uppermost. Cut the lockwires and remove the capscrews from the shifting yokes and blocks. See Fig. F-3.

From the left side of the transmission shifting bar housing remove the capscrews and lockwashers securing the air valve cover and gasket to the housing. Remove actuating plunger spring and actuating plunger from housing (Fig. F-4).

Remove the welch plugs from the rear of the housing and drive the three upper bars from the housing, starting with the reverse shifting bar which is uppermost. At the left center of the housing remove the setscrew and jam nut which engages the shifting block and prevents radial movement of the reverse shifting bar. The welch plugs in the yoke bar holes at the front of the housing will be driven from the housing as the bars emerge. After removing the reverse shifting bar remove one of the air valve intermediate plungers from the air valve opening in the housing. Repeat this procedure after removing each successive bar. There are three intermediate plungers.

NOTE: With the spring tension removed from the yoke bars, it may be necessary to move them by hand into the neutral position before the upper bars will move. This procedure may be necessary as each bar is started from the housing (except the last one). Excessive force is not necessary to remove the bars.

At the right rear of the housing remove the setscrew and jam nut which engages the overdrive shifting block and prevents radial movement of the overdrive shifting bar.

Move the overdrive shifting bar forward until it clears the housing. Then pry forward with a heavy screw driver until it can be removed from the housing.

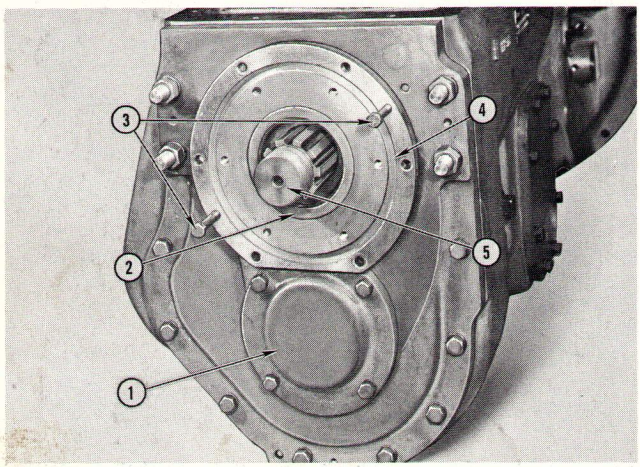


FIGURE F-6. REMOVING BEARING COVER

1. Countershaft Cover Plate
2. Oil Seal
3. Pusher Capscrews
4. Bearing Cover
5. Mainshaft

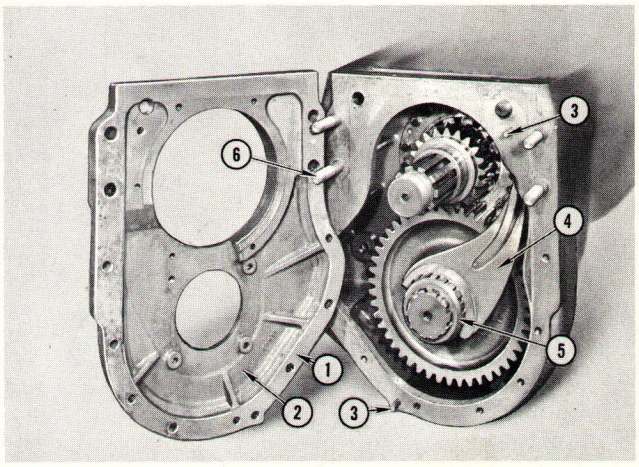


FIGURE F-7. SUPPORT PLATE, REMOVED

1. Gasket
2. Support Plate
3. Dowel
4. Overdrive Shift Yoke
5. Overdrive Sliding Clutch
6. Studs

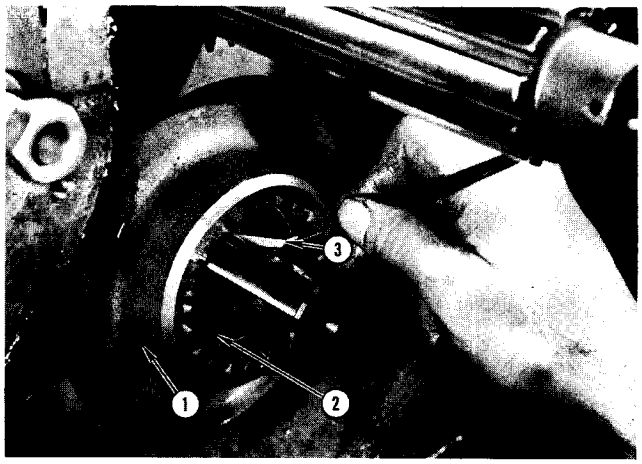


FIGURE F-8. REMOVING KEY
1. Gear 2. Thrust Washer 3. Key

OVERDRIVE GEARING

Engage transmission into two speeds at once. Place wrench over transmission mainshaft locknut and remove locknut. Pull splined adaptor from the mainshaft.

Remove the six capscrews fastening the mainshaft rear bearing cover and adaptor to the transmission case.

Install two pusher capscrews into the blind tapped holes in the bearing cover and adaptor. Turn these capscrews down evenly to pull the bearing cover and adaptor assembly (Fig. F-6).

Pull double oil seal from inside the adaptor bore. From inside adaptor, remove bearing snap ring and remove bearing and mainshaft rear bearing washer.

The countershaft rear cover plate and gasket may be removed by removing the four capscrews and lockwashers securing it to the rear bearing support plate, or may be removed with the support plate.

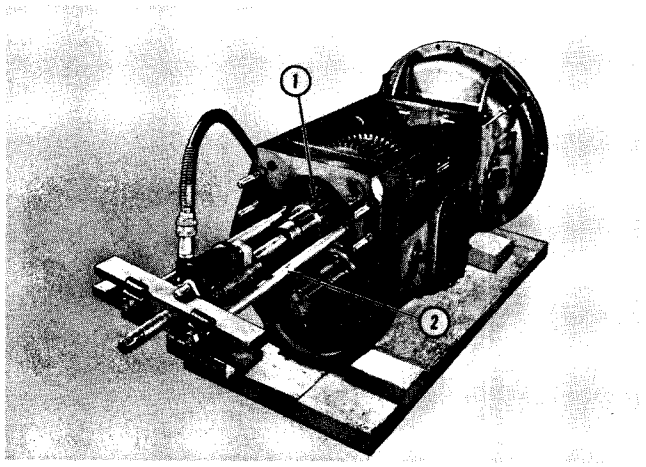


FIGURE F-10. REMOVING MAINSHAFT OVERDRIVE GEAR
1. Overdrive Gear 2. Puller

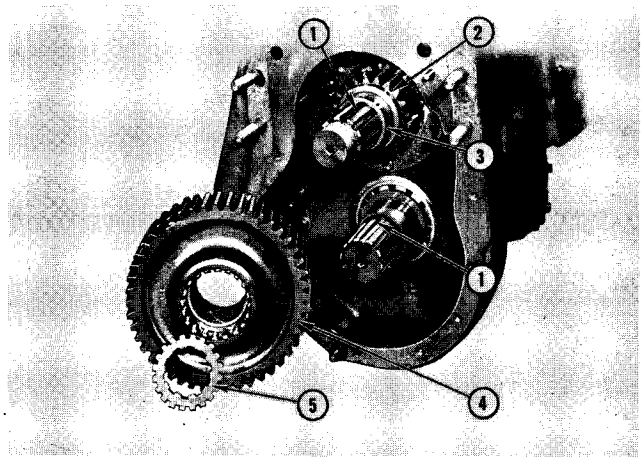


FIGURE F-9. COUNTERSHAFT OVERDRIVE GEAR, REMOVED
1. Keyway
2. Mainshaft Overdrive Gear
3. Bearing Sleeve
4. Countershaft Overdrive Gear
5. Thrust Washer

To remove the support plate, remove the nuts from the four studs and the eight capscrews and washers securing the support plate to the transmission case. Two dowel pins hold the support plate in alignment on the case—pull plate straight to the rear when removing. Remove support plate and gasket. See Figure F-7.

Cut lockwires and remove capscrews clamping overdrive shift yoke to the short overdrive shift bar. Drive the overdrive shift bar to the rear and out of the transmission. This operation will also remove the welch plug from the shift bar hole. Remove overdrive shifting yoke from case. Slide overdrive sliding clutch from countershaft.

Remove its keyway between the splines of the countershaft, pry up on and remove the countershaft thrust washer key (Fig. F-8). Turn the countershaft overdrive thrust washer in its groove until

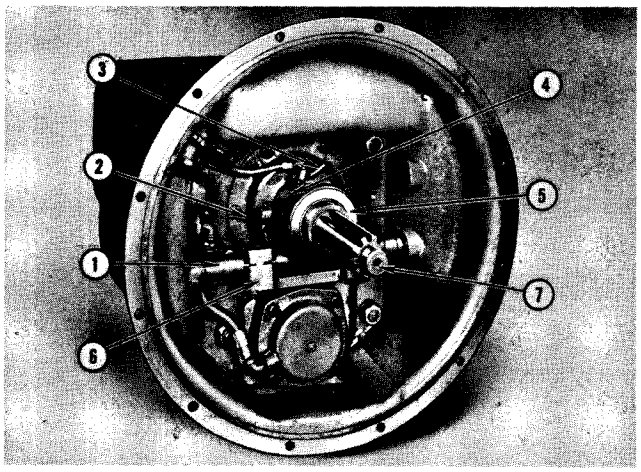


FIGURE F-11. CLUTCH RELEASE YOKE AND BEARING
1. Release Shaft
2. Lockwire
3. Return Springs
4. Clutch Bearing Carrier
5. Bearing
6. Release Yoke
7. Clutch Shaft

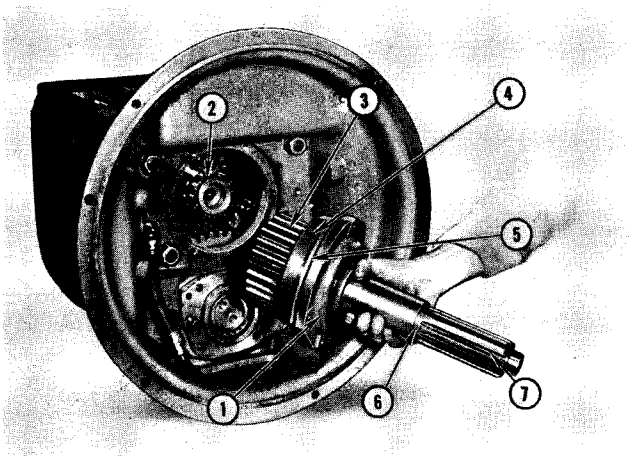


FIGURE F-12. CLUTCH SHAFT AND GEAR, REMOVED

1. Bearing Cover
2. Pilot Bearing
3. Drive Gear
4. Bearing
5. Gasket
6. Gear Shield
7. Clutch Shaft

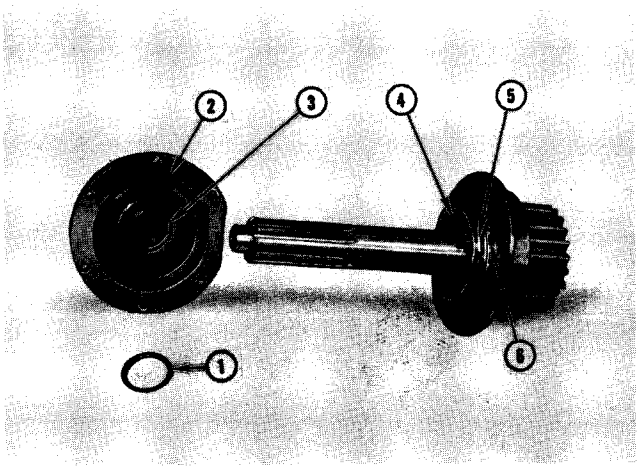


FIGURE F-13. BEARING COVER, REMOVED

1. Gear Shield
2. Cover and Gasket
3. Oil Seal
4. Locknut
5. Piston Rings
6. Bearing

splines on its inside diameter line up with the splines on the countershaft. Pull countershaft overdrive gear from countershaft. This will also remove washer.

Remove mainshaft bearing sleeve from mainshaft. See Figure F-9.

By using a special puller similar to the one shown in Fig. F-10, remove the mainshaft overdrive gear from the mainshaft. Pry mainshaft overdrive gear key from keyway in mainshaft.

CLUTCH SHAFT AND DRIVE GEAR

Loosen the lockbolt clamping the clutch pedal adjusting arm to the clutch release shaft. Slide adjusting arm from splines on shaft.

Remove lockwires fastening clutch release yoke to clutch ears on clutch release bearing carrier. Release clutch release bearing return springs from the holes in capscrews. Disconnect lubrication line from release bearing carrier. Slide clutch release bearing assembly from mainshaft.

Cut lockwires and remove capscrews clamping release yoke to clutch release shaft. Drive shaft partly out of case and release yoke. Do not drive far enough to shear or damage the keys which key each side of the release yoke to the shaft. Remove these keys as soon as they are sufficiently exposed. Remove clutch release shaft and yoke. Refer to Figure F-11.

Remove capscrews and lockwashers fastening front bearing cover to transmission case. Pull the bearing cover, clutch shaft and drive gear from the case as a unit. If cover binds, drive against it lightly with a soft bar; working from the inside of the case (Fig. F-12).

Mount the gear and shaft in a vise with copper jaws. Remove drive gear shield and front bearing cover from clutch shaft. See Figure F-13.

Pull oil seal from inside drive gear.

With special spanner wrench remove the bearing nut from the shaft. This nut has left hand

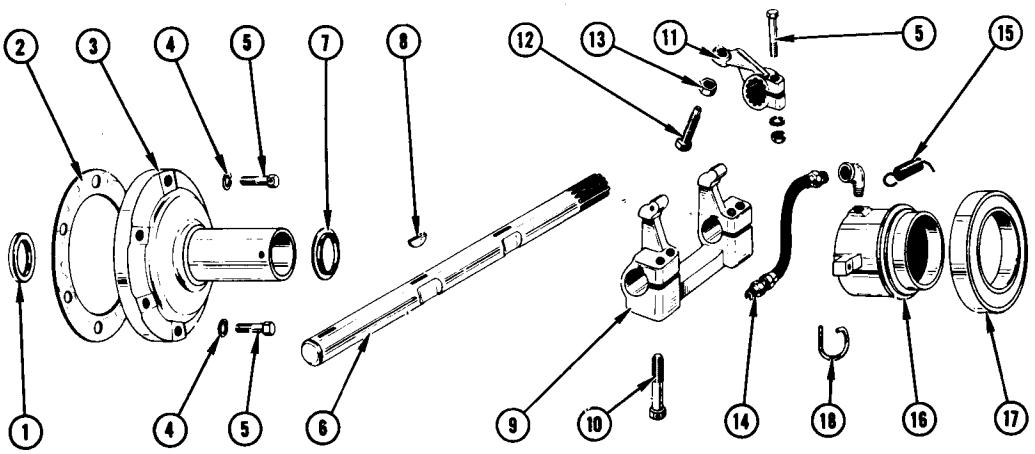


FIGURE F-14. CLUTCH RELEASE MECHANISM, EXPLODED

1. Oil Seal
2. Gasket
3. Bearing Cover
4. Lockwasher
5. Capscrew
6. Cross Shaft
7. Gear Shield
8. Key
9. Yoke
10. Bolt
11. Adjusting Arm
12. Setscrew
13. Nut
14. Hose
15. Spring
16. Clutch Bearing Carrier
17. Bearing
18. Lockwire

threads. Oil seal piston rings may be removed from around locknut if necessary. Pull or press bearing and retainer from clutch shaft. Pull mainshaft pilot bearing from mainshaft and remove mainshaft sliding clutch.

MAINSHAFT

Cut lockwires and remove capscrews clamping reverse shift yoke to short reverse shift bar. Drive the reverse shift bar to the rear and out of the transmission. Remove reverse shifting fork from inside transmission case.

Remove pilot bearing and sliding clutch from front of mainshaft, if not already done.

The mainshaft intermediate bearing is equipped with a combination bearing puller and retainer. There are five 5/16" - 18x15/32" hex head capscrews and one 5/16" - 18x7/16" flat head screw (which hold the retainer and puller together), and six 3/8" - 16x1 1/2" hex head capscrews (which hold the retainer and puller to the transmission intermediate web) around the circumference of the puller and retainer.

Cut the lockwires and remove the six 3/8" - 16x1 1/2" hex head capscrews. Block between the mainshaft first speed gear and the intermediate case web. Install one 3/8" - 16x1 1/2" capscrew in each of the two blind tapped holes in the bearing puller. Turn the two capscrews down evenly to pull the bearing from the web. Remove capscrews and flat head screw fastening bearing retainer and puller together and remove from bearing (Fig. F-15).

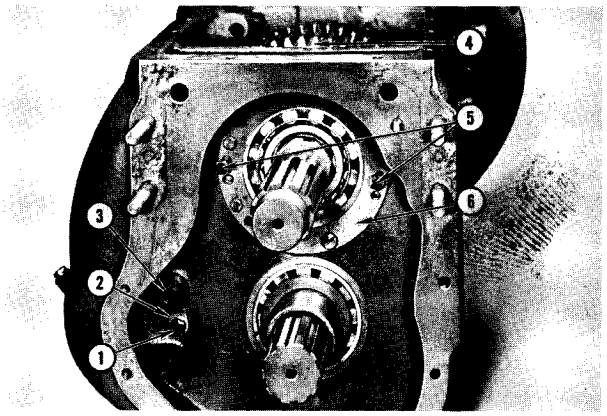


FIGURE F-15. PUSHER CAPSCREWS INSTALLED

1. Capscrew
2. Shaft Lock
3. Reverse Idler Shaft
4. 1st Speed Gear
5. Pusher Capscrews
6. Bearing Retainer and Puller

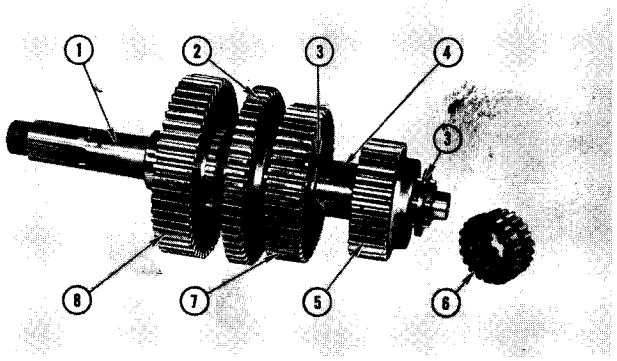


FIGURE F-16. MAINSHAFT, REMOVED

1. Mainshaft
2. 1st and 2nd Speed Clutch Gear
3. Washer
4. 3rd Speed Gear Sleeve
5. 3rd Speed Gear
6. Sliding Clutch
7. 2nd Speed Gear
8. 1st Speed Gear

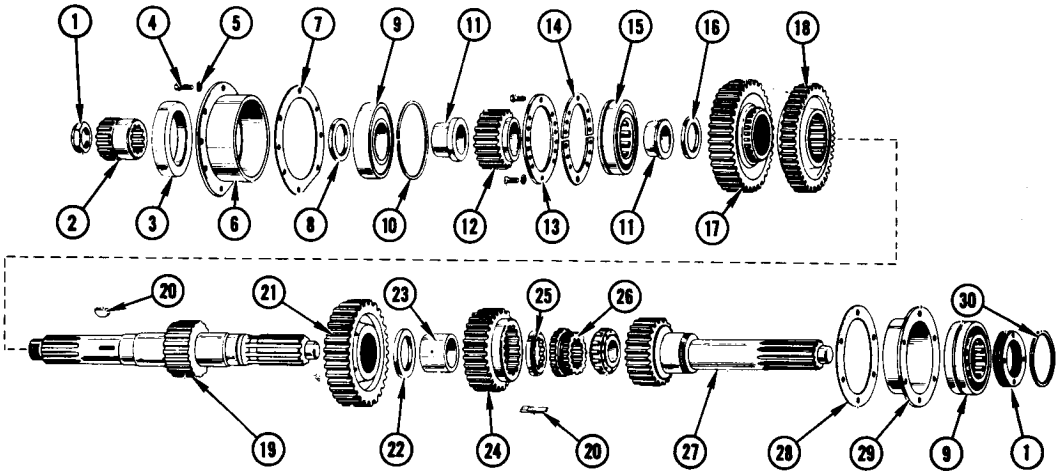


FIGURE F-17. MAINSHAFT, EXPLODED

1. Nut
2. Adaptor
3. Oil Seal
4. Capscrew
5. Lockwasher
6. Adaptor and Cover
7. Gasket
8. Rear Washer
9. Bearing
10. Snap Ring
11. Bearing Sleeve
12. Overdrive Gear
13. Retainer
14. Bearing Puller
15. Intermediate Bearing
16. 1st Speed Gear Spacer
17. 1st Speed Gear and Bushing
18. 1st and 2nd Speed Clutch Gear
19. Mainshaft
20. Key
21. 2nd Speed Gear and Bushing
22. 3rd Speed Gear Rear Washer
23. 3rd Speed Gear Sleeve
24. 3rd Speed Gear and Bushing
25. 3rd Speed Gear Front Washer
26. Sliding Clutch
27. Clutch Shaft and Drive Gear
28. Gasket
29. Adaptor
30. Ring

Lift mainshaft and assembled gears from transmission case. Gears are assembled on the mainshaft from both the pilot and output ends and must be removed in the same manner. Do not attempt to remove them all from the same end.

Holding the mainshaft in an upright position, jar the output end of the shaft against a block of wood placed on the floor. Lift the assembly by holding on to the large sliding gear (mainshaft first and second speed sliding clutch gear). The weight of the mainshaft first speed gear will force the inner race of the intermediate bearing from the shaft. The bushed gear and race should be caught as they are freed from the shaft. Remove bearing race, gear spacer and first speed gear from shaft.

Remove the large sliding gear from the output end of the mainshaft.

With a screw driver pry the mainshaft third speed gear washer key from its keyway between the mainshaft splines at the pilot end of the mainshaft. Turn the third speed gear washer in its groove until the splines on its inside diameter line up with the splines on the mainshaft. Remove third speed gear and washer from the pilot end of mainshaft.

Jar the pilot end of the mainshaft against a block of wood placed on the floor until the weight of the second speed gear unseats the third speed gear sleeve and it can be removed. Remove third speed gear sleeve, rear washer and second speed gear from pilot end of mainshaft.

REVERSE

Remove capscrew from reverse idler shaft lock. See Figure F-15.

A simple puller for the reverse gear shaft may be constructed from a short piece of pipe, the inside diameter of which is slightly larger than the projecting end of the reverse shaft. A long bolt

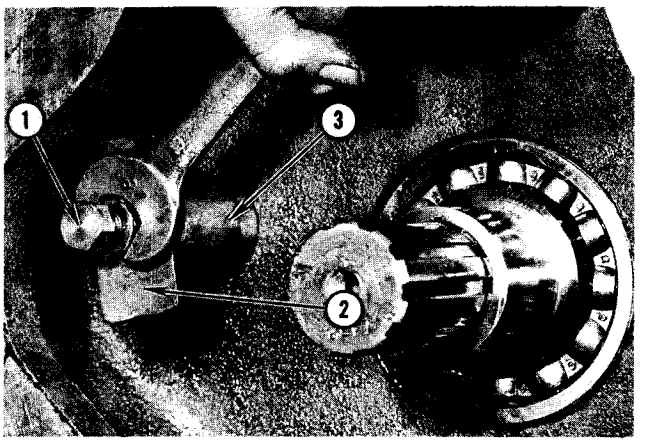


FIGURE F-18. PULLING REVERSE IDLER SHAFT LOCK

1. Bolt and Nut
2. Flat Steel
3. Pipe

having the same thread as the ones in the end of the shaft; and a nut for the bolt and a flat piece of steel having a hole in its center sufficiently large to permit passage of the bolt. The nut is turned onto the bolt and the bolt is then passed through the hole in the flat steel, through the pipe and threaded into the reverse gear shaft. The nut is then tightened against the plate with the result that a pulling action is exerted against the shaft with the transmission case acting as a base through the pipe and plate (Fig. F-18).

Pull reverse idler shaft. Do not allow reverse gears to drop to bottom of case. Lift reverse assembly from case (Fig. F-20).

Remove front and rear thrust washers and pins. Pull reverse sliding gear from reverse driving sleeve.

Remove snap ring from in front of reverse idler gear and remove idler gear from driving sleeve. Remove idler gear rear snap ring.

Pull bearings and bearing spacer from inside reverse driving sleeve.

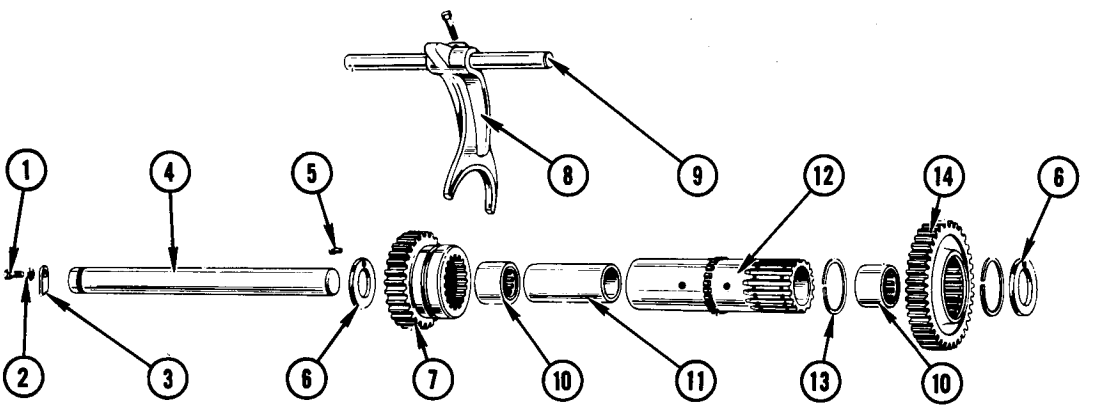


FIGURE F-19. REVERSE SHAFT, EXPLODED

1. Capscrew
2. Lockwasher
3. Lock Plate
4. Idler Shaft
5. Thrust Washer Pin
6. Thrust Washer
7. Reverse Gear and Bushing
8. Shift Yoke
9. Yoke Bar
10. Bearing
11. Spacer
12. Sleeve
13. Snap Ring
14. Reverse Idler Gear

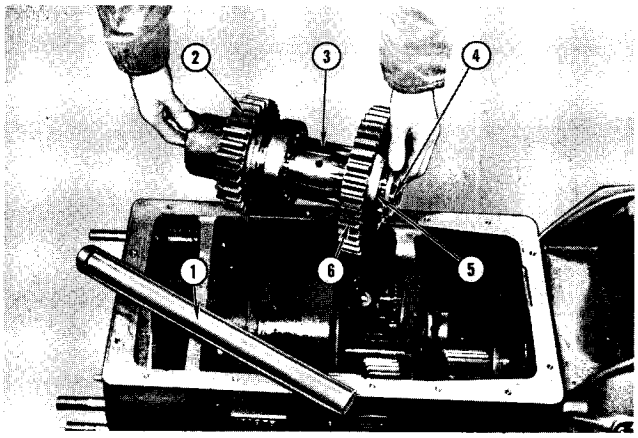


FIGURE F-20. REVERSE GEARING, REMOVED

1. Reverse Idler Shaft
2. Reverse Sliding Gear
3. Driving Sleeve
4. Thrust Washer and Pin
5. Snap Ring
6. Reverse Idler Gear

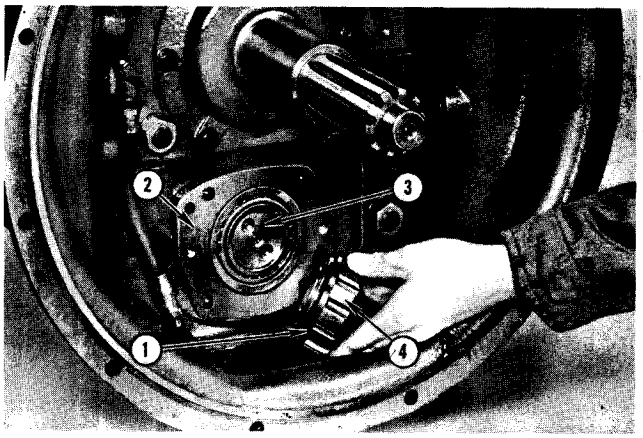


FIGURE F-21. REMOVING DISC CARRIER

1. Grit Seal
2. Bearing Adaptor
3. Countershaft
4. Clutch Brake Disc Carrier

COUNTERSHAFT

Remove the four capscrews and lockwashers fastening the clutch brake cover to the front of the transmission case and remove clutch brake assembly. Clutch brake disassembly is covered under the heading "Clutch Brake". See Figure F-10 for location of capscrews.

Remove the two capscrews securing the clutch brake disc carrier to the countershaft and remove disc carrier and grit seal from shaft (Fig. F-21).

Locate and mark the two blind tapped holes in the countershaft front bearing adaptor. Screw two capscrews into these two holes. Pull the bearing adaptor and bearing from the case and shaft by tightening evenly on these screws. The countershaft will move forward under the force exerted by the puller capscrews. It may be necessary, if the screws are not long enough, to bar the countershaft back out of the bearing races. Remove

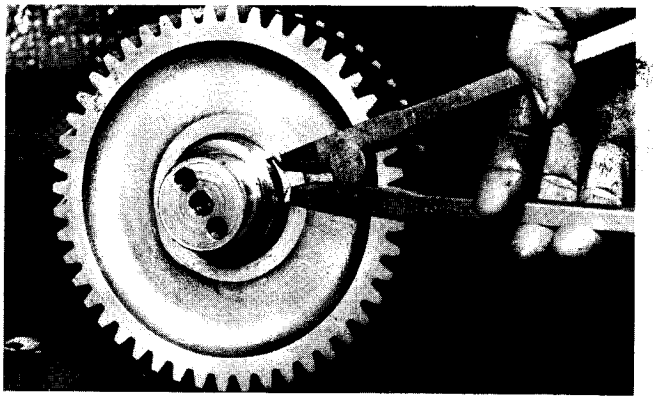


FIGURE F-22. REMOVING COUNTERSHAFT SNAP RING

front bearing adaptor and bearing. Pull bearing assembly from bore of bearing adaptor.

Pull the countershaft assembly to the rear until the rear bearing is completely free from its bore in the case. Pull the bearing, spacer and overdrive

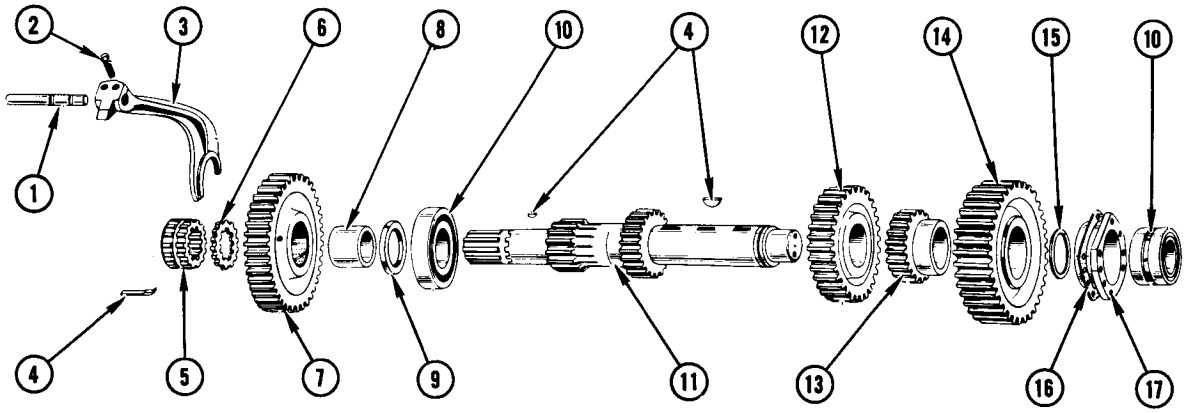


FIGURE F-23. COUNTERSHAFT, EXPLODED

1. Overdrive Short Yoke Bar
2. Lock Screw
3. Overdrive Shift Yoke
4. Key
5. Sliding Clutch
6. Thrust Washer
7. Gear and Bushing
8. Sleeve
9. Spacer
10. Bearing
11. Countershaft
12. 3rd Speed Gear
13. Reverse Driver Gear
14. Countershaft Drive Gear
15. Snap Ring
16. Gasket
17. Bearing Adaptor

gear sleeve to the rear carefully until it comes against the key installed in the countershaft to prevent movement of the overdrive gear sleeve.

Remove puller from bearing, and slide bearing and spacer back toward front of transmission. Insert on the shaft, between the spacer and the gear sleeve, a "C" shaped spacer, making sure that the keyway in the sleeve is in the open end of the spacer and that the spacer is wide enough to allow the key to be completely exposed. Reattach puller to bearing and pull bearing, spacer, "C" shaped spacer and sleeve far enough to expose the key. Remove key from countershaft and pull bearing, sleeve and spacer from mainshaft.

Raise front of countershaft up and tilt back then remove entirely from case.

From front end of countershaft remove the countershaft snap ring (Fig. F-22). Remove the countershaft drive gear, reverse driver gear, third speed gear and keys from the shaft one at a time. Be sure to remove the key for each gear before attempting to remove the next gear.

CLUTCH BRAKE

Remove the four capscrews and lockwashers fastening the clutch brake cover to the front of the transmission case and remove the brake assembly (if not already done).

Separate brake cover and body. See Figure F-24. Remove discs and disc spacer from inside body.

Remove nut and lockwasher from brake piston guide and spring retainer. When nut and washer is removed, piston guide and spring retainer, spring, gasket, piston and cover will be separated. Remove "O" rings from piston. One is located inside the piston guide hole and the other on the outside of the piston. See Figure F-25.

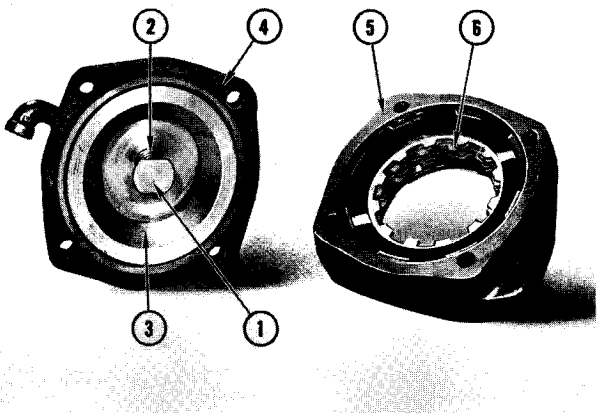


FIGURE F-25. PISTON, REMOVED

1. Piston Guide
2. Spring
3. Piston
4. Cover
5. Body
6. Discs

OIL PUMP

Remove capscrews and lockwashers securing oil pump assembly to the transmission case. Remove pump, gaskets and filler block from transmission.

Remove the capscrews and lockwashers fastening outer head and gasket to pump housing. Pull head and gasket, being careful so as not to damage the soft metal gasket.

Turn pump housing so that reversing head and idler gear will fall out into your hand. It may be necessary to tap the housing gently to dislodge the head and gear. These are finely machined parts, do not handle with unnecessary roughness.

Place bit of screwdriver between gear spacer and pump drive gear. Pry against pump gear to start pump rotor and shaft from bore. Pull pump rotor and shaft, spacer and key from pump. Remove drive gear from pump housing. Remove key and the spacer from rotor shaft.

Expansion plug and bushings may now be removed from pump housing if inspection shows that replacement is necessary.

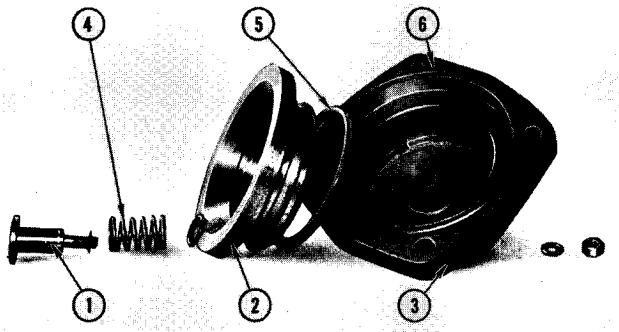


FIGURE F-24. COVER AND BODY, SEPARATED

1. Piston Guide
2. Piston
3. Cover and Gasket
4. Spring
5. "O" Ring
6. Gasket

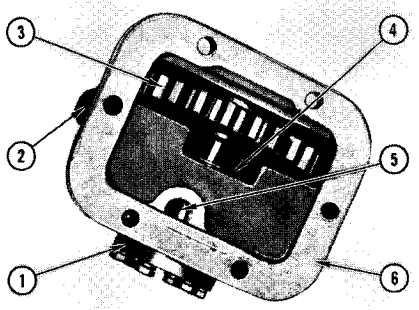


FIGURE F-26. OIL PUMP, REMOVED

1. Outer Head
2. Housing
3. Drive Gear
4. Spacer
5. Rotor and Shaft
6. Gasket

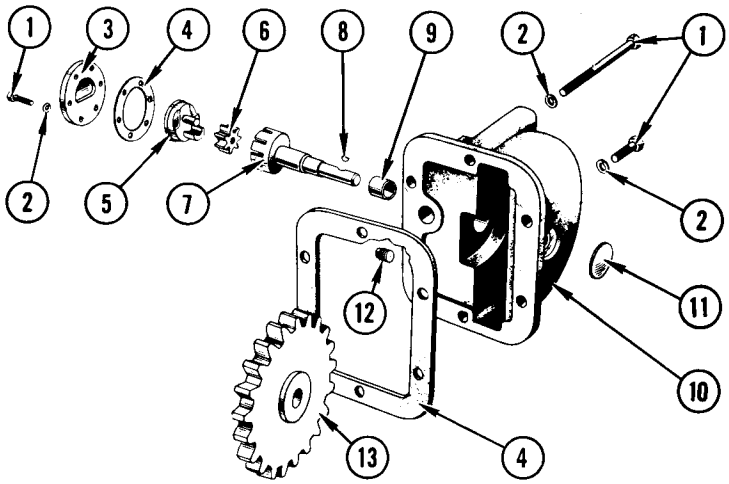


FIGURE F-27. OIL PUMP, EXPLODED

1. Capscrew
2. Lockwasher
3. Outer Head
4. Gasket
5. Reversing Head
6. Idler Gear
7. Rotor
8. Key
9. Spacer
10. Housing
11. Expansion Plug
12. Plug
13. Drive Gear

Reassembly

Before beginning reassembly, clean all parts thoroughly with solvent and blow dry with compressed air. Inspect oil seals for signs of wear or damage. Inspect gears and shafts for excessive wear, pitting or cracking. Check the bearings for rough spots or other damage. Check keyways for any burrs or obstructions. Replace all parts showing damage or excessive wear. Clean inside of case and magnetic plugs to remove any metal particles.

Generally speaking the reassembly process is a reversal of the disassembly procedure. The foregoing instructions can be made to serve this purpose by reversing the order in which they are performed. Following are items to be given particular attention when reassembling the transmission.

All worn gear washers should be replaced to assist in maintaining the original fit.

End play of gears should be held to a minimum of 0.006".

Bushed gears having excessive radial clearance should have new bushings installed in them. To install a new bushing, it is first necessary to press out the old one. Clean bore of gear carefully and remove all burrs. Cover the outside diameter of bushing and the inside diameter of the gear with a saturated solution of salt and water. Line up the oil holes in bushing and gear (if present). Carefully press bushing fully into gear. Do not allow bushing to become tilted as it is being pressed in. Face off any projecting end of bushing. Drill oil holes in bushing, through holes in the gear; making sure all oil holes are open. Remove burrs, resulting from drilling and break all sharp edges on ends of bushing.

When reassembling either new or rebushed gears to a shaft, be sure they move freely after having been assembled in their proper position. Clean all mounting parts and coat with clean oil before replacing gears.

The flat head screw must be replaced on the bottom of the mainshaft intermediate bearing retainer and puller. This is necessary in order to provide clearance for the countershaft overdrive gear.

When replacing discs and disc spacer into the clutch body, place the disc spacer into the body first with the smaller outside diameter of the spacer going into the body first. The first disc to be replaced will be externally splined. Follow it with an internally splined disc. Then alternate until all discs are replaced into the body, finishing with one that is externally splined.

When replacing the clutch shaft front locknut the following instructions will apply. Remember that the nut has left hand threads.

Install the nut and tighten with the special wrench until the nut is approximately ½" from the bearing. (Wrench must be seated fully against face of nut.) Stand the shaft and gear upright with the gear uppermost. Put approximately 8 drops of the sealant "Loctite" on the exposed threads in the locknut. Torque nut to 100 ft. lbs. Add 4 to 6 drops of the sealant (equally spaced) to the bevel of the nut and the bevel on the shank end of the gear and shaft. Allow the assembly to stand in

normal temperature for 8 to 10 hours, before exposing it to oil. The setting action can be hastened by using heat lamp directed on the nut in such a manner that it becomes warm to the touch.

Be sure to line up oil holes in clutch brake body with oil holes in transmission case when replacing the clutch brake.

Transmission mainshaft rear locknut must be torqued to 500 ft. lbs.

When replacing countershaft rear cover and gasket, be sure to replace the shortest one of the four mounting capscrews in the upper right mounting hole. Failure to do this will cause the overdrive shifting fork to contact the end of the capscrew and will prevent the sliding clutch from completely disengaging the overdrive gear.

Transmission oil pump gear must have a minimum of 0.006" backlash. If it is found that this minimum is not present add shims or a thicker filler block between the oil pump and the transmission case. Adding shims or a thicker block will move the pump drive gear away from the countershaft and increase the pump gear backlash. Be sure to put a gasket between the pump body and the filler block and one between the filler block and the case. The backlash may be checked by removing the sump cover and gasket from bottom of transmission and observing the amount of gear movement. (Oil must be drained from transmission before making this check.)

Installation

If transmission is to be installed through the top of the case the piping, oil filter and clutch release air chamber can be installed before transmission is placed in case. The rear transmission hanger can also be installed on transmission case.

If transmission is to be installed through opening in bottom of case, none of these parts can be assembled to the transmission. In addition the oil filter and oil pump should be removed to prevent damaging them when raising transmission through case opening. Place temporary cover over oil pump opening to prevent entrance of foreign material.

Position transmission under opening in Tournapull case, with rear of transmission toward front of Tournapull. Raise transmission into case and turn end for end.

Slide transmission as far to the rear as possible and align the splined transmission mainshaft with the splined clutch disc hubs. Turn the clutch release yoke so top of yoke is back toward transmission.

Turn clutch release bearing so flat part is on top. Pull transmission forward, as it moves forward and mainshaft engages clutch hubs, turn clutch release yoke fingers down over clutch release bearing into their proper position. Care must be taken not to spring clutch or driven disc.

Replace capscrews and washers securing generator end bell to the transmission clutch bell housing. Replace capscrews, shims, nuts and lockwashers securing transmission rear hanger bracket to main case.

Refer to section "C" for alignment procedure.

Coat mounting face of boot adaptor with Permatex and secure to rear of transmission with capscrews and lockwashers.

Place the boot over the adaptor and slide as far forward as possible onto the adaptor.

Coat mounting face of transmission adaptor with Permatex and secure to main case with capscrews and lockwashers.

Push drive shaft forward through auxiliary transmission until splined hub on shaft is engaged with splined adaptor sleeve on transmission mainshaft.

Slide the boot back onto the transmission adaptor. Position boot so that an equal amount of it is on the transmission adaptor and the boot adaptor. Refer to Figure F-2.

Install two hose clamps on each end of the boot. Stagger the lock screws in the clamps so that the two on each end are approximately 90° to 180° apart. Tighten securely.

Install oil filter, piping and clutch release air chamber if not already done.

Tighten all capscrews to proper torque.

Reconnect clutch linkage; replace shift lever and cover plates.

Replace snap ring, spacer, parking brake, nut and washer. Refer to page F-15.

Testing Clutch Brake Control Valves

Looking from the operator's seat, the pre-select valve should be mounted so that the opening marked "NORM-C" is facing to the left, the opening marked "CYL" is facing to the right and the opening marked "NORM-O" is facing UP toward the bottom of the control panel.

The air supply from the scraper quick release valve is connected to the left side of the pre-select

valve at the opening marked "NORM-C".

The opening of the pre-select valve marked "CYL" is connected to the block on the bottom of the firewall, which in turn is connected to the pilot air valve that is mounted on the transmission.

The opening in the pre-select marked "NORM-O" does not have any connections to it.

The small return valve is mounted to the small fitting on top of the pre-select valve, at the opening in the small return valve marked "IN". The outlet at the bottom of the small return valve is connected to the street elbow at the rear of the surge chamber by means of the small brass tubing.

The opening on the return valve marked "CYL" does not have any lines connected to it.

The interlock or trigger valve should be mounted on the transmission cover with the outlet marked "IN" facing approximately 45° to the right and front.

The outlet marked "CYL" should face at 45° to the left rear.

The small exhaust outlet should face at 45° to the right rear.

The outlet marked "IN" is connected to the outlet of the street elbow in the tee at the front of the pilot air valve.

The outlet marked "CYL" is connected to the rear outlet of the two-way valve that is in the rear outlet of the pilot air valve.

If an outside source of air is available, connect it to the "NORM-C" inlet of the pre-select valve to charge this valve. If an outside source of air is not available, build up the air pressure in the air system of the machine in the following manner:

Depress clutch pedal so that engine is disconnected from the transmission.

Start engine and allow to run until air pressure has built up to normal, keep pedal depressed so that engine and transmission are disconnected for as long as engine is running. Shut off engine as soon as air pressure has reached normal operating pressure. Leave engine off during all checks.

Under no circumstances should the pre-select valve button be depressed and held down when the engine is running and the transmission is in neutral, or the high low lever is in the midway of neutral position.

Check all connections up to the pre-select valve for leaks.

Put transmission in gear, and then depress and release pre-select valve button. This will charge lines to the clutch brake trigger valve on the transmission.

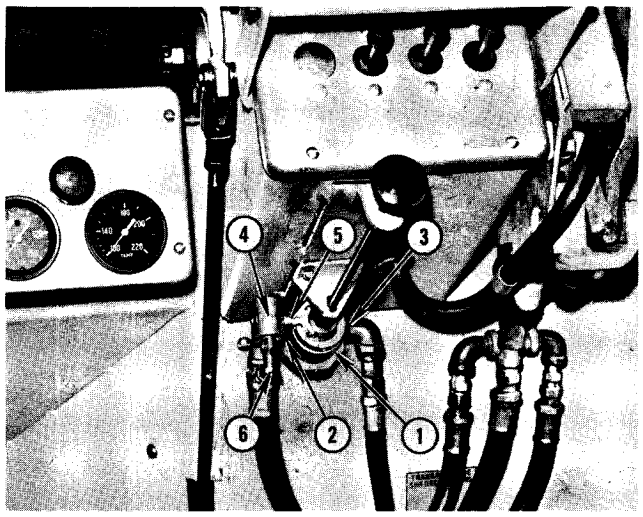


FIGURE F-28. CLUTCH BRAKE PRE-SELECT VALVE

1. Pre-Select Valve
2. "NORM-C" Opening
3. "CYL" Opening
4. Return Valve
5. "IN" Opening
6. To Surge Chamber

Check all connections from pre-select valve to the trigger valve for leaks.

Depress pre-select button and hold down. Shift transmission into neutral. This will charge lines from the trigger valve to the clutch brake and surge chamber, and from the surge chamber to the return valve on the pre-select valve.

Check connections for leaks.

Release pre-select valve button and allow the clutch brake air system lines to drain.

Shift transmission out of neutral. Depress pre-select button.

Check to make certain that air is getting to trigger valve on top of transmission. If not, pre-select valve may be connected wrong, or may be faulty.

Shift transmission into neutral. Check to make certain that air is getting to clutch brake and surge chamber, and from surge chamber to return valve on pre-select valve.

If air is not getting to all components, check action of each valve in the line. The valves involved can be checked by removing the hose on the outlet side. This should be done at one valve at a time, replacing the hose before checking the next valve.

The clutch brake should only stay on momentarily, and then the pre-select button should automatically be tripped, cutting off the air to the clutch brake. Therefore, it will be necessary to shift the transmission into gear, depress the pre-select button and shift into neutral, to activate the clutch brake air system as each valve is checked.

If the valves are not functioning, they may be defective, or may just be incorrectly piped. This

should be checked closely.

Some trouble has also been experienced by the preservative material or thread compound, applied to the pre-select and trigger valves working into the valves and causing them to be inoperative. If there are any restrictions between the return valve and the pre-select valve, the return valve cannot trip the pre-select valve to cut off air to the clutch brake. There is a small "O" ring that fits in a recess in the connection between the return valve and the pre-select valve. This is in the end next to the pre-select valve.

Valves should be checked for these conditions before being discarded.

Valves should be thoroughly cleaned and inspected before being installed on a machine.

After above checks have been made, and necessary corrections have been made, check the action of the pilot air valve.

Shift transmission into gear. Depress pre-select valve plunger. Shift auxiliary transmission from low to high, or high to low.

When lever is midway between high and low, air should momentarily go through pilot air valve, through two-way valve, to clutch brake, to surge chamber, and from surge chamber to return valve on pre-select valve.

If pilot air valve is not functioning properly, it may be defective, or it may not be positioned correctly on the bracket. It is also possible that the pilot air actuating cam is not correctly positioned on the auxiliary transmission control pipe.

All of these possibilities should be checked out before replacing the valve with a new one.

AUXILIARY TRANSMISSION

Removal

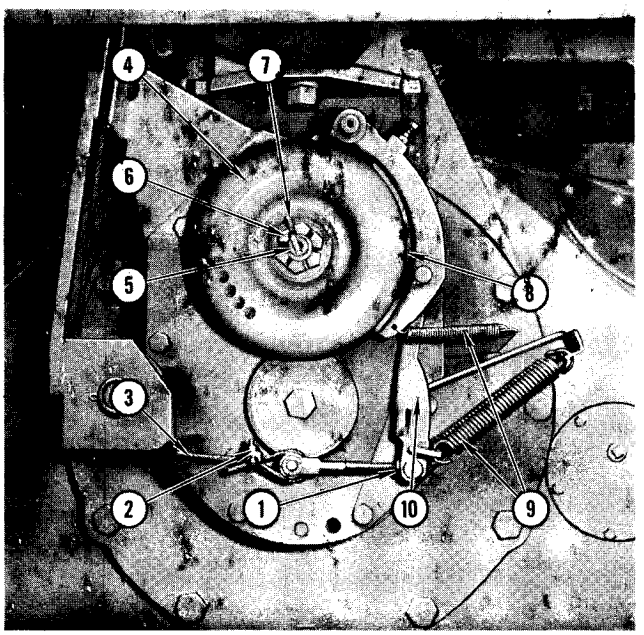


FIGURE F-29. PARKING BRAKE AND AUXILIARY TRANSMISSION

1. Adjusting Yoke
2. Wire Rope Clamp
3. Actuating Wire Rope
4. Brake Drum
5. Drive Shaft
6. Flat Washer
7. Cotter
8. Brake Shoe
9. Release Springs
10. Arm

Remove fuel tank and auxiliary transmission cover plate from rear of Tournapull case.

Place parking brake lever in the released position to remove tension from parking brake actuating wire rope and release springs. Disconnect release springs and parking brake actuating wire rope from actuating arm.

Remove cotter, castellated nut and flat washer from end of drive shaft. Pull brake drum and key from drive shaft. To remove brake shoe assembly as a unit, remove nut and lockwashers from rear of brake shoe pivot stud and pull unit from auxiliary cover.

Drain lubricant from auxiliary transmission and final drive compartments.

Disconnect auxiliary transmission shift linkage. Attach hoist to auxiliary and take up slack. Remove mounting bolts securing auxiliary to rear of Tournapull case. Install pusher capscrews in the blind tapped holes next to the dowels in the auxiliary case mounting flange. Turn in capscrews until transmission has been forced away from the dowel pins in the Tournapull case. Pull auxiliary transmission away from drive shaft and main case, place on work bench for further disassembly.

Disassembly

Remove capscrews and lockwashers securing rear cover plate to the auxiliary transmission. Remove cover plate. Cluster gear rear bearing cup and pinion shaft rear bearing will be removed with the cover plate. Pinion shaft rear bearing race will remain on shaft.

Remove yoke bar spacer tube and oil pipe.

Remove capscrews securing input shaft bearing cover to rear case cover and remove cover. Press the oil seal out of the bearing cover.

Remove the setscrew and locknut from the pinion shaft. Attach gear puller to low speed gear

and pull gear and bushing, rear washer and bearing race from pinion shaft (Fig. F-31). Slide the front washer from shaft.

Pull cluster gear and bearing cones from the drive shaft side of case. Remove snap ring and spacer from bore in gear.

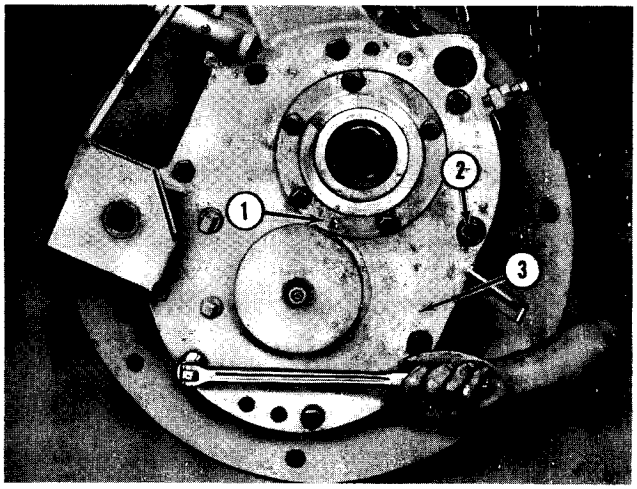


FIGURE F-30. REMOVING GEAR COVER
1. Bearing Retainer 2. Capscrew 3. Cover

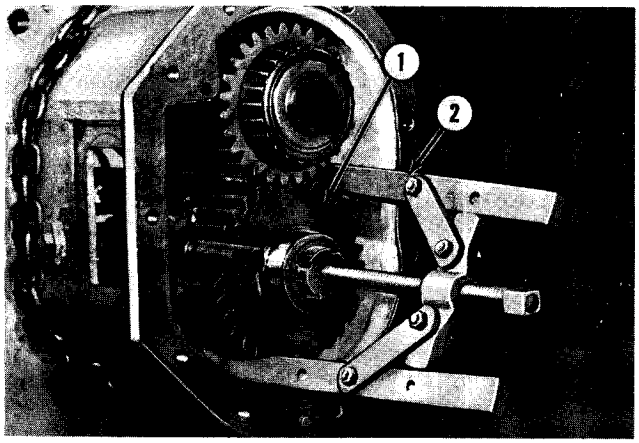


FIGURE F-31. REMOVING LOW SPEED GEAR
1. Low Speed Gear 2. Puller

Remove capscrew holding detent ball and spring against yoke bar and remove ball and spring. Remove the cover plate from the left side of the case, exposing the yoke and sliding clutch structure. Loosen the two capscrews clamping the yoke structure to the yoke bar. Pull the yoke bar from the auxiliary transmission. Remove the yoke structure from the case.

Remove capscrews securing baffle plate to inside of case and remove baffle plate.

Remove the sliding clutch from the pinion shaft.

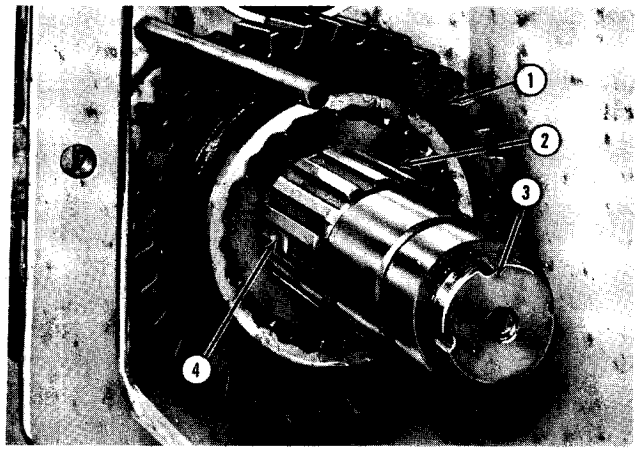


FIGURE F-32. HIGH SPEED GEAR
1. High Speed Gear 3. Pinion Shaft
2. Rear Washer 4. Key

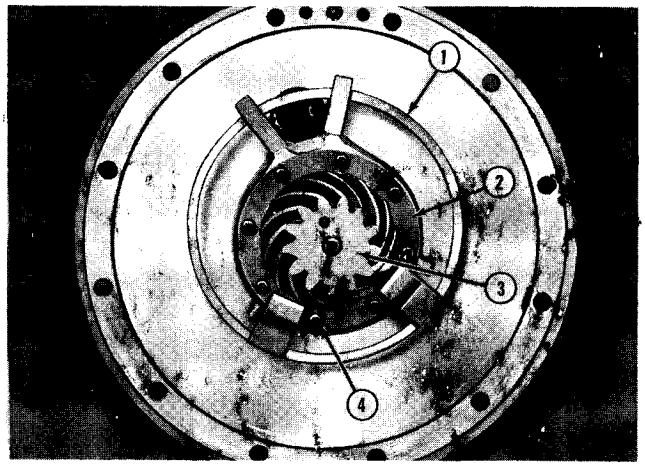


FIGURE F-33. OUTPUT PINION
1. Oil Slushing Ring 3. Pinion
2. Retainer 4. Retainer Capscrews

With a screw driver lift up and remove the key locking the high speed gear to the pinion shaft. Remove the high speed gear rear washer by rotating washer until the splines in washer line up with splines on pinion shaft. Pull high speed gear, bushing and sleeve from pinion shaft. See Figure F-32.

Remove capscrews securing output pinion front bearing retainer to case and remove the pinion and shaft, bearing, shims, locknut and high speed gear front washer from case. Pry small key from recess in pinion shaft. Remove high speed gear front washer from pinion shaft.

Remove setscrew from locknut on pinion shaft and remove locknut. Pull bearing and retainer from shaft.

Reassembly

Clean all parts thoroughly in cleaning solvent. Check for pits or other irregularities in bearing surfaces. Inspect all gears for burrs, chipped or broken teeth. Replace all parts showing excessive

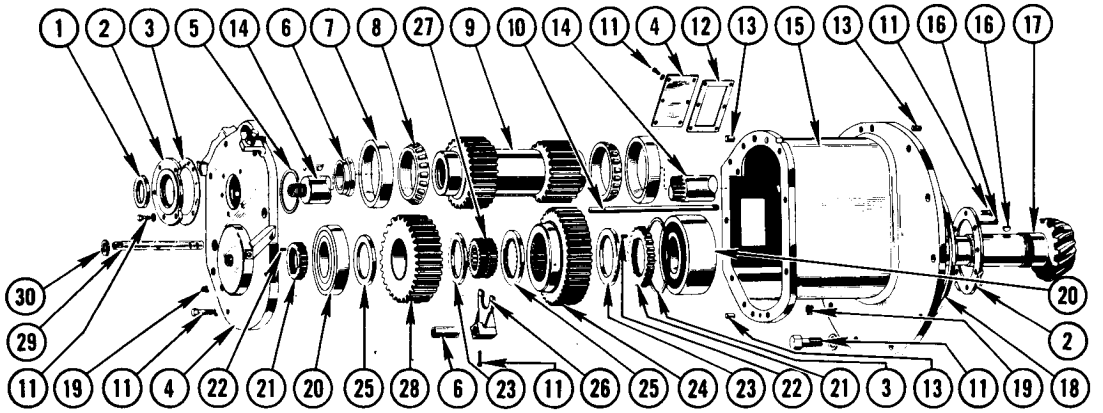


FIGURE F-34. AUXILIARY TRANSMISSION, EXPLODED

1. Oil Seal
2. Retainer
3. Shim
4. Cover Plate
5. Snap Ring
6. Spacer
7. Bearing Cup
8. Bearing Cone
9. Cluster Gear
10. Oil Pipe
11. Capscrew
12. Gasket
13. Dowel Pin
14. Drive Shaft
15. Case
16. Key
17. Pinion
18. Oil Slushing Ring
19. Plug
20. Bearing
21. Locknut
22. Setscrew
23. Front Washer
24. High Speed Gear and Bushing
25. Rear Washer
26. Shifting Yoke
27. Sliding Clutch
28. Low Speed Gear and Bushing
29. Yoke Bar
30. Oil Seal

wear. Replace gaskets and lockwires.

Replace pinion bearing retainer on pinion shaft. Install roller bearing assembly on pinion shaft.

Screw locknut on pinion shaft and torque to 500 ft. lbs. and install setscrew.

Place the pinion and shaft into the case structure. The position of the pinion is checked by measuring between the machined face of the auxiliary transmission which bolts to the Tournapull rear case, and the outer bearing race. This distance must be 2.687″ (±0.001″).

If the pinion is marked M.D. Std., or does not have an M.D. marking and if the auxiliary transmission does not have a reference marking, the pinion is correctly positioned when the distance from the machined surface on the auxiliary transmission to the face of the bearing is 2.687″.

If there is an M.D. minus (—) marking on the end of the pinion, it indicates that the pinion must be set further out of the bearing bore by shimming between the bottom of the bearing bore and the bearing, the distance of the M.D. marking. For example: If the pinion is marked M.D. —0.005″ it indicates that the pinion must be set out an additional 0.005″ from the bearing bore. The measurement between the face of the auxiliary transmission and the face of the pinion bearing should change from 2.687″ to 2.692″.

If the pinion is marked on the end with an M.D. plus (+) marking, it indicates that the pinion must be set deeper in the bearing bore by removing shims from beneath the bearings. For example: If the pinion is marked M.D. +0.005″, the pinion must be set 0.005″ deeper in the bearing bore and the measurement between the machined surface and the face of the bearing will be 2.682″.

If the auxiliary transmission case is marked with a plus (+) number, it indicates that the pinion must be set out of the bearing bore by adding shims, in the manner described above. For example: If the case is marked +0.005″ the pinion must be set out of the bearing bore 0.005″.

If the case is marked with a minus (—) number, it indicates that the pinion must be set deeper in the bore the same distance as the case is marked.

From the above mentioned markings on the pinion and case determine the amount that the pinion mounting will deviate from the required 2.687″ measurement. Add or remove shims to properly install the pinion.

Replace oil slushing ring in position, see Fig. F-32. Install pinion and shaft into bore of auxiliary transmission case with correct amount of shims (as determined above). Replace output pinion bearing retainer capscrews and torque to 60 ft. lbs.

Install high speed gear front washer on pinion shaft. Place small key in keyway in pinion shaft and install sleeve, high speed gear and bushing on shaft. The tapered end of the sleeve must face the rear of the pinion shaft.

Replace high speed gear rear washer. The oil groove in face of washer must face toward pinion gear. Line splines of rear washer with splines on shaft and insert large key into keyway.

Slide sliding clutch gear onto shaft. Position yoke structure on sliding clutch gear, insert yoke bar through the shifting yoke structure and through the front bracket. Replace baffle plate. Push yoke bar forward until first notch in the bar

is aligned with the detent ball opening. Replace detent ball, spring and capscrew.

Replace bearings on cluster gear and place gear into auxiliary case, large gear first.

Install low speed gear front washer (the oil groove in washer must face away from pinion gear), low speed gear and low speed gear rear washer on pinion shaft in that order. Replace bearing inner race on pinion shaft. Install locknut on pinion shaft, torque to 500 ft. lbs. and install setscrew.

Slide yoke spacer tube over yoke bar.

Replace cluster gear bearing cup and pinion shaft rear bearing in cover plate. Apply coating of Permatex to mounting flange of auxiliary case and cover plate. Install cover plate on auxiliary transmission, secure with capscrews and lockwashers.

Replace oil pipe into case.

Position yoke bar so that detent ball is in the first notch on the bar, move yoke and sliding clutch toward the cover plate until the spacer is flush against the cover plate. Tighten capscrews on the shifting yoke structure. Replace cover plate and gasket over shifting yoke and fasten with capscrews and lockwashers.

Replace oil seal in drive shaft bearing cover, place shims between cover and auxiliary cover plate until end play is reduced to 0.001" to 0.005". Secure bearing cover to case with capscrews and lockwashers.

Slide splined hub on the drive shaft through the differential compartment, transmission adaptor and over the splined adaptor nut on the rear of the transmission output shaft. Apply a thin coating of Permatex to mating surfaces of the auxiliary transmission and the Tournapull case. Hoist the auxiliary assembly up even with the drive shaft and then move it forward over the drive shaft, until the drive shaft is protruding through the rear of the auxiliary and the auxiliary is against the case wall. Be sure dowel pins are aligned. Secure with mounting bolts.

Install spacer over drive shaft into bore of cluster gear. Install snap ring in cluster gear against spacer.

Replace parking brake, reconnect parking brake and auxiliary shift linkage.

It is extremely important that the Torflex bushings which are used in the pivot points of the shift linkage for the auxiliary transmission be properly installed and tightened. Failure to do so will not only result in damage to the bushing and bushing bores, but the auxiliary transmission will have a tendency to jump out of gear.

The Torflex bushing is composed of an internal and external sleeve, with rubber material separating them. This rubber material is bonded to the sleeves.

These bushings are designed to absorb the maximum travel of the linkage in operation. Neither the inner or outer sleeves are supposed to rotate during operation of the linkage, as the rubber material absorbs the travel. However, the bushings MUST be properly installed to avoid stretching the rubber beyond its elastic limits.

Before installing the bushing in the hole in the linkage, coat the O.D. of the bushing with white lead.

Do not press or push against the internal sleeve, as this will strain the rubber material and damage it, or break its bond to the sleeves. During installation, all pressing must be on the external sleeve only. A flat washer with an I.D. larger than the O.D. of the internal sleeve, but slightly smaller than the I.D. of the external sleeve, can be used as an adaptor for installing the bushing. Press only against the washer when installing the bushing.

Assemble linkage, but do not tighten the capscrews at this time.

It is important that the capscrews that hold the linkage at the pivot point be properly torqued, and that the linkage be properly positioned.

The linkage must be in the neutral position when torqueing the bolts, which means that the linkage should be exactly midway between its travel distance for the high and low gear positions of the auxiliary. This will insure that the linkage can be operated from high to low or low to high gear positions without stretching the rubber material beyond its elastic limits. Refer to Figure F-35.

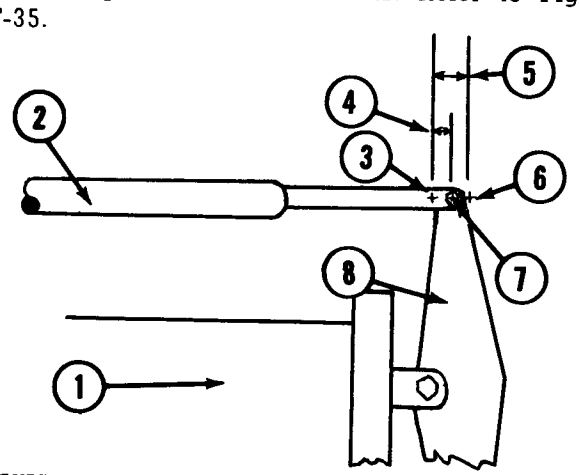


FIGURE F-35. POSITION OF SHIFT LINKAGE

1. Auxiliary Transmission
2. Control Pipe
3. Forward Position
4. 25/32" Travel
5. 1 9/16" Full Travel
6. Rear Position
7. Neutral Position
8. Lever

With all capscrews of the linkage loose, move the lever into the neutral position which is midway between high and low gear range positions. The full travel of the shift control pipe is 1 9/16" at the point where the pipe connects to the vertical control lever at the rear of the auxiliary transmission. When in neutral, the control pipe at this point should be 25/32" from either extreme forward or extreme reverse positions of the pipe. Refer to Figure F-35.

Tighten all of the capscrews at the pivot points where the small Torflex bushings are installed to 30 ft. lbs.

Torque the capscrews at the pivot point of the control lever, and the vertical lever mounted on the rear of the auxiliary to 145 ft. lbs.

The inner sleeve of the bushing should now be secured and prevented from moving by the clamping action imposed by the capscrews. The external sleeves should be snug enough in the bushing bores so that they do not turn in these bores.

The linkage should be operated and each of the bushings checked to make certain they are operating as intended before the machine is put into operation. The linkage should be checked periodically, as well as after any repairs or adjustments have been made to the linkage.

Refill main case and auxiliary transmission with correct type and amount of lubricant. See section "K" for lubrication instructions.

Replace fuel tank and auxiliary transmission guard plate.

TRANSFER CASE

Removal and Disassembly

Place parking brake lever in the released position to remove tension from actuating linkage and release springs.

Remove brake release springs.

Disconnect actuating wire rope from actuating arm. Remove cotter from castellated nut on end of drive shaft. Remove nut and large flat washer.

Pull brake drum and key from drive shaft. Remove large locknut and lockwasher from brake mounting stud and pull brake shoes from rear of transfer case.

Remove drain plugs and drain lubricant from transfer case and final drive compartments.

Attach a hoist to the transfer case and take up the slack.

Remove mounting bolts securing transfer case to the Tournapull main case. Install pusher capscrews in the blind tapped holes next to the two dowel pins in the transfer case mounting flange. By turning these capscrews in evenly push the transfer case away from the Tournapull until it clears the dowel pins.

Pull transfer case away from drive shaft and Tournapull. Place on work bench for further disassembly.

Remove the capscrews and lockwashers securing the cover plate to the rear of the case. Remove cover plate. Upper gear rear bearing cup will be removed with cover plate. Pull or press bearing cup from case.

Remove capscrews and lockwashers securing drive shaft rear bearing retainer to cover and remove retainer, shims, and oil seal. Press oil seal out of bearing retainer.

Remove oil pipe.

Pull upper gear, with front and rear bearing cones attached, from case. Pull bearing cones from gear and remove snap ring and spacer from bore in gear. Cut lockwires and remove the capscrews securing the end plate to the pinion shaft. Pull end plate, roller bearing, and spacer ring from pinion shaft.

Pull pinion shaft gear and spacer from pinion shaft.

Move to front of transfer case, cut lockwires and remove capscrews securing pinion front bearing retainer to the case. Pull pinion and shaft, bearing and shims from case.

Pull bearing from shaft if necessary.

Reassembly

Clean all parts thoroughly in cleaning solvent. Check for pits or other irregularities in bearing surfaces.

Inspect all gears for burrs, chipped or broken teeth and cracks. Ring gear and pinions are sold in matched sets only.

Press pinion front bearing onto shaft. Place pinion and bearing into the case.

The correct position of the pinion is checked by measuring between the machined face of the transfer case which bolts to the Tournapull main case, and the face of the outer bearing cone. This distance must be 2.687" (±0.001").

If the pinion is marked M.D. Std., or does not have an M.D. marking and if the transfer case does not have a reference marking, the pinion is correctly positioned when the distance from the machined surface on the transfer case to the face of the outer bearing cone is 2.687".

If there is an M.D. minus (—) marking on the

end of the pinion, it indicates that the pinion must be set farther out of the bearing bore by shimming between the bottom of the bearing bore and bearing cup, the distance of the M.D. marking. For example: If the pinion is marked M.D. —0.005", it indicates that the pinion must be set out an additional 0.005" from the bearing bore. The measurement between the face of the transfer case and the face of the pinion outer bearing should change from 2.687" to 2.692".

If the pinion is marked on the end with an M.D. plus (+) marking, it indicates that the pinion must be set deeper in the bearing bore by removing shims from beneath the bearing cup. For example: If the pinion is marked M.D. +0.005" the pinion must be set 0.005" deeper in the bearing bore and the measurement between the machined surface and the face of the outer bearing cone will be 2.682".

If the transfer case is marked with a plus (+) number, it indicates that the pinion must be set out of the bearing bore by adding shims, in the manner described above. For instance: If the case is marked +0.005" the pinion must be set out of the bearing bore an additional 0.005".

If the case is marked with a minus (—) number, it indicates that the pinion must be set deeper in the bore the same distance as the case is marked.

From the above mentioned markings on the pinion and case determine the amount that the pinion mounting will deviate from the required 2.687" measurement. Add or remove shims between the bottom of the pinion bearing bore and the bearing cup to properly install the pinion.

Replace oil slushing ring. Install pinion and shaft into bore in case with correct amount of shims as determined above. Replace pinion shaft front bearing retainer. Secure with capscrews torqued to 60 ft. lbs. and install lockwires.

Install spacer on pinion shaft. Replace upper gear inner bearing cup into case.

Position pinion shaft gear, gear spacer, and roller bearing on pinion shaft. Bearing snap ring must be toward gear. Replace end plate over end of pinion shaft. Secure with capscrews torqued to 60 ft. lbs. and secure with lockwires.

Press bearing cones onto upper gear. Install gear into case. Replace oil pipe.

Press upper gear outer bearing cup into rear cover plate and install cover plate on transfer case. Put coat of Permatex on machined surface of cover plate. Secure cover to case with capscrews and lockwashers.

Replace oil seal in drive shaft bearing retainer, place shims between retainer and transfer case until end play of gear is reduced to 0.003" to 0.005". Secure retainer, with proper amount of shims to cover plate with capscrews and lockwashers.

Slide the splined hub on the drive shaft through the differential compartment, transmission adaptor and over the splined nut on the rear of the transmission mainshaft.

Apply a thin coating of Permatex to the mating surface of the transfer case and Tournapull case.

Hoist transfer case and position so that the splines on the drive shaft are engaged with the splines in the upper gear. Position transfer case against Tournapull and secure with mounting bolts.

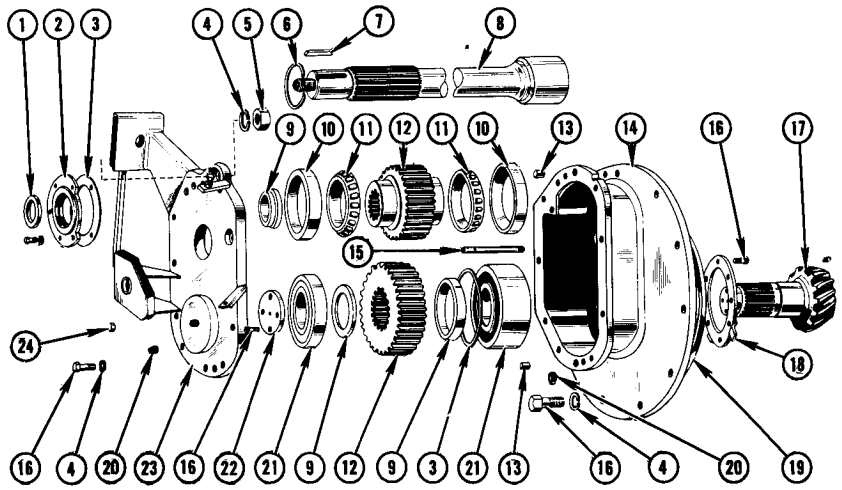


FIGURE F-36. TRANSFER CASE, EXPLODED

1. Oil Seal
2. Bearing Cover
3. Shim
4. Lockwasher
5. Nut
6. Snap Ring
7. Key
8. Drive Shaft
9. Spacer
10. Bearing Cup
11. Bearing Cone
12. Gear
13. Dowel Pin
14. Case
15. Oil Pipe
16. Capscrew
17. Pinion
18. Retainer
19. Oil Slushing Ring
20. Pipe Plug
21. Bearing
22. Plate
23. Cover Plate
24. Cap

Install spacer over drive shaft into bore of upper gear. Install snap ring into upper gear, against spacer.

Install parking brake, reconnect linkage, and replace any other assemblies that were removed.

FINAL DRIVES

INDEX

FINAL DRIVES

FINAL DRIVE PINION

Removal

Drain lubricant from the main case and auxiliary transmission (or transfer case if machine is equipped with power shift transmission).

Block up the machine and remove the wheel and tire from the side to be worked on.

Remove the round cover plate from the rear of the final drive compartment containing the pinion to be removed. Also remove the large cover plate and gasket at the front of the compartment, exposing the final drive gear (Fig. G-1).

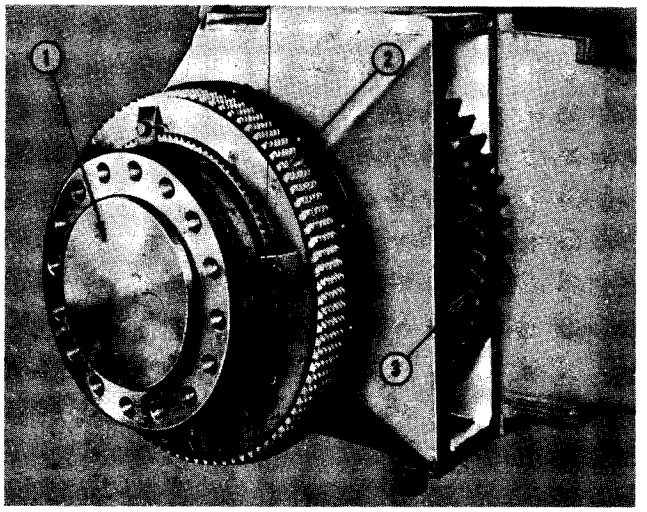


FIGURE G-1. WHEEL AND COVER PLATE REMOVED

1. Axle. 2. Brake Assembly 3. Final Drive Gear

Remove the capscrews securing the pinion bearing retainer cap to the case wall and remove the cap (Fig. G-2).

Pull pinion, outer bearing assembly and inner race of the inner roller bearing assembly from the case.

Press bearing races from the pinion shaft.

Remove the bearing from inner case wall by rolling it behind the final drive gear and removing from front of final drive compartment.

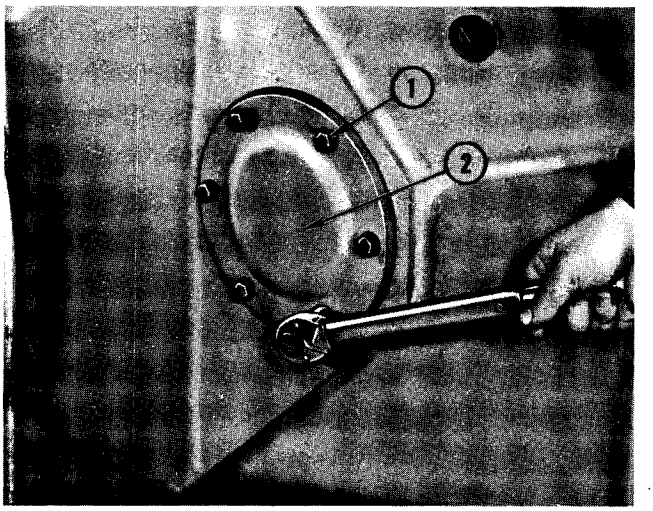


FIGURE G-2. REMOVING RETAINER CAP

1. Capscrew 2. Retainer Cap

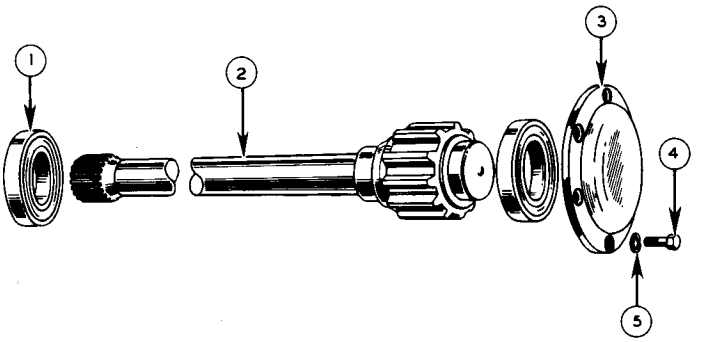


FIGURE G-3. FINAL DRIVE PINION, EXPLODED

1. Bearing 2. Pinion and Shaft 3. Bearing Cap 4. Capscrew 5. Lockwasher

Installation

Press inner and outer bearing races onto pinion shaft. The flange end of the bearing races must be toward the pinion gear.

Replace bearing in inner case wall. The snap ring on the bearing must be facing the pinion gear for both inner and outer bearings.

Insert pinion through bearing bores into case (Fig. G-4). Align splines on end of pinion shaft with internal splines of differential bevel gear. Tap with soft hammer until pinion and shaft is seated in case.

Replace outer bearing (Fig. G-5).

Replace bearing retainer cap and secure to outer case with capscrews and lockwashers.

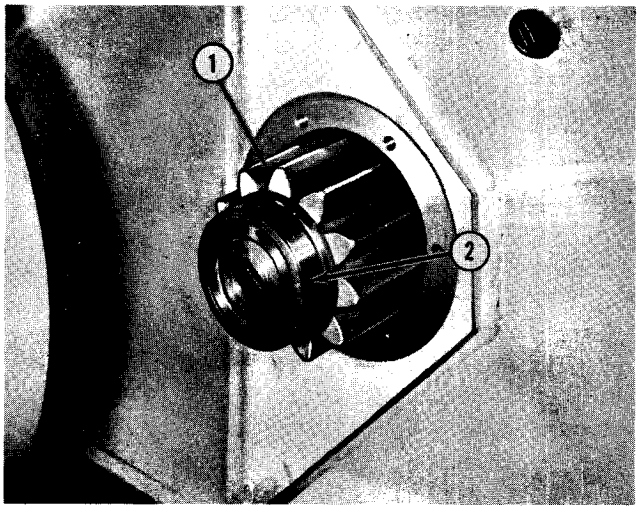


FIGURE G-4. REPLACING PINION
1. Pinion 2. Bearing Race

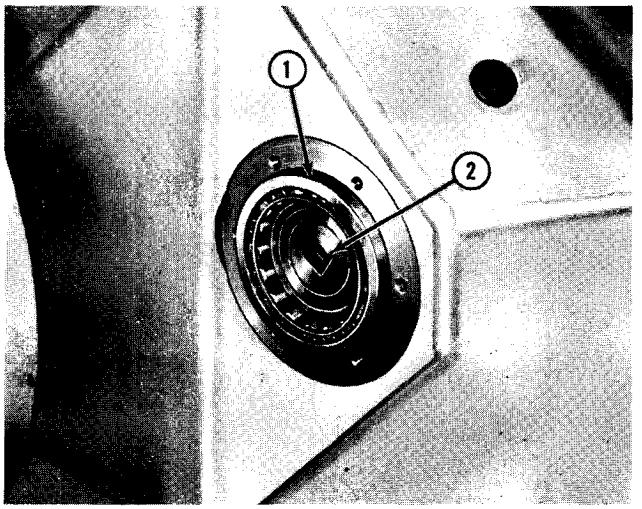


FIGURE G-5. REPLACING OUTER BEARING
1. Bearing 2. Pinion

FINAL DRIVE AXLE

Removal

Drain the oil from the main case and auxiliary transmission (or transfer case if machine is equipped with power shift transmission).

Block up machine and remove wheel and tire from side to be worked on.

Remove the round cover plate from the rear of the final drive compartment containing the axle to be removed. Also remove the large cover plate and gasket at the front of the compartment, exposing the final drive gear (see Fig. G-1).

Cut lockwires and remove capscrews securing axle bearing retainer cap to the inner case wall (Fig. G-6).

Remove bearing retainer cap.

Remove locking setscrew from axle locknut. Place wrench over locknut and block to prevent its turning. Remove bearing cap from the final drive

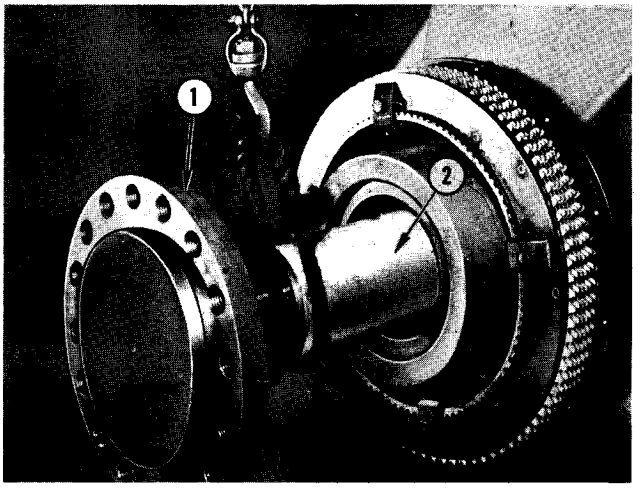


FIGURE G-7. REMOVING AXLE
1. Axle 2. Spacer Tube

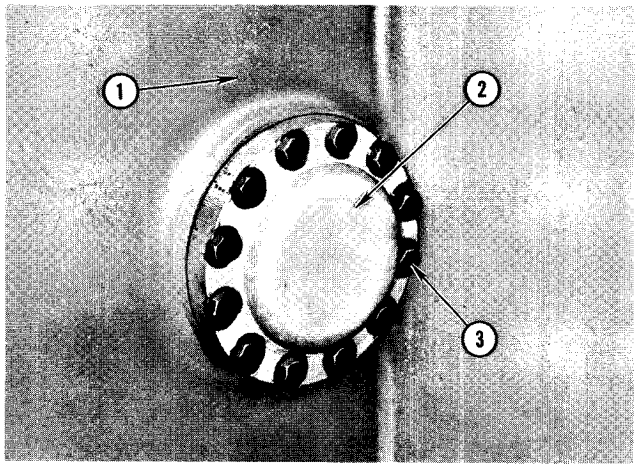


FIGURE G-6. BEARING RETAINER CAP
1. Case Wall 2. Retainer Cap 3. Capscrew

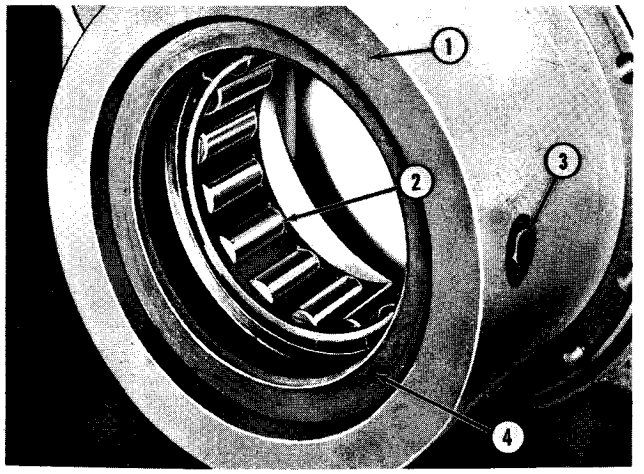


FIGURE G-8. OUTER BEARING
1. Axle Housing 2. Bearing 3. Lockbolt 4. Oil Seal

pinion on the same side. Put wrench with square drive in hole in pinion shaft and turn pinion clockwise to loosen the axle nut. Transmission must be in neutral.

Place the six long retainer cap capscrews back to hold the inner bearing retainer in place while the axle is being removed.

Place blocks under the final drive gear to prevent it from dropping to the bottom of the case as the axle is being removed.

Position hydraulic jack in case against the end of the final drive axle. Use a hardwood block between the end of the jack and the bearing retainer cap on the opposite side of the machine. Force axle loose from bearings.

Remove axle, bearing race, seal ring and spacer tube from the case. Do not allow axle spacer to drop to the bottom of the case as the axle is being removed (Fig. G-7).

Remove gear from case.

Remove the six capscrews and remove the bearing retainer from the inner case wall and remove the bearing.

Back out the bearing lock bolt from the axle housing. Remove oil seal and bearing (Fig. G-8).

Exercise caution when removing oil seal to prevent damaging the lip of the oil seal. Remove all old lubricant from axle housing. It may contain abrasive particles which will accelerate bearing wear.

Installation

Clean all parts thoroughly. Check bearings for damage or excessive wear. Check oil seals for stiffness, cracks or damage. Check general condition of gear, axle, and shaft for chipped or broken teeth, cracks or checks. Check threads. Replace all worn or damaged parts.

Replace bearing in axle housing and install bearing lock bolt.

Install oil seal with leathers facing the center of the case (Fig. G-8).

Place inner bearing race into bearing bore. Place bearing retainer over bearing with the largest diameter of the retainer bore facing the outside of the machine, hold in place by screwing two of the long bearing retainer cap capscrews through the case wall and into the inner bearing retainer. See Fig. G-9.

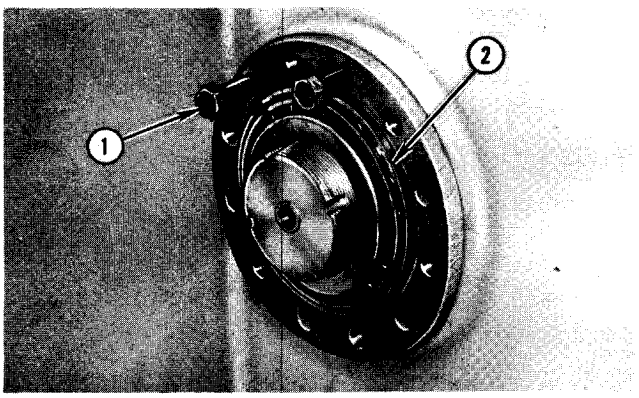


FIGURE G-9. INNER BEARING
1. Capscrews 2. Bearing

Press roller bearing race onto axle. Position seal ring and spacer tube over axle. The largest inside diameter of the seal ring goes next to the axle flange.

Position final drive gear into the case with the gear hub facing the outside of the machine.

Attach sling to axle and insert into axle housing.

As the end of the axle comes through the final drive gear, place the spacer between the gear and the inner bearing retainer. The tapered side of the spacer goes into the bearing retainer (Fig. G-10).

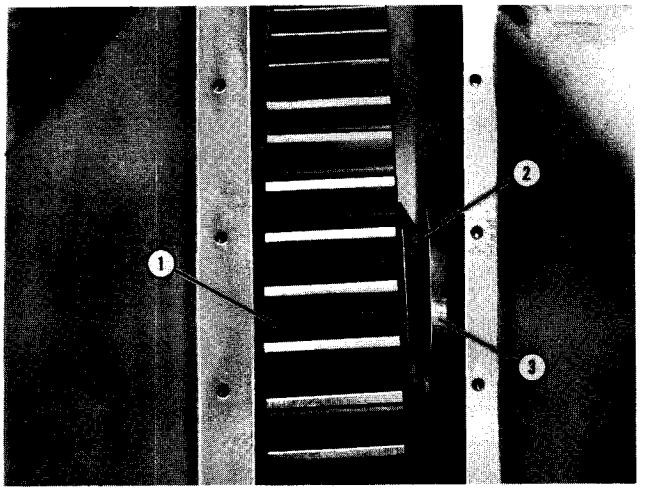


FIGURE G-10. GEAR AND SPACER
1. Gear 2. Spacer 3. Retainer

Turn axle until the splines on the axle fit into the splines in the final drive gear.

Drive against the center of the axle flange to seat the final drive gear on the axle.

Check spacer tube. It should have 3/16" movement when gear is properly seated on axle.

Replace bearing race, spacer and outer bearing in inner case wall.

Remove the two capscrews holding the bearing retainer.

Place locknut over axle shaft, tighten and torque to 2000 ft. lbs., using the same method as described to remove axle nut, only turn the pinion counterclockwise. Approximately 400 ft. lbs. force

applied to the pinion in this manner will torque axle nut to the required amount.

Put a thick coat of Permatex on bearing retainer cap and replace cap on case.

Replace the capscrews and copper washers securing the bearing retainer cap to the case wall. Alternate the long capscrews with the short ones. The long ones go through the case wall and into the inner bearing retainer. The short ones go into the tapped holes in the case.

Tighten capscrews and install lockwires.

Replace final drive pinion, cover plates, and other parts or assemblies removed.

Replace final drive front cover and gasket. Secure with capscrews and lockwashers.

Replace lubricant in final drive compartment. See Section "K" of this manual for correct type and amount of lubricant.

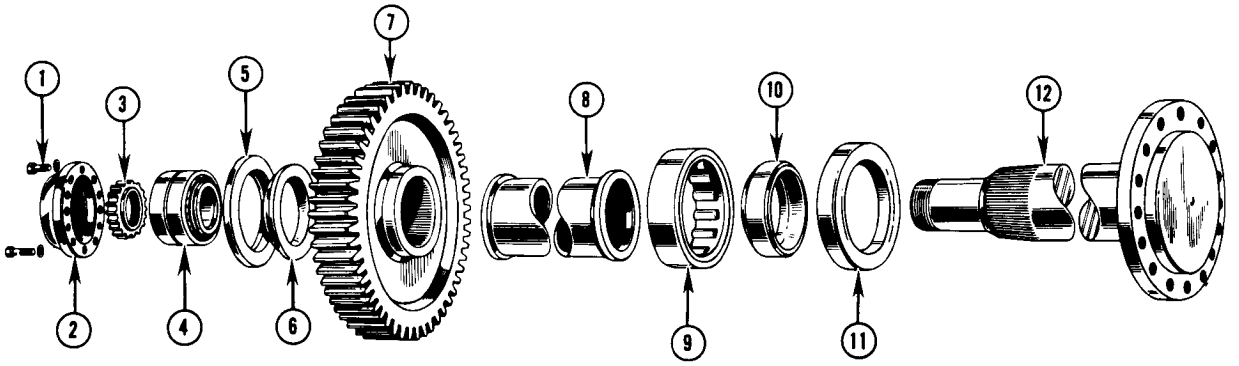


FIGURE G-11. FINAL DRIVE GEAR AND AXLE, EXPLODED

1. Capscrew
2. Retainer Cap
3. Locknut
4. Bearing
5. Retainer
6. Spacer
7. Gear
8. Spacer Tube
9. Bearing
10. Seal Ring
11. Oil Seal
12. Axle

DIFFERENTIAL

The differential provides a means of slowing the inner wheel and speeding the outer wheel when turning, and accomplishes a proportioning of power between the wheel with poor traction and the wheel with better traction.

The differential pinion is a compensating linkage with the differential housing, used to connect the axle shaft to the drive shaft. If the pinions were removed from the differential, the vehicle could not move. The nature of a standard differential is to permit power to flow to the wheel with the least resistance. This inherent nature results from the freedom of the pinions to rotate within the differential housing, giving the compensation needed on turns. The only way we can prevent all the engine power from going to the wheel with the least resistance, and still keep the differential simple in design and construction, is to restrict the rotation of the pinions when one wheel starts to slip.

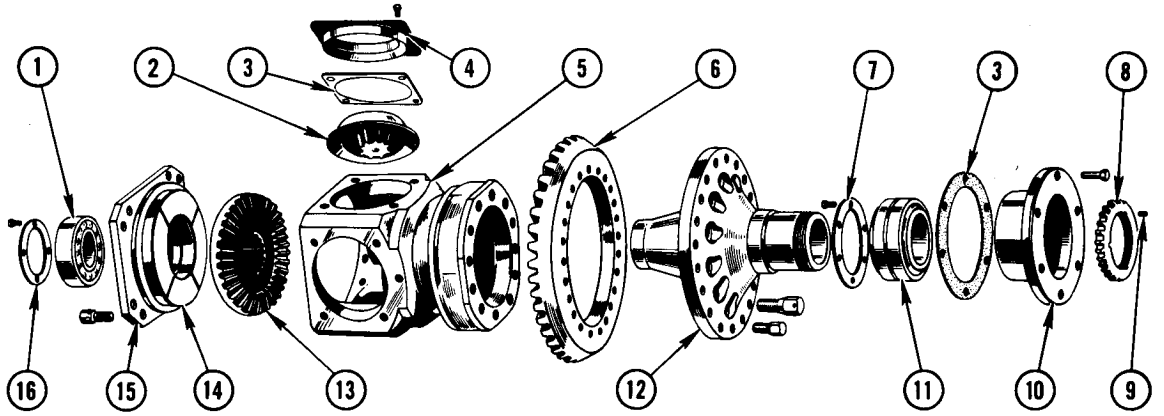


FIGURE G-12. DIFFERENTIAL, EXPLODED

1. Bearing
2. Differential Pinion
3. Shim
4. Bushing
5. Housing
6. Ring Gear
7. Retainer
8. Locknut
9. Setscrew
10. Bearing Cage
11. Bearing
12. Ring Gear Carrier
13. Differential Gear
14. Bushing
15. End Cover
16. Retainer

The LeTourneau-Westinghouse differential capitalizes on the simple design of the standard differential by placing large friction bushings at the top of each differential pinion. There is no intricate gearing, collars or springs to require maintenance. When one wheel starts to slip, the pinions rotate within the differential housing. The rotation forces the pinions out against the bushing which restricts the speed of pinion rotation. As the speed of their rotation is restricted, a portion of engine power is automatically diverted to the opposite wheel. The greater the speed of the slipping wheel, the greater the restriction, and the greater the portion of engine power that is diverted to the opposite wheel.

The reason one wheel can pull four times as much as the other is that the pinion is small and rotates rapidly when differentiating. At the same time the lubricated bronze bushings are very large, which increase the lineal feet per minute at the bushing surfaces which resists the differentiating action enough to make one wheel pull approximately four times as much as the other.

When the Tournapull is traveling in a straight line, the differential pinion gears act merely as linkage, and do not rotate with respect to the differential pinion bushings. When the Tournapull is turning, the differential pinion gears are meshed to both differential gears, and therefore act as compensators as well as linkage.

Removal

Disconnect fuel lines to fuel tank at the couplings on the rear of the Tournapull case.

Attach hoist to fuel tank assembly. Remove the mounting bolts securing the assembly to the Tournapull main case. Remove fuel tank.

Drain the lubricant from the main case and auxiliary transmission (or transfer case).

Remove parking brake, auxiliary transmission (or transfer case) and drive shaft. Refer to Section "F".

Remove both final drive pinions as previously described.

Cut the lockwires and remove capscrews securing ring gear to ring gear carrier. With soft hammer drive ring gear from seat on ring gear carrier (Fig. G-13).

Remove capscrews fastening bearing cage to main case wall, also remove the capscrews fastening the bearing retainer to the bearing cage (Fig. G-14).

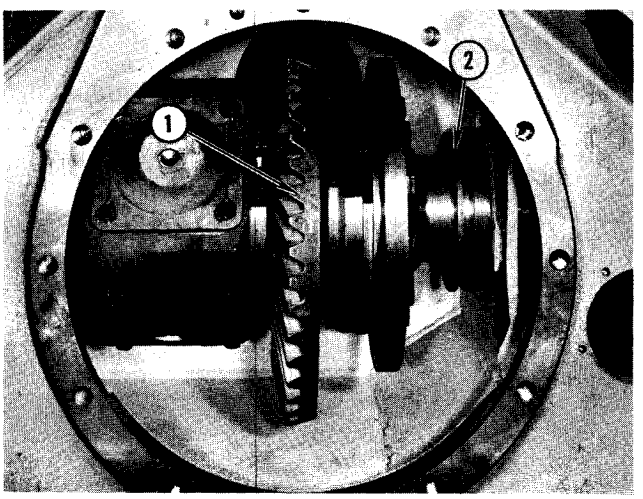


FIGURE G-13. RING GEAR AND RETAINER CAPSCREWS REMOVED

1. Ring Gear 2. Retainer

Attach removal tool (similar to the one shown in Fig. G-15) to differential assembly. (There is a tapped hole in one side of the differential housing for attaching the tool.) Attach hoist to tool.

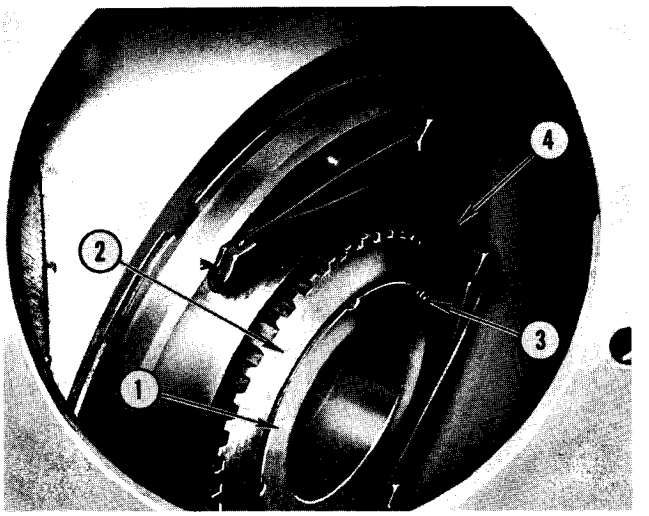


FIGURE G-14. CARRIER SHAFT LOCKNUT

1. Carrier Shaft 2. Locknut 3. Setscrew 4. Bearing Cage

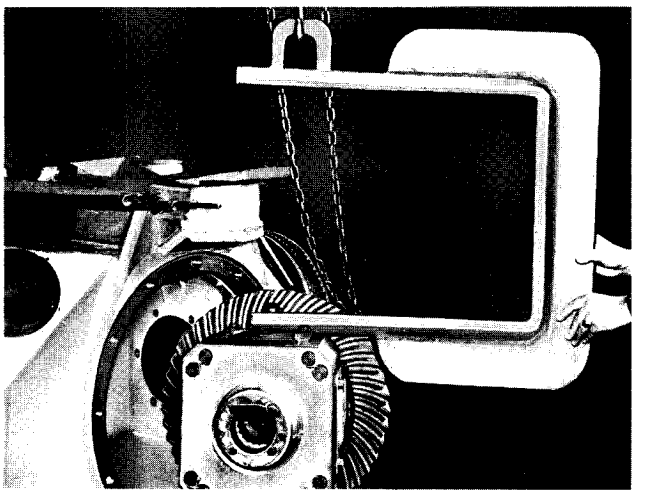


FIGURE G-15. REMOVING DIFFERENTIAL

Cut lockwires and remove capscrews securing bearing retainer to bearing cage.

Tap bearing cage out of bore in case wall. Remove and keep together the split shims between the bearing cage and the case wall. Differential is now free.

Move differential and ring gear to the right until the roller bearing on the left end of the differential clears the bearing bore in the case wall.

Remove differential and ring gear from case. Place on bench for further disassembly.

Pull bearing cone from case wall.

Remove locking setscrew from carrier shaft and remove locknut. Pull bearing from shaft.

Disassembly

Cut lockwires and remove capscrews securing ring gear carrier to differential housing. (Fig. G-16).

Use a brass drift to drive the ring gear carrier from the differential housing.

Cut the lockwires and remove the capscrews securing the pinion gears and pinion gear bushings to the housing.

Remove the bushings, shims and pinion gears. Mark the bushings, gears, shims and housing so that each part can be replaced in the position from which it was removed.

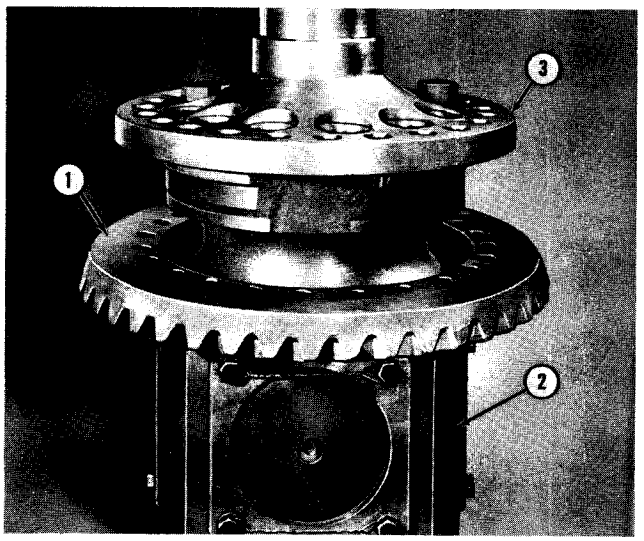


FIGURE G-16. CAPSCREWS REMOVED

1. Ring Gear
2. Housing
3. Carrier

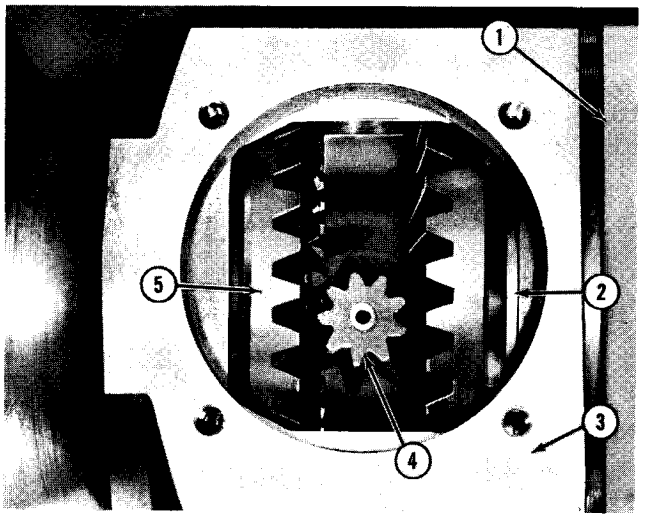


FIGURE G-17. DIFFERENTIAL HOUSING AND GEARS

1. End Cover
2. Bushing
3. Housing
4. Differential Pinion
5. Differential Gear

Remove capscrews securing bearing retainer to differential end cover.

Cut the lockwires and remove the capscrews securing the end cover, differential gear and bushing to the housing.

Remove the differential gears from cover and housing.

Pull the differential gear bushings from their respective positions.

NOTE: Use mating marks on housing, bushings and gears to insure reassembly in correct position.

Reassembly

Thoroughly clean all parts of the differential assembly. Check each part for wear or damage. Check the ring gear and pinion gear teeth. Replace parts that show evidence of excessive wear or damage. (Ring gear and pinion are replaceable in matched sets only.)

Press differential gear bushings into housing and end cover.

Replace differential gears in their respective positions in housing and end cover.

Secure end cover, differential gear and bushing to housing with capscrews. Torque to 285 ft. lbs. and install lockwires.

Install pinion gears and bushings. Pinion gears should have from 0.020" to 0.040" free drop in bushing when turned to bottom side. Check with a dial indicator. There should be no more than 0.002" variation between any two of the pinion gears. Bushings are to be hand fitted to gears so that they turn without drag or bind. Use shims between bushings and housing to obtain proper adjustment.

Place ring gear over neck of differential housing with gear teeth toward the pinion bushings.

Press ring gear carrier into differential housing. Be sure to align tapped holes in housing with

holes in carrier. Do not bolt ring gear to carrier.

Install capscrews securing carrier to differential housing. Do not torque up at this point.

Press bearing race onto end cover and replace retainer. Secure with capscrews and lockwashers.

Installation

Replace single row roller bearing into bearing bore in left side of differential compartment (Fig. G-18).

Place retainer over carrier shaft, press bearing onto carrier shaft (Fig. G-15).

Attach tool and hoist to differential assembly and position into case.

Swing right end of carrier shaft into bearing cage bore until retainer and bearing race on left side of differential will fit into bearing in case wall.

Position bearing cage into main case with oil hole in top. Do not seat it in bore in case (Fig. G-19).

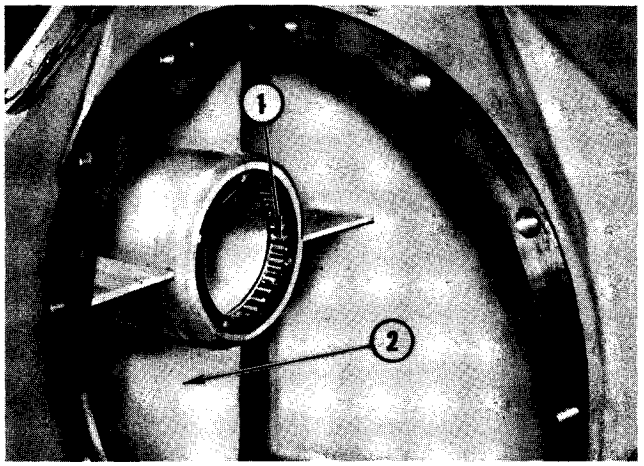


FIGURE G-18. BEARING IN POSITION
1. Bearing 2. Case

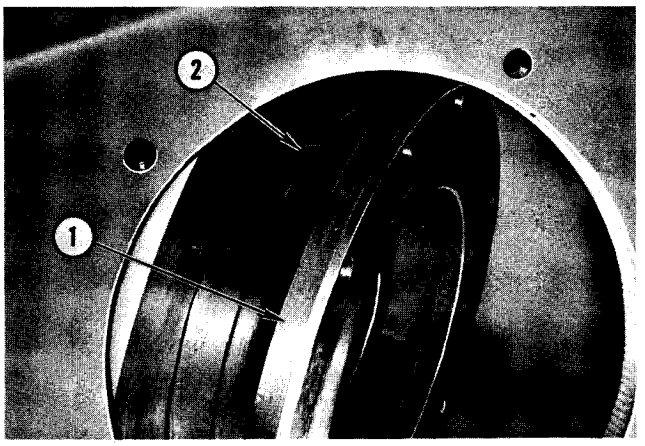


FIGURE G-19. INNER BEARING CAGE
1. Cage 2. Oil Hole

Replace shims and tap bearing cage into place over bearing on carrier shaft. Keep holes in cage aligned with holes in case wall. Remove tool.

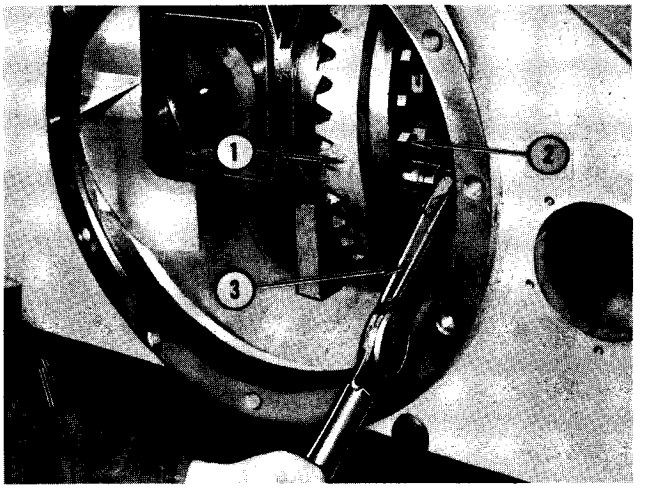


FIGURE G-20. TIGHTENING CAPSCREWS
1. Ring Gear 2. Carrier 3. Torque Wrench

Fasten bearing retainer to bearing cage and install lockwires.

Push ring gear up on seat on carrier shaft, loosen the bolts fastening the carrier to the housing. Pull ring gear up on carrier shaft using capscrews and washers. Place wood block under differential to keep it from turning while tightening capscrews (Fig. G-20).

Secure ring gear to carrier shaft flange with bolts. Torque bolts to 285 ft. lbs. and install lockwires. Torque bolts securing carrier to housing to 870 ft. lbs. and install lockwires.

Mount the auxiliary transmission (or transfer case) on the machine. Make certain that the pinion tooth marked with an "X" is placed between the two ring gear teeth marked with "X's". Note the amount of backlash etched on the gear. (Ring gear and pinion are sold in matched sets only.)

Remove the cover plates from the right rear of the Tournapull main case.

Mount dial indicator on the wall between the differential compartment and the final drive pinion compartment.

Indicator button must be touching the ring gear teeth. Set the indicator at "O".

Now move the ring gear carrier endwise in the direction needed, until the backlash between the ring gear and pinion, as indicated by the movement of the dial indicator needle, is equal to the dimension etched on the edge of the ring gear.

Moving the ring gear is accomplished by removing the capscrews securing the right bearing cage

to the case wall and inserting the necessary shims between the bearing cage and the case wall. These are split type shims. Adding shims increases the amount of backlash, removing shims decreases the backlash (Fig. G-22).

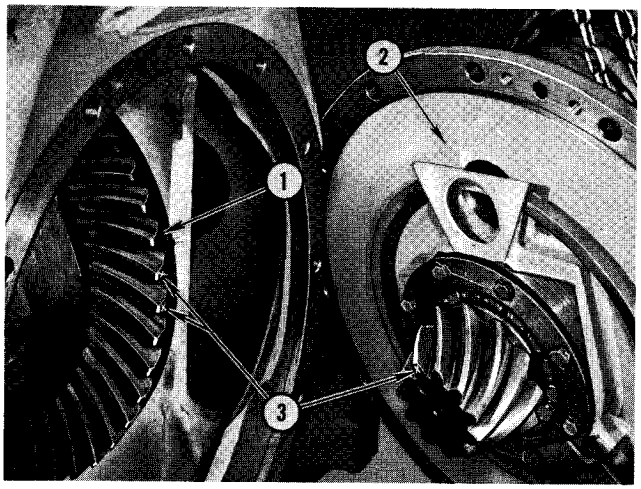


FIGURE G-21. MOUNTING AUXILIARY TRANSMISSION
1. Ring Gear 2. Pinion 3. "X" Marks

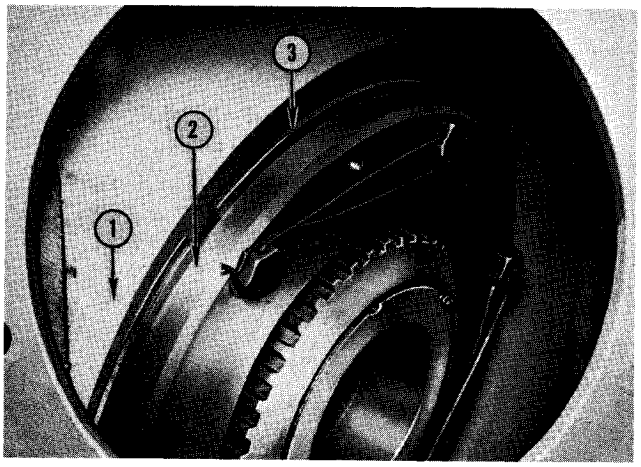


FIGURE G-22. POSITION OF SHIMS
1. Case Wall 2. Bearing Cage 3. Shims

Check the backlash at four points equidistant around the circumference of the gear.

After proper adjustment has been obtained, tighten bearing cage capscrews to 285 ft. lbs. torque and install lockwires. Recheck backlash adjustment after capscrews have been tightened.

Remove dial indicator.

Coat the ring gear and pinion teeth with a thin coating of red lead and check the tooth pattern. Turn the ring gear one complete turn in each direction under no load conditions. The tooth patterns of the ring gear should approximate the ones shown in Fig. 23.

As the load increases, the tooth patterns should extend toward the heel of the teeth, in proportion to the load, until the tooth patterns approximate

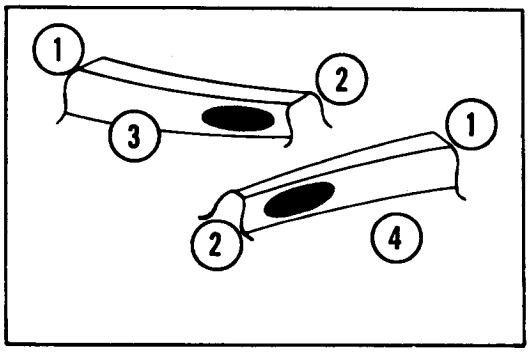


FIGURE G-23. RING GEAR TOOTH BEARING PATTERN, UNLOADED
1. Heel 2. Toe 3. Forward 4. Reverse

those in Fig. 24, under full loaded conditions.

NOTE: The patterns shown are what could be considered ideal patterns, which are almost impossible to obtain, and the patterns can deviate within reasonable limits. The full load pattern can be considered acceptable even though the pattern should run up the toe or back to the heel as long as it extends along the tooth approximately the length shown, and does not indicate heavy tooth

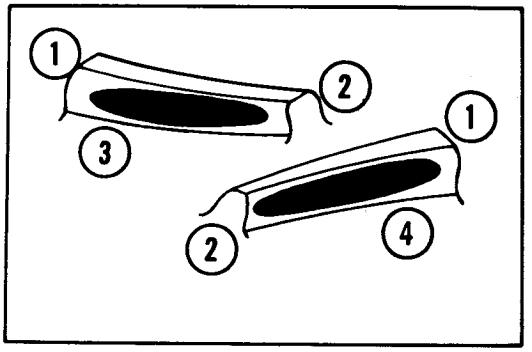


FIGURE G-24. RING GEAR TOOTH BEARING PATTERN, LOADED
1. Heel 2. Toe 3. Forward 4. Reverse

bearing on the heel or toe. The patterns **are not** acceptable if they run off the toe or heel of the teeth as this will usually result in chipping of the teeth. The patterns can also run higher toward the top than those shown, and even run slightly off the top, as long as most of the tooth bearing is below the top. The pattern however, **cannot** run to the bottom of the teeth as this would cause scrubbing of the teeth and premature failure of the ring gear or pinion.

The backlash adjustment between the pinion and ring gear is required whenever one or both of these units are installed in the machine, or if the adjustment is disturbed for any other reason.

Replace cover plates.

Fill compartment with correct amount and type of lubricant. Refer to Section "K" of this manual.

TROUBLE SHOOTING

TROUBLE: Noisy Gears
CAUSE: Chipped, broken, pitted or galled teeth.
REMEDY: Replace gears.

TROUBLE: End play in axle.
CAUSE: Bearing failure.
REMEDY: Replace bearing(s).
CAUSE: Loose axle nut.
REMEDY: Tighten nut. Replace if threads are damaged.
CAUSE: Loose retainer cap.
REMEDY: Tighten retainer cap capscrews.

TROUBLE: Axle oil seal leakage.
CAUSE: Lubricants may not be those which are recommended. Oils lighter than the recommended may seep out under seals. Incorrect type of oil may break down and become fluid from heat of operation.
REMEDY: Remove lubricant and replace with recommended type.
CAUSE: Oil seal incorrectly installed with lips cupped outward from lube chamber.
REMEDY: Remove oil seals and install with lips cupped inward.
CAUSE: Gear case filled with oil above oil level plug.
REMEDY: Lower oil level to level plug.
CAUSE: Oil seals becoming burned and hardened as a result of overheating.
REMEDY: Correct cause of overheating and install new oil seals.

TROUBLE: End play in pinion.
CAUSE: Loose bearing cap or bearing out of adjustment.
REMEDY: Tighten cap—adjust bearing.

TROUBLE: Differential slips on pulls.
CAUSE: Excessive wear in pinion and bushings.
REMEDY: Remove shims or replace the worn parts.

TROUBLE: Noisy operation on turns—rough operation.
CAUSE: Broken gear teeth—galled bearings.
REMEDY: Replace broken or worn parts.

TROUBLE: Shock load on ring gear when starting.
CAUSE: Excessive backlash between ring gear and pinion.
REMEDY: Re-adjust backlash.

BRAKES, WHEELS AND TIRES

INDEX

BRAKES, WHEELS AND TIRES

BRAKES

Each wheel is equipped with an air actuated and spring released multiple disc air brake. The principal parts of the brake are: brake hub which is bolted to the main case structure; discs of two types, steel discs which are splined to the brake hub and fabricated discs which are splined to the brake drum; and the pressure plate and diaphragm.

When a brake is actuated by foot pressure on the metering type air valve on the floor of the cockpit, or by a hand brake valve, compressed air from the supply tank is admitted to the brake. The air exerts pressure through the diaphragm against the pressure plate. The pressure plate presses against the discs forcing them together. Since part of the discs are splined to the revolving brake drum and part to the stationary brake hub, the wheel is braked when the discs are forced together.

When air to the brake is cut off (Brake pedal, or valve released), the return springs force the pressure plate to its original or released position. These springs are compressed when the brake is engaged. See Figure H-1.

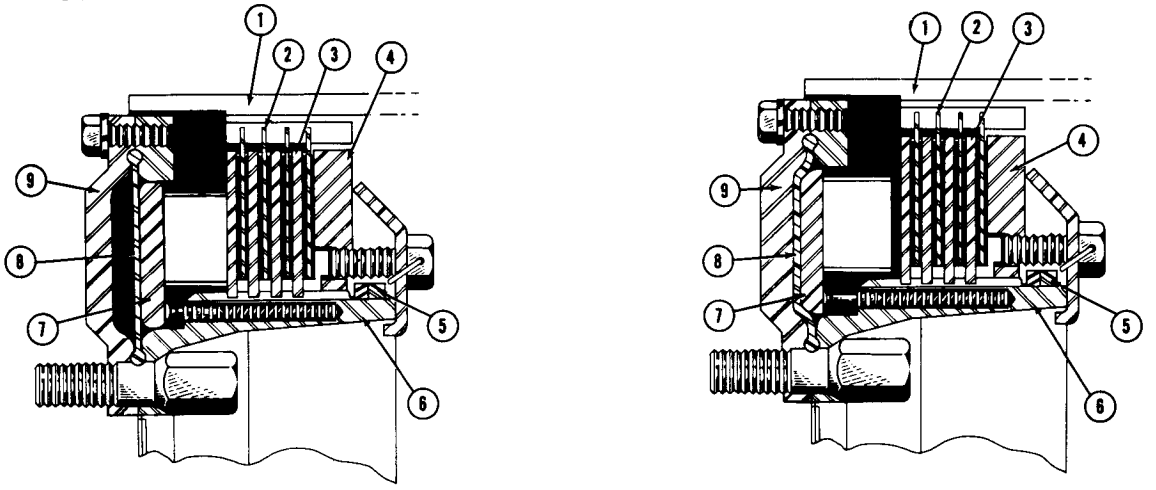


FIGURE H-1. WHEEL BRAKE OPERATION

1. Brake Drum
2. Revolving Discs
3. Stationary Discs
4. Backing Plate
5. Snap Ring
6. Brake Hub
7. Pressure Plate
8. Diaphragm
9. Diaphragm Backing Plate

Removal

Block up Tournapull or trail unit so that the wheel and tire to be removed will roll free.

Place a sling around the wheel and tire. Remove the capscrews securing the wheel to the hub, or to the axle.

Remove tire and wheel from machine.

As a safety precaution, bleed the air system before disconnecting the air line to the brake to be removed.

Disassembly

The following instructions apply to disassembling the brake assembly after it has been removed from the machine.

The brake can be disassembled while still on the machine as described. However, the same capscrews which secure the brake assembly to the main case fasten the brake hub to the plate, with the exception of the four short capscrews. These four, the middle capscrews in the groups of three, do not extend through to the brake plate on the main case. If tapered capscrews are all removed, the drum will be separated from the plate and the plate from the main case all in one operation.

To remove the brake as a unit remove all the capscrews except the four short ones. It is then necessary to remove only these four to separate the hub from the plate.

Be sure no air pressure is applied to the brake.

Cut the lockwires and remove the capscrews securing the snap ring guards around the circumference of the brake (Figure H-2).

Pry out snap ring, using bar or other suitable

tool.

Remove the backing plate, lined and unlined discs from the hub (Figure H-3).

Remove the four capscrews securing the hub to the diaphragm backing plate. Note the position of the brake release springs and guides as the hub and plate are separated (Figure H-4).

Remove springs and guide pins from hub.

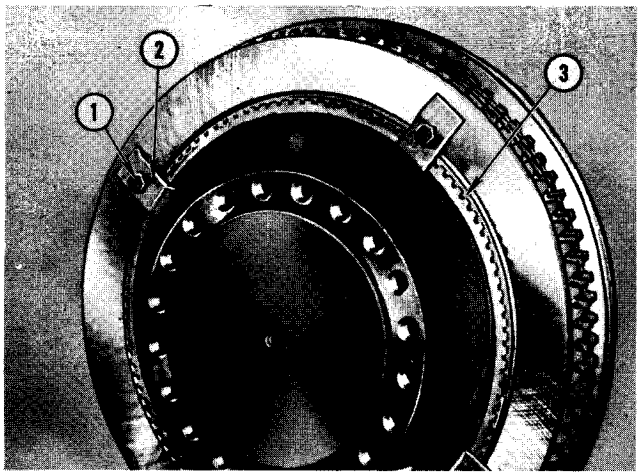


FIGURE H-2. SNAP RINGS AND GUARDS

1. Capscrews 2. Snap Ring Guards 3. Snap Rings

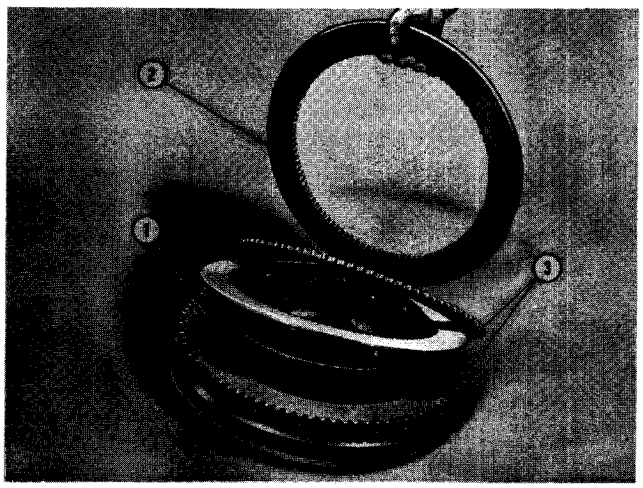


FIGURE H-3. REMOVING BACKING PLATE AND DISCS

1. Hub 2. Backing Plate 3. Discs

Remove pressure plate (Figure H-5).

Mark position of dust guard in relation to the backing plate.

Remove the capscrews and lockwashers securing the diaphragm retainer ring, dust guard and backing plate together (Figure H-6).

Separate the three units. Remove diaphragm from backing plate.

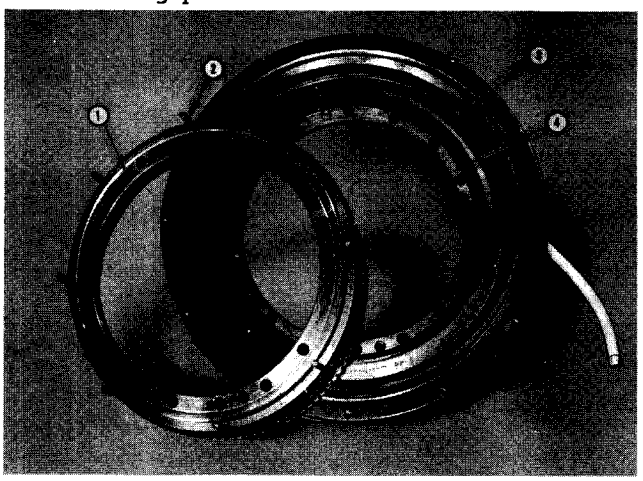


FIGURE H-4. BRAKE HUB, REMOVED

1. Brake Hub 3. Pressure Plate
2. Springs and Guides 4. Backing Plate

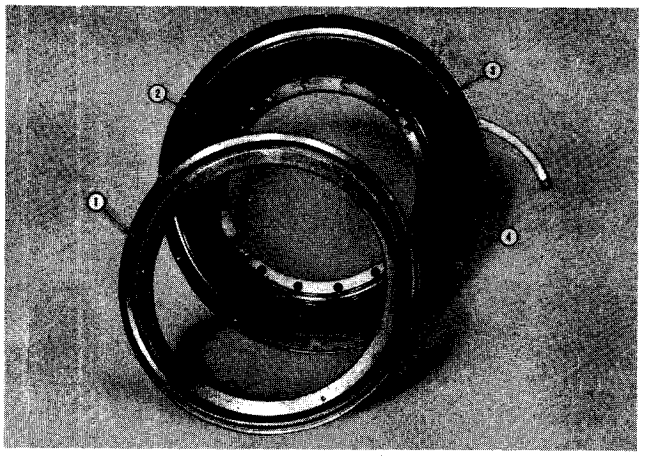


FIGURE H-5. PRESSURE PLATE, REMOVED

1. Pressure Plate 3. Retainer Ring
2. Diaphragm 4. Backing Plate

Reassembly

Clean all parts thoroughly. Inspect carefully for damage or wear.

Check diaphragm carefully. A leaking diaphragm causes slippage and excessive wear, and must be replaced with a new unit.

Keep the brake hub splines clean. Any obstruction in the splines is apt to cause uneven movement and sluggish brake action.

Correct any defect in the air lines which may retard the flow of air to the brake such as compressed, broken or clogged lines.

In extremely cold weather, any moisture present in the air lines may freeze and impede the flow of air. Add alcohol to the air system to absorb the moisture and help eliminate this condition (1 pint each day to the air supply tank).

NOTE: Whenever a brake is disassembled and is found to have small type release spring guides, discard them and replace with heavier ones. The heavier ones can be made from #12d common nails, including the head. Cut the nail to 2 3/8" (+0") (−1/8") overall length, and remove burrs from cut

ends.

Lubricate the diaphragm with a thin coating of good grade cup grease (black rubber diaphragms only).

If the brake is equipped with a silicone rubber diaphragm caution must be used to keep it clean and free of oil and grease when handling, storing, or installing. This diaphragm may be identified by its gray color.

Place diaphragm on backing plate and replace retainer. Be sure that diaphragm is seated properly so that it will not be pinched.

Replace the capscrews fastening the dust guard and retainer ring to the backing plate. Torque to 30 ft. lbs.

Check condition of brake release springs. Replace if necessary (see above).

Install brake release springs and guide pins in holes around the circumference of brake hub. Put pressure plate over hub with flat side against diaphragm. Place brake hub on brake plate with holes in hub to the top of the brake assembly, and replace the four short capscrews that hold the hub to the plate (middle capscrews in the groups of three), torque to 190 ft. lbs.

Replace brake discs, starting with a steel disc next to the pressure plate; alternate steel and lined discs.

Replace backing plate. Install snap ring in groove in hub.

Replace snap ring guards and secure with capscrews. Install lockwires.

Install brake unit on machine and secure with capscrews (torque to 190 ft. lbs.). The brake must be mounted so that the air inlet fitting the brake backing plate is in such a position that it can be connected to the air line from the quick release valve. (Holes in brake hub must be on top.)

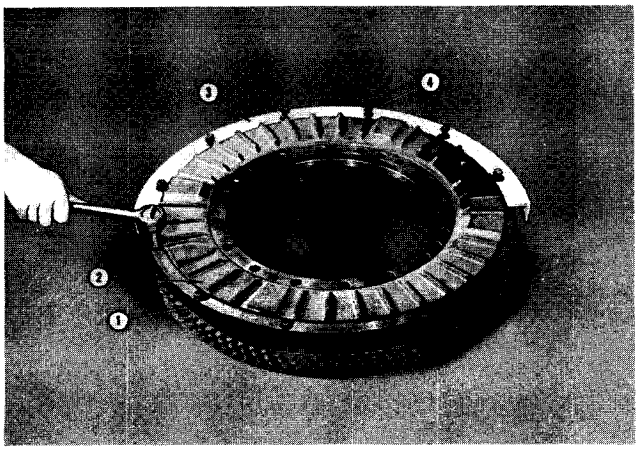


FIGURE H-6. REMOVING BACKING PLATE

1. Retainer Ring
2. Backing Plate
3. Dust Seal
4. Capscrew

Reconnect air line to brake actuating plate. Apply air pressure and check for air leaks.

Replace tire and wheel.

NOTE: If replacement steel discs are installed in the brake, the variation in thickness of discs may result in a tight brake. Should this occur and the counterbore of the backing plate faces the disc, reverse the position of the backing plate so that the counterbore faces the ring guards and snap rings. Clearance between brake discs should be from 3/16" to 1/4".

PARKING BRAKE

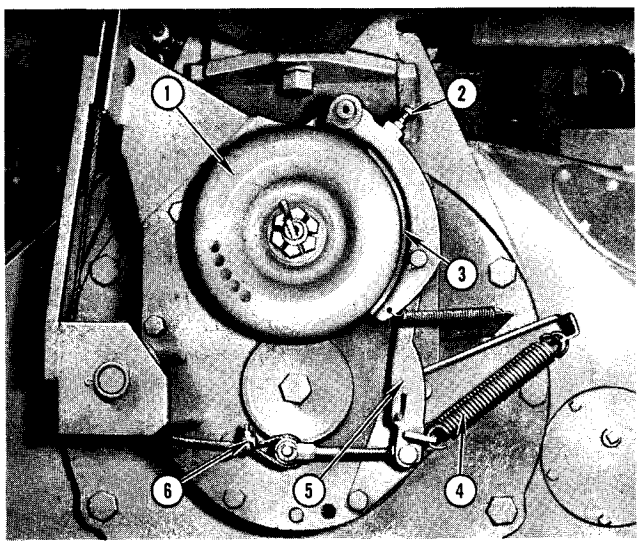


FIGURE H-7. PARKING BRAKE ASSEMBLY

1. Brake Drum
2. Adjusting Screw
3. Brake Shoe
4. Release Springs
5. Lever
6. Adjusting Linkage

The parking brake is a wire rope operated band type brake. A brake drum is keyed to, and revolves with, the drive shaft at the rear of the auxiliary transmission or the transfer case.

Two fiber lined brake shoes are connected so that one is against the inside surface of the drum and one is against the outside surface.

Pulling back on the parking brake lever exerts a pull on the wire rope linking the lever to the brake actuating arm. This pull brings the brake shoes into contact with the revolving brake drum (against spring pressure).

Pushing the parking brake lever forward releases the pull on the wire rope, and brake release springs pull the brake shoes away from the brake drum.

For the most efficient operation of the parking brake, leave the transmission in gear (except when engine is running), this provides a direct connection through the transmission and engine.

Removal and Disassembly

Place the parking brake lever in the released position to relieve tension on actuating wire rope and release springs.

Remove the wire rope clamp securing the wire rope to the adjusting yoke.

Remove the three brake release springs.

Remove cotter, castellated nut and flat washer from end of drive shaft (Fig. H-8). Pull brake drum and key from shaft (Fig. H-9).

To remove the brake assembly as a unit, remove the nut and lockwasher from the brake shoe pivot stud and remove brake shoes and stud from auxiliary transmission.

The following instructions apply to disassembling the brake after it has been removed from the machine, however, the same instructions will apply for disassembly while still mounted. See Fig. H-10.

Remove snap ring and washer from pivot stud and pull brake shoes from stud.

Remove lockwires from ends of actuating arm studs and remove brake shoes.

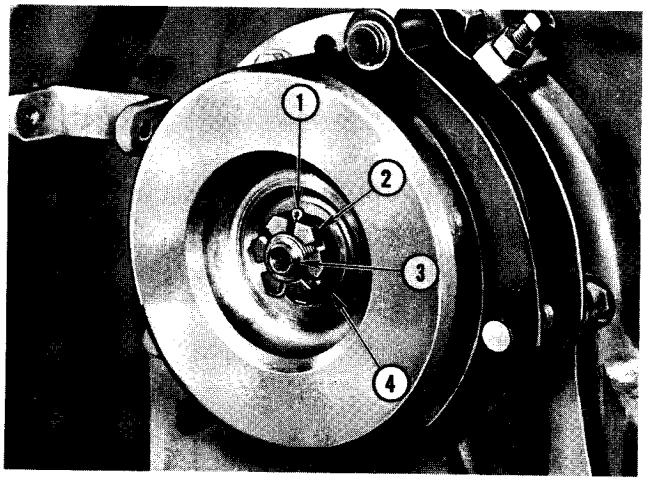


FIGURE H-8. BRAKE DRUM AND OUTER SHOE
1. Cotter 2. Nut 3. Drive Shaft 4. Flat Washer

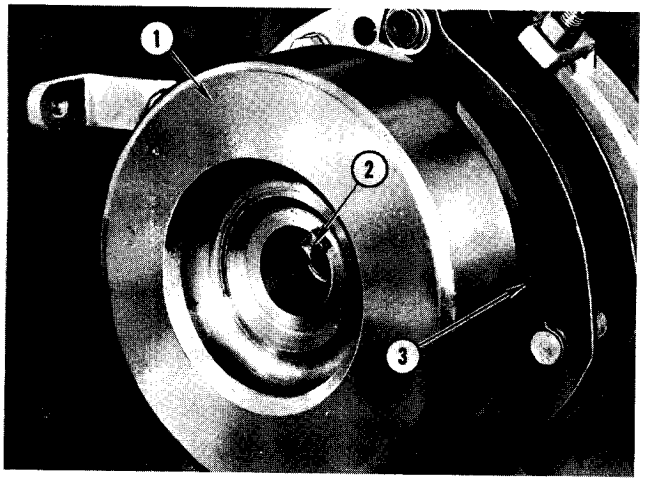


FIGURE H-9. REMOVING BRAKE AND KEY
1. Brake Drum 2. Key 3. Brake Shoe

Reassembly

Inspect for broken, cracked or otherwise damaged parts. Check brake drum for cracks or warpage. Replace if necessary.

Inspect brake linings and actuating wire rope.

Replace brake shoes onto actuating arm studs and secure with lockwires. Replace pivot stud into holes in outer brake shoe. Secure with flat washer and snap ring.

Mount unit on auxiliary transmission and replace lockwasher and nut on pivot stud.

Place brake drum over drive shaft with lip of drum between inner and outer brake shoes.

Align keyway in brake drum with keyway in the shaft and install key.

Secure brake drum to drive shaft with flat washer, castellated nut and cotter.

Fasten control wire rope to adjusting yoke with wire rope clamps.

Replace brake release springs.

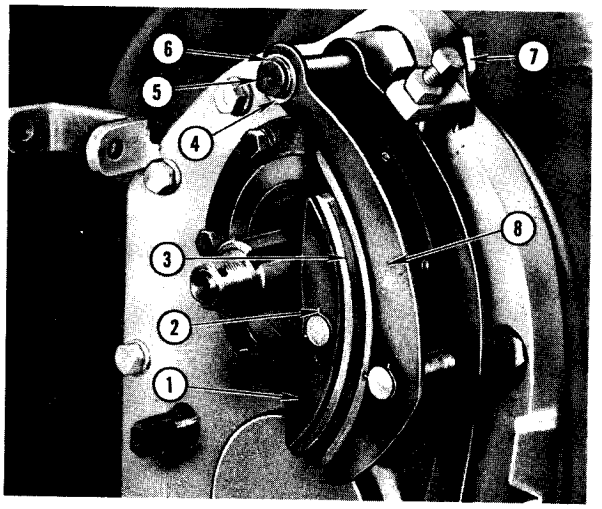


FIGURE H-10. BRAKE SHOES
1. Inner Brake Shoe
2. Lockwire
3. Lining
4. Washer
5. Lock Ring
6. Pivot Stud
7. Nut
8. Outer Brake Shoe

Adjustment

Place parking brake lever into the released position and shift the transmission into neutral. Put wrench over the large slotted nut on the drive shaft to turn the brake drum.

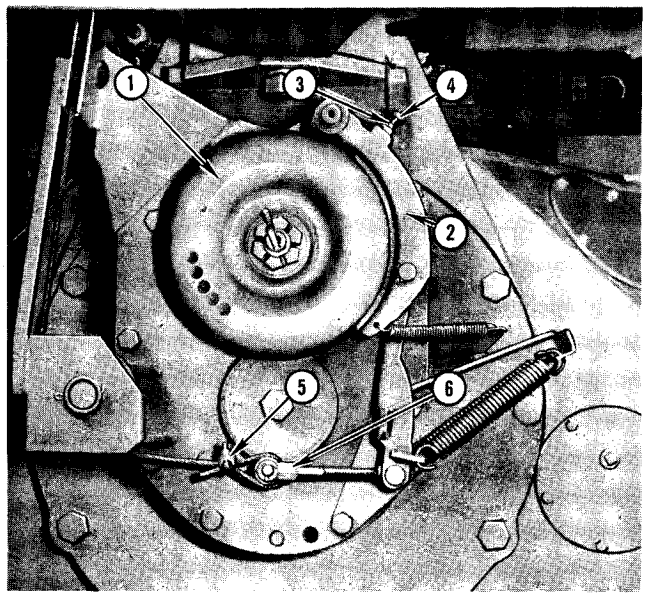


FIGURE H-11. PARKING BRAKE ADJUSTMENT

1. Brake Drum
2. Brake Shoe
3. Locknut
4. Adjusting Screw
5. Rope Clamp
6. Yoke

Loosen the locknut on the brake band adjusting screw. Turn the adjusting screw in a clockwise direction, while rotating the brake drum, until the brake linings begin to rub on the drum. Then turn the adjusting screw counter-clockwise until the brake linings cease to rub. Tighten locknut on adjusting screw.

After the brake shoes have been properly adjusted move brake lever to the applied position and check the tension in the brake wire rope. If brake is not fully applied, shorten or lengthen the wire rope (whichever is necessary) by using the two nuts on the threaded end of the adjusting yoke. If enough adjustment cannot be made this way, shorten the wire rope by moving wire rope clamp.

Finally check brake with lever in the released position to make certain brake is fully releasing and is not dragging on the drum. Improper release may be caused by weak release springs. If this condition exists, replace the springs.

TIRES

The tires should be checked at least once each week (before operation) with an accurate tire pressure gauge.

Tire pressures may be varied due to operating conditions. Consult the tire manufacturer's representative for recommendations.

Recommended normal air pressure (when tires are cold) for the various tires is as follows:

27.00-33 24 Ply Rating . . . . . 40 p.s.i.
27.00-33 30 Ply Rating . . . . . 50 p.s.i.

While a weekly inflation check with a gauge is recommended, the operator must watch the tires constantly as punctures or slow leaks may develop at any time.

Do not depend on the valve cores being air tight; always keep valve caps securely applied to the valve stems. Caps also protect the valve from damage and deterioration.

Do not bleed air from tires which are hot due to operating. Under such circumstances it is normal for the pressure in the tube to increase due to expansion.

A bent or damaged rim which does not support the bead properly may cause abnormal strain on the tire and result in failure.

Should a tire become cut exposing the cords of the body plys of fabric, it should be removed and repaired. Neglected cuts cause many tire failures. Water, sand, grit, and dirt and other foreign materials work their way into a tire through a cut, eventually causing tread or ply separation and tire failure.

A tire may be retreaded if removed in time.

Tires and tubes should be stored indoors if possible. If not practical to store inside, be certain to cover them with tarpaulin to keep out dirt, water and other foreign materials. Storage should be in a dark, cool, dry and free-from-draft location. Avoid contact with petroleum products such as oil, grease, fuel oil, etc.

Before storing used tires, clean thoroughly, inspect for damage, and repair where necessary. When a rubber tired vehicle is placed in storage, it should be blocked up to take its weight from the tires, and the tires deflated.

If the vehicle cannot be blocked up, check the air and tires twice a month and keep properly inflated.

Always store or transport tires standing up. Be careful not to damage beads with hooks, ropes or chains. If necessary to raise tire by bead, always pad bead with burlap or canvas. Do not lift rims by the valve holes.

Use a lead or babbitt hammer, never a sledge.

Changing

Securely block all wheels other than the one on which the tire change is to be made. Jack up the wheel sufficiently for the tire to clear the ground. As a safety precaution block up under the

axle to prevent falling if the jack should slip.

Attach sling hoist around tire, remove wheel mounting capscrews, and remove wheel and tire from machine.

Remove valve core and exhaust air pressure before starting to dismount tire. Always replace valve cap to protect the soft metal threads during tire removal.

The use of a hydraulic bead breaker is a "must". Use according to the manufacturer's recommendations.

TUBELESS TYPE

Break outer bead loose from bead seat.

Insert flat end of tire tool into lock ring breaking notch and pry out lock ring (Fig. H-12).

Remove "O" ring from rim base, being careful not to damage it. Then remove bead seat band and outer ring (Fig. H-13).

Turn tire over and with hydraulic bead breaker loosen bead from wheel. Lift wheel rim out of tire.

To mount the tire, first clean dirt and rust from all wheel parts, being particularly careful to clean "O" ring groove and bead seats. It is advisable to paint used rims with a good anti-rust paint. Insert the proper valve and tighten securely. 50 to 55 inch pounds torque is recommended. With inner ring in place raise at least 4" off the floor with blocks so that weight of tire will help to seat the inner bead.

Coat beads lightly with tire mounting compound or soap flake solution. Raise tire with rope or chain sling and lower into position.

Put top flange in place. Position bead seat band on rim base being careful to line up slug in base with lug slot in bead seat band (Fig. H-14).

Install lock ring and tap into place with babbitt or lead hammer. Lock ring lug **must** fit into gutter slot. Tap bead seat band down so that "O" ring groove is visible.

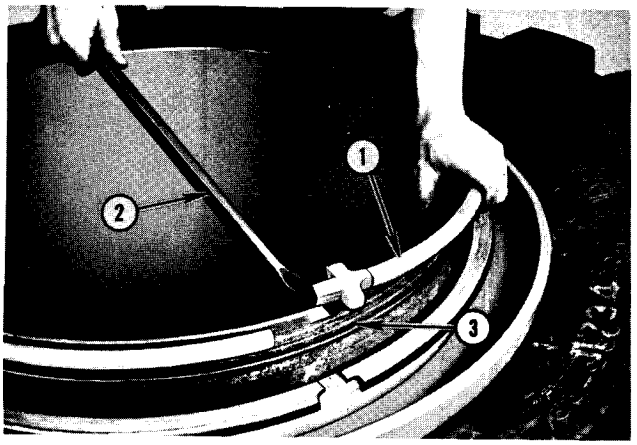


FIGURE H-12. REMOVING LOCK RING
1. Lock Ring 2. Tire Tool 3. "O" Ring

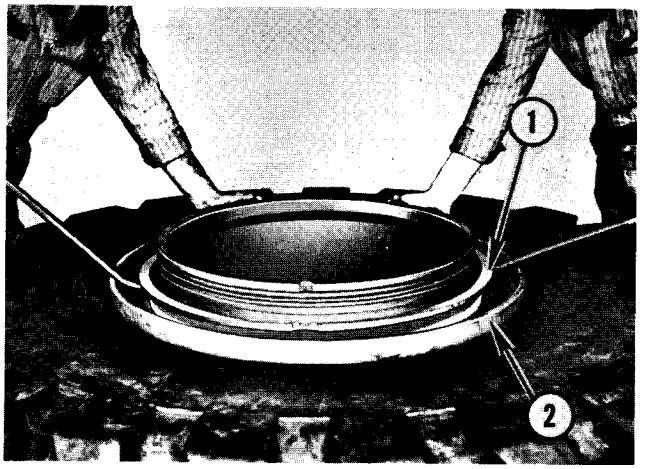


FIGURE H-13. REMOVING BEAD SEAT BAND
1. Bead Seat Band 2. Flange

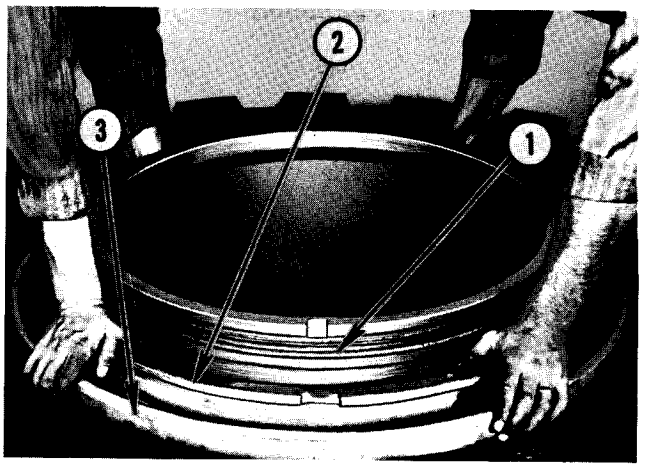


FIGURE H-14. REPLACING BEAD SEAT BAND
1. "O" Ring Groove 2. Bead Seat Band 3. Flange

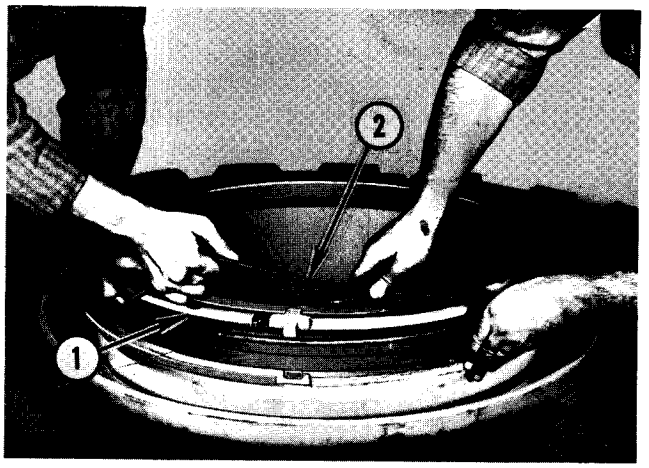


FIGURE H-15. REPLACING "O" RING
1. Lock Ring 2. "O" Ring

Insert "O" ring in groove and lubricate with tire mounting compound or soap flake solution (Fig. H-15).

Remove valve core so that the most rapid initial air flow can be obtained. Stand to one side of

wheel and tire when inflating. If upper bead and "O" ring do not seal within one minute, raise the tire by the tread. This tends to push upper bead into position. Stand to one side when inflating tire.

As soon as sealing is effected, reinstall the valve core and inflate to 75 pounds per square inch pressure to seat bands. Reduce air pressure to correct recommended amount.

Replace wheel and tire on machine. Tighten wheel mounting capscrews to 870 ft. lbs.

TUBE TYPE

Special tools are available to aid in changing the wide base tire. See Fig. H-16.

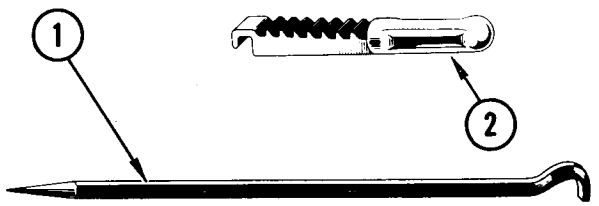


FIGURE H-16. SPECIAL TIRE TOOLS
1. Bar Tool 2. Ratchet Tool

Securely block all wheels other than the one on which the tire change is to be made. Jack up the wheel sufficiently for the tire to clear the ground. As a safety precaution block up under the axle to prevent machine falling if jack should slip.

Remove the valve core and exhaust all the air pressure before starting to dismount the tire. Always replace valve cap after the rim is disassembled to protect the soft metal threads during tire removal.

Place the flat hooked end of a bar tool into one of the four breaking slots between the bead seat band and the rim flange. With a 5' length of pipe slipped over the straight end of the tool for leverage, twist the tool in a circular direction. A second operator now inserts another bar tool between the bead seat band and the side flange, and with the same twisting action holds the amount of space gained with first tool. Move the first tool forward around the circumference of the bead seat band until the outer tire bead is loose.

Start the bead seat band in away from the lock ring by placing a bar tool in the gutter section between the ends of lock ring and prying radially with the tool. Using two tools as described above, work completely around the tire.

Pry out lock ring starting at prying notch and working around the tire using two irons to pry and hold.

After lock ring has been removed, pry the bead seat band out over the gutter section and remove it, together with the side flange, from the rim base.

Four similar breaking slots are provided on the inside of the tapered bead rims, and inside bead may be broken loose from the rim base in the same manner. Another method is to place a small jack between the side flange and some part of the vehicle. By extending the jack, pressure is exerted to force the tire bead off the rim taper. Work progressively around the tire to loosen the bead at all points on the circumference.

Before working the tire off the rim make certain that the valve is pried out sufficiently to clear the gutter section.

Before replacing tube in tire, inspect the tire carefully, inside and out, for breaks, bruises, nails, etc. Clean out all dirt and foreign material inside the casing.

Replace the tube in casing, starting at the bottom and working around the tire. Adding air as the tube is worked in will help to hold it in place and eliminate the possibility of wrinkles.

Insert flap in casing. Make sure it is properly centered and free from wrinkles. Rotate the tire as the flap is worked in so that the portion being inserted is at the bottom of the tire. In some cases, it may be necessary to spread the beads, using spreader or car jack.

Clean wheel of rust and dirt by scraping and by the use of a wire brush. Pay special attention to the cleaning of all foreign matter out of the lock ring gutter. Apply coating of rust preventive to bead seats (zinc chromate and red lead are excellent). The prevention of rust building up inside and under the tire bead means the difference in the use of the simple hand tools or force enough to require power tools.

Place rear flange on rim base and line up the driving lug with slots in rim.

Hoist or roll tire into position, making certain that the valve stem lines up with the valve slot before sliding tire onto wheel. If hoist is not used, lower wheel far enough to permit top of tire to be hooked over top of rim, then raise the wheel and "walk" the tire on in the same manner as described for removing the tire.

Hook two of the ratchet tools into the rim gutter approximately four inches from either side of the valve slot. Place the bead seat band in the outside flange, lining up the driving lug on the flange with the slot in the bead seat band. Mount the bead seat band and side flange on the rim base by hooking them over the two ratchet tools and sliding on the rim. Be sure the driving lug on the bead seat is lined up with the valve slot in

the rim base.

Engage two of the bar tools in the proper notches of the ratchet tools and force the bead seat band into position by prying. Holding pressure against the band with one bar tool, slide the other ratchet tool and bar tool around the circumference of the rim, stopping approximately every foot to pry the bead seat band in. Follow up with second ratchet tool and bar tool to hold pressure against the band and retain clearance gained.

After going around the rim once in this manner, it should be possible to hook one of the bar tools into the gutter for additional prying. Continue to work around the rim, using the two bar tools without the ratchet tools, until the bead seat band has been forced 3/4" to 7/8" inside the gutter edge.

Hold the band in this position and drive the tapered end of a bar tool, or any suitable tapered wedge, between the band and the rim base, directly under the bead in the bead seat band.

Hook one end of the lock ring into the gutter next to the wedge. Retain pressure with one of the bar tools against the bead seat band, and at the same time pry or snap the lock ring into place with the flattened end of another bar tool. When lock ring is in place remove wedging tool from between ends of lock ring.

Pry the bead seat band out over the ledge of the lock ring, making certain that no binding occurs when this is done. NEVER START TO INFLATE A TAPERED BEAD TIRE UNLESS THE BEAD SEAT HAS BEEN PRIED OUT OVER THE LOCK RING. Stand to one side when inflating tire.

Check to be sure that driving lugs on both flanges are engaged, then inflate to approximately 75 pounds pressure to insure proper seating of the beads. Completely exhaust air from tire. Inflate tire to recommended air pressure.

Replace wheel and tire on machine (if removed) and torque wheel mounting capscrews to 870 ft. lbs.

STEERING ASSEMBLY

INDEX

STEERING ASSEMBLY

OPERATION

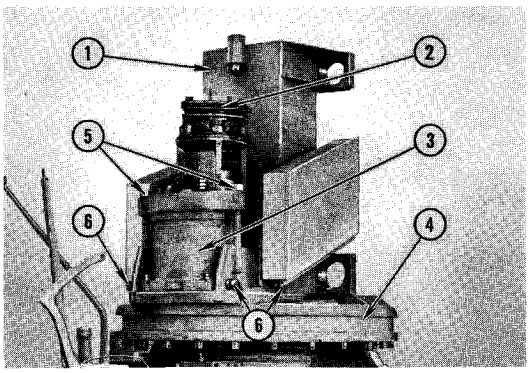


FIGURE I-1. STEERING TRUNNION ASSEMBLY

1. Kingpin Housing
2. Steering Motor
3. Gear Box
4. Ring Gear
5. Hold Down Bolts
6. Setscrews

The basic parts of the steering assembly are: the steering wheel, switch box, kingpin bushing, steering motor with gear reduction box, ring gear and kingpin.

The steering wheel, simple linkage and electrical switches are combined to provide a positive power electrical steering system. A mechanical method for opening the main switches in the power circuit to the steering motor eliminates the possibility of switch lock-in and over steer in either direction.

The kingpin housing is bolted solidly to the trail unit yoke structure by bolts and bolt bar plugs, and the steering motor and gear box unit is secured to the bottom plate of the kingpin housing. The kingpin housing rotates around the kingpin on large roller bearings.

The kingpin is secured to the prime mover by a mounting arrangement which permits the top of the kingpin to move from side to side in short arcs. The ring gear is bolted to the kingpin flange. The teeth on the pinion gear, extending from the bottom of the steering motor gear box, are in mesh with the teeth on the ring gear.

When the electric motor is operated the pinion gear rotates, moving the ring gear to the right or left, depending upon the direction of motor rotation. Ring gear, kingpin and prime mover turn together as a unit since they are all interconnected.

The steering wheel automatically returns to the neutral position when released, opening the control circuit to the steering motor. The prime mover is locked at whatever angle it makes with the trail unit at that instant. The locking effect comes about through the steering motor brake, which stops the rotation of the motor rotor and gear box pinion as soon as the motor circuit is broken. To return to a straight ahead position it is necessary to turn the steering wheel in the opposite direction.

With the steering motor brake applied, any free play or slack is eliminated by the precision fit of the entire chain of gears from the steering motor to the steering ring gear. A cam mounted on the top of the kingpin and two limit switches control the degree of limit of turn in either direction. These switches can be set for turns of any angle up to approximately 90 degrees, right or left from the straight ahead position. The steering wheel is connected to a shaft which operates the linkage that opens and closes the control switches, which in turn actuate the steering motor main switches.

STEERING TRUNNION

Removal

Crib up nose of Tournapull and block wheels to prevent movement.

Remove steering motor cover.

Disconnect all conductor cables to the main switch boxes mounted on the kingpin housing and to the steering motor. Remove cable clamp and remove cable from cable hanger.

Bleed the air system and disconnect all wires and tubing which lead back to the trail unit.

Position blocks to hold the trunnion assembly firmly in an upright position.

Attach sling hoist to trail unit yoke. Take up slack until the tension is relieved on the connecting bolts.

Cut the lockwires and remove the bolts from the upper and lower yoke bolt bar plugs.

Separate Tournapull and trail unit.

Attach hoist to steering trunnion. Cut lockwires and remove capscrews securing the front and rear trunnion caps to the trunnion sockets. Remove caps. Lift assembly from machine and lower to the floor or stand for further disassembly.

Remove bearing inserts and shims from trunnion sockets and caps (Fig. I-3). Keep shims grouped together as they are removed as they should be replaced when reassembling the steering trunnion.

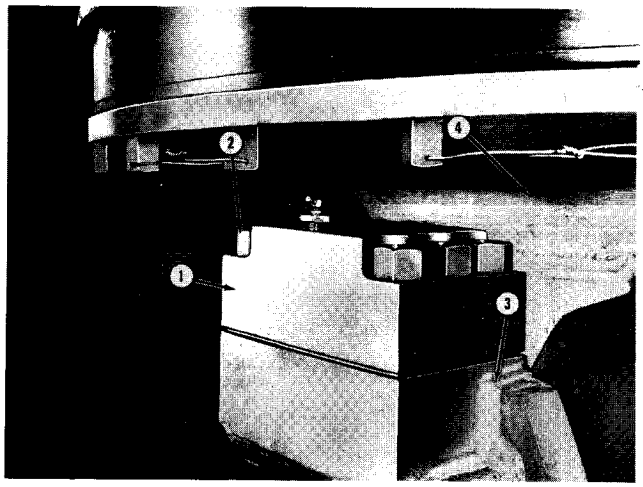


FIGURE I-2. TRUNNION SOCKET JOINT
1. Cap 2. Capscrew 3. Socket 4. Trunnion

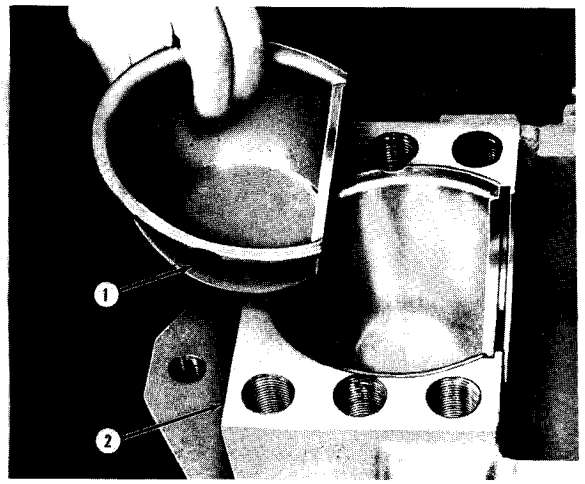


FIGURE I-3. REMOVING INSERT
1. Insert 2. Socket

Disassembly

Remove the four capscrews on top of the kingpin housing and take off the cover plate and gasket. Disconnect wires from the two steering limit switches.

The limit switches can be removed from the housing by removing the capscrews securing the switch support plate to the inside of the housing.

Remove switch support plate and switches. See Fig. I-4.

To separate the motor and gear box from the kingpin housing, first disconnect all wiring to the steering motor.

Remove the nuts securing the hold down bars on the front and rear of the gear reduction box. (See Fig. I-1.)

Loosen the setscrews at the bottom of the gear box.

Remove the four gear box mounting capscrews. Attach sling to motor and gear box assembly and lift straight up to prevent damage to the gear box output pinion.

Care should be taken when lowering motor and gear box to the floor or stand not to damage the gear box output pinion.

Refer to section "J" of this manual for disassembly of the a.c. motor and gear reduction box.

Loosen the cam shaft jam nut and back cam shaft out of the tapped hole in top of the kingpin. (See Fig. I-4.) Remove setscrew from the kingpin upper bearing retainer nut. Remove the retainer nut with the special wrench provided in the tool kit. (Fig. I-6.)

Attach hoist to housing assembly. Lift housing, kingpin upper bearing, oil seal and lower bearing cup from the kingpin. Remove grease seal ring from top of ring gear if replacement of gear or seal ring is necessary (Fig. I-7).

Remove upper bearing cone, cup and oil seal

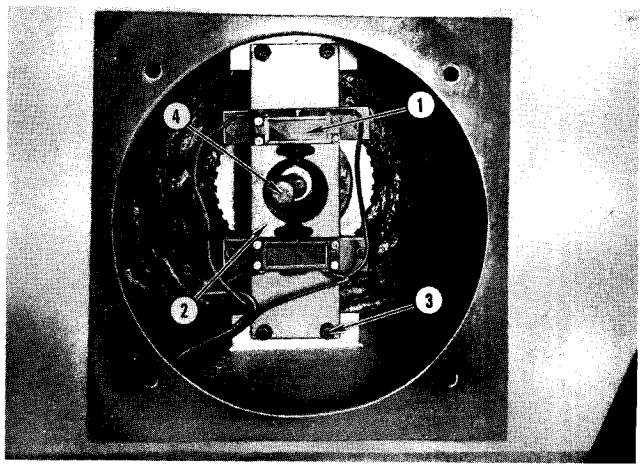


FIGURE I-4. STEERING LIMIT SWITCHES
1. Limit Switch 2. Support Plate 3. Capscrews 4. Cam

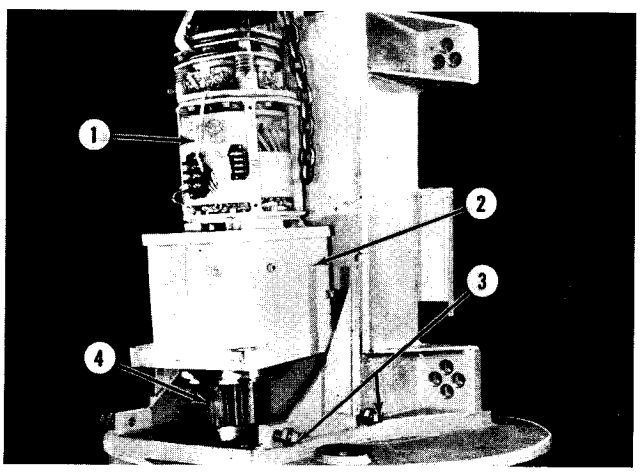


FIGURE I-5. REMOVING MOTOR AND GEAR BOX
1. Motor 2. Gear Box 3. Setscrew 4. Pinion

from housing.

To separate the kingpin and ring gear, cut the lockwires and remove the capscrews securing the ring gear to the king pin base.

Remove lower kingpin bearing cup from the kingpin housing (Fig. I-8).

Remove lower kingpin bearing cone from kingpin by prying up on the spacer beneath bearing cone.

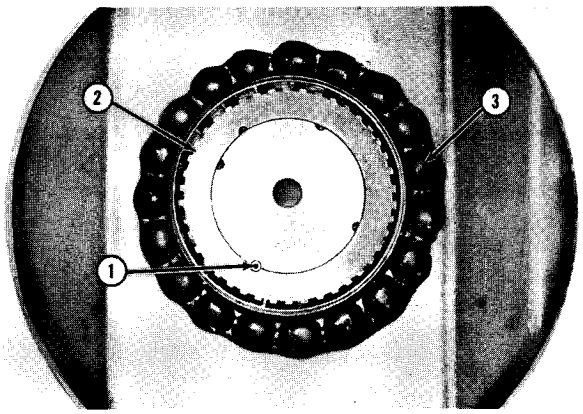


FIGURE I-6. BEARING AND RETAINER NUT
1. Setscrew 2. Retainer 3. Bearing

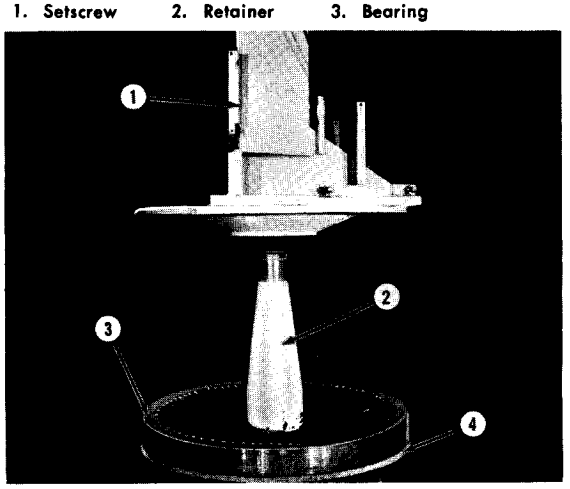


FIGURE I-7. REMOVING HOUSING
1. Housing 2. Kingpin 3. Steering Gear 4. Flange

NOTE: Steering motor and gear box, and kingpin housing may be removed while the steering assembly is still mounted on the machine. Follow the procedure described above with the exception of removing the capscrews from the trunnion ball sockets and caps. See Fig. I-9.

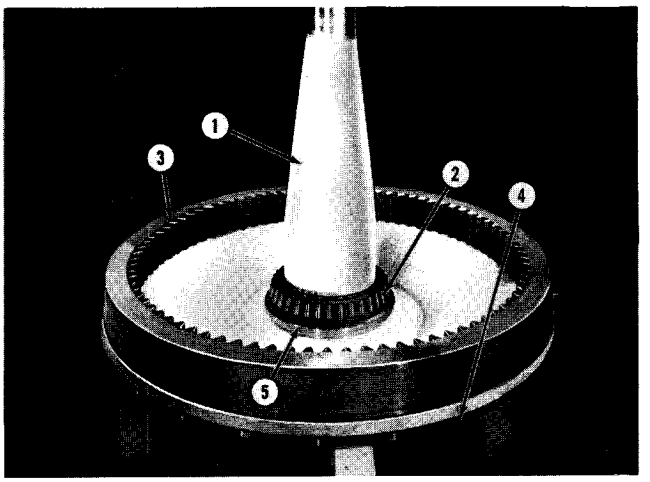


FIGURE I-8. KINGPIN ASSEMBLY
1. Kingpin 3. Steering Gear 5. Spacer
2. Bearing 4. Capscrew

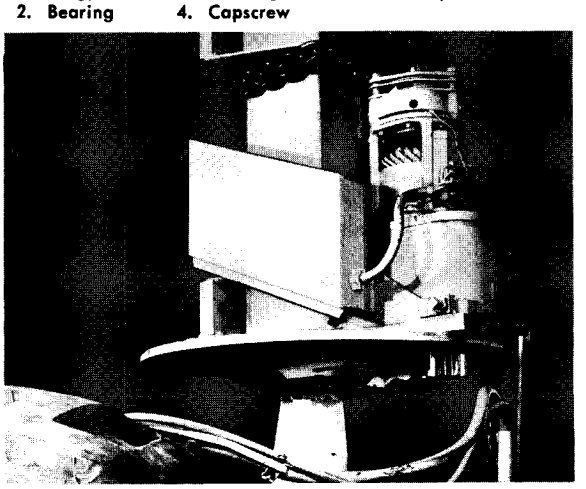


FIGURE I-9. REMOVING MOTOR, GEAR BOX AND HOUSING

Reassembly

Clean and inspect all bearings. Lubricate thoroughly before reassembly. Use medium weight wheel bearing grease.

Check oil seals for dryness, hardness, or excessive wear. Replace if damaged or if condition of seal is such that it will leak.

Carefully inspect the teeth on the ring gear for chips or excessive wear. If this condition is in evidence, remove the ring gear mounting capscrews and rotate the gear until the teeth which have not been used occupy the old position of teeth which have been used. This change can be made when the wear on gear teeth is noticeable. The same method can be used to position any chipped or broken teeth so that they will not interfere with the operation of the unit.

Inspect the electric motor for damage to windings, for dirt, and for mechanical trouble.

Clean all parts thoroughly before reassembly.

Place kingpin upper and lower bearing cups in housing.

Place coat of Permatex on kingpin base. Install ring gear on base. Replace capscrews. Tapered collars fit on flat head capscrews. They are to be installed five on each side of the trunnion shaft, and alternated with the tapered head capscrews.

Torque tapered head capscrews to 540 ft. lbs. and the flat head capscrews to 360 ft. lbs. Install lockwires.

To install seal ring, clean rim of ring gear with naptha and apply a coat of "rubber to metal" cement to the ring gear and the seal ring. Let dry until tacky. Press the seal ring onto the ring gear and let dry over night, under pressure.

Replace spacer and lower bearing cone over kingpin.

Grease gear rim before assembling housing onto it to lubricate rubber seal ring.

Place housing in position over kingpin.

Place oil seal and upper bearing cone in top of the housing. Lip of seal should be toward top of housing.

Replace bearing retainer nut and adjust. Install locking setscrew.

Place the cam shaft in the threaded hole in top of kingpin and tighten jam nut. Replace the switch support plate, set limit switches in position and fasten to kingpin housing with capscrews and lockwashers. (Position of limit switches can be adjusted after machine is in operating condition and degree of turn can be checked.) See below for limit switch adjustment.

Install motor and gear box on housing. Secure with mounting capscrews, setscrews and hold down bars.

Connect all wiring to the limit switches. Replace gasket and cover plate on top of kingpin housing and secure with capscrews.

Install sponge neoprene oil seals into slots in trunnion sockets and caps. Replace insert bushings in trunnion sockets and caps. The bushings must fit without any rocking motion. (Fig. I-10.)

Hoist trunnion assembly onto machine and fit

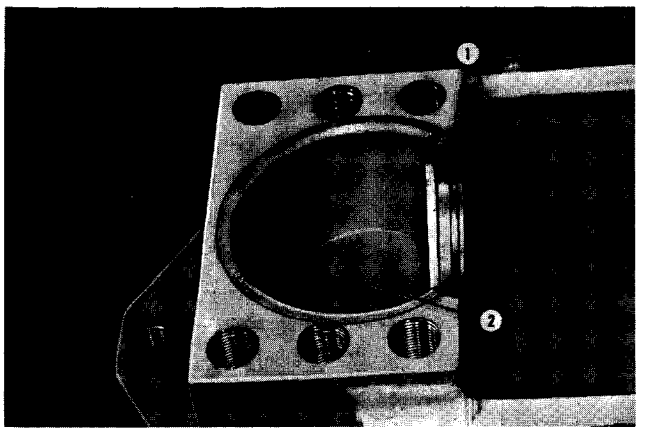


FIGURE I-10. SOCKET AND BUSHING
1. Oil Seal Slot 2. Bushing

caps over balls and sockets. Tighten the corner capscrews uniformly with 50 ft. lbs. torque and equalize the gap between socket and cap.

Measure this gap with feeler gauge and note. Do this on both front and rear caps and sockets. Add 0.010" to the gap reading between the front socket and cap. This is the correct amount of shims for the front socket and cap. Repeat this procedure for the rear socket and cap.

Remove capscrews, cap and top bushings. Raise trunnion assembly and coat balls with #250 E.P. gear oil.

Lower trunnion assembly, install correct shims (as determined above) replace top bushings in caps and install caps.

Replace capscrews and torque to 580 ft. lbs. Install lockwires.

To check this adjustment, tilt the steering assembly to one side, place dial indicator near ball, raise steering assembly with jack, indicator reading should be from 0.005" to 0.010" on each ball.

Adjustment

Remove the cover plate and gasket from the top of the kingpin housing.

Loosen the capscrews clamping the limit switches to the switch support plate. See Fig. I-11.

Operate steering motor until nose of machine is at an approximate angle of 90 degrees (right or left) with the rear unit. If the nose of the machine was moved to the left, move the left limit switch until the switch button is against the cam. Switch must make a definite "clicking" sound, but not bottom completely.

Tighten clamping screws. Repeat the procedure, with the nose of the Tournapull in the opposite direction, for the other limit switch.

Replace cover plate and gasket, secure with capscrews and lockwashers.

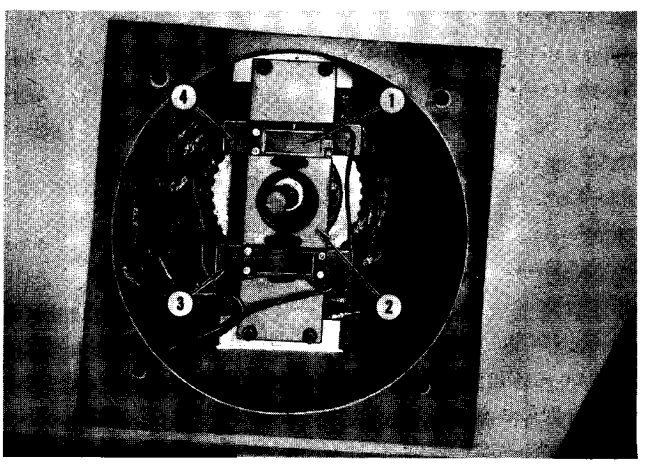


FIGURE I-11. ADJUSTING LIMIT SWITCHES
1. Limit Switch 2. Support Plate 3. Clamp Plate 4. Capscrews

STEERING WHEEL AND SWITCH BOX

Removal and Disassembly

STEERING WHEEL

Remove nut and washer securing steering wheel to upper steering shaft. Pull steering wheel and hub from shaft. Remove key from steering wheel shaft.

Remove capscrews and lockwashers fastening bearing retainer to steering column.

Pull bearing and retainer.

Pull steering shaft from universal coupling and steering column. Do not lose key from inside universal.

Remove cotter and pin from the clevis on linkage from steering shaft to switch box at the switch box. (Fig. I-12.)

Remove cotter and castellated nut from end of lower steering shaft.

Remove linkage lever and spacer from lower steering shaft. Pry key from keyway in shaft.

Remove capscrews and lockwashers securing the bearing retainer and shims to the mounting frame.

Pull bearing retainer and shims from mount.

Pull shaft from mounting frame and universal. Do not lose key.

Mounting frame may be removed by removing the capscrews fastening it to the cockpit firewall.

SWITCH BOX

Remove cover from steering switch box. Disconnect electric cables to the switches (mark to facilitate reassembly), loosen cable clamps on bottom of box and remove cables.

Remove capscrews, lockwashers and nuts fastening switch box to cockpit. Lift off switch box and place on bench for further disassembly.

Disconnect control leads to the small control

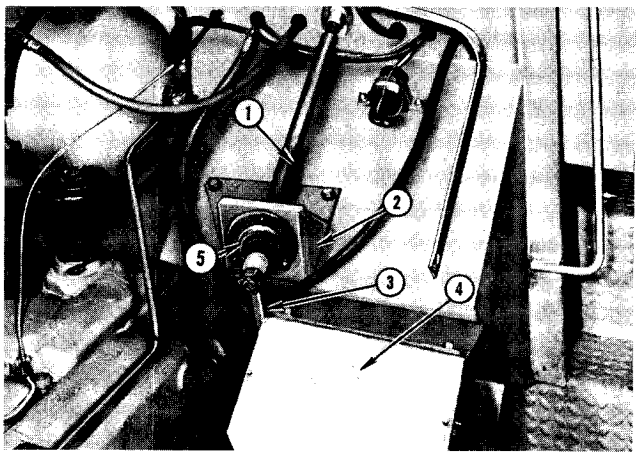


FIGURE I-12. STEERING LINKAGE

1. Steering Shaft
2. Mounting Frame
3. Linkage
4. Switch Box
5. Bearing

switches. Remove the capscrews, flat washers, and lockwashers fastening each control switch mounting bracket and insulator to the switch box. Remove switches, mounting plate and insulator.

Disconnect jumper wires between the two main contactor switches. Disconnect leads to the contactor switch holding coils.

Remove the four capscrews securing the contactor switch to the mounting blocks in the switch box. Remove the switch. Repeat this operation for the other contactor switch (Fig. I-15). Refer to section "J" for disassembly of main contactor switches.

Remove nut and lockwasher from pivot pin on switch box. Push pin from hole in cover to relieve spring tension on cam.

Drive roll pin from cam and pivot shaft. Remove cam from shaft. Remove bearing retainer

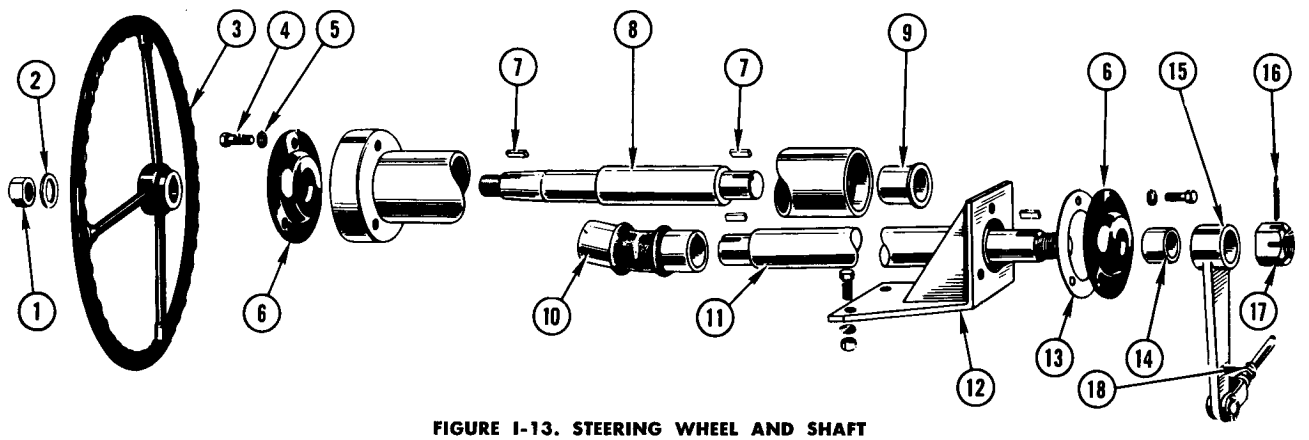


FIGURE I-13. STEERING WHEEL AND SHAFT

1. Nut
2. Washer
3. Wheel
4. Capscrew
5. Lockwasher
6. Bearing
7. Key
8. Upper Shaft
9. Bushing
10. Universal
11. Lower Shaft
12. Mounting Frame
13. Shim
14. Spacer
15. Lever
16. Cotter
17. Nut
18. Linkage

capscrews and remove retainer (two piece) and bearing.

Back large hex nut from pivot shaft. Remove spacer.

From opposite end of pivot shaft remove cotter nut and lever from pivot shaft. Remove capscrews securing the bearing retainer to the switch box.

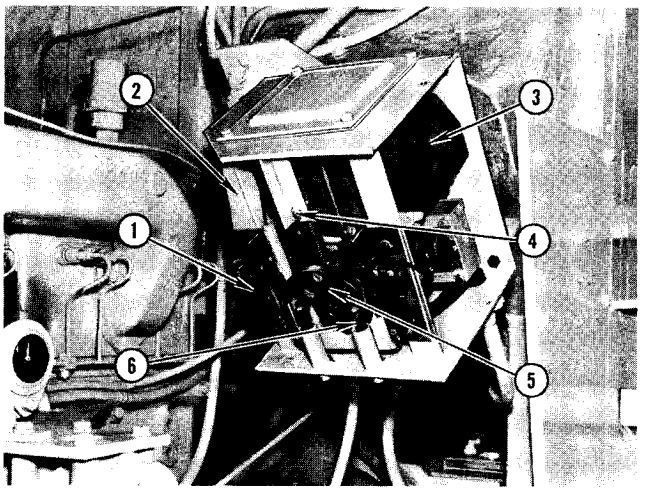


FIGURE I-14. STEERING SWITCH BOX

1. Control Switch
2. Mounting Bracket
3. Main Switch
4. Pivot Pin
5. Cam
6. Spring

Remove outer retainer. Pull bearing from shaft and remove inner retainer and spacer.

Lift pivot shaft and cams from switch box. Remove cams from shaft. Cams are keyed to shoulders on shaft, do not lose keys.

Remove nuts from compression spring bolts. Remove springs and bolts from spring tubes.

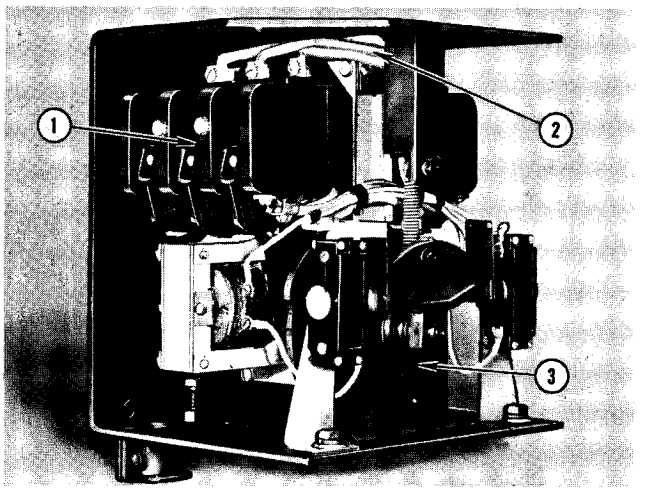


FIGURE I-15. REMOVING MAIN SWITCH

1. Main Switch
2. Leads
3. Bearing Retainer

Reassembly

SWITCH BOX

Replace compression springs and bolts into spring tubes. Secure with nuts and lockwashers. Compress springs sufficiently to allow replacing cam.

Replace keys in keyways in pivot shaft. Slide cams onto shoulders on pivot shaft until slot in cam engages key and cam is against shoulder.

Replace pivot shaft and cams into switch box and threaded end of shaft through the hole in the rear of the box.

Slide spacer over threaded end of shaft and replace inner bearing retainer, bearing and outer retainer. Replace retainer capscrews and lockwashers.

Move to opposite end of pivot shaft and replace spacer and hex nut. Tighten nut.

Replace inner bearing retainer, bearing and outer bearing retainer. Secure to switch box with capscrews and lockwashers.

Position cam on pivot shaft. Align hole in cam with hole in pivot shaft, insert roll pin. (The highest part of the small cam must be pointing the same direction as the highest part of the large cam.)

At opposite end of shaft replace key into keyway on pivot shaft and slide adaptor into place on shaft. Secure with castellated nut and cotter. Replace pivot pin in cover and replace nut and lockwasher. Install spring on pivot pin.

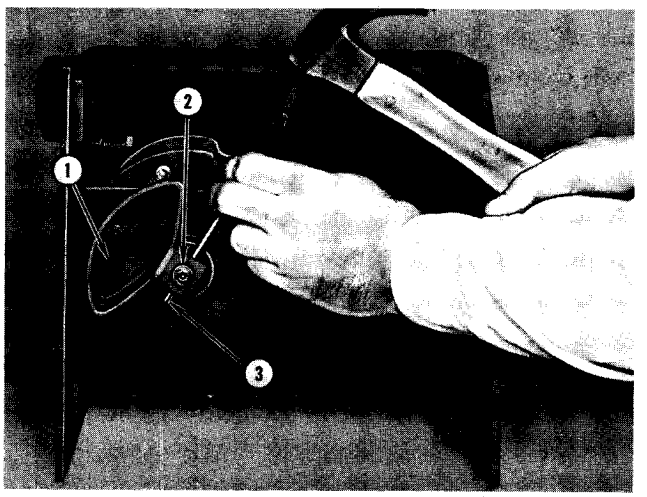


FIGURE I-16. REMOVING ROLL PIN

1. Cam
2. Pivot Shaft
3. Roll Pin

Replace contactor main switch into box, engaging studs on switch with slots in large cams, and secure with capscrews.

Reconnect leads to holding coil and jumper wires between the main switch terminals.

Position control switches, mounting brackets and insulators on switch box. Replace flat washer, lockwasher and capscrew but do not tighten.

STEERING WHEEL

Replace switch box on cockpit wall and secure with capscrews, lockwashers and nuts. Reconnect all wires to the switch terminals.

Insert upper steering wheel shaft into steering column. Replace retainer and bearing on shaft. Replace capscrews and lockwashers fastening retainer to steering column. Install key into keyway on shaft and replace steering wheel and hub, aligning key on shaft with keyway in hub. Secure with flat washer and nut.

Replace key and universal on steering shaft. Insert key in keyway on lower steering shaft and position through mounting frame into universal joint.

Position bearing, shim and retainer on shaft, secure to mounting frame with capscrews and lockwashers.

Replace spacer onto shaft. Install key into keyway and replace linkage lever. Secure with castellated nut and cotter.

Reconnect linkage to switch box.

Adjustment

Rotate pivot shaft until cam has rotated in an arc of approximately 90 degrees to the right. Slide right control switch in the desired direction until the cam pushes the striker plate against the switch plunger and the switch makes a definite "ticking" sound. (Do not bottom switch completely.) Tighten mounting capscrews. Rotate pivot shaft to the left and repeat the same procedure with the left control switch.

Cam stops are located in the switch box so that they will stop the rotation of the large rear cam. To adjust the stops, first loosen the jam nuts.

Rotate the steering wheel to the right until the small cam actuates the small control switch. Continue to rotate steering wheel until the large cam mechanically closes the main switch. Turn right adjusting screw in desired direction until head of screw is against the raised shoulder of large cam. Tighten jam nut. (See Fig. I-17.) Move to other side of switch box and repeat the same procedure with the left adjusting screw while turning the wheel to the left.

Adjust the compression springs so that when the wheel is turned and the small control switch is closed the head of the spring bolt is against the plate on the actuating cam. These springs help to prevent over steering by offering resistance to turning the steering wheel too far and by returning the steering wheel to the neutral position when released. Yet this spring pressure can be overcome to allow the steering switches to be mechanically operated.

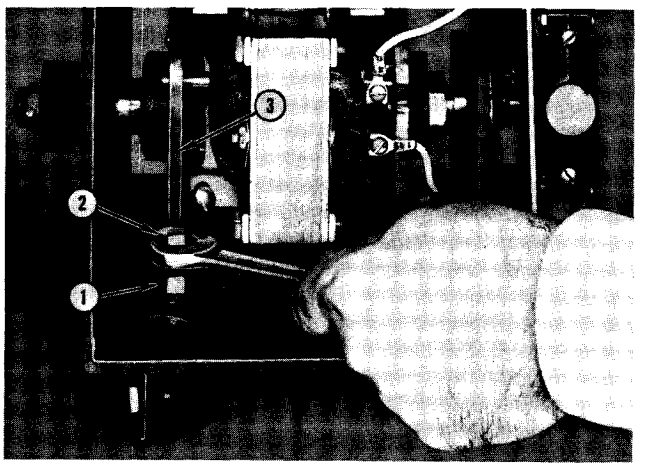


FIGURE I-17. ADJUSTING CAM SHAFT

1. Jam Nut 2. Adjusting Screw 3. Cam

ELECTRIC MOTOR, GEAR BOXES AND SWITCHES

INDEX

ELECTRIC MOTOR, GEAR BOXES, AND SWITCHES

ELECTRIC MOTOR

The a.c. electric motors used on LeTourneau-Westinghouse equipment are induction motors, all of the three phase, 120 cycle, high slip type. These motors have been designed especially to handle the various operations peculiar to the equipment on which they are used.

These motors are instantly reversible in operation. Each direction of rotation is controlled by a separate main switch, which in turn are controlled by a single control switch in the cockpit. Direction of rotation may be reversed by reversing two of the three main leads to the motor. This reversal is made in the wiring of the main switches.

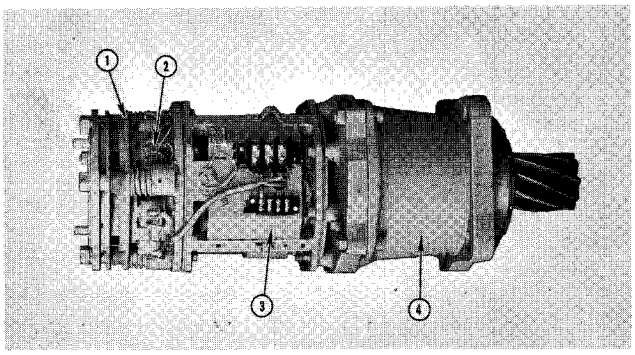


FIGURE J-1. A.C. MOTOR AND GEAR BOX
1. Motor Brake 2. Brake Coils 3. Motor Stator 4. Gear Box

The electric motors are made up of the following major assemblies.

Stator—the outside or stationary member which is bolted to the gear reduction box.

Rotor—the inner or rotating member, which is attached to the pinion shaft and drives the gears in the gear reduction box.

Brake—a spring loaded, disc type, electro-magnetic unit which is automatically released when the electric motor is operated.

Each motor is equipped with an electrically operated disc brake. This brake is held in the engaged position by strong coil springs when the motor is not operating. It is disengaged automatically by the electromagnets which are energized as the electric motor is operated. The instant the flow of current to the motor is shut off, the electromagnets are de-energized and the brake springs re-engage the brake.

The motor brake is simple in construction and includes the following assemblies.

Adjusting Ring — an externally threaded ring which is used to adjust the motor brake air gap (between the end bell and floating plate). A clockwise turn decreases the air gap and a counter-clockwise turn increases the air gap.

Brake Discs (two types)—steel discs, or stationary plates held in position by three brake studs, and internally splined friction discs. Spring pressure forces the discs together until released by action of the electromagnets.

Coils—six electromagnetic coils pull the brake into the released position when energized by the current which at the same time flows to the motor.

Springs—powerful coil springs which force the brake discs together braking the motor. The brake springs are manufactured with several different compression ratings. The brakes supporting the heavier loads are equipped with springs having higher compression ratings.

Removal

Position the component operated by the motor so there will be no movement when the braking action of the motor is removed.

Remove the capscrews securing the motor cover to the stator (Fig. J-2). Remove motor cover.

Disconnect all wires leading to the motor terminal strips and mark for easy reconnection.

Before separating motor and gear box, remove drain plug and drain lubricant from gear box.

Place sling around motor. Enough tension must be maintained to prevent mounting capscrews from binding as they are removed. Remove the mounting capscrews.

Pull motor straight away from gear box until motor pinion clears the gear box core. Take care not to damage the oil seal in the gear box bore, if

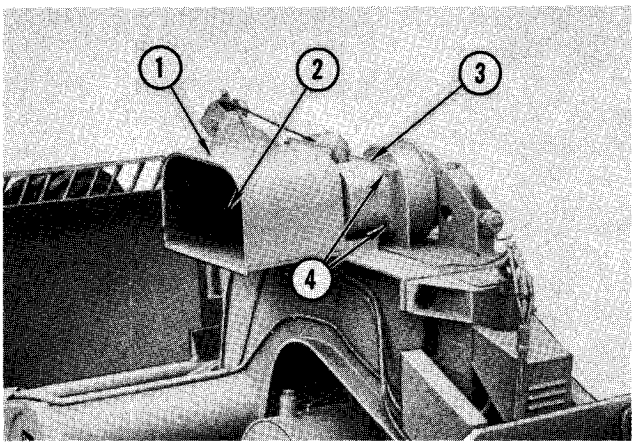


FIGURE J-2. MOTOR AND GEAR BOX, MOUNTED
1. Cover 2. Motor 3. Gear Box 4. Mounting Capscrews

equipped, or the motor pinion.

Place on bench for further disassembly. Cover opening in gear box to prevent entrance of foreign material.

To remove steering motor, remove motor cover and disconnect the motor leads at the motor terminal strip. (See section "I".)

Remove capscrews and lockwashers securing the motor stator to gear box.

Attach hoist to motor and lift straight up to prevent damage to the motor rotor shaft.

Care should be taken when placing motor on floor or work bench to prevent damage to rotor shaft.

Disassembly

Remove the end bell capscrews, disconnect the brake coil leads at the terminal strip, and using sling or chain hoist, lift brake assembly, end bell and rotor as a unit from the stator (Fig. J-3).

Remove cotter from brake hub nut and loosen nut.

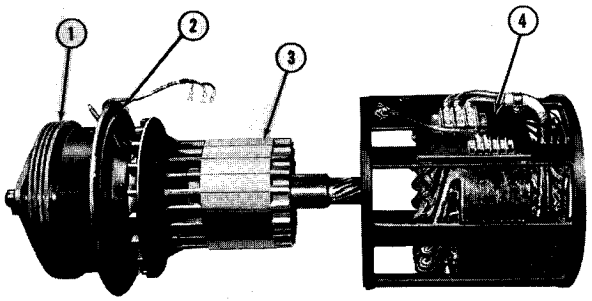


FIGURE J-3. ROTOR AND BRAKE REMOVED
1. Brake 2. End Bell 3. Rotor 4. Stator

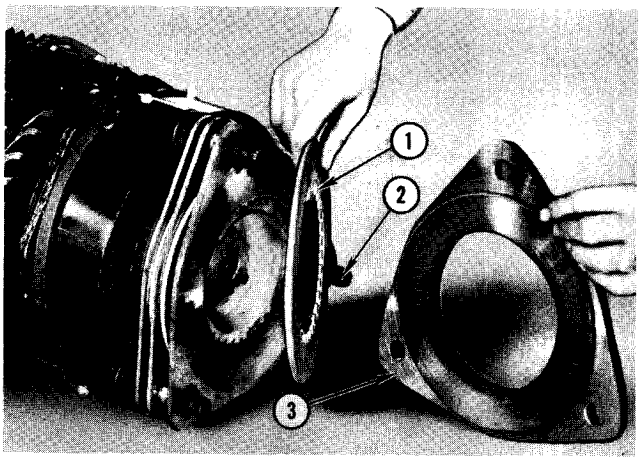


FIGURE J-4. REMOVING BRAKE PLATE AND DISCS
1. Discs 2. Stud 3. Brake Plate

Loosen the nut on the lock bolt which locks the adjusting plate in position and remove the adjusting plate.

Remove the three stud nuts and lockwashers, then the brake plate, stationary plates and brake discs (Fig. J-4).

Remove the brake hub locking nut, brake hub, floating plate and coil springs (Figs. J-5 & J-6).

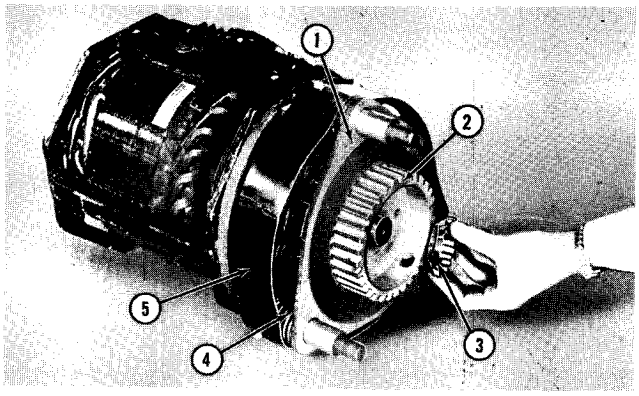


FIGURE J-5. REMOVING BRAKE HUB LOCKNUT
1. Floating Plate 3. Locknut 5. Cover Band
2. Brake Hub 4. Spring

Remove the bearing retainer capscrews and lift off the end bell from rotor.

Remove cover band from around the brake coils.

If coils are damaged, or should for some reason need to be removed, remove hold down screws clamping the coils to the top end bell and remove the brake coils. See Fig. J-7.

Remove the bearing retainer locknut. The locknut may be locked in position by a pin inserted in a hole drilled parallel to the rotor shaft, half in the nut and half in the rotor shaft. On later ma-

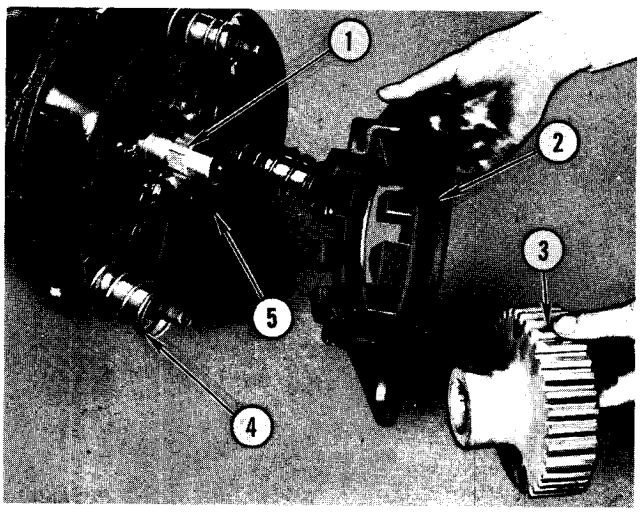


FIGURE J-6. HUB AND FLOATING PLATE, REMOVED
1. Rotor Shaft 3. Hub 5. Brake Coil
2. Floating Plate 4. Spring

chines the locknut will be staked into a machined slot in the rotor shaft. To remove the staked nut, unstake it with a slender flat tool that is tapered on one end. The tool must be narrow enough to fit in the staking slot in the rotor shaft, and used with the flat side toward the bottom of the slot. Careful unstaking of the nut will usually allow re-using the nut.

Using the special wrench provided with the machine, remove the retainer nut. Pull outer and inner seal rings, bearing and retainer from rotor shaft.

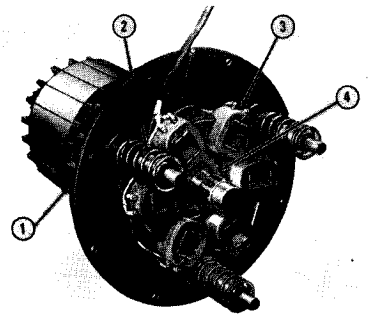


FIGURE J-7. TOP END BELL

1. End Bell
2. Spring
3. Brake Coil
4. Locknut

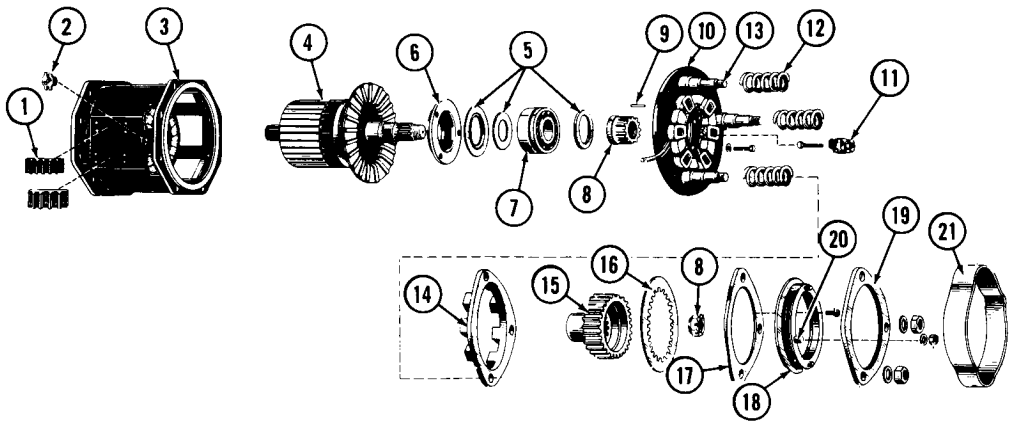


FIGURE J-8. MOTOR, EXPLODED

1. Terminal Strip
2. Heat Switch
3. Stator
4. Rotor
5. Seal Ring
6. Bearing Retainer
7. Bearing
8. Retainer Nut
9. Lock Pin
10. Top End Bell
11. Brake Coil
12. Spring
13. Stud
14. Floating Plate
15. Brake Hub
16. Disc
17. Stationary Plate
18. Adjusting Plate
19. Brake Plate
20. Lock Bolt
21. Cover Band

Reassembly

Replace inner and outer seal rings, oil seal, bearing retainer and bearing. Replace seal and bearing retainer locknut and torque locknut to 350 ft. lbs.

Use a blunt punch or tool to stake the lip of the locknut into the rotor staking slot. Do not use a chisel or sharp tool. Or install lockpin in hole drilled in the locknut and rotor shaft (if so equipped).

Replace end bell and install bearing retainer capscrews. Replace coil springs on the three studs and place floating plate over rotor shaft, aligning the holes over the studs.

Replace hub and hub locknut, torque nut to 300 ft. lbs.

Install disc, stationary plate, disc, stationary plate, and brake plate over the brake hub, then the adjusting plate, in that order.

Replace washers and nuts on studs.

Adjust brake as described in section "K" and tighten lock bolts. Replace brake cover band.

Reassemble motor to gear reduction box and secure with mounting capscrews and lockwashers. Reconnect electrical wiring to motor terminal strips.

GEAR BOX

Removal

The procedure for removing all gear boxes is basically the same. The following instructions will serve as a guide for the mechanic.

Drain lubricant from gear box and remove the motor cover.

Disconnect leads from the motor terminal strip and release cable from any clamps securing it to the motor.

If gear box output shaft is attached to a wire rope drum, remove the setscrew from the wire rope dead end and remove wire rope. Remove setscrew from wire rope drum locknut and back nut from

output shaft. Pull drum free of shaft.

Fasten a rope sling about the motor and gear box before removing the gear box mounting capscrews. Remove capscrews. Pull motor and gear box straight away from mounting to prevent damaging oil seal or output shaft.

Separate motor and gear box (refer to page J-2).

The steering motor gear box may be removed in the following manner.

First remove motor cover. Disconnect all leads from the electric motor terminal strip and release cable from cable clamp on the motor stator.

Remove nuts securing the hold down bars on the front and rear of the gear box and remove bars.

Loosen the setscrews (two on each side) at the base of the gear box.

Remove the four mounting capscrews securing the gear box to the steering trunnion assembly. Attach hoist to the motor and gear box and lift straight up, taking care not to damage the gear box output pinion and oil seal.

Separate motor and gear box.

No. 2 GEAR BOX

Disassembly

Remove the five capscrews, lockwashers and nuts securing the face plate to the gear box case.

Remove face plate and gasket. Note the bearings in face plate (Fig. J-9). Use puller to remove bearings. Remove rotor shaft, oil seal and bearing at the same time.

Drive out roll pins (if so equipped) and remove the capscrews securing the output shaft bearing retainer to the gear box and remove the retainer and gasket (Fig. J-10). (Bearing retainer may be equipped with an "O" ring.)

Remove setscrews from first and second reduction gear bearing caps. Use special wrench provided with machine to remove gear bearing caps (Fig. J-11). Remove locking setscrews from locknuts and remove locknuts (Fig. J-12).

Pull first and second reduction gears from the gear box case. Remove locking setscrew from output shaft locknut and remove locknut. Remove outer bearing cones and bearing cups from the bores in the case and press bearing cones from shafts.

Drive out the output shaft, using a soft hammer. Outer roller bearing will come out with the shaft. Press bearing and oil seal from shaft and remove locking ring.

Remove output gear from case.

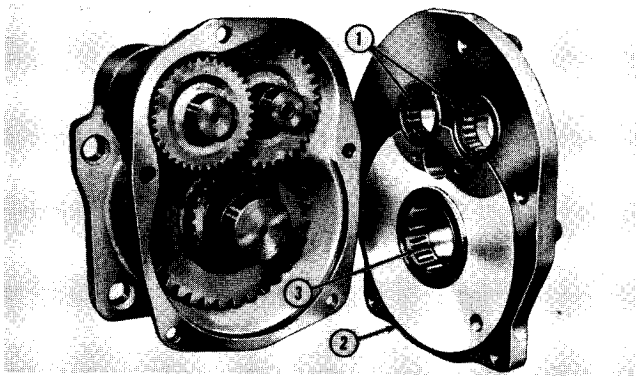


FIGURE J-9. FACE PLATE, REMOVED

1. Bearing 2. Face Plate 3. Output Shaft Bearing

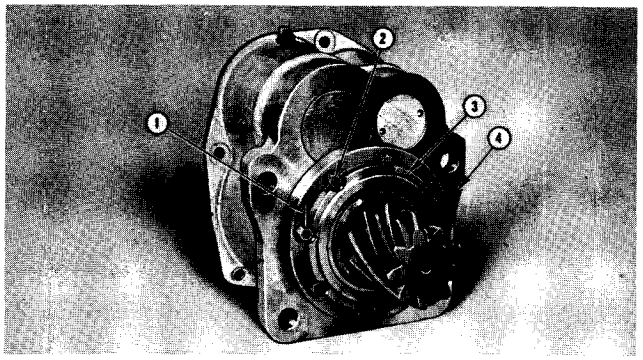


FIGURE J-10. BEARING RETAINER

1. Roll Pin 2. Capscrew 3. Retainer 4. Case

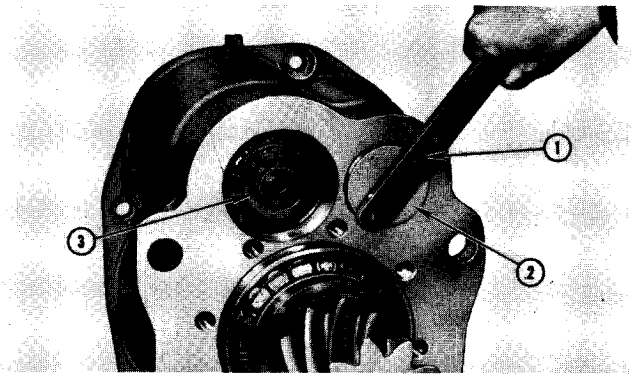


FIGURE J-11. REMOVING BEARING CAP

1. Wrench 2. Bearing Cap 3. Lock Nut

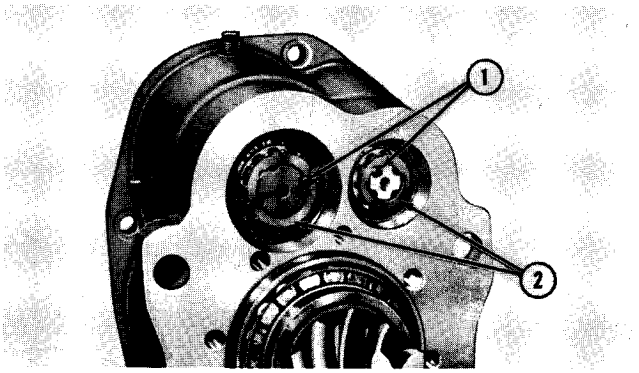


FIGURE J-12. LOCKNUTS AND SETSCREWS IN POSITION

1. Setscrews 2. Locknuts

Reassembly

Carefully check all gear teeth for damage. Wash and check all bearings and replace those damaged. Clean gear box and all parts before reassembling.

Check oil seals for dryness, hardness, or excessive wear. Replace if damaged or if condition of seal is such that it will leak.

Bearings may be heated to 250° F. in oil to facilitate reassembly.

Install tapered roller bearing on output shaft. Press oil seal into retainer. Install bearing and oil seal in face plate.

Install shaft into case by pressing bearing into large bore in case. Position output gear over the splines on shaft, thread locknut on shaft and tighten with 2000 ft. lbs. torque. Install locking setscrew in face of gear and between splines on the locknut.

Press bearings into blind bores in the face plate.

Press bearing cones on 1st and 2nd reduction gear shafts. Press bearing cup into bores in case. Install 2nd reduction gear, then 1st reduction gear.

Slide spacers on gear hubs, install the bearing cones, thread bearing locknuts onto gear hubs and tighten locknuts. Tighten 1st reduction gear locknut with 100 ft. lbs. torque and 2nd reduction gear locknut with 200 ft. lbs. torque.

Position the face plate on the case, inserting the gasket between the face plate and the case, and secure with capscrews, lockwashers and nuts.

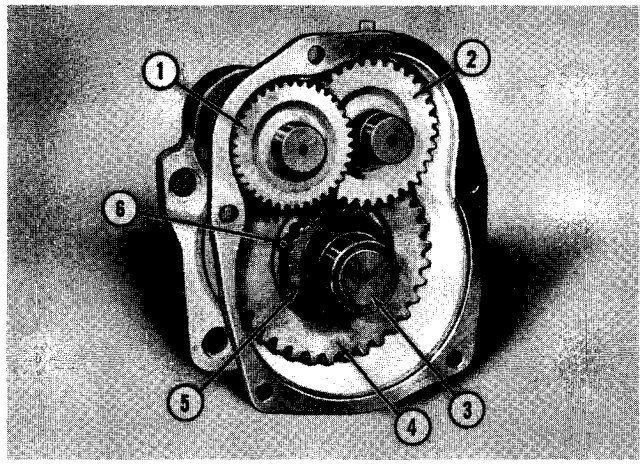


FIGURE J-13. GEAR BOX REDUCTION GEARS

1. First Reduction Gear
2. Second Reduction Gear
3. Output Shaft
4. Output Gear
5. Locknut
6. Setscrew

Install and tighten bearing retainer plugs in bores in case. Install bearing retainer, seal and gasket. Secure with capscrews and copper washers.

Secure motor to gear box. Fill gear box with the required amount and type of lubricant and install on machine. Refer to Section "K" for lubrication instructions.

No. 3 GEAR BOX

Disassembly

Remove capscrews and washers securing the face plate to the case and remove the face plate and gasket (Fig. J-14). The bearings in the face plate must be removed with an expansion puller.

Drive out roll pins and remove capscrews securing the output shaft bearing retainer to the case.

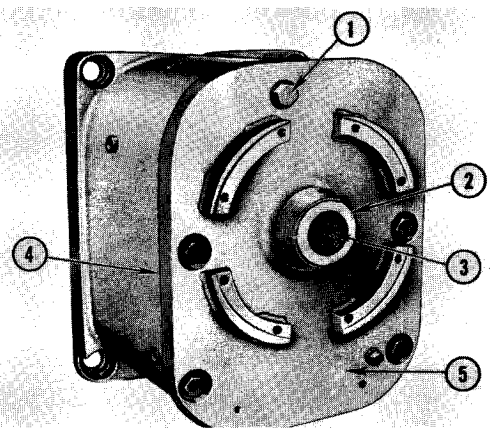


FIGURE J-14. GEAR BOX FACEPLATE

1. Capscrew
2. Oil Seal
3. Bearing
4. Gasket
5. Faceplate

Remove the retainer, gasket and oil seal (Fig. J-15). Remove "O" ring from inside retainer (if so equipped).

Remove the two bearing retainer plugs exposing the locknuts on the 1st and 2nd reduction gear shafts (Fig. J-16). Remove "O" rings from inside locknut bore.

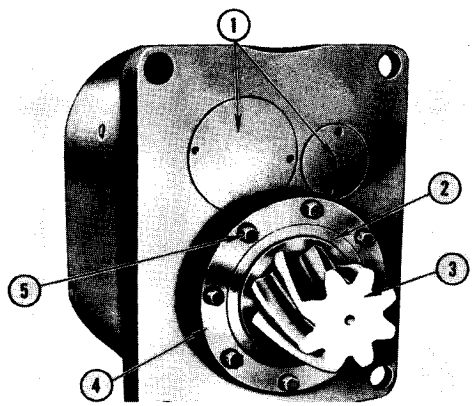


FIGURE J-15. BEARING RETAINER PLUGS

1. Plug
2. Oil Seal
3. Pinion
4. Retainer
5. Capscrew

Remove the setscrews from the reduction gear shafts and remove locknuts.

Remove the 1st and 2nd reduction gears from the case. Remove the setscrew from the output shaft locknut and remove locknut. See Fig. J-17.

Now drive out the shaft, using a soft hammer.

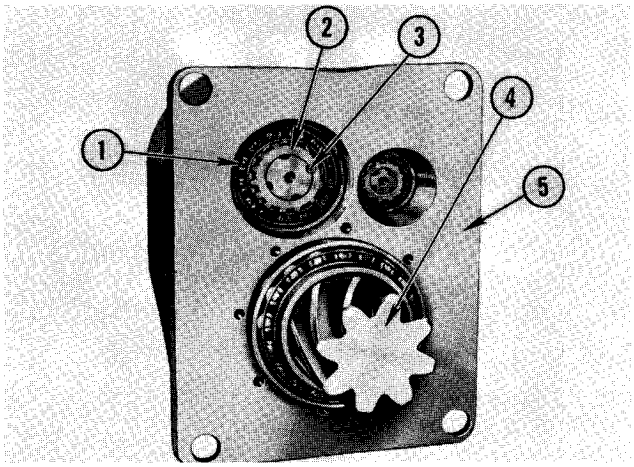


FIGURE J-16. RETAINER, REMOVED

1. Bearing
2. Locknut
3. Setscrew
4. Pinion
5. Case

Drive out the output shaft bearing from the inside of the case.

Remove the output gear from the case.

Remove oil seal from the output shaft.

Tap the 1st and 2nd reduction gear bearings out of their respective bores in the case.

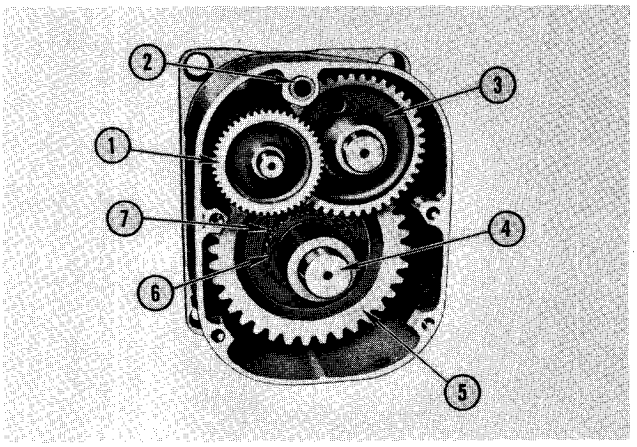


FIGURE J-17. REMOVING GEARS

1. First Reduction Gear
2. Dowel
3. Second Reduction Gear
4. Output Shaft
5. Output Gear
6. Locknut
7. Setscrew

Reassembly

Carefully check all gear teeth for damage. Wash and check all bearings and replace those damaged. Clean gear box and all parts before reassembly.

Check oil seals for dryness, hardness or excessive wear. Replace if damaged in any way or condition of seal is such that it will leak. Replace all "O" rings.

Bearing cones may be heated to 250° F. in oil to facilitate reassembly.

Install bearings in gear box case and the face plate.

Set output gear into case and install output shaft through bearing and into gear. Drive shaft into splines in gear.

Replace locknut and torque to 2000 ft. lbs. Install setscrew.

Install 1st and 2nd reduction gears in case.

Replace locknuts on 1st and 2nd reduction gear shafts and torque to 100 and 200 ft. lbs. respectively.

Replace gasket and face plate. Install capscrews to secure face plate to case.

Wipe a heavy layer of bearing grease into the bearing retainer plug bores. Work into the threads and around the bearing. Grease the "O" ring and position it carefully into the bore so it will not be pinched when reinstalling retainer plug.

Grease threads of the bearing plugs. Thread plugs into the housing by hand until the plug is against the bearing. Torque plugs to 400 ft. lbs.

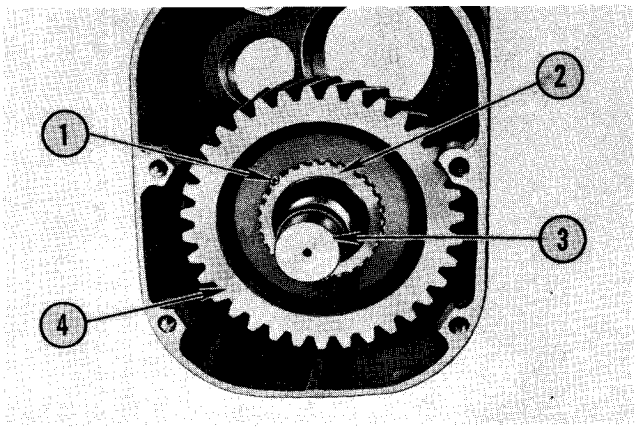


FIGURE J-18. OUTPUT GEAR AND LOCKNUT

1. Setscrew
2. Locknut
3. Shaft
4. Gear

Care must be taken when threading the plugs into place to prevent "O" ring from getting between plug threads and bore threads. This will prevent plug from seating and also will cut the "O" ring.

Install "O' ring into output bearing retainer (if so equipped). Replace oil seal, gasket and retainer over output shaft. Replace hex head capscrews to secure retainer to case.

Secure motor to gear box and install on machine. Fill gear box with the required amount and type of lubricant. Refer to Section "K" for lubrication instructions.

No. 6 GEAR UNIT

Disassembly

Remove the cover plate and gasket from back of gear unit case.

Remove the setscrew locking the gear unit axle bearing retainer cap in position. Using the special wrench, adaptor and handle provided with the machine remove the retainer cap (Fig. J-19).

Remove the cotter from axle nut. Block the drive gear inside the case to prevent its turning, and remove the axle nut (Fig. J-20).

Insert a pry bar between the drive gear and the case wall and work the gear back and forth on the axle. Rotate the gear and repeat until the tapered sleeve has been loosened and forced from its seat on the axle.

Using a block of wood or other soft material which will not damage the axle, drive against the axle from the motor side of the gear unit until wire rope drum and axle have been freed of the gear case. Keep the tapered sleeve from wedging into the gear again as the axle is removed. Block under the gear to prevent it dropping to the bottom of the case as the axle and wire rope drum are withdrawn (Fig. J-21).

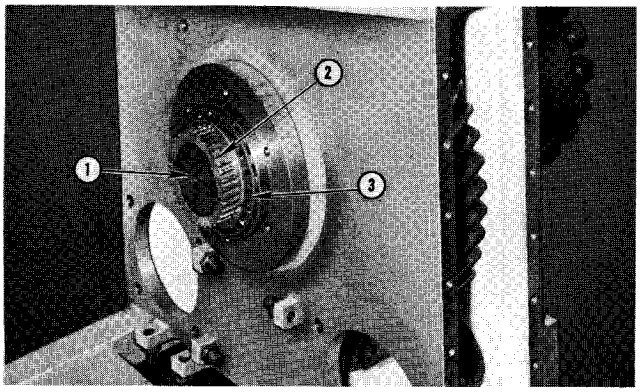


FIGURE J-19. RETAINER CAP REMOVED

1. Axle
2. Locknut
3. Bearing

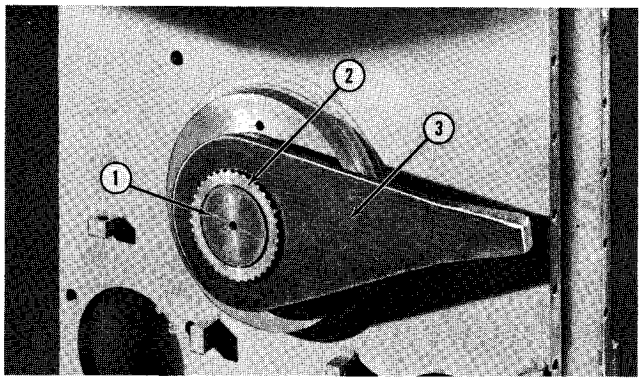


FIGURE J-20. REMOVING LOCKNUT

1. Axle
2. Locknut
3. Wrench

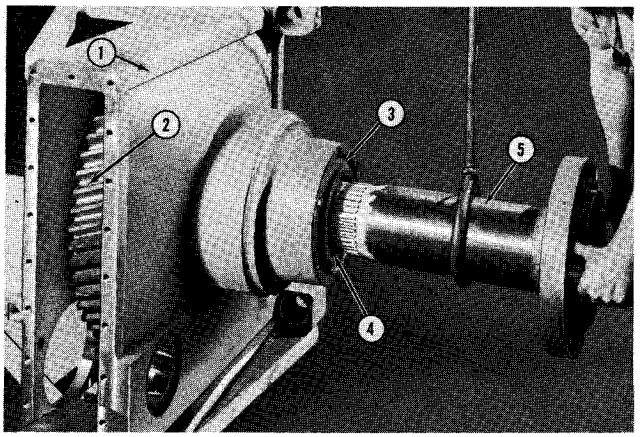


FIGURE J-21. REMOVING AXLE

1. Case
2. Drive Gear
3. Retainer
4. Oil Seal
5. Axle

Remove outer bearing retainer. Loosen the capscrew which locks the bearing race into place in the bore and remove the oil seal, outer roller bearing, bearing race and bearing retainer.

Remove the inner ball bearing and the tapered sleeve. Roll the drive gear from the opening at the rear of the gear unit case.

Remove the pinion bearing cap and gasket from side of case and remove roller bearing and outer bearing race.

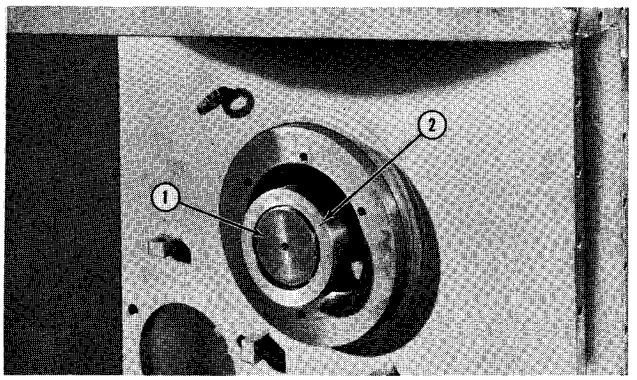


FIGURE J-22. AXLE REPLACED

1. Axle
2. Tapered Collar

Reassembly

Inspect the oil seals. Make certain they have not become hardened, checked, or cracked and that the sealing surface has not become worn or damaged by abrasive action from external sources, such as dust or sand.

Check bearings for serviceability. Replace bearings which have been pitted, or excessively worn.

Bearing cones may be heated in oil to 250° F.

to facilitate reassembly.

Inspect gear and shaft structure. If there are indications of gear tooth failure, chipping, checking or cracking, replace the gear. Inspect the threads for cracks, cross threading or excessive wear and distortion.

Install pinion bearing, and outer race in case. Replace gasket and bearing cap.

Replace outer bearing retainer, bearing race and bearing. Lock race in position with special capscrew. There is a hole in the race which must be aligned with capscrew hole in hub before the capscrew is inserted and tightened. Replace inner ball bearing.

Install oil seal. Roll gear into case and insert axle into case bore, through gear, collar and ball bearing (Fig. J-22). Thread axle nut on axle and torque to 8000 ft. lbs. Install and lock cotter.

Replace bearing retainer cap and torque to 200 ft. lbs.

Replace unit on machine. Fill gear unit with the required amount and type of lubricant. Refer to section "K" for lubrication instruction.

SWITCHES

Fingertip Control Switch

The main switches which operate the a.c. electric motors are remote controlled by fingertip operated control switches. These switches are mounted in the cockpit.

Each fingertip control has two individual switches mounted to a single frame. The switches are operated by the lever arm which protrudes through the control panel.

A fingertip control switch in the released position does not have current flowing through it. When a switch is closed, the control circuit energizing holding coil of the corresponding main switch is closed. The main switch then closes and the a.c. motor will operate.

Heat Control Switch

The control circuit also includes a heat control switch. This switch is actuated by temperature changes in the motor. This safety switch has an element constructed of two metals having different rates of expansion and contraction. When subjected to an increased temperature, the metals expand and "bow up" away from the contact points, opening the motor control circuit and stopping the a.c. motor. When motor has cooled sufficiently, the switch will again close the control circuit.

This is true of all motors except the steering motor. On the steering motor the heat switch is connected with a warning light on the instrument panel. This light remains on at all times unless the temperature of the steering motor exceeds the safe operating range. When the temperature exceeds the safe operating range the metals bow up and open the circuit to the warning light, causing the light to go off.

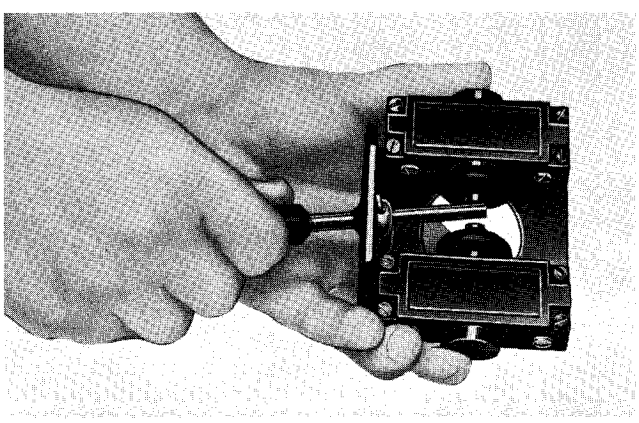


FIGURE J-23. FINGERTIP CONTROL SWITCH

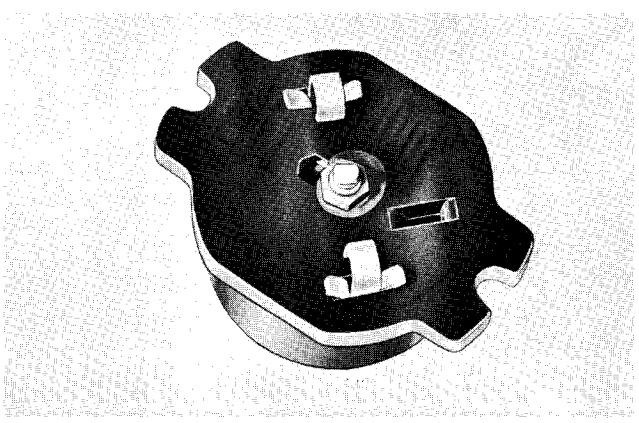


FIGURE J-24. HEAT CONTROL SWITCH

Limit Switch

The control circuit also includes the limit switches. Both the heat control switch and the limit switches are safety devices which prevent damage to the machine from improper operation.

The limit switch is operated by action of a stop plate against an actuator arm. The action of the

actuator will cut off the flow of current to the motor main switch holding coil, thus prevent any damage to the equipment.

To adjust a limit switch, first remove the cover and loosen the jam nut on the adjusting screw. Back out adjusting screw until spring pulls actuator against switch, and the switch makes a "clicking" sound. Turn adjusting screw in until switch again makes the "clicking" sound. Tighten jam nut. Do not bottom switch completely.

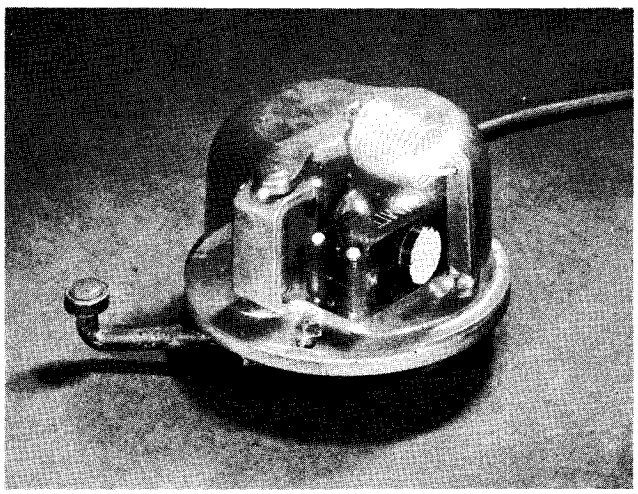


FIGURE J-25. LIMIT SWITCH

Install switch on machine. Loosen the two capscrews and nuts clamping the actuator arm to the actuator shaft. Move the component, governed by the limit switch to the limit of travel desired. Place actuator arm against stop block on moving component and open the limit switch by hand (pulling against the spring). Holding the switch open, tighten the two capscrews and nuts clamping the actuating arm to the actuator, being sure the actuating arm is against the stop block.

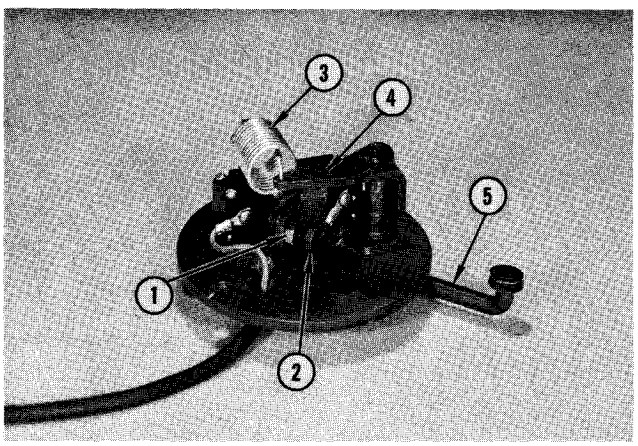


FIGURE J-26. LIMIT SWITCH ADJUSTMENT

1. Jam Nut
2. Adjusting Screw
3. Spring
4. Actuator
5. Arm Structure

Main Switch

Main switches, inserted in the circuit between the generator and the motor, control the flow of current to the motor. When the contacts within the switches are closed, the a.c. motors will operate.

Heavy current flows through these switches when the motor is in operation. Large contact points of special material are used to carry the heavy load.

Main switches are actuated by electromagnets which are called holding coils. These coils are energized by a separate circuit known as the control circuit (see section "L").

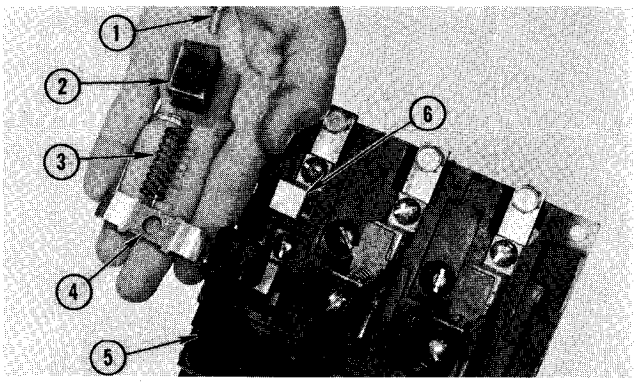


FIGURE J-27. MOVING POINT, REMOVED

1. Machine Screw
2. Holder
3. Spring
4. Moving Point
5. Arm
6. Stationary Point

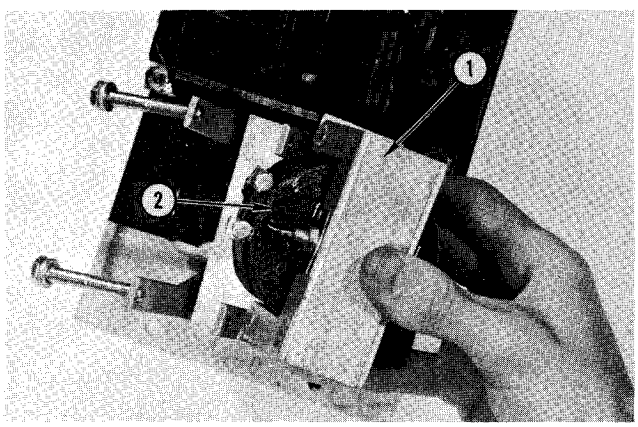


FIGURE J-28. REMOVING BRACKET

1. Magnet
2. Coil

DISASSEMBLY

Remove cover from main switch box. Disconnect leads from switch and holding coil to be worked on. Remove the two screws and washers holding the arc snuffer in position and lift off arc snuffer.

Remove screw and lockwasher securing the moving contact point arm structure and lift out point, holder, spring and shims (if present). Remove the spring from holder (Fig. J-27).

NOTE: For point replacement only, the moving points can be removed by lifting up on moving con-

tact, rotate 90 degrees and remove. Stationary points can be removed by removing the screw securing it to the base and lifting out point.

Remove the capscrews and lockwashers securing coil and magnet structure to mounting bracket on contactor base and lift coil and magnet from bracket. Remove screw, lockwashers and nut securing coil to magnet and separate the two units (Fig. J-28).

Press down on arm structure and remove key (Fig. J-29). Lift out the arm and remove arm support spring (Fig. J-30).

Remove the two screws and lockwashers securing contactor base to contactor base plate and lift off contactor base. Remove stationary contactor points, terminal bars and spacers from contactor base.

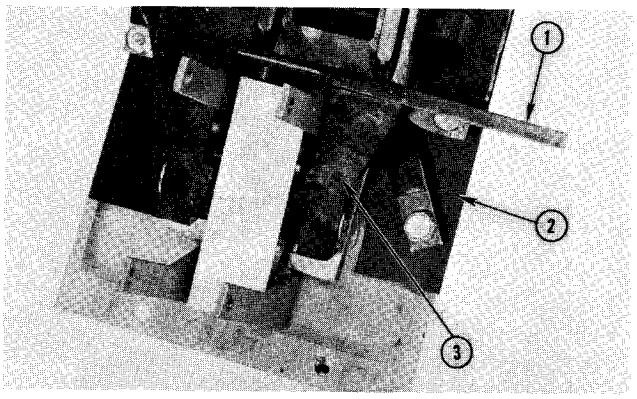


FIGURE J-29. REMOVING KEY
1. Key 2. Base 3. Arm

REASSEMBLY

Replace terminal strips, arc snuffers and stationary contactor points in contactor base.

Position contactor base on base plate and secure with capscrews.

Place arm support spring on stud on contactor base and replace arm structure over spring.

Replace key holding arm structure to contactor base.

Reassemble coil to magnet structure and replace in bracket on arm structure. Replace moving contact points, holders and springs. Complete reassembly and installation of unit. Refer to section "K" for adjustment of switch points.

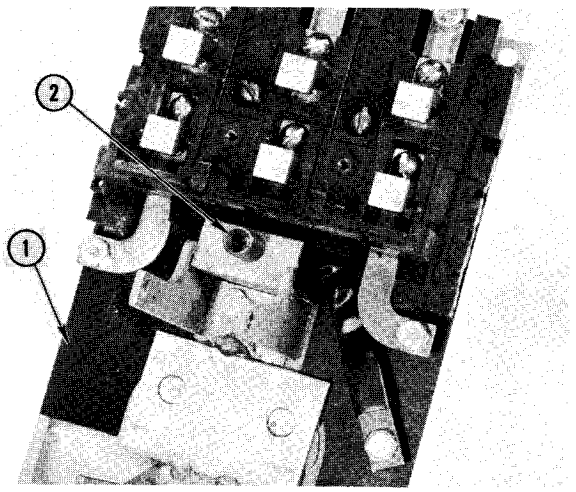


FIGURE J-30. BAR MAGNET AND ARM REMOVED
1. Base 2. Spring

D.C. Field Breaker Switch

REMOVAL AND DISASSEMBLY

Disconnect wires from switch terminals and pull cables from grommets in switch box. Remove capscrews, washers and nuts fastening switch box to Tournapull case. Lift switch box from machine.

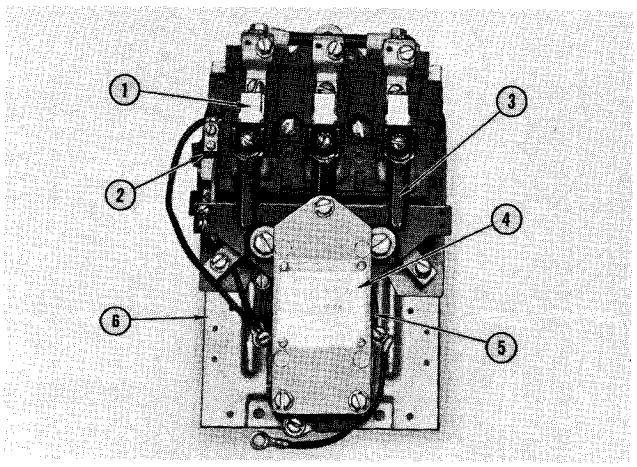


FIGURE J-31. MAIN SWITCH ASSEMBLY
1. Moving Point 2. Interlock Switch 3. Arm 4. Magnet 5. Coil 6. Base Plate

Disconnect capacitor leads from switch. Remove the four capscrews, washers and nuts fastening the switch assembly to the switch box. Place switch on bench for further disassembly.

Remove two screws and washers holding arc snuffer in position and remove from switch.

NOTE: For point replacement only, the moving points can be removed by lifting up on moving contact, rotate 90 degrees and remove from holder. Stationary points can be removed by removing the screw securing it to the contactor base.

Disconnect leads from holding coil terminals. Remove the three slotted head machine screws and washers fastening the magnet and coil to the magnet and bracket assembly. Lift magnet and coil from magnet and bracket (Fig. J-32).

Remove the two large slotted head machine screws that fasten the point arm to the magnet bracket. Separate arm and bracket.

With screw driver press down and out on the spring support until it can be removed (Fig. J-33). Exercise caution as spring and spring support may

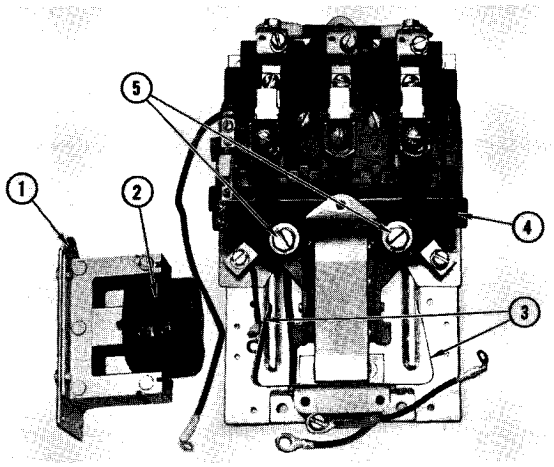


FIGURE J-32. MAGNET AND COIL, REMOVED

1. Magnet
2. Coil
3. Clips
4. Arm
5. Capscrews

fly out. Spread spring clips on base plate and lift bottom end of magnet and bracket and remove from base plate (Fig. J-34).

Contactor base may be removed from base plate by removing the two machine screws and washers securing the parts together (Fig. J-35). Terminal bars may now be removed.

Remove screws securing interlock switch to contactor base. Interlock switch is replaceable as a unit only.

REASSEMBLY

Replace terminal bars, stationary points and interlock switch on contactor base. Position contactor base onto base plate and secure with machine screws and washers. Be sure to place rubber insulators under interlock switch mounting screws.

Place magnet bracket onto base plate and secure with spring and spring plate. Spring and plate must be positioned as shown in Fig. J-33.

Replace arm onto magnet bracket and secure with screws and washers. Turn down spring clips and replace coil and magnet onto magnet and bracket. Secure with screws and washers.

Reconnect leads to holding coil. Replace moving points, if removed, and complete reassembly of unit.

Refer to section "K" for switch point adjustment.

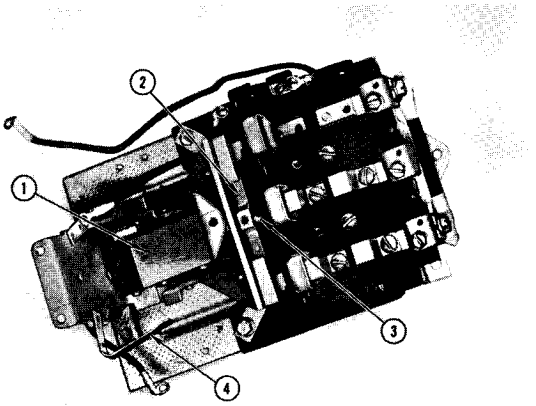


FIGURE J-33. REMOVING SPRING

1. Magnet
2. Spring Support
3. Spring
4. Clips

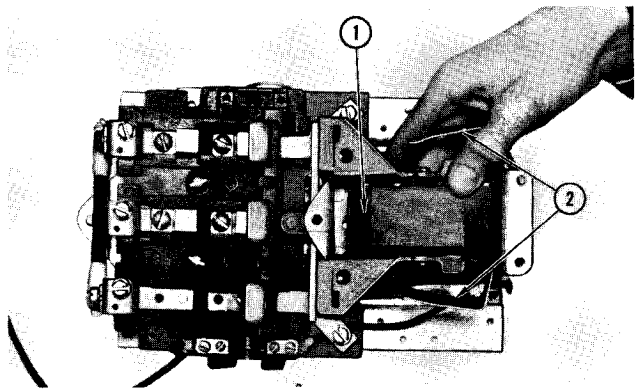


FIGURE J-34. REMOVING LOWER MAGNET

1. Magnet
2. Clips

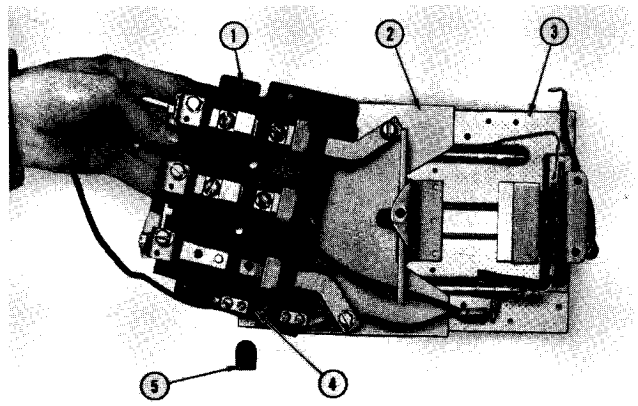


FIGURE J-35. REMOVING CONTACTOR BASE

1. Contactor Base
2. Insulating Sheet
3. Base Plate
4. Interlock Switch
5. Insulator

MAINTENANCE AND LUBRICATION

INDEX

MAINTENANCE AND LUBRICATION

Proper maintenance, lubrication and lubricants are essential for successful operation with a minimum of unproductive down time.

Use care in lubricating the machine. Use only the recommended lubricants obtained from a reputable supplier.

Clean all grease fittings and filler plugs before lubricating. Any foreign material in the fittings or plugs may be forced into the machine and cause faster wearing of the moving parts.

Do not over lubricate. Too much lubricant may rupture the oil seals and permit the lubricant to leak out and allow the entrance of harmful abrasives.

The lubrication intervals are broken down into hours of operation. The intervals may vary somewhat, depending upon climate and working conditions.

Extreme Pressure (E.P.) gear oils specified must meet U.S. Army Specification MIL-L-2105, engine oils must meet U.S. Army Specification MIL-L-2104A.

MAINTENANCE

A.C. Generator

Inspect the generator at 500 hour intervals for any large accumulation of oil and dirt on the stator. Any excessive amount of waste material will prevent proper cooling of the generator. Make sure that drains in the bottom of the engine compartment are open and the waste materials are draining away. The drains sometimes plug up with mud and allow the dirt and water to build up to the level of the generator stator.

Inspect the stator windings. Remove accumulation of grease and dirt with a low pressure siphon hose and a cleaning fluid, such as carbon tetrachloride. After the windings have been washed down with the cleaning fluid, blow off the surplus with air.

Make sure the leads connected to the transformer and generator terminals are tight. Remove any accumulation of grease or dirt found on the terminal strips with cleaning fluid.

The generator brushes should be inspected for wear whenever the generator is disassembled. The brushes are 3/8" thick when new and should be discarded and replaced when one half of the brush has worn away.

A.C. Motor

Every 1000 hours remove motor cover and blow the dust and dirt from around the windings, rotor and brake assembly with an air hose.

Inspect all electrical connections every 100 hours, making sure they are all tight and free from grease and dirt.

Check brake clearance every 100 hours. Excessive clearance at the brake magnets will cause improper brake release, over-heating of the motor, and warping of the brake plates thus causing them to wear out prematurely. Insufficient brake clearance will also prevent proper brake release.

Adjust the brake as follows: Loosen the nut on the tapered bolt locking the adjusting plate in

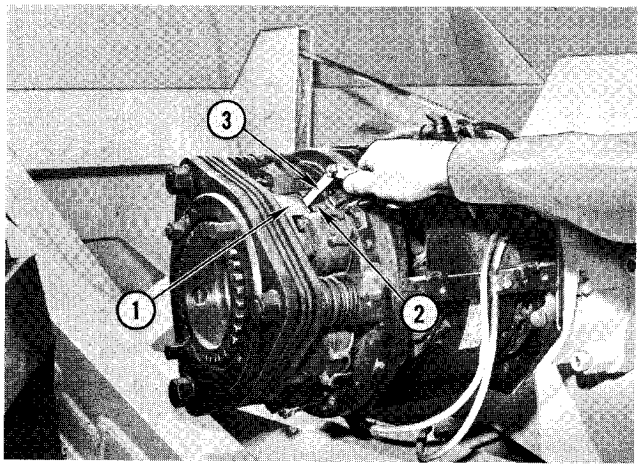


FIGURE K-1. CHECKING BRAKE CLEARANCE
1. Floating Plate 2. End Bell 3. Feeler Gauge

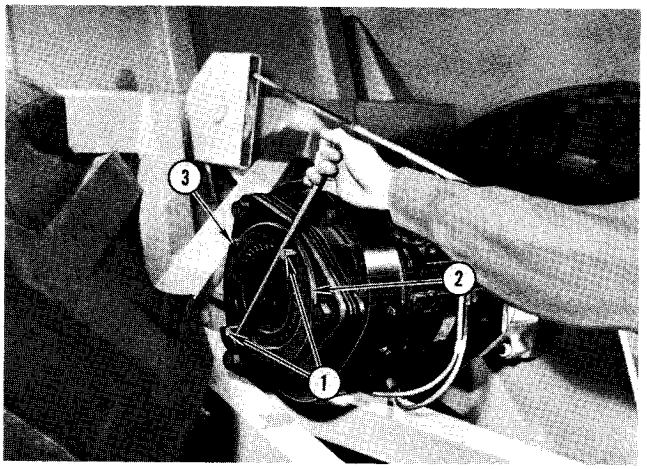


FIGURE K-2. ADJUSTING MOTOR BRAKE
1. Locknut 2. Adjusting Ring 3. Bar

position. Tap bolt down lightly to release bolt and relieve tension on adjusting plate.

Insert special adjusting tool over lugs or insert a bar between the adjusting lugs on the adjusting ring and turn either clockwise or counter-clockwise until the air space between the floating plate and the end bell is 1/16" for double disc brakes. Clockwise rotation decreases the space and counter-clockwise rotation increases the space.

After the proper adjustment is obtained, tighten the nut on the end of the tapered bolt, locking the ring in position.

Air Brakes

Correct any defect in the air lines which may retard the flow of air to the brakes, such as compressed, broken or clogged lines.

In extremely cold weather, moisture in the air lines may freeze and impede the flow of air. Add alcohol to the air system to absorb the moisture and help to eliminate this condition (1 pint each day to the air tank).

Air Cleaners

OIL BATH TYPE

Daily inspection is necessary to determine the amount of maintenance to be given to the air cleaner.

The wire screen condensing element will need very little attention if the correct oil level is maintained, using the proper oil. However, the bottom of the screen element should be inspected whenever the air cleaner is serviced. Any accumulation of dirt or straw should be removed. The heavy duty oil bath air cleaner is provided with a removable section in the lower portion of the element. When service of the element is required this removable piece can be taken out, washed in a cleaning fluid, dried and replaced.

A push up, slight turn to the left, and a downward pull will remove the prefilter element.

The inlet tube requires periodic attention, since an accumulation of dirt will restrict the flow of air through the filter and to the engine. Cleaning is best accomplished by pushing a rag on a stick through the inlet tube.

The entire air cleaner should be removed from its mounting and the wire screen condensing element washed thoroughly in cleaning solvent or steam cleaned at least once each season—more often if dust conditions are severe.

Loose connections between the air cleaners and the engine will allow dust to enter the cylinders. Vibration may loosen these connections. Check them frequently and keep air tight.

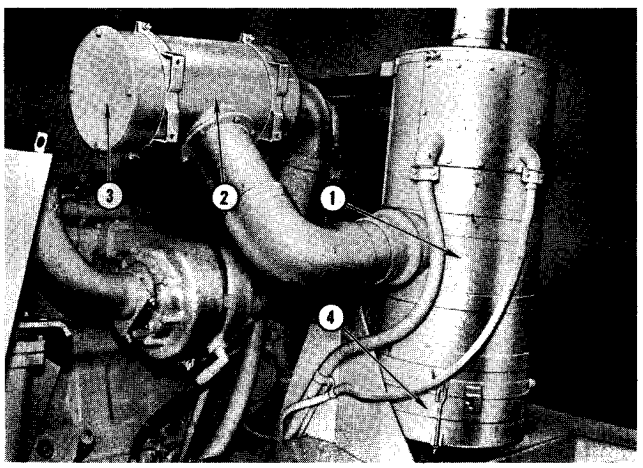


FIGURE K-3. AIR CLEANERS

1. Oil Bath
2. Dry Type
3. Cover and Gasket
4. Oil Cup

DRY TYPE

Every 50 hours remove capscrews securing end cover and gasket to the cleaner housing. Remove filter element.

Use clean, dry, low pressure air to blow the accumulated dirt from the element. Apply the air to the outlet side so that the flow of air through the element is the reverse of normal. NEVER use a liquid for cleaning the element.

Every 500 hours replace the filter element. When replacing element, make sure cover and gasket are tightened securely to make a dust tight seal.

Air Compressor

Water lines connect the two openings in the compressor water jacket to the water circulating system of the engine. The lower opening is connected to the pressure side of the engine cooling system and the upper opening to the suction side. Both connections should be checked for leaks and tightened periodically. During cold weather, compressor jacket should also be drained whenever the engine is drained. Anti-freeze will protect the compressor to the same extent as the engine (See page K-10).

Keep the air inlet fittings tight. Check the

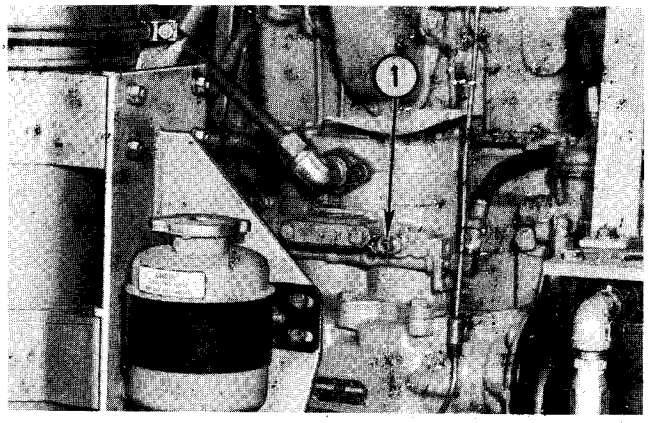


FIGURE K-4. AIR COMPRESSOR
1. Cylinder Block Drain Cock

blanking cover and gasket covering the air inlet opening or the intake manifold not in use for leaks and improper installation.

With compressor running, check for noisy operation and oil or water leaks.

Keep the oil lines clean and tight. One line connects the compressor end cover with the lubrication oil distribution cavity on the engine. The oil in this line is under pressure. Oil which has circulated through the compressor lubricating system drains back into the engine crankcase through a line from the compressor base.

Failure of the compressor to maintain normal air pressure usually denotes loss of efficiency due to wear, provided loss is not excessive in the remainder of the system. Another sign of wear is excessive oil passing. If either of these conditions develop and inspection shows the remainder of the system to be in good condition, the compressor must be repaired or replaced.

Excessive leakage past the discharge valves can be detected by fully charging the system with air and then (with engine stopped) listening at the compressor for the sound of escaping air.

Remove the cover from air strainer opening. Fully charge the system (compressor unloaded) and observe for leakage by squirting oil around the unloader valve stems. If excessive leakage occurs, the unloader piston seal should be replaced.

Air Line Cleaner and Strainer

CLEANER

Drain cleaner body every 100 hours. Replace element every 500 hours. To change element, unscrew cap from body. Remove cap and gasket carefully so spring will not pop out. Remove spring, spider and element from body.

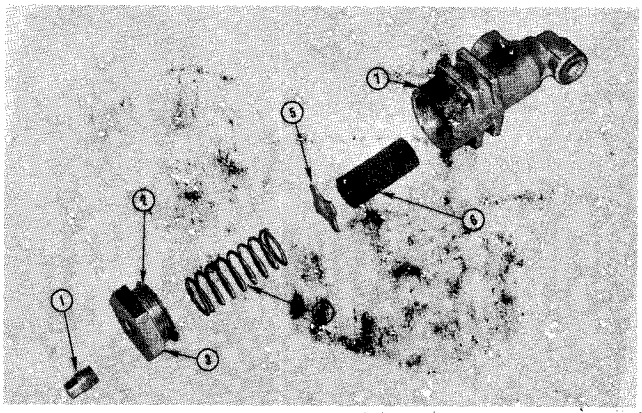


FIGURE K-5. AIR CLEANER, EXPLODED
1. Plug
2. Gasket
3. Cap
4. Spring
5. Spider
6. Element
7. Body

STRAINER

Drain strainer body every 10 hours. Replace element every 500 hours. To change element, remove capscrews and lockwashers securing cover to body. Remove cover and gasket. Remove strainer support and element from body.

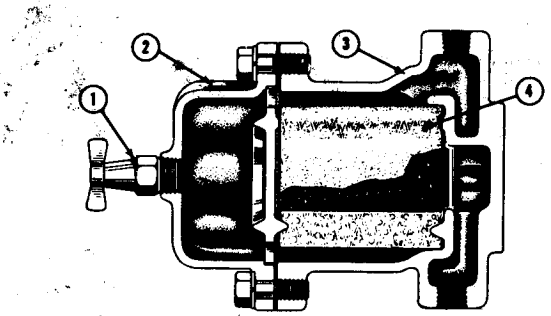


FIGURE K-6. AIR STRAINER
1. Drain
2. Cover
3. Body
4. Element

Batteries

Precautions should be taken to prevent machine down time caused by dead batteries. Batteries of one half charge or less cannot be depended upon to supply adequate current for starting and the various other electrical demands placed upon it. Therefore, it is not only imperative that the battery charging circuit be operating properly, but also that periodic checks be made on the batteries for proper water level, condition of cables and clamps, and cleanliness.

Any withdrawal of current must be balanced by current input from the battery charging circuit. If

the output should exceed the rate of current input, this will result in the batteries becoming discharged.

By placing insulating shims under the magnetic flux bridge of the main transformer the output to the battery charging circuit can be increased. Removing shims will decrease the transformer output to the battery charging circuit.

Periodic servicing of the batteries will, in most cases, prevent premature failure. The most important of these servicings is the addition of water to the cells to prevent the electrolyte level from falling below the tops of the battery plates. Plates and separators exposed to air will dry out and become ruined.

Over filling should be avoided as this will cause a loss of electrolyte. This not only results in a loss of battery capacity, but over flowing of the electrolyte on cables and clamps will cause corrosion and furnish a path for the battery to discharge.

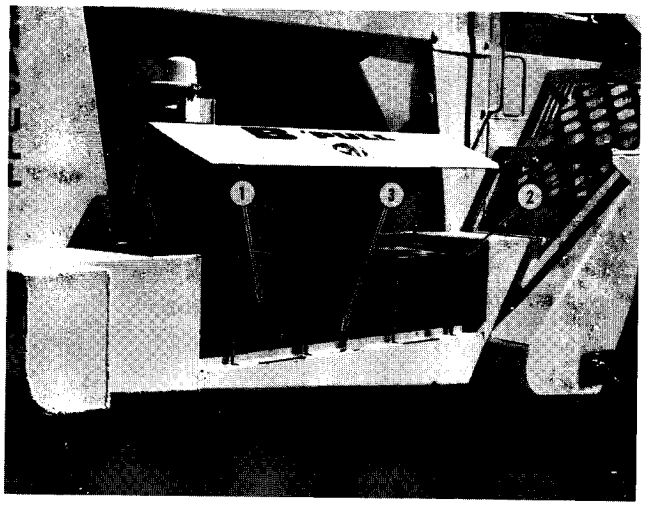


FIGURE K-7. BATTERIES
1. Battery 2. Hold Down Plate 3. Spacer

When adding water, use only distilled water or water from local sources approved by the battery manufacturer. Water having a high mineral content will greatly shorten the life of the battery.

Add water just prior to operation of the machine to insure a good mixture between water and electrolyte. The water will stay on top and freeze in cold weather at about 32° F. unless it is thoroughly mixed.

Keep the batteries clean by washing them off with ammonia or soda solution. Be sure caps are fastened securely to prevent the solution from entering the cells. When through cleaning, rinse the tops of the batteries with clear water.

Check battery cables to be sure a good contact is being made between the clamps and terminals. Remove any corrosion which may be present and apply a coating of terminal grease or petroleum jelly to the clamps and terminals to retard corrosion. Do not apply grease until clamp is on the terminal.

The following specific gravity readings indicate the different charge values:

1.280	Full Charge
1.225	Half Charge
1.150	Discharge

In tropical climates, the full charge should read between 1.220 and 1.215. The battery charging circuit should maintain the batteries above 1.155.

Refer to section "L" for instructions on making temperature corrections when making specific gravity tests.

Batteries which are being charged, or have been recently charged, will have gas at each of the cells, which is highly explosive. A spark or flame at this gas will result in an explosion. When charging of batteries has been completed, remove the caps and blow air across the cells to dissipate these gases. Do not blow hard enough to splash the electrolyte.

Use a hydrometer to check the specific gravity of the batteries at each cell. Hold the tube in a vertical position with the float suspended in the electrolyte. The reading should be taken at eye level (see Fig. K-8).

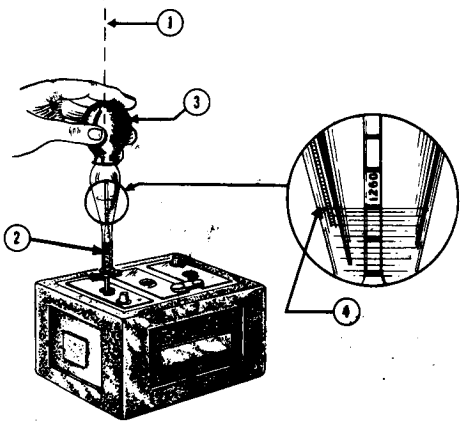


FIGURE K-8. CHECKING SPECIFIC GRAVITY
1. Hold Tube Vertical 2. Float Must Be Free
3. Take Reading at Eye Level

A common cause of battery failure is overcharging. This is usually caused by improper adjustments, defects or faulty operation of the battery charging circuit.

One of the evidences of overcharging is the swelling of the positive sides of the cell covers. This is caused by the following; during normal charging action, water in the electrolyte is converted to hydrogen and oxygen. This oxygen en-

ters the positive plate to reconvert the lead sulphate into active material. When full charge has been reached, there remains no lead sulphate to convert. Should charging continue after this point, the oxygen will gradually convert the lead in the positive plate into lead peroxide. This lead requires more room than the original lead, therefore as it swells it will cause the positive side of the cell covers to be raised.

Another indication of over charging is the necessity of frequent additions of water.

Under charging is usually indicated by the need for frequent charging.

Fan Belt Adjustment

To adjust the fan belts, remove cotter and loosen the large castellated nut at the rear of the fan spindle shaft. See Figure K-9.

Back out the adjusting screw to tighten the belts, or turn the screw in to loosen the belts. After proper belt tension has been obtained, tighten the castellated nut and replace cotter.

The recommended belt tension allows approximately ¾" movement downward with normal thumb pressure.

Both fan belts should be replaced when one or both of them have become badly worn or stretched beyond the adjusting limits. Never replace one belt without replacing the other one.

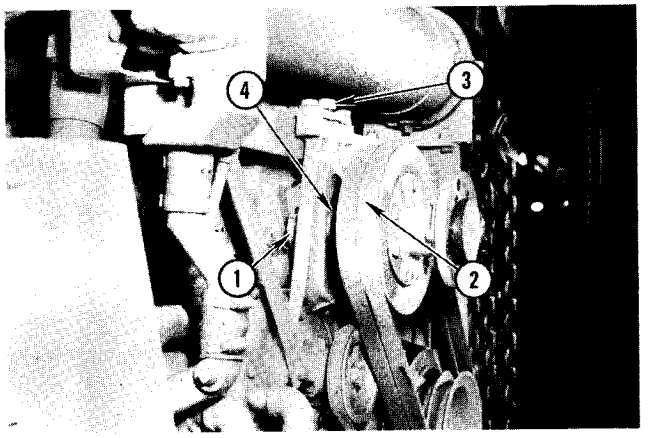


FIGURE K-9. FAN BELT ADJUSTMENT

1. Adjusting Nut
2. Fan Belts
3. Locknut
4. Fan Hub

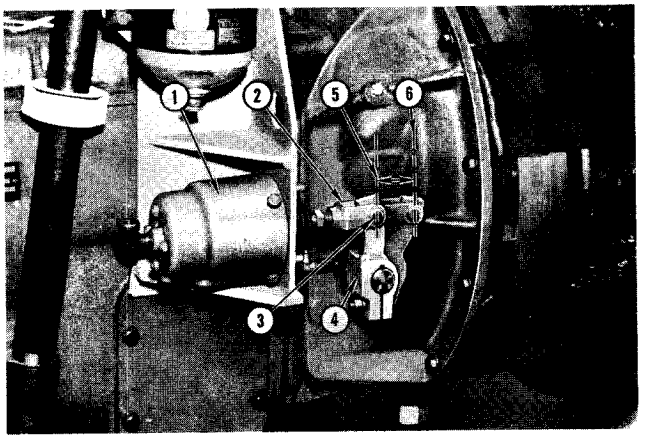


FIGURE K-10. AIR CHAMBER ADJUSTMENT

1. Air Chamber
2. Clevis
3. Pin
4. Release Lever Arm
5. 1st Measurement
6. 2nd Measurement

Flywheel Clutch

CLUTCH ASSIST AIR CHAMBER

With air chamber mounted on transmission, unscrew clevis far enough to insert pin through clevis and hole in clutch release lever arm.

Rotate clutch release lever arm by hand until the clutch release fingers are just touching the release bearing, but do not move it.

Measure the distance from the center of the clevis pin in the lever arm to the face of the transmission end bell.

Apply air pressure to the air chamber so that the clutch release bearing disengages the clutch. Measure the distance between the center of the clevis pin to the face of the transmission end bell again. Determine travel of the air chamber shaft by subtracting the second measurement from the first. The travel should be 1 5/8". If travel was less, screw out the clevis until the 1 5/8" measurement is obtained. If travel was more, screw clevis in to obtain 1 5/8". Repeat the measuring procedure to be certain the adjustment is correct. Air chamber must bottom forward at full clutch release, but must not bottom on return stroke.

CLUTCH ASSIST AIR VALVE LINKAGE

Adjust clutch linkage clevises at either end of air valve until the distance between the clutch pedal arm and the bottom of the cockpit measures 9/16". See Figure K-11.

CLUTCH RELEASE BEARING

When the clutch assembly is new, and both the clutch assembly and pedal linkage are in correct adjustment, there should be 3/16" clearance between the clutch release bearing and each of the clutch release levers when the clutch pedal is in the fully released position. Refer to Fig. E-6. This gap is to insure that the clutch levers will be unrestricted, and the clutch will be fully engaged at that time.

As the facings of the clutch plates wear, the position of the levers, when the clutch is fully en-

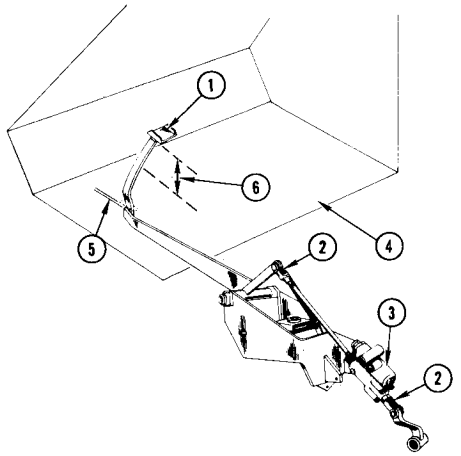


FIGURE K-11. AIR VALVE LINKAGE ADJUSTMENT

1. Clutch Pedal
2. Clevis
3. Air Valve
4. Cockpit Floor Plate
5. 9/16" Distance
6. Pedal Free Play (1 3/16" to 1½")

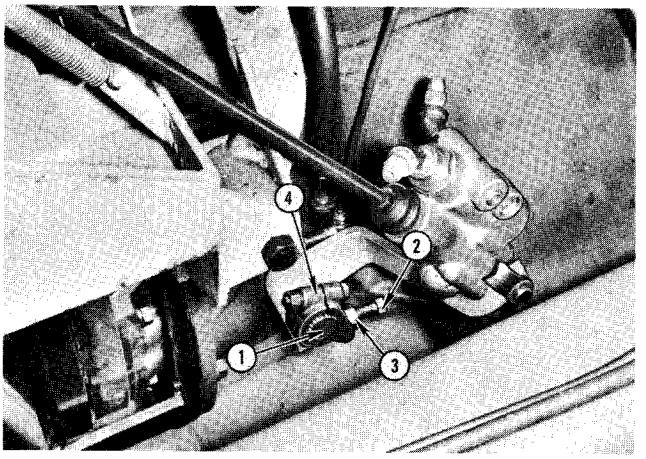


FIGURE K-12. CLUTCH PEDAL FREE PLAY ADJUSTMENT

1. Cross Shaft
2. Setscrew
3. Jam Nut
4. Adjusting Lever

gaged, will gradually move back in relation to the release bearing. The gap between the release bearing and the release levers will decrease until eventually the release levers will ride on the release bearing and cause the clutch to slip.

The 3/16" clearance is normally maintained by moving the release bearing-carrier back by means of the pedal linkage adjustment. When it is no longer possible to maintain this clearance, because the pedal linkage has been adjusted to its limits, the clearance can be obtained by changing the relative position of the clutch release levers.

This is done by means of the lever adjusting nuts. One half turn of the nut will move the end of the lever approximately ⅛". For example, if the levers were bottomed against the face of the release bearing, it would require approximately three fourths of a turn of the nut to obtain the required 3/16".

It is important that all levers be adjusted identically to obtain correct clutch action, and to prevent abnormal clutch wear.

FREE PEDAL TRAVEL

Screw the setscrew of the clutch release bearing cross shaft adjusting lever into the lever as far as possible.

Rotate the cross shaft as far as possible in a clockwise direction so that release bearing has been moved back as far as possible. Hold it in this position.

Install the lever on the cross shaft, aligning it on the shaft splines so that the end of the setscrew just rests on the lower extension of the pedal lever arm that is on the cross shaft (Fig. K-12).

Check the pedal free play. This should be 1 3/16" to 1½". (See Fig. K-11 for location of free play.) If it is considerable less than this, remove the adjusting lever and move it one or more splines counter-clockwise until the pedal clearance is as near to the 1 3/16" to 1½" as can be obtained by this method. Make the final accurate adjustment by backing out the setscrew in the adjusting lever. When correct adjustment has been obtained, lock setscrew in place with jam nut. Check clutch air chamber adjustment.

Main Switches

To avoid excessive wear and arcing of the main switch points, all three points must make contact at the same time with a maximum of 0.015" variation between any two points. This also means that the top and bottom portions of each individual moving contact point must contact the mating stationary point at the same time, within the 0.015" limit.

When installing a new magnet and arm assembly, moving or stationary contact points, or replacing a complete main switch assembly, shimming between the arm and the moving contact holders may be necessary to keep within the specified limits.

Incorrect angle will cause the top or bottom of the contact points to engage first. If such is the case, replacement of the holder will be necessary.

Check the condition of the contactor points for wear or pitting every 500 hours. Pitted or burned contactor points tend to reduce or restrict flow of current to the electric motors.

To avoid rapid burning or pitting of points, the engine speed should be kept as near high idle as possible while operating any of the electric mo-

tors. Check tightness of screws that hold the power leads to switches, also main power leads coming in on the multiple cable.

Check the hinge bolts and other hardware on the contactor group. These must not be loose or binding. Keep excessive dust blown off. If grease or oil has worked into the assembly, wash with a solvent such as carbon tetrachloride. Keep the main switch panel cover securely fastened and in place at all times.

Check the collector cups and blow out any accumulation of dust, dirt or other foreign material every 1000 hours. More often if necessary in dusty conditions.

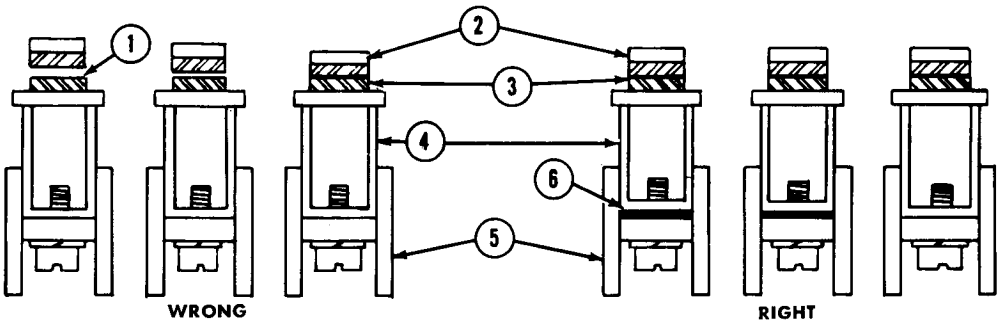


FIGURE K-13. SHIMMING BETWEEN ARM AND MOVING CONTACT HOLDER

1. Gap
2. Stationary Points
3. Moving Points
4. Point Holder
5. Magnet and Arm
6. Shims

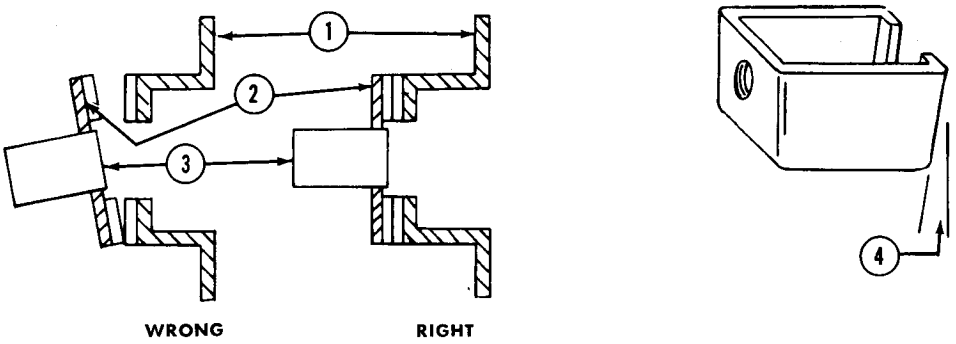


FIGURE K-14. MOVING CONTACT HOLDER ANGLE

1. Stationary Points
2. Moving Points
3. Holder
4. Point Holder Angle

Oil Cooler (GM Engine)

Engine oil coolers should be cleaned periodically to insure continued efficient cooling of the oil. The cooler element should be removed for inspection and cleaned of sludge and hardened oil deposits in the oil cooler core; and rust or lime deposits in the water coolant area surrounding the core.

Steam cleaning, under pressure, or immersion into a solvent may be employed for cleaning those units which contain a normal accumulation of sludge and hardened oil; or, the cooler may be removed from the engine unit and immersed into a vinegar bath consisting of 1 part vinegar to each 15 parts water. The length of time required for the vinegar to soften the lime and rust deposits will vary depending upon the established frequency of cleaning.

After cleaning, oil coolers must be flushed thoroughly to remove all cleaning solvent or vinegar, and softened deposits. After flushing, all traces of moisture must be removed from the oil passage ways of the cooler by heating, before installation onto the engine.

It is recommended not to attempt cleaning any oil cooler wherein the history of the usage shows an engine failure which has released metal particles from worn or broken parts into the lubricating oil. In all probability all metal particles could be flushed out after the unit thoroughly cleaned, however, a few particles could become lodged in the cooler, and later loosen and circulate through the system with the lubricating oil.

Therefore, the chance is too great to take, considering the cost of the cooler against the cost of

another tear-down on the engine. In this instance, recoring of a tube type oil cooler, or replacement of the core element in a plate type oil cooler is strongly recommended.

Power Shift Transmission

Check the transmission oil level once each shift. A cold check (engine not running) is to be done only to make sure there is sufficient oil in the system to make it safe to start, especially if the machine has been idle for a long period.

The oil level should be checked with the engine running at idling speed, with oil at operating temperature and the transmission in neutral. The oil level cocks are located at the bottom rear of the transmission (see Fig. K-15). Oil should be level with the top oil level check cock. Add oil if necessary so that the level is just even with the lower oil level check cock, then close the check cock and add 1½ gallons of the proper lubricant.

Change oil every 500 hours or oftener if operating conditions warrant. The oil in the system must also be changed when the oil shows traces of dirt or the effects of high operating temperature, evidenced by discoloration or a strong odor.

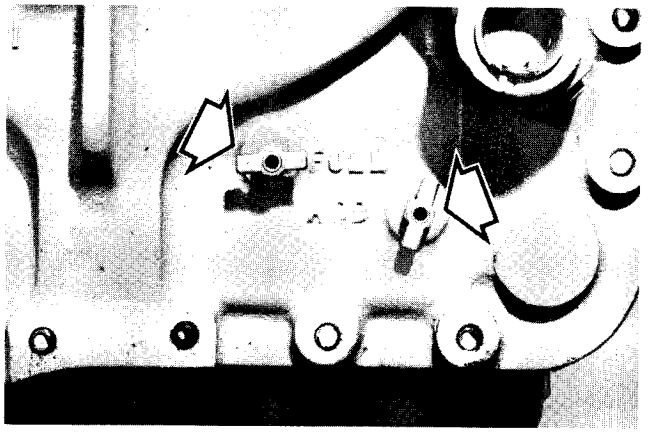


FIGURE K-15. POWER SHIFT TRANSMISSION OIL LEVEL
1. Top Level Cock 2. Lower Level Cock

If the oil shows metal contamination, the system must be thoroughly drained and cleaned. All the components of the hydraulic system, transmission, torque converter assembly, oil lines and passage, sump, filters, strainers, cooler, valves and pumps must be thoroughly cleaned. This means disassembly of the components. Metal particles in the oil are evidence of failure of some part and repair must be made.

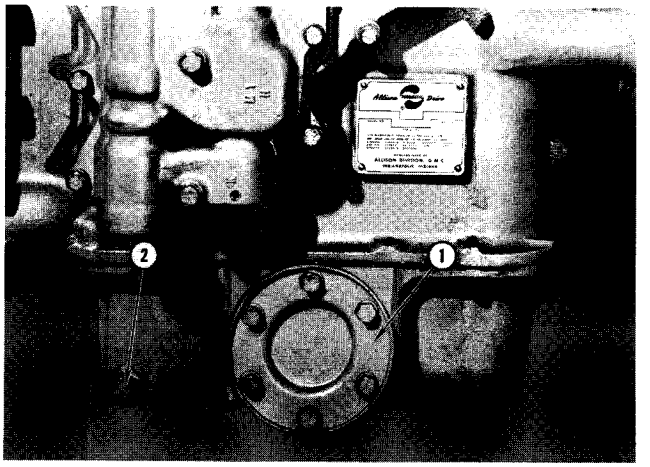


FIGURE K-16. TRANSMISSION OIL STRAINER
1. Strainer Cover and Gasket 2. Drain Plug

Replace the filter elements every 500 hours. Remove drain plug from filter housing to drain filters before removing them.

The oil should be warm when draining it from the hydraulic system. Clean or replace all filters, screens and strainers. Examine oil for metallic contamination and evidence of high temperature operation.

Remove the drain plug from the right hand side of the sump. Remove the strainer from the sump. Clean strainer with mineral spirits using a soft bristle brush.

Remove filter drain plugs and then remove and replace filter elements.

Install drain plug at the right side of the sump. Install strainer. Replace filter drain plugs.

Pour 7 or 8 gallons of Hydraulic Transmission Fluid, Type "C" into the transmission oil filler hole.

Start engine and let it run at idling speed with the transmission in neutral range to charge the hydraulic system. After the engine has been running at idle speed for two minutes, add enough Type "C" oil to bring the oil level up to the lower level cock. Close lower level cock and add 1½ gallons more. This will bring the oil up to the upper (or "Full") level cock.

Radiator

The radiator and power shift transmission oil cooler are connected together, therefore cleaning the oil cooler is accomplished when the radiator is cleaned. Apply the following instructions to include the oil cooler.

Drain and flush radiator every three to six months, depending upon the condition of the coolant and the type and amount of service required

of the engine. Flush the radiator and the engine block separately. Flushing water should enter the radiator at the bottom connection, the reverse of the regular flow of water. Thermostats must be removed from engine and power shift oil cooler before flushing engine.

A badly clogged radiator may have to be cleaned with the aid of a commercial cleaner. Follow the manufacturer's recommendation when using cleaning solvent. With caution, a solution of washing soda may be used to remove the grease and oil. The solutions should be lukewarm before used, and allowed to stay in the radiator or water jackets for three to four hours. The effectiveness of the solution will be increased if the engine is warm. Drain and thoroughly rinse the engine and radiator so that no trace of the cleaning solution remains.

A leaking water pump should be repaired immediately and defective parts replaced. Be sure all hose connections are tight and that the hoses themselves are in good condition. Even a slight leak will be sufficient to pass large quantities of air, causing a greatly accelerated corrosion attack.

Do not add rust inhibitor to cooling system containing anti-freeze.

ANTI-FREEZE MIXTURES

Temperature	Power Shift Trans.		Step Gear Trans.	
Degrees Fahrenheit	Permanent	Methanol	Permanent	Methanol
+20	17 qts.	16 qts.	14 qts.	12 qts.
0	33 qts.	28 qts.	27 qts.	22 qts.
−10	40 qts.	32 qts.	32 qts.	26 qts.
−20	44 qts.	37 qts.	35 qts.	30 qts.
−30	48 qts.	42 qts.	39 qts.	33 qts.
−40	52 qts.	46 qts.	42 qts.	37 qts.

Water Pump Belt Adjustment

To adjust the water pump belt, loosen the capscrews and lockwashers in the water pump clamp ring.

Insert a large screw driver in the hole provided in the water pump housing. Turn the pump housing on its eccentric until the proper adjustment is obtained. Rotating counter-clockwise tightens the belt, clockwise rotation loosens the belt. See Figure K-17.

Tighten capscrews in the clamp ring.

The recommended belt tension allows approximately ¾" movement under normal thumb pressure.

Replace belt when it has stretched beyond adjusting limits or is worn or frayed.

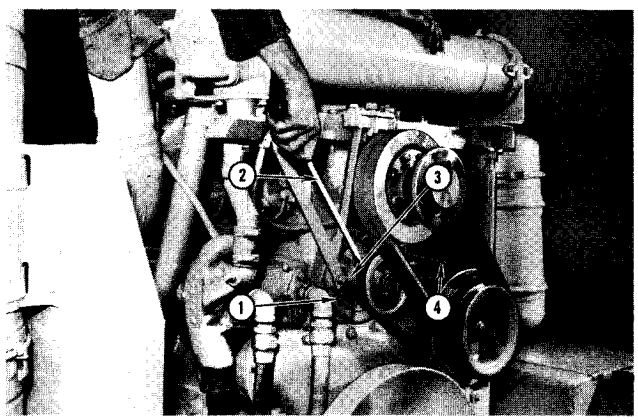


FIGURE K-17. WATER PUMP BELT ADJUSTMENT
1. Clamp Ring 2. Screwdriver 3. Water Pump 4. Drive Belt

Wire Rope

Proper care and treatment is very important and will pay big dividends in way of longer wire rope life.

The windings of the first layer of a multiple layer drum is important. It is important to recognize the fact that a properly wound first layer, upon which subsequent layers may be wound with uniformity, will result in less abuse to the rope.

The relation of rope lay must be considered in relation to the winding on the drum. Using a right lay rope and underwinding on a smooth face drum, rope must be started from the right flange. When overwinding a right lay rope, start from the left flange, as seen from the back of the drum. The reverse of this is true of left lay rope.

A reversal of the procedure outlined above will cause spaces between the initial wraps of rope in the first layer. Succeeding layers of rope will be crowded down into these spaces, nicking the wires and causing unnecessary crushing and abrasion.

The perfectly wound first layer obtained under proper winding conditions, results in uniformity in subsequent layers and longer rope life.

Whenever possible, the drum anchorage should be positioned as to favor right lay rope, since left lay rope is not always immediately available from stock.

This method applies to either regular or lang lay rope. Listed below are some suggestions that will help to prolong wire rope life.

Check rope frequently for worn or frayed spots.

Use the recommended sizes of wire rope as the design of the sheave wheels vary somewhat for ropes having different diameters.

When installing new rope, make sure the rope sleeves evenly onto the drum. Do not permit the rope to criss-cross or stack up on the drum.

Always make sure the sheave wheels and or rollers are turning free of debris and that none are broken, because if either of these are not functioning properly, the rope will wear extremely fast.

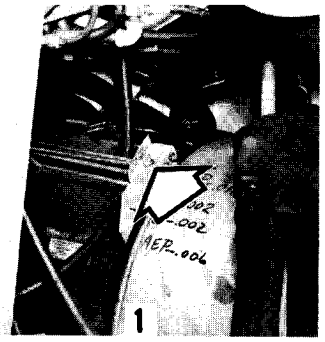
Replace sheave wheels having badly worn rope grooves, especially those having a rope lay impression worn into them.

Do not cause rope to become kinked by allowing an excessive amount of slack.

Lubricate at intervals determined by operating conditions. Use a mixture of crater compound and petrolatum.

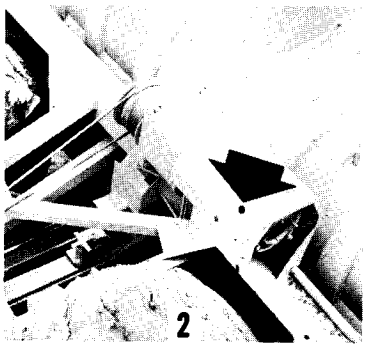
Unless operating in dusty conditions, lubricating the rope will normally add to its life. Apply rope dressing as needed. If the dressing is applied to rope in dusty conditions, dust and grit will adhere to the lubricant and become abrasive. This will greatly accelerate the rope wear.

LUBRICATION



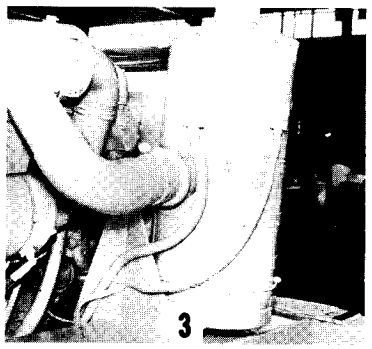
1. A.C. Generator Rear Bearing —

Lubricate every shift with high temperature ball bearing grease. Do not over lubricate. Make certain tube between fitting and bearing is filled with grease, otherwise the bearing will not receive lubricant during the first few lubrication intervals. One or two shots with a hand gun should be sufficient.



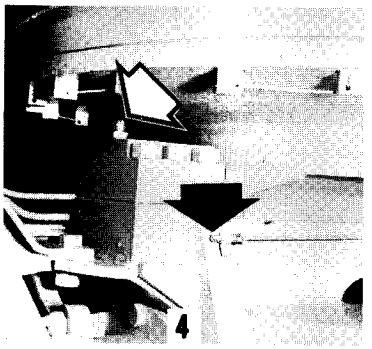
2. A. C. Electric Motor (Brake end of the motor only) —

Lubricate every shift with high temperature ball bearing grease. One shot with a hand gun should be sufficient. Make certain tube between fitting and bearing is filled with grease, otherwise bearing will not receive lubricant during the first few lubrication intervals. Do not over lubricate.



3. Air Cleaner (Oil Bath) —

Check oil level every shift. Change oil every 50 hours or more often if operating conditions warrant. Use SAE 20 in summer and SAE 10 or lighter in winter. Fill to level mark on disc. Capacity is approximately 5 quarts. Every 500 hours clean filter body with cleaning fluid and blow dry with compressed air. Refer to page K-3 for service of dry type air cleaner.

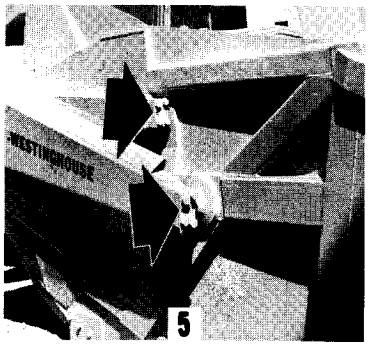


4. Ball and Sockets (Steering Trunnion) —

Lubricate once each shift. Use chassis grease (heavy) for temperatures above 32° F., and chassis grease (medium) for temperatures below 32° F.

5. Ball and Sockets (Trail units) —

Lubricate once every shift. Use chassis grease (medium) for temperatures below 32°F.

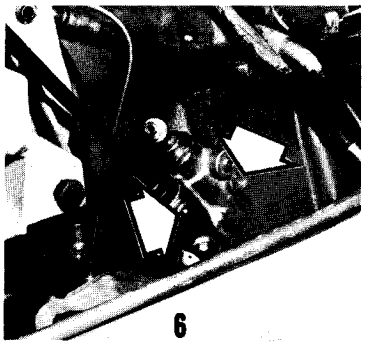


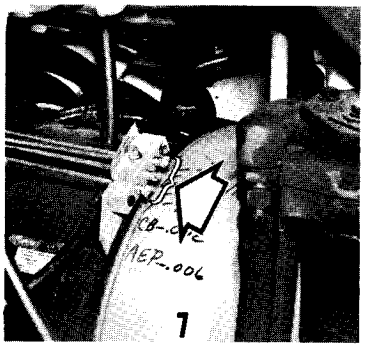
6. Clutch Air Valve —

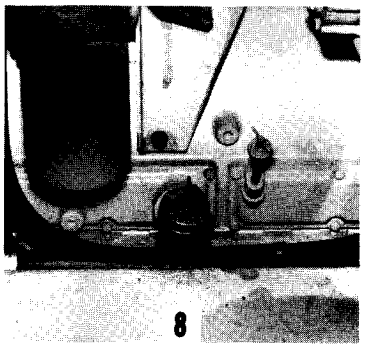
Lubricate ball type oiler on side of valve every 100 hours. Use clean engine oil. Two or three drops should be sufficient. Every 500 hours remove air strainer from side of valve body—wash in cleaning solvent. Blow dry with compressed air. Dip in clean engine oil then shake off excess oil.

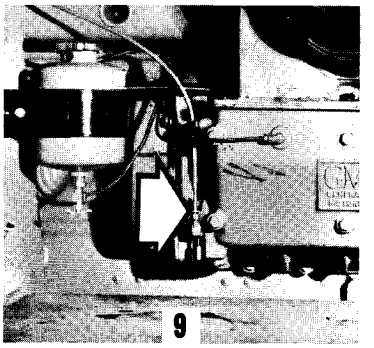
7. Clutch Release Linkage and Bearing —

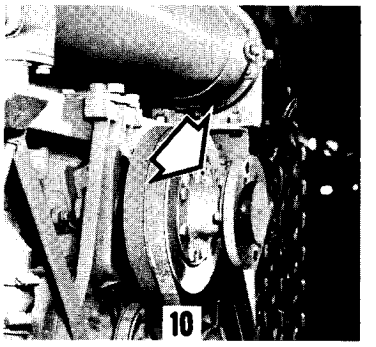
Lubricate once every 100 hours. Use chassis grease (heavy) for temperatures

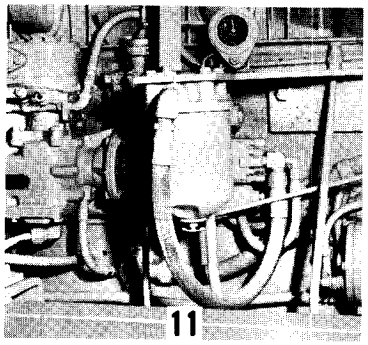








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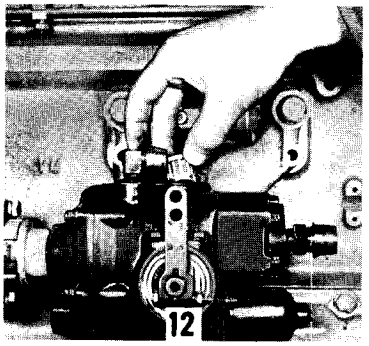
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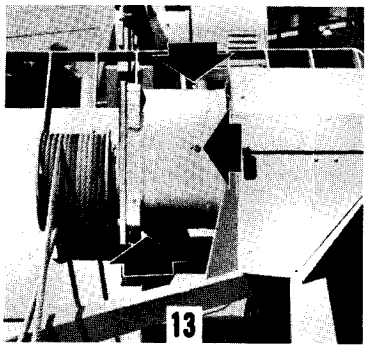
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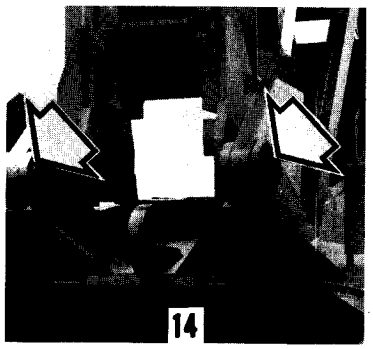
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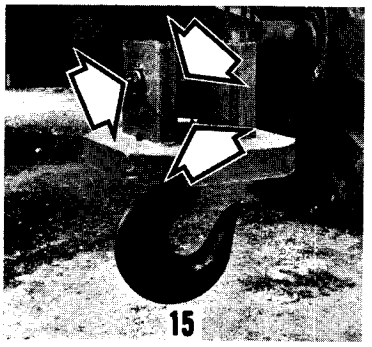
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above 32° F., and chassis grease (medium) for temperatures below 32° F. Lubricate through fittings on grease manifold. Two or three strokes with a hand gun should be sufficient. Make certain tubes between fittings and bearings are filled with grease, otherwise bearings will not receive lubricant during the first few lubrication intervals. Two or three drops of engine oil at pivot points and joints will allow easier operation.

8. Crankcase —

CUMMINS — Check level every shift. Change oil every 100 hours. Use SAE #30 engine oil for temperatures above 90° F., SAE #20 engine oil for temperatures from 32° to 90° F., and SAE #10W for temperatures below 32° F. Capacity 12 gallons.

GM — Check level every shift. Change oil every 100 hours. Use SAE #30 Heavy Duty engine oil for temperatures above 32° F., and SAE #20 Heavy Duty engine oil for temperatures below 32° F. Capacity 9 gallons.

9. Emergency Engine Shut-Down (GM only) —

Lubricate cable every 100 hours with light engine oil.

10. Fan Bearing —

CUMMINS — Lubricate every 500 hours with a good grade short fiber grease. Remove plug on fan hub, lubricate through grease fitting. Replace plug. Do not over lubricate.

GM—Lubricate every 1000 hours. Use a high grade short fiber grease. Remove plug on fan hub, install grease fitting and fill with hand gun, remove fitting and replace plug. Do not over lubricate.

11. Fuel Filters —

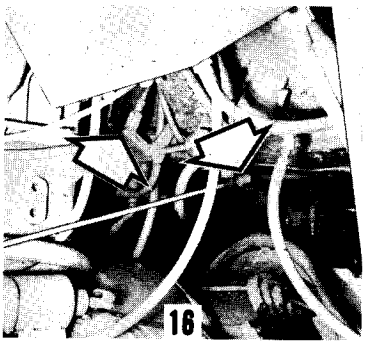
PUROLATOR—Drain sediment from filter shell every 100 hours. Replace element every 200 hours.

AC—Drain sediment from filter shell every shift. Change element every 500 hours.

FRAM—Drain sediment from filter shell every 100 hours. Replace element every 200 hours.

12. Fuel Pump Filter Screen —

Remove screen from fuel pump every 100 hours. Clean thoroughly in cleaning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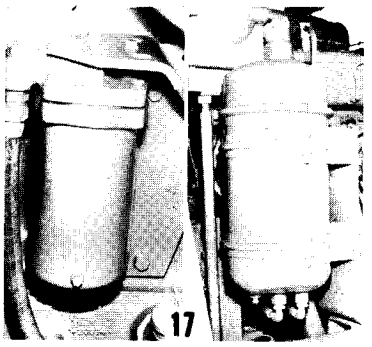
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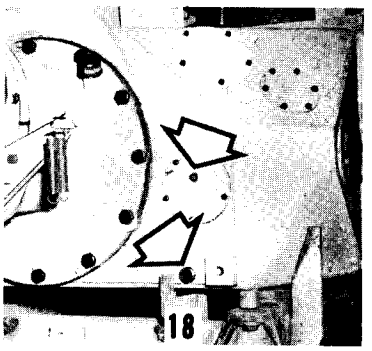
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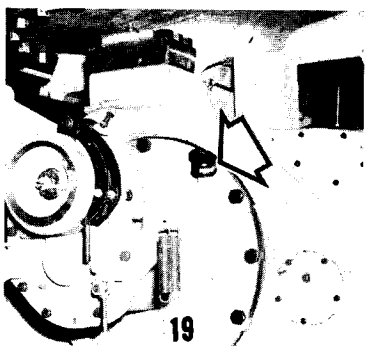
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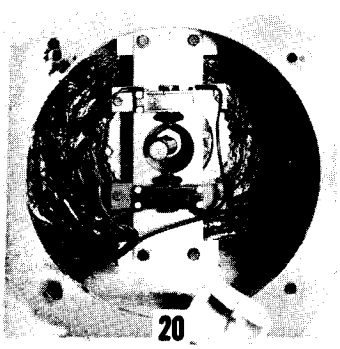
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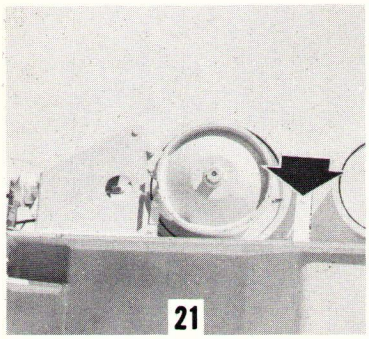
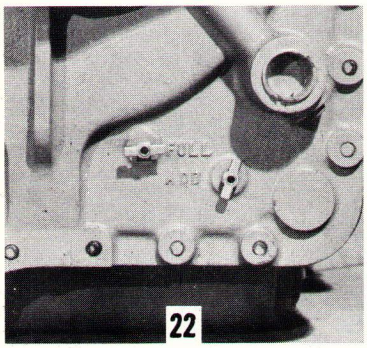

21

solvent. Refer to engine manual for procedure.

13. Gear Boxes —

Check the level of the lubricant every 100 hours. Change lubricant every 1000 hours. Use SAE #90 E.P. gear oil for temperatures above 32° F., and SAE #80 E.P. gear oil for temperatures below 32° F. Fill to level plug.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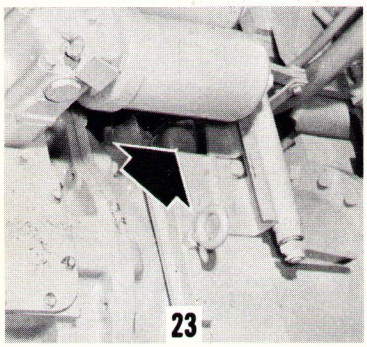
14. Hinge Pins (Crane) —

Lubricate every shift. Use chassis grease (heavy) for temperatures above 32° F., and chassis grease (medium) for temperatures below 32° F.

15. Hook (Crane) —

Lubricate every 100 hours, with wheel bearing grease (medium). Fill until a small amount of old grease is forced out.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16. Linkage —

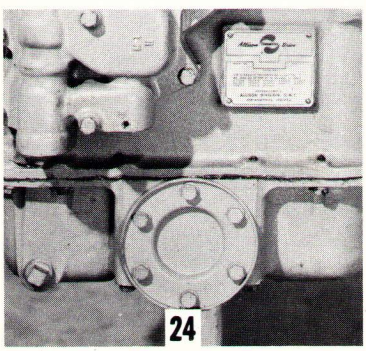
Where not equipped with a grease fitting, apply one or two drops of engine oil at each connection or joint every 100 hours.

17. Lube Oil Filters —

NUGENT — Drain sediment from filter shell and change bag every 100 hours.

LUBER-FINER—Drain sediment from filter shell every shift. Replace element every 100 hours or when crankcase oil is changed.

AC — Drain sediment from filter shell and change element every 100 hours.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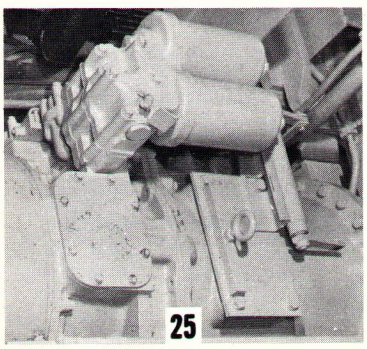
18. Main Case (Includes Final Drives) —

Check level of lubricant every 100 hours. Change oil every 1000 hours. Use SAE #90 E.P. gear oil for temperatures above 32° F., and SAE #80 E.P. gear oil for temperatures below 32° F. Remove drain plug from both main case and auxiliary transmission. Replace plugs and fill to level plug on rear of case. Capacity is approximately 70 gallons. When filling pour 1½ gallons into the auxiliary transmission case.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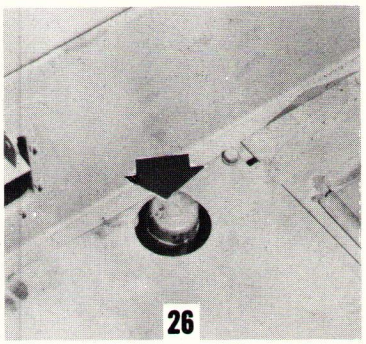
19. Main Case Breather —

Wash in cleaning fluid and dip in clean crankcase oil every 100 hours.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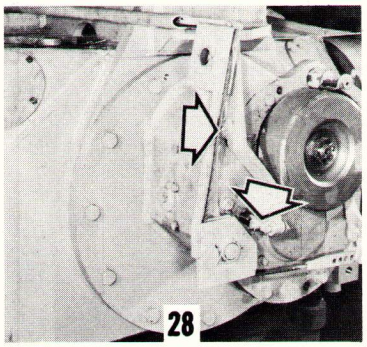
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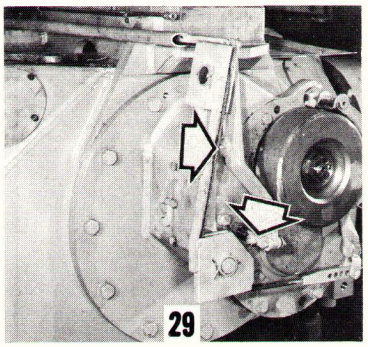
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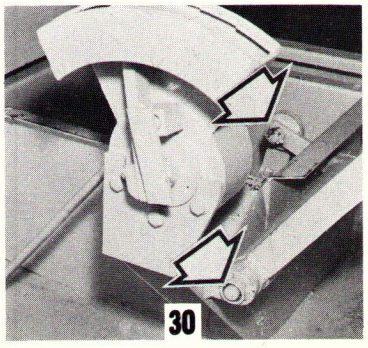
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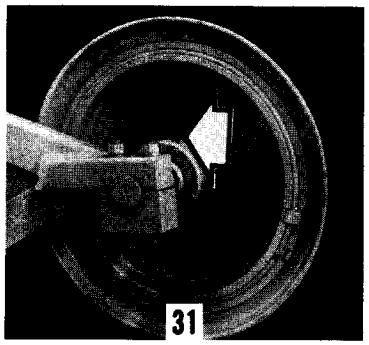
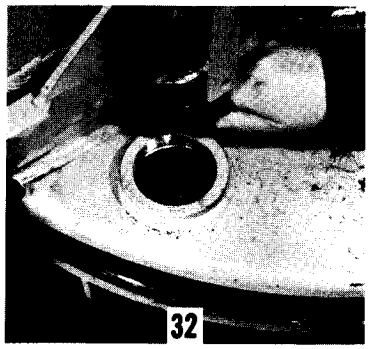
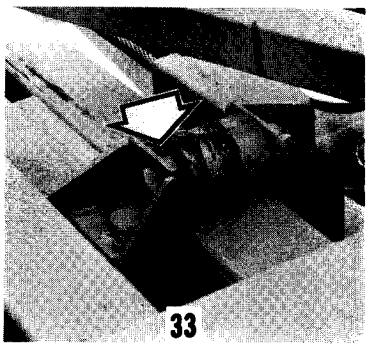






20. Kingpin Upper Bearing —
Check level of grease at upper bearing every 500 hours. Repack if the level is below upper bearing, use wheel bearing grease (medium).

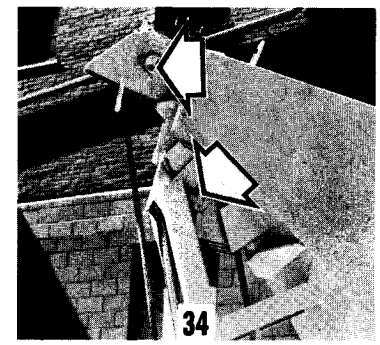
21. Quick Release Cable Drum —
Check the oil level every 100 hours. Drain and change oil every 1000 hours. Use SAE #90 E.P. gear oil for temperatures above 32° F., and SAE #80 E.P. gear oil for temperatures below 32° F. Capacity —approximately ½ gallon. To check the oil level, rotate drum until fill plug is in line with "Oil Level" mark on frame. Remove plug and check oil level.

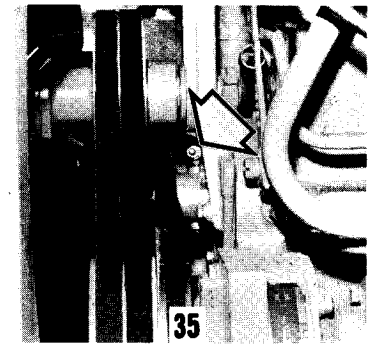
22. Transmission (Power Shift) —
Check oil level every shift. Change oil every 500 hours, or more often if operating conditions warrant. Use Hydraulic Transmission Fluid, Type "C".

23. Transmission Breather (Power Shift) —
Wash in cleaning fluid and dip in clean oil every 100 hours.

24. Transmission Sump Screen (Power Shift) —
Remove and clean every 500 hours or every oil change. Refer to page K-9 for procedure.

25. Transmission Oil Filter (Power Shift) —
Replace elements every 500 hours. Refer to page K-9 for procedure.





26. Transmission (Step Gear) —
Check oil level every 100 hours. Change oil after first 100 hours of operation. Subsequent changes to be made at 500 hour intervals. Use SAE #140 straight mineral oil for temperatures from 32 to 90° F., and SAE #90 straight mineral oil for temperatures below 32° F. Capacity—18 quarts.

27. Transmission Oil Filter (Step Gear) —
Change filter element after first 100 hours of operation. Subsequent changes to be made at 500 hour intervals.

28. Transmission Shift Linkage (Auxiliary)
Lubricate every 100 hours. Use chassis grease (heavy) for temperatures above 32° F., and chassis grease (medium) for temperatures below 32° F. One or two shots with a hand gun should be sufficient. If not equipped with grease fitting, apply one or two drops of engine oil at each joint or connection.

29. Parking Brake Linkage —
Lubricate every 100 hours. Use chassis grease (heavy) for temperatures above 32° F., and chassis grease (medium) for temperatures below 32° F. If not equipped with grease fitting, apply one or two drops of engine oil at each joint or connection.

30. Hydraulic Retarder Linkage —
Lubricate every 100 hours. Use chassis grease (heavy) for temperatures above 32° F., and chassis grease (medium) for temperatures below 32° F. If not equipped with grease fitting, apply one or two drops of engine oil at each joint or connection.

31. Wheel Bearings (Trail Unit) —

Lubricate every 100 hours. Use wheel bearing grease (medium). Fill housing approximately ½ full.

32. Steering Gear and Pinion —

Check the lubricant level every 100 hours. Change grease only when trunnion is disassembled. Use wheel bearing grease. Fill to 1" above bottom of the pinion gear.

33. Rollers —

Lubricate every shift. Use chassis grease (heavy) for temperatures above 32° F., and chassis grease (medium) for temperatures below 32° F. The lower covered rollers on scraper tailgate are to be checked every 1000 hours. Repack the bearings at time of disassembly.

34. Sheave Bearings —

Lubricate every shift. Use chassis grease (heavy) for temperatures above 32° F., and chassis grease (medium) for temperatures below 32° F.

35. Water Pump —

Lubricate every 500 hours. Use ball bearing grease (sodium soap base). Two or three strokes with a hand gun should be sufficient. Do not over lubricate.

ELECTRICAL THEORY AND TESTING

INDEX

ELECTRICAL THEORY AND TESTING

The electrical system on LeTourneau-Westinghouse equipment consists of five basic circuits. These circuits are: Basic Excitation, Three Phase Power, Battery Charging, Booster and Control.

In order for the mechanic to do a more thorough job of testing the system it is necessary that he understand the operation of the circuits and their component parts.

Following is a brief description of the circuits, generator, transformer, and rectifiers.

The circuit diagrams are representative of the system and are not intended as hook up diagrams.

THEORY

Basic Excitation Circuit

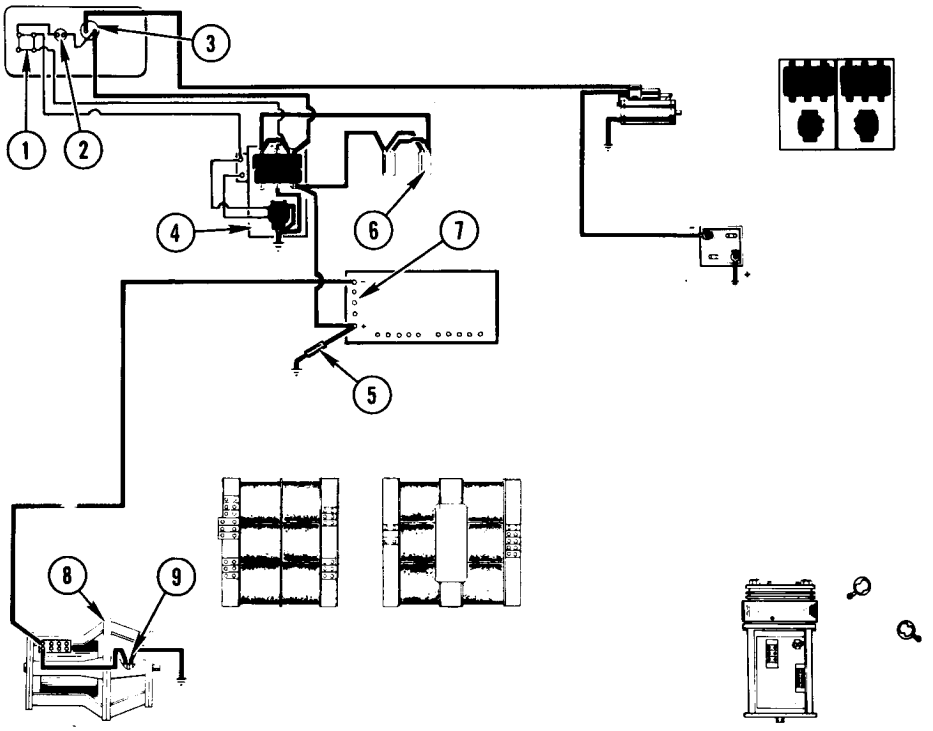


FIGURE L-1. BASIC EXCITATION CIRCUIT

1. D.C. Main Switch
2. Key Switch
3. Ammeter
4. D.C. Circuit Breaker Switch
5. Resistor
6. Capacitor
7. Booster Rectifier
8. A.C. Generator
9. Slip Rings (Field)

The purpose of the basic excitation circuit is to provide the direct current necessary to initially excite the alternating current generator.

Before any usable amount of alternating current can be generated and delivered to the electrical system, an exciting current must be flowing through the generator field and the field itself must be rotating.

The engine, to which the generator rotor is directly connected, drives the rotating field (rotor). The basic excitation circuit provides the current flow through the field windings.

Closing the key switch and the d.c. main switch on the instrument panel allows the direct current from the batteries to flow through the switches and through the booster rectifier to the generator field windings (through one generator brush and slip ring). The current flows through the field windings, out the outer slip ring and brush, to a grounded terminal, then on to the batteries completing the circuit.

Capacitors are connected across the direct current field breaker switch to prevent arcing of the switch points when the switch is closed.

Three Phase Power Circuit

The purpose of the three phase power circuit is to provide the current necessary to operate the alternating current induction motors.

When rotating at 1800 RPM, and properly ex-

cited by the excitation circuit, the generator will deliver 3 phase, 300 volts, 120 cycle, alternating current to an electric motor when the power circuit to that motor is closed.

When the main switch between the generator and the motor is closed, current flows from the generator stator windings through the heavy primary windings of the voltage control transformer and the main switch to the motor stator windings and to the brake coils on the motor releasing the electromagnetic motor brake, and rotating the motor rotor simultaneously.

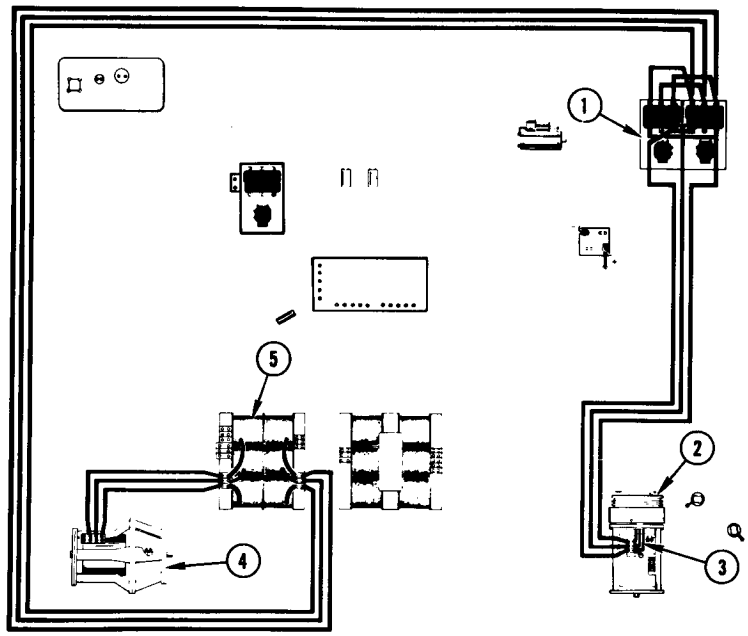


FIGURE L-2. THREE PHASE POWER CIRCUIT

1. Main Switches
2. A.C. Motor
3. Brake Leads
4. A.C. Generator
5. Voltage Control Transformer

Battery Charging Circuit

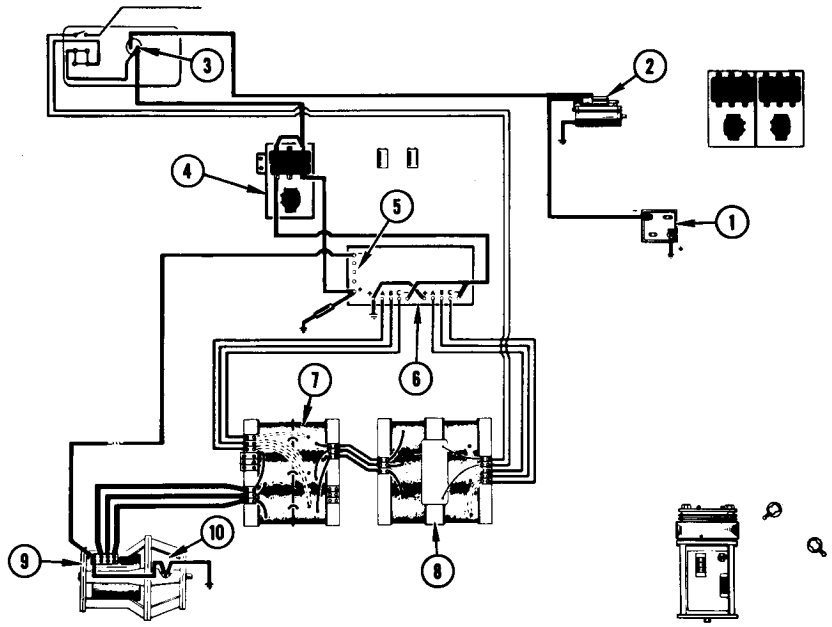


FIGURE L-3. BATTERY CHARGING CIRCUIT

1. Batteries
2. Starting Motor
3. Ammeter
4. D.C. Circuit Breaker Switch
5. Main Rectifier
6. Battery Charging and Compensating Rectifier
7. Voltage Control Transformer
8. Main Transformer
9. A.C. Generator
10. Slip Rings (Field)

The purpose of the battery charging circuit is to provide current necessary to keep the storage batteries in a charged condition and provide no load excitation to the generator.

As the generator output increases the compensating part of the voltage control transformer and the main transformer are energized, sending an a.c. output into the battery charging and compensating rectifiers.

The output of the main transformer varies with the position of its flux bridge, the amount of current flowing through the main transformer primary windings, and also in proportion to the amount of current flowing through the flux bridge windings, as used by lights and accessories.

The output of the compensating part of the voltage control transformer varies as the load on the system varies.

These two outputs are changed to direct current in the battery charging and compensating rectifier and are available upon demand for battery charging and generator excitation.

Booster Circuit

The purpose of the booster circuit is to provide a means of maintaining the generator output when a load is placed on the electrical system.

When the main switch between one of the motors and the generator is closed, current flows from the generator stator to the motor through the primary windings of the voltage control transformer.

If the load on the motor increases or if additional motors are operated, the current flow from the generator through the heavy primary windings of the voltage control transformer increases to handle the additional load.

The output of the secondary windings of the booster half of the voltage control transformer is proportional to the amount of current flowing through the primary windings. When current does flow through the primary windings, induced current at a reduced voltage flows from the secondary windings to the booster rectifier.

Here the alternating current is converted into direct current and fed into the excitation circuit being supplied by the compensating portion of the voltage control transformer and main transformer, (see Battery Charging Circuit) increasing the generator output to take care of the increased load without a drop in the terminal voltage at the generator output terminals.

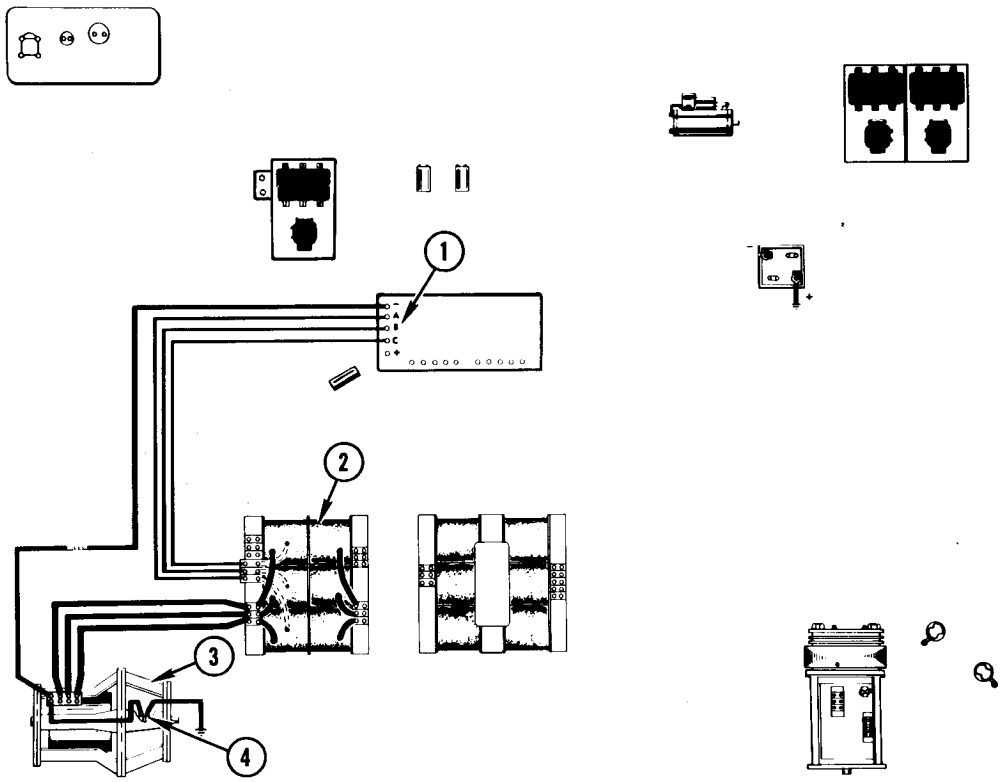


FIGURE L-4. BOOSTER CIRCUIT

1. Main Rectifier
2. Voltage Control Transformer
3. A.C. Generator
4. Slip Rings (Field)

Control Circuit

The control circuit provides current necessary to operate the main switches in the 3 phase power circuit.

The control circuit for each motor includes the control switch on the control panel, main switch holding coils, heat control switch, and limit switch (if used).

When the control switch on the control panel is closed, current from one phase of the three phase system flows from the constant voltage transformer through the switch. From the control switch the current flows through the main holding coil, through the limit switches and heat control switch, back to one of the remaining two phases (activating the switch). As the main switch is activated three phase current flows to the motor and brake causing the motor to operate (see Three Phase Power Circuit).

When the component operated by the motor has reached its safe limit of travel the limit switch opens the control circuit, the main switch opens, stopping the flow of current to the motor, and the motor stops. The motor can be operated in reverse until the limit of travel has been reached in the opposite direction.

If the temperature of the motor at any time exceeds safe operating limits, the heat control switch automatically opens the control circuit to the motor. This is true of all motors except the steering motor. On the steering motor the heat switch is connected with a warning light on the instrument panel. This light remains on at all times unless the temperature of the steering motor exceeds the safe operating range, opening the circuit and causing the light to go off.

When the motor has cooled to safe operating temperatures the switch closes the circuit and the motor will operate or the steering motor warning light will come on again.

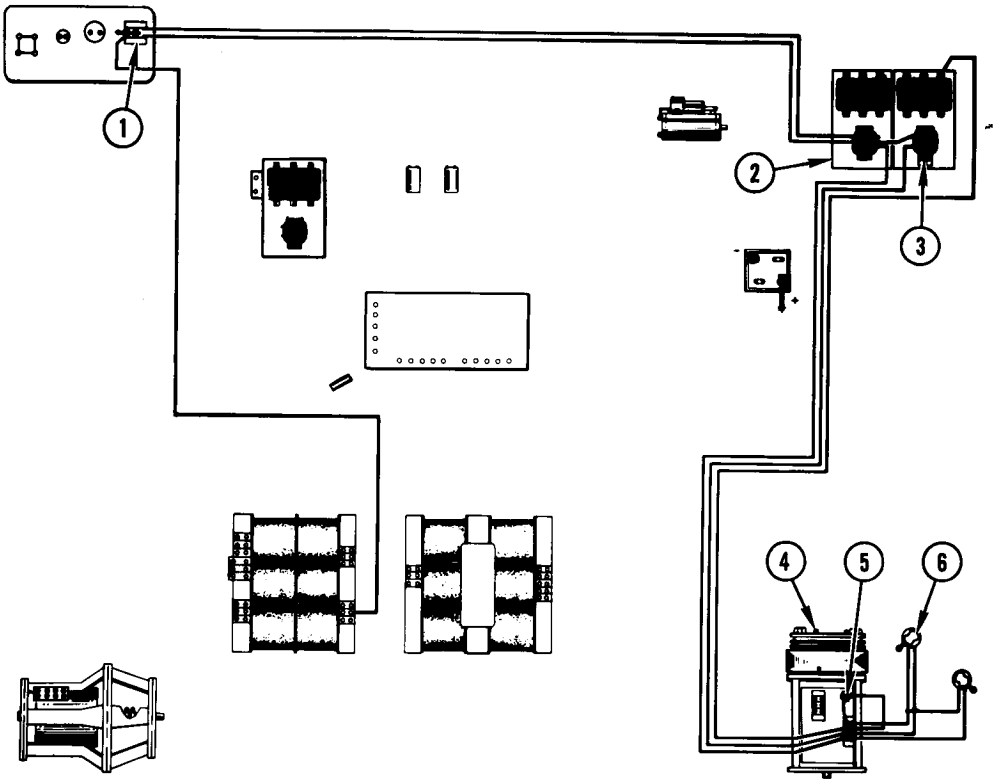


FIGURE L-5. CONTROL CIRCUIT

1. Control Circuit
2. Main Switches
3. Holding Coil
4. A.C. Motor
5. Heat Switch
6. Limit Switch

A.C. Generator

The a.c. generator operates on the principle of a coil cutting magnetic lines of force causing a current to flow in the coil windings. The coil in this case is stationary (stator), while the magnetic field (rotor) rotates.

The generator is mounted in line with and is driven by the engine. This unit is designed and constructed to produce current without the fluctuation and power loss of the ordinary generator, and to handle the loads required by the various oper-

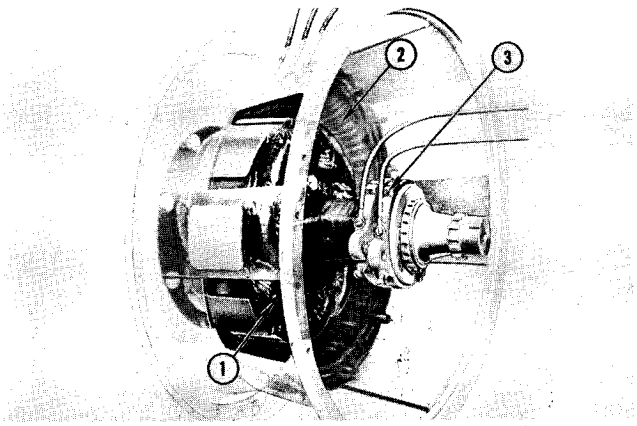


FIGURE L-6. A.C. GENERATOR
1. Rotor 2. Stator 3. Brush Assembly

ations peculiar to the equipment.

The generator is a three phase, 8 pole, 300 volt, 120 cycle, rotating field type, rated on the basis of rotor speed of 1800 RPM.

The three major assemblies that make up the a.c. generator are:

1. Stator — the outside or stationary member which bolts to the engine flywheel housing at the front and to the end bell at the rear.

2. Rotor — the rotating member which is attached to the engine flywheel by a drive disc and to the secondary flywheel by a splined hub.

3. Brush Holder — two aluminum brush holders hold the segments of the generator brushes. The holder farthest from the engine is grounded to the generator end bell. The other holder is connected to the terminal strip on the generator stator. Both holders are insulated from the holder nuts by insulating bushings.

Each split type holder is composed of two half rings, held together by capscrews. Two clips are inserted between the two halves, extending slightly into the counterbore which holds the brush segments, preventing them from turning in the holder. The brushes are made of graphite carbon. Non-adjustable springs between the brush holders give the required amount of brush tension as the brushes make contact with the rotor slip rings.

The exciting current flows through the generator field wire to the inside slip ring, through the rotor windings and out the rear slip ring to the ground. With the rotor energized and rotated by the engine, the lines of force set up by the magnetic field in the rotor are cut by the stator windings, thereby generating alternating current. The current leaves the stator by the three a.c. leads from the generator to the constant voltage transformer.

Transformers

A transformer is basically a devise for receiving electric current at one voltage and sending it out at a different voltage. The output voltage may be either higher or lower than the input, depending upon the windings. The input coil is directly connected to the main line and is called the primary coil. The output coil is connected to the secondary line and is called the secondary coil.

A two unit transformer group, mounted under the right cockpit floor plate, provides excitation current for the a.c. generator field, and current for charging the batteries. Rectifiers convert the alternating current from the transformer secondary windings into the direct current required for generator excitation and battery charging.

The voltage control transformer, with a "built-in" boostering action to the generator excitation circuit, is connected in the excitation circuit to help maintain constant voltage at the generator output terminals regardless of the varying loads experienced during the operating cycle.

The main transformer unit provides current necessary for no load excitation of the generator, and keeps the batteries charged. The flux bridge winding is used as an electrical means of controlling the output and charge rate of the main transformer. The flux bridge is nothing more than a path for the magnetic lines of force from the primary windings to by-pass the secondary windings if necessary. The more lines of force that by-pass the secondary windings (via the flux bridge), the less the transformer output.

By electrically controlling the amount of lines of force permitted to flow through the flux bridge and therefore by-pass the secondary windings, the output of the main transformer can be controlled.

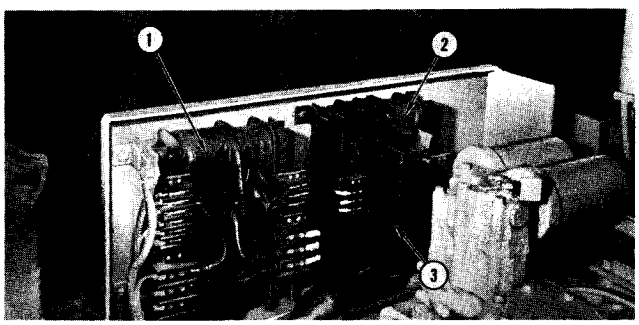


FIGURE L-7. TRANSFORMER
1. Voltage Control Transformer 2. Main Transformer
3. Flux Bridge

Rectifiers

Selenium coated plate type rectifiers, mounted in the air stream of the engine air intake, receive alternating current from the transformer's secondary windings and deliver direct current to the generator field, battery charging system, and for the operation of lights and accessories.

The rectifiers consists of full wave selenium coated aluminum plates, with suitable connectors and insulators.

Selenium will allow current flow in one direction only when it is plated on aluminum. This flow is always from the selenium side to the aluminum side of a plate. If a single phase is connected to the selenium side of one plate and the aluminum side of another, connecting the aluminum side of the first plate to the selenium side of the second will produce a pulsating direct current in an external circuit when the phase itself is alternating. For a three phase system (as used in LeTourneau-Westinghouse equipment), the minimum number of plates would be 6 or multiples of this, dependent upon the use to which the rectifier is subjected.

The direct current from the battery charging rectifier must flow through the batteries, out the battery ground to the grounded terminal of the rectifier to complete battery charging circuit. Therefore, the battery charging rectifier is the only one that is grounded.

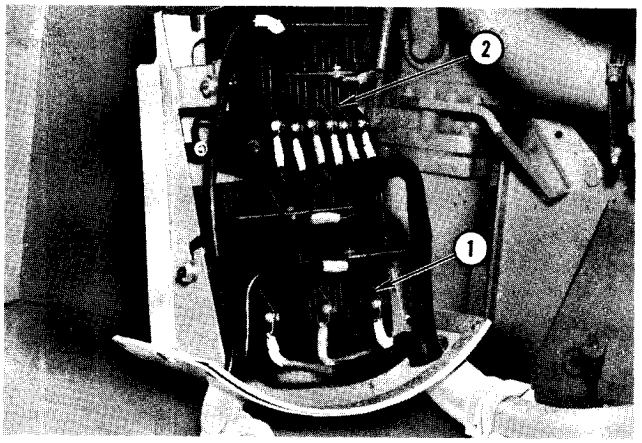


FIGURE L-8. RECTIFIERS

1. Booster Rectifier
2. Battery Charging and Compensating Rectifier

TESTING
Test Meter

This test meter has been designed specifically for LeTourneau-Westinghouse electrical equipment testing. Encased in a steel box with a leather carrying handle, it is small enough to be carried from job to job.

Although the test meter is a very accurate instrument, it is not a delicate piece of laboratory equipment. However, the user of this meter should exercise reasonable caution in its use. It should not be dropped or roughly handled.

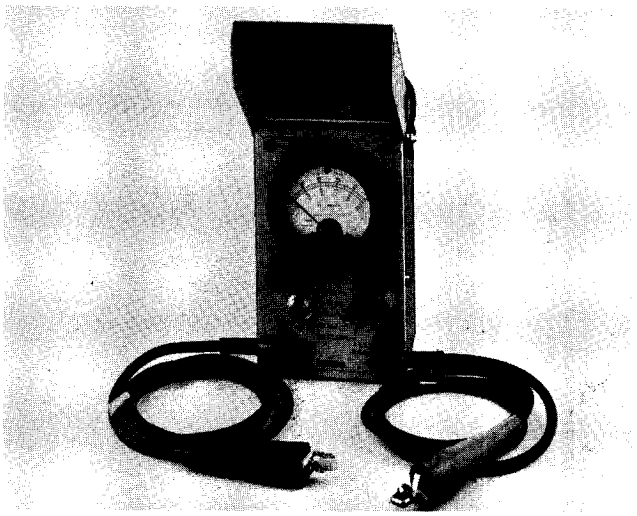


FIGURE L-9. TEST METER

The meter may be used for both alternating current (a.c.), and direct current (d.c.) volts, also for d.c. amperes. The following scales are available on the meter and are sufficient to cover all tests on LeTourneau-Westinghouse equipment.

0 to 500 Volts A.C.	0 to 100 Volts D.C.
0 to 100 Volts A.C.	0 to 100 Amps D.C.
	0 to 200 Volts D.C.

In addition to the above the meter includes built in batteries and a test lamp. This test lamp is used for ground tests and for checking continuity of wires.

Directly below the meter are two binding posts labeled (+) and (—). These binding posts are to be used only for d.c. amperage tests. Use the test leads supplied with the meter.

The binding posts at the bottom of the meter, also marked (+) and (—), are used for all voltage (both a.c. and d.c.) and for ground and continuity tests with the test lamp. Use the test leads supplied with the meter.

The selector switch is a six position switch and can be set to the scale desired. Positions are marked clearly and identified.

The meter should be checked for accuracy 2 or 3 times each year. This accuracy test can be a comparative test using another new test meter or the meters in any good electrical shop as standard.

Flashlight batteries for the test lamp are standard #1 batteries and can be purchased from most retail stores. The test lamp itself is a 2 volt pintle type lamp, No. GE 49, which can be purchased in any radio shop or electrical supply house.

Batteries can be replaced by removing the four screws securing the meter panel to the case.

CAUTION: Never place the test leads across a live circuit with the selector switch set in the test lamp position. The current in the live circuit will probably be more than the lamp capacity, causing it to burn out.

Keep meter face and case free from grease and dirt. Do not drop or abuse meter. With good care it should give long and satisfactory service.

D.C. Amperage Tests

For direct current amperage tests it is necessary to disconnect the wire under test and connect the test meter in series with this wire since amperage tests are series or "in-the-line" tests.

Attach the two test leads to the top pair of binding posts marked "D.C. Amps". Turn the selector switch to the position marked "100 D.C. Amps".

Disconnect the wire under test and fasten this wire to one of the leads on the test meter.

Touch the second meter lead to the connector and remove it with rapid motion. Watch the needle carefully. Make certain that the needle is not swinging off the scale to the right. Under this condition a short circuit is indicated and if the meter is left in the circuit for any appreciable length of time, it will sustain damage resulting from the heavy current flow.

Short circuit tests should be made only when engine is stopped.

After checking for short circuits, as described above, fasten the meter lead to the connector.

While making direct current checks, should the meter needle swing to the left rather than the right, polarity of the meter is reversed and the test leads must be reversed. The left swing is then changed to right.

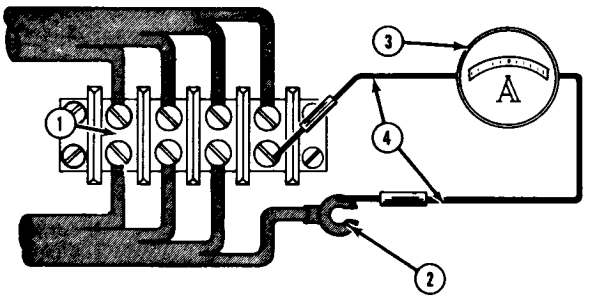


FIGURE L-10. D.C. AMPERAGE TEST

1. Terminal Strip
2. Wire
3. Ammeter
4. Test Leads

After the meter has been connected, testing is a matter of comparing the reading on the correct printed scale on the meter face with the known value obtained under normal conditions and operation.

Voltage Tests

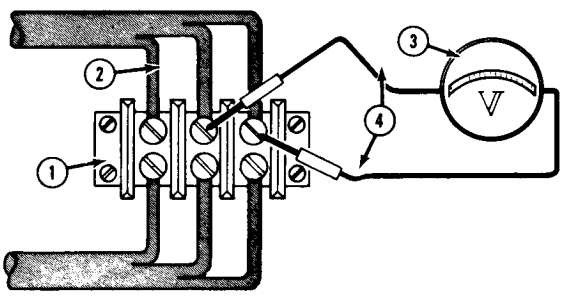


FIGURE L-11. A.C. VOLTAGE TEST

1. Terminal Strip
2. Wire
3. Voltmeter
4. Test Leads

Before making any voltage test determine if the test is going to be in alternating or direct current voltages. Select the meter scale to be used accordingly. If this precaution is not taken, the meter may be seriously damaged.

Proceed with the test, reading the scale calibration corresponding to the test being taken.

A voltage test, whether it be alternating or direct current, is always an "across-the-line" test and no wires need be disconnected.

Attach the two test leads to the two bottom binding posts on the test meter. Turn the selector switch to the position on the scale desired. Using the clip ends of the test leads, connect the meter across (in parallel with) the circuit or equipment under test.

After the meter has been connected as described above, testing again is a matter of comparing the reading on the correct printed scale on the meter face with the known value obtained under operation.

In testing d.c. volts it may be necessary to reverse the clip positions to obtain the correct direction of swing of the meter needle. This condition will not arise during the a.c. voltage tests.

A variation of the voltage readings between phases of the motor being tested indicates an open circuit either in the motor or in the conductor cable between the motor and the main switch.

Figure L-12 gives readings on the a.c. voltmeter taken with the point of test between the generator

and the open in the circuit. Tests are made in two of the three leads at one time. One lead will be present in two of the three tests which will have high voltage readings, and the open can be isolated in this lead. (Main switch must be closed.)

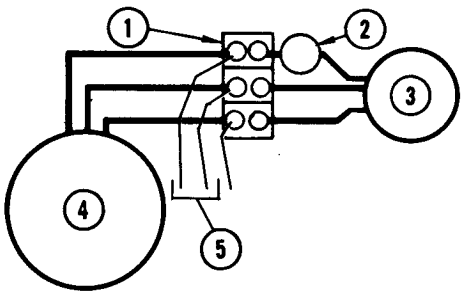


FIGURE L-12. HIGH VOLTAGE READING

1. Terminal Strip
2. Open
3. Motor
4. Generator
5. High Reading

Figure L-13 gives readings on the a.c. voltmeter when the open in the circuit is between the point of test and the generator. Note also that the same lead is present in both low readings. The open can then be isolated in this lead.

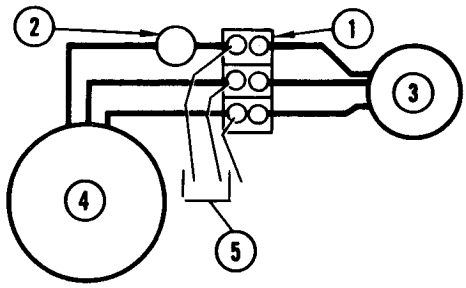


FIGURE L-13. LOW VOLTAGE READING

1. Terminal Strip
2. Open
3. Motor
4. Generator
5. Low Reading

Continuity Test

An open or ground in the stator can be located by a continuity test after the leads to the brake coils have been disconnected.

An open in the leads to the motor can be located by a continuity test.

A continuity test is a test to determine whether or not an individual wire has a break which will prevent it from conducting current, and to localize the break.

Attach the two test leads to the two bottom binding posts on the test meter. Position the selector switch in the test lamp position.

If the lead from the test lamp will reach from one end of the wire to be tested to the other, it is only necessary to disconnect one end of the wire, and apply one test meter lead to each end of the wire. If the lamp glows, the wire is not broken. If the lamp fails to glow, the wire has a break somewhere along its length causing an open circuit. Either locate the break and repair it or replace the wire.

If the test leads will not reach from one end of the wire to the other, one of the two following methods may be used:

1. Add extensions to the test meter leads or;
2. Disconnect each end of the wire to be tested. Fasten one end to a good electrical ground then touch the other end with one of the test lamp leads. Hold the other test lead to the same ground. The test lamp should glow if the wire is not broken.

Often the break can be localized if as the test lamp is being used on the wire in question, the wire is flexed at the points which are apt to be flexed during operation of the machine. Should the light glow or flicker as the wire is being flexed a break at that point is indicated. While in some cases the break can be repaired, it is advisable when possible to replace the entire cable with a new one. Since the flexing may have weakened other wires in the same cable.

Ground Test

The LeTourneau-Westinghouse three phase system is an ungrounded system. Therefore whenever occasion arises for testing the system always make a ground test in conjunction with any test. A ground test should be made as a preventive maintenance measure at least three times a year.

Place one lead of the test light on a connector in the circuit to be tested and place the other lead on a good electrical ground on the frame of the machine. A lighted lamp during the test indicates a ground. When attempting to isolate a ground in generator, motor or transformer, all wires must be disconnected from the terminal strips of the unit being tested, completely isolating the unit from the rest of the electrical system. Place one test lead on an a.c. terminal and the other lead to the ground. Repeat the test for each of the terminals.

REMEMBER, the system, since it is an ungrounded system, must have two grounds to completely ground and short a circuit. An indication of arcing and burning at one point due to ground can mean that the circuit is grounded at one other point also. Locate and correct this before operating the machine. If the second ground is not located, failure may result at this point during future operations.

Test Procedures

Before making any test read the instructions carefully on making amperage and voltage tests. Select the proper scale on the test meter for the test, being sure that the scale selected is sufficient to accommodate the highest reading to be encountered. Make certain any leads removed to make a test are reconnected before proceeding to the next one.

When making ground tests, the unit being tested must be completely isolated. Disconnect all leads from the terminal strips. Make the required tests and replace the leads.

The readings given are achieved with batteries and component parts of the electrical system in good operating condition. The engine is running at high idle (approximately 2220 to 2260 RPM).

Voltage readings taken may vary slightly due to the temperature at which the generator is operating. A higher temperature will result in a lower voltage reading. However, the temperature will not cause a variation between any two phases during the same test.

When making a test with the test lamp, touch the ends of the two test leads together to make certain the batteries and the lamp bulb are in good condition. The lamp should glow.

The test following were made under normal no load conditions. The readings are approximate, definite readings cannot be given because of the difference in normal operating characteristics of each machine.

Batteries

The batteries must be operated at or near full charge and keep the electrolyte at the proper level. A battery half charged or less cannot be depended upon for starting and wears out rapidly. A low battery indicates that the charging system is out of adjustment or very often an old or defective battery.

The following is a chart indicating charge at different specific gravity readings:

CHARGE	SPECIFIC GRAVITY
Full	1.280
Half	1.225
Discharge	1.150

In tropical climates, full charge should read between 1.200 and 1.215 specific gravity. The battery charging circuit should maintain the battery specific gravity above 1.155.

The specific gravity of the electrolyte varies with the temperature. As the temperature increases, the electrolyte expands or becomes thinner so that the specific gravity is reduced. As temperature drops the electrolyte contracts or becomes thicker so that the specific gravity increases. Unless these variations in specific gravity which are produced by temperature are taken into account, the readings may not give a true indication of the state of charge of the battery.

Correction can be made for temperature by adding four gravity points to the reading for every 10 degrees that the electrolyte is above 80° F. For every 10 degrees that the electrolyte is below 80° F., four gravity points must be subtracted from the gravity reading.

The voltage reading across each cell of the fully charged battery should be 2 volts d.c.

Refer to batteries in section "K" of this manual for proper electrolyte level and maintenance of batteries.

A.C. Generator

(AMPERAGE TO THE GENERATOR FIELD)

Attach the two test meter leads to the top binding posts. Set the selector switch to the 100 D.C. Amp scale. Read the bottom scale on the printed meter face.

Disconnect the field lead from the generator terminal strip. Connect the test meter in series with the lead and the terminal strip.

Turn on the key switch and the D.C. Main Switch. Meter should read approximately 11 to 14 d.c. amps.

Start the engine and after it has warmed up to operating temperature, operate at high idle. The meter should read approximately 22 to 27 d.c. amps.

Do not operate any electric motors during this test.

(VOLTAGE TO THE GENERATOR FIELD)

Attach the two test leads to the bottom binding posts. Set the selector switch to the 100 D.C. Volt scale. Read the second scale from the bottom of the printed meter face.

Attach one of the test meter leads to the field wire at the generator terminal strip. Attach the other test meter lead to a good ground. No wires are to be disconnected during this test.

Turn on the key switch and the D.C. Main Switch. Meter should read approximately 16 to 19 volts d.c.

Start the engine and after warm up operate at high idle. Meter should read approximately 28 to 31 volts d.c.

Do not operate any electric motors during this test.

(OUTPUT VOLTAGE — NO LOAD)

Attach the two test meter leads to the bottom binding posts. Set the selector switch to the 500 A.C. Volt scale. Read the top scale on the printed meter face.

Turn on the key switch and the D.C. Main Switch. Start the engine and after warm up operate at high idle.

Make a voltage test across the three a.c. terminals on the generator terminal strip, (three tests, A to B, A to C, and B to C). Meter should read approximately 370 to 390 volts a.c. Readings should not vary over 5% between any two tests.

No wires are to be disconnected during this test. Do not operate any electric motors.

(STATOR GROUND TEST)

Attach the two test leads to the bottom binding posts. Set the selector switch to the Lamp Short position.

The stator must be completely isolated from the rest of the electrical system. Disconnect all leads from generator terminal strip. Attach one test lead to an a.c. terminal, touch the other lead to a good electrical ground on the frame of the machine. The lamp should NOT glow.

If the lamp does glow it indicates there is a ground in the phase being tested. Make three tests (A to ground, B to ground, and C to ground).

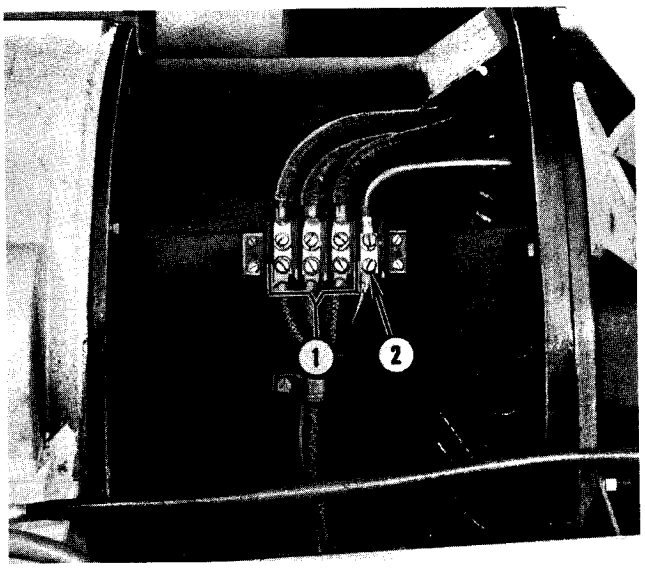


FIGURE L-14. GENERATOR TERMINAL STRIP

1. A.C. Terminals
2. Field Terminal

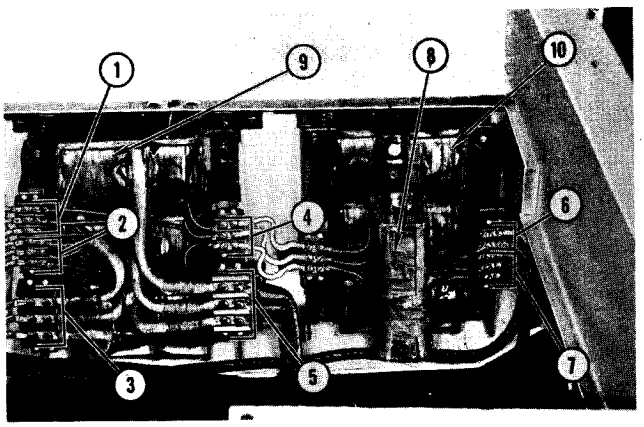


FIGURE L-15. TRANSFORMER TERMINAL STRIPS

1. A.C. Output to Compensating Rectifier
2. A.C. Output to Booster Rectifier
3. A.C. Input
4. A.C. Output To Main Transformer
5. A.C. Output to Power Circuit
6. Accessory Circuit
7. A.C. Output to Main Rectifier
8. Flux Bridge
9. Voltage Control Transformer
10. Main Transformer

Transformers

(A.C. INPUT)

Attach the two test leads to the bottom binding posts. Set the selector switch to the 500 A.C. Volt position. Read the top scale on the printed meter face.

Turn on the key switch and the D.C. Main Switch. Start engine and after warm up operate at high idle.

Make a voltage test across the three input terminals on the transformer terminal strip. Make three tests (A to B, A to C, and B to C). No wires are to be disconnected during this test. Do not operate any electric motors. Meter should read approximately 370 to 390 volts a.c.

NOTE: This reading should correspond with the generator output voltage.

(A.C. INPUT TO MAIN TRANSFORMER)

Attach the two test leads to the bottom binding posts. Set the selector switch to the 500 A.C. Volt position. Read the top scale on the printed meter face.

Turn on the key switch and the D.C. Main Switch. Start engine and after warm up operate at high idle.

Make a voltage test across the three a.c. input terminals on the main transformer input terminal strip. Make three tests (A to B, A to C, and B to C). Meter should read approximately 360 to 380 volts a.c., or 10 to 15 volts less than the preceding test. This is due to voltage drop across the voltage control transformer. Do not disconnect any wires for this test.

(A.C. OUTPUT — TO POWER CIRCUIT)

Attach the two test leads to the bottom binding posts. Set the selector switch to the 500 A.C. Volt position. Read the top scale on the printed meter face.

Turn on the key switch and the D.C. Main Switch. Start engine and after warm up operate at high idle.

Make a voltage test across the three a.c. output terminals on the voltage control transformer output terminal strip. Make three tests (A to B, A to C, and B to C). The meter should read approximately 370 to 390 volts a.c. This reading should be approximately the same as the a.c. input to the transformer. Any slight variation will be due to voltage drop across the transformer.

No wires are to be disconnected for this test.

(A.C. OUTPUT — BOOSTER PORTION OF THE VOLTAGE CONTROL TRANSFORMER)

Attach the two test leads to the bottom binding posts. Set the selector switch to the 100 A.C. Volt position. Read the second scale from the top of the printed meter face.

Turn on the key switch and the D.C. Main Switch. Start the engine and after warm up operate at high idle.

Attach the test meter leads to two of the three a.c. output terminals (the lower three terminals of the six terminal strip on the voltage control transformer). Make three tests (A to B, A to C, and B to C). The meter should read approximately 11 to 14 volts a.c. No wires are to be disconnected for this test.

(A.C. OUTPUT — COMPENSATING PORTION OF THE VOLTAGE CONTROL TRANSFORMER)

Attach the two test leads to the bottom binding posts. Set the selector switch to the 100 A.C. Volt position. Read the second scale from the top of the printed meter face.

Turn on the key switch and the D.C. Main Switch. Start the engine and after warm up operate at high idle.

Attach the test meter leads to two of the three a.c. output terminals (the upper three terminals of the six terminal strip on the voltage control transformer). Make three tests (A to B, A to C, and B to C). The meter should read approximately 21 to 23 volts a.c.

No wires are to be disconnected for this test.

(A.C. OUTPUT — MAIN TRANSFORMER)

Attach the two test leads to the bottom binding posts. Set the selector switch to the 100 A.C. Volt position. Read the second scale from the top of the printed meter face.

Turn on the key switch and the D.C. Main Switch. Start the engine and after warm up operate at high idle.

Attach the test meter leads to two of the three a.c. output terminals (the lower three terminals of the five terminal strip on the main transformer). Make three tests (A to B, A to C, and B to C). Meter should read approximately 21 to 23 volts a.c.

No wires are to be disconnected for this test.

(GROUND TEST)

Isolate the transformer from the rest of the system, by disconnecting leads from the transformer terminal strips. Attach one test lead of the test light to a voltage control transformer a.c. terminal, touch the other lead to a good ground. The lamp should NOT glow. If the lamp does glow it indicates a ground.

Repeat the above procedure for all of the terminals on the transformer.

Rectifiers

It must be assumed that the transformer output will be the same as the corresponding input at the rectifiers. However, due to possible aging of the rectifier, broken wires, or other defects, this does not insure that the rectifier is functioning properly.

If rectifier assembly is removed from the air cleaner housing for testing or for any other reason, the engine should not be operated unless the rectifier is definitely grounded; preferably by an extra ground wire from the rectifier assembly to a good electrical ground on the frame of the machine.

(BATTERY CHARGING AND COMPENSATING RECTIFIER OUTPUT)

Attach the two test leads to the bottom binding posts. Set the selector switch to the 100 D.C. Volt position. Read the second scale from the bottom on the printed meter face.

Attach one test meter lead to the cranking motor solenoid input terminal and the other lead to a good ground.

Turn on the key switch and the D.C. Main Switch. The test meter should read approximately 24 volts d.c. This is the battery voltage at the cranking motor.

Start the engine and after warm up operate at high idle.

Ammeter on the instrument panel should register a charge rate. The voltage reading on the test meter should be approximately 24 to 26 volts d.c.

A defective rectifier will not show a charge rate on ammeter. However, a rectifier may not show a charge rate because of age or loose a.c. connections. These conditions must be taken into consideration.

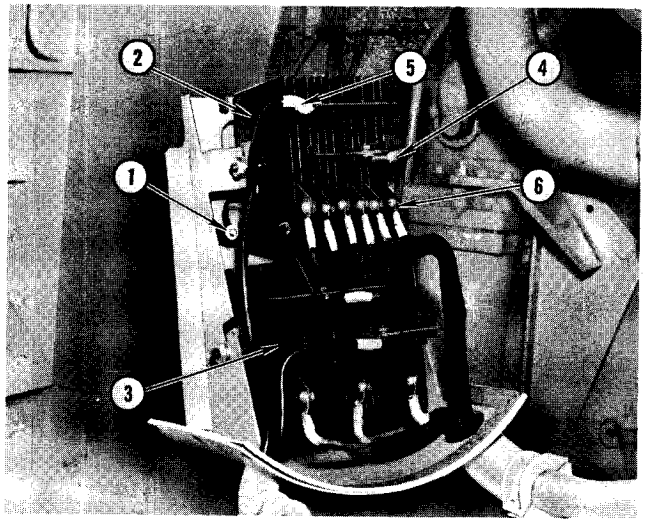


FIGURE L-16. RECTIFIER TERMINALS

1. Resistor
2. Battery Charging and Compensating Rectifier
3. Booster Rectifier
4. Positive Terminal (+)
5. Negative Terminal (−)
6. A.C. Terminal

(BOOSTER RECTIFIER OUTPUT)

Attach the two test meter leads to the bottom binding posts. Set the selector switch to the 100 D.C. Volt position. Read the second scale from the bottom of the printed meter face.

Attach one test meter lead to the generator field terminal and the other lead to a good ground. No wires are to be disconnected for this test.

Turn on the key switch and the D.C. Main Switch. Start the engine and after warm up operate at high idle. Meter should read approximately 28 to 34 volts d.c. This reading is the generator field voltage.

Subtract the battery charging and compensating rectifier output voltage (see previous test) from the field voltage. The difference is the no load output of the booster rectifier.

Do not operate any electric motors during this test.

(CONTINUITY)

If it is suspected that there is a defective rectifier, remove it from the housing and proceed as follows.

Attach the two test meter leads to the bottom binding posts. Set the selector switch to the lamp short position.

Attach one test lead to the mounting bolt of the rectifier under test. With the other lead, touch all other portions of the rectifier at random. A light during this test will indicate that a plate or plates are shorted out to the mounting bolt, and that the rectifier is defective.

Reverse the test leads and repeat the above test. This must be done, since occasionally the plates will short out in one direction only.

Attach either of the test lamp leads to any one of the a.c. terminals. Touch the other lead alternately to the d.c. positive terminal and the d.c. negative terminal. The test lamp should glow only when touching either the d.c. positive or the d.c. negative terminal. If the light glows when both terminals are touched, the rectifier is defective since the current is free to flow in both directions through the plates. If the light does not glow at all during this test, this also indicates a defective rectifier since it must pass current in one direction only to perform its function in the circuit.

Repeat the above test for the remaining a.c. terminals.

Reverse the test leads and repeat the above test. This is necessary because it is not possible to determine in advance in which direction the rectifier plates may be defective.

The brilliancy of the test meter lamp will vary with the number of plates in the rectifier being checked. Caution should be exercised when checking that the glowing lamp does not go undetected, especially when making tests in brightly lighted areas.

(VOLTAGE DROP)

Attach the two test meter leads to the bottom binding posts. Set the selector switch to the 100 D.C. Volt scale. Read the second scale from the bottom of the printed meter face.

Attach one test lead to the positive terminal of the rectifier being tested, and the other test lead to a good ground. No wires are to be disconnected for this test.

Turn on the key switch and the D.C. Main Switch. Record the voltage reading.

Attach one test lead to the negative terminal of the rectifier being tested, and the other to a good ground.

Turn on the key switch and the D.C. Main Switch. Make a voltage reading. Both readings should be the same (approximately 24 volts).

Control Circuit

(A.C. INPUT VOLTAGE TO SWITCH PANEL)

Attach the two test meter leads to the bottom binding posts. Set the selector switch to the 500 A.C. Volt scale. Read the top scale on the printed meter face.

Turn on the key switch and the D.C. Main Switch. Start the engine and after warm up operate at high idle.

Test the a.c. voltage across the three a.c. input leads at the point of connection with the first main switch on the switch panel. The a.c. input leads are part of the multiple wire conductor. Make three tests (A to B, A to C, and B to C). The meter should read approximately 370 to 390 volts a.c. There should be no more than 5% variation between any two readings. No wires are to be disconnected for this test.

(MAIN SWITCH)

If motor does not operate when the main switch is engaged, make the following tests:

Make a voltage test from input to output side of main switch as the finger tip control switch on the control panel is engaged and disengaged rapidly. Make three tests, one for each of the three leads. This test is made to determine whether or not the contactor switches are functioning. A voltage reading on all or any of these tests when the finger tip switch is closed indicates that the contactor points are not operating properly if the motor does not run.

(OPEN HOLDING COIL)

If the main switch does not pull in when the finger tip switch on the control panel is engaged there may be two sources of trouble, either an open holding coil or an open control circuit.

First make a voltage test, with the selector switch at the 500 Volt A.C. scale, across the two leads of the main switch holding coil as the finger tip switch is engaged. A voltage reading on this test indicates an open holding coil. Replace the coil. If, however, no voltage is recorded, proceed to test for an open control circuit.

(ISOLATING OPENS IN CONTROL CIRCUIT)

Since each circuit has its own "C" phase return, but all are energized by the same phase (A or B) the following assumptions may be made:

Should no control circuit work but normal voltage exists at the main switches, the open exists between the transformer and the control switches. If one control circuit does not function then the open exists in that circuit only.

The phase which has been used to energize the control circuits may be determined in this manner: set the test meter selector switch to the 500 Volt A.C. scale. Remove the "C" phase return lead from a switch that does not function. Attach one test meter lead to one of the remaining two phases as the control switch for that unit is operated. If meter registers a voltage reading, touch the other phase. The meter will register no reading when the input phase to the control circuits has been located.

Set test meter selector switch to the Lamp Short position. After the input phase has been determined, disconnect the leads at the holding coils that come from the control panel in the defective circuit. Attach one lamp lead to the energized phase, connect the other lead to the wire disconnected from the holding coil. Operate the finger-tip control switch. A light indicates that this circuit is complete through the control switch to the holding coil.

Attach one test lead to the coil terminal from which the lead has been removed. Attach the other to the return phase. A light indicates that

the control circuit is complete from the holding coil, through the heat switch, limit switch and back to the return phase. No light indicates an open in that part of the control circuit from the holding coil, through the heat switch, limit switch, to the return phase.

Place test lamp leads across holding coil terminal after disconnecting one of the leads to the holding coil.

If the coil is in good condition the test lamp will glow. A faulty coil will give no glow. Replace coil if defective.

(LIMIT SWITCH)

Check the limit switch for mechanical operation. If the limit switch is not defective mechanically, proceed with the following:

Use the test meter in the Lamp Short position. Do not operate the engine during this test. Keep the key switch and the D.C. Main Switch in the off position.

Make a test directly across the two connections of the limit switch controlling the movement which is not operating. For example: If the hoist motor on the bowl will go down but not up, make a test across the limit switch. If the light does not glow the limit switch is faulty and should be replaced.

NOTE: Actuating arm should touch the switch button until moving part has reached its limit of travel.

(HEAT CONTROL SWITCH)

The following is a test to determine the condition of the heat control switch.

Before making this test make certain that the heat switch is not open due to an overheated motor. If the switch is not too hot to touch for one second with a finger, the heat control switch should be closed.

Put the two test lamp leads directly across the two terminals of the heat switch. If the test lamp glows the heat control switch is in operating condition. If the lamp does no glow, the heat switch has failed and should be replaced.

(CONDUCTOR CABLES)

Make a visual inspection of all connections at both the main switch panels and the motor terminal strips.

If they are in good order, look for a pinched cable or a spot where the cable might be flexing. If a break is found, it can be repaired in some cases, however, it is advisable to replace the entire cable. See "Continuity Testing" for correct procedure when a break is suspected in a conductor.

(CONTROL PANEL)

Remove the machine screws securing the control panel to the cockpit and pull the panel down, exposing the rear of the panel.

If the open circuit has been isolated (by the previous tests) forward of the main switch the first thing to establish is whether or not the finger-tip control switch is functioning properly, as this is the most likely point of trouble.

Disconnect the top holding coil lead at the main switch that is controlled by the inoperative switch. Make certain that this lead does not touch any other leads or terminals in the main switch panel.

Test across the terminals of the finger-tip control switch controlling the movement that is inoperative.

Make tests on switches across terminals to which leads are connected. If the test lamp glows when switch is depressed, the switch is operating properly. If the lamp does not glow the switch is defective and should be replaced.

(CONTINUITY OF COCKPIT CONTROL CIRCUIT)

Make a continuity test on the conductor between the finger-tip control switch and the top of the holding coil.

Make continuity test on the conductor between the common lead terminal for the finger-tip switches and the center a.c. lead on the voltage control transformer output terminal strip.

A.C. Electric Motors

(MOTOR)

Attach the two test meter leads to the bottom binding posts. Set the selector switch to the 500 A.C. Volt position. Read the top scale on the meter.

Check the motor brake for proper clearance, binding, warping, and other mechanical troubles and make certain that there are no loose wires or

visible defects.

Turn on the key switch and the D.C. Main Switch. Start the engine and after warm up, operate at high idle.

Disconnect the three a.c. input leads from the motor terminal strip. Attach one test meter lead to one of the a.c. leads, and the other lead to another a.c. lead. Close the finger-tip control switch controlling the motor under test. Make three tests (A to B, A to C, and B to C).

Meter should read approximately 370 to 390 volts a.c. Readings should vary no more than 5% between any two readings.

Reconnect the a.c. leads to the motor terminal strip. Repeat the above test with the leads connected.

Readings should be the same as above. If normal reading is not obtained, disconnect brake leads. Make voltage readings (as above). If uneven readings persist, trouble is in the stator. If readings are even, trouble is in the brake coils or wires.

(GROUND TEST)

Turn the test meter selector switch to the Lamp Short position.

Disconnect the leads at the motor terminal strip (a.c. input, and the leads to the motor brake).

Attach one test lamp lead to an a.c. terminal and touch the other lead to a good ground, the lamp should not glow. If the lamp does glow, it indicates a ground. Make three tests (A to ground, B to ground, and C to ground).

Repeat the above test for the motor brake by attaching one test lamp lead to a brake lead and the other to a good ground on the motor frame. Make three tests. If the test lamp glows, a ground is indicated. Proceed to the next test. If no ground is indicated proceed to "Open Brake Coil" test.

(BRAKE COIL)

Disconnect both leads to the brake coil under test.

NOTE: Because of the manner in which the coils are interconnected, it would be difficult to localize the trouble should these leads be left connected.

Use a test lamp. Touch one test lamp lead to a good ground and touch each of the terminals on the coil with the other lead. If the test lamp glows, a grounded brake coil is indicated. Replace the coil.

(OPEN BRAKE COIL)

Disconnect one lead to the coil under test. Use a test lamp.

Touch one coil terminal with a test lamp and the other coil terminal with the remaining test lead. If the coil is in good condition the test lamp will glow. If the lamp fails to glow, the coil is open and should be replaced.

TROUBLE SHOOTING

All preceding tests have been made under normal no load conditions. The readings are approximate. Definite readings cannot be given because of the difference in normal operating characteristics of each machine.

Since each electrical system will have its normal operating characteristics, the ammeter readings are listed as deviations from the observed normal range of the machine.

It must be assumed that the batteries have been checked and are in good condition.

I. The following circuits can be checked with the key switch on and the D.C. Main Switch off.
   - A. Head Lights
   - B. Rear Lights
   - C. Windshield Wiper
   - D. Heater
   - E. Defroster

II. Turn on the key switch and press the cranking motor switch. If engine starts and runs properly, the following circuits have been checked.
   - A. Starting System
   - B. Batteries
   - C. Oil Pressure Switch
     1. If oil pressure switch does not operate, the following will not operate:
        - a. P.T. Fuel pump
        - b. Hourmeter

III. Basic Excitation Circuit. Turn on key switch and D.C. Main Switch. DO NOT start engine.
   - A. No movement of the ammeter needle indicates:
     1. Open in the excitation circuit between the D.C. Main Switch and the ground

at the generator. Friction between brush and slip ring may eventually wear away brush, increasing distance between the brush rings, and reducing spring pressure against brushes. This condition may increase resistance in the excitation circuit, reducing excitation current. If brush springs are exposed to high heat, springs lose their tension with the same result.

2. Open in the D.C. field breaker switch circuit between the D.C. Main Switch and the ground at the d.c. field breaker switch holding coil. (NOTE: Close the d.c. field breaker switch manually to differentiate between the two possibilities. (If machine is so equipped.)

B. Less than normal discharge indicates:
   1. Worn brushes or weakened brush springs. See "1" above.
   2. Poor ground at the brushes or poor contact. If brush rings are kept from sliding freely on their studs or if studs become misaligned and brush rings bind, the resulting poor contact may reduce or cut off the excitation current completely. This condition may result in no a.c. voltage at all, or in a.c. voltage which rapidly varies from normal to zero reading depending upon whether or not the brush is making contact with the slip ring at the time that the reading is taken.
      (NOTE: This condition will be apparent only when engine is operating, since brushes will not wobble when the rotor is stationary.)
   3. Increased resistance in booster rectifier.
   4. Poor connections.

C. More than normal discharge indicates:
   1. Short in rotor (loss of one or more field poles). This may be confirmed by:
      a. Excite the rotor directly (excluding the other portions of the basic excitation circuit), using 24 volt d.c. excitation current. Place a jumper wire directly from the batteries to the generator field. A current draw of more than approximately 20 amperes indicates a possible shorted rotor.
      b. Take three readings (phase to phase) of the no load, high idle output of the generator.
         (1) Low but even readings indicate a possible shorted rotor.
         (2) Uneven a.c. readings always indicate troubles in the a.c. system. Possibilities are:
            (a) Three phase wires
            (b) Generator stator
            (c) Transformer windings
            (d) Motor stator or brake
            (e) Main switches
      c. To check pole windings on generator rotor, insert a long steel shim between generator rotor and stator (with excitation current flowing in the field windings — but without engine operating).
         In a rotor in normal condition, each rotor pole will exert a definite pull on the gauge. No pull above a pole indicates that no current is flowing in the windings of the pole under test and that there must be an open in the excitation circuit between the pole windings and the source of the excitation current.
         If only one or two poles fail to exert a pull there may be a combined open and ground in the rotor.
         If all the poles fail to exert a pull there may be an open in either the rotor or in the excitation circuit outside the rotor.
         NOTE: Rear generator bearing failure may cause brushes to skip (make and break contact with the slip rings) giving erratic a.c. voltage. Misalignment of generator rotor or stator may result in scrubbing between the two units and a reduction in a.c. voltage. This condition normally does not affect the readings on a rotor test unless rotor windings have been damaged and shorts or opens are evident. If the scrubbing is very severe the stator and/or rotor may become damaged. As a precautionary measure check the air gap with a feeler gauge all around the rotor to make certain there is clearance (0.020" to 0.040") between the rotor and stator. Usually if the stator is at fault, it will have smoked or burned out because of the high current involved. However, unbal-

anced readings may occur when part of the coils in one phase are shorted out in the stator windings, and this condition may or may not have a visible effect on stator windings. With all other units in a normal condition, it can be assumed that the cause of a variation in the voltage readings lies in the generator stator windings if the variation occurs in a "no load" test. Should one or more windings short out of the field circuit both excitation current and the a.c. output voltage will be affected. Amperage to field will increase, yet due to loss of field windings, a.c. voltage will be reduced, (this can be applied to motor and transformer windings as well).

D. Complete discharge indicates:
   1. A short in the excitation circuit between the D.C. Main Switch and the generator slip rings.
   2. Short in the d.c. field breaker switch circuit between the D.C. Main Switch and the d.c. field breaker switch holding coil.
      (NOTE: Close the d.c. field breaker switch manually to differentiate between the two possibilities.)

IV. Three Phase Power Circuit. Turn on key switch and D.C. Main Switch. Start engine and after warm up, operate at high idle. Actuate motor finger-tip control switch.
   A. Motor hums and attempts to turn but will not start (known as single phasing).
      1. Operate other motors to determine if more than one motor is affected.
      2. If all motors single phase check generator voltage and continuity of 3 phase wires from generator to main switches.
      3. If only one motor single phases, check voltage at motor, and continuity of wires.

V. Battery Charging Circuit. Turn on key switch and D.C. Main Switch. Start engine and after warm up, operate at high idle.
   A. No charge rate indicates:
      1. No power to transformer coils.
         a. Check by running an electric motor or,
         b. Check with test meter at input terminal strip on transformer.
      2. No input to primary or output at secondary coils of main transformer.
         a. Check with test meter at battery charging and compensating rectifier a.c. terminals.
      3. Broken or loose wire from negative of battery charging and compensating rectifier to main switch.
      4. No output from main rectifier negative terminal.
   B. Less than normal charge rate indicates.
      1. Aging rectifiers
      2. Broken leads to rectifiers
      3. Flux bridge not shimmed out far enough.
   C. More than normal charge rate indicates.
      1. Flux bridge lost
      2. Flux bridge shimmed out too far.

VI. Booster circuit. Turn on key switch and D.C. Main Switch. Start engine and after warm up, operate at high idle. Depress fingertip control switch with motor or motors under load.
   A. Loss of power, improper releasing of motor brakes, overheating, indicates:
      1. Defective booster rectifier.
      2. Aging booster rectifier.
      3. Broken a.c. leads to booster rectifier.
      4. No output from secondary coils of the voltage control transformer. Even though the motor may operate under a low voltage condition, operating temperature will rise, in some cases high enough to cause the heat control switch to cut out the motor. If this occurs make a voltage check at the motor terminals while the motor is in operation.
         If power leads to brakes become broken or disconnected brakes may be only partially releasing, resulting in a drag on the motor. Burned out brake coils may have the same effect.
         Open coils in the stator are indicated by unequal voltage during a.c. voltage tests with the motor under load.
         The rotor may be dragging on the stator because of the following:
         a. Stator and end bell hold down bolts loose or tightened unevenly, boss filled with dirt, foreign material between stator and rotor. The rotor may be filled with dirt causing improper ventilation in the rotor because of the opening in the rotor stack being plugged up. Over-

loading of the assembly operated, failure of the gear box, or binding assemblies may cause additional drag on the motor.

VII. Control Circuit. Turn on key switch and D.C. Main Switch. Start engine and after warm up operate at high idle. Depress fingertip control switch.

A. Motor fails to operate.

1. Operate other switches to determine if one or more motors are inoperative.
2. Actuate contactor switch manually to isolate trouble. If motor fails to run check out power circuit. If motor does operate, the trouble is in the control circuit.
3. Check out the control circuit.

WIRING DIAGRAMS

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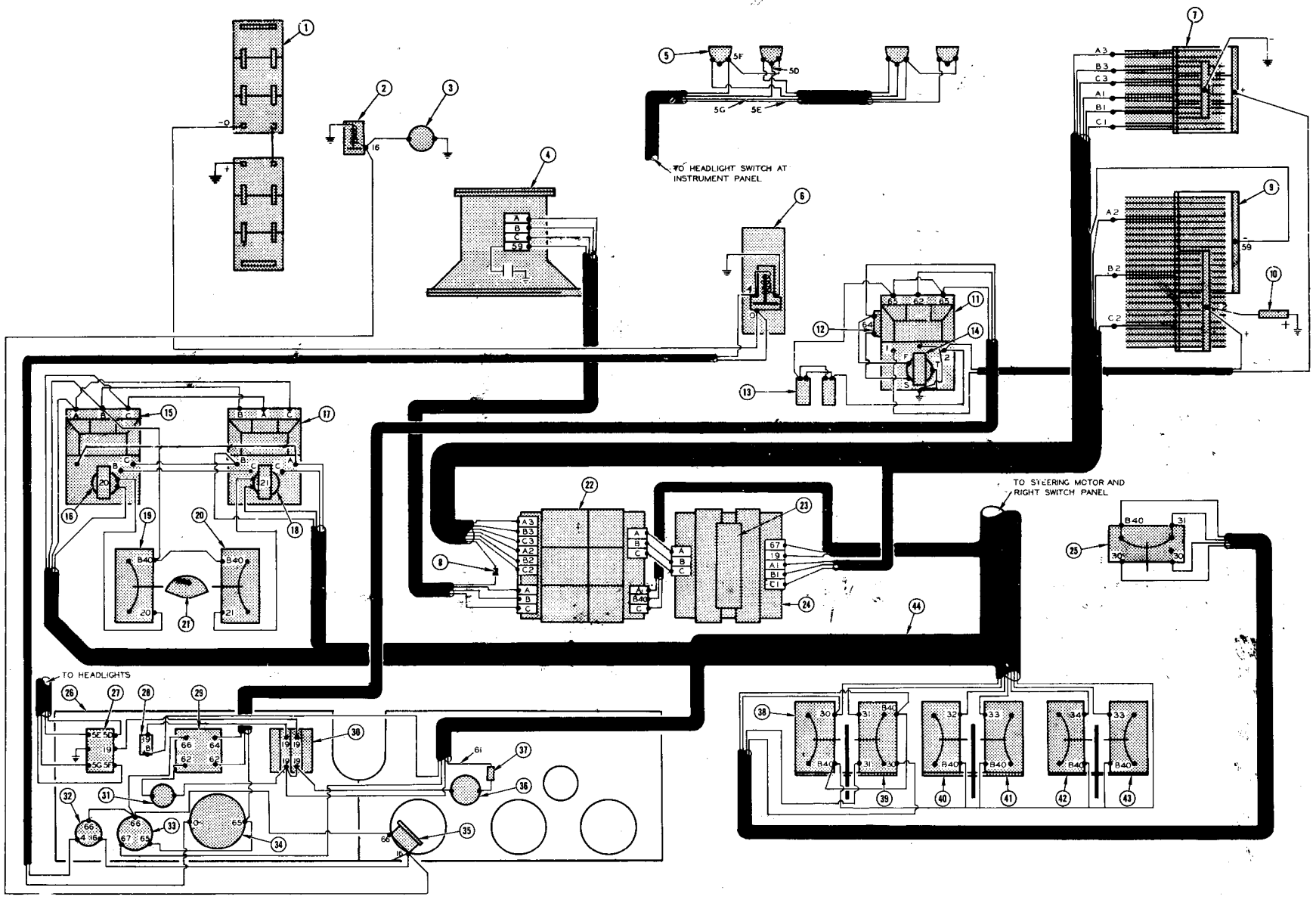

FIGURE M-1. TYPICAL WIRING DIAGRAM (TOURNAPULL)

1. Batteries (24 V.D.C.)
2. P.T. Fuel Pump Solenoid
3. Engine Hourmeter
4. A.C. Generator
5. Headlights
6. Cranking Motor
7. Battery Charging and Compensating Rectifier
8. Service Connector
9. Main or Booster Rectifier
10. Resistor
11. D.C. Field Breaker Switch
12. Interlock Switch
13. Capacitor
14. Breaker Switch Holding Coil
15. Right Turn Steering Main Switch
16. Right Turn Holding Coil
17. Left Turn Steering Main Switch
18. Left Turn Holding Coil
19. Right Turn Steering Switch
20. Left Turn Steering Switch
21. Steering Actuator Cam
22. Voltage Control Transformer
23. Flux Bridge
24. Main Transformer
25. Scraper Quick Drop Switch
26. Instrument Panel
27. Headlight Switch
28. Rear Light Switch
29. D.C. Main Switch
30. Terminal Strip
31. D.C. Main Switch Warning Light
32. Cranking Motor Switch
33. Key Switch
34. Ammeter
35. Oil Pressure Switch
36. Steering Motor Warning Light
37. Quick Disconnector
38. Hoist Up Control Switch
39. Hoist Down Control Switch
40. Apron Up Control Switch
41. Apron Down Control Switch
42. Tailgate Forward Control Switch
43. Tailgate Back Control Switch
44. Main Cable

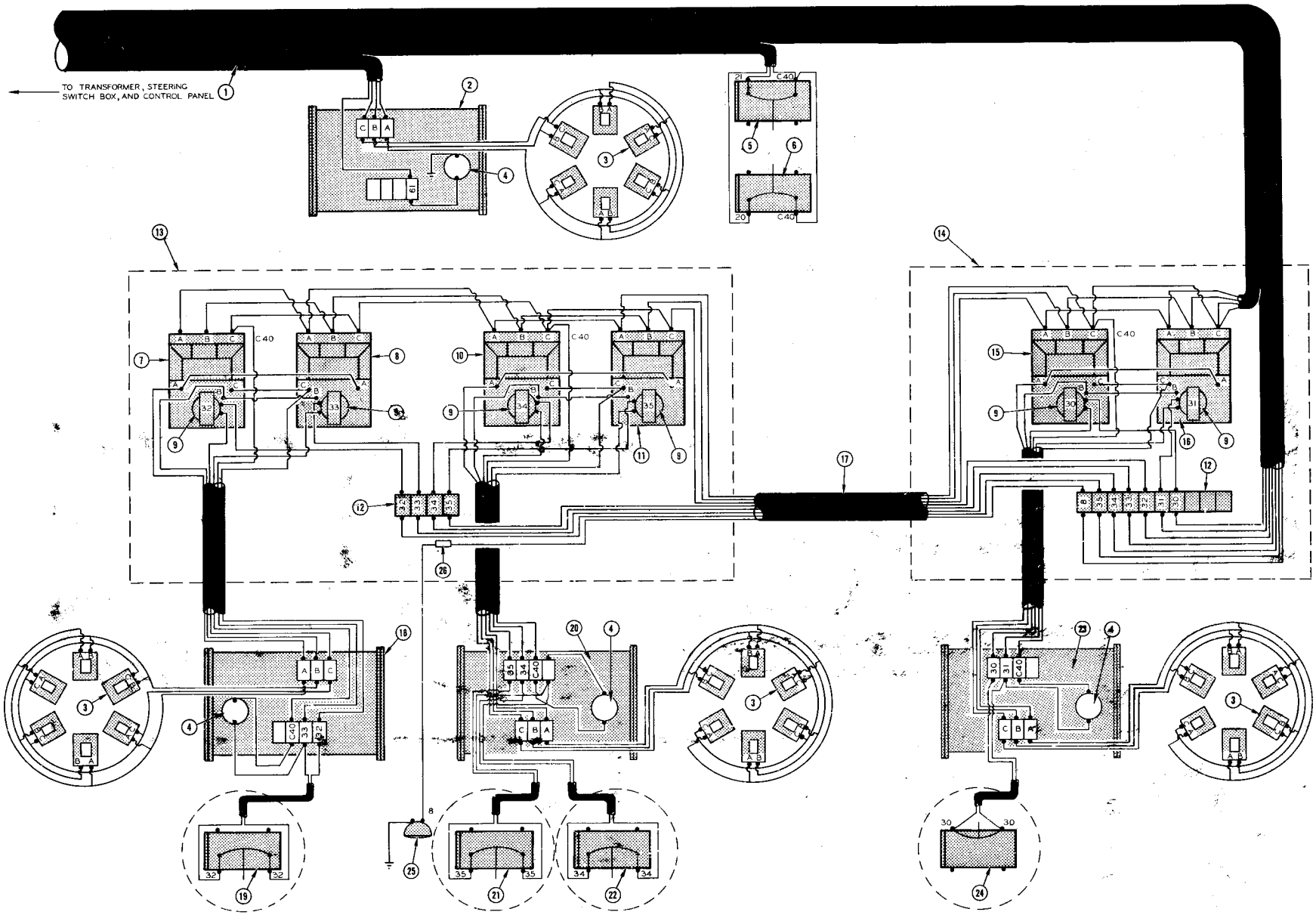

FIGURE M-2. TYPICAL WIRING DIAGRAM (STEERING AND TRAIL UNIT MOTORS)

1. Main Cable
2. Steering Motor
3. Motor Brake Coils
4. Heat Switch
5. Left Turn Limit Switch
6. Right Turn Limit Switch
7. Apron Up Main Switch
8. Apron Down Main Switch
9. Holding Coil
10. Tailgate Forward Main Switch
11. Tailgate Back Main Switch
12. Terminal Strip
13. Left Main Switch Box
14. Right Main Switch Box
15. Hoist Up Main Switch
16. Hoist Down Main Switch
17. Crossover Cable
18. Apron Motor
19. Apron Up Limit Switch
20. Tailgate Motor
21. Tailgate Back Limit Switch
22. Tailgate Forward Limit Switch
23. Hoist Motor
24. Hoist Up Limit Switch
25. Rear Light
26. Quick Disconnector

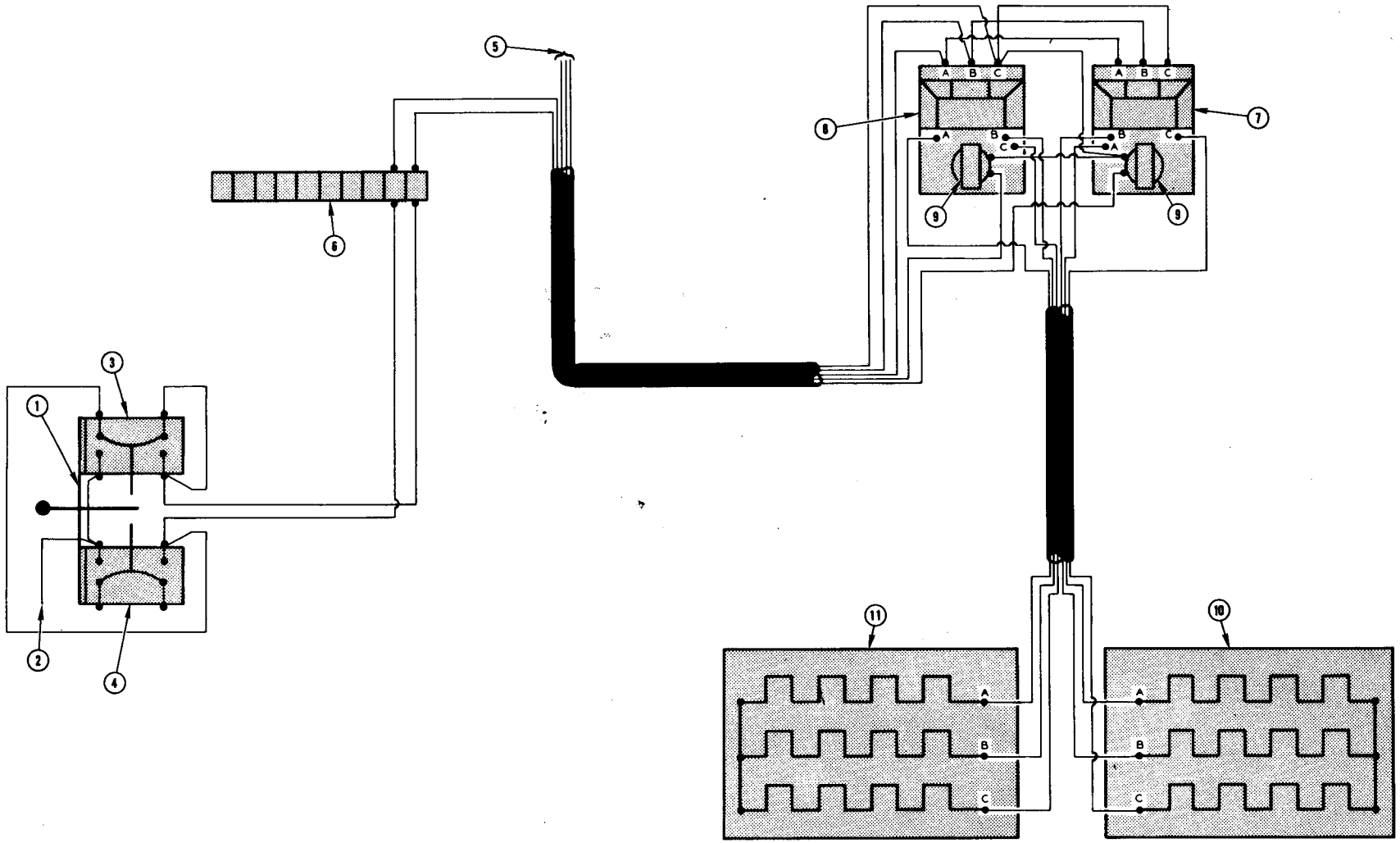

FIGURE M-3. TYPICAL WIRING DIAGRAM (ELECTROTARDER)

1. Electrotarder Control Switch (On Control Panel)
2. Phase "B"
3. #1 and #2 Electrotarder Switch
4. #1 Electrotarder Switch
5. 3 Phase Power Leads (From Right Main Switch Box)
6. Terminal Strip In Right Switch Box
7. #1 Electrotarder Main Switch
8. #2 Electrotarder Main Switch
9. Holding Coil
10. #1 Electrotarder Grids
11. #2 Electrotarder Grids

MODEL B SCRAPER

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MODEL B SCRAPER

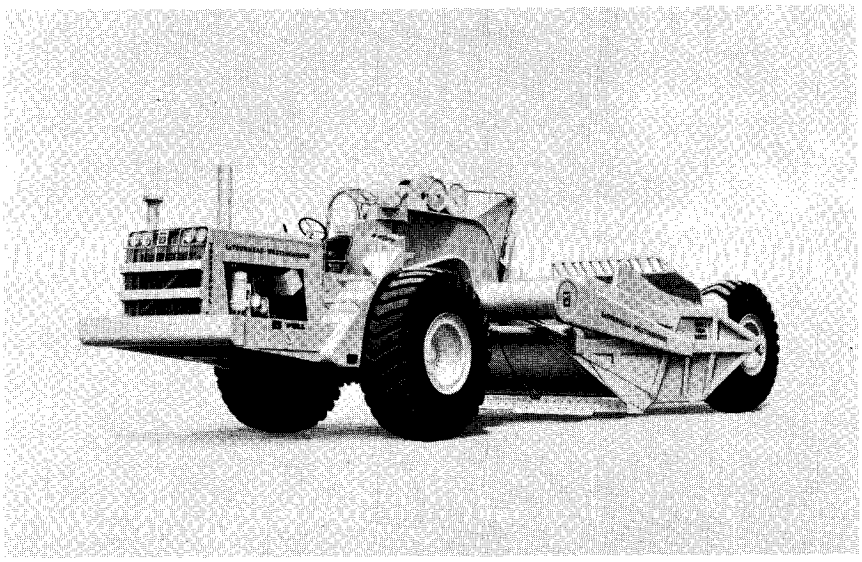

FIGURE N-1. MODEL B TOURNAPULL WITH SCRAPER

SEPARATING TOURNAPULL AND SCRAPER

Lower apron and bowl until the operating wire ropes are slack. Crib up nose of the prime mover using good solid cribbing. Construct the cribbing carefully. Apply parking brake.

Disconnect scraper apron bowl and tailgate wire rope from dead ends. Pull ropes from sheaves on scraper.

Raise scraper bowl slightly to allow the nose of the prime mover to settle on the cribbing. Block prime mover wheels, front and rear, to prevent movement when the units are separated.

Remove main switch box covers and disconnect the cables leading to the scraper.

Bleed the air system and disconnect air lines to scraper brakes and quick release cable drum.

Place chain hoist around the yoke structure. Position wood blocks along yoke to protect any tubing or cables which may be damaged by the chain. Apply only enough tension to support weight of the scraper and relieve any strain on the yoke connecting bolts.

Position blocks under each side of the steering trunnion to prevent its tipping when the scraper is removed.

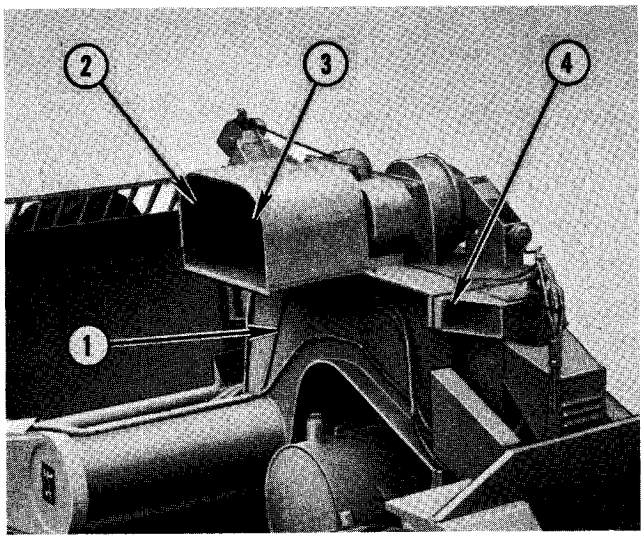

FIGURE N-2. STEERING TRUNNION AND YOKE

1. Yoke
2. Apron Motor
3. Hoist Motor
4. Bolt Bar Plug Bolts

Cut the lockwires and remove the bolts from the upper and lower bolt bar plugs. Separate the two units and lower scraper until yoke and bowl are both resting on the ground.

YOKE REMOVAL

Disconnect the conductor cable to tailgate motor and limit switches; and air lines to scraper wheel brakes.

Free apron hoist, and body hoist wire ropes from dead ends. Pull body hoist rope from sheaves on body.

Fasten hoist to yoke arms, near the pivot point, to prevent yoke from dropping when caps are removed.

Take up slack in hoist chains. Remove the capscrews and lockwashers securing the yoke arm caps to the yoke arms. Remove caps and shims.

Keep shims together for replacement. Separate yoke and body.

APRON REMOVAL

Attach hoist to apron arms. Remove capscrews and lockwashers securing apron arm caps to apron arms. Remove caps and shims. Keep shims together for replacement. Separate apron and bowl.

Lower apron to ground.

ASSEMBLING TRUNNION CAPS

When reassembling yoke or apron ball and socket joints, first clean them thoroughly.

Raise arms with hoist until sockets on arms fit against balls on bowl.

Place cap over exposed side of ball on one side. Place enough shims between cap and socket to make a snug fit. Secure with capscrews and lockwashers. Torque capscrews to 360 ft. lbs.

Repeat procedure for opposite side.

Lubricate thoroughly. See Section "K" for the correct type of lubricant and intervals.

TAILGATE REMOVAL

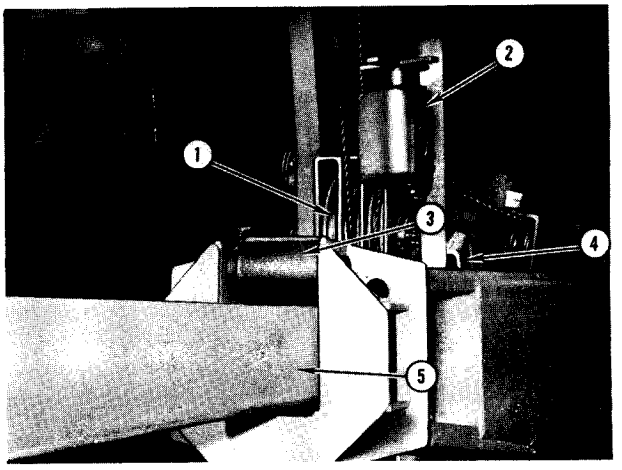

FIGURE N-3. TAILGATE BEAM

1. Sheave
2. Wire Rope Tightener
3. Roller
4. Dead End
5. Beam Structure

Position tailgate for access to shielded tailgate rollers. Remove covers from rollers and remove the three capscrews and lockwashers securing each roller to the tailgate. Later machines may have these rollers mounted on an eccentric cam. In this case, remove the nut from beneath the cam and lift off roller.

Remove capscrews and lockwashers securing rail scraper to tail beam.

Back off wire rope tightener and pull tailgate reverse wire rope from dead end and pull from the sheaves.

Remove tailgate forward wire rope from dead end and pull from sheaves.

Remove nut and bolt from upper tailgate roller. CAUTION: As bolt is removed, tailgate beam structure will be free to drop.

Place chain about tailgate and pull forward out of scraper body (toward the front). It may be necessary to move tailgate box beam structure to the right to permit clearance at rear and sides of bowl. Remove tailgate.

MOTOR AND GEAR BOX REMOVAL

WIRE ROPE DRUM

Unwind wire rope from wire rope drum. Loosen setscrew in dead end and pull wire rope free.

Remove setscrew from wire rope drum locknut. Using wrench and extension handle, back off splined locknut from drum shaft. Remove wire rope drum.

MOTOR

Remove drain plug and drain lubricant from the gear box.

Remove capscrews securing motor cover to stator. Disconnect electric cables from terminal strips on motor and free from cable clamps. Remove cover.

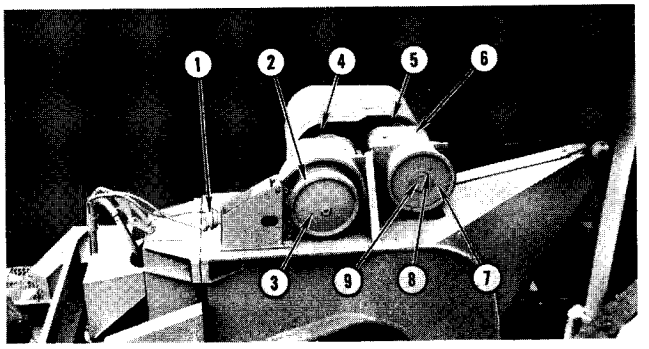

FIGURE N-4. MOTORS AND GEAR BOXES

1. Quick Release Brake Cylinder
2. Brake Band
3. Brake Drum
4. Hoist Motor
5. Apron Motor
6. Gear Box
7. Wire Rope Drum
8. Setscrew
9. Locknut

Support motor with rope sling. Place only enough tension on sling to relieve tension on motor mounting capscrews.

Remove capscrews securing motor to gear box. Pry motor away from gear box until motor pinion has cleared bore in gear box. Pull motor straight away from gear box to prevent damaging oil seal in gear box bore.

GEAR BOX

Proceed as above to the point of removing the capscrews securing the motor to the gear box. Substitute the following:

Remove the capscrews securing the gear box to the mounting flange. Pry gear box and motor (unless motor has previously been removed) away from flange until the output shaft has cleared the flange.

Place on bench for further disassembly. Refer to Section "J".

QUICK RELEASE DRUM

Removal and Disassembly

Unwind wire rope from wire rope drum and remove from dead end. Drain lubricant from quick release planetary.

Disconnect linkage from brake cylinder to brake band, remove band from around brake drum (see Fig. N-4).

Remove nuts and "O" ring securing brake drum to sun gear shaft and pull drum from splined shaft.

Remove the capscrews and lockwashers fastening the gear support to the drum. Remove gear support and gasket from the wire rope drum.

Remove cotter and washer from planet gear axle. Pull planet gear and bearing from shaft.

Press sun gear and shaft from gear support. Remove oil seal, snap ring and bearings from bore in gear support.

Remove setscrew from locknut securing the internal gear to the gear box output shaft. Remove locknut and "O" ring. Pull cable drum and internal gear from gear box output shaft.

If equipped with double row tapered roller bearing remove the locking setscrew from the locknut on the gear box side of the cable drum. Remove locknut and oil seal. Move to the other side of wire rope drum and pull internal gear from wire rope drum.

Remove snap ring from gear box side of bore and pull bearing assembly.

Pull inner bearing cone from internal gear shaft. Inner bearing cup, outer bearing cone and cup will remain in wire rope drum bore.

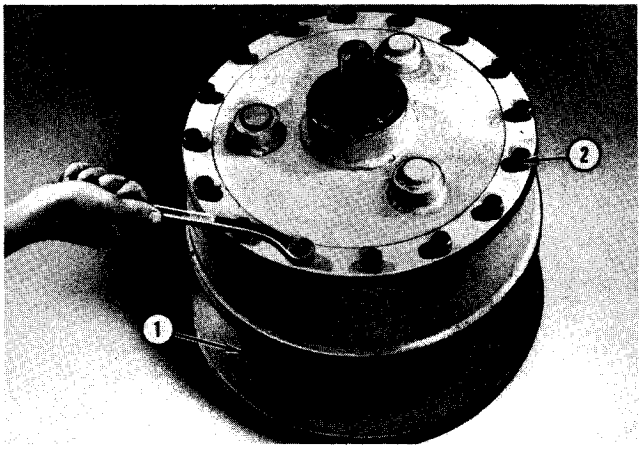

FIGURE N-5. REMOVING CAPSCREWS

1. Wire Rope Drum
2. Gear Support

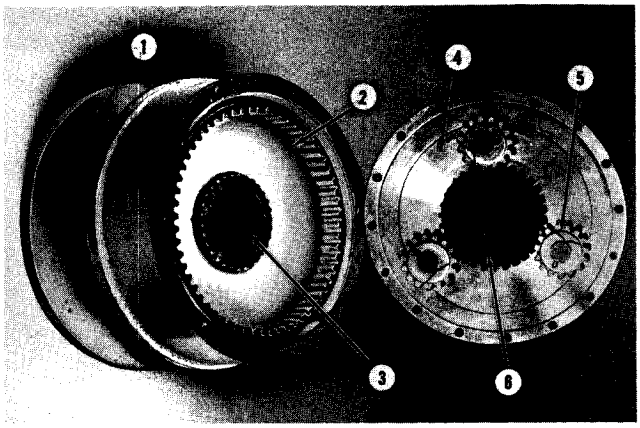

FIGURE N-6. GEAR SUPPORT, REMOVED

1. Wire Rope Drum
2. Internal Gear
3. Output Shaft
4. Gear Support
5. Planet Gear
6. Sun Gear

Reassembly

Clean all parts thoroughly in cleaning solvent. Inspect gears for broken, chipped or cracked teeth. Check bearings carefully. Inspect oil seals for cracks or dryness. Replace all damaged or worn parts. Replace all used "O" rings with new ones.

Replace bearing and snap ring into bore of wire rope drum. Place internal gear into wire rope drum bearing bore (if equipped with double row tapered roller bearing).

Replace inner bearing cup in bore of wire rope drum. Position bearing cone on shaft of internal gear. Place internal gear into wire rope drum. Replace outer bearing cup and cone.

Install oil seal and locknut over threaded end of internal gear. Permatex threads of locknut before installing. Tighten nut until a slight drag is felt when turning wire rope drum by hand.

Position wire rope drum over gear box output shaft, engaging splines on output shaft with the splines in internal gear. Lubricate "O" ring and place over gear box output shaft. Install locknut over threaded end of gear box output shaft. Torque to 2000 ft. lbs. and replace locking setscrew.

Replace bearing, snap ring and oil seal into bore of gear support; press sun gear shaft into bore of gear support.

Place planet gears over studs on gear support. Secure with flat washers and cotters.

Put gasket on rim of wire rope drum and position gear support and gears over gasket. Replace capscrews and lockwashers securing the gear support structure to the wire rope drum.

Replace brake drum on splined shaft. Grease "O" ring and position over shaft. Install jam nuts and torque to 750 ft. lbs.

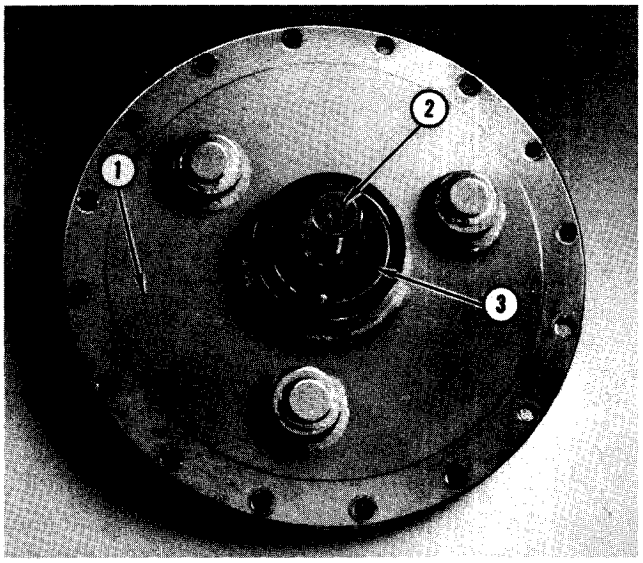

FIGURE N-7. GEAR SUPPORT PLATE

1. Gear Support Plate 2. Sun Gear Shaft 3. Oil Seal

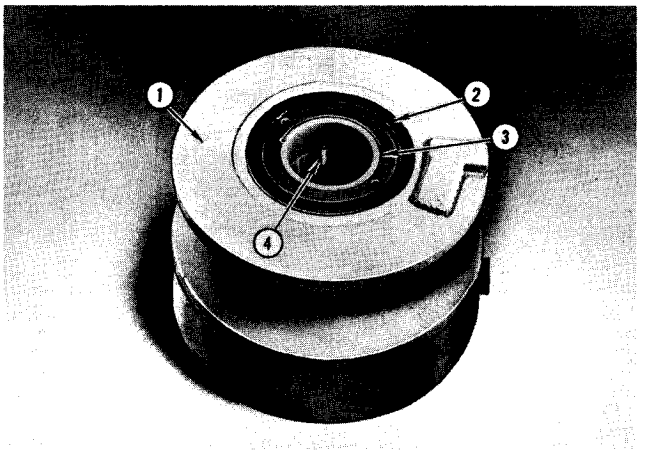

FIGURE N-8. WIRE ROPE DRUM LOCKNUT

1. Drum 2. Oil Seal 3. Locknut 4. Internal Gear

Place brake band around brake drum and reconnect linkage. Fill planetary with proper amount and type of lubricant. See Section "K".

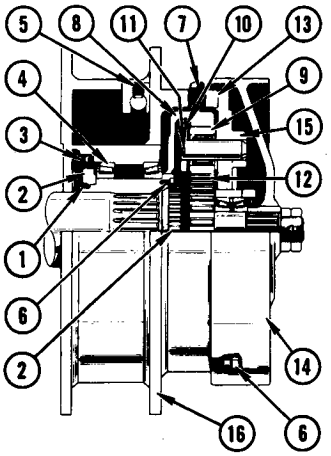

FIGURE N-9. QUICK RELEASE DRUM, SECTIONAL

1. Setscrew
2. Locknut
3. Oil Seal
4. Bearing
5. Oiler
6. Capscrew
7. Plug
8. Internal Gear
9. Planet Gear
10. Washer
11. Cotter Pin
12. Sun Gear
13. Gasket
14. Brake Drum
15. Gear Support
16. Wire Rope Drum

QUICK RELEASE BRAKE

Removal and Disassembly

Disconnect linkage and remove nuts securing brake chamber to scraper yoke. Remove brake chamber. See Figure N-10.

Loosen yoke locknut, then unscrew yoke and locknut from push rod. Remove rubber boot from cover and push rod.

Unscrew the hex head screws that hold the cover to the body. They are located on the outside diameter of the body near the mounting surface.

Remove the cover and the brake chamber release springs. Unscrew the nuts holding the outer clamp to the body.

Pull and wiggle the push rod, and the entire assembly consisting of push rod, push plate, diaphragm guide, diaphragm. Inner and outer diaphragm clamps should ease out of body.

Straighten out the rolled diaphragm. Remove outer diaphragm clamp.

Unscrew the nuts inside the diaphragm guide. Disassemble inner diaphragm clamp, diaphragm and push plate-push rod assembly from the diaphragm guide.

Reassembly

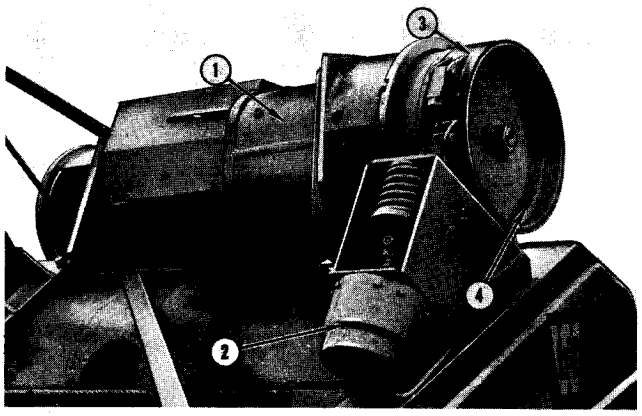

FIGURE N-10. QUICK RELEASE BRAKE

1. Gear Box
2. Brake Cylinder
3. Brake Band
4. Brake Drum

Clean all metal parts in cleaning solvent. Inspect the body, inner and outer diaphragm clamps and diaphragm guide, for cracks or damage. If found cracked or damaged they should be replaced. Inspect the push plate-push rod assembly. Be sure the push rod is not bent, cracked or damaged. If either of these conditions are found, replace the entire assembly. Replace the diaphragm and rubber boot. Inspect release spring. If damaged or cracked, replace with correct new release spring.

Stand the tubular diaphragm on end in the inner diaphragm clamp. The small diameter end of the diaphragm should be against the inner diaphragm clamp. Position and install the diaphragm guide within the diaphragm and over the inner diaphragm clamp studs. Install the push plate-push rod assembly within the diaphragm guide and over the inner diaphragm clamp studs.

Install nuts on the inner diaphragm clamp studs and tighten securely. Place the assembly consisting of the push rod, push plate, diaphragm guide, diaphragm and inner clamp inside of the outer clamp. Roll the free end of the diaphragm back over the end of the outer diaphragm clamp.

The inside wall of the body should be given a light application of a good grade of air brake cylinder grease. The rolled surface of the diaphragm also should be given a light application of grease.

Slide the above completed assembly into the body, making sure the end of the diaphragm fits snugly against the shoulder in the body by positioning the outer diaphragm clamp studs through the holes in the end of the body. Install nuts on the outer diaphragm clamp studs and tighten securely. Install release spring over the push rod against the push plate. Install cover over push rod and into body. Attach cover to body with capscrews.

Install rubber boot over the push rod and attach to cover. Install yoke locknut and yoke on push rod.

Replace brake chamber on mounting bracket and reconnect linkage and air line.

(Effective with Serial Suffix BM-2)

Removal and Disassembly

Disconnect air line, linkage and remove nuts from mounting studs. Remove nut from yoke. See Figure N-11.

Remove all dirt and grease from exterior of brake chamber, using cleaning solvent and a brush. Inspect for broken or damaged parts. All broken or damaged parts must be replaced.

Mark both the non-pressure plate and the pres-

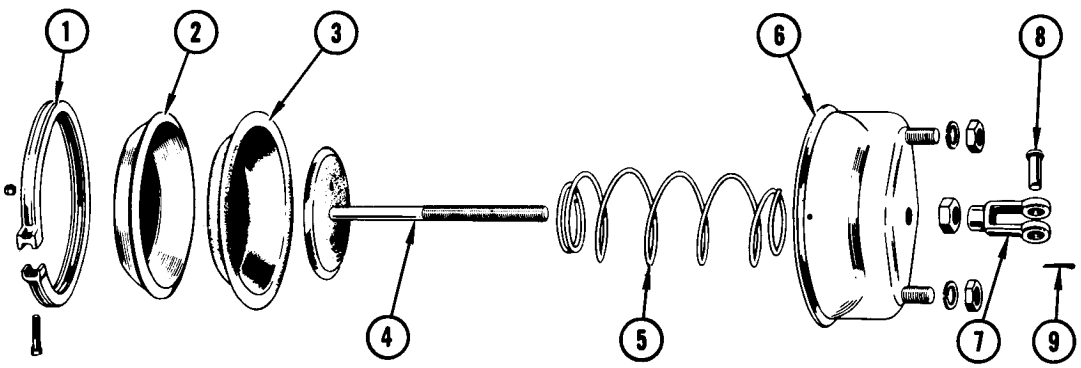

FIGURE N-11. QUICK RELEASE BRAKE AIR CYLINDER, EXPLODED

1. Clamp Ring
2. Pressure Plate
3. Diaphragm
4. Push Rod
5. Spring
6. Non-Pressure Plate
7. Yoke
8. Pin
9. Cotter

sure plate with relation to the clamping ring, so that the bolts of the clamp ring will be at the same location when reassembled. This will eliminate the possibility of installation interference when the brake chamber is installed on the scraper.

Pull out push rod and clamp it at the non-pressure plate by using a vise or vise grip pliers. This will relieve the tension of the spring on the diaphragm and clamp ring.

Remove the clamp ring nuts and bolts. Spread clamp ring slightly and push the clamp ring onto the pressure plate and off of the non-pressure plate. Remove the pressure plate and the diaphragm.

Remove yoke and locknut from push rod. Release clamp on push rod. Remove push rod assembly, spring, seal and seal spring, from non-pressure plate.

Reassembly

Rest push rod assembly upright on a flat surface and add seal spring, push rod seal, return spring, and non-pressure plate complete. Force down the non-pressure plate until it rests on the flat surface. Holding the non-pressure plate in this position, against the tension of the return spring, clamp the push rod at the non-pressure plate with vise grip pliers or similar tool. After the push rod is held secure, place the clamp ring over the clamping surface of the non-pressure plate aligning the marks made before disassembly.

Position diaphragm in the pressure plate and join with open end of non-pressure plate, working the clamp ring over the clamping surface of the pressure plate. With the two halves in this position, using the vise grip pliers or similar tool, grip one set of clamp ring lugs and draw together.

Assemble bolt and nut in the other lug and secure. Remove vise grip pliers and install remaining bolt and nut. Tighten each clamp ring bolt and nut only sufficiently to eliminate leakage at the clamping ring surface.

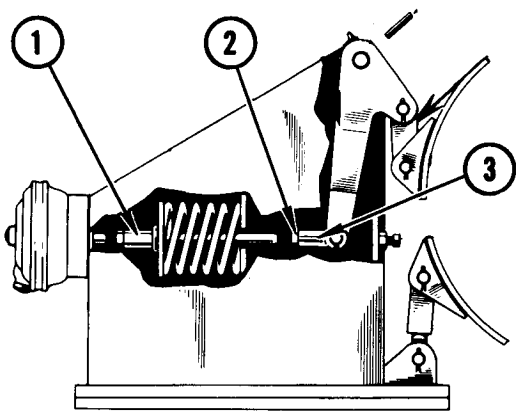

FIGURE N-12. BRAKE ADJUSTMENT
1. Push Rod 2. Locknut 3. Yoke

BRAKE ADJUSTMENT

Release the push rod yoke locknut. Remove cotter and pin securing push rod yoke to brake band linkage. Adjust push rod so that it has a minimum travel of ⅛" and a maximum of ¼". When this adjustment has been obtained tighten locknut on push rod. Replace cotter and pin securing push rod yoke to brake band. See Figure N-12.

QUICK RELEASE LEVER

Removal and Disassembly

Bleed the air system and disconnect the air lines at the air valve.

Remove machine screws securing the cover to the base, remove cover. Disconnect wires to control switch.

Remove capscrews and lockwashers fastening the lever base to the control box and remove lever assembly.

To remove air valve, remove capscrews fastening valve to base.

Control switch may be removed in the same manner.

Drive out roll pin locking handle to pivot pin. Drive pivot pin and bearing from lever and bracket. Remove lever.

Refer to Page B-17 for service of air valve.

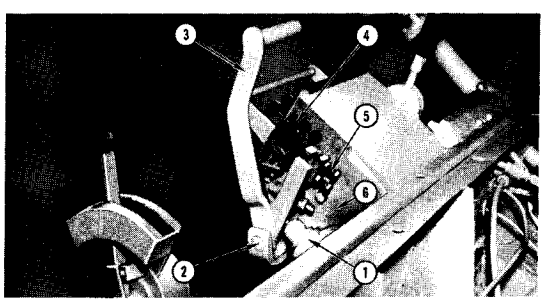

FIGURE N-13. QUICK RELEASE LEVER
1. Air Valve 3. Handle 5. Adjusting Screw
2. Pivot Pin 4. Control Switch 6. Base

Reassembly and Adjustment

Reassemble handle to bracket with bearing, pivot pin, and roll pin. Replace air valve and switch on base.

Place base on control box and secure with capscrews and lockwashers.

Loosen jam nuts and back out adjusting screws. Pull release lever back until screw head (A) is against stop (B) with enough pressure to return the lever to neutral position when released.

Turn adjusting screw (C) down until the control switch makes a definite "ticking" sound, tighten jam nut. With lever in this position, turn adjusting screw (D) down until it is against the stop button (E), tighten jam nut.

Reconnect wires to switch and air lines to valve. Replace cover.

AXLE

Removal

Block up side of scraper from which axle is to be removed, until wheel rolls free. Bleed the air system and disconnect the air line to the wheel brake.

Attach sling to tire. Lift wheel and tire enough to relieve any strain on the capscrews fastening the axle blocks to the scraper body. Remove capscrews.

Remove wheel and tire and axle from the scraper by pulling straight to the rear. Lay wheel and tire down so the hub cap is up.

Remove wheel and tire as a unit by removing the tapered capscrews securing the wheel to the axle hub. Also remove the capscrews and lockwashers securing the outside top and bottom axle blocks together and remove the blocks. Lift wheel and tire from axle hub. Lift brake drum from axle hub.

EFFECTIVE WITH SERIAL SUFFIX BM-2

Block up rear of scraper so that wheel and axle to be removed rolls free.

Bleed the air system and disconnect the air line to the wheel brake.

Position rope sling around tire. Apply enough lift on the sling to relieve any strain on the capscrews fastening the axle blocks to the scraper body.

Remove the capscrews and lockwashers securing the inner axle blocks and brake arm to the scraper body.

Remove the two bolts, nuts and lockwashers securing the spacer block, axle cap and axle to the outer mounting block.

NOTE: Later machines with BM-2 serial suffix will have one "U" bolt in place of the two bolts.

Lower wheel and axle until axle and inner axle blocks are clear. Pull directly to the rear and remove from scraper body. Lay wheel and tire down so hub cap is up.

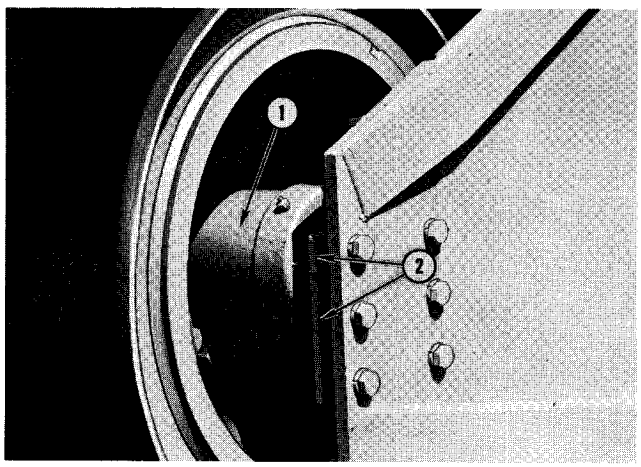

FIGURE N-14. WHEEL AND AXLE
1. Axle Hub 2. Axle Blocks

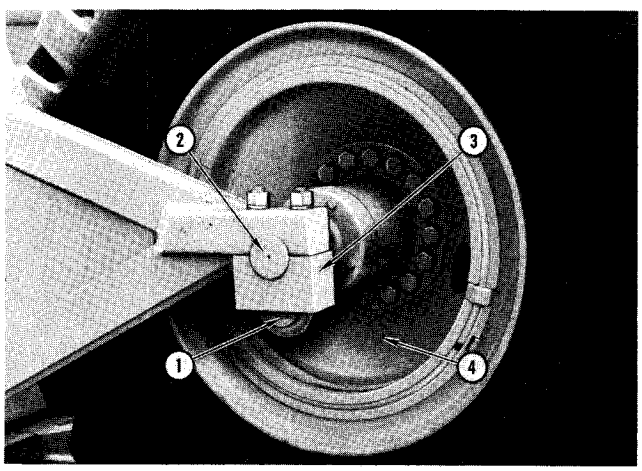

FIGURE N-15. WHEEL AND AXLE (BM-2)
1. "U" Bolt 2. Axle 3. Axle Block 4. Wheel

Disassembly

Remove wheel and brake drum as described above, if not already done. See Figure N-16.

Cut lockwires and remove capscrews fastening the inside axle blocks together, remove axle blocks.

Lift brake arms and brake from axle. See section "H" for brake removal and disassembly.

Remove capscrews securing retainer ring to

hub, remove retainer, gasket and oil seal. Remove oil seal from retainer.

Remove capscrews fastening hub cap to axle hub.

Remove hub cap, oil seal and gasket. Remove nut and capscrew from axle nut and back nut from axle.

Pull hub, outer bearing assembly and inner bearing cup from axle. Pull inner bearing cone and oil seal boss ring from axle. Remove outer bearing assembly and inner bearing cup from hub.

Reassembly

Clean and inspect all parts thoroughly. Check bearings for damage or excessive wear. Check oil seals for stiffness, cracks or damage. Replace all damaged or worn parts.

Pack bearings and axle shaft with wheel bearing grease.

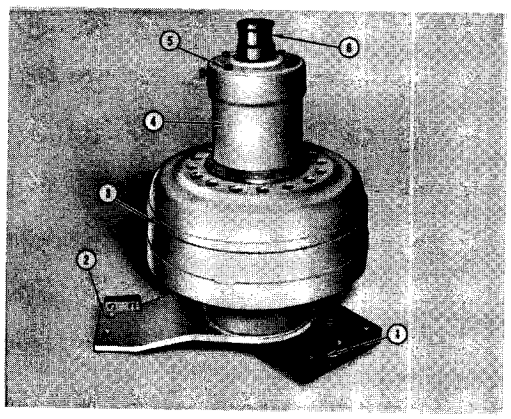

FIGURE N-16. AXLE ASSEMBLY, REMOVED

1. Axle Blocks
2. Brake Arm
3. Brake Drum
4. Hub
5. Hub Cap
6. Axle

Press oil seal boss onto axle shaft until it is against machined shoulder on axle. Place oil seal into retainer and position retainer and oil seal over oil seal boss. Lip of oil seal should be pointing toward outer end of axle. Put gasket on retainer.

Press inner and outer bearing cups into axle hub. Put inner bearing cone onto shaft.

Replace axle hub over axle shaft (hub cap end up). Pack axle hub approximately ½ full of wheel bearing grease. Install outer bearing cone and axle nut. Tighten axle nut until bearing cones are seated in their cups and a slight drag is felt when turning the hub. Install and tighten lock bolt and screw in axle nut.

Place oil seal into hub cap. Replace gasket and

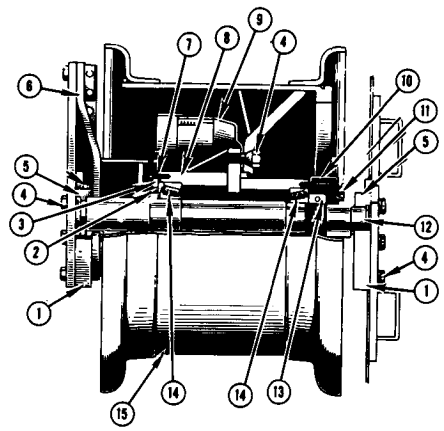

FIGURE N-17. WHEEL AND AXLE ASSEMBLY

1. Axle Block (Bottom)
2. Oil Seal
3. Retainer Ring
4. Capscrew
5. Axle Block (Top)
6. Brake Arm
7. Gasket
8. Hub
9. Brake Drum
10. Hub Cap
11. Pipe Plug
12. Axle
13. Nut
14. Bearing
15. Wheel

hub cap and secure with capscrews and lockwashers.

Mount brake drum, wheel and tire. Replace wheel and axle assembly on machine.

Those scrapers equipped with 27.00-33 tires have a spacer block mounted on top of the outer axle mounting blocks, held in place by the axle mounting bolts (or "U" bolts). To lower the axle, the spacer blocks must be removed from the top of the block and installed between the upper and lower outer axle blocks (see Fig. N-15).

The inner axle blocks must be reversed to keep the axle properly aligned. The smaller upper blocks then become the lower blocks, and the lower blocks become the upper blocks.

The position of the brake arm must also be changed. They must be moved down and bolted through the lower mounting holes in the scraper plate.

BLADES

The scraper is equipped with a three piece blade. Each piece is self sharpening and reversible. The scraper blades should be changed before they wear back into the blade base. Otherwise, the blade base or scraper bottom may become permanently damaged.

To change blades, hoist the scraper body and apron to a height that will allow sufficient clearance to work. Next block the apron and bowl as a safety measure, and remove the blade bolts.

When installing the new blades into position, hard faced side up, use a round drift punch, if possible, to help in lining up the bolt holes. Use new bolts whenever a blade is changed.

To reverse the blades, remove the old blade bolts and discard. Use new bolts.

Next, turn the blades over—hard faced side up —and install the left blade tip on the right side, and the right blade tip on the left side. This will assure uniform wear.

Then reverse the center section so the hard faced side is up.

Periodically check the scraper runner rail shoes for wear. If worn down almost to the runner rail, the old shoes should be removed and new ones welded or bolted on. The shoes prevent wear on the scraper rails and scraper sides while the blade is in the ground.

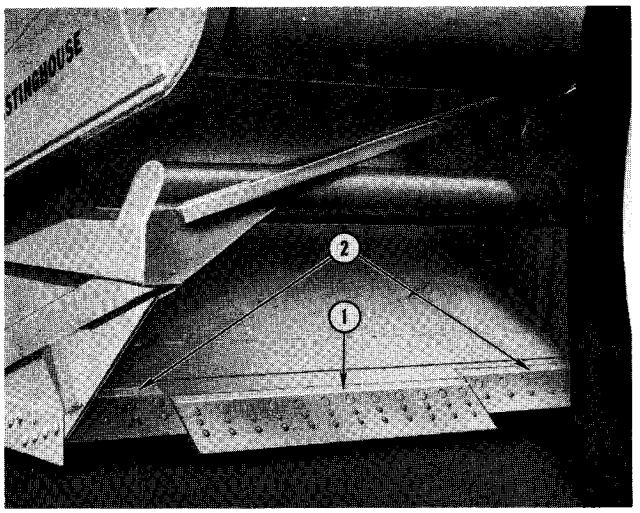

FIGURE N-18. SCRAPER BLADES
1. Center Blade 2. End Blade

MODEL B REAR DUMP

INDEX

MODEL B REAR DUMP

FIGURE O-1. MODEL B TOURNAPULL WITH REAR DUMP

SEPARATING TOURNAPULL AND REAR DUMP

Crib up under nose of Tournapull, using good solid cribbing. Construct cribbing carefully. Block Tournapull wheels, front and rear.

Raise bowl slightly until nose of Tournapull is resting on the cribbing and the tension is relieved on the body down wire ropes.

Remove cotter, nut and pin from wire rope anchor on front of bowl and remove wire rope. If the wire rope is to be replaced, remove wire rope clamp from wire rope and pull free. While yoke is in the slightly raised position, place blocks between yoke and body stops. Depress bowl control switch in the cockpit. This will pay out hoisting wire rope and lower the body on the blocks. The blocks will prevent the down limit switch from opening the circuit to the bowl motors.

After the bowl has come to rest on the blocks, operate motor until hoisting wire rope has completely unwound from drum. Loosen locking setscrews from dead ends on each of the two wire rope drums. Remove wire rope. If hoist wire rope is to be replaced, it may now be removed from around the equalizer wheel at the rear of the rear dump body.

Open air tank bleeder valves on the Tournapull and rear dump air tanks to bleed the air system. Disconnect air lines to rear dump at the couplings on the yoke structure.

Disconnect the cables at main switch box terminal strip and pull cable from box.

Place chain hoist about the yoke structure and apply only enough tension to relieve any strain on the yoke mounting bolts. Position blocks under the steering trunnion to prevent its tipping when the trail unit is disconnected.

Cut the lockwires and remove the bolts from the upper and lower bolt bar plugs. Separate the two units and lower yoke and bowl until both are resting on ground.

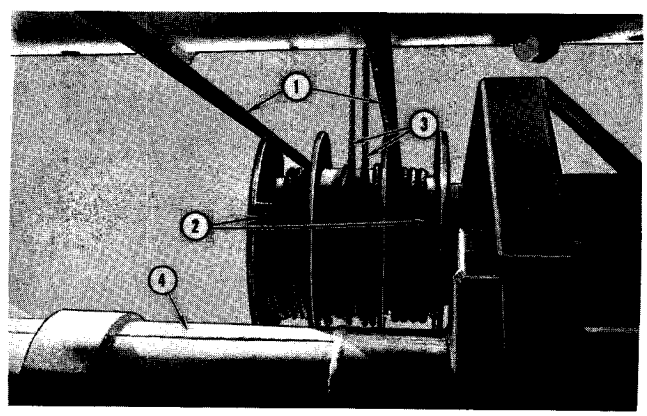

FIGURE O-2. WIRE ROPE DRUM

1. Body Hoist Rope
2. Dead Ends
3. Body Down Rope
4. Yoke

Disconnect wire to rear light. Disconnect air lines to wheel brakes and air supply tank.

Attach hoist to yoke arm structure to prevent yoke from dropping when caps are removed. Take up the slack in the hoist. Remove the capscrews and lockwashers securing the yoke arm caps to the yoke arms. Remove caps and shims. Keep shims together for replacement. Lift yoke arm away from body.

ASSEMBLING YOKE ARM

Thoroughly clean ball, socket and cap.

Raise arms with hoist until sockets on arms fit against balls on bowl.

Place cap over exposed side of ball on one side. Place enough shims between cap and socket to make ball a snug fit. Secure with capscrews and lockwashers. Torque capscrews to 360 ft. lbs.

Lubricate thoroughly. See section "K" for correct amount and type of lubricant.

BODY HOIST UNIT

The body hoist unit consists of two motors and gear boxes, No. 6 gear unit and wire rope drums.

To remove body hoist unit first disconnect the conductor cable from the terminal strip on the bottom motor.

Remove cover from motors. Fasten chain hoist around the unit and remove the four bolts securing the gear unit to the yoke. Lift gear unit, motors and wire rope drum away from yoke.

Remove the capscrews fastening the wire rope drum to the No. 6 gear unit axle and remove wire rope drum.

Refer to section "J" of this manual for removal and disassembly of the motors, gear boxes, and gear unit.

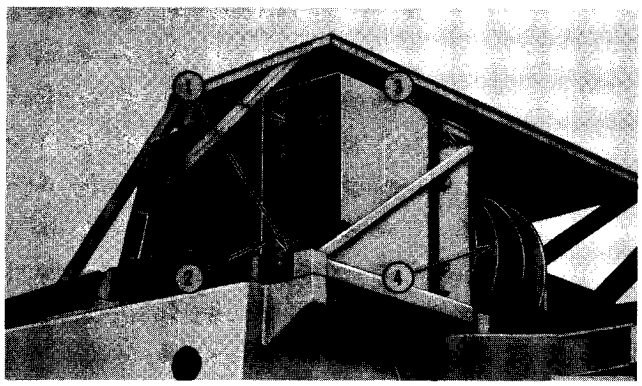

FIGURE O-3. BODY HOIST UNIT
1. Motors 2. Cover 3. Gear Unit 4. Wire Rope Drum

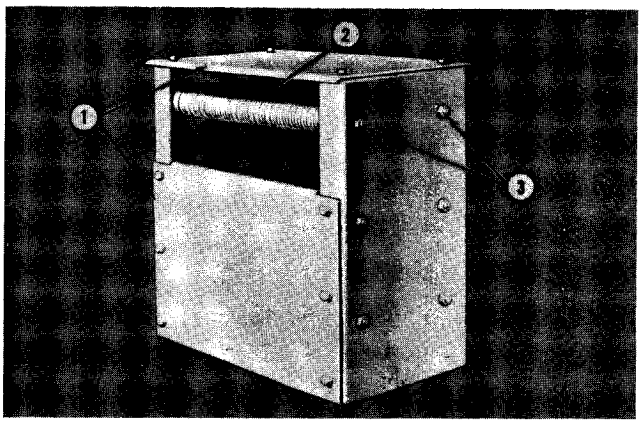

FIGURE O-4. ELECTROTARDER
1. Cover Plates 2. Grid 3. Support Rods

ELECTROTARDER

The electrotarder group is made up of these grid assemblies mounted in a case. Each grid assembly consists of resistance grid plates which are connected in series. The electrotarder is connected to the three phase output terminals on the transformer strip by means of a main switch. The main switch is operated by a toggle switch in the cockpit.

When loaded machines are operating down grades, the load has a tendency to push the machine. This will force the machine to overspeed, thus causing the machine to go beyond safe operating speeds unless the wheel brakes are applied to hold the load.

The electrotarder is placed on the rear dump as an additional means of slowing down the machine. Operated by the switch in the cockpit, the electrotarder is a resistance which when added to the generator circuit, places a load on the generator, thereby slowing down the rotor. Since the generator rotor is part of the power train, this will cause the machine to slow down.

The electrotarder is mounted on the rear dump yoke arm. The case can be removed after disconnecting the leads to the grids and removing the mounting capscrews.

Disassembly

Remove the top and front cover plates.

Remove the nuts from the support rods which secure the front support plate in position or the rear plate, depending upon whichever is closer to the point to repair.

Remove nuts, steel spacers and insulation washers from support rods.

Be sure to note the relative position of the spacers, both mica and steel, and grids so they can be replaced in the same order as removed.

Repeat the same procedure for each grid assembly.

AXLE

Disassembly

Raise wheel and tire from ground by blocking beneath the axle housing. Remove wheel and tire from trail unit.

Remove capscrews and lockwashers securing hub cap to axle housing, remove hub cap and gasket. Drive out the large cotter from the axle and nut. Remove axle nut.

Move to flange end of the axle and pull axle from housing. Remove capscrews and lockwashers securing retainer from housing. Remove retainer, oil seal and gasket from housing (Fig. O-5).

Back out the bearing race lockbolt from axle housing, and pull inner bearing retainer and roller bearing from axle housing (Fig. O-6).

From opposite end of housing remove the double row ball bearing.

Refer to section "H" for removal and disassembly of the wheel.

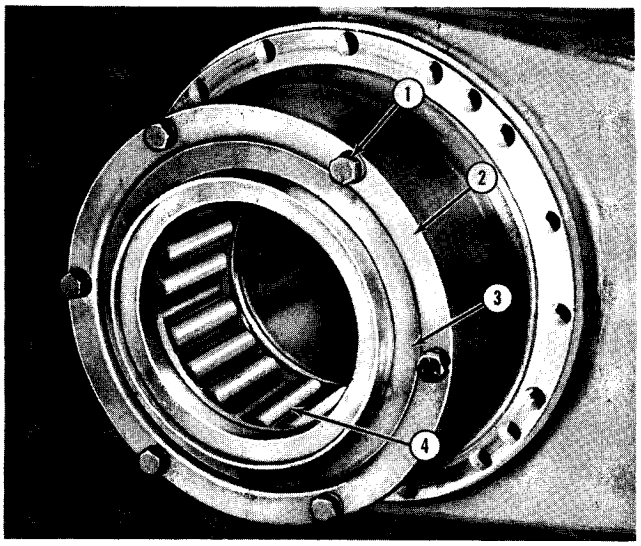

FIGURE O-5. AXLE REMOVED

1. Capscrews
2. Retainer
3. Oil Seal
4. Bearing

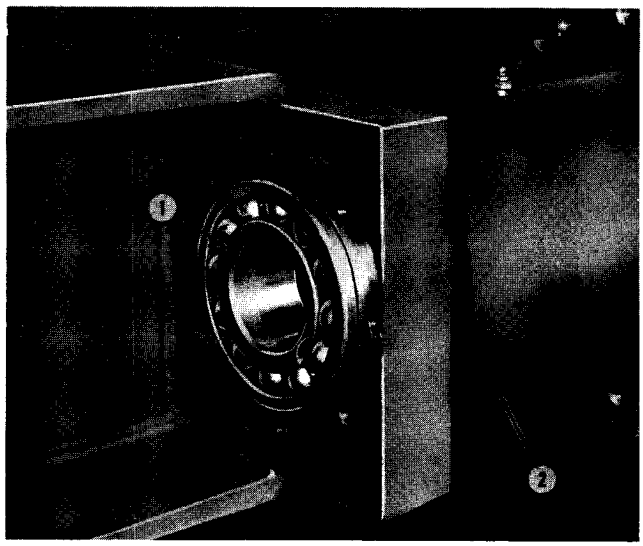

FIGURE O-6. INNER AXLE BEARING

1. Bearing
2. Axle Housing

Reassembly

Clean and inspect all parts thoroughly. Replace all parts that are worn or damaged.

Hand pack bearing with wheel bearing grease (medium) before reassembly.

Replace inner bearing retainer and roller bearing into axle housing. Align hole in bearing race with lockbolt in axle housing. Tighten bearing race lockbolt.

Replace gasket, retainer and oil seal. Lip of oil seal should be toward center of the trail unit. Secure with capscrews and lockwashers.

Replace axle shaft into bearing and axle housing. Install ball bearing on axle and replace the axle nut. Torque axle nut to 450 ft. lbs. and install cotter.

Replace gasket and hub cap. Secure with capscrews and lockwashers.

Remove pipe plug from axle housing and fill housing approximately ½ full with wheel bearing grease (medium). Replace plug.

Replace wheel and tire.

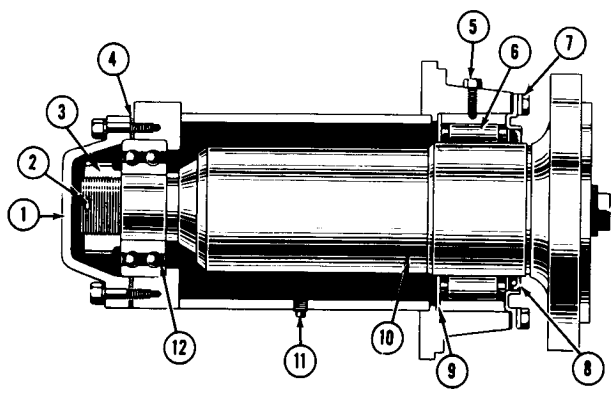

FIGURE O-7. AXLE, SECTIONAL

1. Hub Cap
2. Cotter
3. Axle Nut
4. Gasket
5. Lockbolt
6. Bearing
7. Capscrew
8. Oil Seal
9. Retainer
10. Axle
11. Grease Fitting
12. Bearing

EMERGENCY BRAKING SYSTEM

Operation

The rear dump is equipped with an emergency air braking system which includes; a governor, air cleaners, air filter, tractor protection valve, air supply tank and relay valve in addition to the regular air brake system.

Assuming the foot treadle valve is open and delivering air to the brakes in a steady application, and that the leakage through any broken line will sufficiently load the compressor so it cannot build up pressure in the main air supply tank.

If either or both of the air lines to the rear dump wheel brakes (A and B) break, the air pressure in the main and emergency air tanks will drop to 90 p.s.i. (the minimum setting of the protection valve governor). The tractor protection valve will close; closing the service and emergency lines to the rear dump. The main air tank minimum pressure will be 90 p.s.i., the emergency tank will be empty. When the air pressure in the main air tank builds up to 120 p.s.i. (maximum setting of the protection valve governor), the emergency and service lines to the rear dump are opened and the cycle repeats. 90 p.s.i. minimum air pressure is available in the main air tank for the operation of the Tournapull brakes.

If either or both of the air lines to the Tournapull brakes (C and D) break, air pressure in the main and emergency air tanks will drop to 90 p.s.i. With the pressure at 90 p.s.i. the tractor protection valve will close, closing the service and emergency lines to the rear dump. The rear dump brakes will automatically be applied with 90 p.s.i. air pressure from the emergency tank. The main air tank will continue to empty. There will be no minimum air pressure in the main air tank for application of the Tournapull brakes.

If the emergency line (E) to the rear dump breaks, the rear dump brakes are automatically applied with 145 p.s.i. air pressure from the emergency air tank. The main air tank pressure will drop to 90 p.s.i. and the tractor protection valve will close, closing the service and emergency lines to the rear dump. When the main air tank pressure builds up to 120 p.s.i. the tractor protection valve opens and the rear dump brakes exhaust, and the cycle repeats. 90 p.s.i. minimum air pressure is available in the main air tank for operation of the Tournapull brakes.

If the service line (F) to the rear dump breaks the rear dump brakes exhaust and the main air tank pressure drops to 90 p.s.i. The tractor protection valve closes, closing the service and emergency lines to the rear dump. Rear dump brakes are automatically applied with 145 p.s.i. air pressure from the emergency tank. When main air tank pressure builds up to 120 p.s.i. the tractor protection valve opens, rear brakes exhaust and the cycle repeats. 90 p.s.i. minimum air pressure is available in the main tank for operation of the Tournapull brakes.

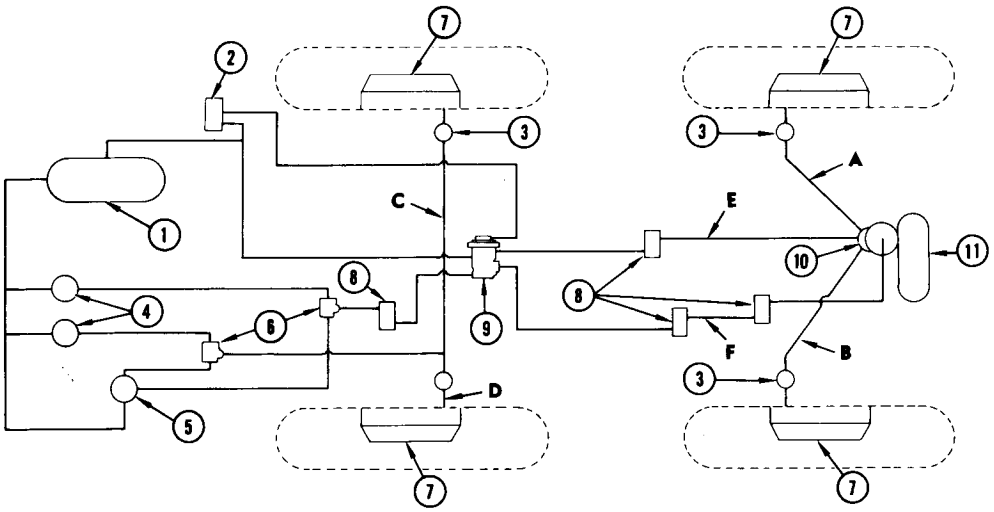

FIGURE O-8. EMERGENCY BRAKING SCHEMATIC

A. Rear Dump Brake Line	1. Main Air Tank	7. Wheel Brake
B. Rear Dump Brake Line	2. Governor	8. Air Strainer
C. Tournapull Brake Line	3. Quick Release Valve	9. Tractor Protection Valve
D. Tournapull Brake Line	4. Hand Brake Valves	10. Emergency Relay Valve
E. Emergency Air Line	5. Foot Brake Valve	11. Emergency Air Tank
F. Service Air Line	6. Double Check Valve	

TRACTOR PROTECTION VALVE

Removal and Disassembly

Bleed the air system. Disconnect air lines to the tractor protection valve. Remove mounting bolts and remove valve from bracket.

Remove all dirt or grease from the exterior of the valve by using cleaning solvent and a brush. Inspect body of valve for cracks or breaks. If damaged in any way, the body must be replaced.

Remove the four capscrews and lockwashers securing the cover to the body. Remove the cover and grommet. Lift service disc valve spring, disc valve, disc valve seat, grommet, emergency valve spring, and emergency and exhaust valve from body. Remove grommet from emergency and exhaust valve stem.

Remove cap nut securing cap to body and remove cap. Lift diaphragm and exhaust valve plunger assembly and exhaust valve plunger spring from body. Remove exhaust plunger grommet. Remove cotter and slotted nut securing followers and diaphragm to the exhaust valve plunger. Remove followers, grommet and diaphragm.

Mark springs when disassembling in order to get the right spring in the right location when reassembling valve.

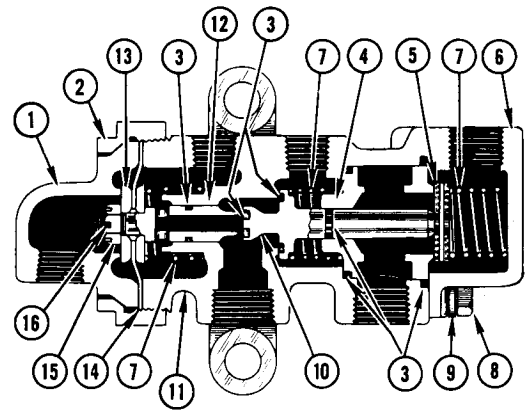

FIGURE O-9. TRACTOR PROTECTION VALVE

1. Cap
2. Cap Nut
3. Grommet
4. Discharge Valve Seat
5. Valve
6. Cover
7. Spring
8. Capscrew
9. Lockwasher
10. Emergency and Exhaust Valve
11. Body
12. Exhaust Valve Plunger
13. Follower
14. Diaphragm
15. Nut
16. Cotter

Reassembly

Clean all metal parts in cleaning solvent. Inspect all valves and seats for damage or wear. If either the seat or valve is damaged or worn, the seat or valve or both must be replaced. Check fit of exhaust valve plunger in body. It should be a neat sliding fit.

Check fit of emergency and exhaust valve in disc valve seat guide. It should be a neat sliding fit.

Carefully install new greased grommets in the grooves on emergency and exhaust valve, and diaphragm and exhaust valve plunger assembly.

Place follower, diaphragm, grommet and upper follower on exhaust valve plunger and secure in place with hex nut. Insert cotter pin securing hex nut in place.

Place lubricated disc valve seat grommet in body. Place emergency valve spring and emergency and exhaust valve in guide portion of the disc valve seat.

Place emergency and exhaust valve and disc valve seat in body. Hold in place and install cover grommet, service disc valve and disc valve spring. Position and hold the cover on body while installing lockwashers and capscrews. Place exhaust valve plunger spring and exhaust valve plunger assembly in body. Position and hold cap over diaphragm and exhaust valve plunger assembly and install cap nut securing cap to body.

EMERGENCY RELAY VALVE

Removal and Disassembly

Open drain cocks and bleed the air system. Disconnect the air lines from the relay valve. Remove mounting bolts and remove valve from the air tank.

Remove four capscrews and lockwashers attaching relay valve to emergency valve. Remove gasket and separate relay valve from emergency valve.

RELAY VALVE

Remove all dirt and grease from exterior of valve, using cleaning solvent and a brush.

Inspect the exterior of valve for broken or dam-

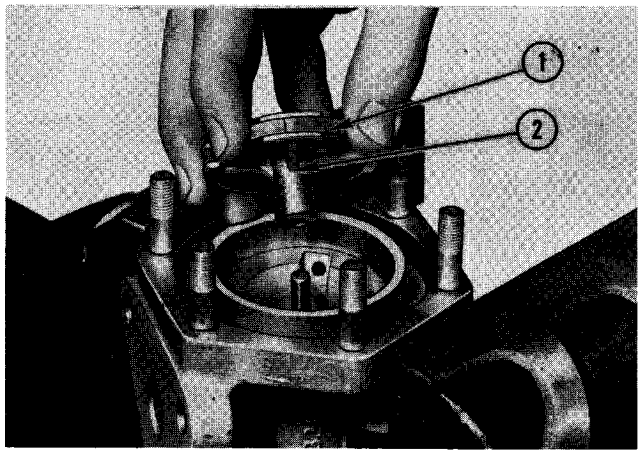

FIGURE O-10. REMOVING DIAPHRAGM GUIDE
1. Dampener 2. Diaphragm Guide

aged parts. All broken or damaged parts must be replaced.

Remove capscrews securing cover to body. Remove cover, diaphragm, diaphragm ring, and bleeder passage grommet from body.

Using fingers, pull the diaphragm guide and dampener out (Fig. O-10).

Unscrew the supply valve cap nut and remove the supply valve spring and supply valve.

NOTE: Do not remove supply valve seat bushing unless replacement is absolutely necessary. Remove the bushings by pressing out through the bottom of the body.

EMERGENCY VALVE

Remove pressure regulating cap and lift out pressure regulating spring and shims from the cavity in the cap nut. Do not misplace any shims as the same number must be replaced in the valve during assembly. Lift out diaphragm seal ring. Lift out pressure regulating diaphragm assembly.

The pressure regulating valve seat bushing should not be removed unless it has to be replaced. If this bushing has to be removed, it will have to be drilled out.

Remove supply cap nut and strainer from emergency valve cover.

Remove check valve cap nut. Lift out check valve guide, and check valve from cavity in the emergency valve body.

Remove the emergency valve cover from body by removing the four capscrews. Remove emergency valve spring from valve body.

Remove emergency valve cap nut. Using screw driver to keep the upper emergency valve stem from turning, remove the emergency diaphragm retaining nut. Remove diaphragm follower, diaphragm and lower emergency valve. Remove upper emergency valve.

Do not remove emergency valve seat bushing unless replacement is absolutely necessary; when necessary, remove the bushing by pressing out with a tap through the emergency valve cap nut hole.

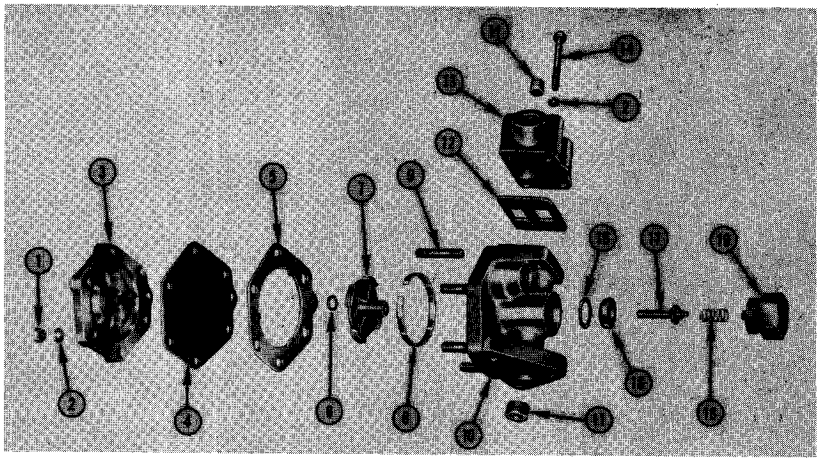

FIGURE O-11. RELAY VALVE, EXPLODED

1. Nut
2. Lockwasher
3. Cover
4. Diaphragm
5. Diaphragm Ring
6. Lower Grommet
7. Diaphragm Guide
8. Guide Ring
9. Stud
10. Body
11. Pipe Plug
12. Gasket
13. Adaptor
14. Capscrew
15. Grommet
16. Supply Valve Seat
17. Supply Valve
18. Supply Valve Spring
19. Supply Valve Cap Nut

Reassembly

RELAY VALVE

Position supply valve and spring and install supply valve cap nut. Tighten supply valve cap nut securely.

Position guide ring in groove of diaphragm guide and holding it in place with the fingers,

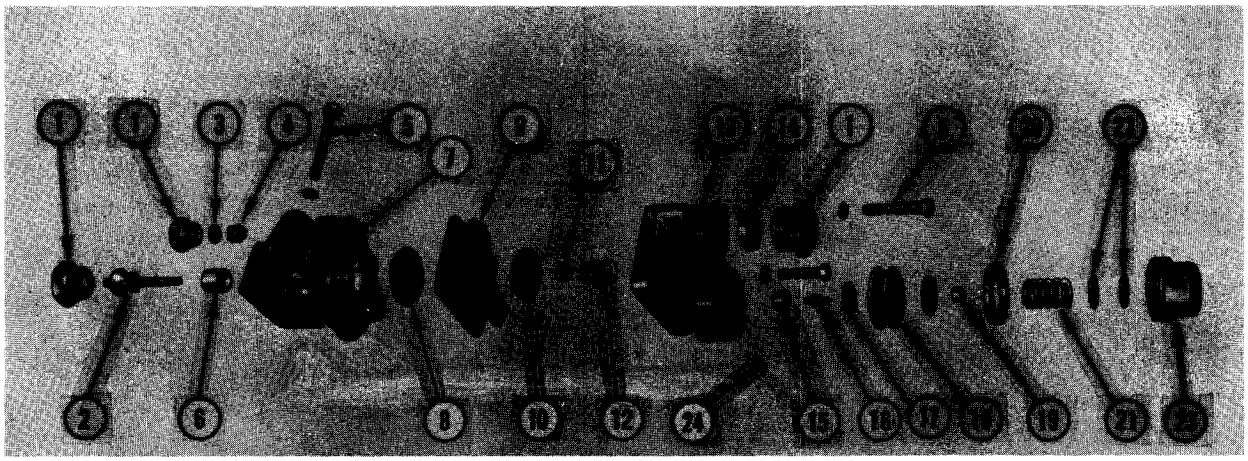

FIGURE O-12. EMERGENCY VALVE, EXPLODED

1. Cap Nut
2. Upper Emergency Valve
3. Disc Valve
4. Check Valve Guide
5. Stud
6. Valve Seat
7. Emergency Valve Body
8. Lower Emergency Valve
9. Diaphragm
10. Diaphragm Follower
11. Locknut
12. Emergency Valve Spring
13. Cover Body
14. Air Strainer
15. Valve Seat
16. Valve
17. Follower
18. Diaphragms
19. Locknut
20. Diaphragm Ring
21. Pressure Regulating Spring
22. Shims
23. Cap
24. Pin

push diaphragm guide into place.

Install bleeder passage grommet in body. Install diaphragm rings. Install relay diaphragm. Install cover in body.

Use care to see that bleeder passage openings in body, diaphragm ring, diaphragm, and cover line up.

Install lockwashers and tighten nuts securely.

EMERGENCY VALVE

Holding check valve cap nut so that threads are up, place check valve guide in groove in cap nut and place check valve in guide. Then, holding emergency body upside down, screw check valve cap nut into body. Tighten securely.

Position upper emergency valve in valve body. Install lower emergency valve, diaphragm, and diaphragm follower on the emergency valve stem. The curved side of lower emergency valve and diaphragm follower must be against diaphragm. Install emergency diaphragm retainer nut. Hold valve stem from turning with a screwdriver (Fig. O-13) and tighten nut screw securely.

Position strainer in the emergency valve cover and install supply cap nut. Tighten securely.

Position the pressure regulating diaphragm assembly in emergency valve body being sure edges of diaphragms are beneath the end of the pin. Position diaphragm ring so that curved side is toward diaphragm and notch in the ring engages the pin. Position same number of shims and same spring that were removed during disassembly in the pressure regulating cap, and screw cap into position. Tighten cap securely.

Position emergency valve spring under the emergency diaphragm retaining nut. Carefully line up holes in emergency diaphragm with holes in emergency body and install emergency cover. Securely tighten the four cap nuts and lockwashers that hold cover to body.

Before installing emergency valve cap nut, make sure that emergency valve can move up and down freely without binding. Install emergency valve cap nut, tighten securely.

Using a new gasket, position relay valve and emergency valve and install and tighten four capscrews and lockwashers attaching relay valve to emergency valve.

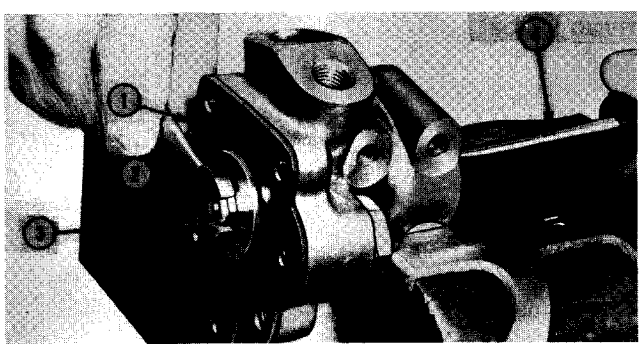

FIGURE O-13. INSTALLING EMERGENCY DIAPHRAGM

1. Diaphragm
2. Diaphragm Follower
3. Nut
4. Screw Driver

MODEL B CRANE

INDEX

MODEL B CRANE

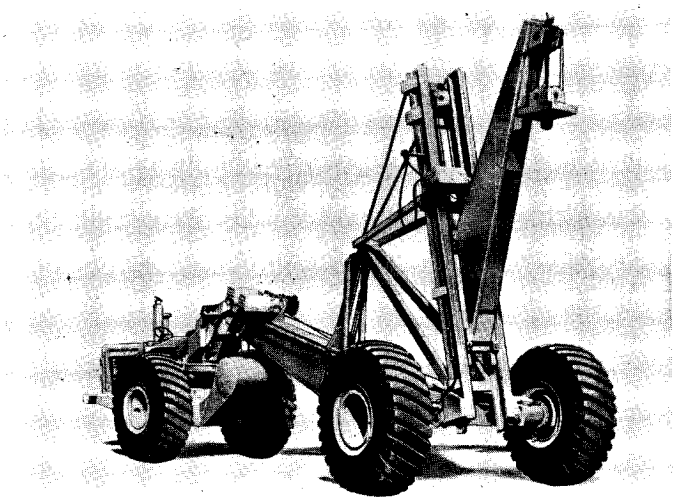

FIGURE P-1. MODEL B TOURNAPULL WITH CRANE

SEPARATING TOURNAPULL AND CRANE

Block up front of Tournapull using good, solid cribbing. Construct cribbing with considerable care to eliminate the danger of the rig moving forward and off of the cribbing. Block the Tournapull wheels, front and rear, to further lessen the danger. Apply parking brake.

Raise the boom in the carriage track to the limit of its travel. Tilt carriage track forward until it comes to rest on the stop block on the crane tongue.

Disconnect the electric cables to the a.c. electric motors and limit switches from the main switch boxes. Bleed the air system and disconnect the air lines to the crane wheel brakes at the connection on the steering trunnion.

Fasten chain hoist to crane tongue and apply only enough lift to relieve the tension on the bolt bar plug bolts. Remove the bolt bar plug bolts securing the crane to the Tournapull. Separate the two units. Place stand beneath crane tongue, or lower unit to floor.

ELECTRIC MOTORS AND GEAR BOXES

Removal

TRAVELING HOOK

Lower hook to the ground and release the wire rope from rope dead end along side the sheaves on the end of the boom structure.

Press "hook up" control switch on the control panel until the wire rope has rewound on the drum.

Remove setscrew from wire rope drum locknut and remove locknut. Pull rope drum from gear box output shaft.

Disconnect leads from electric motor terminal strip. Release the cable from cable clamp on the motor cover.

Fasten a rope sling around the motor and gear box. Apply only enough tension to relieve any strain on the mounting capscrews. Remove mounting capscrews and lockwashers and pull unit away from crane. Place on bench or stand for further service or disassembly.

CARRIAGE

Tilt the carriage track toward front of the machine until it has come to rest on the stop block on the carriage tongue.

Lash carriage track to the tongue as a safety precaution. Lower the boom and carriage structures to a point just short of activating the down limit switch and lash into place. By doing this the boom motor can still be operated. Press the "carriage down" control switch until the wire rope has completely unwound from drum. Loosen setscrew from rope dead end and remove wire rope.

Remove lock setscrew from wire rope drum locknut. Back off locknut and pull drum free of the gear box output shaft.

Disconnect the electric motor leads at the motor terminal strip. Remove cable from cable clamp.

Fasten a rope sling around motor and gear box. Apply only enough tension to relieve any strain

on the mounting capscrews. Remove mounting capscrews and lockwashers and pull unit away from crane. Place on bench or stand for further service or disassembly.

BOOM

While carriage track is in the position described for carriage motor and gear box removal, press the "boom down" control switch until all the wire rope has unwound from the drum. Loosen the setscrew in the rope dead end and pull free.

Proceed to remove motor and gear box as described above.

Refer to section "J" of this manual for further disassembly of the a.c. electric motors and gear boxes.

TRAVELING HOOK

Lower the hook to the ground and free wire rope from dead end on boom structure. Rewind wire rope onto drum.

To disassemble sheaves, pull cotter pin and drive out sheave pin. Lift sheave wheel from structure and remove bearing.

This hook is a non-removable swivel-type and does not require disassembly.

WHEELS AND BRAKES

Refer to section "H" of this manual for procedure and instructions on removal and disassembly of the wheels and wheel brakes.

AXLE

Removal

Remove wheel and tire as described in section "H". Also refer to section "H" for wheel brake removal.

Remove capscrews and lockwashers securing hub cap to the axle housing. Remove hub cap and gasket.

Remove cotter from end of axle shaft and remove axle nut. Pull axle from housing.

From opposite end of axle remove the capscrews and lockwashers fastening the retainer to the axle housing. Remove retainer, gasket and oil seal. Refer to Figures O-5 and O-6.

Back out the bearing race lockbolt from the housing and pull the inner bearing retainer and bearing from housing. Remove the double row ball bearing from the opposite end of the axle housing.

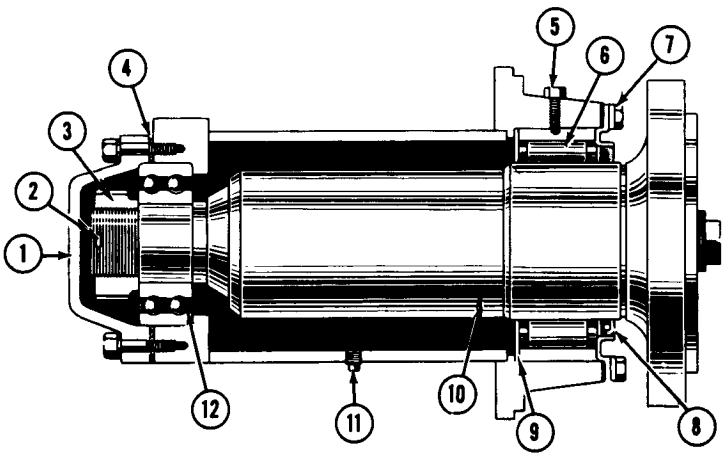

FIGURE P-2. AXLE, SECTIONAL

1. Hub Cap
2. Cotter
3. Axle Nut
4. Gasket
5. Lockbolt
6. Bearing
7. Capscrew
8. Oil Seal
9. Retainer
10. Axle
11. Grease Fitting
12. Bearing

Installation

Clean and inspect all parts thoroughly. Replace all parts that are damaged or worn. Hand pack bearings and axle with wheel bearing grease (medium) before reassembly.

Replace inner bearing retainer and roller bearing into axle housing. Tighten down bearing race lockbolt.

Replace gasket and bearing retainer and secure

to axle housing with capscrews and lockwashers. Install oil seal in retainer.

Replace axle shaft into housing. Install ball bearings on opposite end of axle. Replace axle nut on axle and torque to 450 ft. lbs. Replace cotter.

Replace gasket and hub cap over axle nut and secure with capscrews and lockwasher.

Remove pipe plug from axle housing and fill housing approximately ½ full of wheel bearing grease (medium).

Complete reassembly of brake, wheel and tire.

TRACK AND BOOM STRUCTURES

With the carriage track in an upright position, lower the boom to a point just short of activating the limit switch. Disconnect the leads from the traveling hook electric motor terminal strip and free the cable from clamps alongside the track structure.

Lash the boom and carriage structure to the track and release the carriage wire rope from the dead end at top of track. Rewind the wire rope on drum.

Fasten a chain hoist about the carriage track and boom structure and then release the carriage tilt wire rope from dead end alongside of crane tongue sheaves. Rewind the wire rope onto the drum taking care to keep track structure in an upright position. Disconnect the leads at the two limit switches located on the cross members of the track structure.

Take up enough slack on the hoist to relieve any strain on the track hinge pins. Remove the cotters from each hinge pin and drive out pins. Exercise caution when these pins are removed as the carriage track and boom may tilt abruptly.

Lower the boom structure and track to the ground and separate the two units.

OVERLOAD LIMIT SWITCH

An overload limit switch arrangement is attached to the boom wire rope to prevent lifting loads beyond the rated capacity of the machine.

One end of the boom wire rope is attached to a sliding clevis on the switch operating lever. When the line pull on the wire rope exceeds maximum limit, the pull on the lever arm overcomes the resistance of a spring in the spring pipe and the spring is compressed.

As the spring compresses the inner pipe and switch discs move toward the limit switches, contacts and depresses the switch plungers, and opens the "hook up", "carriage up" and "boom out" control circuits. As a result only movements possible after the limit switch has been opened by the above action are lowering the carriage and hook or moving the boom in, thereby reducing the distance between the load and the centerline of the crane axle.

When the line pull is reduced, the spring overcomes the pressure of the lever, moving the inner tube away from the switches and closing the control circuit so that normal operation can again be resumed.

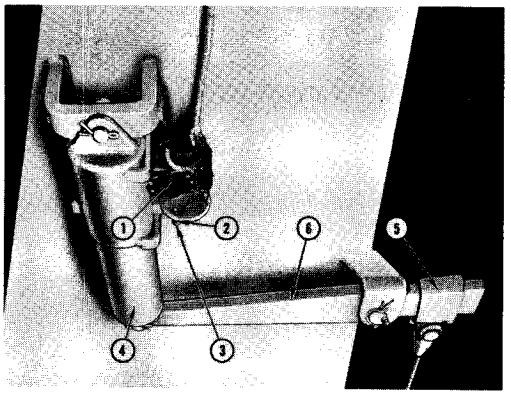

FIGURE P-3. OVERLOAD LIMIT SWITCH

1. Switch
2. Jam Nut
3. Adjusting Screw
4. Spring Pipe
5. Clevis
6. Lever Arm

Adjustment

Position carriage and boom so that the distance from the center of the hook to the centerline of the crane axles measures 20'.

Attach hook to 28,500 pound load. Hoist load a short distance. Loosen jam nuts on three adjusting screws. Turn each adjusting screw until its respective switch plunger is pushed in and makes a "clicking" sound. Do not bottom switches. Tighten jam nuts.

If spring does not compress enough for the capscrews to depress the switch plungers, lower the load to the ground. Loosen the lock screws on the slide and move it away from the lever arm pivot point to increase the line pull on the lever arm. Tighten the lock screw and readjust.

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