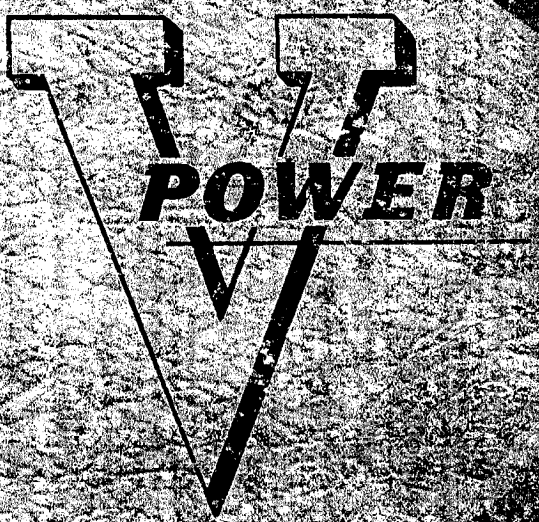
MODEL C

TOURNAPULL



MAINTENANCE AND REPAIR MANUAL

WABCO

LeTOURNEAU-WESTINGHOUSE

PEORIA, ILL. A SUBSIDIARY OF WESTINGHOUSE AIR BRAKE CO.

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.

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.

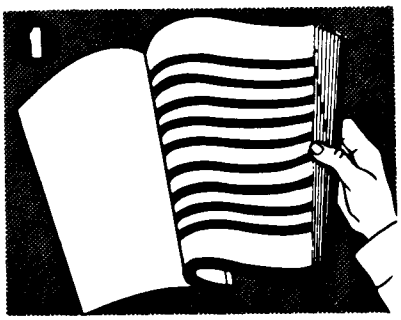
All reference to locations "right" or "left" is made from the operator's normal seated position.

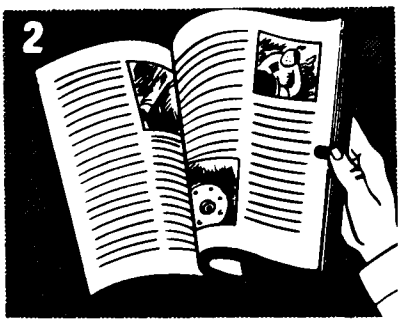
How to use Table of Contents

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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GENERAL INFORMATION

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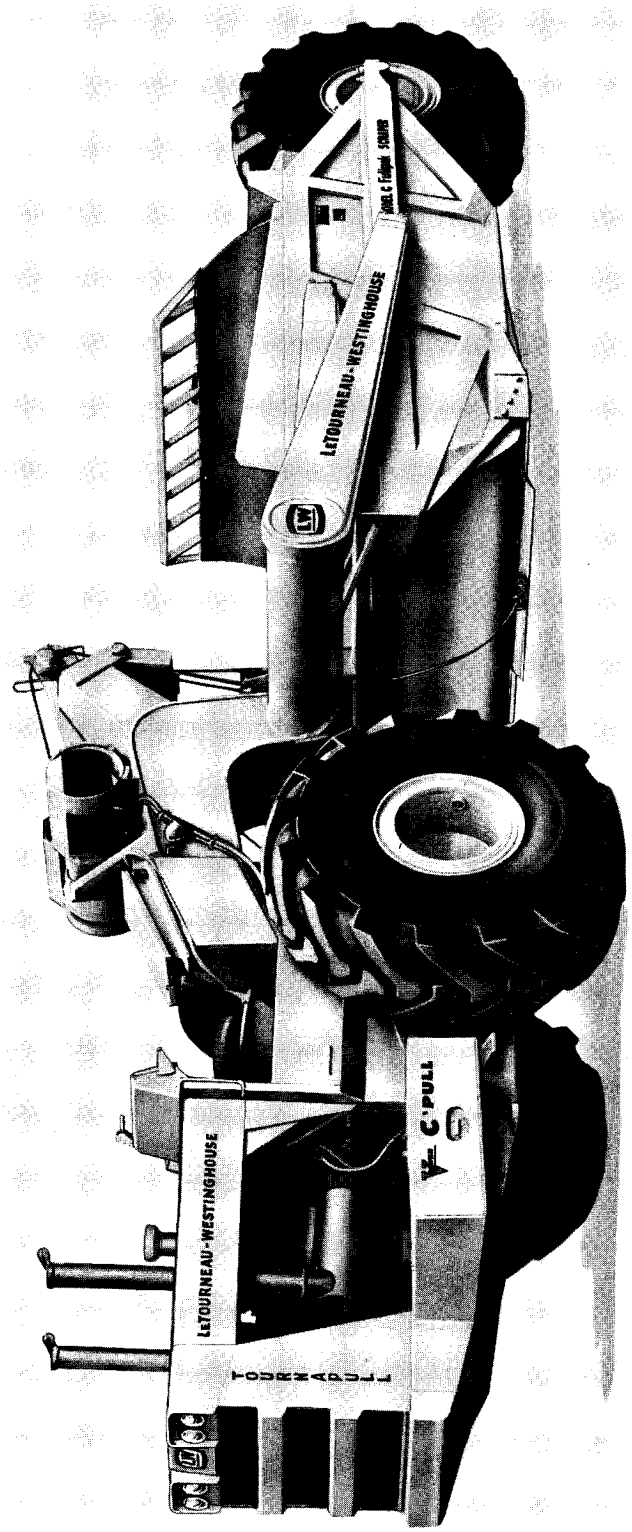

FIGURE A-1. V POWER C TOURNAPULL WITH SCRAPER

GENERAL INFORMATION

The V Power C Tournapull® is a modern high-speed, two-wheeled prime mover; which, when connected to one of its interchangeable trail units, becomes a highly versatile earthmoving and materials handling tool.

The Tournapull is powered by a high-speed, full diesel engine: GM 8V-71, 8 cylinder, capable of delivering 270 horsepower at 2100 RPM.

An a.c. generator mounted in line with and driven by the engine provides efficient and trouble-free electrical power for the operation of the steering and trail unit control motors. Revolving at an engine speed of 1800 RPM, the generator is capable of developing 300 volt, 3 phase, 120 cycle alternating current. Part of this power is used to maintain the storage batteries in a charged condition and to operate accessories, such as lights, heater, etc.

The Tournapull is equipped with a heavy-duty sliding gear transmission. This transmission has a semiautomatic clutch brake to facilitate changing gear ratios. It is also equipped with a self-contained, pressurized lubricating system and filter. This assures adequate lubrication of moving parts, greatly adding to the life of the transmission. This transmission provides 5 forward and one reverse gear ratio. Careful mating of the gears and use of the clutch brake assure positive engagement and easy shifting. See "Changing Speeds" for shifting procedure and use of the clutch brake.

The flywheel clutch is a heavy-duty, double disc type and is located between the generator and the transmission. A universal-type joint between clutch and transmission allows removal of the transmission or clutch without major disassembly of the machine. Air valves and chambers offer an air assist in disengaging the clutch. The clutch is disengaged or engaged by the clutch pedal in the Tournapull cockpit.

A power transfer differential transfers the driving power to the wheel with the best tractive advantage, permitting the Tournapull to "walk" through normally impassable spots. This can mean more profit by being able to work the machine when weather could have shut the job down.

The large low-pressure pneumatic tires increase the usefulness of the Tournapull with trail unit by permitting it to travel over paved surfaces and through materials that would normally bog down a tracked vehicle. The tires also lessen the road shock transmitted to the operator, giving a softer ride and reducing operator fatigue.

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

The steering is electrically controlled, 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 steering motor is controlled by a fingertip control switch in the lower left corner of the instrument panel.

All switches, gauges, and controls necessary to operate the Tournapull and trail unit are conveniently located on the instrument panel or in the cockpit, so as to be readily accessible to the operator.

Each wheel is equipped with a multiple disc, air actuated, spring released brake. Operation of the brakes is controlled by a foot-operated application valve located in the cockpit floor. Hand brake valves may also be included for special applications such as rear dump or crane operation. The hand valves control the wheel brakes independently of the foot valve.

Limit switches in the control circuits of the electric motors prevent "over-steer" or "over-travel" of the apron, body hoist and tailgate.

DRIVE SYSTEM

The drive system of the Tournapull is simple and rugged in design with a minimum of lubrication points.

The rotating engine flywheel is attached to and drives the generator rotor and 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 clutch, power goes to the transmission through a universal joint.

The spiral bevel pinion on the transmission output shaft drives the spiral bevel ring gear and differential assembly. The differential assembly drives the final drive pinions which in turn rotate

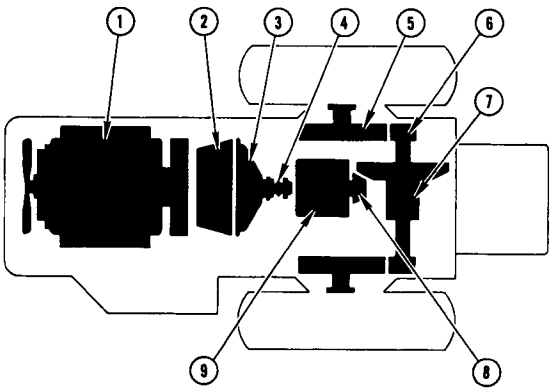

FIGURE A-2. TOURNAPULL DRIVE SYSTEM

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

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

The electrical system provides an instantaneous and trouble-free means of activating the trail unit moving components.

When a control switch on the instrument panel is closed, the main switch (in the circuit between the generator and the motor) is closed and the motor will operate in the direction desired.

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

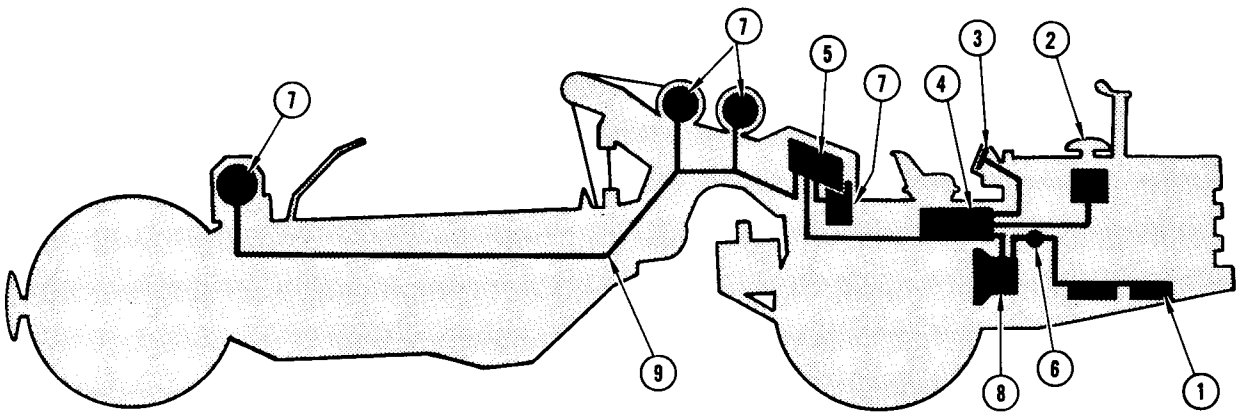

FIGURE A-3. ELECTRICAL SYSTEM

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

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 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.) Make sure drain cocks on engine, air compressor and radiator are closed.

Check drive belt adjustment.

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

Make sure float in dry air cleaner restriction indicator is free.

Check oil level in oil bath type air cleaner (if machine is so equipped).

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.

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

Check engine oil pressure gauge on instrument panel.

Check temperature of coolant at temperature gauge.

Check engine shut down controls to be sure they are pushed all the way in (normal and emergency).

Open air tank bleeder valve to drain off any accumulated condensation. Close bleeder valve.

TRANSMISSION

Check flywheel clutch adjustment.

Check oil level of transmission. Check transmission for correct operation at all speeds.

Check transmission oil pressure.

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 130 to 145 pounds per square inch.

Hook up wire ropes to trail unit.

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

Check trail unit hitch bolts, universal joint capscrews and steering circle gear mounting capscrews for tightness. Check each shift for first few days of operation and then intermittently thereafter.

Check scraper quick drop brake band for proper adjustment. See section "M".

OPERATING INSTRUCTIONS

The instructions which follow are intended to acquaint the mechanic with the instruments and controls and their proper use in operating and maintaining the 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 downtime.

INSTRUMENT PANEL

STEERING SWITCH

The steering switch (1) controls the reversible a.c. electric motor which turns the Tournapull. To turn either right or left, move the switch in the direction of travel desired. The switch will automatically return to the off position when released. Extremity of turn is governed by limit switches inserted into the steering motor circuit and acti-

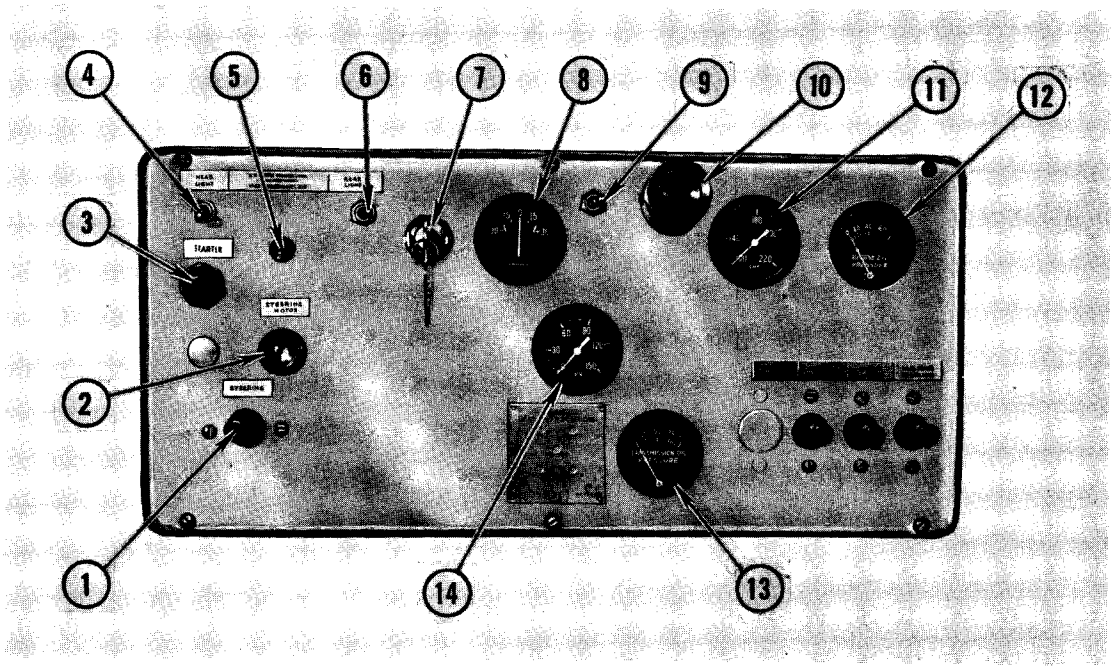

FIGURE A-4. INSTRUMENT PANEL

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

vated by a cam located on top of the steering kingpin.

STEERING MOTOR WARNING LIGHT

The steering motor warning light (2) 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.

CRANKING MOTOR SWITCH

The cranking motor switch (3) 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.

FRONT LIGHT SWITCH

The front light switch (4) controls the front lights. Lift toggle up to turn on lights. Push toggle down to turn lights off.

D.C. MAIN SWITCH

The D.C. Main Switch (5) opens and closes the 24 volt basic excitation circuit to the a.c. generator. When the toggle is up, the circuit is closed (on), when the toggle is down, 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.

REAR LIGHT SWITCH

The rear light switch (6) 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.

KEY SWITCH

The key switch (7) opens and closes the 24 volt circuit to the cranking motor switch. To start engine, turn the switch to the "on" position, completing the circuit to the cranking motor switch.

AMMETER

The ammeter (8) 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.

PANEL LIGHT SWITCH

The panel light switch (9) controls the operation of the panel light (10).

PANEL LIGHT

The panel light (10) is used to illuminate the instrument panel during night time operation.

ENGINE TEMPERATURE GAUGE

The engine temperature gauge (11) indicates the temperature of 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.

ENGINE OIL PRESSURE GAUGE

The engine oil pressure gauge (12) 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 25 to 35 p.s.i.

TRANSMISSION OIL PRESSURE GAUGE

The transmission oil pressure gauge (13) indicates the pressure of the lubricating oil in the transmission lubricating system. Normal operating pressure, after the oil has warmed up, is approximately 5 to 10 p.s.i.

AIR PRESSURE GAUGE

The air pressure gauge (14) indicates the amount of compressed air in the air supply tank, in pounds per square inch. Correct operating pressure is 130 to 145 p.s.i.

COCKPIT CONTROLS

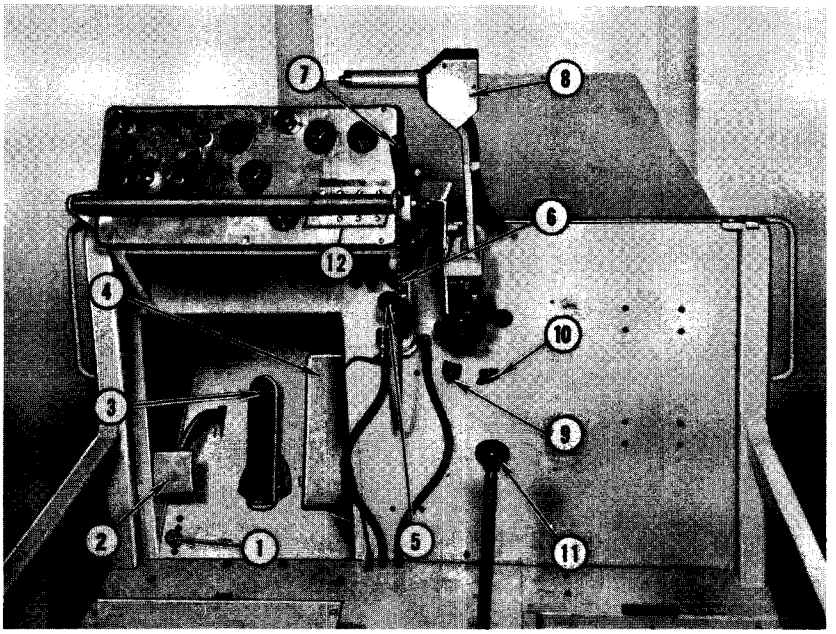

FIGURE A-5. COCKPIT CONTROLS

1. Dimmer Switch
2. Clutch Pedal
3. Brake Pedal
4. Accelerator
5. Clutch Brake Pre-select Button
6. Air Horn Chain
7. Hand Throttle
8. Quick Drop Lever
9. Engine Emergency Shut-Off Control
10. Engine Normal Stop Control
11. Transmission Shift Lever
12. Motor Control Switches

DIMMER SWITCH

The dimmer switch (1) dims or brightens the headlights. Press switch with foot to operate.

CLUTCH PEDAL

The clutch pedal (2) is a foot-operated pedal which disengages or engages the flywheel clutch. Depressing the pedal disengages the clutch, releasing the pedal engages the clutch.

BRAKE PEDAL

The brake pedal (3) operates a metering-type air valve controlling air flow to the wheel brakes for slowing and stopping the machine.

ACCELERATOR

The accelerator (4) 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.

CLUTCH BRAKE PRE-SELECT BUTTON

The pre-select button operates a valve (5) which delivers air pressure to the clutch brake interlock valve to aid in up shifting the transmission from one gear to another.

AIR HORN CHAIN

The air horn chain (6) operates the twin air horns when pulled.

HAND THROTTLE

The hand throttle (7) is connected to the accelerator linkage and may be used to maintain a fixed engine speed without use of the accelerator.

QUICK DROP LEVER

The quick drop lever (8) operates the bowl quick drop assembly on the scraper bowl hoist wire rope drum. The push botton switch is interconnected with the hoist motor control switch on the control and can be used to raise the scraper bowl. The hoist motor will run as long as the push button is held in. With the button pushed in, pulling the lever back will raise the bowl. Pushing the lever forward will drop the bowl regardless of the position of the push button. When loading, the button may be held in to allow "pumping-in" of the load. The hoist motor control switch on control panel will raise and lower the bowl independently of the quick drop lever.

ENGINE EMERGENCY SHUT OFF CONTROL

The engine emergency shut off control (9) stops the flow of air to the engine. Use this control to stop engine in case of EMERGENCY only. Do not use during normal operation. This control must be reset at the engine after each use.

ENGINE STOP CONTROL

The engine stop control (10) stops the flow of fuel oil to the engine injectors. This control is used to stop the engine during normal operation.

TRANSMISSION SHIFT LEVER

The transmission shift lever (11) 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.

CONTROL SWITCHES

The motor control switches (12) control the operation of the electric motors which in turn control the operation of the trail unit. Pushing a switch up results in an upward or forward movement. Pushing the switch down results in a downward or rearward movement.

AIR CLEANER SERVICE INDICATOR

The air cleaner service indicator (Fig. A-6) indicates the need for servicing the dry type air cleaner filter element. As the filter becomes dirty the additional vacuum, created by the engine's demand for air, causes the red colored indicator float to rise. See page K-4 for service instructions.

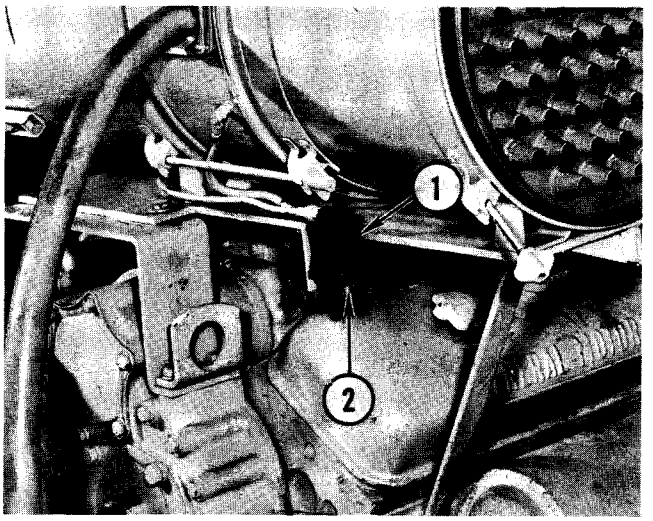

FIGURE A-6. AIR CLEANER SERVICE INDICATOR
1. Float 2. Stem

REVOLUTION COUNTER

The revolution counter (Fig. A-7) is attached to the engine's right balancer shaft and indicates length of engine service in hours of operation. The numbers appearing on the counter dial are to be read as hours of engine operation.

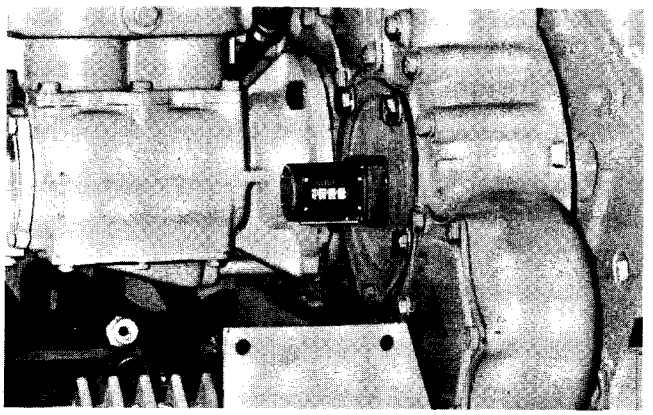

FIGURE A-7. REVOLUTION COUNTER

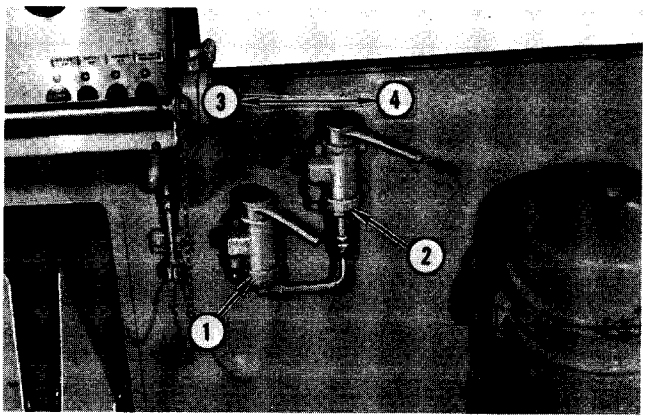

FIGURE A-8. HAND BRAKE VALVES
1. Tournapull 3. "On" Position
2. Trail Unit 4. "Off" Position

HAND BRAKE VALVE

The hand brake valve(s) (Fig. A-8) 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 wheel brakes are applied independently of the trail unit wheel brakes. By moving the right valve handle to the left (on) the trail unit wheel brakes are applied independently of the Tournapull wheel brakes. With both valve handles moved to the right (off) the foot valve controls all four wheel brakes.

STARTING THE ENGINE

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

Check to be sure normal and emergency shut off controls are pushed all the way in. If emergency shut off control was used, it must be reset at the engine before any attempt is made to start the engine.

Put transmission shift lever into the neutral position. Turn on key switch and D.C. Main Switch—press accelerator about half way down, and press cranking motor switch.

NOTE: Do not operate cranking motor more than 30 seconds at one time. Due to the high temperatures built up in the cranking motor during operation, allow at least two minutes for heat to dissipate before re-engaging cranking motor.

Turning the D.C. Main Switch on 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 a.c. generator, without which a.c. current cannot be generated and the trail unit control and steering motors will not operate. When idling the engine for long periods of time, it is advisable to turn the switch off to prevent unnecessary drain on the storage batteries. Be sure the switch is turned off when the machine is not operating.

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

Check engine for correct operation.

Do not move machine until minimum air pressure has been built up in the air supply tank.

STOPPING THE ENGINE

Throttle the engine down to idling speed for a few minutes to reduce engine temperature. Turn off D.C. Main Switch to break the generator excitation circuit. Turn off key switch to break circuit to cranking motor switch.

Pull out on normal engine shut off control and hold out until engine stops running. Use the emergency shut off control in EMERGENCY ONLY. Be sure to reset after using.

STEERING AND BRAKING

The Tournapull is steered by a reversible a.c. electric motor. This motor is controlled by the steering switch located in the lower left corner of the instrument panel.

The steering system is independent of the drive wheels and includes an 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 unit wheels are equipped with disc type air brakes. Two types of discs are used in this brake — internally splined steel discs splined to the stationary brake hub, and externally splined, lined discs which turn with the wheels. When the air is 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 to the foot 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 pedal and the air pressure is released.

The rear dump may be equipped with an automatic emergency air braking system. Independent lines, an extra air tank, governor, tractor protection valve, and emergency relay valve make it

HAND BRAKE VALVE

The hand brake valve(s) (Fig. A-8) 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 wheel brakes are applied independently of the trail unit wheel brakes. By moving the right valve handle to the left (on) the trail unit wheel brakes are applied independently of the Tournapull wheel brakes. With both valve handles moved to the right (off) the foot valve controls all four wheel brakes.

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

Check engine for correct operation.

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The steering system is independent of the drive wheels and includes an 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 unit wheels are equipped with disc type air brakes. Two types of discs are used in this brake — internally splined steel discs splined to the stationary brake hub, and externally splined, lined discs which turn with the wheels. When the air is 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 to the foot 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 pedal and the air pressure is released.

The rear dump may be equipped with an automatic emergency air braking system. Independent lines, an extra air tank, governor, tractor protection valve, and emergency relay valve make it

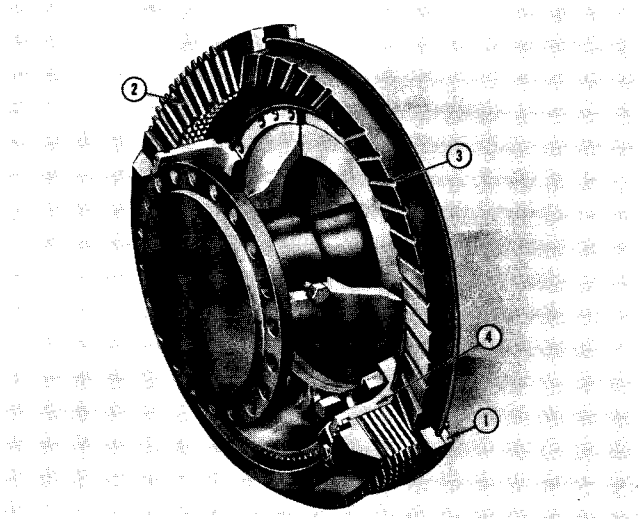

FIGURE A-9. WHEEL BRAKE

1. Backing Plate
2. Discs
3. Pressure Plate
4. Hub

completely automatic. This is all in addition to the regular braking system. See figure A-10.

If for any reason a line becomes broken on the rear dump in such a way that the emergency relay valve does not operate, the tractor protection valve permits this condition to exist only until the main reservoir pressure is lowered to 90 pounds. The tractor protection valve then shuts off until such time as the reservoir fills back up to 120 pounds, and allows the cycle to repeat. Under this condition, the Tournapull always has a minimum of 90 pounds of air pressure to apply its brakes at the operator's command.

Another condition that may exist is a break in the service or emergency lines between the Tournapull and the rear dump. The tractor protection valve maintains 90 pounds on the Tournapull, and at the same time, the emergency valve on the rear dump becomes operative and automatically applies the brakes to the rear dump, using the air in the emergency air tank. The tractor protection valve also goes into operation if either of the lines from the relay valve to the rear dump brake diaphragms is broken, or a diaphragm ruptures.

When a line is broken on the Tournapull, the emergency valve on the rear dump automatically shuts off, not allowing the reservoir on the rear dump to lose its air and at the same time applies the rear dump brakes automatically, bringing the machine to a safe stop.

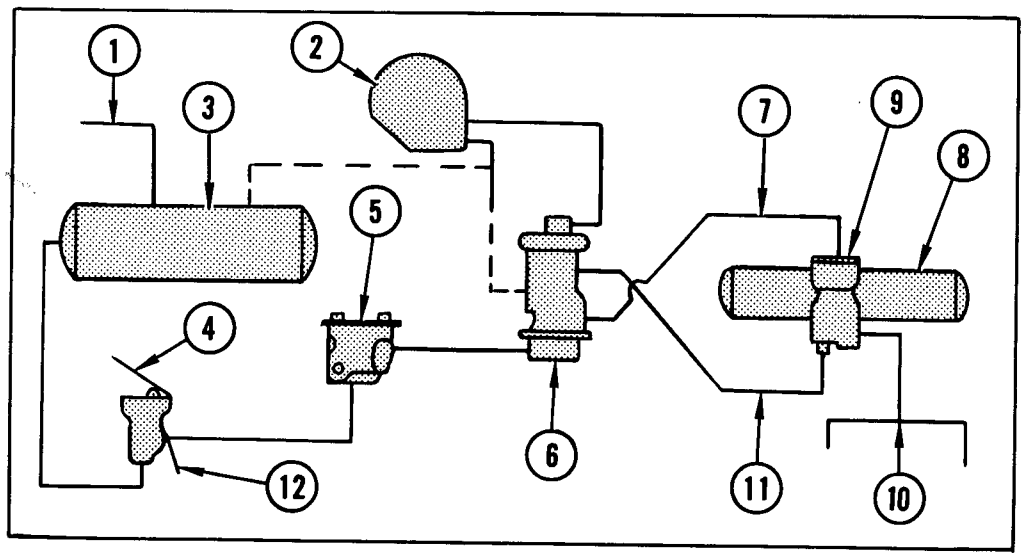

FIGURE A-10. EMERGENCY BRAKING SCHEMATIC

1. From Compressor
2. Governor
3. Main Air Tank
4. Foot Brake Valve
5. Double Check Valve
6. Tractor Protection Valve
7. Service Line
8. Emergency Air Tank
9. Emergency Relay Valve
10. To Rear Brakes
11. Emergency Line
12. To Tournapull Brakes

CHANGING SPEEDS

Working in conjunction with the transmission 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 the button is pressed in, air is admitted to a trigger valve located on the transmission. This valve is normally in the closed position. As the shift lever is moved into the neutral position, the shifter yoke bars operate actuating plungers,

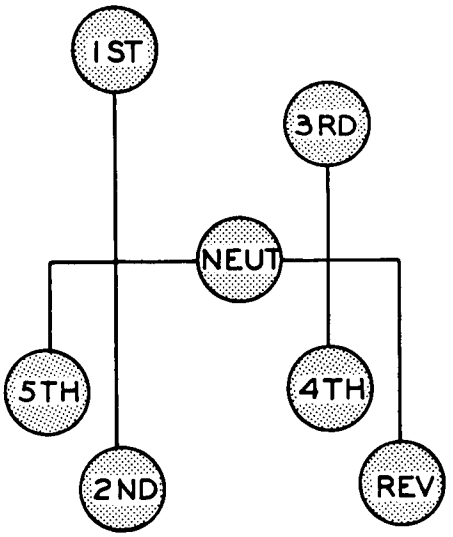

FIGURE A-11. TRANSMISSION SHIFTING DIAGRAM

which in turn 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 the speed of the countershaft to allow shifting of the gear without clashing or "double clutching".

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, then builds 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.

Following are some suggested practices for the operator when shifting from one gear ratio to another. The actual shifting depends upon the operator's technique which will improve with practice. Refer to figure A-11 for shift lever positions.

Always disengage the clutch completely before changing gears.

The clutch brake is to be used only when shifting the transmission to a higher gear. Do not use when down shifting.

To shift out of neutral into first speed forward or reverse use the following procedure:

1. Depress clutch pedal, completely, to disengage the flywheel clutch.
2. Push in on the clutch brake pre-select button.
3. Shift the transmission into 1st forward or reverse immediately after pushing in on the pre-select button. This is necessary as the clutch brake is applied only momentarily while the transmission is in neutral.
4. Engage flywheel clutch and accelerate engine simultaneously.

To shift into a higher travel speed, use the following procedure:

1. Push in on clutch brake pre-select button.
2. Depress the clutch pedal, completely, to disengage the flywheel clutch.
3. Shift transmission into position desired.
4. Engage flywheel clutch and accelerate engine simultaneously.

To shift the transmission down into a lower travel speed, it is necessary to "double clutch". DO NOT use the clutch brake.

To "double clutch", depress the clutch pedal and shift the transmission into neutral. Engage the clutch (with transmission 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, then engage the clutch and accelerate engine simultaneously.

Progressive shifting is always recommended.

Always drive down grades! Keep the transmission in gear and the clutch fully engaged.

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

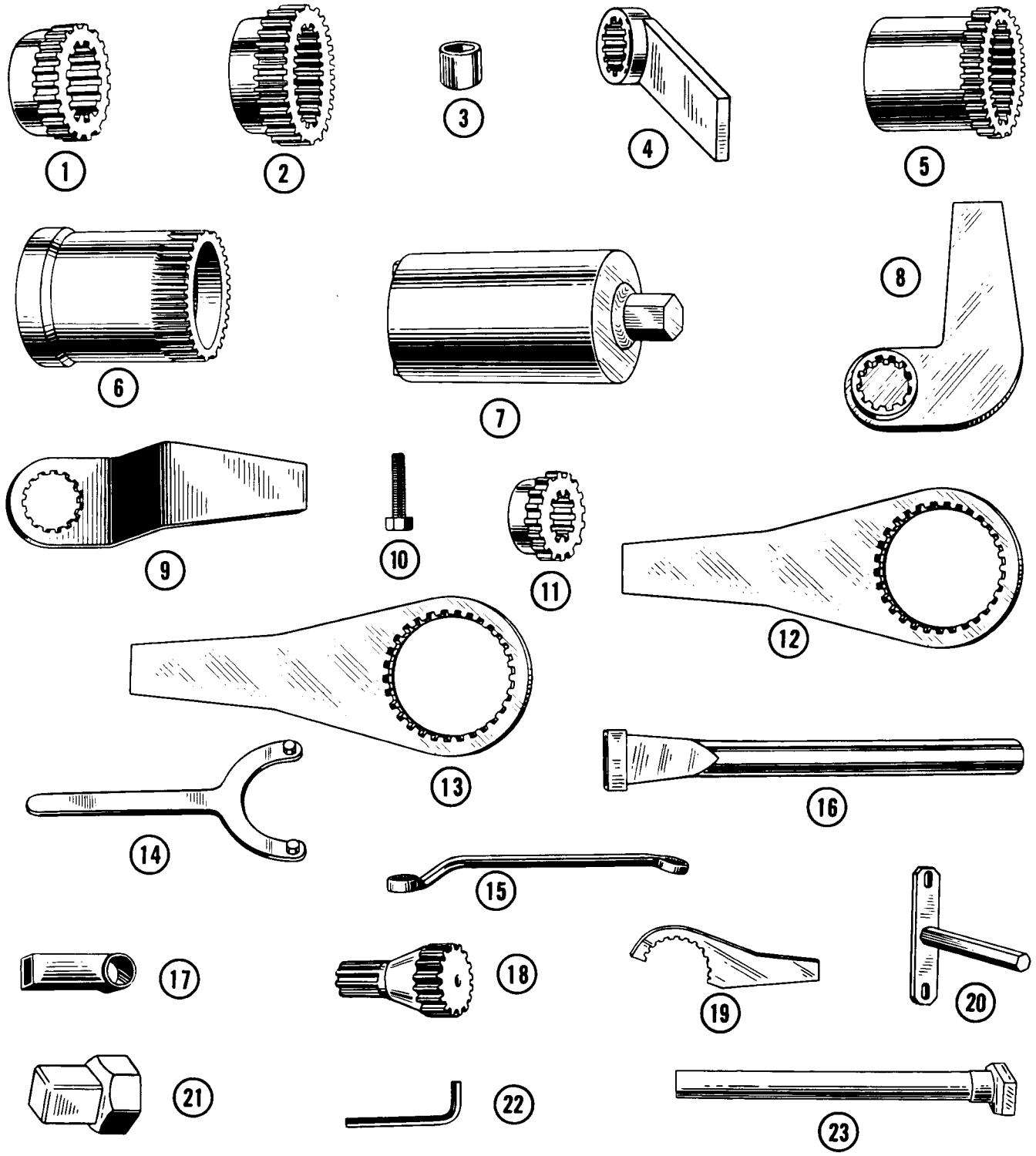

FIGURE A-12. SPECIAL TOOLS

1. Adaptor (14T - 25T), Motor Brake Hub and Rotor Retainer Nuts
2. Adaptor (22T - 30T), Generator Tapered Nut
3. Socket, Wheel Capscrews
4. Wrench, Yoke Hitch Bolt Nut
5. Adaptor (25T - 30T), Motor Brake Hub, Rotor Retainer and Gear Box 2nd Reduction Gear Nuts
6. Adaptor (30T), Wire Rope Drum Locknut, For Use With #12
7. Wrench, Kingpin Nut Adjusting
8. Wrench, Spiral Bevel Pinion, For Use With #18
9. Wrench, Final Drive Pinion and Gear Box 1st Reduction Gear Locknut, For Use With #11
10. Capscrew, Axle Pulling
11. Adaptor (11T - 16T), Gear Box 1st Reduction Gear Locknut
12. Wrench Handle, For Use With #1, 2, 5, 6
13. Wrench, Axle Nut
14. Spanner Wrench, Quick Drop Drum
15. Box Wrench
16. Wrench Handle
17. Wheel Capscrew Wrench Support, For Use With #3, 23
18. Splined Wrench Head (6T - 12T)
19. Motor Brake Hub Wrench
20. Motor Brake Adjusting Wrench
21. Adaptor, Final Drive Pinion
22. Allen Wrench
23. Wheel Capscrew Wrench, For Use With #3, 7

TORQUE CHART

LOCATION	TORQUE IN FT. LBS.
Case staybolts	600
Differential pinion bushing capscrews	150
Differential cage bolts	190
Differential carrier bearing cap locknuts	600
Differential adjusting nut lockbolts	70
Engine rear mounting capscrews	460
Final drive axle locknut	4500
Generator bearing locknut	1200
Generator rotor to engine flywheel capscrews	250
Generator end bell to stator capscrews	30
Gear box output shaft locknut	2000
Gear box 1st reduction gear locknut	100
Gear box 2nd reduction gear locknut	200
Gear box 1st reduction gear bearing retainer plug	100
Gear box 2nd reduction gear bearing retainer plug	200
Gear unit axle locknut	8000
Gear unit bearing retainer cap	200
Motor bearing retainer locknut	350
Motor brake hub locknut	300
Quick drop wire rope drum locknut	2000
Quick drop planetary jam nuts	750
Ring gear to differential mounting capscrews	400
Steering ball and socket capscrews	900
Steering trunnion locknut	600
Steering ring gear taperhead capscrews	600
Steering ring gear flathead capscrews	400
Steering trunnion housing to trail unit yoke bolts	1400
Trail unit ball joint capscrews	360
Transmission mainshaft locknut	500
Tailgate side thrust roller clamp bolts	300
Transmission drive gear shaft locknut	150
Transmission output pinion bearing locknut	600
Transmission adaptor mounting stud jam nuts	175
Universal joint mounting capscrews	70–80
Wheel brake mounting capscrews	190
Wheel mounting capscrews	900

STANDARD CAPSCREW AND NUT TORQUES

	Flat Head Capscrews & Nuts		Taper Head Capscrews	Jam Nuts	
Capscrew Size	UNC NC	UNF NF	NC, NF, UNC, UNF	UNC NC	UNF NF
1/4	11	12	12	5	6
5/16	21	23	25	10	11
3/8	38	40	45	20	21
7/16	55	60	75	33	36
1/2	85	95	105	47	52
9/16	125	140	135	60	67
5/8	175	210	190	80	96
3/4	300	330	285	127	140
7/8	450	490	400	177	193
1	680	715	540	240	250
1 1/8	885	990	675		
1 1/4	1255	1380	870	387	425
1 3/8	1635	1875	1000		
1 1/2	2180	2430	1275	567	630

V-POWER C TOURNAPULL

SPECIFICATIONS

Specifications are subject to change without notice or obligation.

TOURNAPULL

ENGINE (Diesel)	GM 8V-71
Number of Cylinders	8
Operating Cycle	2 Stroke
Maximum Brake Horsepower	290 HP @ 2100 RPM
HP Rated at	Sea Level @ 60° F.
Maximum Torque	805 ft. lb. @ 1200 RPM
Bore	4 1/4 in.
Stroke	5 in.
Displacement	567.4 cu. in.

CLUTCH ..... Rockford 16", Single or Double Plate with air assist clutch release

TRANSMISSION

Step Gear Type ..... Fuller LM-1220

SPEED in MPH and RIMPULL in pounds	Speed @ 2100 RPM	Rimpull @ 2100	Maximum Rimpull
Forward 1st	2.6	31,650	35,550
2nd	5.1	16,250	18,250
3rd	9.8	8,450	9,500
4th	17.1	4,850	5,450
5th	27.0	3,100	3,450
Reverse	2.6	....	....

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

SERVICE CAPACITIES (U. S. Standard Measurement)

Cooling System	16 Gals.
Crankcase	7 1/2 Gals.
Fuel Tank	100 Gals.
Final Drive (Main Case)	37 Gals.
Transmission	3 3/4 Gals.

SCRAPER

CAPACITY

Cubic Yards, heaped	20
Cubic Yards, struck	14
Tons	22

SCRAPER OPERATING DATA

Apron opening	6' 1"
Depth of cut, maximum	Unlimited
Depth of spread, maximum	18"
Type of ejection	Forward, positive
Cutting edge, length (three-piece)	9' 6"
Center section	7/8" x 16" x 60"
Each end section	3/4" x 13" x 27"

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

GENERAL

OVERALL MEASUREMENTS (with Tournapull)

Length	37' 3"
Width	11' 4"
Height	10' 1"
Wheelbase	22' 4"
Gauge, center to center tires, Tournapull	6' 10"
Gauge, center to center tires, scraper	6' 10"
Ground clearance, Tournapull	15½"
Ground clearance, scraper	14"

TIRES

Standard	24.00-25, 24 ply rating, Rock Service
Optional	24.00-25, 18 ply rating, Traction
	26.5-25,26 ply rating, Traction

STEERING	Positive power steer, electric control
Maximum turning angle	90° left and right
Width required for 180° turn	32' 7"

BRAKES	Multiple disc air brakes on all four wheels
Square inches of braking surface	3,764
Electrotarder	Optional
Parking brake	Mechanical, optional

WEIGHTS

Shipping weight, approximate		45,160 lbs.
Distribution	Empty	Loaded
Drive Axle	66%	53%
Rear Axle	34%	47%

REAR DUMP

CAPACITY	Tons	Cu. Yds. Struck	Cu. Yds. Heaped 1:1	Cu. Yds. Heaped 2:1
Standard	22	14.7	22	19
*With 17" Sideboards	22	20	28	25
*With Tailgate only	22	15.8	24	20
*With Tailgate and Sideboards (17")	22	21.4	29	26

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

REAR DUMP MEASUREMENTS

Length	16' 8"	Height, extreme dump position	17' 2"
Width, outside yoke	10' 7"	Loading height, average	8' 3"
Height	11' 4"	Angle of dump	66°

BOWL MEASUREMENTS

Length	10' 10"
Width	8' 9"
Depth, Maximum	6' 4"

BODY CONSTRUCTION

Bottom	3 layer: ½" steel bottom; 1½" steel reinforcing strips; ¾" steel wear plates
Sides	Quarry Body, ½" plate with ¾" wear plates. Regular Body, ½" plate
Front	¾" steel plate, reinforced

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

CABLE SPECIFICATIONS

Body lift	7/8" x 47' 5"
Return	7/8" x 19' 3"

Type recommended: 6 x 19 filler wire, Preformed LeTourneau-Westinghouse wire rope, improved plow steel, right lang lay, I.W.R.C.

GENERAL

OVERALL MEASUREMENTS (with Tournapull)

Length	29' 6"
Length, dump position	25' 8"
Width	11' 7"
Height	11' 4"
Height, dump position	17' 2"
Wheelbase	16' 4"
Wheelbase, dump position	8' 1"
Gauge, center to center tires:	
Tournapull	6' 10"
Rear Dump	9' 4"
Ground clearance:	
Tournapull	17½"
Rear Dump	26"

TIRES (Tubeless)

Standard	24.00-25, 24 ply rating, Rock Service

STEERING	Positive power steer, electric control
Maximum turning angle	90° left and right
Width required for 180° turn	28' 8"
Width required for 180° turn, dump position	20' 8"

BRAKES	Multiple disc air brakes on all four wheels
Square inches of braking surface	3,840
Electrotarder	Optional
Parking brake	Mechanical, Optional
Automatic emergency braking system	Optional

WEIGHTS

Shipping weight with Quarry Body, approximate ..... 48,200 lbs.

Distribution	Empty	Loaded
Drive Axle	68%	50%
Rear Axle	32%	50%

COOLING AND AIR SYSTEMS

INDEX

COOLING AND AIR SYSTEMS

COOLING SYSTEM

The cooling system includes the fan and fan belts, radiator, thermostat 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 jackets and then into the water manifold at the top of the engine. A thermostat in the water outlet manifold controls the flow of water. Before the water reaches 160° F., thermostat stays closed and the water by-passes the radiator. When the temperature of the circulating water reaches approximately 165° F., the thermostat begins to open and allows the water to flow through the by-pass line and into the inlet side of the water pump.

When the water temperature exceeds approximately 175° F., the thermostat is fully open and permits the flow of water into the radiator.

Under normal operating conditions, the water temperature should range from 165° to 185° F.

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

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

Radiator

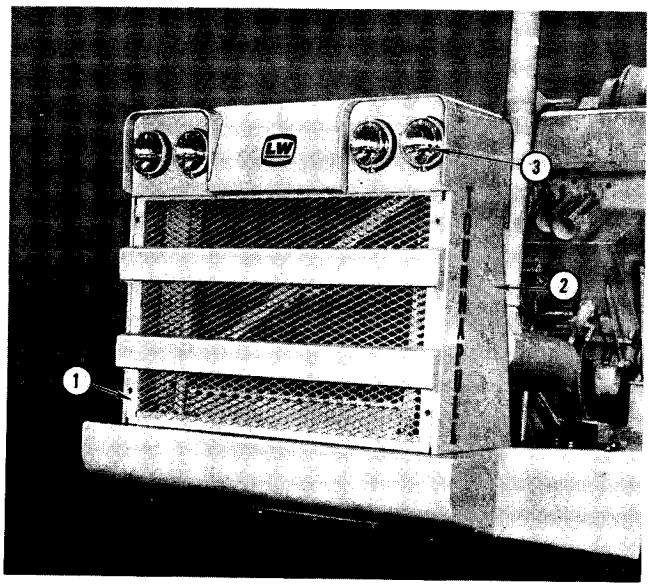

FIGURE B-1. RADIATOR MOUNTING

1. Removable Grille
2. Shell
3. Headlights

REMOVAL

Drain the coolant from the radiator and engine block. Disconnect top and bottom radiator hoses.

Disconnect headlight wires from terminal strip located on radiator shell (at the left front, near radiator mounting).

Remove capscrews fastening the hood to the radiator shell. Prop up hood, using blocks of wood between under side of hood and top of the engine.

Hood may be removed if desired. It will be necessary to remove capscrews fastening the hood to cockpit firewall. Lift hood straight up over the exhaust pipes, after removing rain caps.

Remove the four screws and lockwashers fastening the removable grille section to the radiator shell. Remove grille. See figure B-1.

Attach hoist to shell. Remove the four mounting capscrews and lockwashers. See figure B-2. Lift radiator up and out of case.

Remove the four capscrews and lockwashers fastening radiator to case.

Attach hoist to radiator and remove from case.

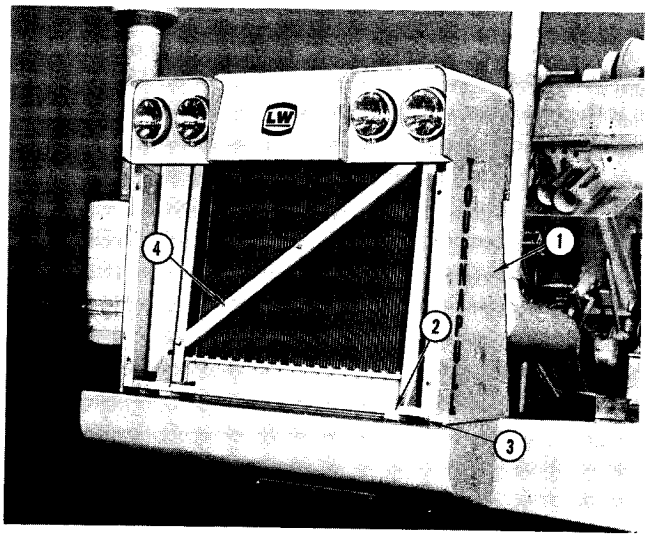

FIGURE B-2. RADIATOR, GRILLE REMOVED

1. Shell
2. Shell Mounting Bolt
3. Radiator Mounting Bolt
4. Diagonal Brace

DISASSEMBLY

Remove capscrews and lockwashers fastening fan shroud to the radiator. Remove shroud and overflow tube. See figure B-3.

Remove capscrews and lockwashers fastening the side plates to top and bottom radiator tanks.

To separate the radiator core from the top and

bottom tanks, remove the capscrews and lockwashers securing the tanks to their respective headers.

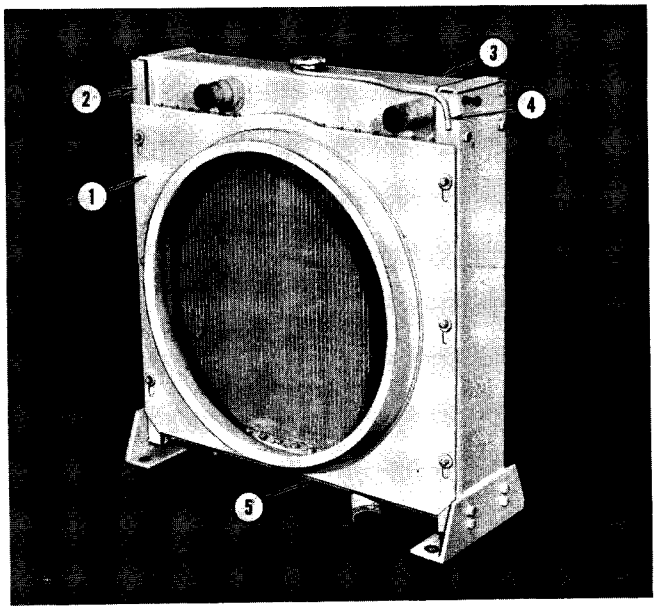

FIGURE B-3. RADIATOR, REMOVED

1. Shroud
2. Side Plate
3. Top Tank
4. Overflow Pipe
5. Bottom Tank

REASSEMBLY

Inspect all parts carefully for damage. Scrape all sealer material from the headers and radiator tanks.

Coat sealing surfaces with sealer. Coat capscrews with sealer. Replace tanks and headers, secure with capscrews and lockwashers. All capscrews must be started into tapped holes in header before tightening. Replace side plates.

Replace diagonal brace across the front of the radiator and secure to side plates with capscrews and lockwashers.

Position fan shroud and overflow tube. Secure with capscrews and lockwashers.

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

Replace radiator on machine and replace the four mounting capscrews and lockwashers.

Position shell over radiator, and secure with mounting capscrews and washers.

Replace the grille and secure with capscrews and lockwashers.

Check to be sure fan is centered in the shroud opening. Center by loosening the shroud mounting hardware and sliding it into the correct position. Re-tighten mounting hardware.

Reconnect headlight wires to terminal strip.

Replace and secure hood. Be sure edges of the hood are down in the guide clips at the radiator shell and at the firewall.

Reconnect hoses and close drain cocks. Refill cooling system. Use anti-freeze in winter and a water soluble rust inhibitor in summer. See page K-12.

Temperature Gauge

The temperature gauge is located on the instrument panel and indicates the temperature in degrees F. of the coolant in the engine's cooling system.

If the temperature registers at a level in excess of the normal operating range, checks are to be made to determine and correct the trouble.

Replace gauge and indicator bulb if the gauge should become inoperative.

Thermostat

Before installing thermostat, examine for corrosion and replace if excessively corroded or if the frame is bent or damaged. Check for holes in the bellows.

To check a thermostat, place it in a vessel containing hot water and a thermometer. Raise the temperature of the water. The thermostat should begin to open at a temperature corresponding with the mark on the thermostat.

The degree difference between the start and the fully opened point is approximately 10° F. If the thermostat does not function properly, replace.

AIR SYSTEM

Dry Type Air Cleaner

The dust laden air is drawn into the air cleaner through the hooded intake tube, into the lower air chamber, which is a common entrance to the cyclone tubes and is rotated downward by the helix shaped vane to create centrifugal force on the dust particles.

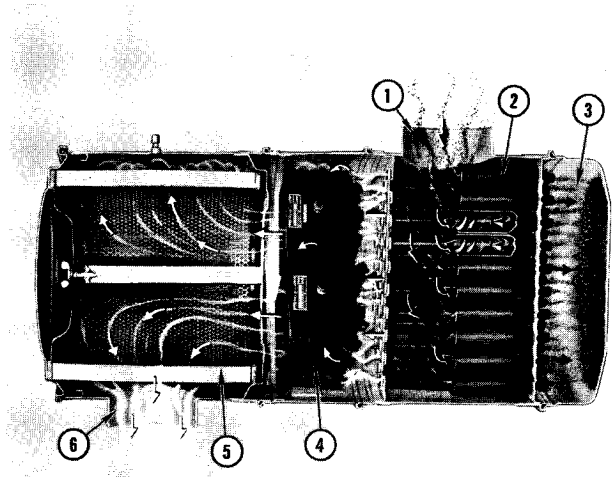

FIGURE B-4. DRY TYPE AIR CLEANER, AIR FLOW

1. Intake
2. Cyclone Tube
3. Dust Cup
4. Rectifiers
5. Filter Cartridge
6. Discharge

The air spirals into the tapered section of the tube and reverses direction at the end. As the air reverses direction, the dust particles are thrown into the dust cup by centrifugal force.

The partially cleaned air then moves through the center of the cyclone tubes into the rectifier chamber. The air going past the rectifiers into the upper chamber cools them.

Air in the upper chamber is then drawn through the filter cartridge into the engine's intake air system.

A service indicator on the air cleaner body indicates the need for filter cartridge service. As the filter becomes dirty the additional vacuum, created by the engine's demand for air, causes the indicator float to rise. See page K-4 for service instructions.

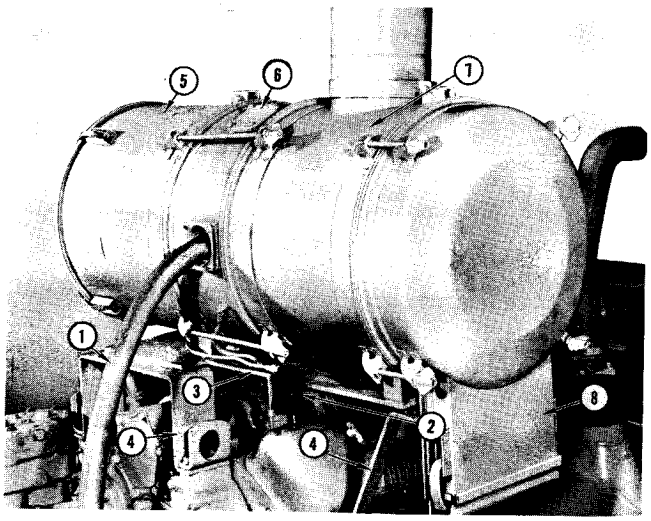

FIGURE B-5. DRY TYPE AIR CLEANER, MOUNTED

1. Rectifier Cable
2. Service Indicator
3. Mounting Plate
4. Brackets
5. Upper Body
6. Rectifier Housing
7. Lower Body
8. Dust Collector Cup

REMOVAL

To remove air cleaner assembly as a unit, use the following procedures. See figure B-5.

Remove exhaust stacks and engine hood.

Disconnect rectifier leads from transformer terminal strip and D.C. field breaker switch. Free cable from clamps.

Disconnect service indicator vacuum line from side of air cleaner body.

Remove the four capscrews, lockwashers and nuts securing the air cleaner mounting plate to the mounting brackets. Also remove the two capscrews and lockwashers fastening the mounting plate to the engine air box.

Loosen hose clamps on air cleaner discharge hose.

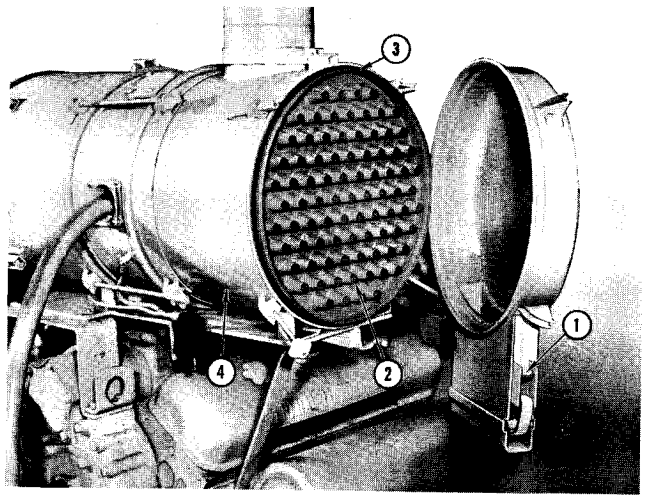

FIGURE B-6. REMOVING COLLECTOR CUP

1. Collector Cup
2. Cyclone Tubes
3. Gasket
4. Lower Body

Lift air cleaner, rectifiers and mounting plate from engine.

Use the following instructions to disassemble air cleaner or to remove from machine other than as a unit. Exercise caution so as not to damage gaskets.

Remove air inlet pipe from air cleaner inlet. Loosen wing nuts holding collector cup and lower body together, then pull collector cup from lower body assembly. Remove rubber gasket from lower body (figure B-6).

Disconnect rectifier ground wire. Loosen wing nuts fastening lower body, rectifier housing and upper body together. Remove the two capscrews, lockwashers and nuts securing lower body to mounting plate. Pull lower body away from recti-

fier housing. Pull rectifier housing from upper body. Remove gasket from upper body (figure B-7).

Remove the two capscrews, lockwashers and nuts securing upper body to mounting plate. Remove upper body.

Loosen cover clamp and remove cover. Remove cartridge hold down wing bolt and lift cartridge from upper body (figure B-8).

Reassembly of the air cleaner is accomplished by reversing the disassembly procedure. Make sure hose connections, gaskets and grommets make air tight connections.

See page K-4 for air cleaner service and checking instructions.

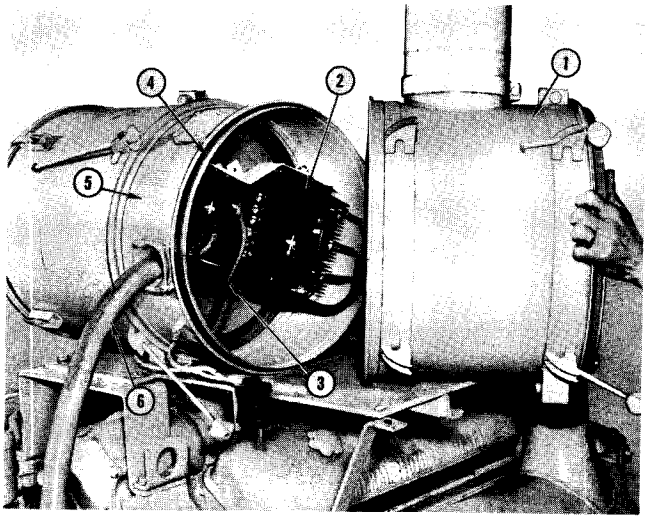

FIGURE B-7. REMOVING LOWER BODY

1. Lower Body
2. Rectifiers
3. Ground wire
4. Gasket
5. Rectifier Housing
6. Upper Body

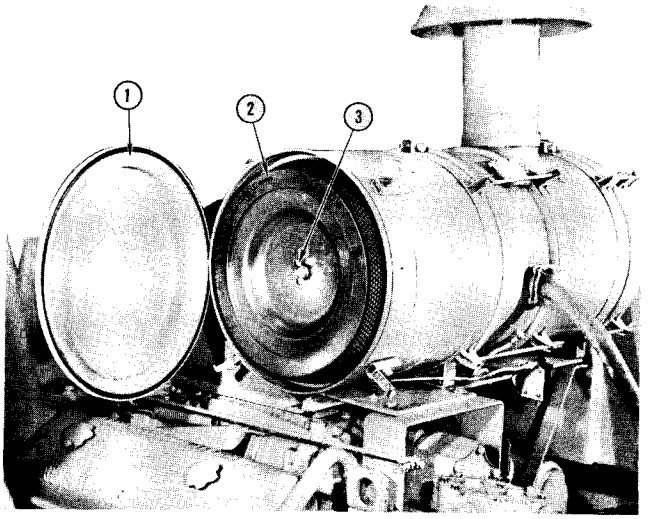

FIGURE B-8. COVER REMOVED

1. Cover
2. Cartridge
3. Wing Bolt

Oil Bath Air Cleaner

The engine's air intake manifold is connected to the discharge side of the air cleaner. The dust laden air is drawn into the inlet cap through the openings around the outside of the cap.

The inlet cap keeps fibrous materials such as chaff or lint from entering the main body of the air cleaner. In the air cleaner oil cup air is combined with the oil and forms a spray which is drawn upward through the filter element in the cleaner body. Oil and dirt particles are separated from the air in the filter element and drain back into the oil cup. Cleaned air is then drawn into the engine's intake manifold.

REMOVAL

Loosen wing nuts at bottom of air cleaner assembly and remove oil cup and disc.

Remove rectifier housing clamp band and lift off rectifier housing and inlet cap.

Remove capscrews from air cleaner mounting bands and remove air cleaner. Place assembly on a bench for further service or disassembly.

Pre-filter may be removed by pushing it up slightly and turning to the left, then pull down.

Refer to page K-4 for air cleaner service instructions and maintenance.

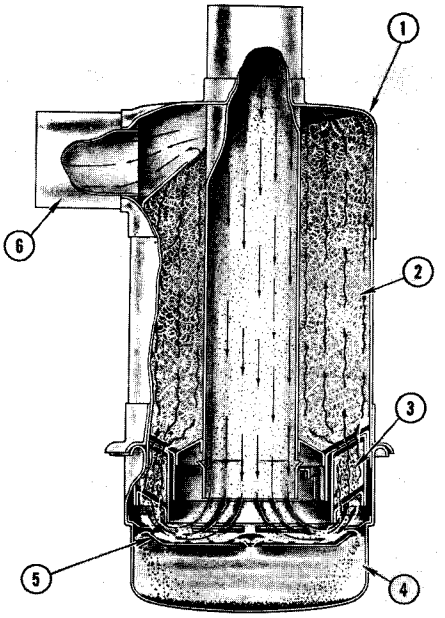

FIGURE B-9. OIL BATH AIR CLEANER, AIR FLOW

1. Body
2. Element
3. Pre-Filter
4. Oil Cup
5. Disc
6. Discharge

Air Compressor (Tu-Flo 500)

DESCRIPTION

The air compressor is a two cylinder, single acting, reciprocating type and has a rated capacity of 12 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 hose 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 passage in the compressor base.

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

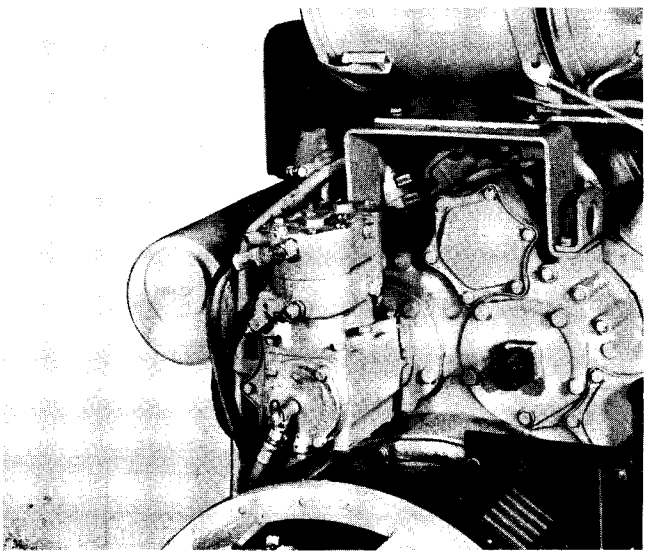

FIGURE B-10. AIR COMPRESSOR, MOUNTED

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.

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 pistons 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 com-

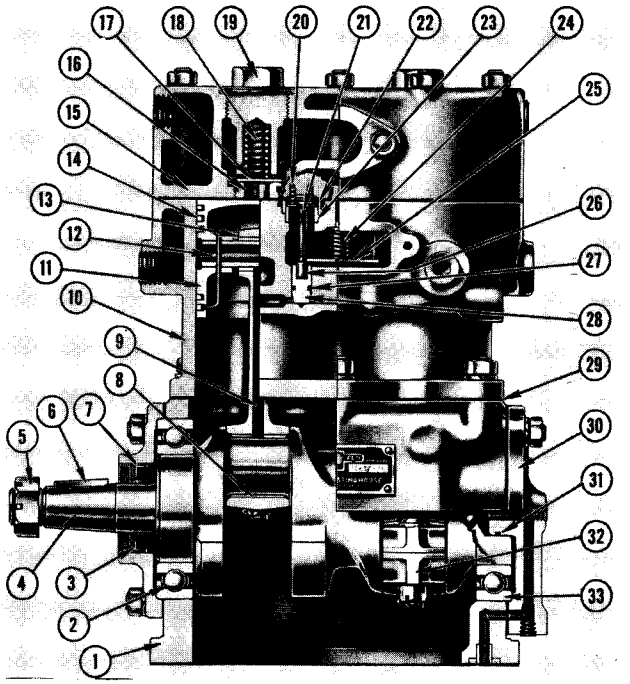

FIGURE B-11. AIR COMPRESSOR (TYPICAL), CROSS SECTION

1. Crankcase
2. Bearing
3. Oil Seal
4. Crankshaft
5. Nut
6. Key
7. 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

pressor 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

Drain the air system completely by opening the bleeder valve on the air tank. The air tank is located in left side of Tournapull case.

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

Disconnect air, water, and oil lines connected to the compressor.

Remove capscrews and lockwashers fastening compressor crankcase flange to rear of engine. Pull compressor away from engine. Do not allow splined drive sleeve to fall as compressor is removed (figure B-12).

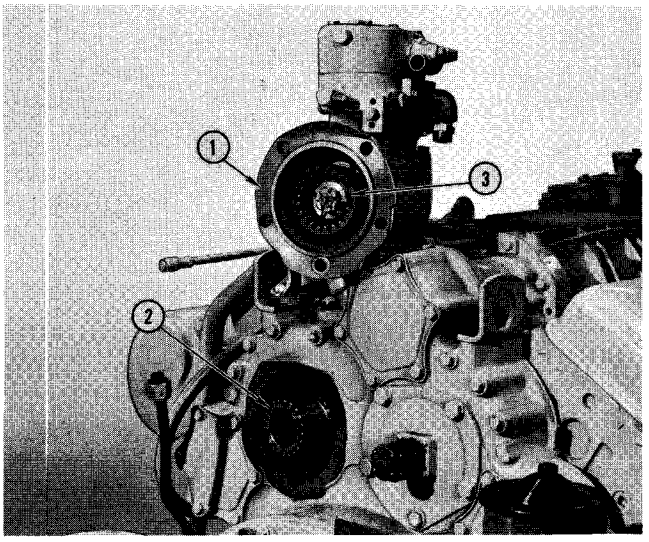

FIGURE B-12. REMOVING AIR COMPRESSOR

1. Mounting Flange
2. Drive Sleeve
3. Compressor Drive Disc

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

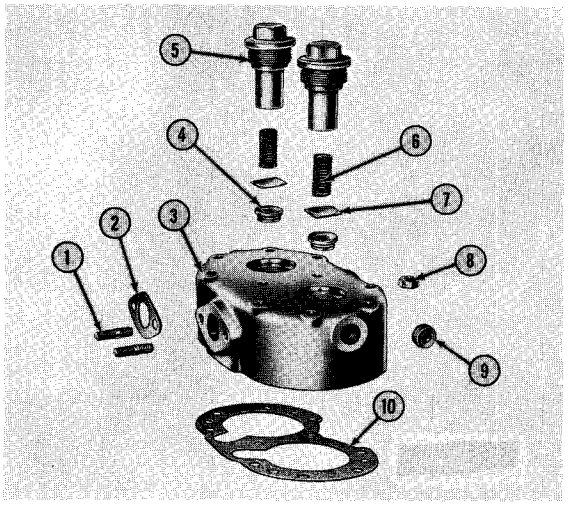

FIGURE B-13. CYLINDER HEAD, EXPLODED

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

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 rear end cover in relation to the crankcase.

Marking the crankcase with one punch mark at the rear end will permit the crankshaft to be positioned 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 or plastic 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 bottom cover plate and gasket.

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 at-

tached, 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 pins from pistons and connecting rods.

Remove cotter, nut and drive plate from front end of compressor crankshaft. Remove machine screws holding front bearing retainer to crankcase. Remove retainer.

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

The crankshaft may be removed only through the rear of the crankcase. Press crankshaft and rear ball bearing out of the crankcase, then press ball bearing off crankshaft. Remove front bearing from crankcase.

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

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 bushings only if they are worn or damaged.

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 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 the oil passages through the crankshaft, connecting rods, crankcase, and end covers. If necessary, prod the 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 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 the condition of discharge valves and discharge valve seats. If the discharge valves are

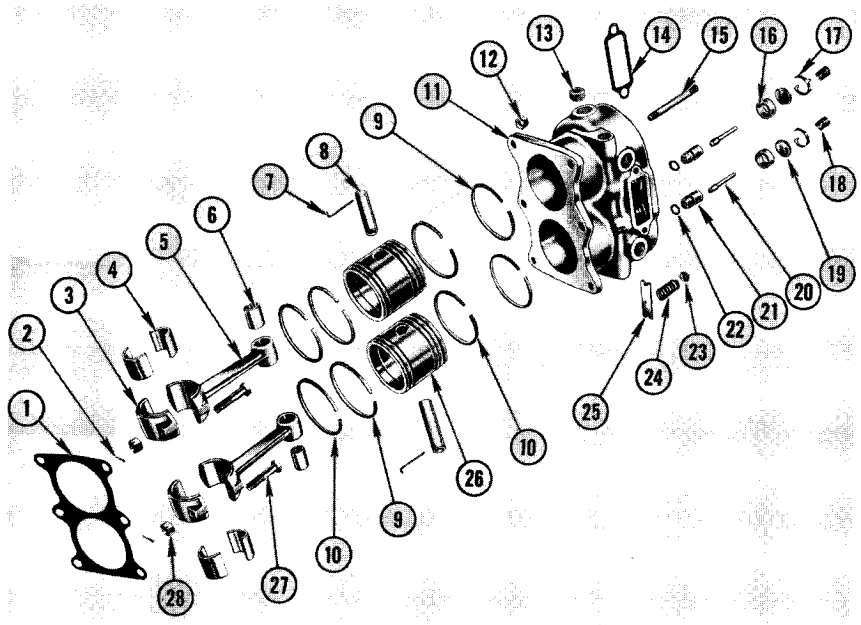

FIGURE B-14. CYLINDER BLOCK, EXPLODED

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

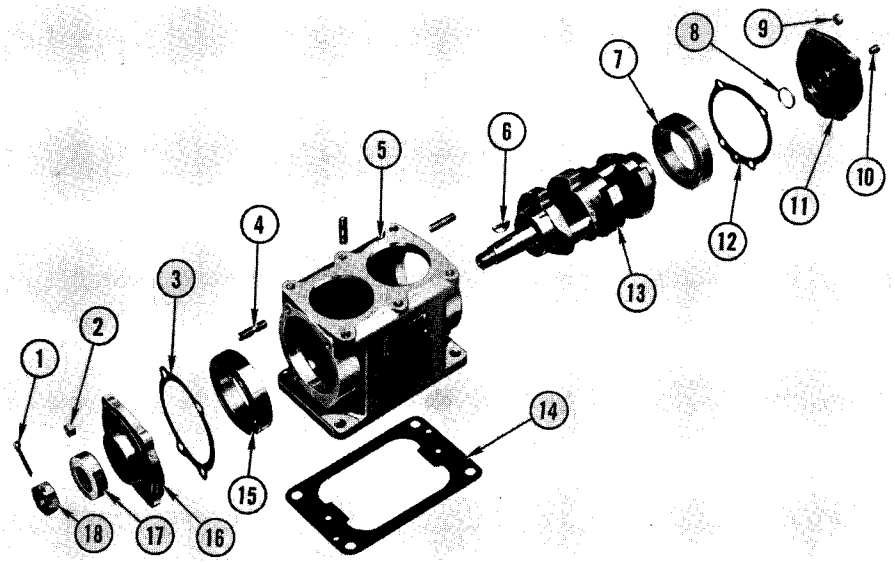

FIGURE B-15. CRANKCASE, EXPLODED

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

grooved deeper than 0.003" where they contact the seats, they must be replaced. If 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 cover for cracks and broken lugs. Replace if any are found.

Check fit of oil seal ring in the ring groove.

Ring must be 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 unloading 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 the cylinder bores for evidence of excessive wear, out-of-round, or scoring. Cylinder bores which are scored and 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" and 0.004" maximum.

Check fit of piston rings in the ring grooves. Refer to figure B-16 for correct gap and ring clearance.

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 the connecting rod bushing by rocking the piston. The clearance

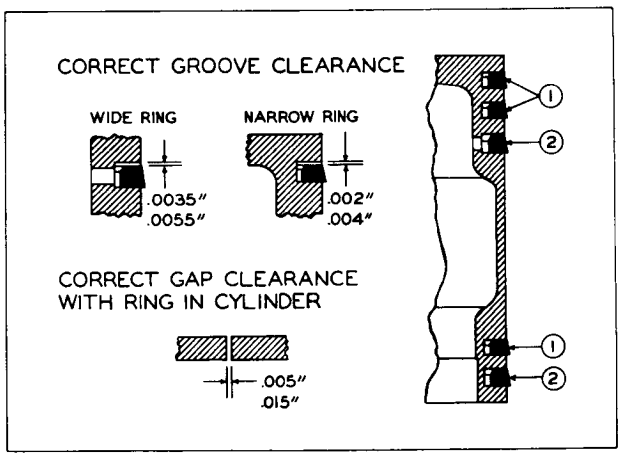

FIGURE B-16. TU-FLO 500 RING GAP AND CLEARANCE
1. Narrow Ring 2. Wide Ring

of the 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 lockwires.

Inspect connecting rod bearings for proper fit on crankcase 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 capscrews.

Clearance between the connecting rod journals and the connecting rod bearings 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 or flat spots. If found, the bearings must be replaced.

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 0.056" and 0.070".

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 valves 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 shown 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 installed 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 of 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 rear ball bearing and crankshaft in the crankcase. Be sure the drive end of the crankshaft is positioned to the front of the crankcase. 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. Press front bearing into place and secure with retainer and machine screws. Replace drive plate, nut and cotter.

Install oil seal ring. Then position rear end cover lined up with the oil hole in the gasket and crankcase being sure that the oil hole in the rear end cover lines up with the oil hole in the gasket and crankcase. Install capscrews and lockwashers securing the end cover in place. Install pipe plug in end cover oil opening which is not in use.

Assembling Pistons and Connecting Rods

If wrist pin bushings have been removed from the connecting rods, press new bushings in place, making sure that oil holes in the bushings line up with the oil holes in the connecting rods. Bushings must 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 figure B-17 for lockwire position. Keep lockwire 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.

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 figure B-16 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

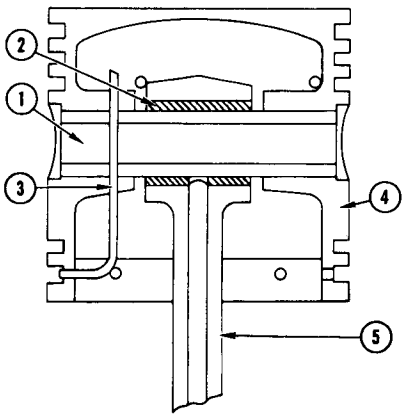

FIGURE B-17. WRIST PIN LOCKWIRE POSITION

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

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 same connecting rod. Install two slotted nuts and cotters.

Install other piston and connecting rod in the same manner.

Replace bottom gasket and cover. Secure with capscrews and lockwashers.

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 vave 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.

INSTALLATION

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

Clean oil return passage to be sure oil can return to the engine from compressor base.

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

Place gasket between compressor and engine.

Engage splines on drive sleeve with splines in engine drive disc, and compressor drive disc. Secure compressor to engine with capscrews and lockwashers.

Reconnect air, fuel, oil and water lines.

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. Test air system for serviceability.

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

Air Compressor Governor

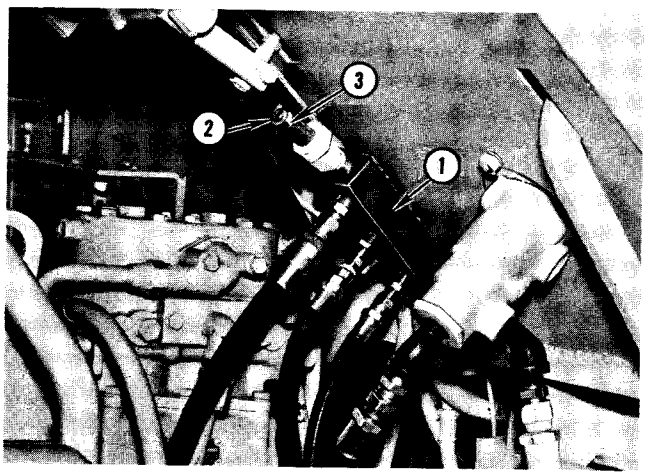

FIGURE B-18. GOVERNOR MOUNTING

1. Junction Block
2. Adjusting Screw
3. Locknut

An air compressor governor has been inserted in the air supply system to regulate the pressure of the air 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 the minimum pressure setting of the governor.

After pressure has again been built up to the maximum governor 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 system by opening the air tank bleeder valve. Disconnect air line from

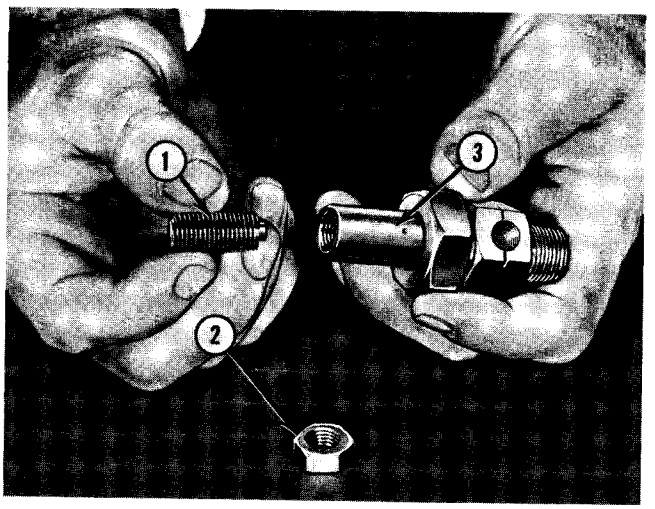

FIGURE B-19. REMOVING ADJUSTING SCREW

1. Adjusting Screw
2. Locknut
3. Sleeve

side of governor. Unscrew governor from fitting at the rear of air line filter, or from junction block.

Release the nut which locks the adjusting screw in place and then back adjusting screw out of sleeve (Fig. B-19).

Lift spring and plunger from sleeve (Fig. B-20). Loosen sleeve collar, until it is entirely free of the governor body, permitting removal of sleeve (Fig. B-21).

The end of the sleeve is a snug fit in governor body, but can be removed by hand. Sleeve must not be forced or pried from its seat. After sleeve has been removed, exposed ball check and shim(s) may be removed (Fig. B-22).

REASSEMBLY

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

Place collar over sleeve and screw down onto the governor body. Replace spring and plunger into sleeve with the largest end of the plunger toward the ball check.

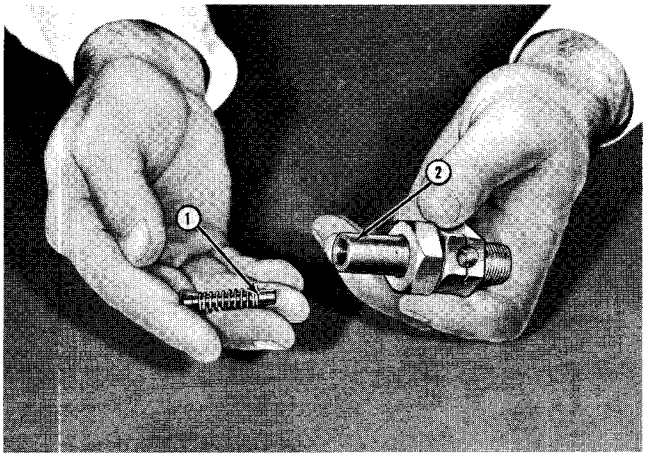

FIGURE B-20. REMOVING SPRING AND PLUNGER
1. Spring and Plunger 2. Sleeve

Replace adjusting screw and locknut.

Replace governor. Do not reconnect the line to the compressor unloader.

Operate the engine until the air pressure in the supply tank reaches the maximum (145 p.s.i.) Refer to air pressure gauge on instrument panel. The valve should open at this point and exhaust air through the port in the side of the governor body. See figure B-18.

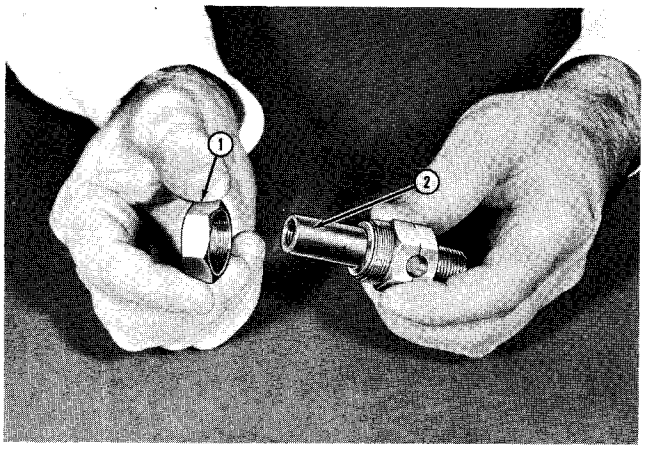

FIGURE B-21. REMOVING COLLAR
1. Collar 2. Sleeve

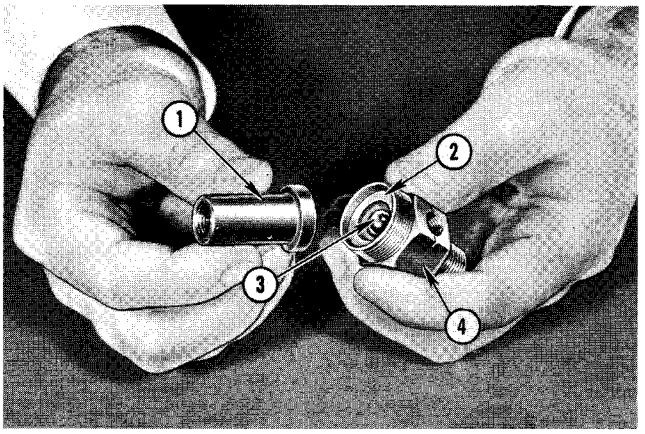

FIGURE B-22. REMOVING SLEEVE
1. Sleeve 3. Ball Check
2. Shim 4. Body

If air should exhaust before the desired pressure limit is reached, loosen the locknut and screw in the adjusting screw. If the air does not exhaust when the desired pressure has been reached, loosen the locknut and screw the adjusting screw out.

If proper adjustment cannot be obtained by using the adjusting screw it may be necessary to add or remove shims between the governor body and the sleeve. Adding shims will, in effect, lengthen the spring, while removing shims will shorten the spring.

When the proper adjustment has been obtained, lock the adjusting screw into place with the locknut.

Safety Valve

A safety valve is mounted on the line between the air compressor and the tank (see figure B-23). This valve is set to open when the air pressure in the air tank reaches approximately 150 p.s.i. This eliminates the danger of excessive air pressure.

If the air pressure in the air tank should rise to a point above the setting of the safety valve, the pressure will force the ball, against spring pres-

sure, from its seat and allow the air to flow around the ball and out through the exhaust port.

As soon as pressure is reduced to the setting of the valve, the spring forces the ball back on its seat, stopping the exhaust.

The safety valve may be tested to be sure it is operative by pulling the exposed end of the valve stem. This overcomes the spring load on the ball and permits the valve to exhaust. If the valve does not exhaust when this is done the ball may be stuck on its seat. The complete valve should be removed and dismantled for cleaning or replacement.

NOTE: Always bleed air system before removing safety valve.

Leakage at the exhaust port should not exceed a three inch soap bubble in three seconds, with the air system fully loaded.

The pressure setting may be adjusted by loosening the locknut and turning the adjusting screw. Turning the screw clockwise raises the pressure setting, turning the screw counterclockwise lowers the pressure setting. After the desired setting has been obtained, lock the adjusting screw in position with the locknut. An accurate test gauge must be used when adjusting the safety valve.

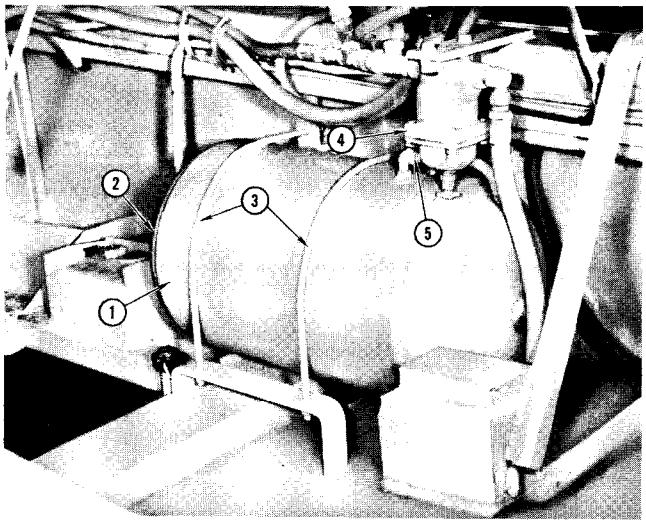

FIGURE B-23. AIR TANK AND SAFETY VALVE

1. Air Tank
2. Safety Valve
3. Mounting Bands
4. Air Filter
5. Bleeder Valve

Air Tank

The air tank is mounted inside the Tournapull case, directly under the operator's seat and against the left case wall. See figure B-23.

A bleeder valve is located on top 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 will require little attention because of its welded, steel construction. Care should be exercised, however, to prevent bending or breaking the inlet and outlet lines or fittings.

To remove the tank, first open the bleeder valve and completely bleed the air system.

Remove engine, generator and clutch. Disconnect inlet and outlet air lines.

Remove nuts and lockwashers clamping rings to air tank mounting brackets. Lift off the air tank being careful not to damage the fittings or safety valve.

Quick Release Valve

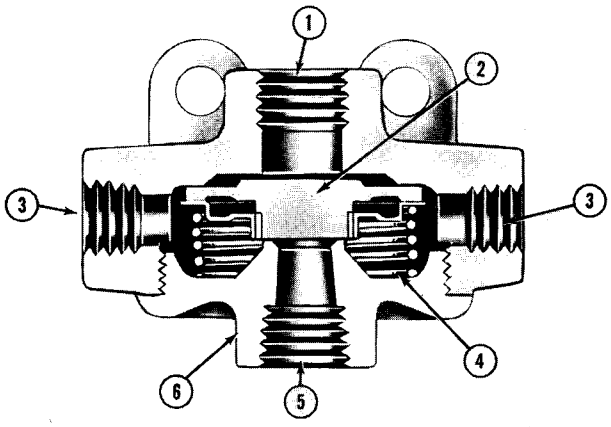

FIGURE B-24. QUICK RELEASE VALVE, CROSS SECTION

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

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 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 brake, or quickly releases the brake air pressure when the brake valve pressure is reduced and thus maintains 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 prime mover 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 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.

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 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.

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

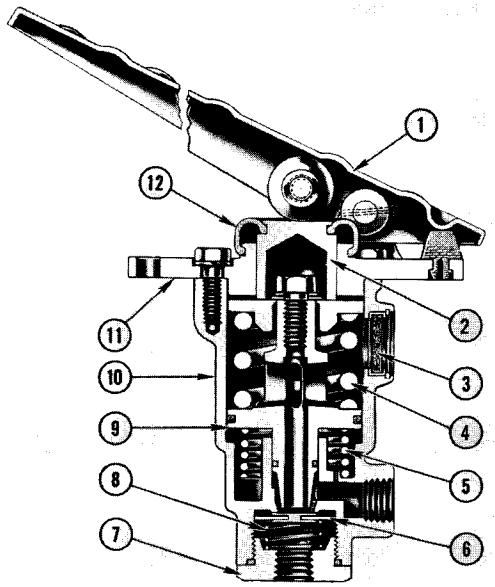

FIGURE B-25. BRAKE TREADLE VALVE, CROSS SECTION

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

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 to bleed the air system. Disconnect the air lines to the brake valve and remove junction block.

Remove mounting bolts from the mounting plate and lift the 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 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 spring assembly in body.

Install mounting plate and secure in place with three capscrews and lockwashers. Install the 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 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 valve does not release promptly, or does not fully release, it indicates that the exhaust valve is not functioning properly. This can be caused by improper adjustment of the treadle or pedal stop; lack of lubrication in the body causing the piston and spring assembly to bind; or dirt between the heel of the treadle and the body.

If the brake valve does not apply promptly, or does not apply fully, it indicates that the inlet valve is not opening sufficiently. This can be caused by improper adjustment of the treadle or pedal stop.

If the brake valve does not graduate the delivered pressure properly, check to be sure bleed hole to the cavity immediately below the piston is not restricted.

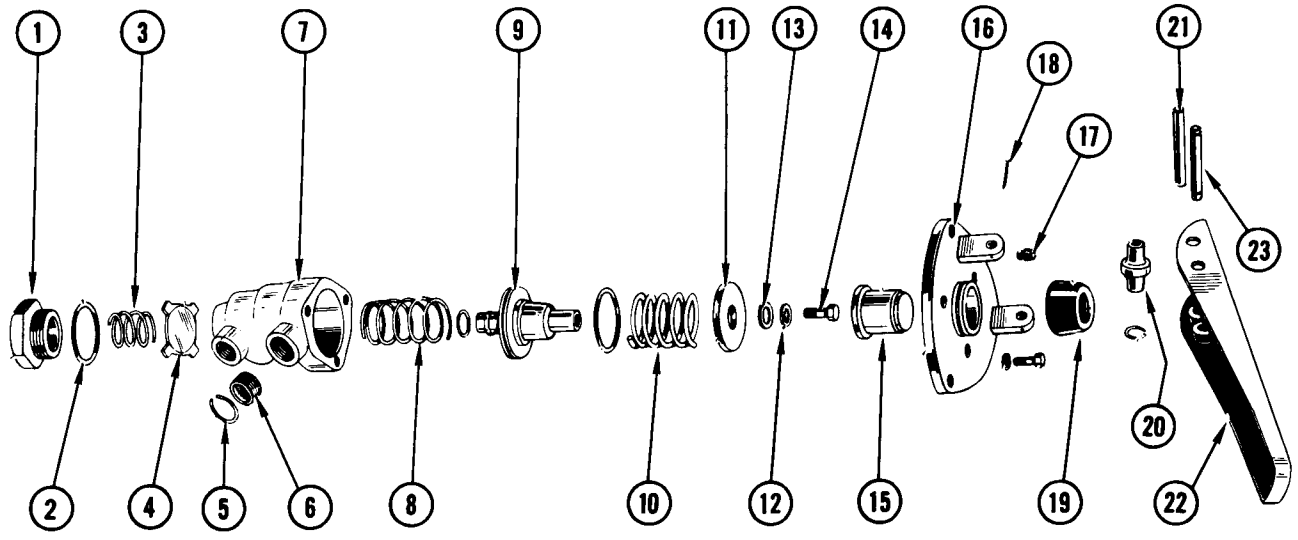

FIGURE B-26. BRAKE TREADLE VALVE, EXPLODED

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

Quick Drop Air Valve

The quick drop air valve applies air to the quick drop brake cylinder, permitting hoist wire rope drum to free wheel.

Hand brake valves are identical in operation. A handle is substituted for the actuating button.

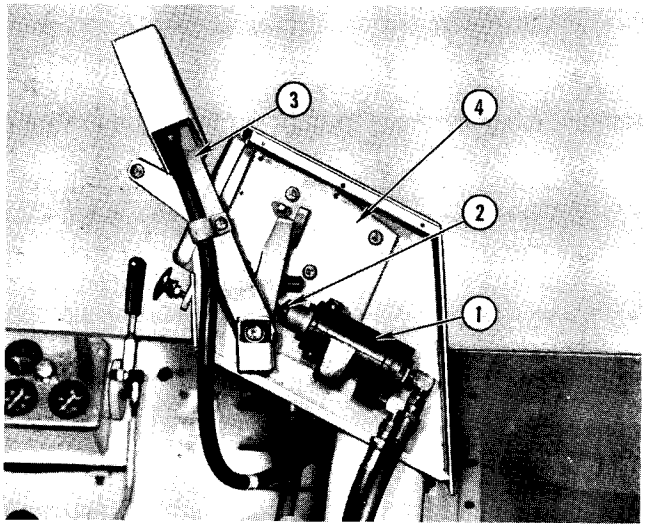

FIGURE B-27. QUICK DROP AIR VALVE, MOUNTED

1. Air Valve
2. Plunger
3. Handle
4. Base

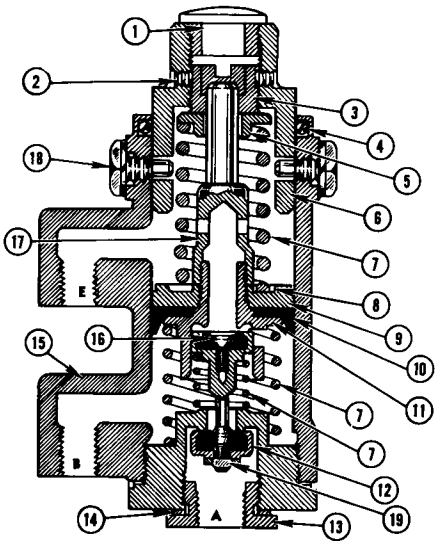

FIGURE B-28. QUICK DROP VALVE, CROSS SECTION

1. Button
2. Setscrew
3. Guide
4. "O" Ring
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. Nut

DISASSEMBLY

Remove valve from 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 screwdriver 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 insert.

Remove actuating button. Insert 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 in position. Engage the two slots in the piston and unscrew the

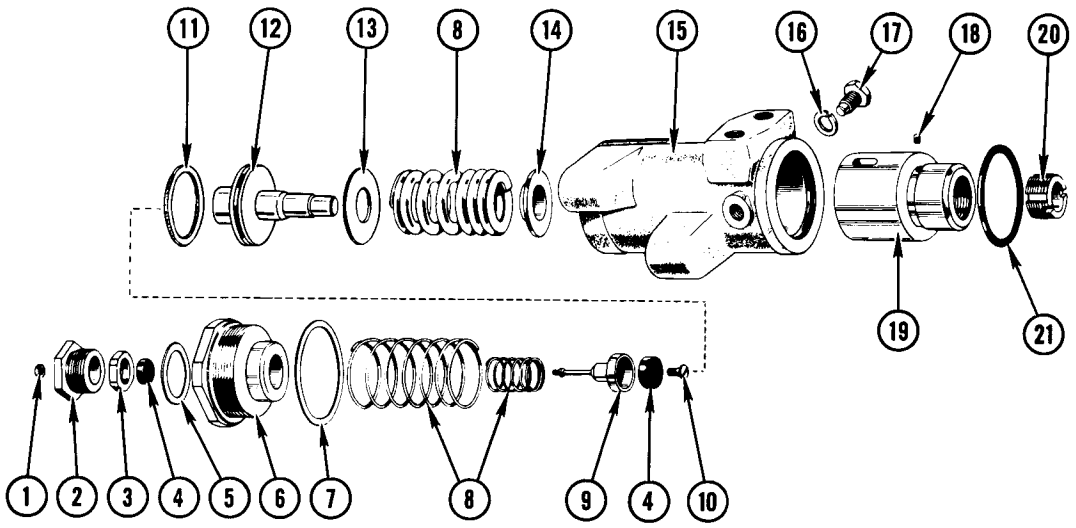

FIGURE B-29. QUICK DROP VALVE, EXPLODED

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

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.

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

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.

Loosen adjustment screw. 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" (see figure B-28).

Turn adjusting nut and piston rod guide in opposite direction 1 ½ 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 pressure released 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 application button 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 "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.

Clutch Air Valves

Refer to section "E" for service instructions for clutch release air valves.

ENGINE

INDEX

ENGINE

REMOVAL

Remove battery ground cable from battery post, tape and fasten it away from post to prevent accidentally shorting out battery.

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

Loosen the capscrews in clamps holding the exhaust pipes to the mufflers. Remove exhaust pipes.

Remove the capscrews fastening the two piece hood to the cockpit firewall and to the radiator shell. Lift off hood sections.

Disconnect headlight wires from terminal strip on radiator shell (at the left front, inside near radiator mounting).

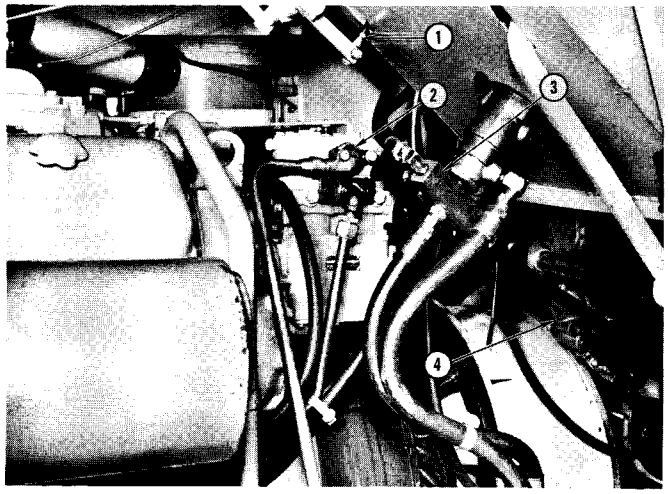

FIGURE C-1. JUNCTION BLOCK

1. Throttle Linkage
2. Air Compressor
3. Junction Block
4. Clutch Air Valve

Drain coolant from engine's cooling system. Disconnect radiator hoses. Remove radiator and shell (see page B-2).

Remove cockpit floor plate. Disconnect and remove universal joint (see page F-3).

Disconnect rectifier leads from transformer terminal strip and D.C. field breaker switch. Free cable from clamps.

Loosen hose clamps on air cleaner discharge hose.

Remove capscrews and lockwashers fastening air cleaner mounting brackets to engine. Lift off air cleaners and mounting brackets as a unit.

Disconnect air lines at air compressor.

Disconnect fuel lines at fuel filters.

Disconnect main lead from cranking motor solenoid.

Remove coolant temperature bulb from engine block.

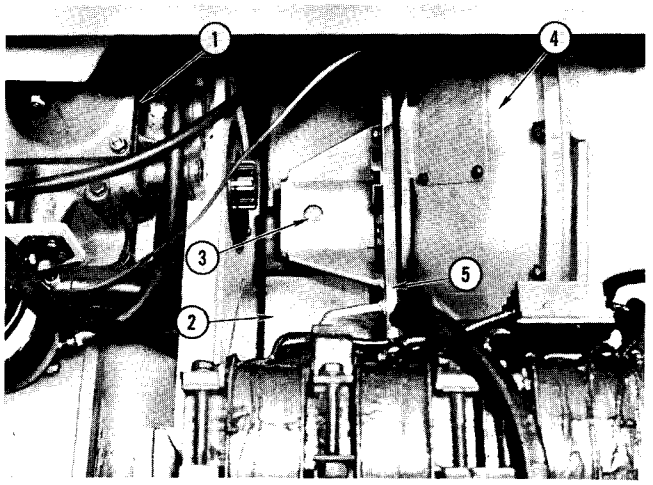

FIGURE C-2. CLUTCH HOUSING, UNIVERSAL REMOVED

1. Transmission
2. Stabilizer
3. Stabilizer Setscrew
4. Clutch Housing
5. Mounting bracket

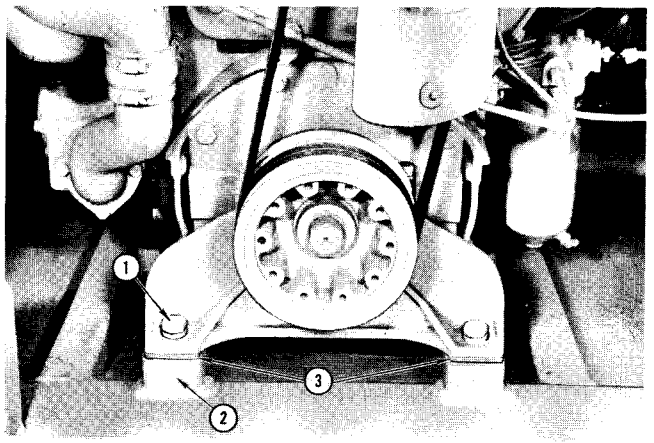

FIGURE C-3. FRONT ENGINE MOUNT

1. Mounting Bolt
2. Mounting Pad
3. Shims (If Present)

Disconnect engine oil pressure line.

Disconnect throttle linkage and engine shut down controls (normal and emergency).

Disconnect clutch pedal linkage at clutch release cross shaft and remove air line from clutch release air chamber.

Disconnect cable from generator terminal strip. Remove from cable clamp.

Loosen locknut on stabilizer setscrew and turn setscrew up into clutch air chamber mounting bracket to relieve down pressure on stabilizer plate.

Remove engine front and rear mounting bolts.

Attach sling and hoist to remove engine, generator and clutch as a unit. Hoist assembly very slightly and remove shims from all mounting pads. Keep shims together as they may be replaced in their same position if the original engine, generator, clutch housing and mounting bracket are replaced. If not reshimming will be necessary.

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

Hoist assembly and pull forward out of case. Place on stand or blocks for further disassembly. Separate clutch and generator as described in their respective sections.

Refer to engine manufacturer's manual for overhaul procedures and instructions.

INSTALLATION

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

Clean outside of engine, generator and clutch housing thoroughly to remove any accumulation of grease and dirt. Clean inside of case to remove accumulation of dirt, grease or other foreign material present.

Clean engine mounts and shims.

Sling entire unit and position into case. If the **original** engine, generator and clutch housing are being replaced, replace shims in position on the mounting pads from which they were removed. Replace engine mounting bolts. Torque taperhead rear engine mounting capscrews to 460 ft. lbs.

Run stabilizer setscrew up into air chamber mount until it is carrying no weight, but is just touching the stabilizer plate.

Mount a dial indicator so that it can indicate up and down movement of the clutch shaft (see Fig. C-4). Set indicator dial at "0".

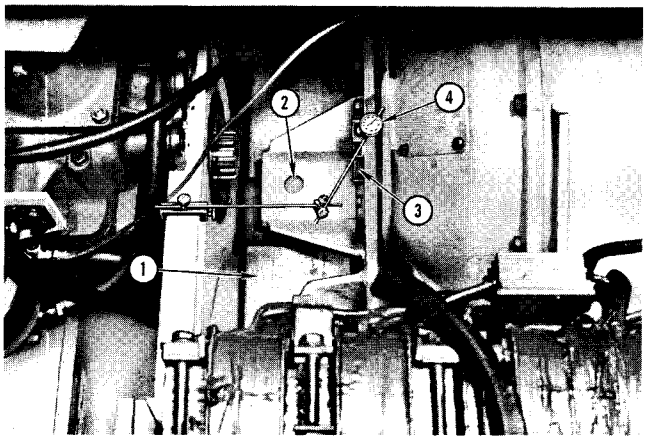

FIGURE C-4. INDICATING CLUTCH SHAFT

1. Stabilizer Plate
2. Setscrew
3. Clutch Shaft
4. Dial Indicator

Run stabilizer setscrew down against stabilizer plate until indicator shows that clutch shaft has been raised 0.008" (approximately 1 1/3 turns). Lock in position with jam nut.

If using a **replacement** engine, generator, clutch housing or clutch air chamber mounting plate, use the following procedure for determining the correct amount of shims to be used.

By using the hoist, position unit until the following dimensions are obtained.

1. The centerline of the clutch shaft is to be positioned 1/8" (plus 1/16", or minus 0) above the centerline of the transmission input shaft. Refer to figure C-5.

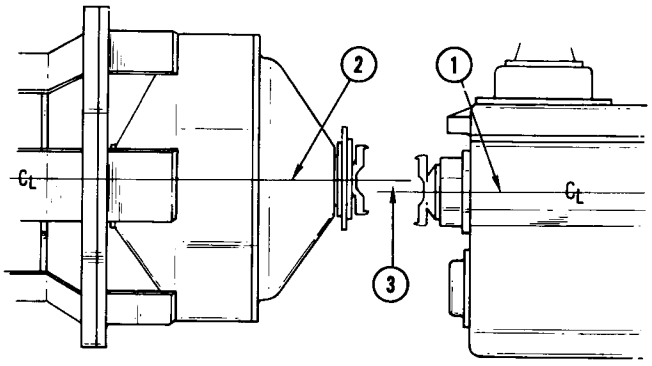

FIGURE C-5. VERTICAL ALIGNMENT TOLERANCE

1. Centerline Transmission Mainshaft
2. Centerline Clutch Shaft
3. Maximum Allowable Deviation (1/8" [+1/16", −0"])

2. Looking down on the transmission and clutch shaft, the centerline of the clutch shaft and the centerline of the transmission input shaft should be in line with a lateral tolerance of plus or minus 1/16". Refer to figure C-6.

3. The centerline of the clutch shaft and the centerline of the transmission must be held in the same plane within 3/16" for each foot of the length of clutch, generator and engine. Normally this angular alignment need not be checked, as the front end of the engine would have to move approximately 1 1/8" out of its original position before exceeding the allowable tolerance of 3/16" per foot. Refer to figure C-7.

With units properly positioned measure the distance between the mounting pads and the engine mounts. Prepare and install shim packs of the

proper thickness. Replace mounting bolts. Remove hoist and recheck measurements. Torque taperhead rear engine mounting capscrews to 460 ft. lbs.

Run stabilizer setscrew up into air chamber mount until it is carrying no weight, but is just touching the stabilizer plate.

Mount a dial indicator so that it can indicate up and down movement of the clutch shaft (see figure C-4). Set indicator dial at "0".

Run stabilizer setscrew down against stabilizer plate until indicator shows that clutch shaft has been raised 0.008" (approximately 1 1/3 turns). Lock in position with jam nut.

Replace universal joint. Torque universal attaching capscrews to 70 to 80 ft. lbs. and wire in pairs.

Reconnect all controls, cables, hoses and tubing. Complete reassembly and installation of assemblies and components removed.

When reconnecting engine stop controls the normal stop control is connected to the governor shaft, and the emergency stop control is connected to the air box flapper valve.

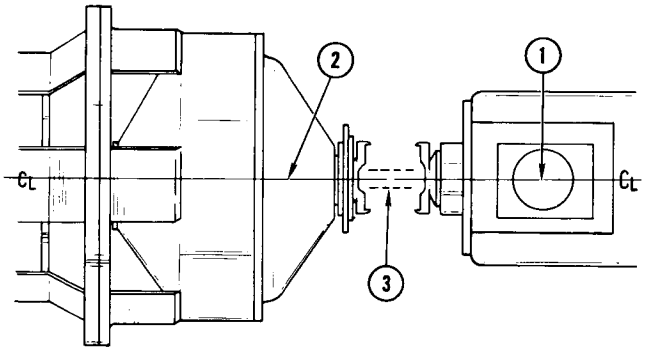

FIGURE C-6. LATERAL ALIGNMENT TOLERANCE

1. Centerline Transmission
2. Centerline Clutch Shaft
3. Maximum Allowable Deviation (±1/16")

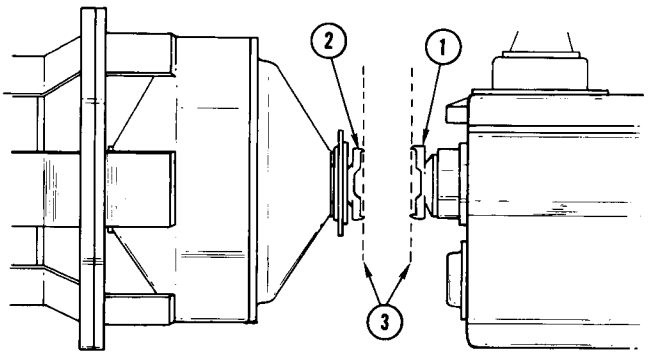

FIGURE C-7. ANGULAR ALIGNMENT

1. Transmission
2. Clutch Shaft
3. Parallel Surfaces

A.C. GENERATOR, RECTIFIERS AND BATTERIES

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A.C. GENERATOR, RECTIFIERS AND BATTERIES

A.C. GENERATOR

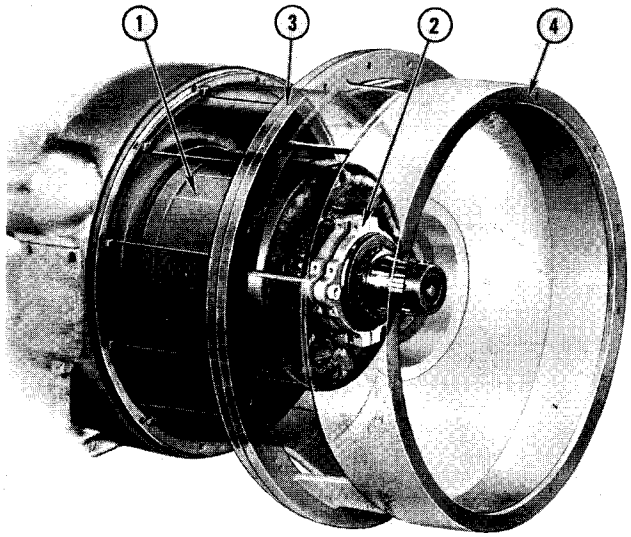

FIGURE D-1. A.C. GENERATOR

1. Rotor
2. Brush
3. Stator
4. End Bell

Removal and Disassembly

Remove the engine, generator and clutch as a unit. Refer to page C-2.

Remove clutch housing and release mechanism. Remove flywheel clutch from secondary flywheel (see page E-2).

Make match marks on the generator end bell, stator and engine flywheel housing so they may be reassembled in their same relative position.

Cut lockwires and remove capscrews fastening secondary flywheel to generator adaptor (Fig. D-2). Remove secondary flywheel.

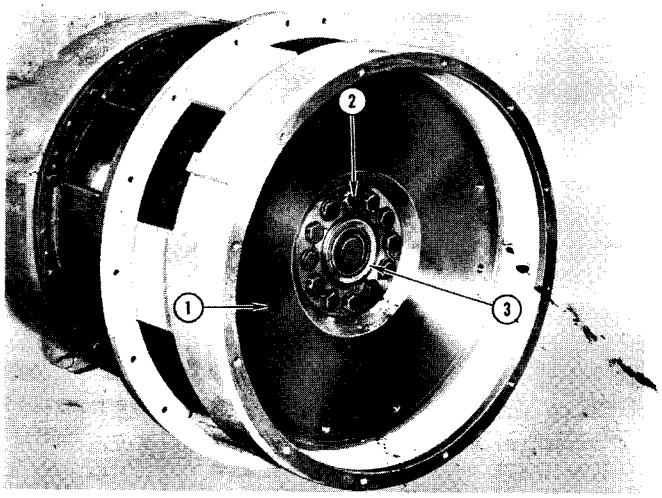

FIGURE D-2. SECONDARY FLYWHEEL

1. Secondary Flywheel
2. Capscrews
3. Pilot Bearing

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

Remove the socket head locking setscrew from the generator locknut (Fig. D-3). Now remove the generator locknut with the special wrench and extension handle provided in the tool kit.

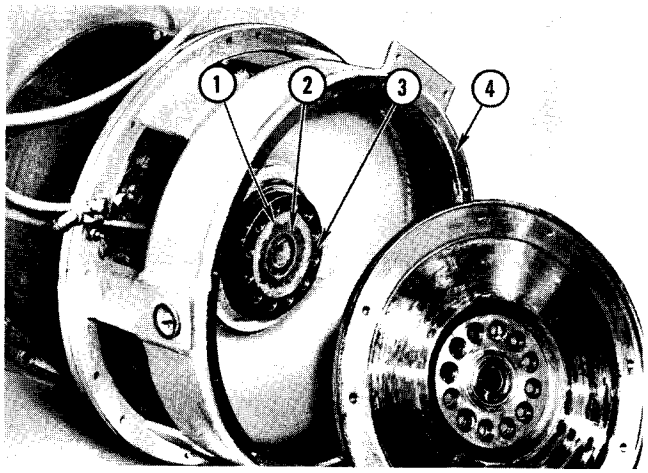

FIGURE D-3. GENERATOR ADAPTOR AND LOCKNUT

1. Setscrew
2. Locknut
3. Adaptor
4. End Bell

Place a sling around the stator and end bell and take up slack.

Pull adaptor assembly from bore in end bell. Remove piston rings from grooves in the adaptor hub and slide retainer ring and bearing from hub. See figure D-4.

Support generator stator and end bell with rope sling. Remove capscrews and lockwashers fasten-

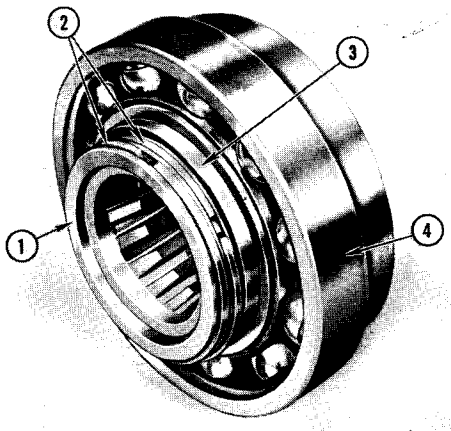

FIGURE D-4. ADAPTOR, REMOVED

1. Hub
2. Rings
3. Retainer Ring
4. Bearing

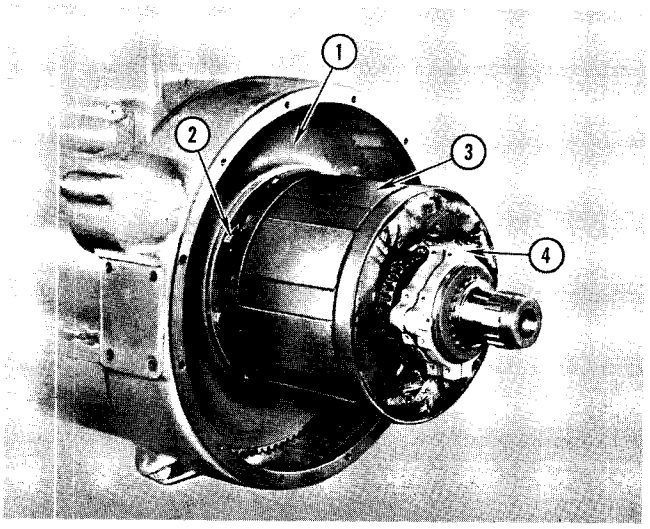

FIGURE D-5. ROTOR, STATOR REMOVED

1. Engine Flywheel
2. Capscrews
3. Rotor
4. Brushes

ing stator to engine flywheel housing. Pull stator and end bell away from engine, being careful not to damage windings. Separate the two units if desired.

Cut lockwires from capscrews fastening rotor to engine flywheel. Support generator rotor with rope sling. Back the capscrews out approximately half way. Pull out on rotor, then take capscrews the remainder of the way out. Be careful when the capscrews are removed as the rotor may tip.

Tape threads and splines on end of rotor shaft to prevent their being damaged.

To disassemble the brush holder, remove the two socket head screws holding each set of brush holder half-rings together (Fig. D-6).

Remove the half-rings, brush segments and the springs from around the rotor shaft.

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

Check for grounds or shorts between the brush holders. Examine insulating washer for damage and replace if necessary. Be sure insulated bushings are not crushed or broken.

Reassembly

The brushes are made of graphite carbon. Non-adjustable springs between the brush holders give the required brush pressure as the brushes make side contact with the rotor slip rings.

Generator brushes should be inspected whenever the generator is disassembled. Brushes are 3/8" thick when new and should be replaced when one half of the brush is worn away, or if the brush becomes chipped or cracked.

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

NOTE: Use carbon tetrachloride with caution in an adequately ventilated place. Prolonged breathing of the fumes is dangerous.

Assemble the two top brush half-rings, brush segments, insulated bushings and tension springs. 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. Make sure that clips are placed in such a position that they will keep brush segments from rotating.

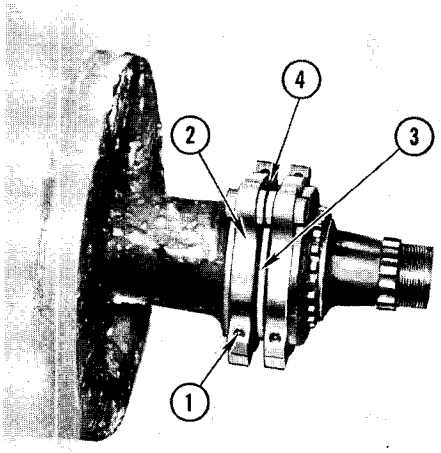

FIGURE D-6. GENERATOR BRUSH HOLDER

1. Capscrew
2. Half Ring
3. Insulating Washer
4. Bushings

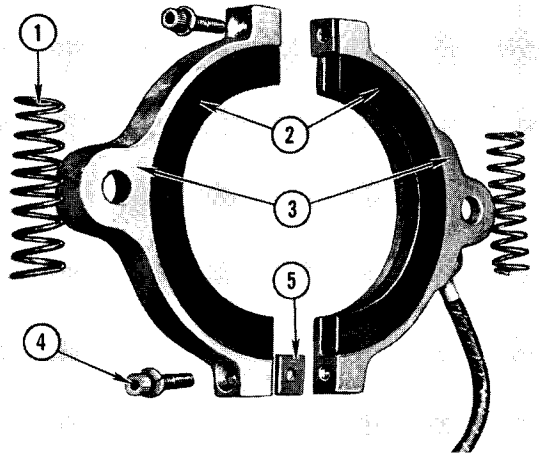

FIGURE D-7. BRUSH AND HOLDER

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

Replace sockethead capscrews and lockwashers, fastening the brush half-rings together.

Hoist rotor into position against engine flywheel. Install taperhead capscrews and torque to 250 ft. lbs. Secure capscrews and lockwires. Wire in pairs.

Hoist the stator into position over rotor. Be sure to position generator terminal strip in same relative position as it was before stator was removed. Secure stator to engine flywheel housing with capscrews and lockwashers. Torque capscrews to 60 ft. lbs.

Repack adaptor bearing with high temperature ball bearing grease (Mobilplex E.P. No. 2). Install bearing over hub of adaptor.

Slide the retainer ring onto hub until it is against bearing (beveled edge of ring away from bearing). Place the piston rings in the grooves in the adaptor ring. Stagger the ring grooves. Compress the rings and slide the retainer ring back over them, thus holding them in the compressed position.

Now start the adaptor hub into the end bell bore (piston ring end first). As the hub goes into the bore the retainer ring is forced back, freeing the piston rings in the bore.

Assemble end bell and adaptor onto rotor shaft. (Match marks made during disassembly.) Make sure the brush holder studs pass through the insulated bushings in the brush holders. Engage splines on rotor shaft with splines in adaptor hub.

Secure end bell to generator stator with capscrews and lockwashers. Torque capscrews to 30 ft. lbs.

Install generator locknut and torque to 1200 ft. lbs. To determine the amount of shims (if any) required between the generator rear bearing and the bottom of the bearing bore in the end bell, first measure the engine crankshaft end play with a dial indicator. Record the reading for future reference.

Bar engine crankshaft far enough forward to take up end play, and hold in this position. Move the bearing forward until it bottoms in the bore.

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

Add .001" to this distance. Insert shims equal to the total distance between the bearing and bottom of the bore.

NOTE: Some end bells have a ½" pipe plug in the bearing hub. If end bell is so equipped, the amount of shims needed between the bearing and the bearing bore in the end bell may be determined as follows. Assemble generator and measure engine crankshaft end play as described above. Remove the ½" pipe plug from the end bell bearing hub. Bar engine crankshaft far enough forward to take up end play, and hold in this position. Insert a feeler gauge into the pipe plug hole and measure the distance between the bottom of the bearing bore and the bearing face. Add .001" to this distance. Insert shims (equal to the total distance) between the bearing and the bottom of the bore. Replace plug.

Recheck the crankshaft end play. It should be reduced by approximately 0.001" to 0.002".

Reconnect brush leads, one to end bell and the other to generator terminal strip.

Replace locknut and torque to 1200 ft. lbs. Install locking setscrew.

Replace clutch housing and release mechanism (See page E-4).

RECTIFIERS

The rectifiers are mounted in the engine air cleaner so that the flow of air to the engine flows across the rectifier plates before going to the engine. This flow of air across the rectifier plates keeps them from overheating.

Two separate rectifiers make up the rectifier assembly, each has its individual function. They are the battery charging and compensating rectifier and the booster rectifier. See page L-1 for additional rectifier information.

Removal and Disassembly

For machines with the oil bath air cleaner the rectifiers are mounted in an extension to the upper part of the air cleaner body. See figure D-8.

Loosen screw from clamping band securing the rectifier housing to the air cleaner body. Remove screw from upper clamp. Lift rectifier housing and

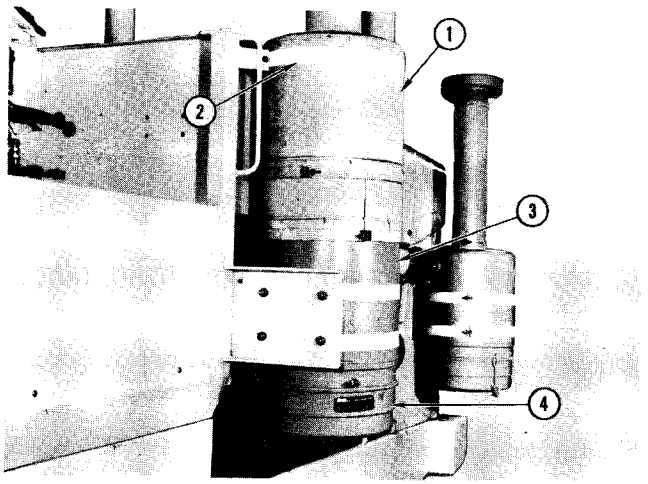

FIGURE D-8. RECTIFIER MOUNTING, OIL BATH AIR CLEANER

1. Rectifier Housing
2. Mounting Band
3. Air Cleaner
4. Oil Cup

rectifiers from air cleaner body.

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

Loosen cable clamp and pull cable from housing.

Loosen nuts on each end of rectifier mounting bolt and slide rectifier from between the mounting bracket ears. See figure D-10.

For machines with the dry-type air cleaner, the rectifiers are enclosed in a housing between the upper and lower air cleaner bodies. See figure D-9.

Remove right hand section of engine hood. Remove the two capscrews, lockwashers and nuts securing the lower body mounting clamp to the air cleaner mounting plate.

Disconnect ground wire from rectifier housing.

Loosen the wing nuts fastening lower body, rectifier housing and upper body together. Pull lower body and dust cup away from rectifier housing. Pull rectifier housing away from upper air cleaner body. Do not damage gaskets between rectifier housing and air cleaner bodies.

Remove machine screws securing cable grommet and packing gland to rectifier housing. Disconnect wires to the rectifier terminals. Mark them as they are removed to facilitate reassembly. Pull the cable from housing.

Loosen nuts on each end of rectifier mounting bolt and slide rectifier from between mounting bracket ears. See figure D-10.

Replace rectifiers assemblies by reversing the removal and disassembly procedures.

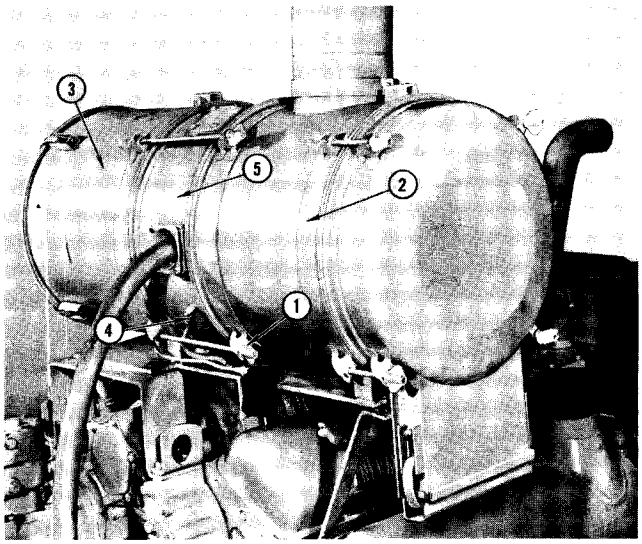

FIGURE D-9. RECTIFIER MOUNTING, DRY AIR CLEANER

1. Wing Nut
2. Lower Body
3. Upper Body
4. Ground Wire
5. Rectifier Housing

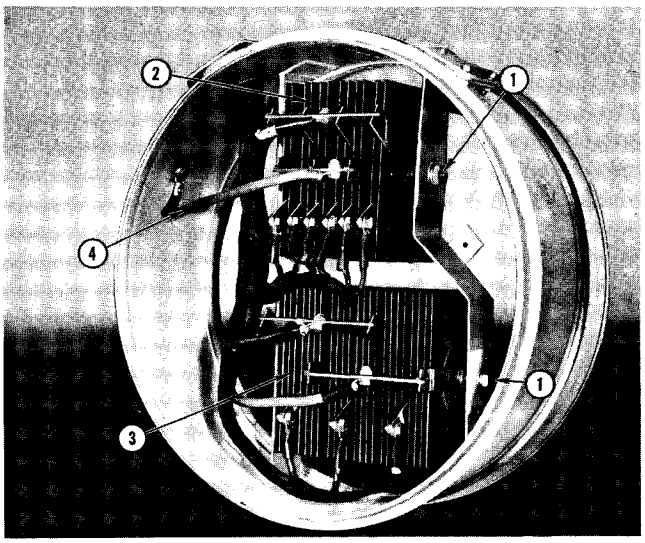

FIGURE D-10. RECTIFIERS

1. Mounting Bolts
2. Battery Charging and Compensating Rectifier
3. Booster Rectifier
4. Ground Wire

BATTERIES

The 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.

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 main transformer 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 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.

Corrosion or dirt 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. Examine vent plugs to see if the gas escape holes are clean afterwards. Do not apply grease between battery post and battery cable clamp.

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

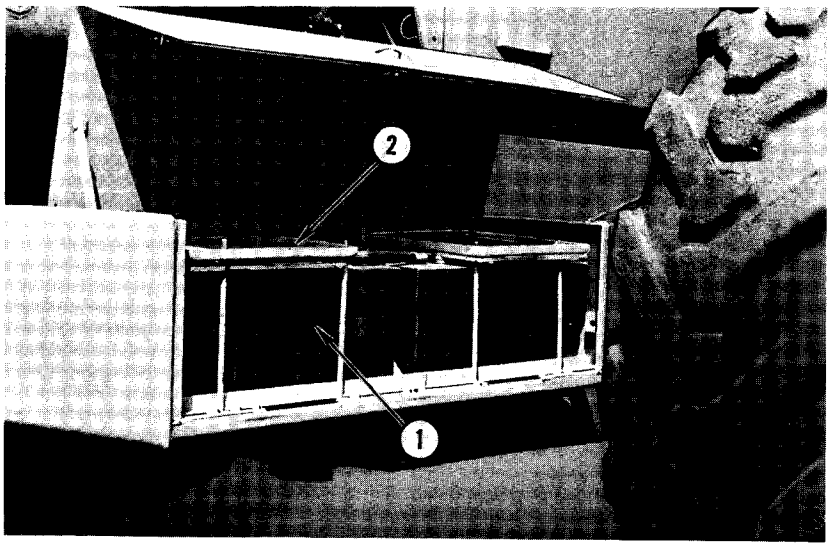

FIGURE D-11. BATTERY BOX

1. Battery
2. Hold Down Plate

FLYWHEEL CLUTCH AND RELEASE MECHANISM

INDEX

FLYWHEEL CLUTCH AND RELEASE MECHANISM

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 clutch housing.

The clutch is normally in the engaged position, and the flow of power passes from the engine, through the generator rotor, clutch and universal 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 release shaft which turns the release yoke, disengages the clutch.

FLYWHEEL CLUTCH

Removal

To remove the clutch without removing engine and generator from Tournapull case use the following instructions. If engine, generator and clutch were removed as a unit (see page C-2), the same instructions will apply with the exception of removing from the machine.

Remove cockpit floor plate.

Bleed the air system and disconnect air line from clutch release air chamber. See figure E-1.

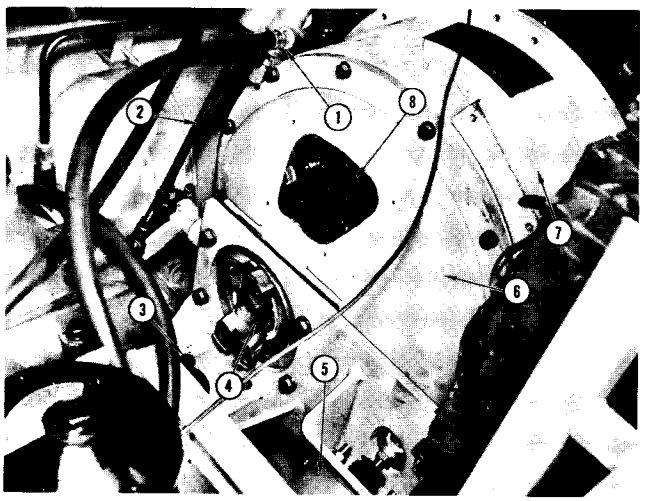

FIGURE E-1. CLUTCH RELEASE MOUNTING

1. Clutch Release Air Valve
2. Clutch Release Shaft
3. Stabilizer Setscrew
4. Clutch Shaft
5. Clutch Release Air Chamber
6. Clutch Housing
7. Generator End Bell
8. Clutch

Disconnect spring and pull pin from clevis fastening clutch air valve shaft to clutch release pedal shaft lever.

Back off jam nut from air chamber mount stabilizing capscrew. Loosen capscrew to relieve tension on stabilizer. Cut lockwires and remove capscrews fastening the universal front cross to the clutch shaft. Cut lockwires and remove capscrews fastening universal rear cross to the yoke on the transmission drive gear shaft.

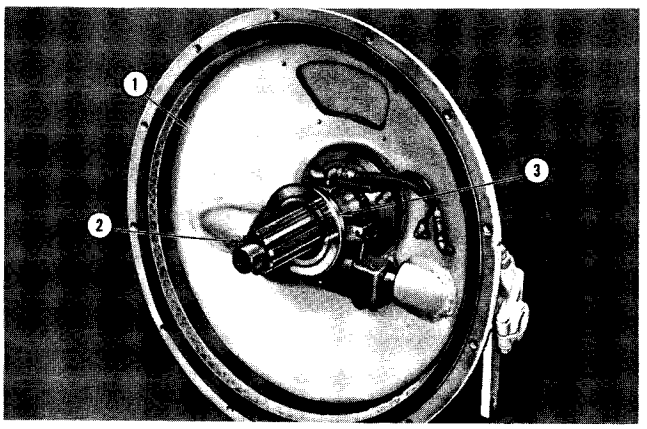

FIGURE E-2. CLUTCH HOUSING, REMOVED

1. Housing
2. Clutch Shaft
3. Release Bearing

Remove capscrews and lockwashers fastening clutch housing to generator end bell.

Pull clutch housing straight back until clutch shaft has cleared the clutch. Lift housing and release mechanism from case. Place on bench or stand for further disassembly. See figure E-2.

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. The bolts should be approximately 5" in length and with sufficient washers on each 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 the 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).

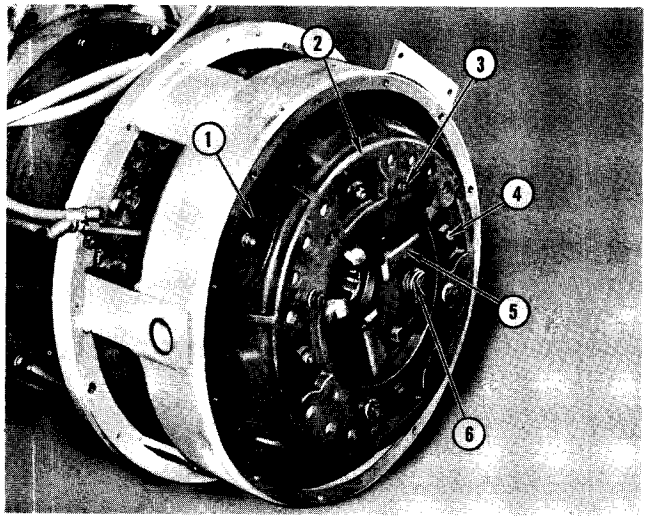

FIGURE E-3. FLYWHEEL CLUTCH

1. Clutch Adaptor
2. Back Plate
3. Hold Down Bolts
4. Eyebolt
5. Release Lever
6. Pressure Spring

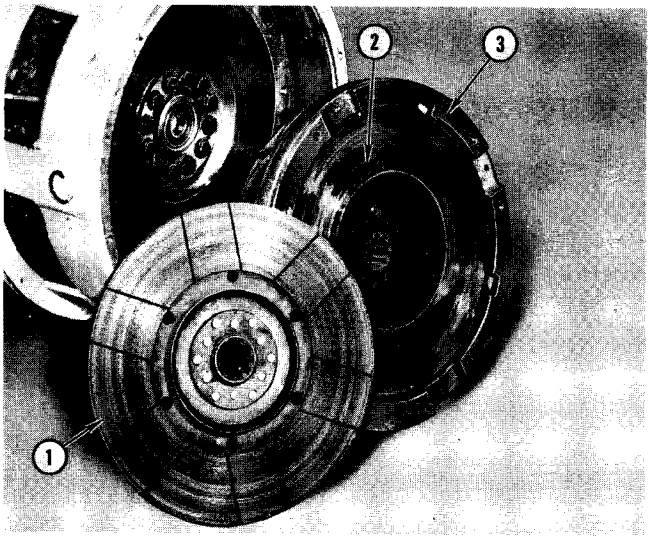

FIGURE E-4. CLUTCH, REMOVED

1. Clutch Plate
2. Center Plate
3. Clutch Adaptor

Disassembly

CLUTCH HOUSING

Remove capscrews and lockwashers fastening air chamber mounting bracket to clutch housing and remove bracket. See figure E-5.

Pull clutch shaft and bearing from clutch housing. See figure E-6.

Loosen setscrew fastening clutch pedal adjusting arm to clutch release shaft. Slide adjusting arm and lever from clutch shaft. Remove cotter and pin from clevis fastening clutch air chamber to lever on clutch shaft.

Remove lockwires fastening clutch release yoke to ears on clutch release bearing carrier. Release

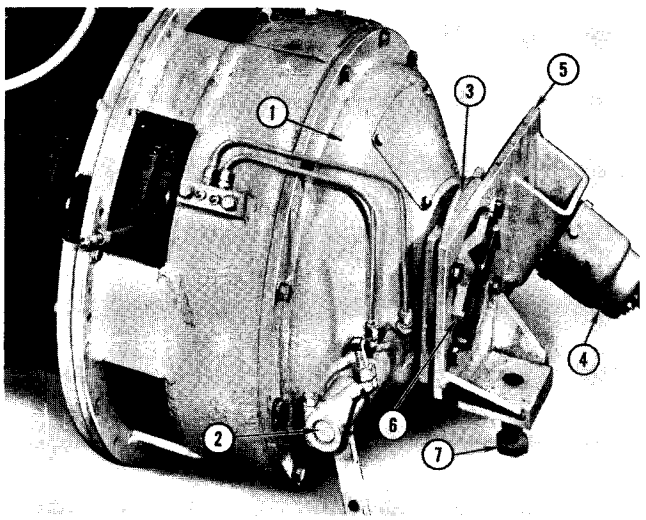

FIGURE E-5. AIR CHAMBER MOUNTING BRACKET

1. Housing
2. Clutch Release Shaft
3. Bearing Carrier Support
4. Air Chamber
5. Mounting Bracket
6. Clutch Shaft
7. Stabilizer Screw

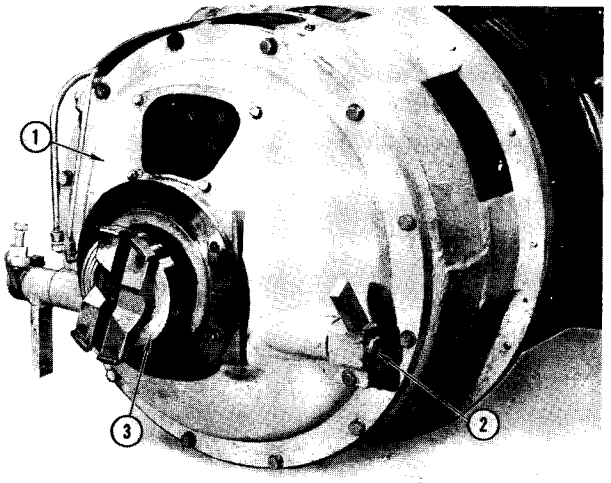

FIGURE E-6. REMOVING CLUTCH SHAFT

1. Housing
2. Clutch Release Shaft
3. Bearing

clutch release bearing return springs from the holes in capscrew heads. Disconnect lubrication line from release bearing carrier. Slide the clutch release bearing assembly from clutch shaft.

Cut lockwires and remove the 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.

Pull release bearing carrier support from bore in clutch housing. Oil seal may be removed from inside support if desired.

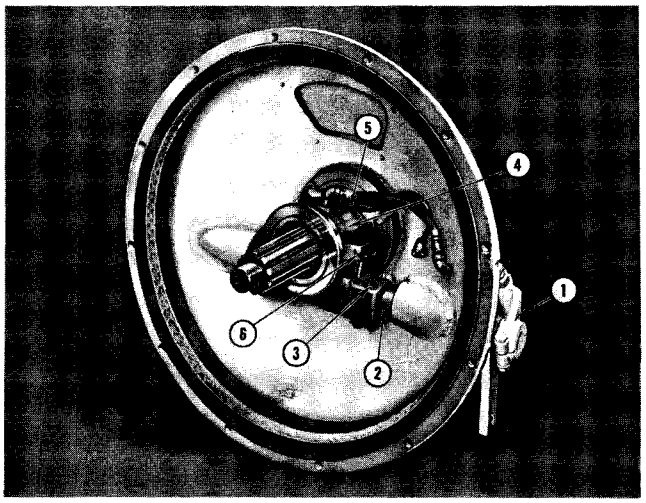

FIGURE E-7. CLUTCH RELEASE MECHANISM

1. Pedal Adjusting Arm
2. Clutch Release Shaft
3. Release Yoke
4. Release Bearing Carrier
5. Return Springs
6. Lockwire

CLUTCH

Inspect clutch shaft pilot bearing in secondary flywheel. Remove only if replacement is necessary. Bearing may be held in place by staking, or by "Loctite". Be sure to hold new bearing in place by the same method, whichever was used.

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.

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-8).

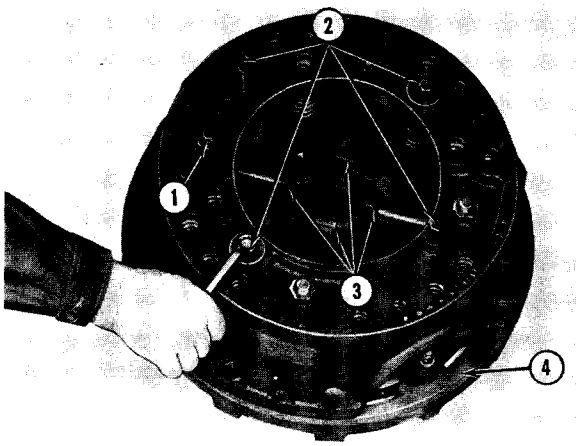

FIGURE E-8. REMOVING BACK PLATE

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

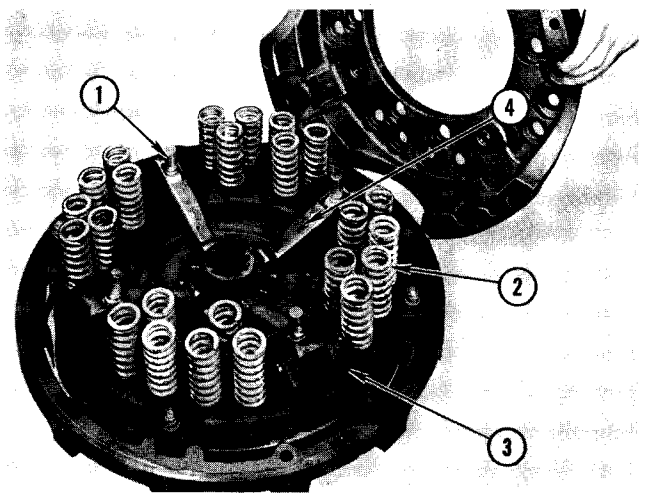

FIGURE E-9. PRESSURE SPRINGS

1. Eyebolts
2. Springs
3. Pressure Plate
4. Release Lever

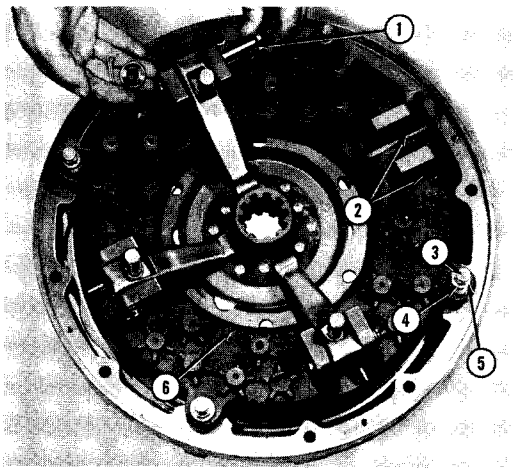

FIGURE E-10. REMOVING RELEASE LEVER

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

Back off the clutch adjusting nuts from the clutch release lever eyebolts. Lift the back plate from the clutch assembly and remove springs from the pressure plate (Fig. E-9).

Remove cotter and washer from each lever pin, and withdraw pins. Lift lever assemblies from between the mounting ears (Fig. E-10).

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-11)

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

Reassembly

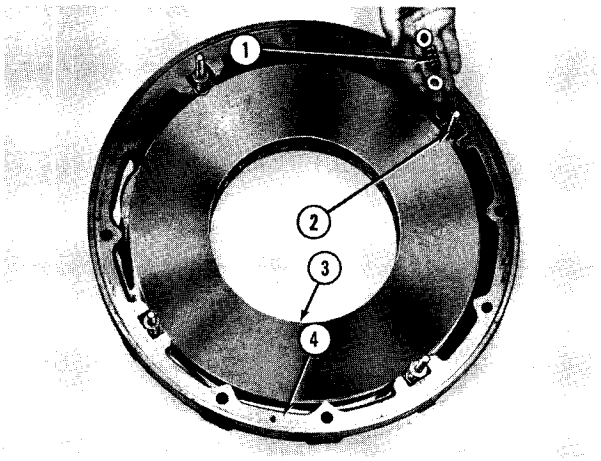

FIGURE E-11. REMOVING SEPARATOR SPRINGS

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

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 mounting lever pin. Head of pins are to be pointing in direction of clutch rotation.)

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 2 1/8". For a new spring, it should take 190 to 200 lbs. to compress the spring to 2 1/8" measurement: for a used spring it should take a minimum of 185 pounds. Springs not meeting these requirements should be replaced.

Place the clutch springs on the pressure plate and then position back plate on top of the springs. Place them evenly around pressure plate to keep clutch in balance. 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.

CAUTION: Care must be taken to see that springs are not cocked before compressing clutch.

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.

If clutch shaft pilot bearing was removed from secondary flywheel, replace and secure in position by the same method as was previously used (staking or by "Loctite"). If using "Loctite" all parts must be completely free of grease and dirt. Put 4 to 6 drops of "Loctite" to the bevel of the bearing and bevel of the flywheel. Allow to stand for 8 to 10 hours at room temperature before exposing to oil. The setting action can be hastened by using a heat lamp directed on the nut in such a manner that it becomes warm to the touch.

Position a dial indicator to indicate run-out on face of secondary flywheel. Maximum allowable run-out is 0.010".

Place the front clutch plate against the secondary flywheel, 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 (Fig. E-12). Tighten or loosen the locknut, which-

ever is necessary, until the correct gap has been obtained. Repeat this procedure for each of the four bushings.

CAUTION: When hand cranking engine pull out both the normal and emergency engine stop controls and have the key switch in the "off" position. This will eliminate the possibility of the engine accidentally starting.

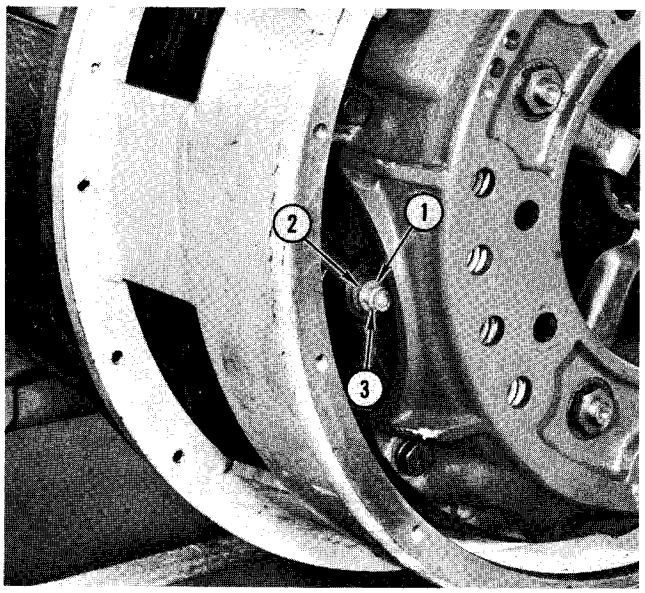

FIGURE E-12. CHECKING RELEASE ADJUSTMENT

1. Bushing
2. Pressure Plate
3. Locknut

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.

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

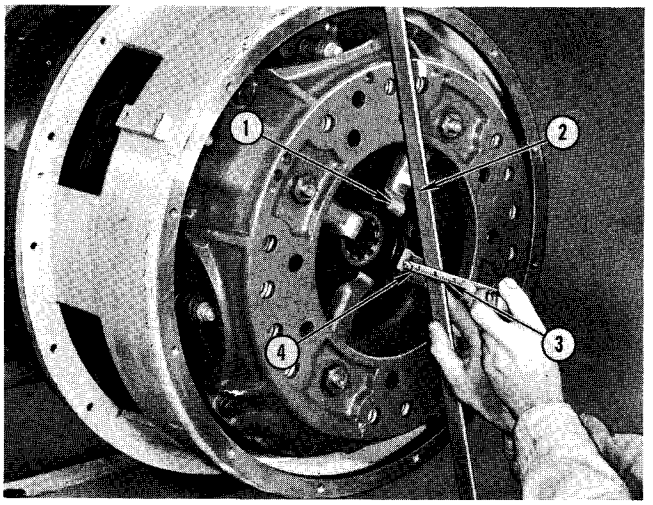

FIGURE E-13. CHECKING CLUTCH RELEASE LEVERS

1. Release Lever
2. Straight Edge
3. Machinist Rule
4. 1 3/16"

in Fig. E-13. This distance should be 1-3/16" (+1/16", −0") at each release lever on the double plate clutches and 1-5/16" (+1/16", 0") for single plate clutches. The ends of the release levers must be in the same plane within 0.020". If necessary, adjust the levers with the adjusting nuts on the eyebolts. Make certain all levers measure the same, within the above specified limits. After checking the release lever adjustment, check the gap between the lip of the return screw bushing and the pressure plate (refer to Fig. E-12). This gap should be 1/16". Tighten or loosen the locknut, whichever is necessary, until the correct gap has been obtained. Repeat this procedure for each of the four bushings.

Reassemble clutch release shaft and bearing assembly into housing. Secure housing to generator end bell. Replace capscrews and lockwashers fastening air chamber mounting bracket and bearing carrier support to clutch housing. Install clutch shaft, through clutch discs and into pilot bearing in secondary flywheel.

Complete installation and align as outlined in section "C".

Refer to page K-9 for clutch and clutch linkage adjustment.

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 clutch 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 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.

Refer to page K-9 for clutch linkage adjustment.

CLUTCH RELEASE AIR VALVE

Removal and Disassembly

Disconnect air lines from valve.

Remove nut and lockwasher from ball joint at each end of air valve linkage. Remove valve and linkage 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 a small drift. Remove lever, pull rod, washer and spring from inside the 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.

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 in-

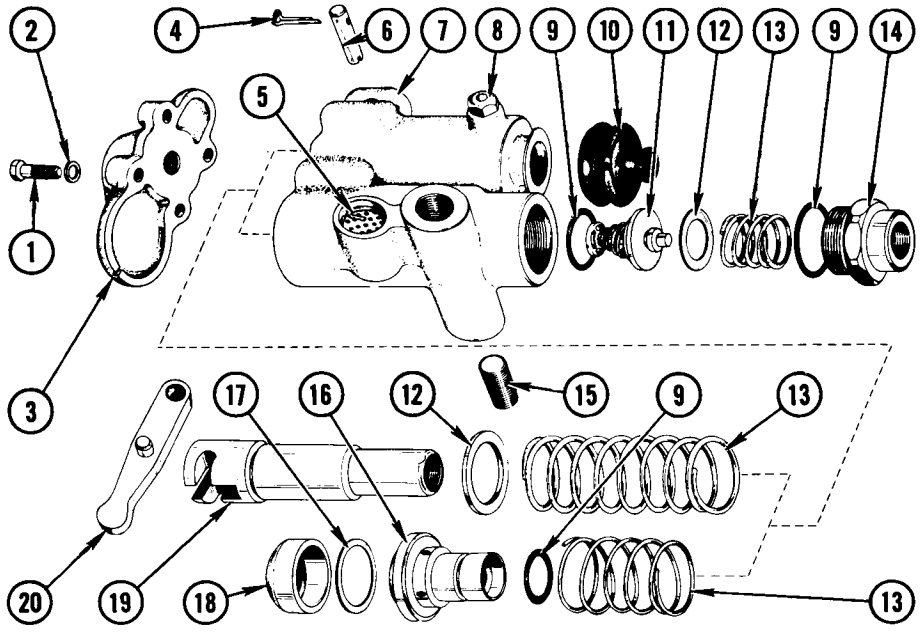

FIGURE E-14. CLUTCH RELEASE VALVE, EXPLODED

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

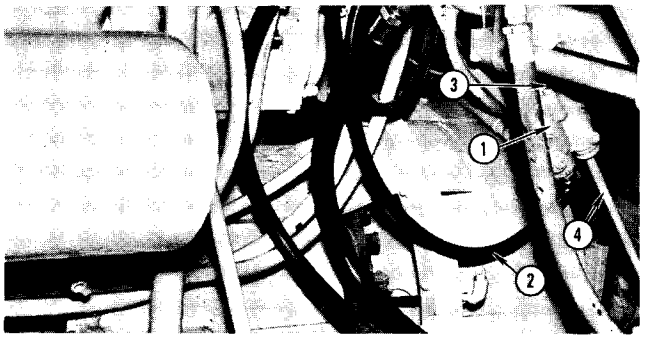

FIGURE E-15. CLUTCH RELEASE AIR VALVE

1. Air Valve
2. Air Supply
3. To Clutch Pedal
4. To Release Cross Shaft

let 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.

CLUTCH VALVE (WAGNER)

Operation

As the clutch pedal is depressed, the pull rod is moved out from the valve and pulls the reaction piston forward, compressing the return spring and causing exhaust valve to close.

Further movement of the pull rod opens the inlet valve allowing air to flow through the outlet port to the clutch release air chamber.

Applied pressure against the reaction piston assists the return spring to oppose the forward pull of the pull rod. Opposing thrust now balances the application pressure against rod pull.

Additional rod pull produces increased air pressure in the system. Releasing the clutch pedal allows the inlet valve to close and the exhaust valve to open. As the air is exhausted the clutch springs engage the clutch.

Removal and Disassembly

Disconnect air lines from valve.

Remove nut and lockwashers from ball joint at each end of air valve linkage. Remove valve and linkage from machine. Remove linkage rods from valve.

Unscrew reactor piston cap from body. Remove cap and gasket.

From inside reactor piston remove the elastic nut from end of push rod. Remove reactor piston and return spring from inside body.

Unscrew inlet valve cap from body. Remove cap and gasket.

Remove inlet valve and spring.

"O" rings may be removed from grooves in inlet valve and reactor in piston.

Repairs kits are available for servicing the valve. Refer to parts catalog for part number. The kit includes the following replaceable parts:

Inlet Valve Cap Gasket
Reactor Valve Cap Gasket
Elastic Stop Nut

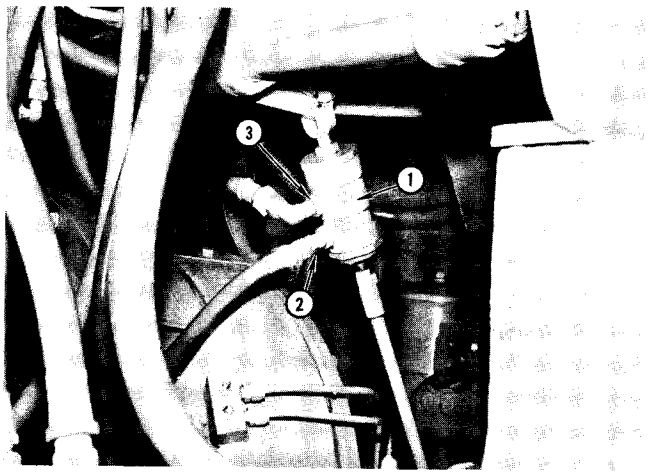

FIGURE E-16. RELEASE VALVE (WAGNER)

1. Clutch Valve
2. Air Inlet
3. Air Outlet

Inlet Valve "O" Ring
Reactor Piston "O" Ring
Inlet Valve

Reassembly

Clean all metal parts in cleaning solvent. Inspect all parts for signs of abnormal wear.

Lubricate "O" rings and moving parts with a light coat of grease before assembly.

Install "O" ring onto inlet valve, replace inlet valve and spring into body. Replace gasket and cap, tighten cap.

Install "O" ring onto reactor piston. Place reactor onto push rod and secure with elastic stop nut. Replace spring and reactor and rod into housing. Replace gasket and cap, tighten cap.

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

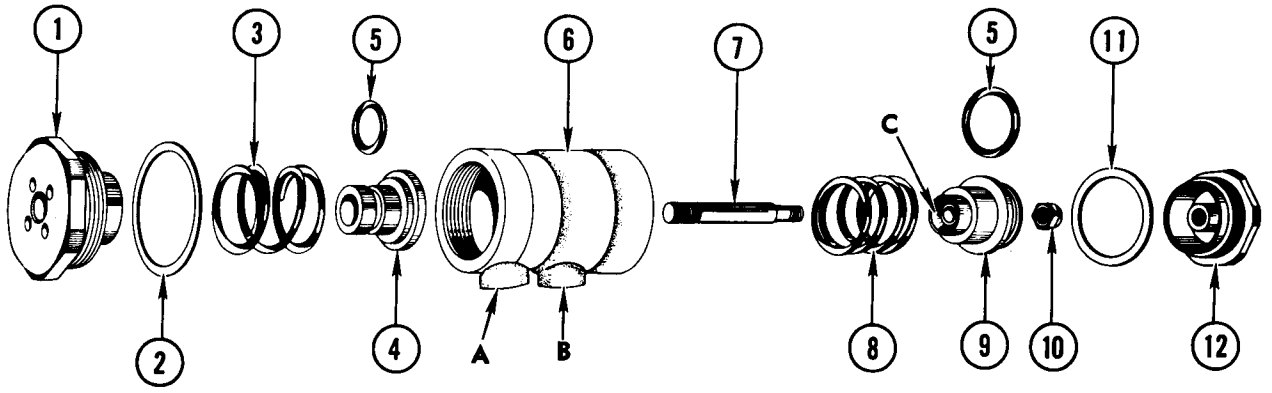

FIGURE E-17. RELEASE VALVE (WAGNER), EXPLODED

1. Inlet Valve Cap
2. Cap Gasket
3. Inlet Valve Spring
4. Inlet Valve
5. "O" Ring
6. Body
7. Push Rod
8. Piston Return Spring
9. Reactor Piston
10. Stop Nut
11. Cap Gasket
12. Reactor Piston Cap

A. Air Inlet
B. Air Outlet
C. Exhaust Valve

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 clevis and locknut from the push rod.

Remove the rubber boot from the cover and the 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 the 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.

Unscrew the nuts inside the diaphragm guide.

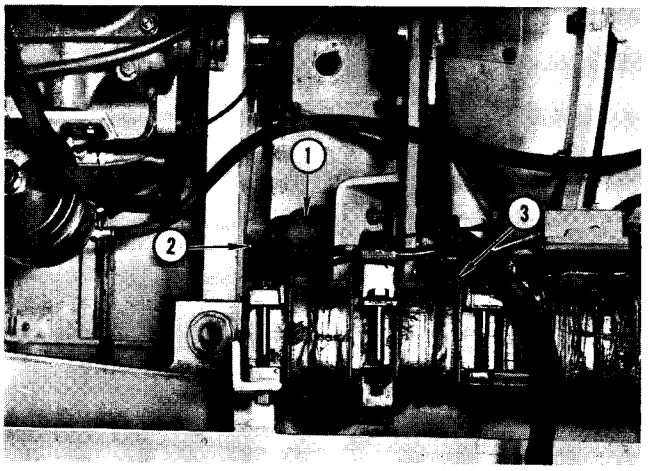

FIGURE E-18. CLUTCH RELEASE AIR CHAMBER

1. Air Chamber
2. From Release Air Valve
3. Clutch Release Shaft

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 re-

placed. Inspect the push plate-push rod assembly. Be sure the push rod is not bent, cracked or damaged. If either of these conditions is 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, 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 locknut and yoke on push rod.

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

Refer to Section "K" for adjustment procedure.

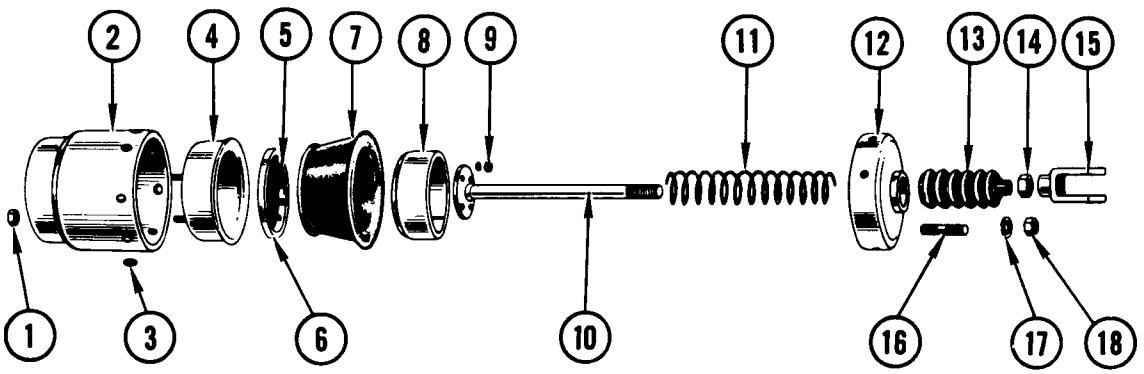

FIGURE E-19. CLUTCH RELEASE AIR CHAMBER, EXPLODED

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

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

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TRANSMISSION

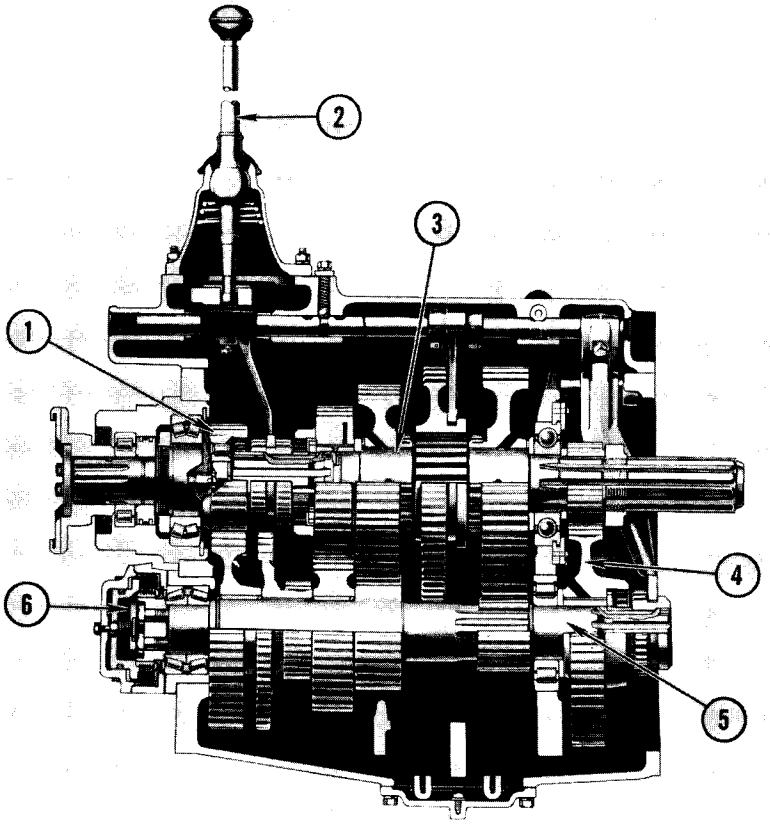

FIGURE F-1. MODEL LM-1220 TRANSMISSION

1. Drive Gear
2. Shift Lever
3. Mainshaft
4. Overdrive Gear
5. Countershaft
6. Clutch Brake

The transmission is a selective gear type, that provides five forward speeds and one in reverse.

Working in conjunction with the transmission 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 the button is pressed in, air is admitted to a trigger valve located on the side of the transmission. This valve is normally in the closed position. As the 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 front of the transmission countershaft. Applying the clutch brake slows down the speed of the countershaft to allow easier shifting of the gears.

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

If by chance the release 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 Speed" in section "A" for procedure to use when shifting the transmission.

REMOVAL

Remove cockpit floor plate and Tournapull rear belly plate.

Remove transmission gear shift lever. Place a temporary cover over opening to prevent entrance of foreign material.

Remove transmission oil sump cover plate and

drain oil from transmission, then remove fill pipe. Cover opening to prevent entrance of foreign material.

Disconnect oil lines from transmission oil filter. Remove capscrews and lockwashers fastening oil filter bracket to transmission case and remove filter and bracket.

Disconnect air lines from surge chamber and trigger valve. Remove lines from clips.

Attach chain hoist to transmission and take up slack.

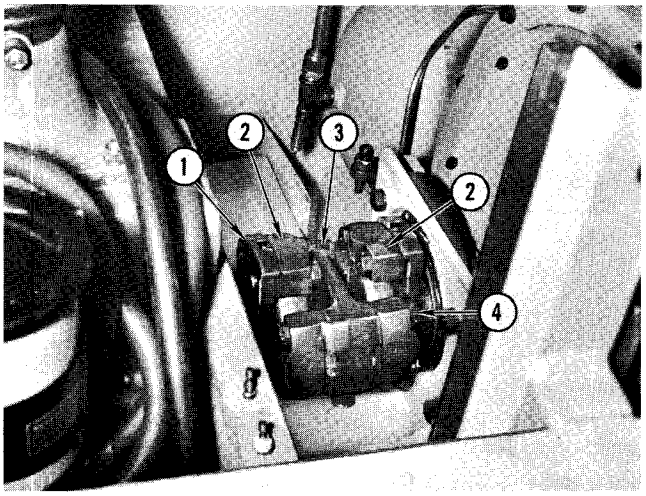

FIGURE F-2. UNIVERSAL JOINT

1. Clutch Shaft
2. Center Cross
3. Coupling
4. Attaching Capscrews

Cut lockwires and remove the capscrews securing the universal crosses to the clutch shaft and to the universal yoke on the transmission drive gear shaft. Lift out universal assembly. Remove the two capscrews from the universal yoke retainer disc. Pull disc and yoke from transmission drive gear shaft.

Drain oil from main case and remove cover plate from differential compartment.

Remove upper jam nuts from each of the transmission hanger bolts. Do not allow transmission to droop. By reaching in through the differential compartment, remove the jam nuts from studs fastening transmission adaptor to main case (two jam nuts on each stud). See figure G-9, page G-6.

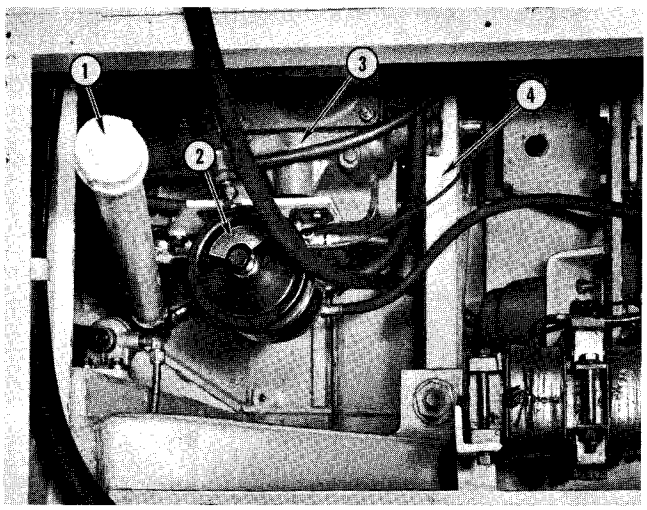

FIGURE F-3. TRANSMISSION, MOUNTED

1. Fill Pipe
2. Oil Filter
3. Transmission
4. Hanger

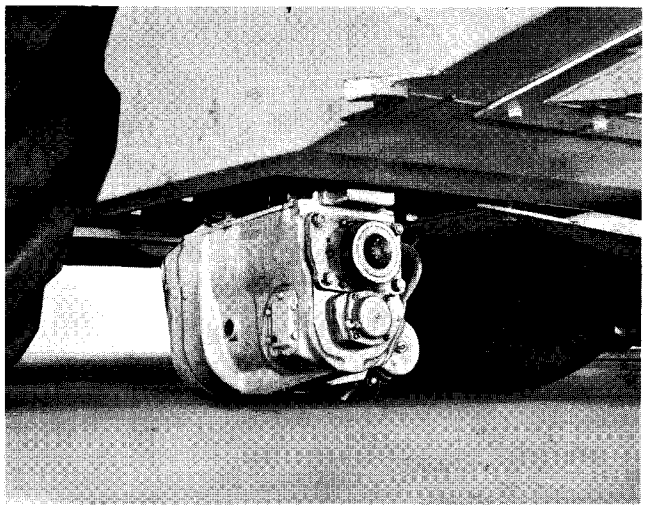

FIGURE F-4. REMOVING TRANSMISSION

Back hanger bolts out of hanger until they are free from mounting ears on case.

Pull hanger and bushing from transmission front bearing housing, remove from case.

Pull transmission forward until studs and pinion are free of main case. Tip transmission and lower through opening in bottom of case. Lower onto pallet or skid. Place on bench or stand for further disassembly.

DISASSEMBLY

Before beginning disassembly the transmission must be drained (if not already done) and the exterior thoroughly cleaned. It is important that no dirt or other foreign matter be allowed to enter the case or get into oil or air lines. Dirt is particularly harmful to the bearings, sleeves and bushings, and will greatly accelerate the wear of these and related parts.

PINION ADAPTOR

Remove the capscrews (or nuts from studs, whichever the case may be) fastening the transmission adaptor to the transmission case. Remove adaptor assembly and gasket from case. Adaptor

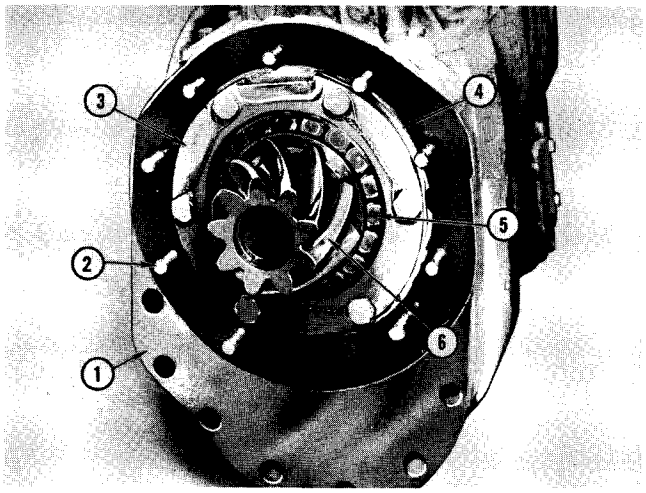

FIGURE F-5. TRANSMISSION ADAPTOR

1. Adaptor
2. Stud
3. Keeper Ring
4. Gasket
5. Bearing
6. Pinion

is positioned on transmission by two dowel pins.

Cut the lockwires and remove the capscrews fastening the keeper ring to the adaptor. Remove keeper ring and gasket.

Pull bearing and pinion from adaptor. Remove double oil seal from inside bore of adaptor.

Remove locking setscrew from pinion bearing locknut and remove locknut.

Pull bearing from pinion.

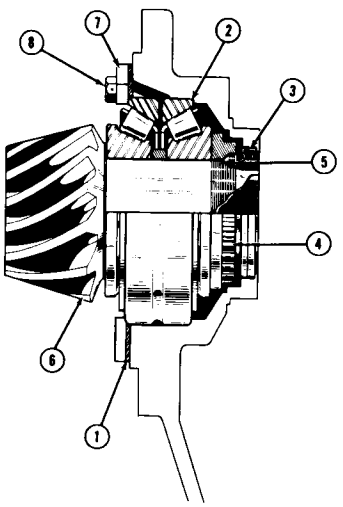

FIGURE F-6. TRANSMISSION ADAPTOR, CROSS SECTION

1. Gasket
2. Shim
3. Oil Seal
4. Nut
5. Setscrew
6. Pinion
7. Keeper Ring
8. Capscrew

GEAR SHIFT LEVER

Remove nuts and lockwashers from studs by which shift lever housing is attached to the shifting bar housing. Lift lever, housing and gasket from transmission (if not already done).

Unscrew lever knob and raise dust bell up over end of lever.

Place lever and housing 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.

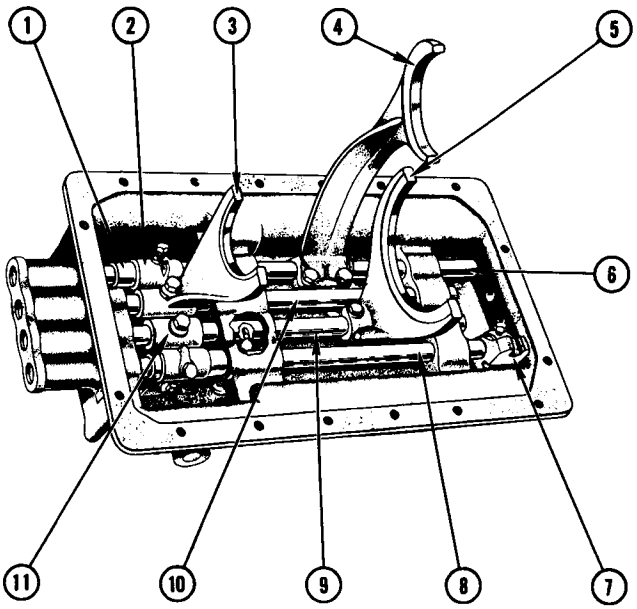

FIGURE F-7. SHIFT BAR HOUSING

1. Front Spacer
2. Central Shift Block
3. 3rd and 4th Speed Shift Yoke
4. Reverse Shift Yoke
5. 1st and 2nd Speed Shift Yoke
6. Reverse Yoke Bar
7. Overdrive Shift Block
8. Overdrive Yoke Bar
9. 1st and 2nd Speed Yoke Bar
10. 3rd and 4th Speed Yoke Bar
11. 1st and 2nd Speed Shift Block

SHIFT BAR HOUSING

Shift transmission into second or reverse.

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

Shift the shifting bar housing into the neutral position. This may be identified by alignment of lever slots.

Remove the tension spring cover and remove the poppet springs. Turn the assembly with yokes upward and jar slightly to remove the steel balls assembled under the poppet springs.

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

From the left side of the shifting bar housing remove the capscrews and lockwashers securing the air valve cover and gasket to the housing. Re-

move actuating plunger spring and actuating plunger and housing.

Remove welch plugs from the rear of the housing. Cut lockwires and loosen the lockscrews from shift blocks and yokes. Drive the three upper bars from the housing, starting with the reverse shifting bar, which is uppermost. Remove the three steel interlock balls from between the shift bars and the two interlock cross pins from the hole in the 1st and 2nd speed yoke bar and in the 3rd and 4th speed yoke bar.

The welch plugs in the yoke bar holes at the front on the housing will be driven from the housing as the bars emerge. After removing the reverse shifting bar, pull the air valve plunger a portion of its length from the air valve opening in the housing. Repeat this procedure after removing each successive bar.

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 screwdriver until it can be removed from the housing.

OVERDRIVE GEARING

Remove adaptor and gasket, if not already done. Engage transmission into two speeds at once. Mainshaft rear locknut is staked onto shaft. Drill out the staked portions of the nut from the staking slots in the mainshaft. Use new nut for reassembly. Place wrench over mainshaft locknut and remove locknut. Pull mainshaft overdrive gear and washer from mainshaft.

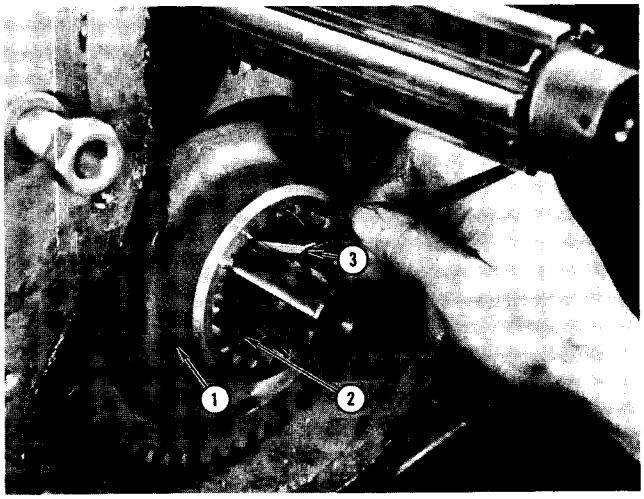

FIGURE F-8. REMOVING OVERDRIVE KEY

1. Gear
2. Thrust Washer
3. Key

Cut the lockwires and remove capscrews clamping overdrive yoke to the short overdrive shift bar. Drive the short overdrive shift bar to the rear and out of the transmission case. Bar will drive out welch plug as it is removed. Lift overdrive shifting yoke from case. Slide overdrive sliding clutch from countershaft.

From its keyway between the splines of the countershaft, pry up on and remove the countershaft thrust washer key. Turn the countershaft thrust washer in its groove until splines on its inside diameter line up with the splines on the countershaft. Pull countershaft overdrive gear from countershaft. This will also remove splined washer.

FRONT BEARING HOUSING

Remove the six capscrews and washers and the four nuts from studs fastening front housing to transmission case.

Install capscrews in the two blind tapped holes on either side of bearing housing. Tighten capscrews down evenly to push bearing housing and drive gear from transmission.

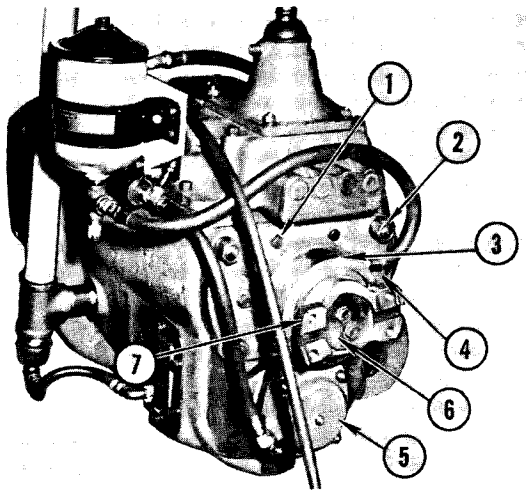

FIGURE F-9. FRONT BEARING HOUSING

1. Capscrews
2. Studs
3. Housing
4. Pusher Hole
5. Clutch Brake
6. Retainer Disc
7. Universal Yoke

NOTE: Clutch brake may have to be removed to allow removal of bearing housing, as the lower edge of housing may not clear the clutch brake.

Exercise caution when removing housing and gear, as it may fall free as housing clears bore in transmission case.

Note oil coupling pressed into gear.

Remove capscrews, retainer disc and universal

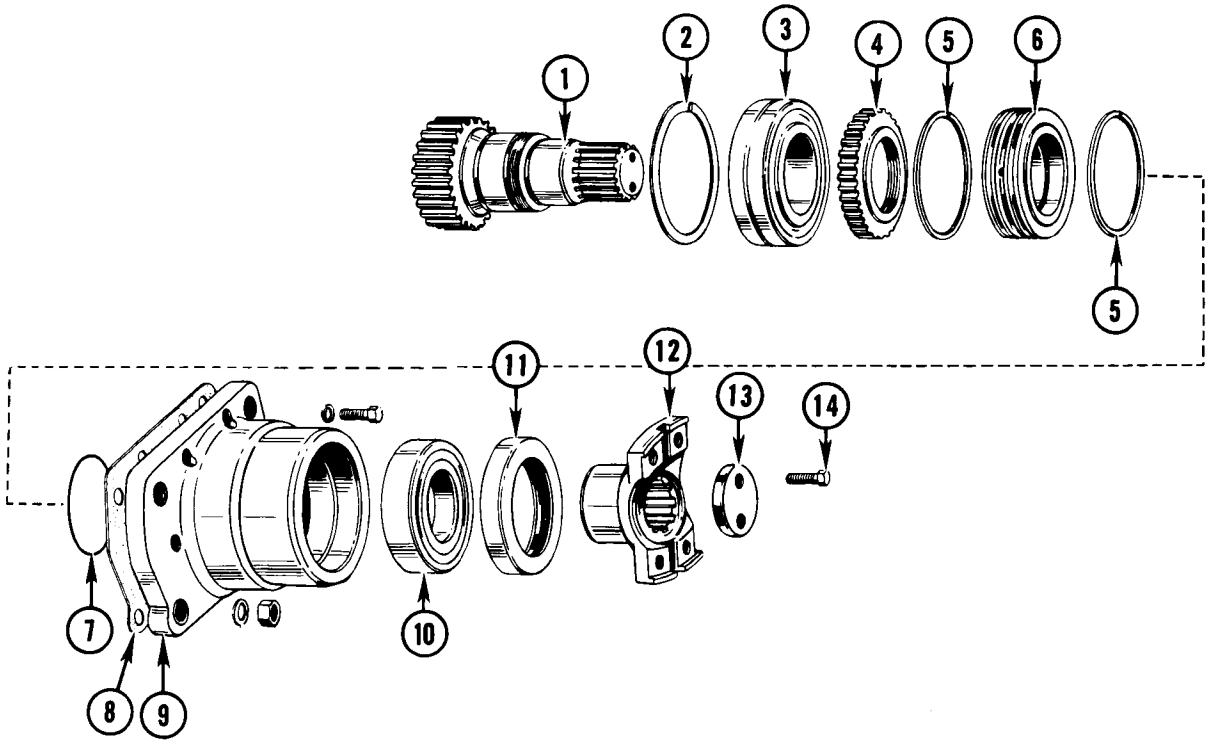

FIGURE F-10. DRIVE GEAR AND HOUSING, EXPLODED

1. Drive Gear
2. Snap Ring
3. Bearing
4. Locknut
5. Piston Ring
6. Ring Carrier
7. "O" Ring
8. Gasket
9. Housing
10. Bearing
11. Oil Seal
12. Universal Yoke
13. Retainer Disc
14. Capscrew

yoke if not already done.

Remove snap ring from inside housing at drive gear end. Press gear and shaft from housing. Rear bearing locknut, ring carrier and "O" ring will be removed with gear.

Pull oil seal and bearing from bore at front of adaptor.

Remove "O" ring and ring carrier from gear shaft. Remove piston rings from carrier.

Remove locknut and pull bearing from gear shaft. Locknut has left hand threads.

MAINSHAFT

Pull mainshaft pilot bearing from mainshaft and remove mainshaft sliding clutch. The mainshaft intermediate bearing is equipped with a combination bearing puller and retainer. There are six 5/16" - 18 NC x 15/32" hex head capscrews (which hold the bearing retainer and puller together), and six 3/8" - 16 NC x 1" 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" - 16 NC x 1" capscrews. Block between mainshaft first speed gear and the case web. Install one 3/8" - 16 NC x 1" capscrew in each of the two blind tapped holes in the bearing puller. Turn the capscrews down evenly to pull bearing from case web. Remove capscrews fastening bearing retainer and puller together and remove bearing.

Lift mainshaft and assembled gears from the 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 onto the large sliding gear (mainshaft first and second speed sliding clutch gear). The weight of the mainshaft first speed gear will force the bearing, first speed spacer and gear from the shaft. The bushed gear and spacer should be caught as they are freed from the shaft. Remove the large sliding gear from the output end of the mainshaft.

With a screwdriver pry mainshaft third speed gear washer key from its keyway between the mainshaft splines at the pilot end of 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 the third speed gear and washer from the pilot end of mainshaft.

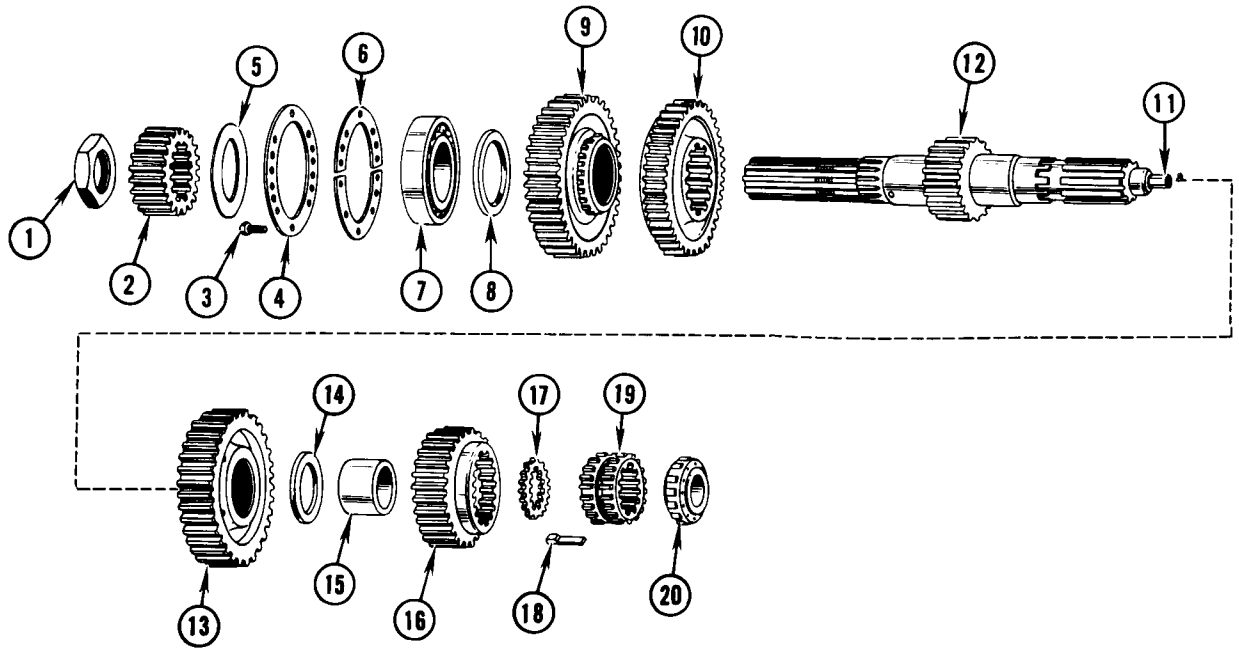

FIGURE F-11. MAINSHAFT, EXPLODED

1. Nut
2. Overdrive Gear
3. Capscrew
4. Bearing Cover
5. Washer
6. Bearing Puller
7. Bearing
8. Spacer
9. 1st Speed Gear
10. 1st and 2nd Speed Clutch Gear
11. Oil Coupling
12. Mainshaft
13. 2nd Speed Gear
14. 3rd Speed Gear Rear Washer
15. Bearing Sleeve
16. 3rd Speed Gear
17. 3rd Speed Gear Front Washer
18. 3rd Speed Gear Key
19. Sliding Clutch
20. Mainshaft Pilot Bearing

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 capscrews from reverse idler shaft lock. 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 having the same thread as the ones in the end of 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

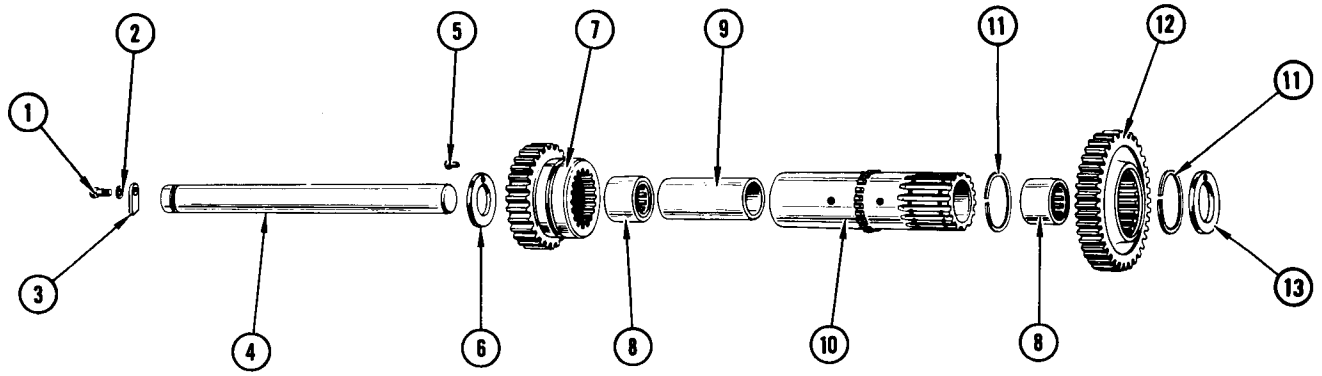

FIGURE F-12. REVERSE SHAFT, EXPLODED

1. Capscrew
2. Lockwasher
3. Lock Plate
4. Idler Shaft
5. Thrust Washer Pin
6. Rear Thrust Washer
7. Reverse Gear
8. Bearing
9. Spacer
10. Sleeve
11. Snap Ring
12. Reverse Idler Gear
13. Front Thrust Washer

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.

Pull reverse idler shaft. Do not allow the reverse gears or washers to drop to bottom of case. Lift reverse assembly from case.

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.

COUNTERSHAFT

Remove the four capscrews and lockwashers fastening the clutch brake cover to the front of the transmission case and remove clutch brake assembly.

Locate and mark the two blind tapped holes in the countershaft front bearing adaptor. Screw capscrews into these two holes. Pull the bearing adaptor and bearing from 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 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 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. Re-attach 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 the countershaft up and tilt back, then remove entirely from case.

From front end of countershaft 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 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. Remove discs and disc spacer from inside body.

Remove nut and lockwashers 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 diameter of the piston.

OIL PUMP

Remove the capscrews and lockwashers securing oil pump assembly to the transmission case.

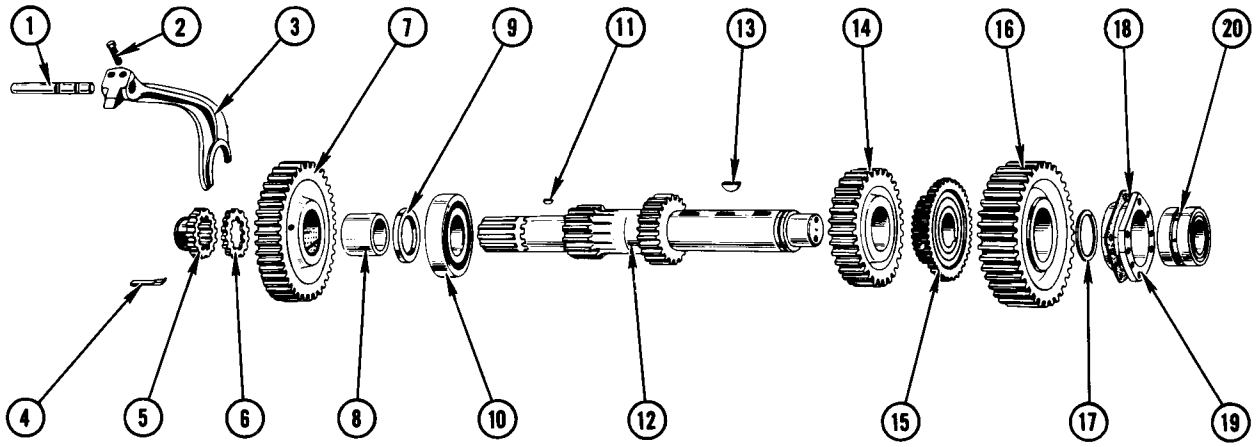

FIGURE F-13. COUNTERSHAFT, EXPLODED

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

Remove pump gaskets, and filler block from the transmission.

Remove 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 the 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 gear from pump housing. Remove key and spacer from rotor shaft.

Expansion plug and bushings may now be removed from pump housing if inspection shows that replacement of bushings is necessary.

To disassemble relief valve, remove retainer ring from valve hole in pump body. Remove spring and valve piston.

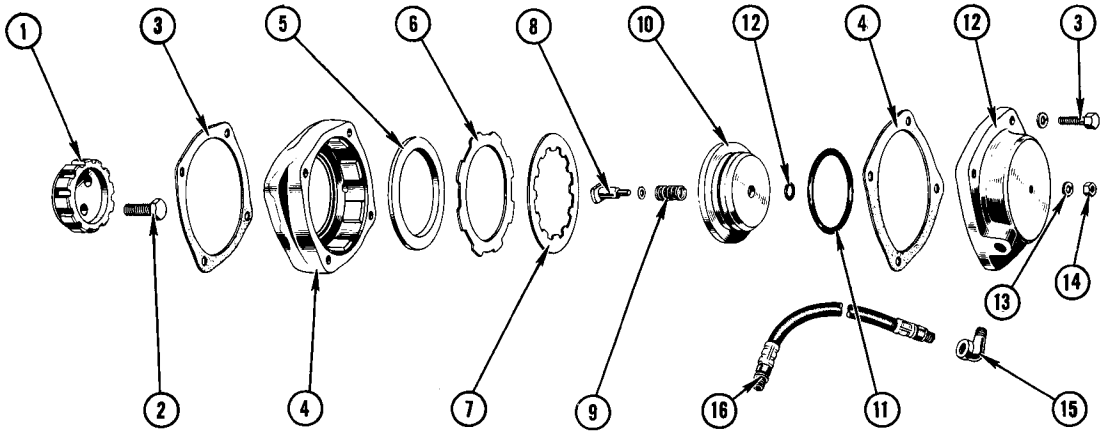

FIGURE F-14. CLUTCH BRAKE, EXPLODED

1. Disc Carrier
2. Capscrew
3. Gasket
4. Adaptor Body
5. Disc Spacer
6. Outer Disc
7. Inner Disc
8. Retainer
9. Spring
10. Piston
11. "O" Ring
12. Cover
13. Lockwasher
14. Nut
15. Street Ell
16. Hose

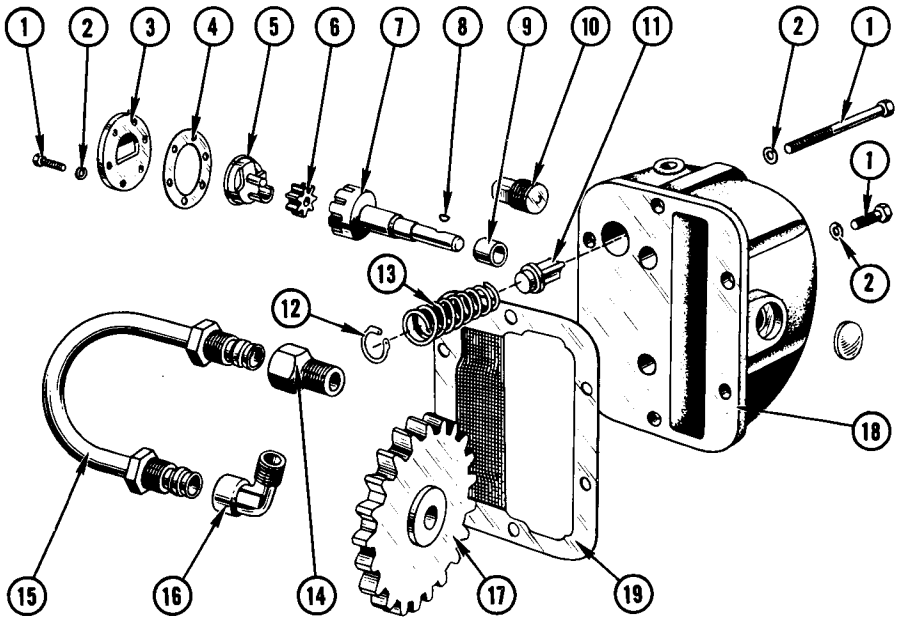

FIGURE F-15. TRANSMISSION OIL PUMP, EXPLODED

1. Capscrew
2. Lockwasher
3. Head
4. Gasket
5. Reversing Head
6. Idler Gear
7. Rotor
8. Key
9. Spacer
10. Pipe Plug
11. By-pass Valve
12. Retainer
13. Spring
14. Connector
15. Tube
16. Street Ell
17. Drive Gear
18. Housing
19. Screen and Gasket

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, chipping 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.

Be sure to replace lube oil coupling into the drive gear and mainshaft (if removed).

All worn gear washers should be replaced to assist in maintaining the original fit.

End play of gears should be held at a minimum of 0.006".

When reassembling shift housing, be sure to replace interlock balls and cross pins. Position as shown in figure F-16.

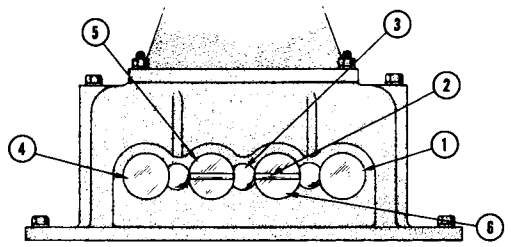

FIGURE F-16. INTERLOCK BALLS AND PINS

1. Reverse Shift Yoke Bar
2. Cross Pin
3. Interlock Ball
4. Overdrive Shift Yoke Bar
5. 1st and 2nd Shift Yoke Bar
6. 3rd and 4th Shift Yoke Bar

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 the bushing and the inside diameter of the gear with a saturated solution of salt and water. Line up the 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 oil before replacing gears.

The mainshaft 1st and 2nd speed gear bushings, mainshaft thrust washers, countershaft thrust washers, idler and reverse shaft thrust washers and the clutch shaft oil seal should be coated with a "Molybdenum Disulphide" lubricant during reassembly.

The lubricant must meet the following specifications for lithium soap base grease with molybdenum disulphide additive:

Minimum "Moly"	3%
NLGI Consistency	No. 2
Dropping Point—ASTM	Minimum 340° F.
Operating Range	−20° F. to +250° F.

When replacing discs and disc spacer into the clutch brake 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 drive gear shaft front locknut the following instructions will apply. Remember that the nut has left hand threads.

Thoroughly clean the clutch shaft and drive gear and clutch shaft and drive gear bearing nut with carbon tetrachloride.

Install the bearing on the clutch shaft.

Pre-heat the shaft, bearing and nut by placing them in boiling water for about ten minutes or until the parts have reached a temperature of 200° to 212° F. Water and container must be clean and free of oil. DO NOT HEAT IN OIL.

Remove parts from water and blow dry with clean dry air.

Clean threads of shaft and locknut again with carbon tetrachloride, to insure that threads are completely clean and dry.

Apply "Loctite" generously to the shaft threads and nut threads. Install bearing nut, and tighten to 150 ft. lbs. torque, using the special wrench. Note that the nut has left hand threads. Wipe excess "Loctite" from outside of nut and shaft.

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. Use a new locknut for reassembly. Stake nuts into the five staking slots in

the mainshaft.

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 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 the bottom of transmission and observing the amount of gear movement. (Oil must be drained from transmission before making this check.)

PINION ADJUSTMENT

If installing a new pinion and ring gear, adaptor or bearing, the pinion mounting distance must be checked and adjusted by using shims.

The mounting distance is checked by measuring the distance between the face of the pinion bearing and the adaptor mounting surface (without gasket). This distance must be 1.122".

Install and seat bearing cup into adaptor bore. Place outer bearing cone into cup. Rotate until rollers are in full contact and surface of bearing is parallel with adaptor mounting surface. (Do not install pinion at this point.) With a dial indicator, indicate the distance between the face of the bearing and the adaptor mounting surface (without gasket). Make readings at at least four points around circumference of bearing, to be sure bearing is parallel.

From this dimension subtract the M.D. variation etched on the end of the pinion gear. For example: If the distance between the face of bearing and mounting surface is 1.142", and if M.D. marking is 0.004", subtract 0.004" from 1.142", or 1.138".

If this distance is more than 1.122", subtract

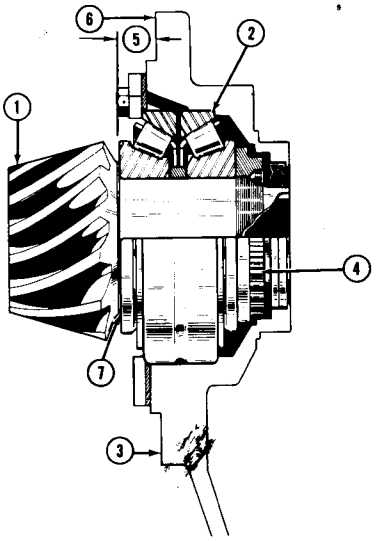

FIGURE F-17. PINION MOUNTING DISTANCE

1. Pinion
2. Pinion Bearing
3. Mounting Surface
4. Locknut
5. M.D. (1.122")
6. Add Shims Here If Distance Is Greater Than 1.122"
7. Add Shims Here If Distance Is Equal To Or Less Than 1.122"

1.122". For example: 1.138"—1.122"=0.016". Prepare a stack of shims equal to this difference (0.016"). These shims are to be positioned between the mounting faces of the final drive compartment and the transmission adaptor. Refer to figure F-17.

If the figure obtained by subtracting the M.D. variation from the distance between the bearing face and adaptor mounting surface is equal to or less than 1.122", subtract the distance from 1.122". For example: If measurements was 1.117", subtract from 1.122". (1.122"—1.117"=0.005".) Prepare a stack of shims equal to this difference (0.005"). These shims are to be positioned between the pinion and the bearing cone. Refer to figure F-17.

Remove bearing cup. Assemble bearing onto pinion, install bearing locknut and torque to 600 ft. lbs. Install oil seals and pinion and bearing into adaptor bore.

INSTALLATION

Position transmission under opening in Tournapull case. Attach hoist and raise transmission into case.

Place gasket (and necessary shims as determined by M.D. adjustment) over transmission adaptor mounting studs.

Mesh pinion teeth with ring gear teeth. Be sure that the "X" marked pinion tooth is between the "X" marked teeth on the ring gear. See page G-8 for backlash adjustment.

Seat transmission adaptor firmly against case. Install jam nuts on mounting studs by reaching through final drive compartment. Tighten nuts to 175 ft. lbs. torque. Make sure adapter is squarely against case and all jam nuts are tightened evenly.

Place transmission hanger and bushing over front bearing housing. Put hanger bolts through hanger and mounting ears with nuts and washers positioned as shown in Figure F-18.

Install universal yoke on transmission mainshaft. Secure with retainer disc and capscrews.

Turn universal yoke to a vertical position. Position dial indicator in such a manner so that it will indicate up and down movement of the universal.

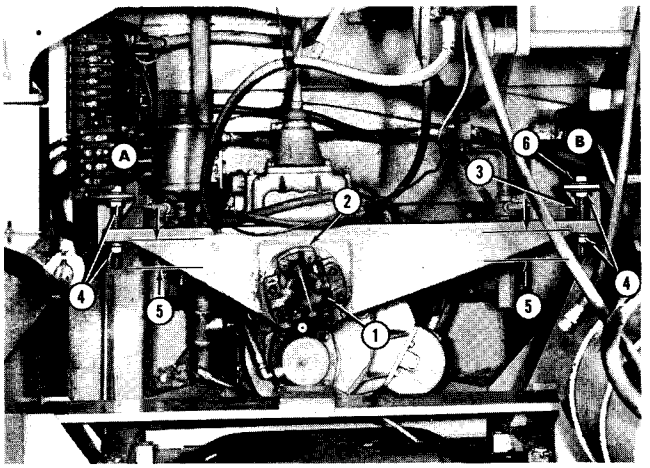

FIGURE F-18. TRANSMISSION FRONT HANGER

1. Universal Yoke
2. Indicate Here
3. Adjusting Capscrew
4. Locknut
5. 1 3/8" (+1/8")
6. Tighten 1/8 Turn

With transmission in the relaxed position, tighten the adjusting capscrews until the yoke is raised from a minimum of 0.0025" to a maximum of 0.003". Lock in this position by running up locknuts and washers. Recheck indicator dial.

If dial indicator is not available use the following procedure. Run the bottom locknut and lockwasher (on each side) up until the distance between the end of the mounting capscrews and the underside of the hanger is 1 3/8" (+1/8"). Lock the "A" side (figure F-18) by tightening both locknuts. Tighten the capscrew on "B" side (figure F-18) until it is snug and any further tightening of the capscrew will raise the transmission. Turn the mounting capscrew on the "B" side approximately 1/8 of a turn. This will raise the transmission yoke the required 0.0025" to 0.003". Lock "B" side by tightening both locknuts.

Replace assemblies removed.

NOTE: If engine was removed, refer to page C-1 for engine realignment procedure.

See page K-15 for correct amount and type of transmission lubricant.

Recheck ring gear and pinion backlash, see page G-8. Replace final drive cover and lubricant, see page K-15.

FINAL DRIVES

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FINAL DRIVES

FINAL DRIVE PINION

Removal

Drain oil from final drive compartment. Remove fuel tank. Block up machine and remove tire and wheel from side to be worked on. If differential is to be removed, both tires and wheels must be removed.

Remove air brake assembly by removing mounting capscrews, with the exception of the four center capscrews in the groups of three. These four capscrews will hold the brake together so it can be removed as a unit. As a safety precaution, completely drain the air system before disconnecting air brake line. Refer to section "H" for air brake disassembly.

Remove cover plate and gasket from rear of final drive compartment containing pinion to be removed.

Cut lockwires and remove case staybolts and washers.

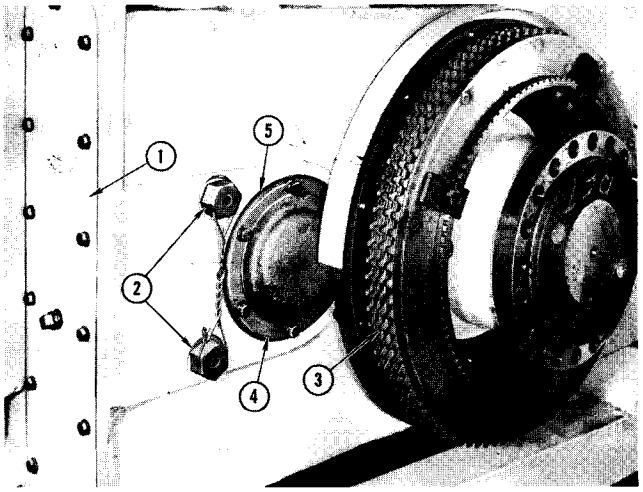


FIGURE G-1. CASE STAYBOLTS

1. Cover Plate
2. Staybolts
3. Air Brake
4. Bearing Retainer Cap
5. Shims

Remove capscrews and lockwashers from pinion bearing retainer cap, then remove cap and shims. Remove final drive axle (see page G-3) and roll final drive gear forward in the case to allow clearance for the pinion inner bearing cone as the pinion is being removed. Block gear to keep it from rolling. Unless replacing pinion inner bearing cup or axle parts it is not necessary to remove the axle to remove pinion.

If axle was removed, either pull pinion from case as shown in figure G-2, or use a pry bar between pinion gear end and case wall to pry the pinion

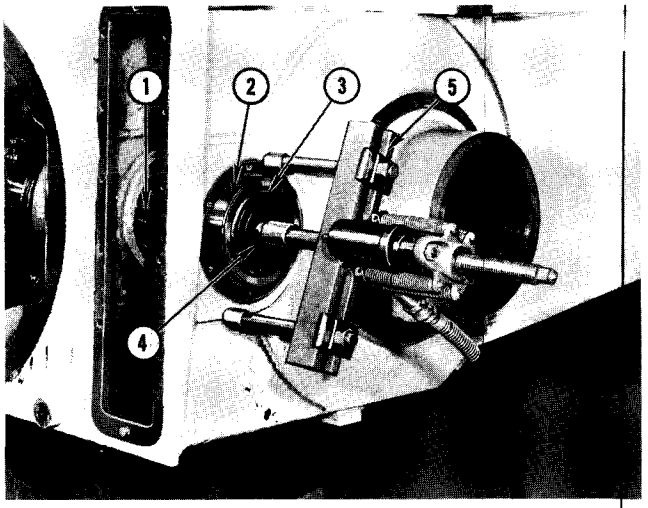


FIGURE G-2. PULLING PINION

1. Inner Bearing Cone
2. Outer Bearing Cup
3. Outer Bearing Cone
4. Pinion Shaft
5. Puller

out. Rotate while prying. Remove pinion outer bearing cup as the pinion forces it out of the case. The inner and outer bearing cones will remain on the pinion shaft and must be pulled or pressed from it if replacement is necessary. Remove inner bearing cup from its bore in the inner wall of the final drive compartment.

If not necessary to remove axle, proceed as above up to the point of pulling the axle. See figure G-3.

Attach puller to pinion shaft. Pull pinion until inner bearing cone comes against final drive gear.

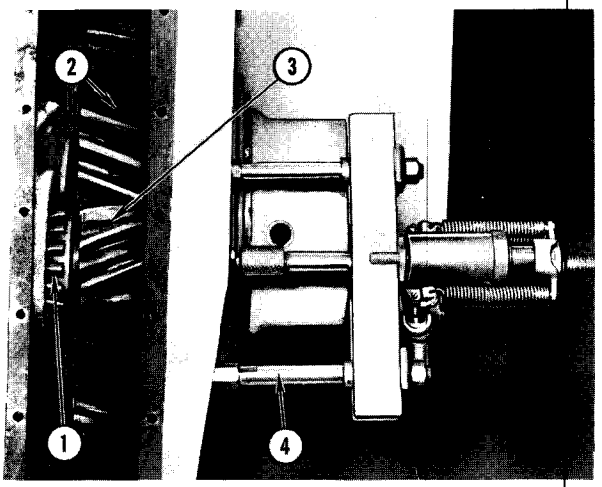


FIGURE G-3. PULLING PINION WITHOUT REMOVING AXLE

1. Inner Bearing Cone
2. Final Drive Gear
3. Pinion
4. Puller

Continue to pull pinion out of bearing and case. Pinion must be rotated during pulling operation to prevent it from becoming cocked and binding on the shaft. Remove pinion outer bearing cup as the pinion forces it out of the case. Do not allow pinion inner bearing cone to fall to floor of case. Pinion inner bearing cup cannot be removed unless final drive axle has been removed.

Installation

If axle was not removed, press pinion outer bearing cone onto pinion shaft. Position inner bearing cone into inner bearing cup. Start pinion shaft through inner bearing cone.

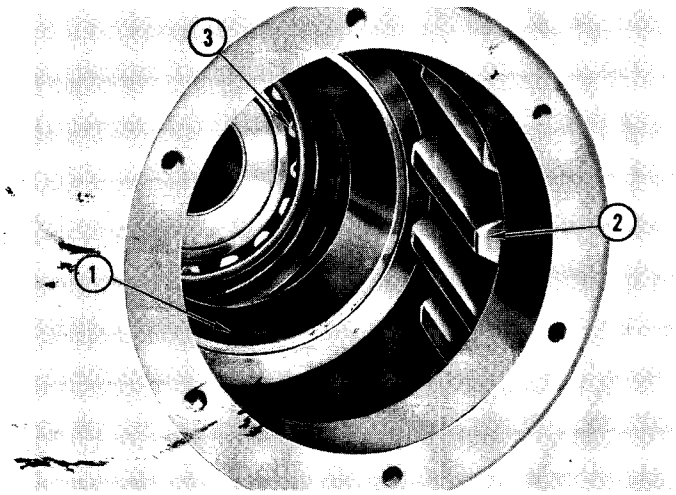


FIGURE G-4. INNER BEARING CUP

1. Bearing Cup
2. Final Drive Gear
3. Differential Carrier Bearing

If axle was removed replace both pinion inner and outer bearing cones onto pinion shaft.

Largest diameter of bearing cones must be against pinion gear. Be sure final drive gear is in the case before installing pinion.

Position inner bearing cup in bore of inner case wall, through final drive compartment.

Insert pinion shaft through bore in case, into differential assembly, engaging splines on end of pinion shaft with splines in differential idler gear.

Replace outer bearing cup.

Snug up pinion bearings by using capscrews and flat washers inserted in the retainer cap capscrew holes. Tighten them down evenly to set the bearing cups. Remove capscrews and flat washers.

Replace retainer cap (do not install shims at this point) secure with capscrews torqued to 40 ft. lbs.

With a feeler gauge measure the distance between the retainer cap and the machined surface of the case. Prepare a shim stack equal to this distance plus 0.002". Remove cap, insert shims, replace cap and torque capscrews to 40 ft. lbs.

Position a dial indicator in such a manner as to indicate end play of the pinion. Set indicator dial at "0".

Measure the amount of end play present.

There must be 0.001" to 0.003" end play. If this end play is not obtained, insert additional shims under retainer cap until it is obtained, or remove shims if end play is over the recommended amount.

The shims are 0.005" and 0.007" thick and by using combinations of the two sizes, adjustments of 0.001" to 0.002" are possible.

When correct adjustment has been obtained, check to be sure all capscrews are tight.

Replace staybolts in case and torque to 600 ft. lbs. Install lockwires.

Install gasket and cover plate. Complete reassembly of machine.

Refer to page K-15 for correct type and amount of lubricant to be used in final drive compartment.

FINAL DRIVE AXLE

Removal

Remove drain plug and drain oil from the final drive compartment. Block up machine and remove tire and wheel from side of machine to be worked on.

Remove air brake assembly by removing mounting capscrews, with the exception of the center capscrews in the four groups of three. These four capscrews will hold the brake together so it can be removed as a unit. As a safety precaution, completely drain the air system before disconnecting air brake line. Refer to section "H" for air brake disassembly.

Remove cover plate and gasket from rear of final drive compartment containing gear and axle to be worked on.

Remove nuts and copper washers from the studs fastening the axle nut cap to the main case. Remove cap and gasket.

Pull cotter from axle nut. Place the axle nut wrench over the axle nut in such a way that it will be firmly braced against the case wall.

Remove the final drive pinion cap and shims, on same side of machine as the axle being removed. Hold pinion in case by placing three capscrews

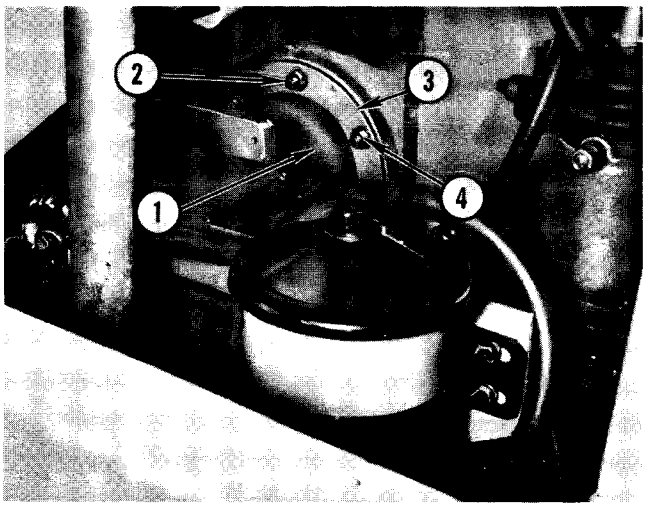


FIGURE G-5. AXLE NUT CAP

1. Cap
2. Stud
3. Gasket
4. Nut

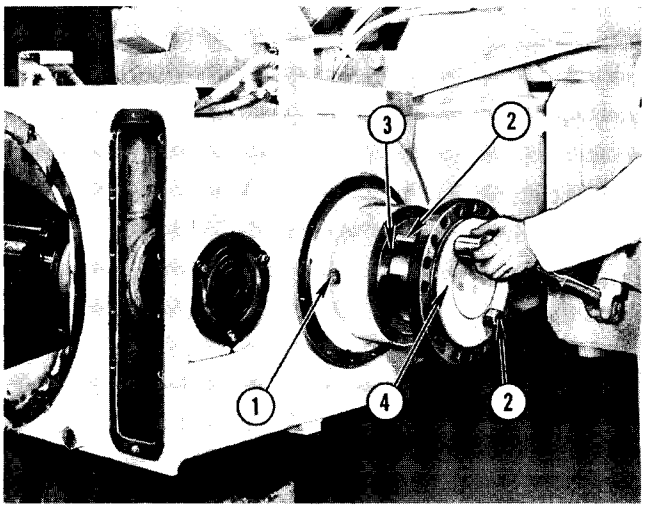


FIGURE G-7. REMOVING AXLE

1. Lockbolt
2. Pusher Capscrews
3. Collar
4. Axle

and flat washers into retainer cap capscrew holes and running them down snugly against bearing. Put the special pinion wrench adaptor (supplied with tool kit) in the exposed end of pinion shaft. Place wrench over adaptor and turn the pinion in the clockwise direction.

By turning the pinion shaft, the mechanical advantage gained from the ratio between the final drive pinion and the drive gear is used to loosen the axle nut. Back nut halfway off axle shaft. See figure G-6.

Cut lockwire and remove case staybolts and

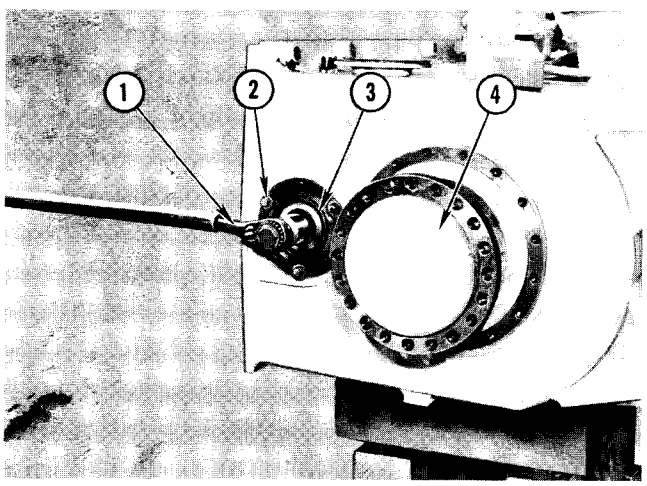


FIGURE G-6. LOOSENING AXLE NUT

1. Wrench
2. Capscrews
3. Bearing
4. Axle

washers.

Remove the cork plugs from the two tapped holes in the axle flange. Install a 1" - UNC x 6" (furnished in tool group) capscrew in each hole. Turn the capscrews down evenly to pull the axle. Pull the axle until the axle nut is pulled up against the bearing cone. See figure G-7.

Place a block of wood under the gear to prevent its dropping to the case bottom as the axle is removed.

In the event gear does not pull squarely up against case, put steel spacers between gear and case to prevent gear from cocking and binding on axle. Remove axle nut and continue pulling axle until outside bearing cone is free and can be removed. Pull axle from case. Spacer tube, roller bearing race, collar and felt seal will be removed with axle.

As axle is being removed, the tapered collar, inside bearing cone, bearing spacer, and drive gear will fall free. Remove from inside case.

Remove final drive pinion and roll gear from case.

From inside case, remove the bearing cup retainer (note that studs are welded to retainer). The nuts for these studs were removed when removing axle nut cap. Remove bearing cup.

Remove roller bearing lockbolt from axle housing. Pull oil seal, seal spacer, roller bearing and bearing retainer from inside axle housing.

Installation

Clean all parts thoroughly and inspect for wear or damage and replace if necessary.

Insert roller bearing retainer into axle housing and press until it bottoms against shoulder in housing.

Place roller bearing outer race into housing,

with the chamfered end going in first. Be careful to align the lockbolt hole in the bearing race with the hole in the axle housing, seat against retainer and install lockbolt. Replace roller bearing, seal spacer and oil seal. Long lip of oil seal should be pointing toward differential.

Cement felt seal to collar using "3M-EC-847" cement or its equivalent, being careful not to allow any cement to get on the oil seal runner surface.

Press collar (with felt seal attached) and roller bearing race onto axle until collar is seated against collar. Slide spacer tube over axle (largest inside diameter first) until it bottoms against bearing race.

Place double row tapered roller bearing cup into bore of the case wall. Position bearing cup retainer (with welded studs) into case. Put nuts on studs and run down finger tight to hold retainer and bearing cup in place.

Roll final drive gear into case with longest hub toward the differential. Tilt top of gear toward outside of machine.

Paint splines of axle with coating of white lead.

Insert axle, spacer, bearing race and collar into axle housing.

With gear still tilted, place inside bearing cone into cup in bore of case. Move gear over against bearing to hold it in position. Maneuver gear and axle until end of axle is started through gear. As end of axle comes through gear, place the tapered collar (with largest inside diameter toward gear) between the gear and the bearing cone. Turn axle until splines on axle fit into splines on the final drive gear.

Check to be sure the gear spacer is squarely in contact with inside bearing cone at one end and the drive gear at the other. On the other side of the gear the spacer tube must be squarely against gear on one end and against bearing race on other end. At this point it is not necessary that the parts be in full contact, but parts must be in such a position that full contact will be assured when assembly is completed.

Place outside bearing cone over end of axle shaft. DO NOT INSERT BEARING SPACER AT THIS TIME.

Put locknut on shaft and tighten nut until cone has started on shaft approximately 1/8". Back nut off and remove bearing cone. Place bearing spacer over axle and into place against inside bearing cone. Make certain spacer is on bearing surface sufficiently to prevent it becoming wedged between cone and edge of bearing surface. Replace outside bearing cone and axle locknut.

Install final drive pinion but do not replace retainer cap. Hold pinion in place by positioning capscrews with flat washers in retainer cap capscrew holes and running them down against bearing.

Place axle nut wrench over axle nut and brace it against the case in such a manner that it will be firmly braced.

Put the special pinion wrench adaptor in the end of the pinion shaft and turn the pinion shaft in a counterclockwise direction. Refer to figure G-6.

By turning the pinion shaft, the mechanical advantage can be used to seat gear and tighten the axle locknut.

Axle locknut should be torqued to 4500 ft. lbs. Applying 715 ft. lbs. of torque to the final drive pinion will put the correct torque on the axle nut.

Install cotter in axle shaft and locknut. Remove nuts from bearing retainer studs. Install gasket and axle nut cap, secure with lockwashers and nuts. Torque nuts to 70 ft. lbs.

Replace case staybolts, torque to 600 ft. lbs. and secure with lockwires. Recheck pinion end play as it must be maintained.

Complete reassembly of machine.

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 drive wheel with poor traction and the drive wheel with better traction.

The differential pinion is a compensating linkage with the differential housing, used to connect the axle shafts to the engine drive train. If the pinions were removed from a 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 the 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.

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

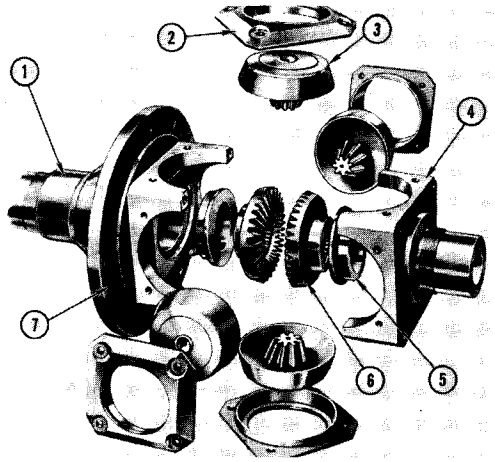


FIGURE G-8. DIFFERENTIAL

1. Carrier
2. Pinion Bushing
3. Pinion
4. Cage
5. Bushing
6. Idler Gear
7. Ring Gear Mounting Surface

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 restriction, the greater the portion of engine power that is diverted to the opposite wheel.

The reason one wheel can pull up to 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 increases 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 prime mover 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 prime mover is turning, the differential pinion gears are meshed to both differential gears, and therefore act as compensators as well as linkage.

Removal and Disassembly

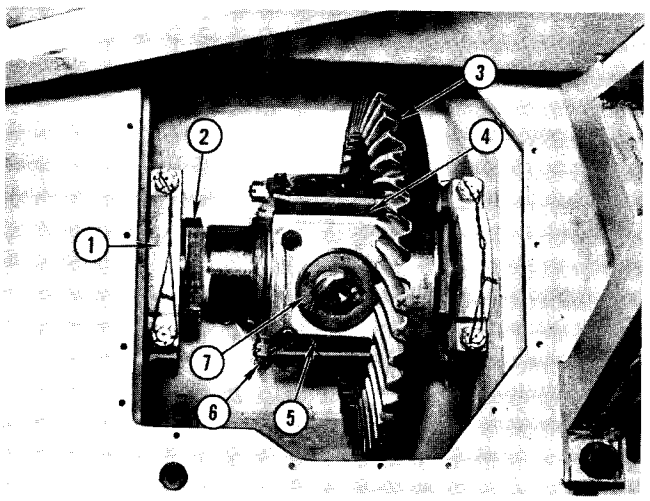


FIGURE G-9. RING GEAR AND DIFFERENTIAL

1. Bearing Cap
2. Adjusting Nut
3. Ring Gear
4. Differential
5. Bushing
6. Transmission Mounting Capscrews
7. Pinion Gear

Drain oil from final drive compartment. Remove fuel tank. Block up machine and remove both wheels and tires.

Remove air brake assemblies by removing mounting capscrews, with the exception of the center capscrews in the four groups of three. These four capscrews hold the brake assembly together so it may be removed as a unit. As a safety precaution, completely drain the air system before disconnecting air brake lines. Refer to section "H" for air brake disassembly.

Remove the three cover plates from rear of machine. Remove both final drive pinions.

Loosen lockbolt in each of the differential adjusting nuts. Back the adjusting nuts away from the bearings. Use the special adjusting nut wrench in the tool kit.

By reaching through the case openings, drive against ends of differential carrier bearing cups, with a brass drift. Drive bearings back (toward differential) until they are flush with ends of carrier.

Remove cotters from bearing cap nuts. Remove nuts and bearing caps. (Two nuts for each bearing cap.) Do not try to remove bearings as they will be removed with differential. Pull differential from case and place on bench or stand for further disassembly. As differential is being removed the bearing cups will come free. Do not allow them to fall and become damaged. See figure G-10.

Bearing cones may be removed from differential carrier by turning the adjusting nuts against the bearings, or by using a bearing puller.

Remove bearing cones and adjusting nuts. Make sure the lockbolts in adjusting nuts are loose only enough to permit nuts to turn freely.

Mark position of ring gear in relation to gear carrier, and positions of bushings and pinion gears

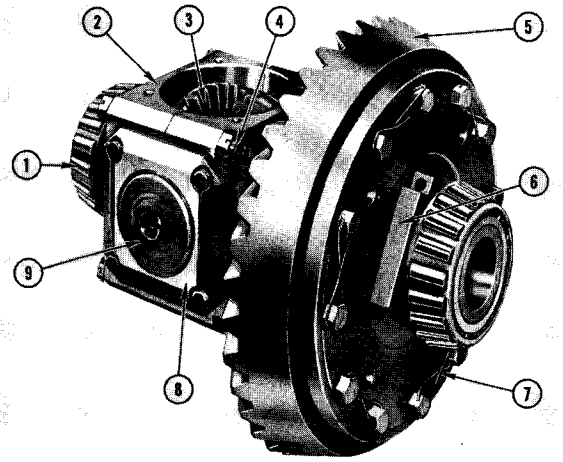


FIGURE G-10. DIFFERENTIAL, REMOVED

1. Bearing Cone
2. Differential Cage
3. Differential Gear
4. Body Fit Bolt
5. Ring Gear
6. Adjusting Nut
7. Lockwire
8. Bushing
9. Pinion Gear

in relation to the differential cage. Also mark the position of the two cage halves in relation to each other.

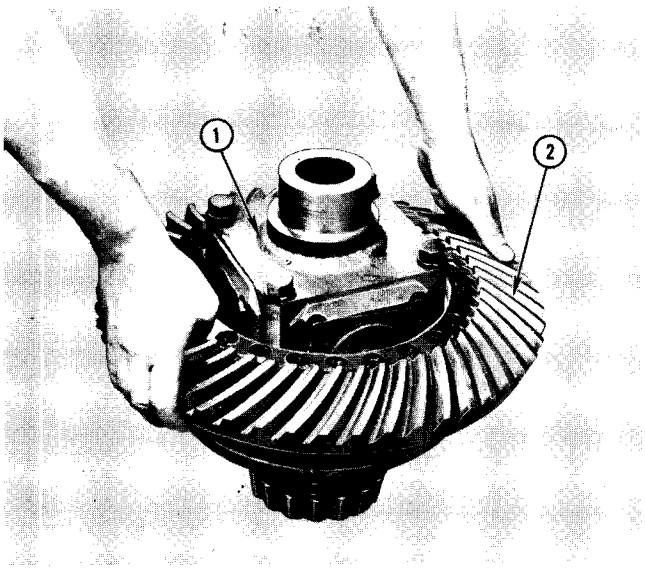


FIGURE G-11. REMOVING RING GEAR

1. Differential
2. Ring Gear

NOTE: Pinion gears and bushings may be removed without removing ring gear, or removing differential from case.

Cut the lockwires and remove the capscrews securing the ring gear to the differential. Lift ring gear from over differential. See figure G-11.

Cut the lockwires and remove the capscrews securing each of the pinion bushings to the differential cage. Keep shims (if any) grouped together with their respective pinion and bushing. Remove bushings, shims and pinions.

Remove cotter from each of the 8 nuts fastening the two differential cage sections together. Screw an expendable nut (3/4" x 16 NF) onto each of the four body fit bolts, on end of differential opposite ring gear. Screw nuts far enough onto threads to protect them. Proceed to alternately drive on the ends of the protected bolts. The shoulders in the center of the bolts will gradually drive the differential cages apart. This will expose the two differential idler gears.

Remove idler gears and pull or press gear bushings from cages. Use marks on housing, bushings and gears to insure reassembly in same position, unless replacement of parts is necessary.

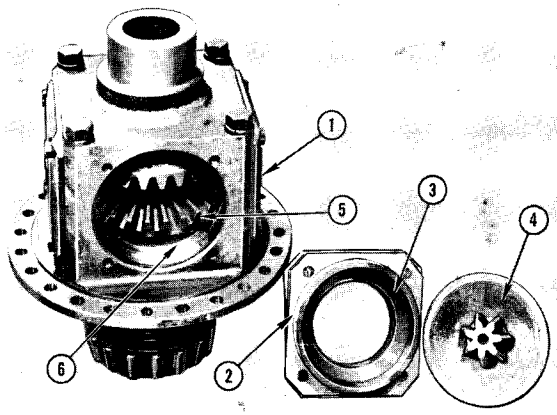


FIGURE G-12. PINION AND BUSHING REMOVED

1. Differential
2. Shims
3. Bushing
4. Pinion
5. Idler Gear
6. Idler Gear Bushing

Reassembly

Thoroughly clean all parts of the differential assembly. Check each part for wear or damage. Check idler and pinion gear teeth, Replace any part that shows evidence of excessive wear or damage. (Ring gear and transmission output pinion are replaceable as matched sets only.)

Replace idler gear bushings and gears into each section of the differential cage.

Put the two sections of the cage together (match marked surfaces) and secure with bolts and nuts. Do not tighten. Replace all four pinion bushings. Now tighten nuts to 190 ft. lbs. torque, and install cotters. Remove pinion bushings.

Lubricate pinion gears and bushings thoroughly with clean engine oil. Replace them in cage two at a time (on opposite sides). Secure bushings with flat washers and capscrews torqued to 150 ft. lbs.

Check the free play of each of the two pinions

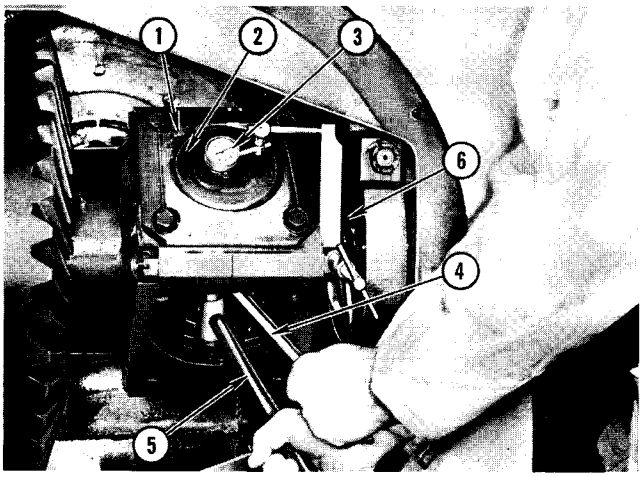


FIGURE G-13. MEASURING END PLAY

1. Bushing
2. Pinion Gear
3. Dial Indicator
4. Bar
5. Hammer
6. Adjusting Nuts

by fastening a dial indicator so it is positioned directly over the pinion. With the pinion down in bushing, set the indicator dial at "0" with the indicator button resting on the pinion. By using a bar as shown in figure G-13, raise the pinion up against the dial indicator as much as possible to determine the amount of free play present. It should be between 0.010" and 0.020". Shims may be added between the bushing and the differential cage to increase the amount of end play. Remove shims to decrease end play.

Now remove these two pinions and bushings and install the remaining two. Make the same check on them without revolving the idler gears. Each of the four readings should read the same or be within 0.002" of each other. SHIMMING MAY BE ACCOMPLISHED WITH DIFFERENTIAL IN OR OUT OF THE MACHINE.

Replace pinions, shims and bushings. Torque attaching capscrews to 150 ft. lbs., and install lockwires. NOTE: Lockwires are to be installed in same plane of rotation as the differential.

Position ring gear over differential. (Match mating marks.) Replace capscrews, torque to 400 ft. lbs. and install lockwires.

Thread adjusting nuts onto differential carrier shaft and replace bearing cones. Put nuts and bearings as close to the differential as possible to allow for installation.

Installation

Position bearing cups over bearing cones while still out of the case. Hoist differential into case with ring gear to the right. Make certain that ring gear teeth marked with "X's" are on each side of the output pinion tooth marked with an "X". Note the amount of backlash etched on the gear. Replace bearing cap, over bearing cups, into studs on main case. Replace nuts and torque to 600 ft. lbs. and install cotters.

Turn adjusting nuts against bearing cones until a 0.001" feeler gauge will not fit between the bearing cup and the bearing seat in the case wall. This can only be checked by reaching through the bores for the final drive pinions.

After the differential has been installed and mated with the spiral bevel pinion, the backlash must be checked and adjusted.

Remove cover plates and gaskets from top of main case and position a dial indicator on the case in such a manner that will allow placing the indicator button against the mating surface of a ring gear tooth. Set indicator dial at "0". Grasp ring gear and rotate it back and forth to determine the amount of backlash present. Backlash must be maintained within ±0.001" of the backlash marked on the pinion gear. Backlash at all other positions around the circumference of the ring gear must fall within a total variation of 0.004" from the backlash obtained between the marked teeth.

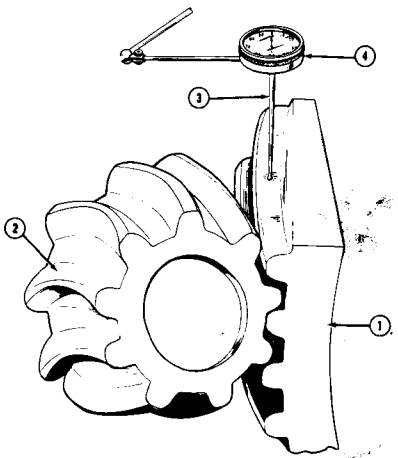


FIGURE G-14. INDICATING BACKLASH

1. Ring Gear
2. Pinion
3. Indicator
4. Dial

Check backlash at four points equidistant around the circumference of the ring gear.

To adjust the backlash, loosen the lockbolts in the differential adjusting nuts. Turn nuts in the direction desired. For example: to move the ring gear closer to the pinion, (decreasing backlash) the right hand adjusting nut must be moved away from the differential (toward bearing), and the left hand adjusting nut must be moved toward the differen-

tial (away from bearing). To move the ring gear away from the pinion, reverse the above procedure. Moving the ring gear away from the pinion will increase backlash.

When backlash adjustment has been made, it is then necessary to preload differential carrier bearings.

Turn adjusting nuts in against their respective bearings so that when a slightly wrinkled piece of 0.002" shim stock is rolled between the bearing's upper rollers it comes out free of wrinkles, but with no roller impression made on it. This will provide an approximate pre-load of 60 ft. lbs.

When pre-load has been obtained, recheck ring gear and pinion backlash, and readjust if necessary. Continue adjusting until both backlash and bearing pre-load are within the specified limits. Tighten adjusting nut lockbolts to 70 ft. lbs. torque.

Replace final drive pinions, brakes and other assemblies that have been removed.

Check tooth pattern by loading bevel gear set with wheel brakes and turning gears over with the engine.

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 figure G-15.

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 those in figure G-16, under full loaded conditions.

NOTE: 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 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.

Replace cover plates and gaskets. Fill compartment with correct level and type of lubricant. See Section K.

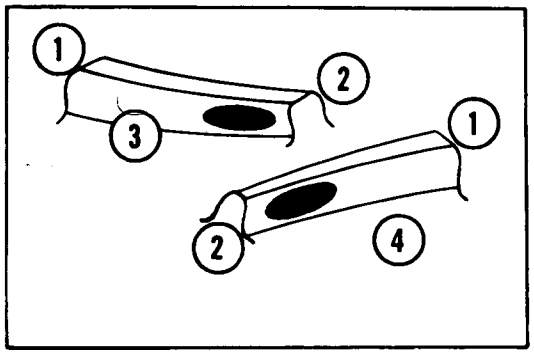


FIGURE G-15. RING GEAR TOOTH PATTERN, UNLOADED

1. Heel
2. Toe
3. Forward
4. Reverse

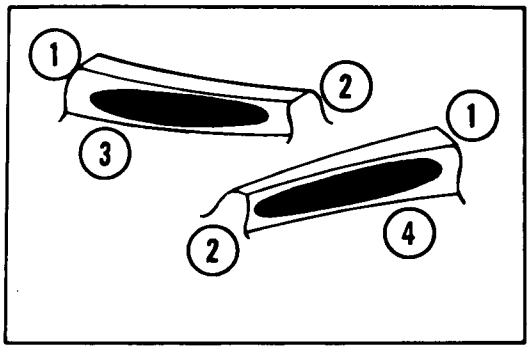


FIGURE G-16. RING GEAR TOOTH PATTERN, LOADED

1. Heel
2. Toe
3. Forward
4. Reverse

BRAKES, WHEELS AND TIRES

INDEX

BRAKES, WHEELS AND TIRES

BRAKES

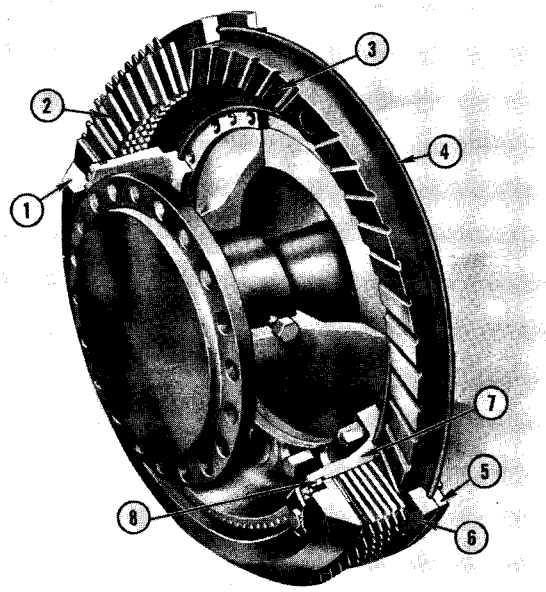


FIGURE H-1. AIR BRAKE, CUT AWAY

1. Backing Plate
2. Discs
3. Pressure Plate
4. Diaphragm
5. Diaphragm Backing Plate
6. Retainer Ring
7. Hub
8. Snap Ring

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 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.

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.

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 brake.

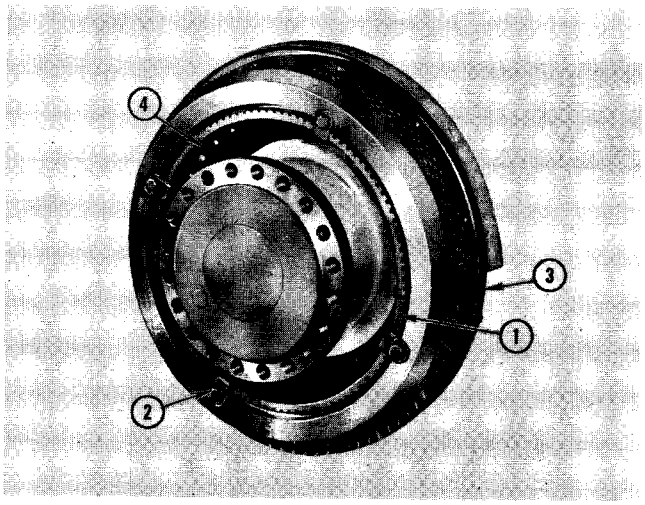


FIGURE H-2. BRAKE, MOUNTED

1. Snap Ring
2. Snap Ring Guard
3. Backing Plate
4. Hub

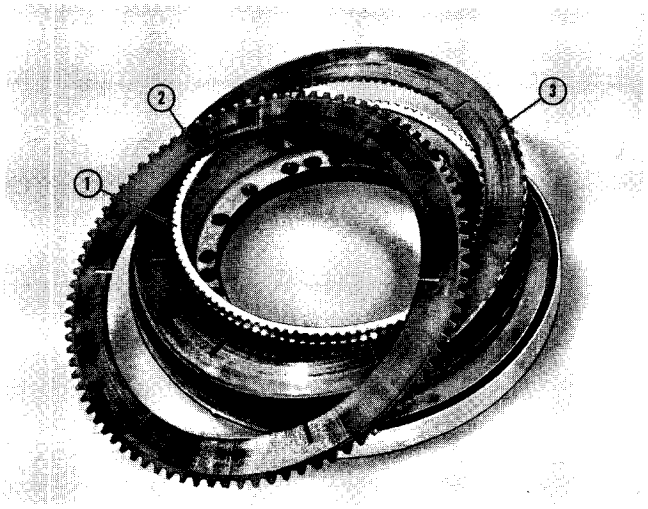


FIGURE H-3. REMOVING BRAKE DISCS

1. Brake Hub
2. Lined Disc
3. Steel Disc

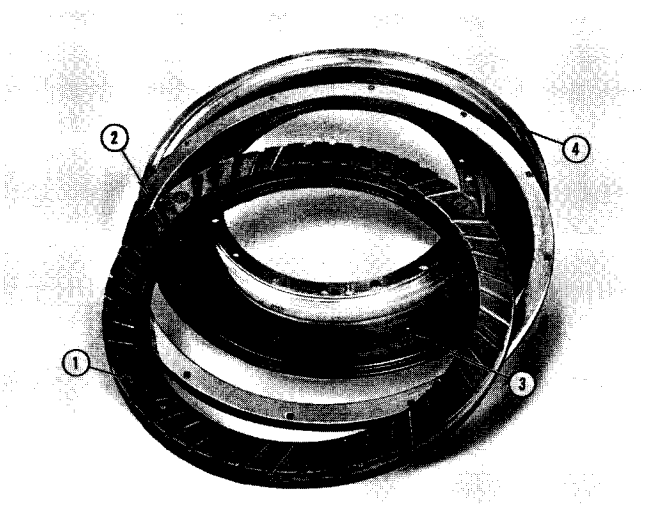


FIGURE H-5. REMOVING PRESSURE PLATE

1. Pressure Plate
2. Retainer Ring
3. Diaphragm
4. Back Plate

Cut the lockwires and remove the capscrews securing the snap ring guards around the circumference of the brake. See figure H-2.

Pry out snap ring, using bar or other suitable tool.

Remove the backing plate, lined and unlined discs from the hub. See 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. See figure H-4.

Remove springs and guide pins from hub.

Remove pressure plate. See 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. See figure H-6.

Separate the three units. Remove diaphragm from backing plate.

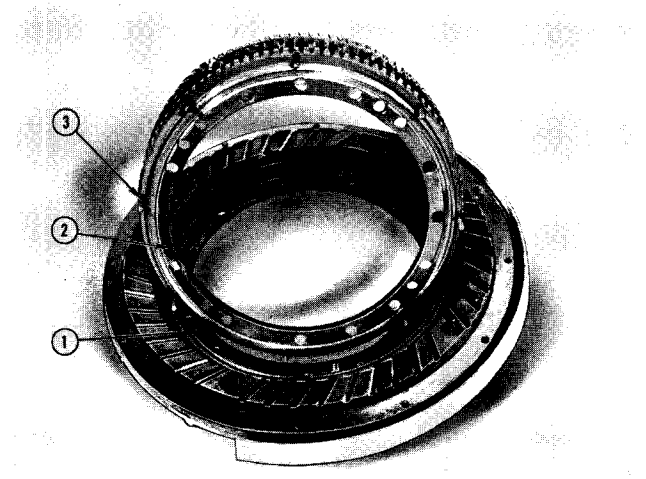


FIGURE H-4. REMOVING BRAKE HUB

1. Diaphragm Backing Plate
2. Brake Hub
3. Spring and Spring Guide

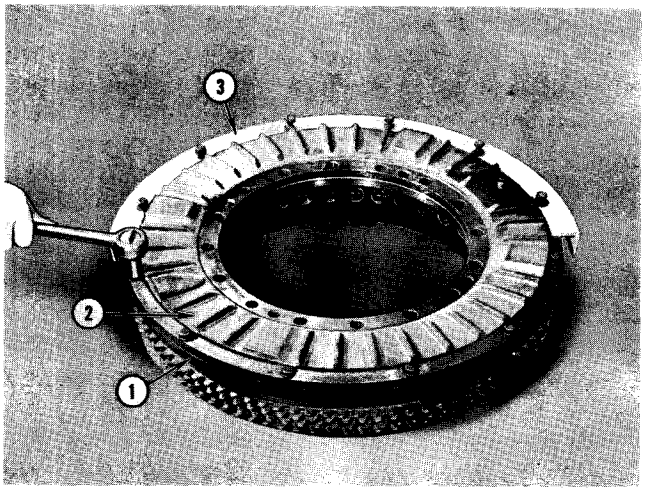


FIGURE H-6. SEPARATING BACK PLATE AND RETAINER

1. Retainer Ring
2. Backing Plate
3. Dust Guard

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 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 com-

pressed, broken or clogged lines.

In extremely cold weather, any moisture present in the air lines may freeze and impede flow of air. A moisture trap in the air system traps and retains the moisture as it leaves the air supply tank.

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. When replacing springs make sure they are the same color as the ones removed. Color indicates size, do not mix colors.

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 on the brake backing plate is in such a position that it can be connected to the air line from the quick release valve. (Holes or slots in the brake hub must be on top.)

Reconnect air line to brake actuating plate. Apply air pressure and check for air leaks.

Replace tire and wheel.

TIRES

The tires should be checked at least once each week (before operation) with an accurate tire pressure gauge.

Tire pressure 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:

24.00 - 25, 18 PR, traction ..... 35 p.s.i.
24.00 - 25, 24 PR, rock service ..... 45 p.s.i.
26.5 - 25, 26 PR, traction ..... 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 tire 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 fabric body plys, 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 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 Tires

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

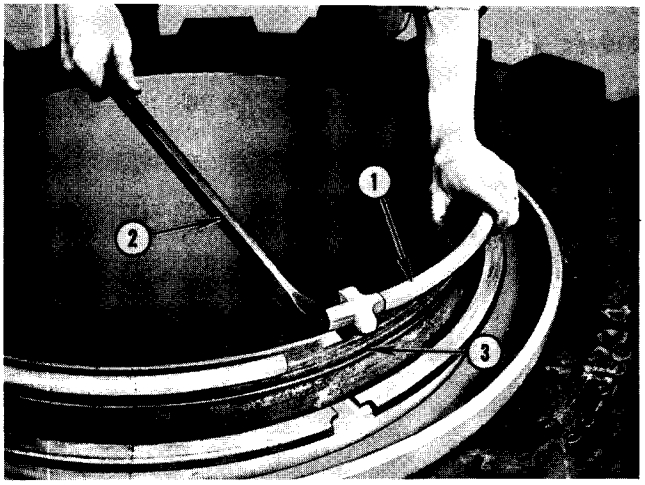


FIGURE H-7. REMOVING LOCK RING

1. Lock Ring
2. Tire Tool
3. "O" Ring

the machine to prevent falling if the jack should slip.

Attach sling hoist around tire, remove wheel mounting capscrews, and remove wheel and tire from machine.

See Section "M" for scraper wheel and axle removal procedures.

Remove valve core and exhaust air pressure before starting to dismount tire. Always replace the valve cap to protect the soft metal threads on the valve stem during tire removal.

The use of a hydraulic bead breaker is a "must". Use according to the tool manufacturer's recommendations.

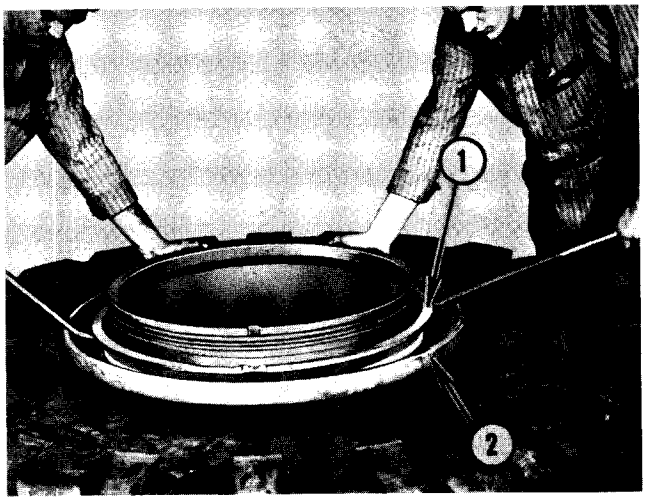


FIGURE H-8. REMOVING BEAD SEAT BAND

1. Bead Seat Band
2. Flange

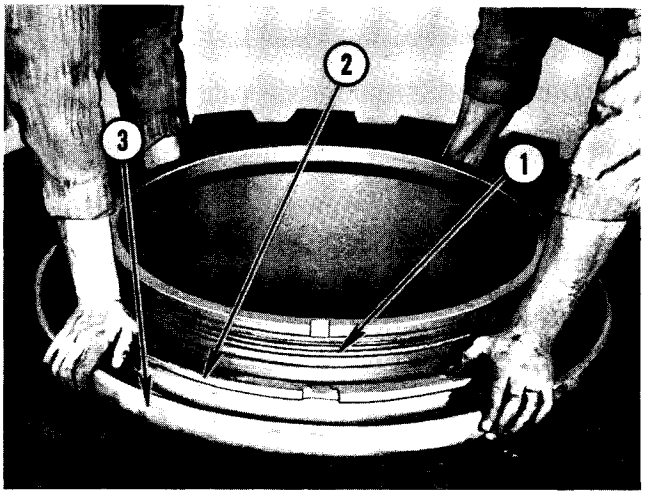


FIGURE H-9. REPLACING BEAD SEAT BAND

1. "O" Ring Groove
2. Bead Seat Band
3. Flange

Break outer bead loose from bead seat.

Insert flat end of tire tool into lock ring breaking notch and pry out lock ring. See figure H-9.

Remove "O" ring from rim base. Then remove the bead seat band and outer ring. Discard "O" ring as a new one must be used when remounting tire. See figure H-10.

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

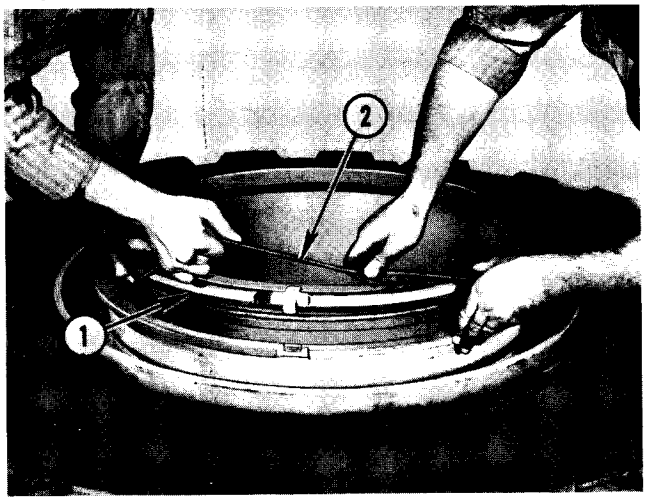


FIGURE H-10. REPLACING "O" RING

1. Lock Ring
2. "O" Ring

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 sling and lower into position.

Put top flange in place. Position bead seat on rim base being careful to line up lug in base with lug slot in bead seat band. See figure H-11.

Install lock ring and tap into place with babbitt or lead hammer. Lock ring MUST fit into gutter slot. Tap bead seat band down so that "O" ring groove is visible.

Insert new "O" ring in groove and lubricate with tire mounting compound or soap flake solution. See figure H-12.

If tire and wheel is not mounted on machine, turn it so that locking ring is down on the floor or ground.

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.

NOTE: NEVER START TO INFLATE A TAPERED BEAD TIRE UNLESS THE LOCK RING HAS BEEN PROPERLY INSTALLED. Stand to one side when inflating tire. Never stand directly over or in front of the lock ring when inflating.

As soon as sealing is effected, re-install 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 900 ft. lbs.

STEERING ASSEMBLY

INDEX

STEERING ASSEMBLY

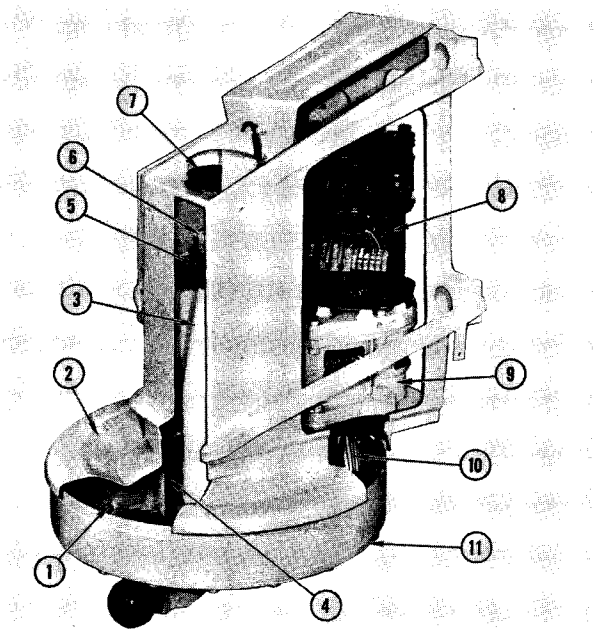


FIGURE I-1. STEERING ASSEMBLY

1. Steering Ring Gear
2. Kingpin Housing
3. Kingpin
4. Lower Bearing
5. Upper Bearing
6. Locknut
7. Limit Switch
8. Motor
9. Gear Box
10. Gear Box Pinion
11. Kingpin Flange

The principal parts of the steering assembly are: the kingpin housing, steering motor with gear reduction box, ring gear and kingpin.

The kingpin housing is bolted solidly to the trail unit yoke structure by four bolts. 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 tapered 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 motor gear box, are in mesh with the teeth on the ring gear.

When the electric motor is operated, the pinion gear rotates, turning the ring gear right or left depending upon the direction of rotation of the motor. Ring gear, kingpin and prime mover turn together as a unit since they are all interconnected.

The steering switch on the instrument panel automatically returns to the off position when released, locking the prime mover at whatever angle it makes with the trail unit at that instant. The locking effect comes about through the steering motor brake which stops and holds the rotation of the motor rotor and gear box pinion as soon as the current to the motor is shut off. The precision fit of the entire chain of gears from the steering motor to the steering ring gear prevents any free play or slack in the prime mover with the steering motor brake applied.

The degree of turning in either direction is controlled by limit switches inside the kingpin housing. These switches can be set for turns of any angle up to approximately 90 degrees, right and left from the straight ahead position. See page K-13 for adjustment procedure.

REMOVAL

Disconnect all conductor cables to the main switch boxes mounted on the steering trunnion assembly. Remove cable clamps from cable and remove cable. Disconnect all hoses and tubing that lead back to the trail unit. Bleed the air system completely before performing this operation.

Position blocks to hold the trunnion assembly firmly in an upright position.

Crib up nose of Tournapull and block wheels, fore and aft.

Attach sling hoist to the trail unit yoke. Take up slack until the tension is relieved on the connecting bolts.

Remove the cotter pins from the two upper yoke nuts. With special wrench, provided in tool kit, remove the four hitch bolts securing the Tournapull to the trail unit. The upper hitch bolts have nuts on them while the lower hitch bolts are threaded

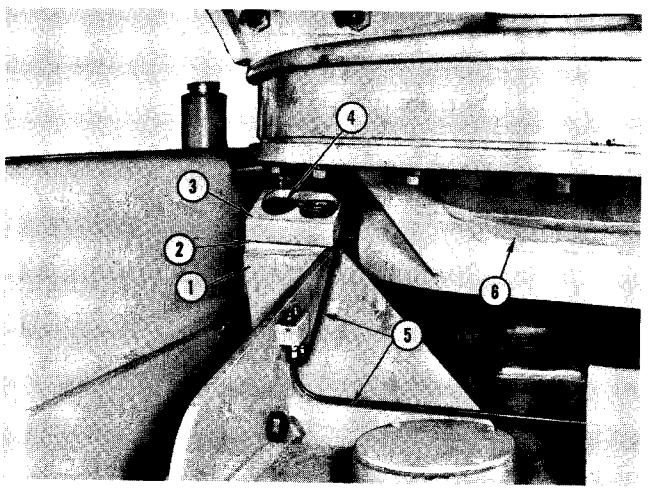


FIGURE I-2. REAR TRUNNION CAP

1. Socket
2. Shims
3. Cap
4. Capscrews
5. Grease Tubes
6. Steering Trunnion

directly into the trail unit yoke. Separate the two units.

Attach hoist to the steering trunnion assembly. Remove grease tubes from the trunnion caps.

Cut lockwires and remove the capscrews securing the front and rear trunnion caps to the trunnion sockets, remove caps. Lift trunnion assembly from the Tournapull. Lower unit to floor or place on stand for further disassembly.

Remove the shims and bearing inserts from the trunnion sockets and caps. Keep the shims together as they were removed, as they should be replaced when reassembling the steering trunnion.

DISASSEMBLY

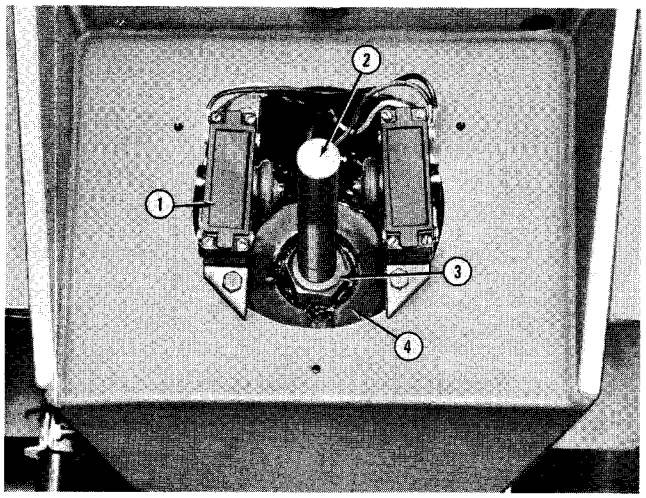


FIGURE I-3. STEERING LIMIT SWITCHES

1. Limit Switch
2. Cam
3. Jam Nut
4. Split Nut

Release cover latch and remove cover. Remove the limit switch housing cap and gasket, disconnect the leads to the limit switches. Then remove the limit switches after backing off the capscrews clamping the switches to the mounting plate in the top of the kingpin housing.

Remove the limit switch cam by loosening the cam shaft jam nut and backing cam shaft out of threaded hole in top of kingpin. See figure I-3.

Loosen capscrew and nut locking split nut on threaded end of kingpin. Drive a chisel, or similar tool, into the slot in the split nut, and then back nut from threads on kingpin. Spread nut only enough to allow backing off of nut without undue force. See figure I-4.

Attach hoist to kingpin housing. Lift kingpin housing, electric motor, and gear box from kingpin. Upper bearing cone, bearing cup, and seal will be removed with the housing. Lower bearing cone will remain in position on the kingpin. Lift straight up to prevent damaging gear box output pinion.

Remove upper and lower bearing cups and seal from the bores in the kingpin housing.

Remove lower bearing cone from the kingpin.

Loosen the setscrews against the side of the steering gear box. See figure I-6.

Remove the gear box mounting bolts and hold down lugs at front of gear box. The front and rear mounting bolts are accessible through openings in the side of the kingpin housing.

Hoist the electric motor and gear box out of the housing. The steering motor and gear box may be removed without disassembling the steering trunnion. Refer to section "J" of this manual for electric motor and gear box removal and disassembly.

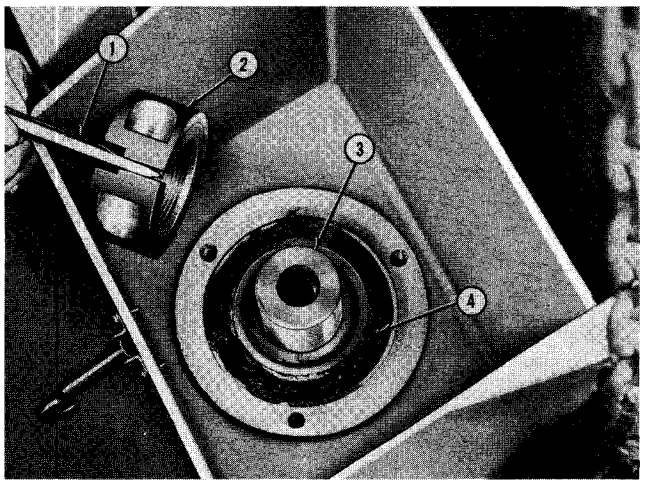


FIGURE I-4. REMOVING SPLIT NUT

1. Chisel
2. Split Nut
3. Kingpin
4. Bearing

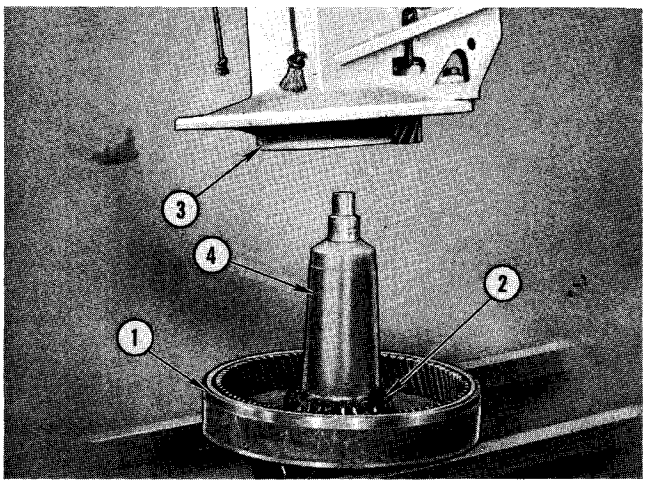


FIGURE I-5. REMOVING KINGPIN HOUSING

1. Ring Gear
2. Bearing Cone
3. Housing
4. Kingpin

To separate the steering gear and kingpin, cut the lockwires (if present) and remove the capscrews securing the steering gear to the kingpin flange. See figure I-6.

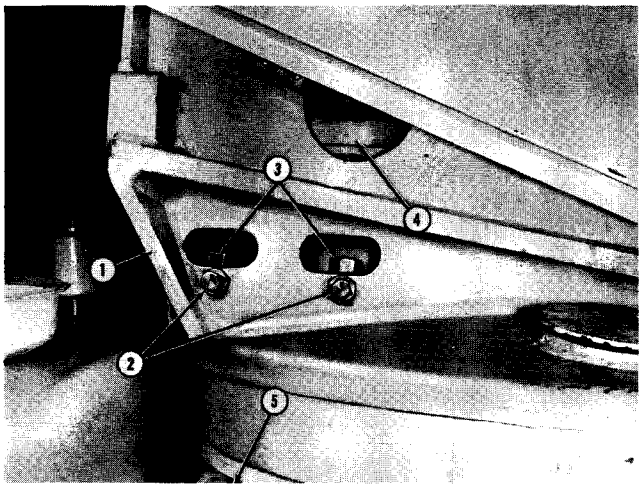


FIGURE I-6. GEAR BOX MOUNTING

1. Kingpin Housing
2. Setscrews
3. Gear Box Mounting Capscrews
4. Gear Box
5. Ring Gear Capscrews

The steering trunnion may be disassembled while still mounted on the Tournapull. Follow the instructions above with the exception of removing the trunnion caps and lifting the unit from the machine.

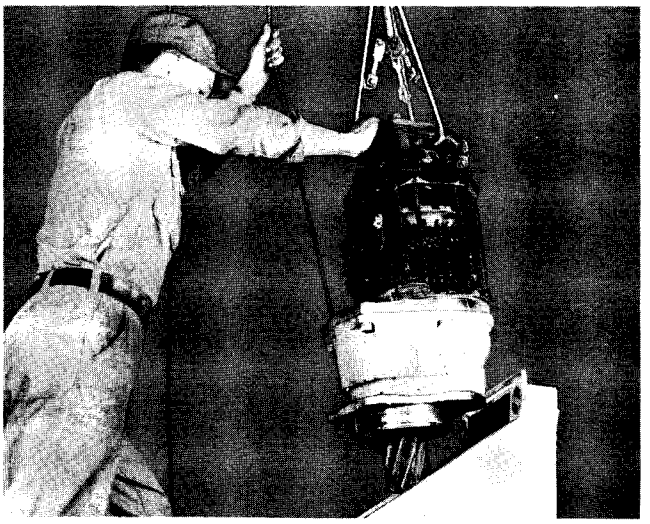


FIGURE I-7. REMOVING MOTOR AND GEAR BOX

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 the seal's condition is such that it will cause leaks.

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 troubles.

Place coat of Permatex on kingpin flange. Install ring gear on flange. Replace capscrews. The eight flathead capscrews and tapered collars are to be placed at the rear of the steering gear, starting at the rear place and equal amount of each side. Replace the ten taperhead capscrews at the front. Torque taperhead capscrews to 600 ft. lbs., and flathead capscrews to 400 ft. lbs. Install lockwires, wire in pairs.

Later machines will not have flathead capscrews and collars. The ring gear will be mounted with 18 taperhead capscrews. Torque to 600 ft. lbs. and

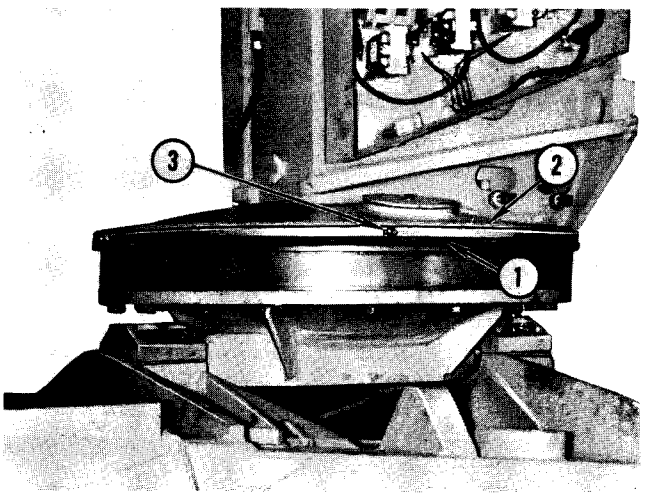


FIGURE I-8. DUST SEAL

1. Extrusion
2. Flange
3. Clamp

wires in pairs (if heads of capscrews are drilled).

If neoprene seal between ring gear and kingpin housing must be replaced, scrape off old one and replace.

To install seal ring, clean rim of ring gear with naphtha, apply a coat of "rubber to metal cement" to the ring gear and seal ring. Let dry until tacky. Press the seal ring onto the ring gear, and let dry overnight, under pressure.

Grease gear rim to lubricate rubber seal ring before assembling housing onto it.

Later machines will be equipped with sealing

extrusion and clamp ring in place of the neoprene seal. To replace seal, fit it over the lip of the kingpin housing so the three sealing ridges are against the outside of the ring gear. Position so that the split joint is at an angle of approximately 90° with the gear box pinion. Place clamp over seal. Locate the worm drive on the clamp approximately 1" from the seal joint. Tighten clamp ring. See figure I-8.

Replace spacer and lower bearing cone on kingpin. Fill cavity with wheel bearing grease to a level approximately 1" above bottom of ring gear. Install bearing cup in lower bore of kingpin housing. Place housing in position over kingpin.

Position upper bearing cup in housing. Replace oil seal and upper bearing cone. Lip of seal should be toward top of housing.

Replace split bearing retainer nut and lockbolt. Adjust to 600 ft. lbs. torque, and tighten lockbolt. Loosen lockbolt, re-tighten bearing nut to 600 ft. lbs. then tighten lockbolt.

Replace steering cam shaft in threaded hole in top of kingpin and tighten jam nut. Install limit switches. (Position of limit switches and cam can be adjusted after machine is in operating condition and degree of turn can be checked. See Section "K".)

Install motor and gear box in housing. Secure with mounting capscrews and setscrews. Replace hold down lugs.

Inspect rubber seals in ball joint caps and sockets. Replace if necessary. Glue seal in the groove in cap or socket and trim so that approximately 1/4" of seal protrudes above face of cap or socket.

Replace insert bushings in trunnion sockets and caps. The bushing must fit without any rocking motion. See figure I-9.

Hoist trunnion assembly onto machine. Assemble cap and insert over front ball as follows: Tighten each capscrew to 540 ft. lbs. torque making sure the space between socket and cap at each capscrew is equal (within 0.005").

Check space between cap and socket as near center on both sides as possible with feeler gauge. To this dimension add 0.010" to obtain the thickness of the shim stack to be placed between the socket and cap.

Remove cap and coat ball and socket with No. 250 E.P. oil, and position shims. Replace cap and capscrews. Leave capscrews loose.

Repeat the same procedure for the rear trunnion joint.

Then tighten all capscrews to 900 ft. lbs. Replace lockwires.

Replace grease tubes. Lubricate steering trunnion assembly as outlined in section "K" of this manual.

Reconnect trail unit to trunnion. Torque mounting bolts to 1400 ft. lbs. Install cotters in the top hitch bolt nuts.

Reconnect wiring, cables and tubing which were disconnected.

Complete reassembly of machine. See page K-13 for steering limit switch adjustment.

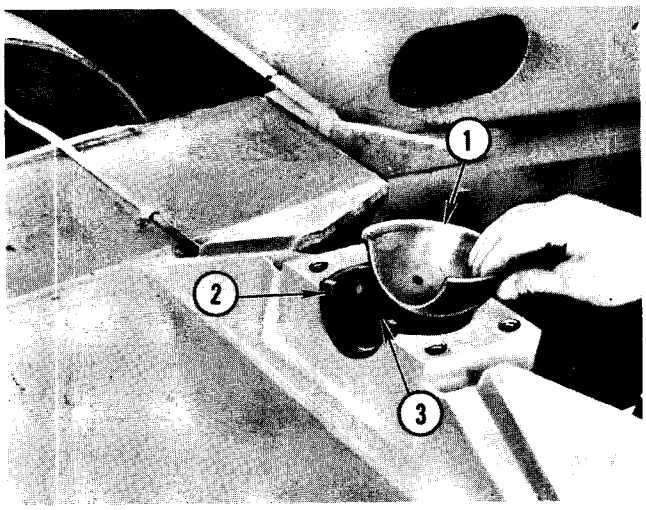


FIGURE I-9. REPLACING INSERT

1. Insert
2. Oil Seal
3. Socket

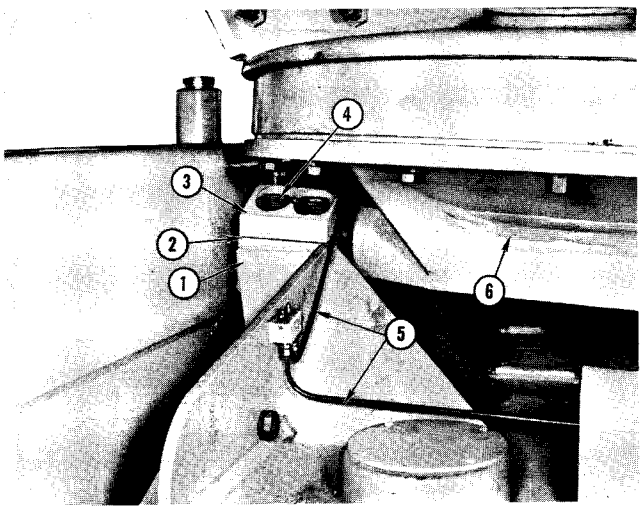


FIGURE I-10. TRUNNION CAP

1. Socket
2. Shims
3. Cap
4. Capscrews
5. Grease Tubes
6. Steering Trunnion

ELECTRIC MOTOR, GEAR BOXES AND SWITCHES

INDEX

ELECTRIC MOTOR, GEAR BOXES AND SWITCHES

ELECTRIC MOTOR

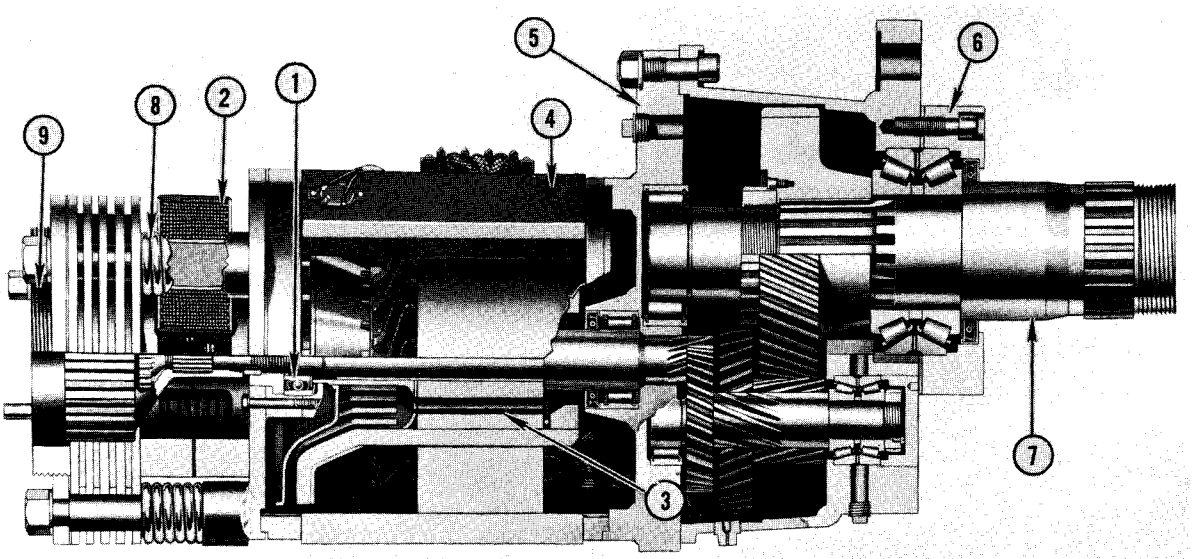


FIGURE J-1. A.C. ELECTRIC MOTOR AND GEAR BOX

1. Motor Bearing
2. Holding Coil
3. Rotor
4. Stator
5. Gear Box
6. Bearing Retainer
7. Output Shaft
8. Brake Release Spring
9. Adjusting Ring

Operation

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.

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, electromagnetic 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 counterclockwise 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 windings.

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

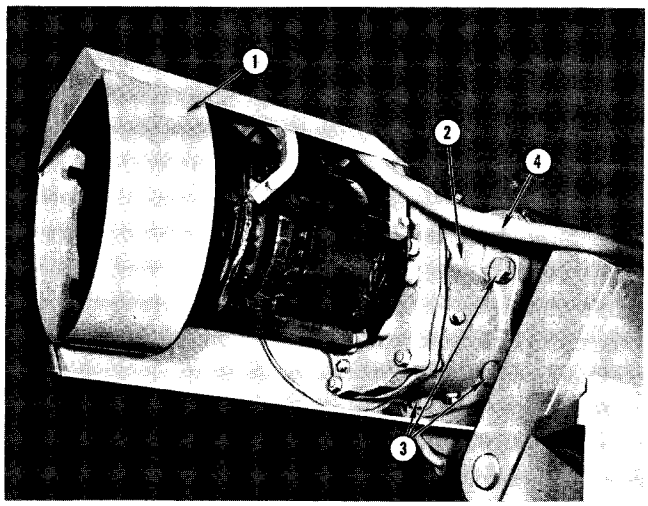


FIGURE J-2. MOTOR, GEAR BOX AND COVER

1. Cover
2. Gear Box
3. Mounting Bolts
4. Conductor Cables

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. Remove motor cover.

Disconnect all wires leading to the motor terminal strips and mark for easy reconnecting.

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 and lockwashers. Be careful not to damage motor windings with wrench.

Pull motor straight away from gear box until motor pinion clears the gear box bore. Take care not to damage the oil seal in the gear box, if equipped, or the motor pinion.

Place on bench for further disassembly. Cover opening in gear box to prevent entrance of foreign material.

It will be necessary to remove the steering motor and gear box as a unit (refer to section "I"). Follow the above instructions for separating motor and gear box.

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 setscrew from brake hub nut, loosen and remove nut.

Loosen the nut on the lock bolt which locks the adjusting ring in position and unscrew the adjusting ring from the brake plate.

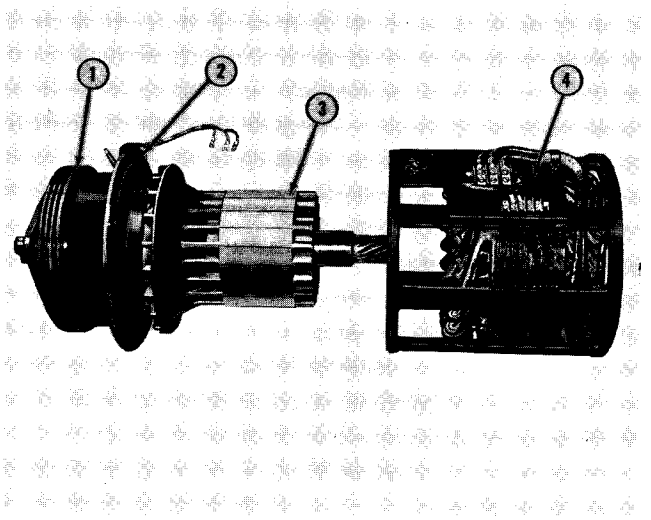


FIGURE J-3. ROTOR AND BRAKES, REMOVED

1. Brake
2. End Bell
3. Rotor
4. Stator

Remove the three stud nuts and lockwashers, then the brake plate, stationary plates and revolving discs (Fig. J-4).

Remove the brake hub locking nut, brake hub, floating plate and coil springs.

Remove the bearing retainer capscrews and lift off the end bell from rotor.

If coils are damaged, or should for some reason need to be removed, remove hold down screws

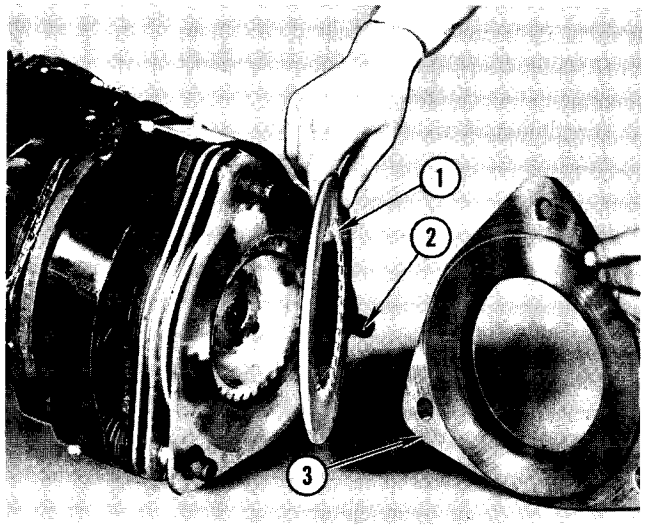


FIGURE J-4. REMOVING BRAKE PLATE AND DISCS

1. Disc
2. Stud
3. Brake Plate

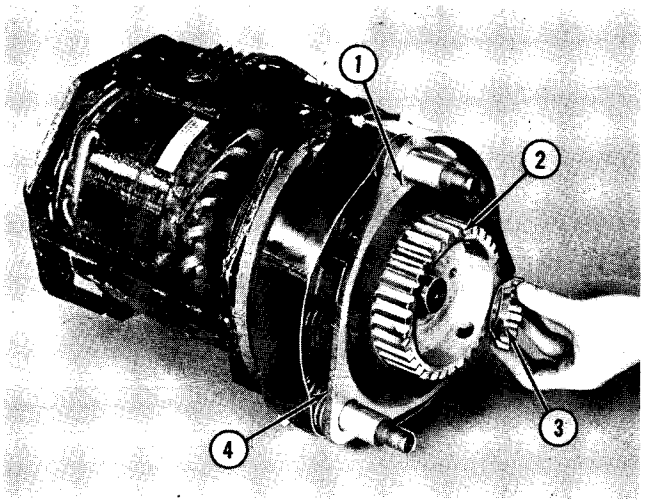


FIGURE J-5. REMOVING BRAKE HUB LOCKNUT

1. Floating Plate
2. Brake Hub
3. Locknut
4. Spring

clamping the coils to the top end bell and remove the brake coils.

Remove the bearing retainer locknut. 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-use of the nut.

Using the special wrench provided with the machine, remove the retainer nut. Pull outer and inner seal rings, bearing and retainer from the rotor shaft.

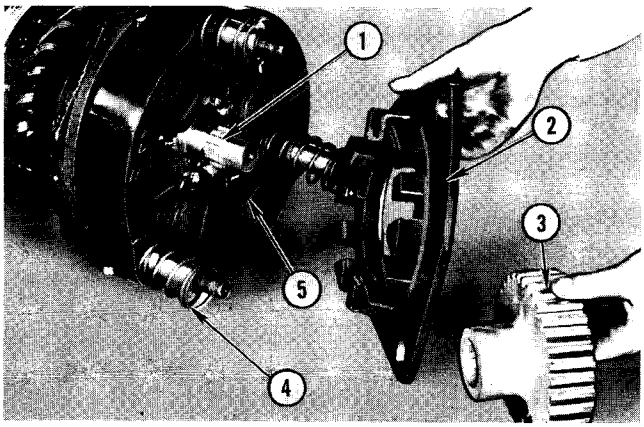


FIGURE J-6. HUB AND FLOATING PLATE, REMOVED

1. Rotor Shaft
2. Floating Plate
3. Hub
4. Spring
5. Brake Coil

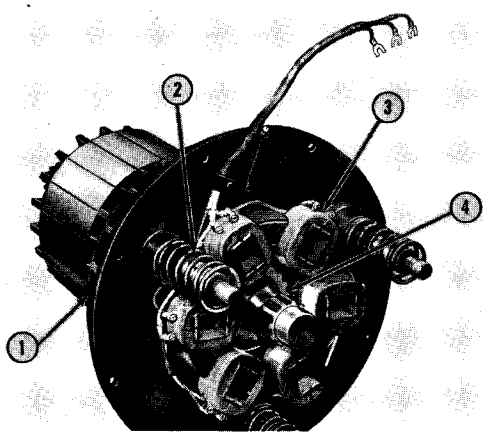


FIGURE J-7. TOP END BELL

1. End Bell
2. Spring
3. Brake Coil
4. Locknut

Reassembly

Replace inner and outer seal rings, oil seal, bearing retainer and bearing. Replace seal and bearing retainer locknut; 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.

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.

Alternately install revolving discs and stationary plates, starting with a revolving disc. Install brake plate over last stationary plate. Screw adjusting ring into brake plate.

Replace washers and nuts on studs.

Adjust brake as described in section "K" and tighten lock bolts.

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 any of the gear box mounting capscrews. Either remove the motor separately as described previously or remove motor and gear box as a unit. Remove the gear box mounting capscrews. Pull motor and gear box straight away from mounting shaft to prevent damaging oil seal or output shaft.

Separate motor and gear box (refer to page J-3).

The steering motor and 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 clamp on the motor stator.

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. Also remove gear box hold down lugs at front of gear box. 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 as described previously.

Disassembly

Disassembly of steering and trail unit gear boxes is identical, except for the output shaft bearing retainer.

For steering gear box, use the following procedure. Drive out roll pins and remove the drilled head capscrews fastening the output shaft bearing retainer to the gear box. Remove retainer, "O" ring and gasket. Remove "O" ring from around retainer.

For trail unit gear boxes, use the following procedure. Remove capscrews and washers fastening output shaft bearing retainer to gear box. Remove retainer and gasket.

Remove the capscrews, lockwashers and nuts fastening the face plate to the gear box. Remove face plate and gasket. Note the bearings in the plate (Fig. J-8). Use puller to remove them. Remove rotor shaft oil seal and bearing at the same time.

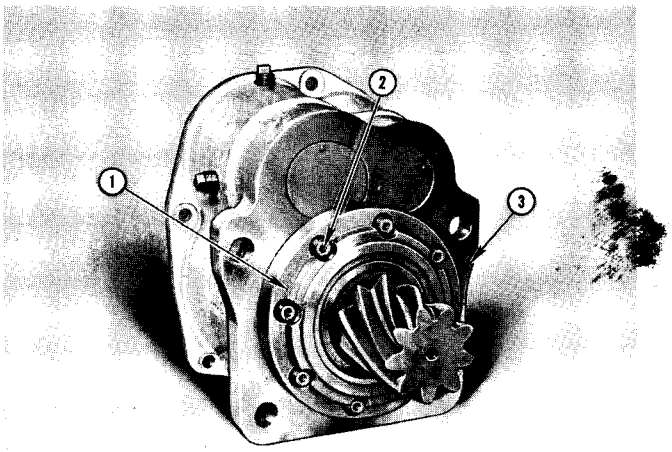


FIGURE J-9. BEARING RETAINER

1. Retainer
2. Capscrews
3. Case

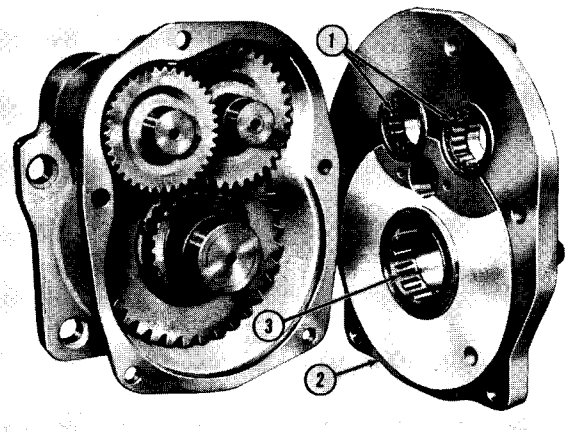


FIGURE J-8. FACE PLATE, REMOVED

1. Bearing
2. Face Plate
3. Output Shaft Bearing

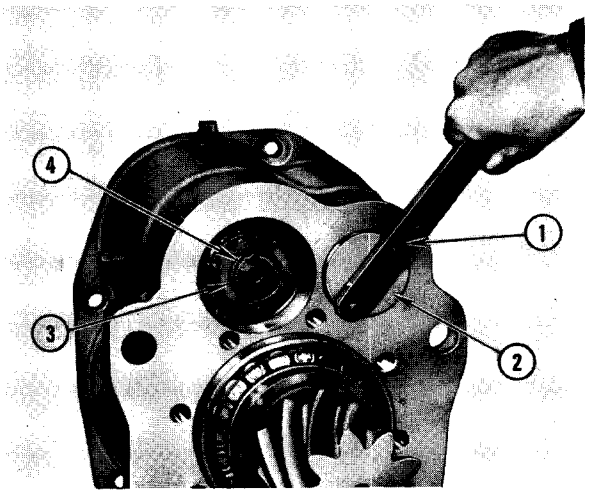


FIGURE J-10. REMOVING BEARING CAP

1. Wrench
2. Bearing Cap
3. Setscrew
4. Locknut

Remove the setscrews from first and second reduction gear bearing caps. With spanner wrench (provided in tool kit) remove bearing caps (Fig. J-10). Remove locking setscrews from locknuts and remove locknuts with wrench provided in tool kit.

Pull first and second reduction gears from gear box case. Remove locking setscrew from output shaft locknut and remove locknut. See figure J-11.

Drive output shaft from final reduction gear and gear box case. Remove gear from inside case. Use a soft hammer or brass drift to drive out shaft.

Remove first and second reduction gear outer bearings from case (if not removed with gears).

Pull bearing and oil seal from output shaft.

For steering gear box output shaft, pull bearing, remove "O" ring from between bearing and seal ring then pull seal ring from shaft.

Remove oil seal from retainer.

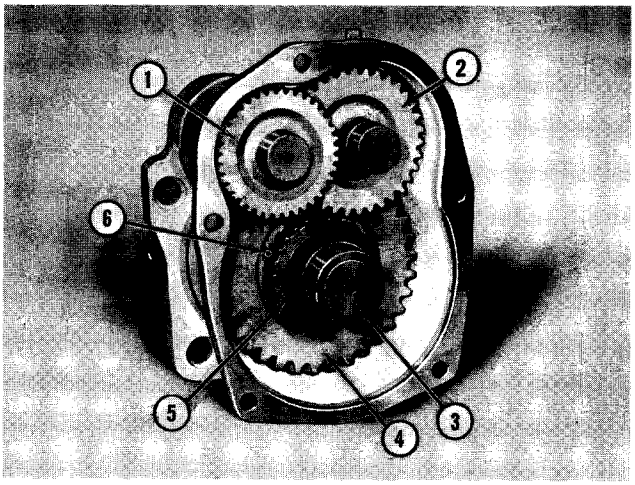


FIGURE J-11. GEAR BOX REDUCTION GEARS

1. First Reduction Gear
2. Second Reduction Gear
3. Output Shaft
4. Output Gear
5. Locknut
6. Setscrew

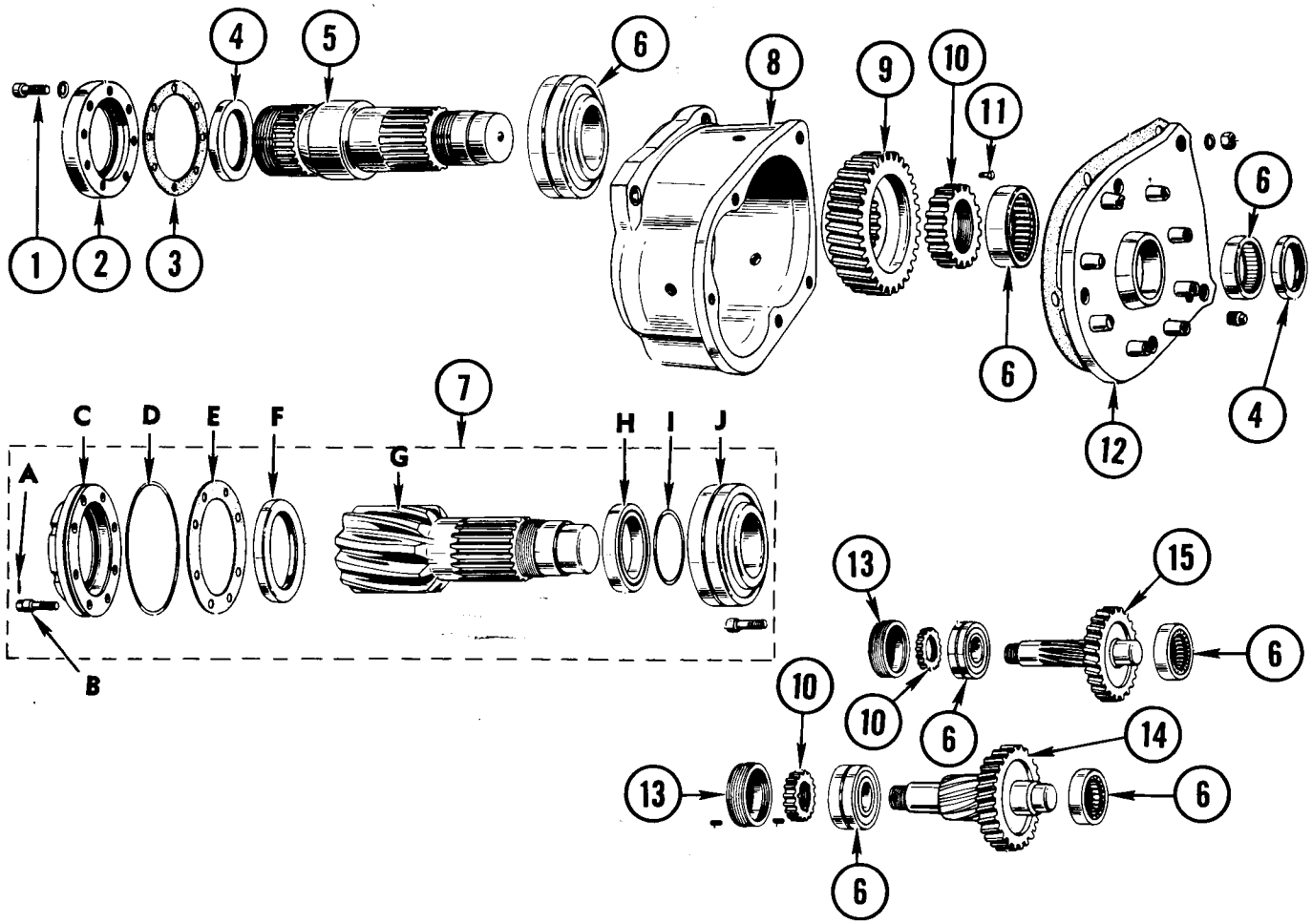


FIGURE J-12. GEAR BOX, EXPLODED

1. Capscrew
2. Bearing Retainer
3. Gasket
4. Oil Seal
5. Output Shaft
6. Bearing
7. For Use With Steering Gear Box Only
   - A. Roll Pin
   - B. Capscrew
   - C. Bearing Retainer
   - D. "O" Ring
   - E. Gasket
   - F. Oil Seal
   - G. Output Shaft
   - H. Seal Ring
   - I. "O" Ring
   - J. Bearing
8. Case
9. Output Gear
10. Locknut
11. Setscrew
12. Face Plate
13. Bearing Cap
14. 2nd Reduction Gear
15. 1st Reduction Gear

Reassembly

Carefully check all gear teeth for damage. Wash and check all bearings and replace those damaged. Clean gear box and all parts thoroughly before beginning reassembly.

Check oil seals for dryness, hardness, or excessive wear. Replace if damaged or if condition of seal is such that it will leak. Replace "O" rings with new ones.

Bearings may be heated in oil to 250° F. to facilitate reassembly.

For steering gear box, press oil seal ring onto output shaft with groove for "O" ring facing threaded end of shaft. Lubricate "O" ring with a good grade cup grease and position in groove, then press bearing into place.

For trail unit gear box, press bearing onto output shaft.

Install output shaft bearing and oil seal into face plate. Press first and second reduction gear bearings into blind bores in face plate.

Install output shaft into case by pressing bearing into large bore in case. Position output gear over the splines on shaft, thread locknut onto shaft and tighten to 2000 ft. lbs. torque. Install locking setscrew in face of gear and between splines on the locknut.

Press bearing cones on first and second reduction gear shafts. Press bearing cups into bores in case. Install second reduction gear, then first reduction gear, into case.

Slide spacers on gear shafts, install the outer bearing cones, thread bearing locknuts onto gear shaft and tighten locknuts. Tighten first reduction gear locknut to 100 ft. lbs. torque and second reduction gear locknut to 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.

Permatex threads of bearing retainer plugs, install in bore in case and tighten first reduction gear bearing plug to 100 ft. lbs. and second reduction gear bearing plug to 200 ft. lbs. torque.

Press oil seal into bearing retainer. Install bearing retainer and gasket. Secure with capscrews and copper washers, or with drilled head capscrews and roll pins, whichever the case may be.

Install "O" ring around retainer for steering gear boxes.

Secure motor to gear box, and install on machine. Fill with required amount and type of lubricant. See Section "K".

NO. 5 GEAR UNIT

Removal and Disassembly

Disconnect and remove wire rope from wire rope drum. Disconnect leads from electric motor terminal strips. Fasten chain hoist about the body hoist unit and remove bolts securing it to the rear dump yoke. Hoist assembly from yoke and lower to floor for further disassembly.

Remove motor and gear box from gear unit as described under "Gear Box Removal".

Remove the cover plate and gasket from rear of gear unit case.

Remove the setscrew locking the gear unit axle bearing retainer cap in position. Using the special

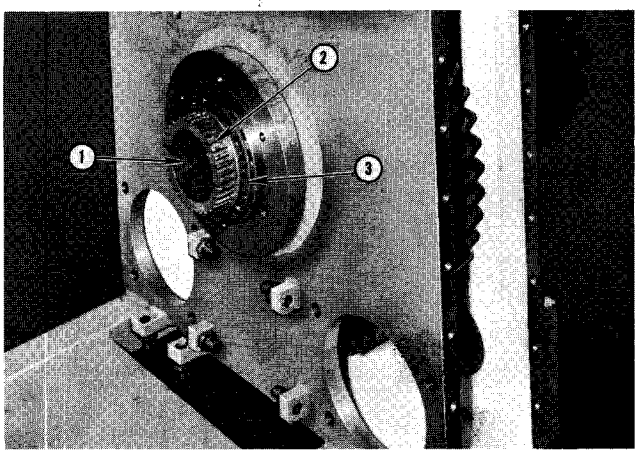


FIGURE J-13. RETAINER CAP REMOVED

1. Axle
2. Locknut
3. Bearing

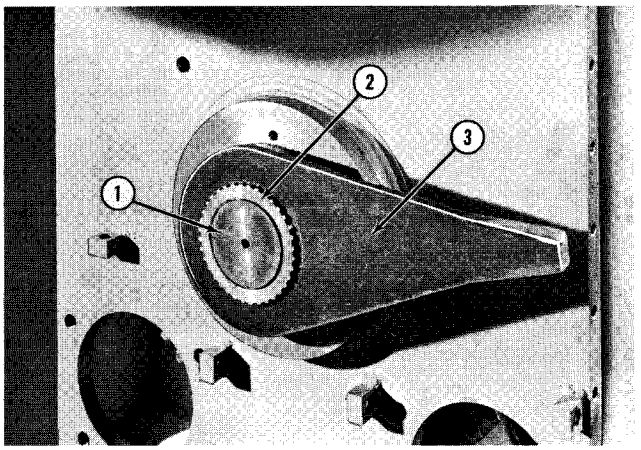


FIGURE J-14. REMOVING LOCKNUT

1. Axle
2. Locknut
3. Wrench

wrench, adaptor and handle provided with the machine, remove the retainer cap.

Remove the cotter from axle nut. Block the drive gear inside the case to prevent its turning, and remove the axle nut. See figure J-13.

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. If available a special puller may be used to remove 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 cable 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 axle and cable drum are withdrawn. See figure J-15.

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.

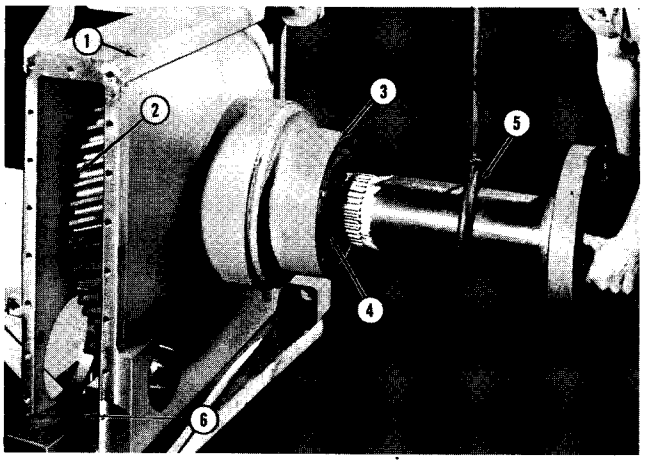


FIGURE J-15. REMOVING AXLE

1. Case
2. Drive Gear
3. Retainer
4. Oil Seal
5. Axle
6. Blocks

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.

Reassembly

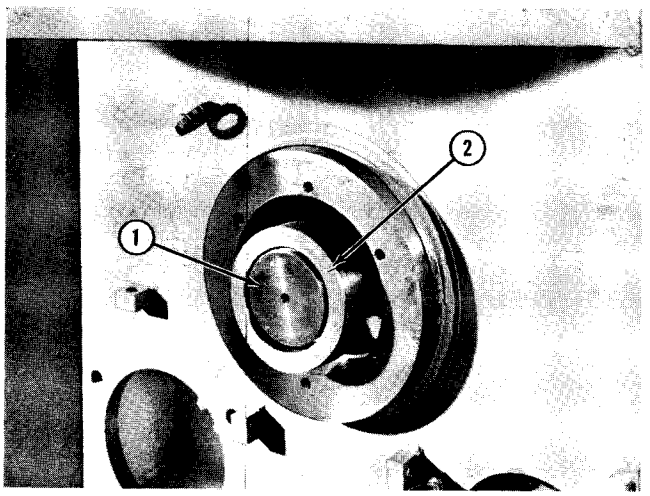


FIGURE J-16. AXLE, REPLACED

1. Axle
2. Tapered Sleeve

Inspect the oil seals. Make certain they have not become hardened, checked, or cracked and that the sealing surface has not become worn by abrasive action from external sources, such as dust or sand.

Check bearing for serviceability. Replace bearings which have become pitted, brinelled or excessively worn.

Inspect gear and shaft structures. 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 can be inserted and tightened.

Install inner ball bearing.

Install oil seal. Roll gear into case and insert axle into case bore through gear, collar and ball bearing. Thread axle nut onto axle and torque to 8000 ft. lbs. Install and lock cotter.

Replace bearing retainer cap and torque to 200 ft. lbs.

SWITCHES

Fingertip Control Switch

The control switches which operate the a.c. electric motors are remote controlled by fingertip operated control switches. These switches are mounted on the instrument panel in the cockpit.

Each fingertip control has two individual switches mounted to a single frame, one for each direction of motor rotation. The switches are operated by the lever arm which protrudes through the instrument panel.

A fingertip control switch in the released position does not have current flowing through it. When a switch is closed, the control circuit energizes the holding coil of the corresponding main switch. The main switch then closes and the a.c. motor will operate.

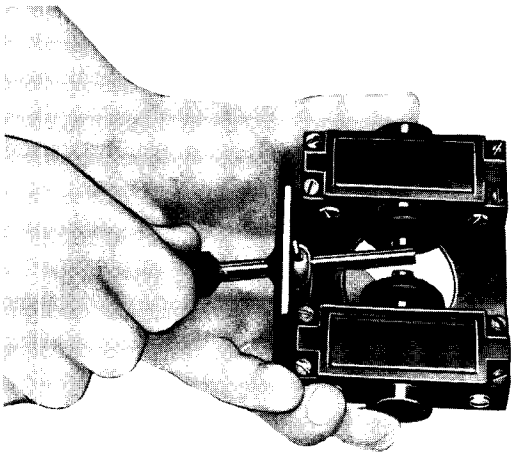


FIGURE J-17. FINGERTIP CONTROL SWITCH

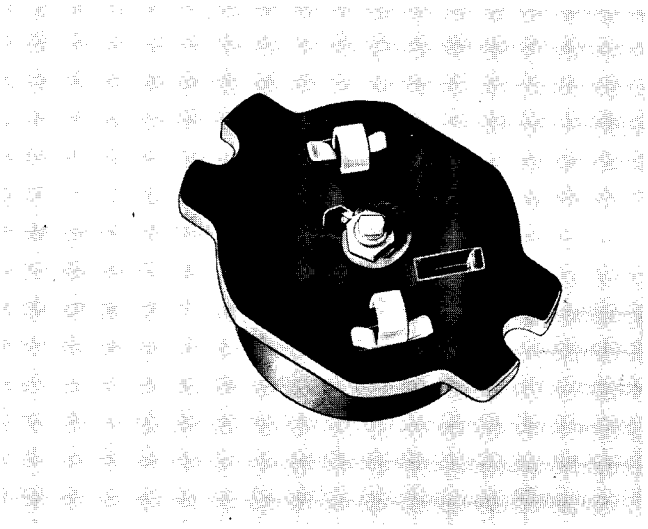


FIGURE J-18. HEAT CONTROL SWITCH

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. If light goes off, stop machine, locate and correct trouble before resuming operation.

Limit Switch

The control circuit also includes the limit switches. Both the heat control switch and 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 preventing any damage to the equipment.

To adjust a limit switch, first remove 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.

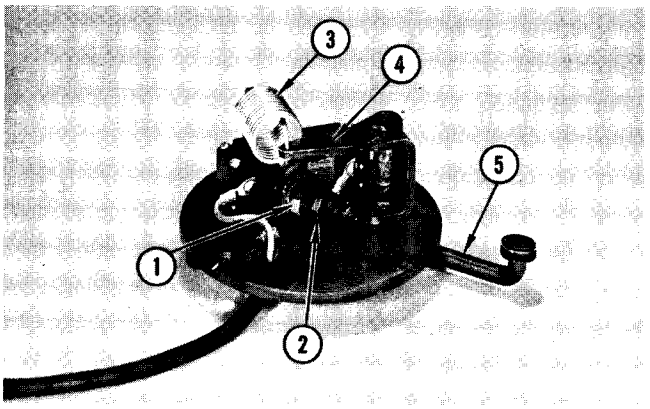


FIGURE J-19. LIMIT SWITCH ADJUSTMENT

1. Jam Nut
2. Adjusting Screw
3. Spring
4. Actuator
5. Arm

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 actuator arm to the actuator, being sure the actuating arm is against the stop block. See page K-13 for steering limit switch adjustment.

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").

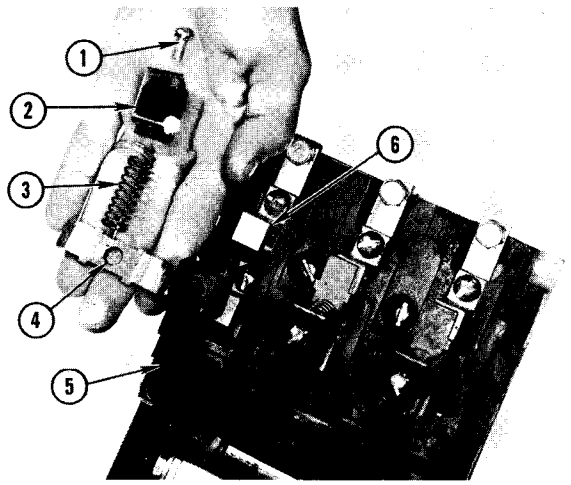


FIGURE J-20. MOVING POINT, REMOVED

1. Machine Screw
2. Holder
3. Spring
4. Moving Point
5. Arm
6. Stationary Point

DISASSEMBLY

Remove cover from main switch box. Disconnect leads from switch and holding coil to be worked on.

If switch is to be disassembled, remove from the switch box by removing the four mounting capscrews. 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 the holder. See figure J-20.

NOTE: For point replacement only, the moving points can be removed by lifting up on moving

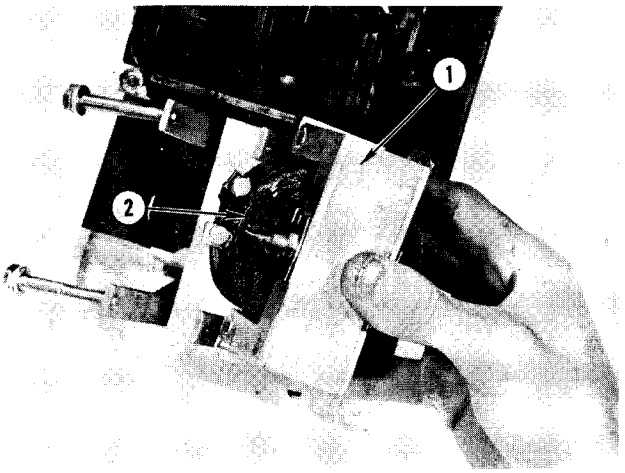


FIGURE J-21. REMOVING MAGNET

1. Magnet
2. Coil

contacts, 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 nuts securing coil to magnet and separate the two units. See figure J-21.

Press down on arm structure and remove key by pulling out to one side. See figure J-22. Lift out

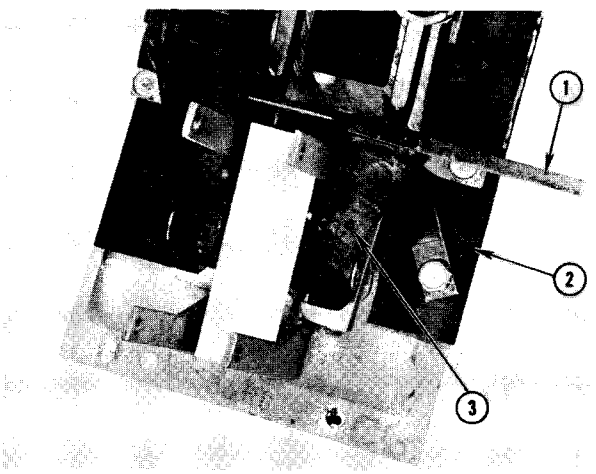


FIGURE J-22. REMOVING KEY

1. Key
2. Base
3. Arm

arm and remove arm support spring. See figure J-23.

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.

REASSEMBLY

Replace terminal strips, arc snuffers and stationary contactor points in contactor base.

Position insulating sheet and contactor base on base plate and secure with capscrews. Replace moving contact points, holders and springs onto arm structure over spring. Replace key holding arm structure to contactor base.

Reassemble coil to magnet structure and replace in bracket on arm structure. Complete reassembly and installation of unit. Refer to page K-12 for adjustment of switch points.

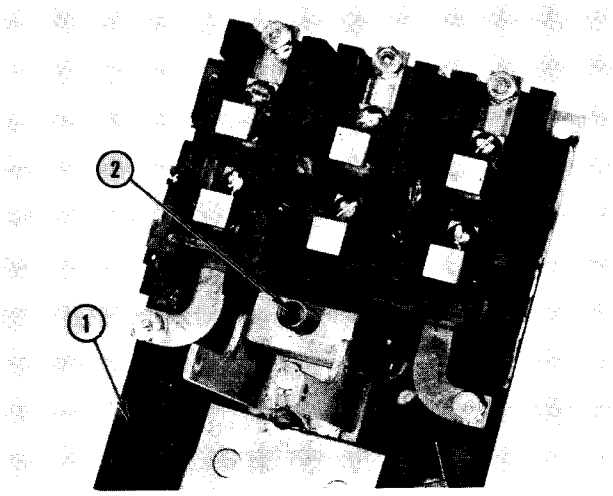


FIGURE J-23. BAR MAGNET AND ARM REMOVED
1. Base 2. Spring

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 or on the fittings and plugs may be forced into the machine and cause faster wear of the moving parts.

Do not over lubricate—too much lubricant may rupture the oil seals. This will allow the lubricant to leak out and permit entrance of harmful abrasives.

Soak new oil seals in clean engine oil to make them pliable before using.

Lubrication and service intervals are given in hours of operation. These intervals may vary somewhat, depending upon climate and working conditions.

Lubricants specified must meet the following military specifications, or be of equal quality.

Chassis Grease	MIL-G-10924 A2
Extreme Pressure Gear Oil	MIL-L-2105
Engine Oil	MIL-L-2104A, S-1
Straight Mineral Oil	FED. SPEC. VV-L-765

Visual inspection by both the operator and the mechanic is an important part of a good preventive maintenance program. A check around the machine, both before and after operation, can uncover minor troubles before they become major ones. This should be done in addition to the regular maintenance and lubrication intervals.

Early discovery of any improper function can save hours of down time by repairing them before they develop into an overhaul job.

By making this inspection, the mechanic can help the owner, and in addition, keep his machine in the best possible operating condition.

Here are some places to check. (Familiarity with the machine will further indicate to the operator or mechanic additional points to check.)

Check cooling system hoses; if spongy, replace. If clamps or connections are loose, tighten. Spongy hoses are a sign of breakdown. When the hose becomes soft, particles of the hose break loose and enter the cooling system. Such particles can clog up the engine's cooling system.

Check under the machine and in the case for signs of oil leaks. A leaking gasket may be the cause of excessive oil consumption. Also, check the engine compartment for debris which may become entangled in the belts, fan or otherwise impair engine operation.

Check drive belts on fan. Check for proper tension and any signs of wear or misalignment. Replace belts when they have stretched beyond adjusting limits. See that the fan blades are not striking the radiator core or the shroud.

Check fittings, tubes and hoses. If connections are loose, tighten. Use the proper size wrench. Do not use pliers as this will damage the fittings. When tightening fittings, exercise caution so as not to twist the tubing.

Check all electrical connections and conductors. Check insulation where cables rub against the machine or where they are subjected to repeated flexing. Wrap with tape where necessary. See that cable clamps are in place to prevent unnecessary movement.

Check wire rope for worn or frayed spots. If badly worn, see to its replacement.

Check sheaves for wear and alignment. Sheaves that are out of alignment will greatly accelerate wire rope wear. See that sheaves rotate freely, and are not clogged with mud or debris.

Check for loose nuts and bolts. If one is found, do not discard it. Find where it came from. This missing bolt may result in downtime.

Check tires for cuts, bulges and rocks wedged in the treads.

Keep dirt and debris away from electric motor brakes, tailgate rollers and any other moving parts.

Inspect battery for proper water level. (Add water only before operation. This insures a proper mixture to prevent freezing.) Check for corrosion, swelling of the case, or other signs of malfunction. Also, see that hold-down bolts and the blocks are in place and adjusted properly to prevent movement of the battery.

MAINTENANCE

A. C. GENERATOR

Inspect generator at 500 hour intervals for any large accumulation of oil and dirt on stator. Any excessive amount of waste material will prevent proper cooling of the generator.

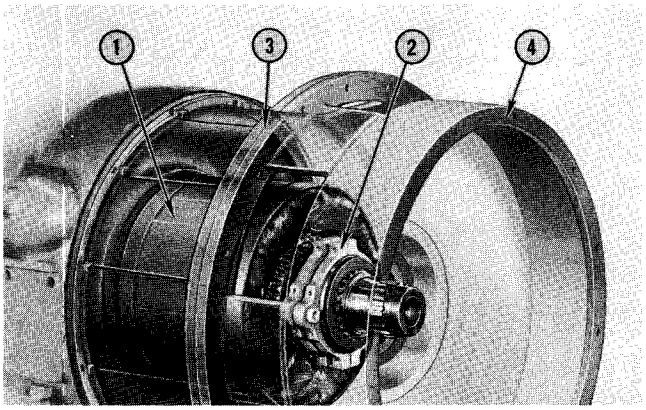


FIGURE K-1. A.C. GENERATOR

1. Rotor
2. Brushes
3. Stator
4. End Bell

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 windings have been washed down with cleaning fluid, blow off the surplus with low pressure air.

Make sure leads connected to the transformer and generator terminal 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 with an air hose, blow away any accumulated dust or chaff from around the windings, rotor and brake assembly.

Inspect electrical connections every 100 hours, making sure they are all tight and free from grease and dirt.

Check the motor brake clearance every 100 hours. Excessive clearance at the brake magnets will cause improper brake release, overheating 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 ring in position. Tap bolt down lightly to release bolt and relieve tension on adjusting ring.

Insert special adjusting tool over lugs, or insert a bar between the adjusting lugs on the adjusting ring. Turn ring either clockwise or counterclockwise until the air space between floating plate and the end bell is 1/16" to 3/32". Clockwise rotation decreases the air space, counterclockwise rotation increases the air space.

After proper adjustment has been made, tighten the nut on end of tapered lock bolt.

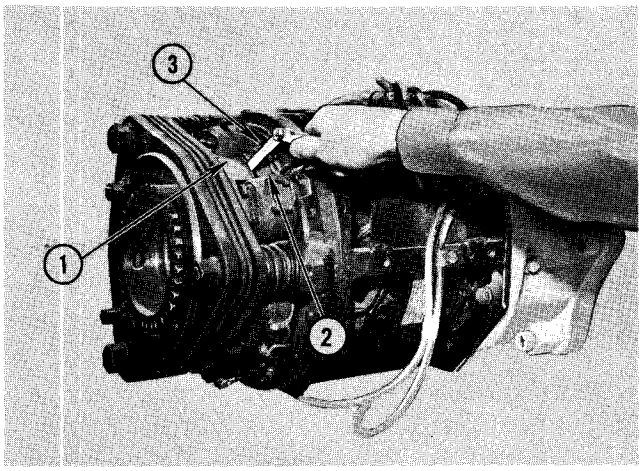


FIGURE K-2. CHECKING MOTOR BRAKE CLEARANCE

1. Floating Plate
2. End Bell
3. Feeler Gauge

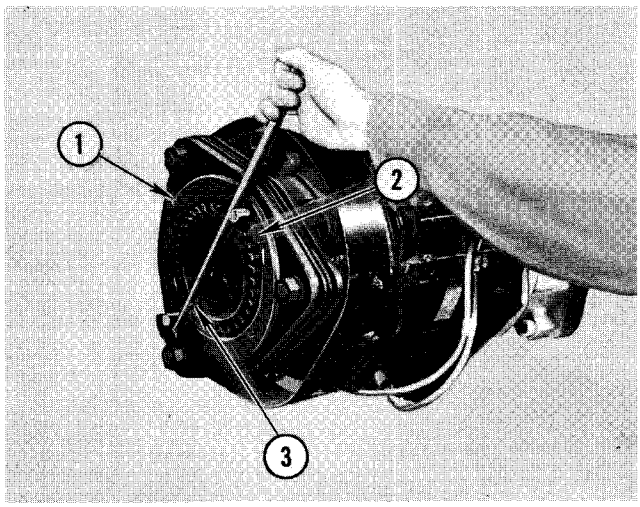


FIGURE K-3. ADJUSTING MOTOR BRAKE

1. Lockbolt
2. Adjusting Ring
3. Bar

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.

Check to see that brakes are applying and re-

leasing fully. There should be from 1/8" minimum to 5/16" maximum clearance between any two adjacent brake discs. To reduce running clearance to compensate for wear, additional stationary discs may be added to the brake assembly.

Drain air tank before each shift of operation.

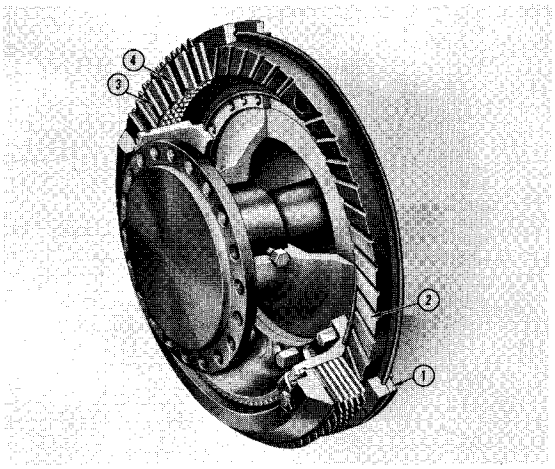


FIGURE K-4. AIR BRAKE

1. Backing Plate
2. Pressure Plate
3. Lined Disc
4. Steel Disc

In extremely cold weather, moisture in the air system may freeze and impede the flow of air. Add alcohol to the air system to absorb the condensation and help eliminate this condition. (1 pint each day to the air tank.) Add only after completely bleeding the system.

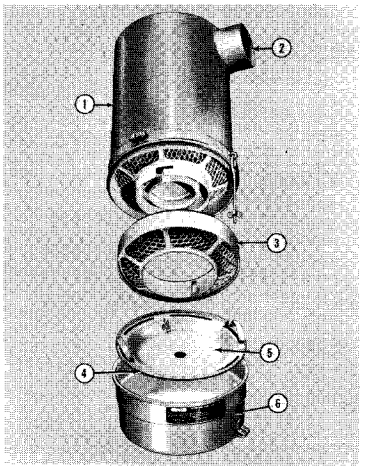


FIGURE K-5. AIR CLEANER, OIL BATH

1. Body
2. Discharge
3. Pre-Filter
4. Gasket
5. Disc
6. Oil Cup

AIR CLEANERS

Oil Bath Type

Daily inspection is necessary to determine the amount of maintenance to be given the air cleaner. If operating in severe dust conditions service may be necessary more than once each shift. Service air cleaner every 50 hours or when sediment has become ½" thick on bottom of oil cup.

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 condensing element should be inspected whenever the air cleaner is serviced. Any accumulation of dirt, straw, or lint 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 solvent, dried and replaced.

A push up, slight turn to the left, and a downward pull will remove the pre-filter element.

The inlet tube requires periodic attention, since any accumulation of dirt will restrict the flow of air through the filter and to the engine. Cleaning is accomplished best by pushing a clean, dust-free rag through the tube with a stick or rod.

The entire air cleaner should be removed from its mounting and the wire screen condensing element washed thoroughly in cleaning solvent at least once each season—more often if dust conditions are severe.

Loose connections between the air cleaner and engine will allow dust to enter the cylinders. Vibration may loosen these connections. Check them frequently and keep air tight.

Dry Type

Daily inspection and service of the dust collector cup is necessary. Do not remove dust cup or otherwise service air cleaner while engine is operating.

Loosen the two clamps securing the clean out cover to the collector cup. If air cleaner is not equipped with the clean out cover, loosen the four wing nuts securing the collector cup to the air cleaner body. Swing nuts and bolts away from cup, and remove cup.

Wipe out cup and gasket with a clean rag. Do not use oil, gasoline or oily waste. Inspect gasket; if it shows signs of wear, damage or leaks, it must be replaced.

Do not allow dust in cup to build up enough to fill the cup extension. If necessary, service cleaner more often.

See that air inlet openings do not become clogged with lint, chaff or other foreign material.

Any time the dust collector cup is serviced the tube section should be inspected. If tubes are dust plugged they must be cleaned.

Remove dust cup and tube section. Inspect both

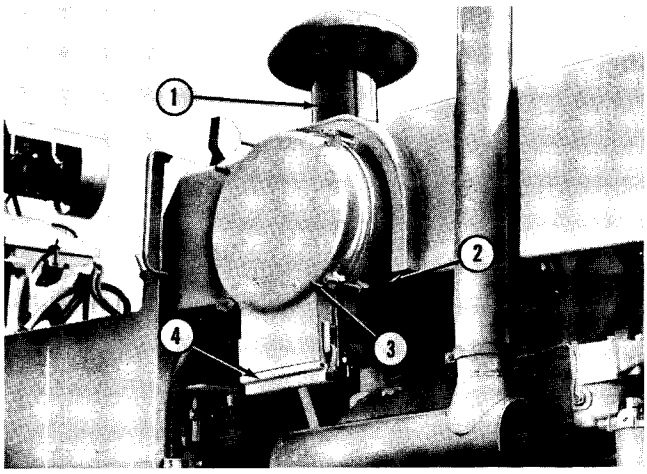


FIGURE K-6. DRY AIR CLEANER, MOUNTED

1. Air Inlet
2. Lower Body
3. Dust Cup
4. Clean Out Cover

ends of tube section. Light should be visible through each tube. Use a stiff fiber brush or compressed air to remove any accumulated dust from around or in the tubes. Replace gaskets if necessary. Do not apply heat of any kind to the tubes.

Service filter cartridge when red restriction indicator stays up. After filter has been serviced, return indicator to the down position by pushing up on the indicator stem. Although a paper filter is normally considered as being expendable, careful and proper cleaning can increase its life. Listed below are two methods of cleaning filter cartridges. The first method is recommended for effective cleaning. As an alternate to the first method, method number two may be used in cases where the inlet air contains substantial amounts of carbon or oil fumes, the dust cake on the filter cartridge may be difficult to clean off.

The service indicator inlet fitting is equipped with a small bronze filter screen. Periodic checks should be made to be sure this screen is not plugged. A plugged screen will cause the indicator to give a false reading. The main air cleaner itself should also be checked at the same time to definitely locate the trouble.

Method #1

Direct a jet of dry, clean air against the downstream or clean air side of the filter cartridge. Move the air jet up and down the pleats, slowly rotating the cartridge.

Exercise extreme caution so that paper is not ruptured by nozzle or air jet. Direct the air jet in the direction opposite that of normal air flow.

Method #2

Cartridges may be cleaned by washing with water using a good household non-sudsing detergent. Warm water (120 to 140° F.) is desirable, however it is not necessary. If a hose is used to wash or rinse the cartridge, be careful not to rupture the paper with the water jet. A maximum water line pressure of 40 p.s.i. is recommended. Flush the cartridge until drain water becomes clear. Air dry thoroughly before replacing in filter body. It is desirable to have a spare cartridge to use while servicing "in service" units.

After cleaning cartridge, inspect for damage or rupture. Place a bright light bulb inside the cartridge. Inspection of the cartridge on the outside

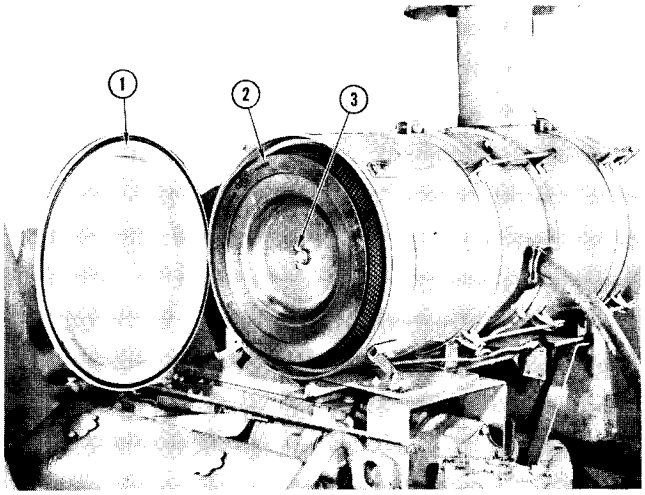


FIGURE K-7. CHANGING CARTRIDGE

1. Cover
2. Cartridge
3. Wing Bolt

will disclose any holes where light shines through. Replace cartridge if any holes are present.

Cartridge should be replaced every 1000 hours, or at other intervals as determined by the condition of the cartridge. Replace gaskets and "O" rings if damaged, or when installing new cartridge.

To remove filter cartridge, loosen clips fastening cover to body and lift off cover. Remove wing bolt holding filter cartridge in position and lift out cartridge.

Inspect gaskets and replace if they show any signs of leaks or are damaged in any way.

Install new or cleaned cartridge, replace the wing bolt and tighten until unit cannot be rotated. Replace cover and gasket. Fasten clamps.

Check connections between air cleaner and engine. Make sure they are air tight.

After reassembly of the air cleaner it is advisable to make a low pressure air check on the air cleaner assembly to insure proper operation. The pressure check is used to locate air leaks which will allow the entrance of harmful, abrasive dirt into the air system. The following steps are to be used for making the check.

CAUTION: Apply a maximum of 5 to 10 p.s.i. air pressure to the air cleaner when making this test.

Remove air inlet cap from air cleaner and cover with heavy tape or some other suitable material which will withstand the required air pressure.

Block air intake to engine by disconnecting the connecting hose. Tape the open end of the hose in the same manner as the inlet opening.

Disconnect the vacuum indicator, or indicator line, from side of air cleaner housing. Attach the low air pressure line to the tapped fitting from which the indicator or line was removed.

Apply air pressure (5 to 10 p.s.i.) to the air cleaner assembly. Liberally coat all gasket and clamping areas with soap suds. Leakage is NOT permissible.

If leakage is in evidence, replace gaskets, tighten clamps or make other necessary adjustments.

Be sure to remove tape from air cleaner outlet and inlet, and to replace vacuum restriction indicator, inlet cap and connecting hose after completing the test. Make sure hose clamps are tight at air cleaner outlet to make an air tight fitting between cleaner and engine.

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 tightness periodically. During cold weather, compressor water 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-12).

Keep air fittings tight.

With compressor running check for noisy operation and oil or water leaks.

Keep oil lines clean and tight. One line connects the compressor end cover with the lubricating 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 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 remainder of system. Another sign of wear is excessive oil passing. If either of these conditions develops 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 intake opening (with 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.

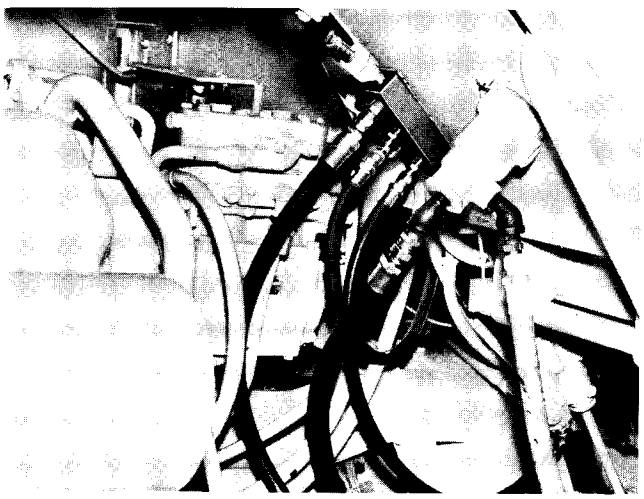


FIGURE K-8. AIR COMPRESSOR, MOUNTED

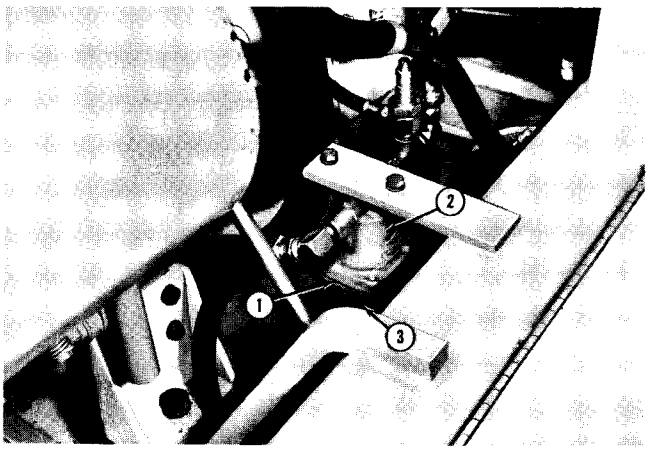


FIGURE K-9. AIR LINE FILTER

1. Cover
2. Body
3. Drain

AIR LINE FILTER

An air line filter has been placed in main air line from the supply tank. Its purpose is to remove any moisture or foreign matter from the compressed air before it reaches the moving parts.

Open the drain cock on the bottom of the filter housing at the beginning of each shift of operation.

The element should be replaced every 500 hours. To change the element, remove capscrews and lockwashers securing cover to body. Remove cover and gasket. Remove filter support and element from body.

Clean inside of body thoroughly. Replace filter element and support. Replace gasket and cover, secure with capscrews and lockwashers.

BATTERIES

Precaution should be taken to prevent machine downtime 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.

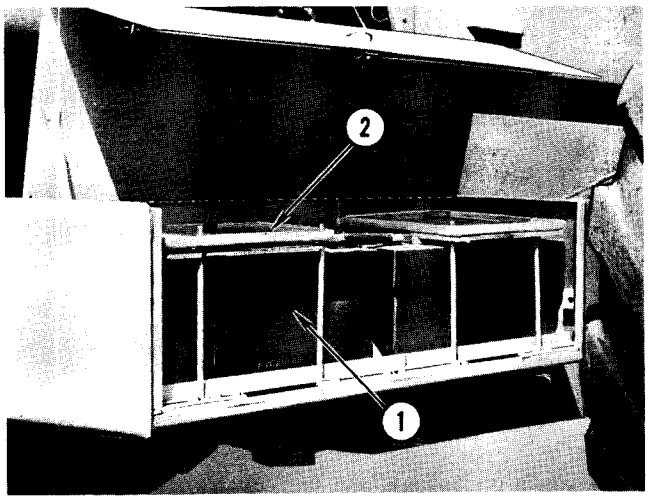


FIGURE K-10. BATTERY BOX

1. Battery
2. Hold Down Plate

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. Periodic servicing of the batteries will, in most cases, prevent premature failure. The most important of these services 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 and become ruined.

Overfilling should be avoided as this will cause loss of electrolyte. This not only results in a loss of battery capacity, but overflowing of the electrolyte on cables and clamps will cause corrosion.

When adding water, use only distilled water or water from local sources approved by the battery manufacturers. 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 in cold weather and freeze at about 32° F. unless it is thoroughly mixed.

Keep the top of 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 clean water.

Check batteries and 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 petroleum jelly or terminal grease to the clamps to retard corrosion.

The following specific gravity readings indicate the different charge values:

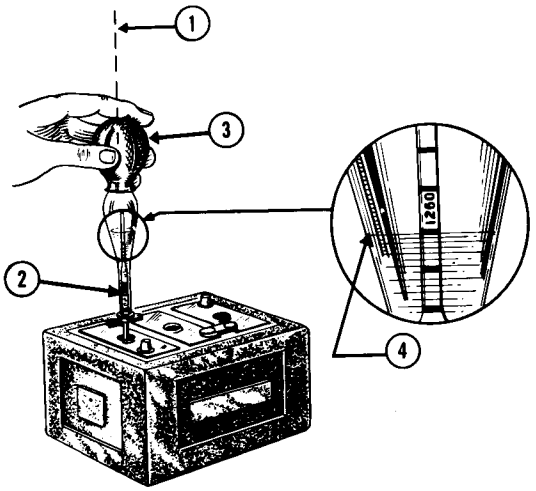


FIGURE K-11. CHECKING SPECIFIC GRAVITY

1. Hold Tube Vertical
2. Float Must Be Free
3. Take Reading at Eye Level

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.

The specific gravity of the electrolyte varies with the temperature. As the temperature in-

creases, 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 temperatures 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 temperatures 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 two volts.

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 of this gas will result in an explosion. When charging of the 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-11).

A common cause of battery failure is overcharging. This is usually caused by improper adjustments, defects or faulty operation of the battery charging circuit. See page L-8 for charge rate adjusting procedures.

One of the evidences of overcharging is the swelling of the positive side of the cell covers.

This is caused by the following: During the normal charging action, water in the electrolyte is converted to hydrogen and oxygen. The oxygen enters the positive plate to convert 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 for expansion than the original lead and therefore as it swells it will cause the positive sides of the cell covers to be raised.

BELT ADJUSTMENTS

Service life of the fan belts can be greatly extended by proper installation and adjustment procedures.

Always shorten the distance between the pulley centers so the belt can be installed without force. Never roll or tighten a belt over the pulley and never pry it on with a tool such as a screwdriver.

Belts should be replaced when they have become worn, frayed, or oil soaked, or have been stretched beyond adjusting limits. If one of a pair needs replacing, both must be replaced. Otherwise, uneven wear will result, causing the need for frequent replacement.

Belts should be checked regularly and kept in proper adjustment. Slipping belts wear both the pulleys and the belts and prevent the pump from delivering its rated output. Use only the proper size belts. An odd size belt will wear both the belt and the pulleys more rapidly.

Lay a straight edge across the two pulleys.

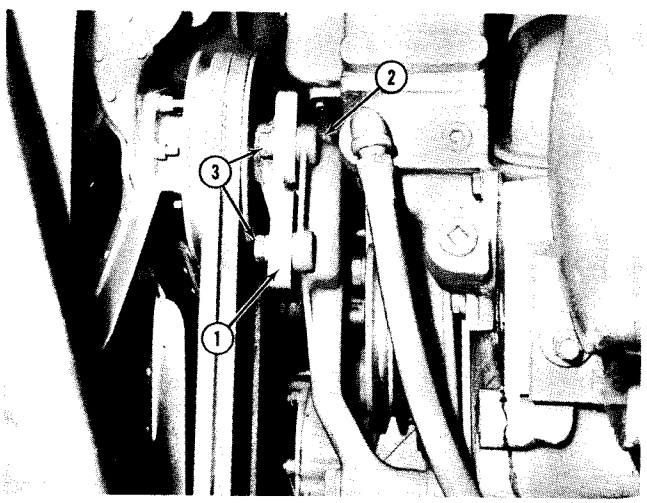


FIGURE K-12. ADJUSTING FAN BELTS

1. Hub Mounting Plate
2. Adjusting Screw
3. Clamping Bolts

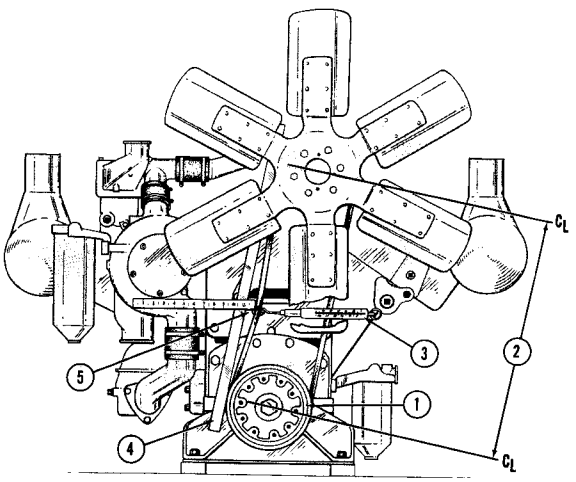


FIGURE K-13. MEASURING BELT DEFLECTION

1. Pulley
2. Free Span
3. Spring Scale
4. Straight Edge
5. Deflection

Fasten a spring scale to the midpoint of the belt and pull down. Measure the amount of belt deflection at the midway point.

For the fan belts the deflection should be 1/2" between the top of the belt and the bottom of the straight edge, with a 15 pound pull on the spring scale. To adjust the belts, loosen the four clamping bolts in the fan hub mounting plate. Turn adjusting screw either in or out to obtain the proper adjustment. When proper adjustment has been obtained, tighten the four clamping bolts. The proper amount of belt deflection is necessary to assure adequate service.

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 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 in such a manner that they cannot fall. Remove the blade bolts.

To reverse the blades, remove the old blade bolts and discard. Use new bolts. Next, turn the blades over—hard faced surface up—and install the left blade on the right side, and right blade on the left side. This will assure uniform wear. Then reverse the center section so the hard surface 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.

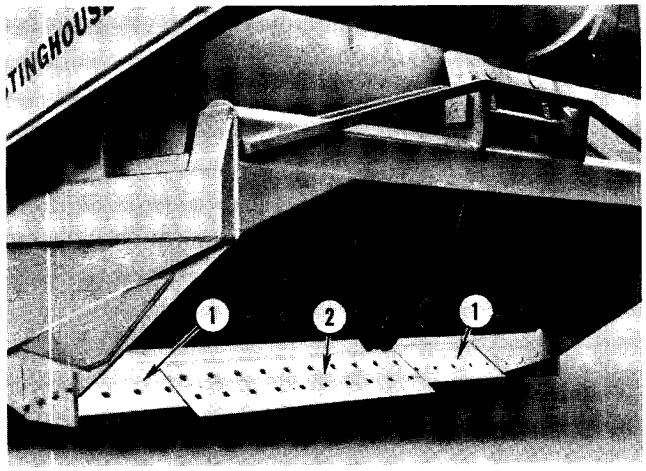


FIGURE K-14. SCRAPER BLADES
1. End Blades
2. Center Blade

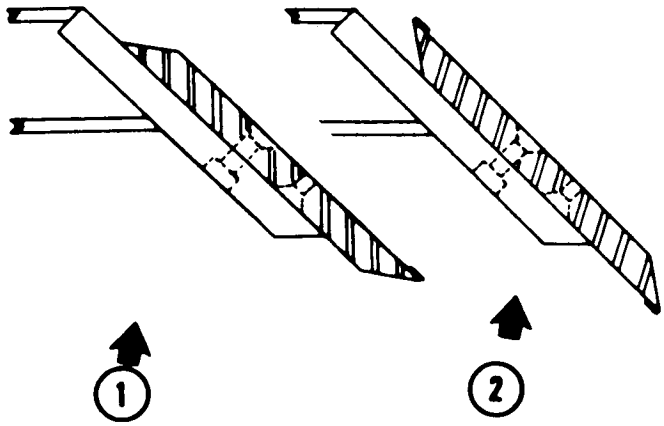


FIGURE K-15. BLADE POSITIONS
1. Correct
2. Incorrect

CLUTCH AND LINKAGE

Clutch Release Bearing

When the clutch assembly is new, and with both the clutch assembly and pedal linkage 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. 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 engaged, 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 1/8", for example: if the levers were bottomed against the face of the release bearing, it would require approximately

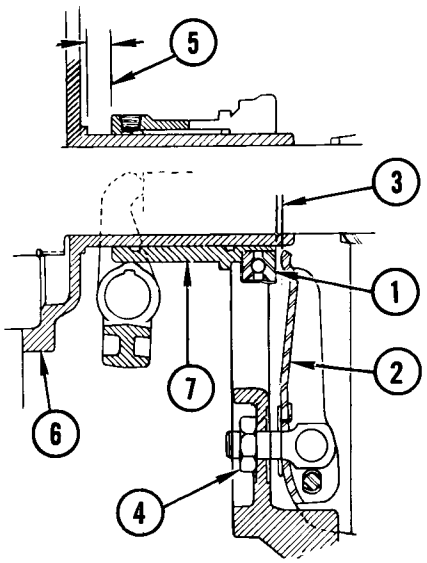


FIGURE K-16. CLUTCH RELEASE BEARING ADJUSTMENT

1. Release Bearing
2. Release Lever
3. 3/16"
4. Adjusting Nut
5. 1/2" When Dimension 3 is Zero
6. Clutch Release Carrier Support
7. Clutch Release Bearing Carrier

three fourths of a turn of the nut to obtain the required 3/16". See figure K-16.

It is important that all levers be adjusted identically to obtain correct clutch action, and to prevent abnormal clutch wear. To make this adjustment, move the clutch release bearing and carrier forward so that it is just barely touching the release levers. Then measure the distance between the clutch release carrier support and the clutch release bearing carrier and adjust the lever to obtain approximately 1/2" dimension (as shown in figure K-16).

If any doubt exists as to the setting of the release levers, it is possible to insert a thin (less than 0.020") feeler gauge between the face of the release bearing and the release lever. Move release levers until the feeler gauge drags slightly as it is being removed. Make this check on all four release levers.

CAUTION: Be sure both normal and emergency engine shut off controls are pulled out and the key switch is in the "off" position before hand cranking engine for access to release lever adjusting nuts.

Free Pedal Travel

Screw the setscrew of the clutch release bearing cross shaft adjusting lever into the lever as far as possible. See figure K-17.

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.

Remove and reinstall the adjusting lever on the

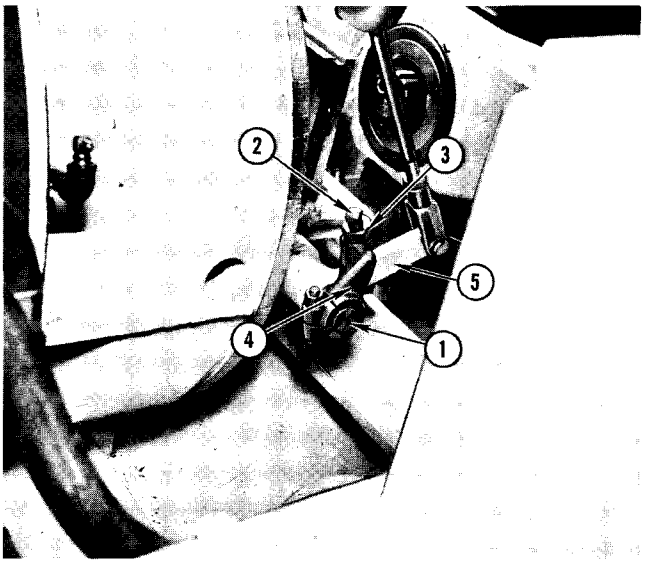


FIGURE K-17. PEDAL FREE TRAVEL

1. Release Bearing Cross Shaft
2. Setscrew
3. Jam Nut
4. Adjusting Lever
5. Pedal Lever Arm

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.

Check the pedal free play. This should be 1-3/8". If it is considerably less than this, remove the adjusting lever and move it one or more splines counterclockwise until the pedal free travel is as near to the 1-3/8" as can be obtained by this method. Make the final accurate adjustment with the setscrew in the adjusting lever.

When correct adjustment has been obtained, lock setscrew in place with jam nut.

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 is such that it will not hit when pedal is completely released.

Clutch Assist Air Chamber

Before adjusting the clutch assist air chamber linkage, make certain the clutch release levers are adjusted properly and the clutch pedal free travel is the required amount (1-3/8").

Remove the pin from the air chamber clevis.

Rotate clutch release lever arm by hand until the clutch release levers are just touching the release bearing, but are not moved by it, hold in this position. Without pulling on air chamber rod, screw the clevis in or out until a distance of 1/2" is obtained between the center of the pin hole in the clevis and the pin hole in the release shaft lever. Pull air chamber rod forward and install

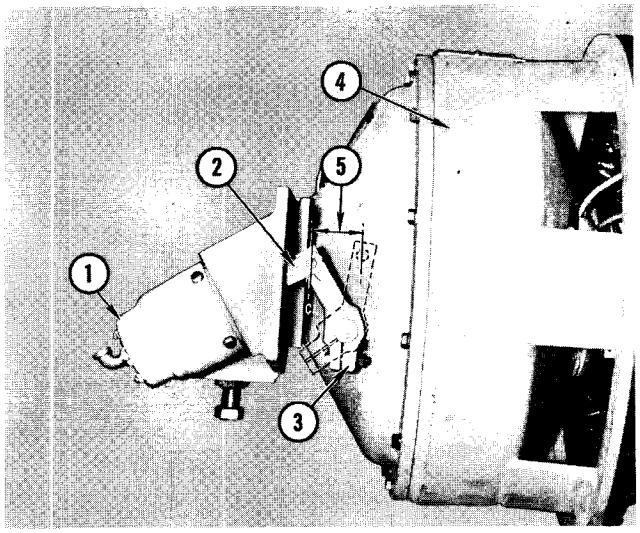


FIGURE K-18. AIR CHAMBER ADJUSTMENT

1. Air Chamber
2. Clevis
3. Release Lever Arm
4. Generator End Bell
5. 1 3/8"

clevis pin in clevis and release shaft lever.

When air is applied to air chamber the rod travel should be 1-3/8", check as follows (refer to figure K-18).

1. Measure the distance from the center of the pin in the air chamber rod clevis to a convenient place on the generator end bell. Note measurement and mark end bell at place where measurement was taken.

2. Apply air to the air chamber to fully extend air chamber rod and completely disengage clutch. Hold in this position and again measure the distance from the center of the clevis pin to the same place on the generator end bell.

3. To find the travel distance of the air chamber rod, subtract the second measurement from the first measurement.

The difference between the measurements should be 1-3/8". If the difference (or rod travel) was less than the required 1-3/8", screw the clevis out, or away from the air chamber, until the correct measurement is obtained. If the difference (or rod travel) was more than the required 1-3/8", screw the clevis in, or toward the air chamber, until the correct measurement is obtained.

Repeat the measuring procedure to be certain the adjustment is correct.

Engage and disengage the clutch several times while observing the air chamber action. Air chamber should bottom (or be fully extended) on the forward stroke, but must not bottom on the return stroke. Refer to Service Bulletin No. 319-A for single plate clutch 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.

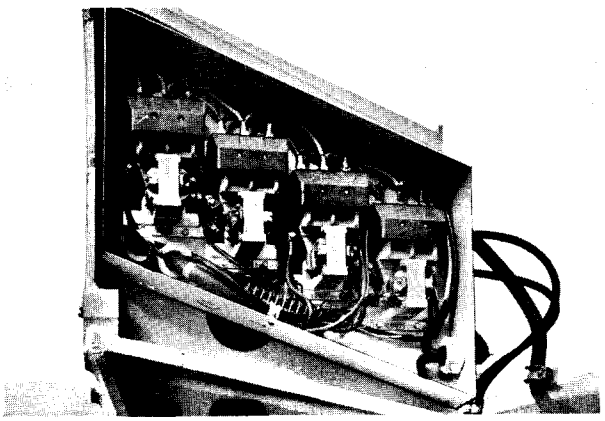


FIGURE K-19. MAIN SWITCH PANEL

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 condition of the contactor points for wear or pitting every 500 hours. Pitted or burned contactor points tend to reduce or restrict the flow of current to the electric motors. To avoid rapid burning or pitting of points, engine speed should be kept as near high idle as possible while operating any of the electric motors. Check the tightness of screws that hold the power leads to the switches, also main power leads coming in on the multiple cable.

Check 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 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. Service more often if necessary in dusty conditions.

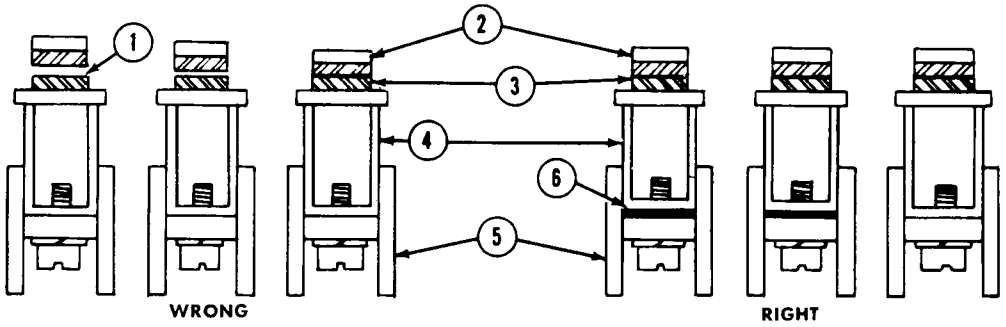


FIGURE K-20. SHIMMING BETWEEN ARM AND CONTACT HOLDER

1. Gap
2. Moving Points
3. Stationary Points
4. Point Holder
5. Magnet and Arm
6. Shims

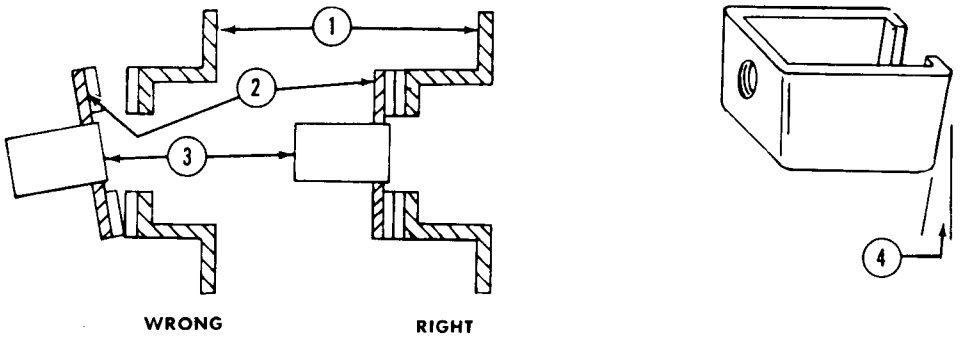


FIGURE K-21. MOVING CONTACT HOLDER ANGLE

1. Stationary Points
2. Moving Points
3. Holder
4. Point Holder Angle

RADIATOR

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 engine block and radiator separately. Flushing water should enter the radiator or block at the bottom connection, the reverse of the regular flow. Thermostat must be removed before the engine can be back flushed.

A badly clogged radiator may have to be cleaned with the aid of a commercial cleaner. Follow the manufacturer's recommendations when using cleaning solvent. With caution, a solution of washing soda and water may be used to remove grease and oil. The solutions should be lukewarm before used, and allowed to stay in the radiator or water jackets for three or 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 or gasket 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 small leak will be sufficient to pass large quantities of air, causing a greatly accelerated corrosion attack.

Do not add rust inhibitor to a cooling system containing anti-freeze as most permanent type anti-freeze already contain rust inhibitors.

ANTI-FREEZE MIXTURES	
Protection Desired Degrees Fahrenheit	**Amount of Ethylene-Glycol Anti-Freeze Needed**
+20	10 quarts
+10	16 quarts
− 3	22 quarts
−19	26 quarts
−26	28 quarts
−34	30 quarts
−43	32 quarts

STEERING LIMIT SWITCHES

Remove the limit switch housing cap and gasket from the top of the kingpin housing. Loosen the capscrews clamping the limit switches to the housing.

Operate steering motor until nose of machine is at an approximate angle of 90 degrees (right or left) with the trail 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 this procedure, with the nose of the Tournapull in the opposite direction, for the other limit switch.

Replace housing cap and gasket, secure with capscrews and lockwashers.

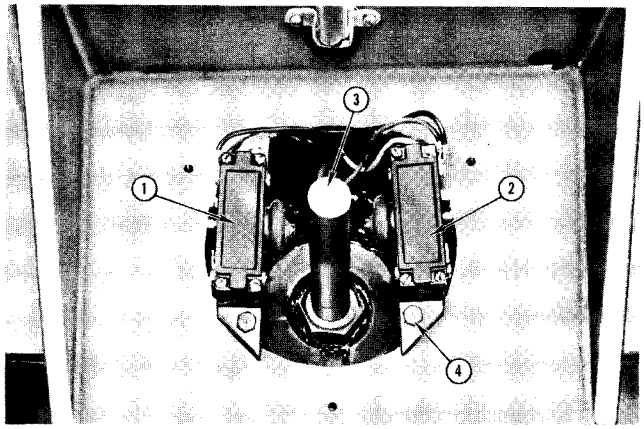


FIGURE K-22. STEERING LIMIT SWITCHES

1. Left Turn Limit Switch
2. Right Turn Limit Switch
3. Cam
4. Clamping Screw

WIRE ROPE

Proper care and treatment is very important and will pay big dividends in the way of longer rope life.

The winding of the first layer on 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 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 also applies to either regular or lang lay rope. Listed below are some suggestions that will help prolong wire rope life.

Check frequently for frayed or worn spots.

Lubricate at intervals determined by operating conditions. Use a mixture of crater compound and petrolatum. Unless operating in very dusty conditions, lubricating the wire rope will normally add to its life. Apply the dressing as needed. If the dressing is applied in dusty conditions, the dust and grit will adhere to the lubricant and become abrasive. This will greatly accelerate the rope wear.

Use the recommended sizes of wire rope as the design of the sheave wheels varies somewhat for wire rope having different diameters.

When installing new wire rope, make sure the rope reeves evenly onto the drum. Do not permit it 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 wire rope will wear extremely fast.

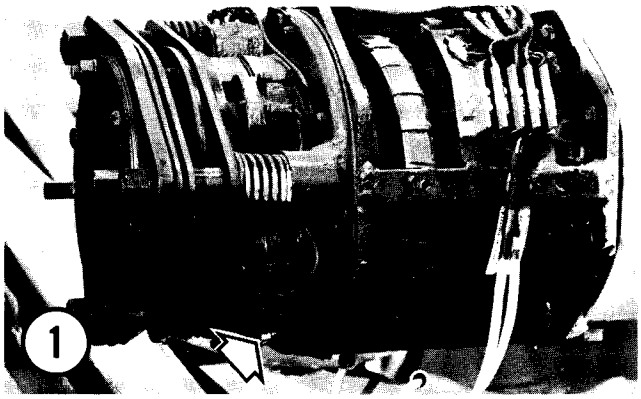
Replace sheave wheels having badly worn grooves, especially those having a rope lay impression worn into them.

Do not cause the wire rope to become kinked by allowing an excessive amount of slack.

LUBRICATION

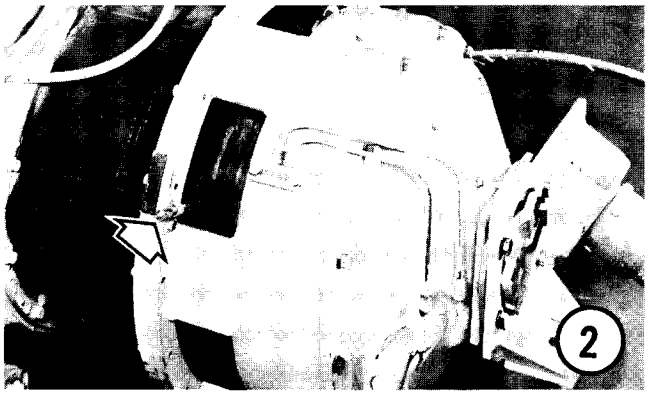
1. A.C. ELECTRIC MOTOR

Lubricate every 10 hours with "Mobilplex E.P. No. 2". Do not over lubricate. Make certain the grease tube between fitting and bearing is filled with grease, otherwise bearing will not receive lubricant during the first few intervals.



2. A.C. GENERATOR REAR BEARING

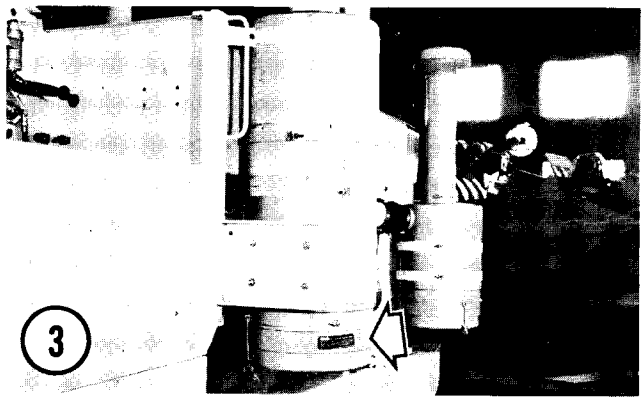
Lubricate every 10 hours with "Mobilplex E.P. No. 2". Do not over lubricate. Make certain the grease tube between fitting and bearing is filled with grease, otherwise bearing will not receive lubricant during the first few intervals.

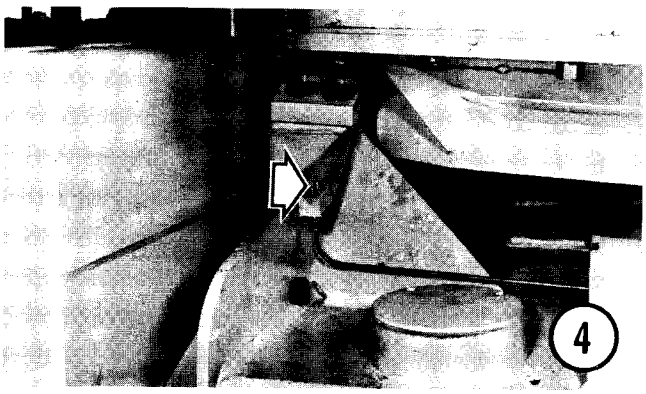


3. AIR CLEANER (OIL BATH)

Check oil level every 10 hours. Change oil every 50 hours or more often if operating conditions warrant. Fill to the full mark on disc. Use SAE No. 20 engine oil in summer and SAE No. 10 or lighter in winter. Every 500 hours clean filter body and element with cleaning fluid, blow dry with compressed air.

See page K-4 for service of dry type air cleaner.



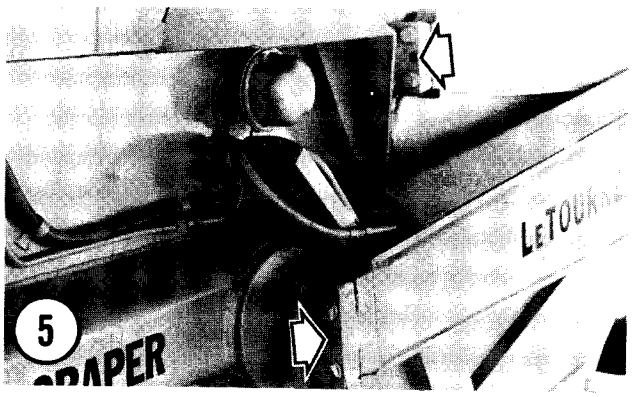


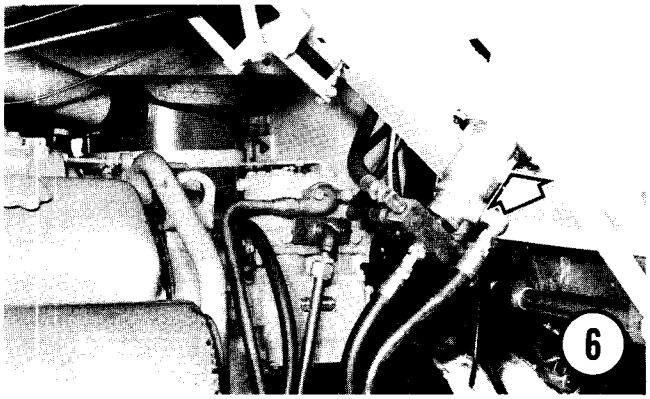
4. BALL AND SOCKET (STEERING)

Lubricate every 10 hours. Use SAE No. 250 E.P. gear oil. Lubricate through pressure fittings provided until a small amount of old oil has been forced out from around caps.

5. BALL AND SOCKET (TRAIL UNITS)

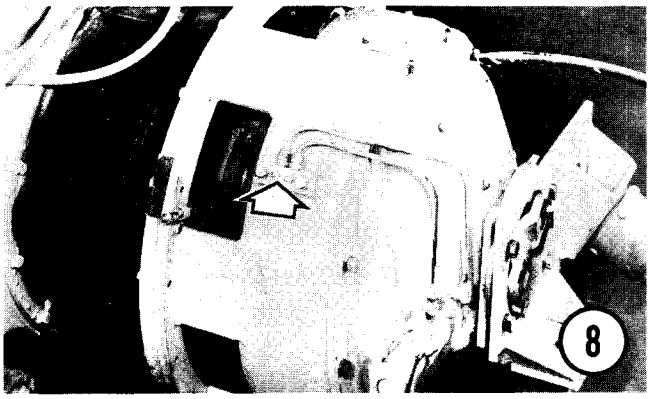
Lubricate every 10 hours. Use chassis grease (heavy) for temperatures above 32° F., and chassis grease (medium) for temperatures below 32° F.





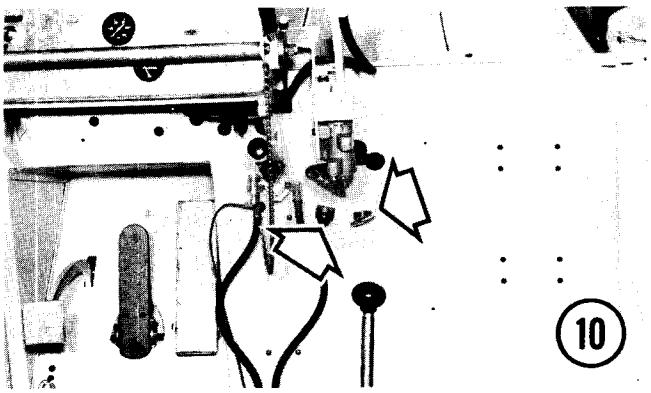
7. CLUTCH AIR VALVE OILER

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 and shake off excess. Replace strainer in body.



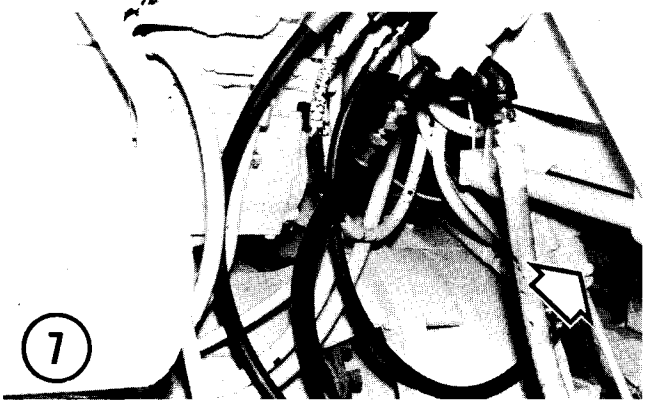
9. CRANKCASE

Check level every 10 hours. Change oil every 100 hours. Use SAE No. 30 Heavy Duty engine oil for temperatures above 30° F., SAE No. 20W Heavy Duty engine oil for temperatures from 0° to 30° F., and SAE No. 10W Heavy Duty engine oil for temperatures from 0° to −20° F. Capacity is 7 1/2 gallons.



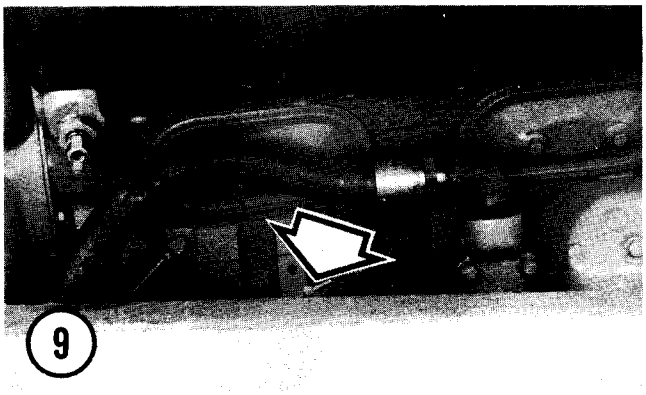
6. BRAKE TREADLE VALVE

Lubricate treadle roller, also hinge pin and linkage every 100 hours with clean engine oil. Lift boot away from mounting plate and put a few drops of SAE No. 20 engine oil between plate and plunger. Every 1000 hours disassemble valve and clean all parts. Install new inlet valves and piston ring grommet.



8. CLUTCH RELEASE SHAFT AND BEARING

Lubricate every 100 hours. Use chassis grease (heavy) for temperatures above 32° F., and chassis grease (medium) for temperatures below 32° F. One stroke with a hand gun should be sufficient.

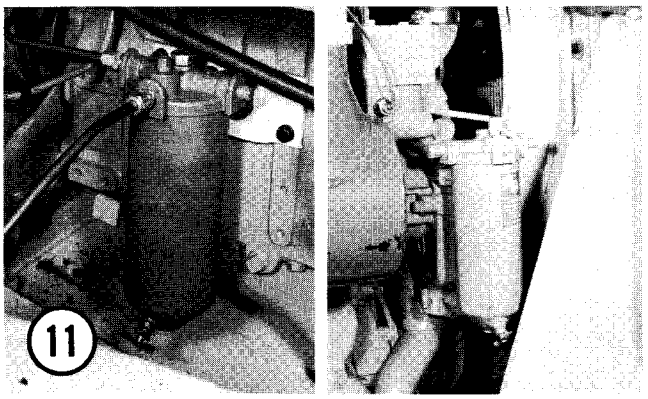


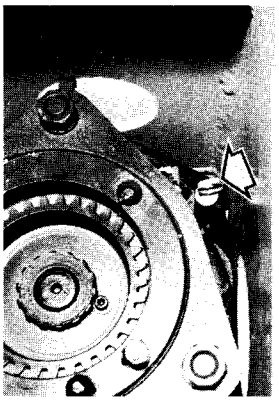
10. ENGINE SHUT DOWN CONTROLS

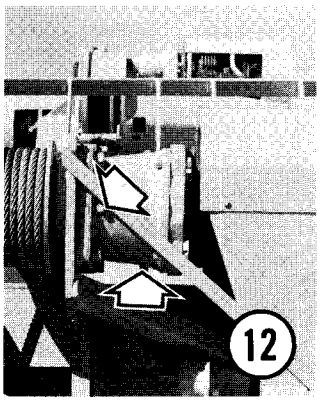
Lubricate both normal and emergency shut down controls every 100 hours with light engine oil.

11. FUEL FILTER

Drain approximately 1/4 pint of fuel and sediment from strainer and filter every 10 hours. Clean shells and replace elements every 300 hours.





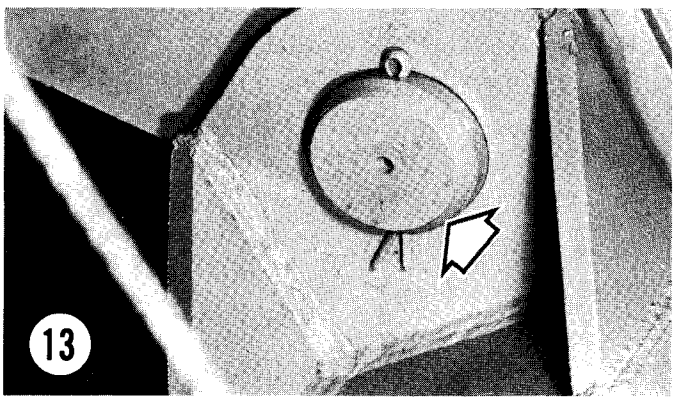


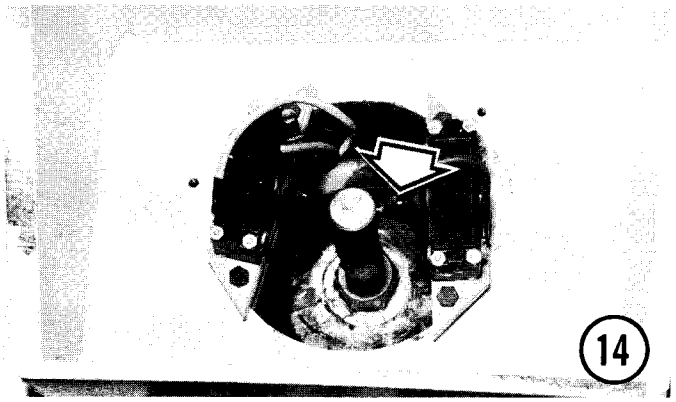
12. GEAR REDUCTION BOXES

Check level of lubrication every 100 hours. Should be up to the level plug. Change lubricant every 1000 hours. Use SAE No. 90 E.P. gear oil for temperatures above 32° F., and SAE No. 80 E.P. gear oil for temperatures below 32° F. Fill to level plug. Steering motor gear box is equipped with a dip stick, fill to full mark on dip stick.

13. HINGEPINS

Lubricate every 10 hours. Use chassis grease (heavy) for temperatures above 32° F., and chassis grease (medium) for temperatures below 32° F.



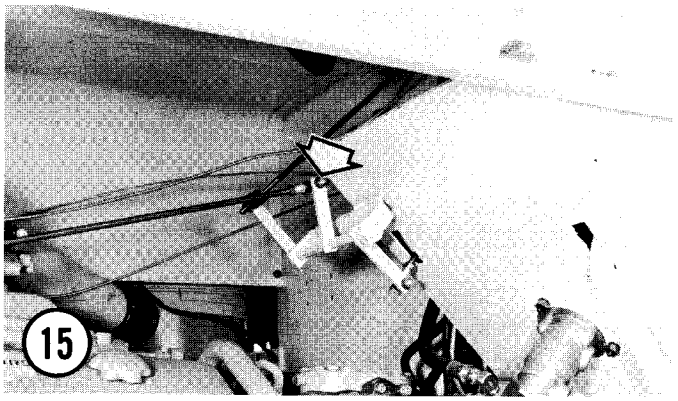


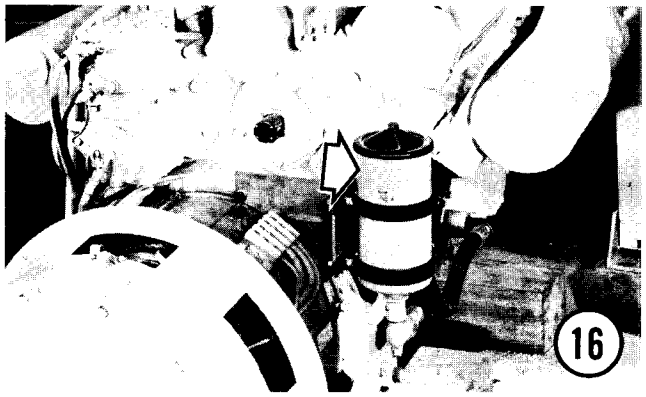
14. KINGPIN UPPER BEARING

Check level of grease at upper bearing every 500 hours. Repack if level of grease is below upper part of bearing. Use wheel bearing grease (medium).

15. LINKAGE

Lubricate at each connection every 100 hours. Use clean engine oil. One or two drops should be sufficient.



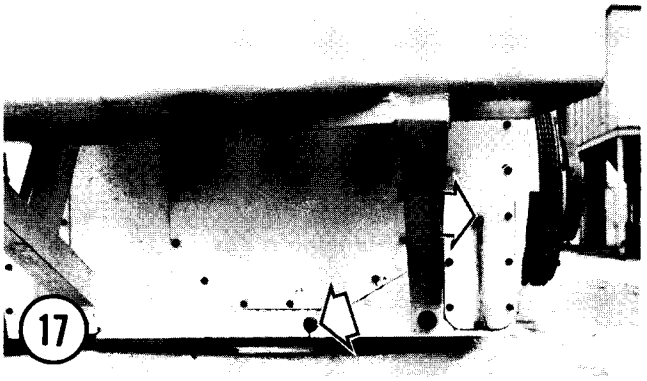


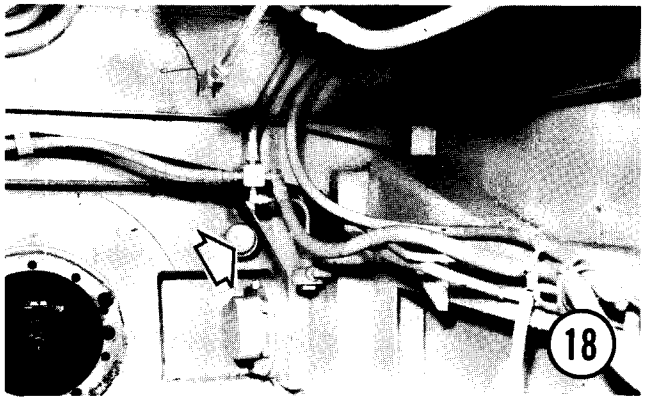
16. LUBRICATING OIL FILTERS

Clean shell and install new filter element every time engine oil is changed (100 hours).

17. MAIN CASE (INCLUDES FINAL DRIVES)

Check oil level every 100 hours. Change oil every 1000 hours. Use SAE No. 90 E.P. gear oil for temperatures above 32° F., and SAE No. 80 E.P. gear oil for temperatures below 32° F. Fill to level plug. Capacity is approximately 37 gallons.



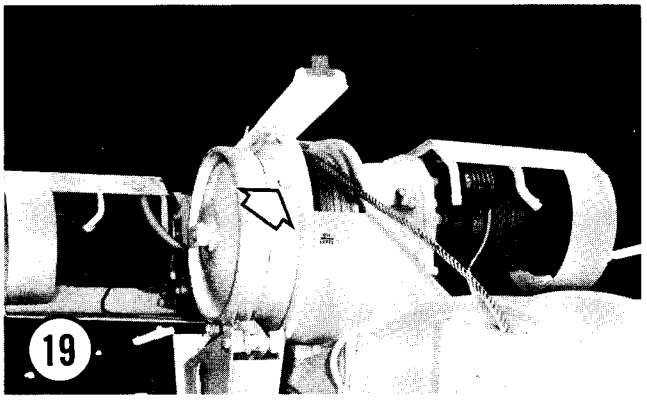


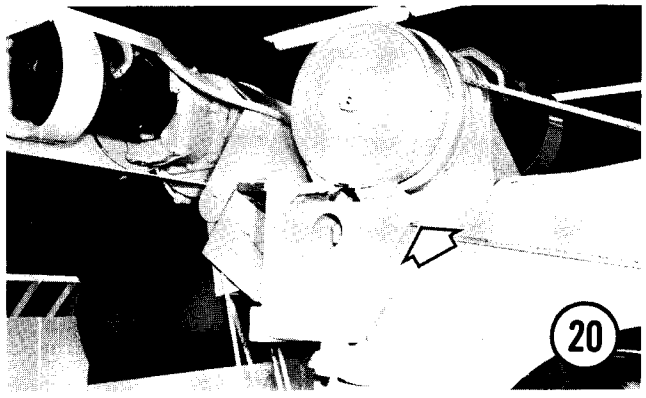
18. MAIN CASE BREATHER

Wash in cleaning fluid, blow dry with compressed air and dip in clean engine oil every 100 hours.

19. QUICK DROP PLANETARY

Check oil level every 100 hours. Drain and change oil every 1000 hours. Use SAE No. 90 E.P. gear oil for temperatures above 32° F., and SAE No. 80 E.P. gear oil for temperatures below 32° F. Capacity is approximately 1/2 gallon. To check oil level, revolve drum until the fill plug is in line with "Oil Level" mark on frame. Remove plug and check level.



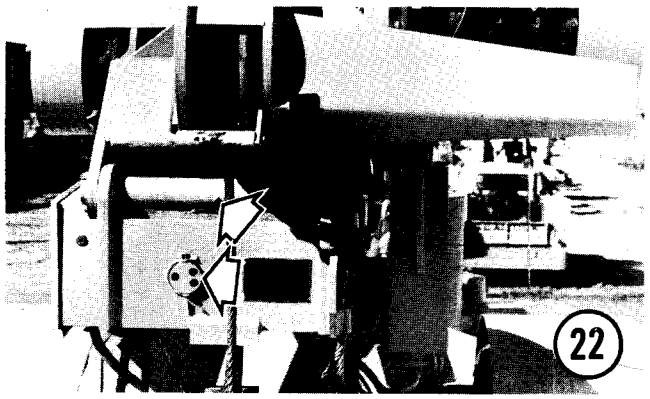


20. QUICK DROP BRAKE LINKAGE

Lubricate every 10 hours. Use chassis grease (heavy) for temperatures above 32° F., and chassis grease (medium) for temperatures below 32° F. Lubricate through pressure fittings.

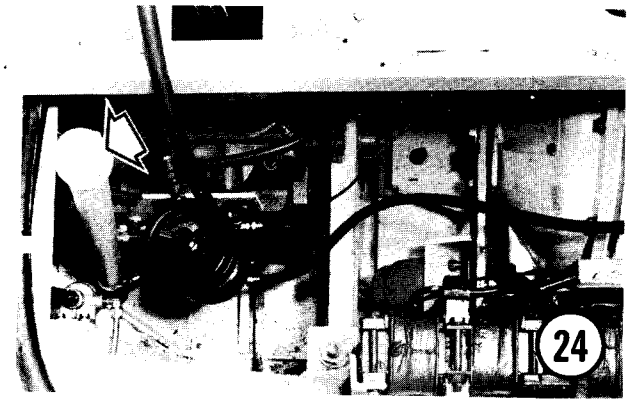
21. STEERING GEAR AND PINION

Check level of lubricant every 100 hours. Change grease only when trunnion is disassembled. Use wheel bearing grease. Fill to 1" above bottom of gear box pinion.



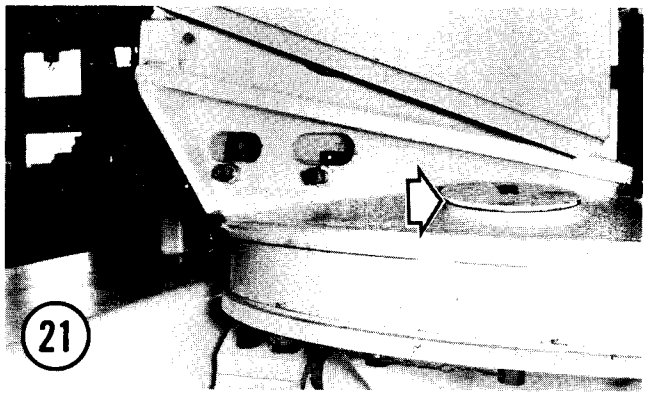
23. TAILGATE AND TRACK ROLLERS

Lubricate every 10 hours. Use chassis grease (heavy) for temperatures above 32° F., and chassis grease (medium) for temperatures below 32° F. Check lower covered rollers on scraper tailgate every 1000 hours. Repack at time of disassembly.



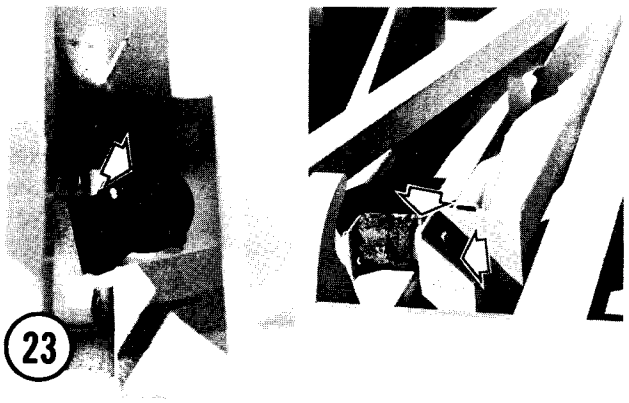
25. TRANSMISSION OIL FILTER

Make first element change at 100 hours. Make each subsequent change at 500 hour intervals, or whenever transmission oil is changed.



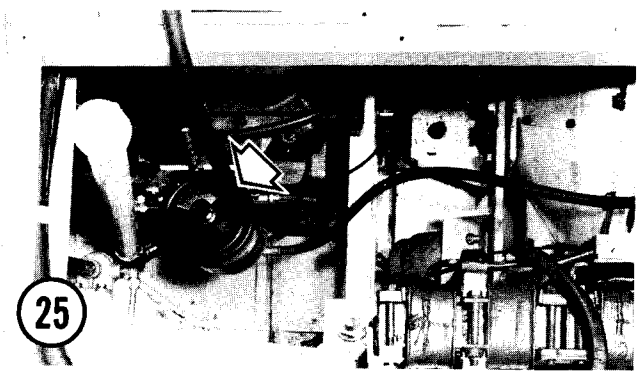
22. SHEAVE BEARINGS

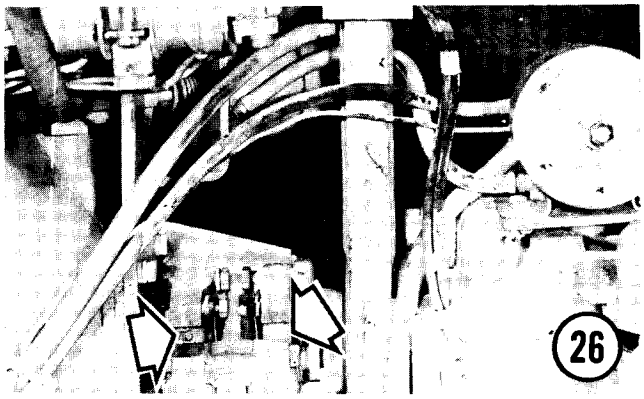
Lubricate every 10 hours. Use chassis grease (heavy) for temperatures above 32° F., and chassis grease (medium) for temperatures below 32° F.



24. TRANSMISSION

Check level every 100 hours. Make first oil change at 100 hours. Make each subsequent change at 500 hour intervals. Use SAE No. 90 straight mineral gear oil for temperatures above +10° F., SAE No. 80 straight mineral gear oil for temperatures from −10° to +10° F. and SAE No. 20 non-detergent type engine oil for temperatures below −10° F. Capacity including filter shell is 14 quarts.



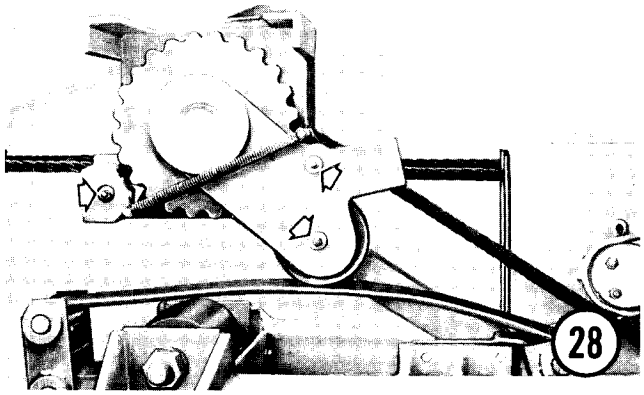


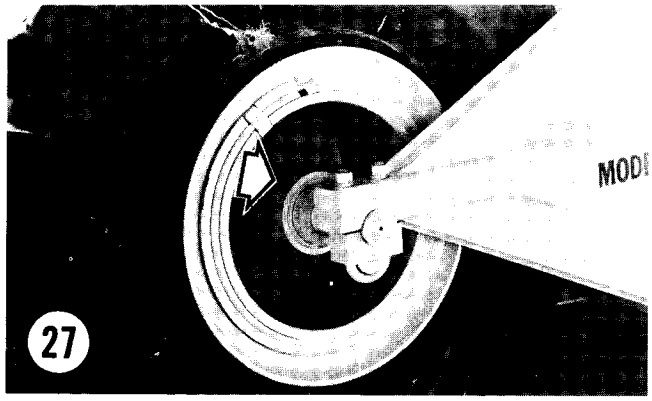
26. UNIVERSAL JOINT

Lubricate every 300 hours through pressure fittings. More often if necessary. One or two shots should be sufficient. Use chassis grease (heavy) for temperatures above 32° F., and chassis grease (medium) for temperatures below 32° F.

27. WHEEL BEARING (TRAIL UNITS)

Lubricate every 500 hours. Use wheel bearing grease (medium). Fill axle cavity approximately 1/2 full.





28. WIRE ROPE TIGHTENER (tailgate)

Lubricate every 10 hours through pressure fittings. Use chassis grease (heavy) for temperatures above 32° F., and chassis grease (medium) for temperatures below 32° F.

LUBRICATION SCHEDULE

Refer to "Lubrication", page K-14 for procedures, type and amount of lubricant.

EVERY 10 HOURS
- A.C. Electric Motor
- A.C. Generator Rear Bearing
- Air Cleaner (Oil Bath)
- Ball and Socket (Steering)
- Ball and Socket (Trail Unit)
- Crankcase — Check
- Fuel Filters — Drain
- Quick Drop Planetary Linkage
- Sheave Bearings
- Tailgate and Track Rollers
- Tailgate Wire Rope Tightener

EVERY 50 HOURS
- Oil Bath Air Cleaner

EVERY 100 HOURS
- Brake Treadle Valve
- Clutch Air Valve Oiler
- Clutch Release Shaft and Bearing
- Crankcase — Change
- Engine Shut Down Controls
- Gear Reduction Boxes — Check
- Linkage
- Lube Oil Filters — Change
- Main Case — Check
- Main Case Breather
- Quick Drop Planetary — Check
- Steering Gear and Pinion
- Transmission — Check

EVERY 300 HOURS
- Fuel Filters — Change
- Universal Joint

EVERY 500 HOURS
- Air Cleaner Oil Bath
- Clutch Air Valve Air Strainer
- Wheel Bearings (Trail Unit)
- Kingpin Upper Bearing — Check
- Transmission — Change
- Transmission Oil Filter — Change

EVERY 1000 HOURS
- Brake Treadle Valve
- Gear Reduction Boxes — Change
- Main Case — Change
- Quick Drop Planetary — Change
- Covered Tailgate Rollers — Check

ELECTRICAL TESTING

INDEX

ELECTRICAL 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.

BASIC EXCITATION CIRCUIT

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 generator slip ring and brush, to a grounded terminal, then on to the batteries completing the circuit.

A capacitor is connected across the direct current field breaker switch to prevent arcing of the switch points when the switch is closed.

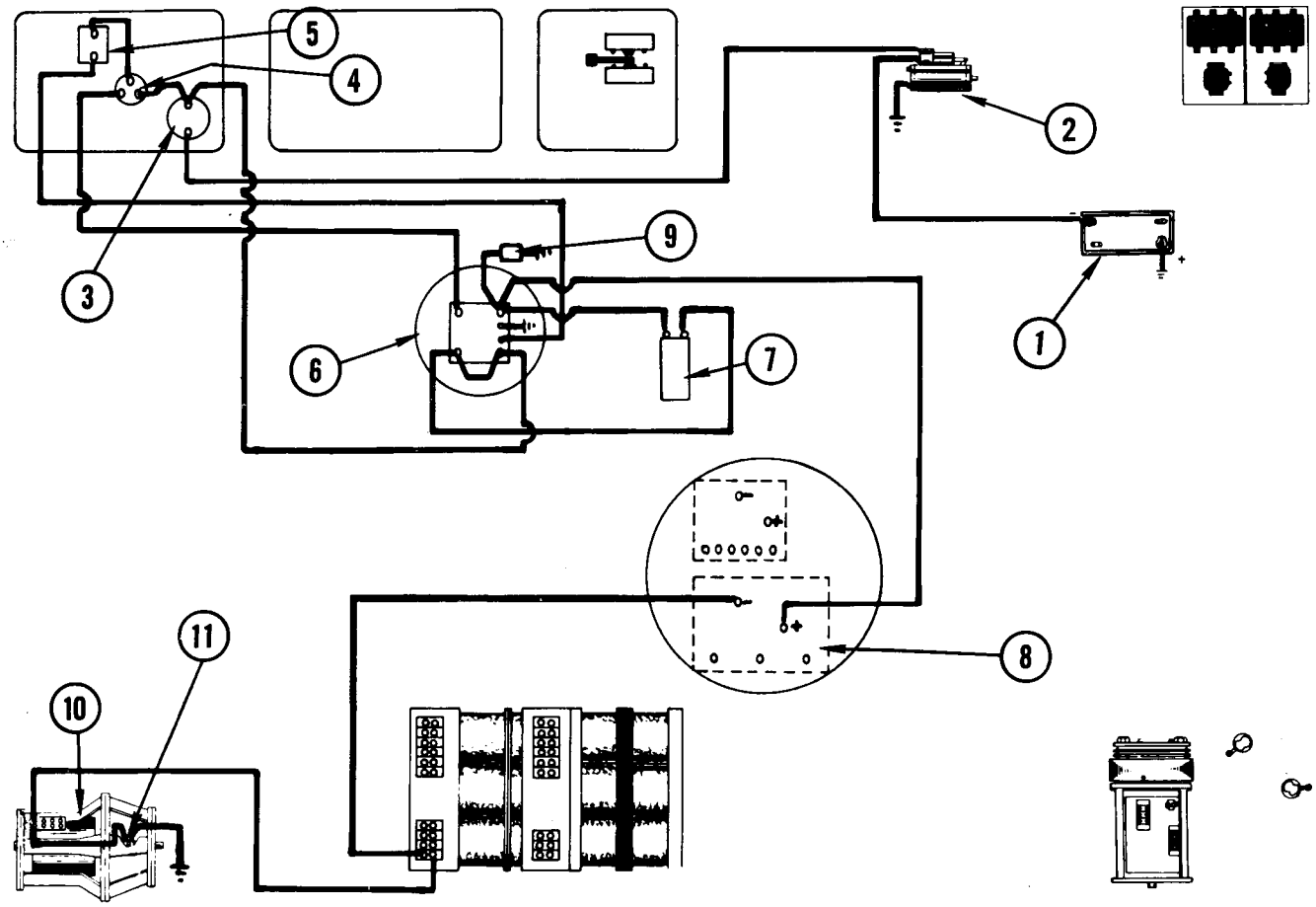


FIGURE L-1. BASIC EXCITATION CIRCUIT

1. Batteries
2. Cranking Motor
3. Ammeter
4. Key Switch
5. D.C. Main Switch
6. D.C. Circuit Breaker
7. Capacitor
8. Booster Rectifier
9. Resistor
10. A.C. Generator
11. Slip Rings (Field)

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 excited 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.

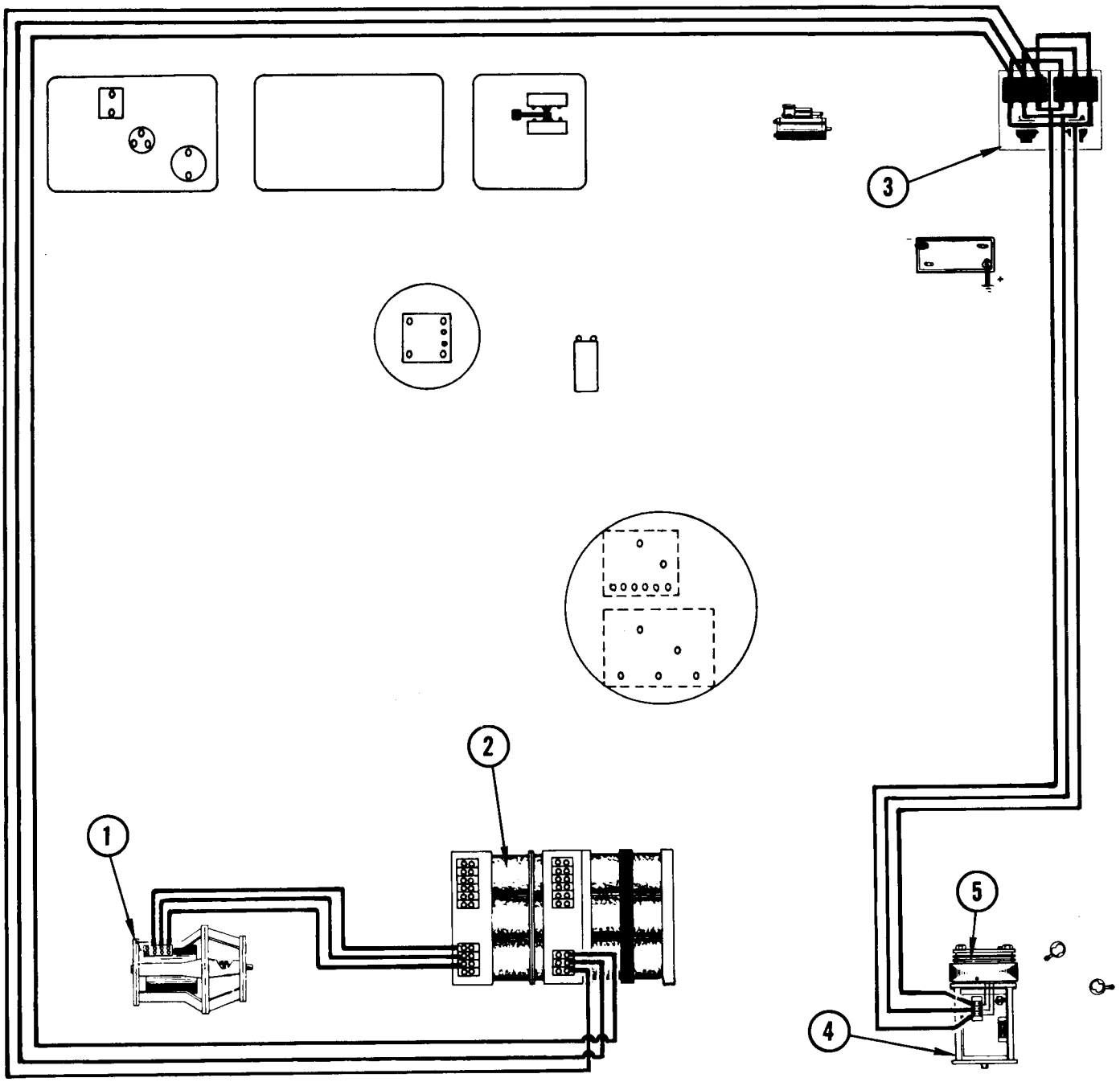


FIGURE L-2. THREE PHASE POWER CIRCUIT

1. A.C. Generator
2. Voltage Control Transformer
3. Main Switch
4. A.C. Motor
5. A.C. Motor Brake

BATTERY CHARGING CIRCUIT

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 of 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 rectifier.

The output of the main transformer varies with the position of its flux bridge and the amount of current flowing through the main transformer primary windings.

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.

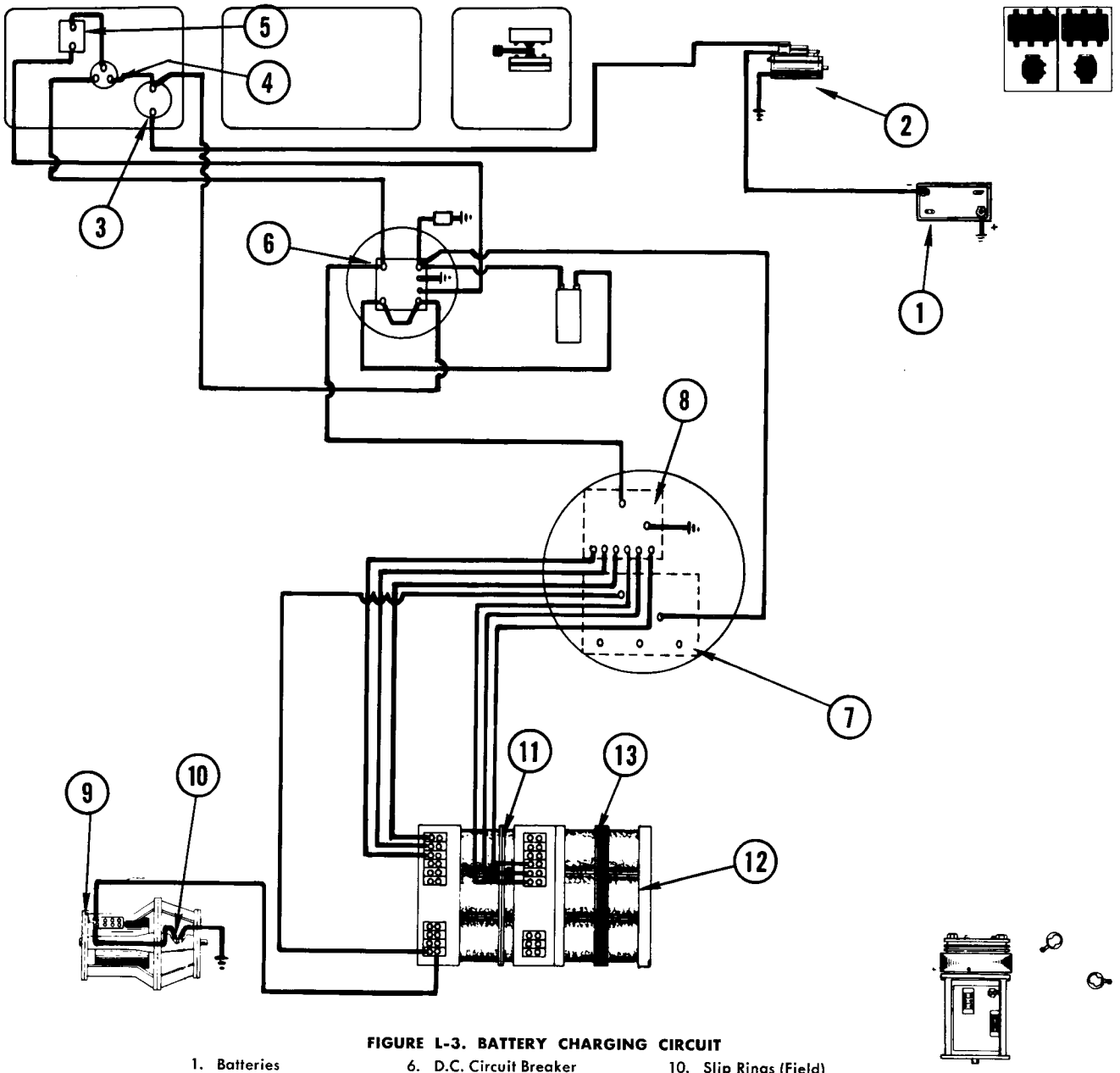


FIGURE L-3. BATTERY CHARGING CIRCUIT

1. Batteries
2. Cranking Motor
3. Ammeter
4. Key Switch
5. D.C. Main Switch
6. D.C. Circuit Breaker
7. Booster Rectifier
8. Battery Charging and Compensating Rectifier
9. A.C. Generator
10. Slip Rings (Field)
11. Voltage Control Transformer
12. Main Transformer
13. Flux Bridge

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 to 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.

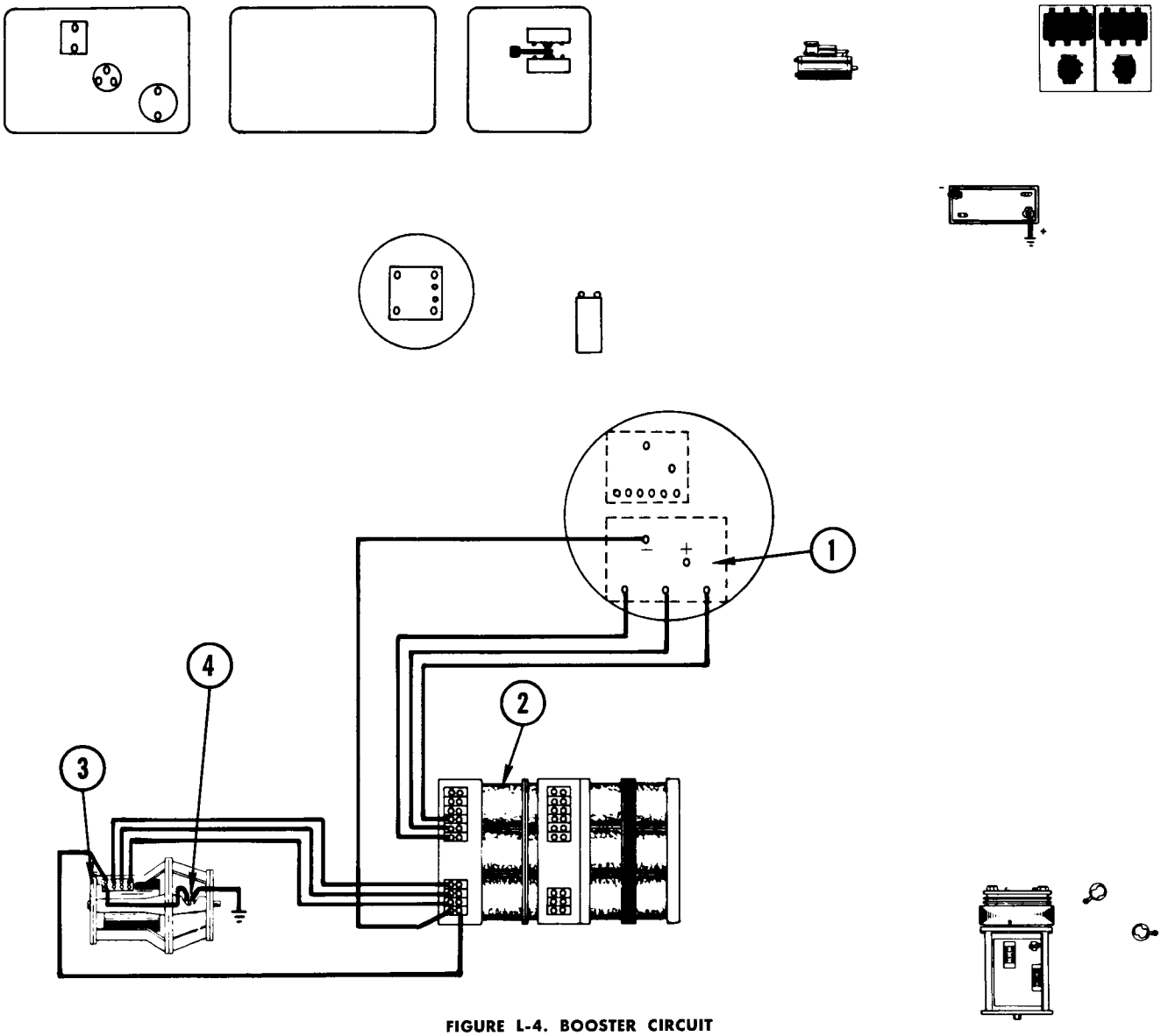


FIGURE L-4. BOOSTER CIRCUIT

1. Booster 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, a main switch for each direction of motor rotation, the main switch holding coil, heat control switch, and the 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 voltage control transformer through the switch. From the control switch the current flows through the main switch 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.

When the motor has cooled to safe operating temperatures the switch closes the circuit and the motor will operate.

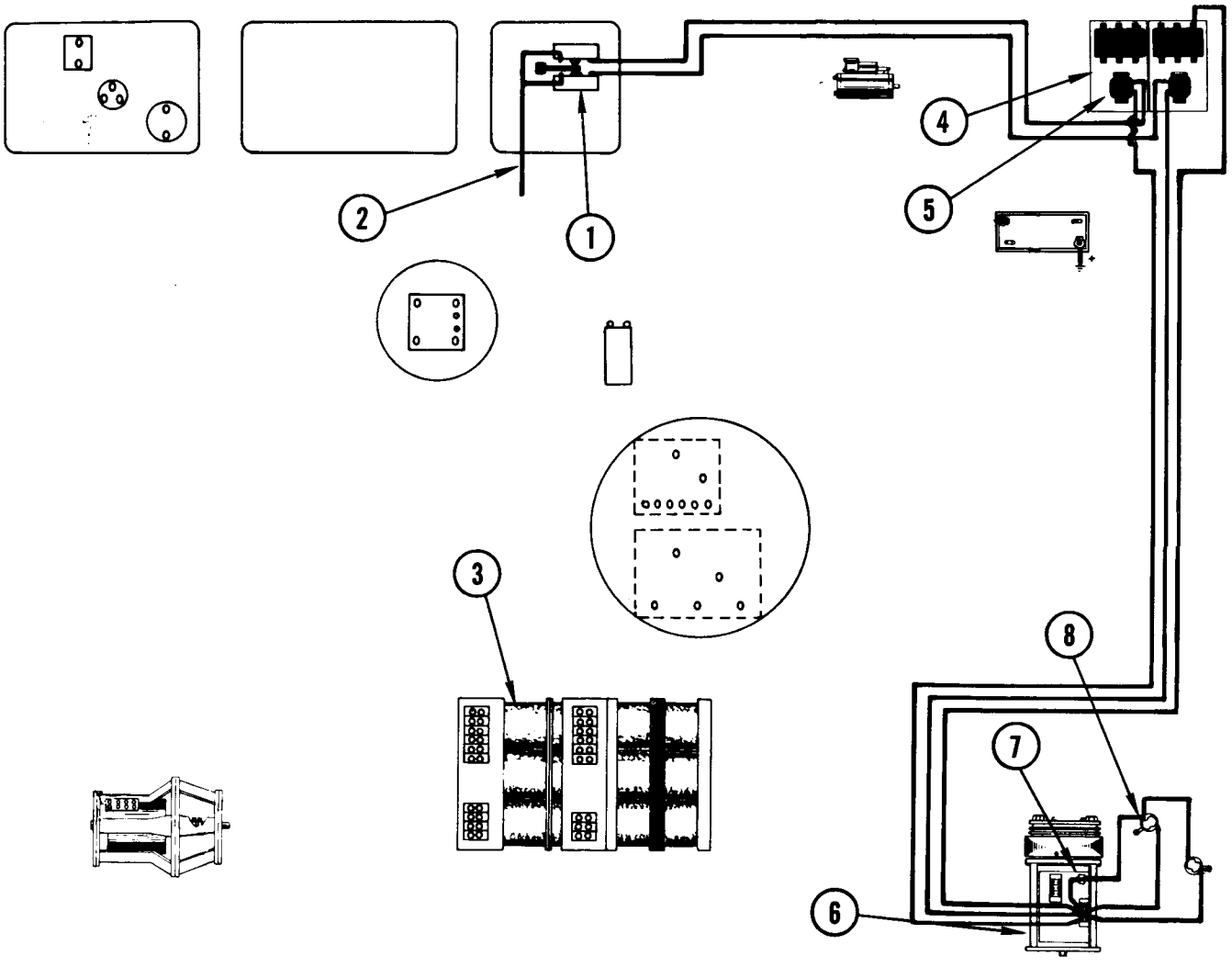


FIGURE L-5. CONTROL CIRCUIT

1. Fingertip Control Switch
2. Phase "B" Control Phase
3. Voltage Control Transformer
4. Main Switches
5. Holding Coil
6. A.C. Motor
7. Heat Switch
8. 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 operations 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.

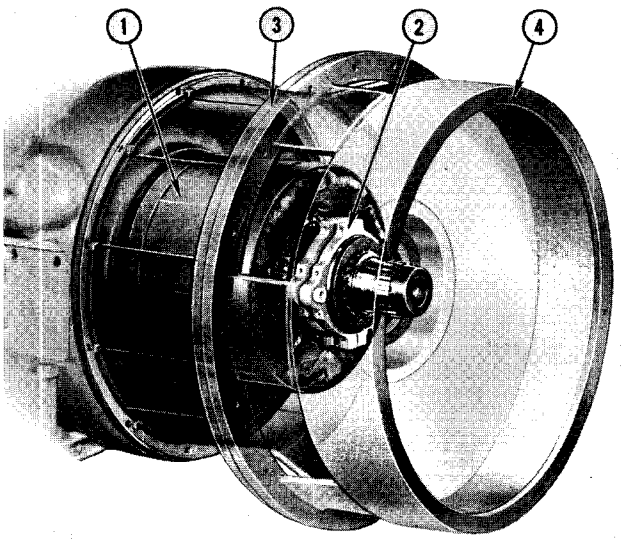


FIGURE L-6. A.C. GENERATOR

1. Rotor
2. Brushes
3. Stator
4. End Bell

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 device 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 (or output) line and is called the secondary coil.

A two unit transformer group, mounted under the cockpit right floor plate, provides excitation tation 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-

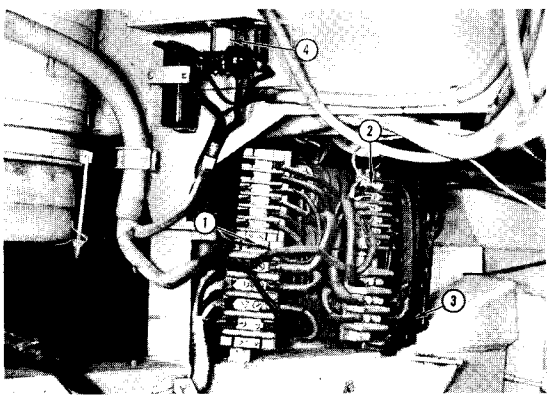


FIGURE L-7. TRANSFORMER ASSEMBLY

1. Voltage Control Transformer
2. Main Transformer
3. Adjustable Flux Bridge
4. D.C. Field Breaker Switch

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 is used as a mechanical 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 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.

Adding shims of a nonconductive material under the flux bridge will increase the output of the main transformer. Removing shims decreases the output.

RECTIFIERS

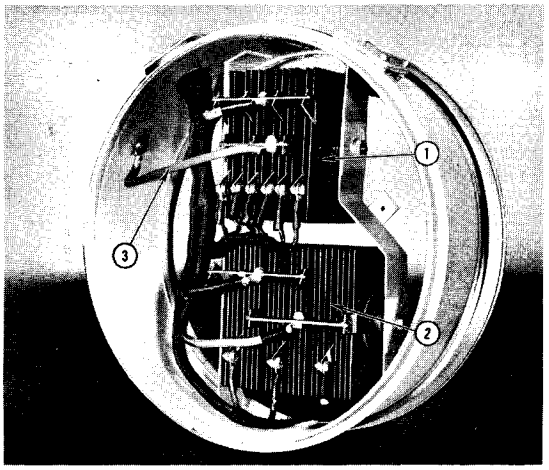


FIGURE L-8. RECTIFIER ASSEMBLY

1. Battery Charging and Compensating Rectifier
2. Booster Rectifier
3. Ground

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 consist 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, depending 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 the battery charging circuit Therefore, the battery charging rectifier is the only one that is grounded.

TESTING

Test Meter

This test meter has been designed specifically for LeTourneau-Westinghouse electrical equipment testing. Encased in a steel box with leather carrying handle, it is small enough to be carried from job to job.

Although the test meter is an 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.

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.

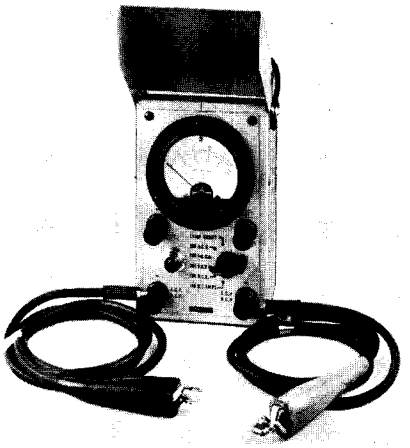


FIGURE L-9. TEST METER

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

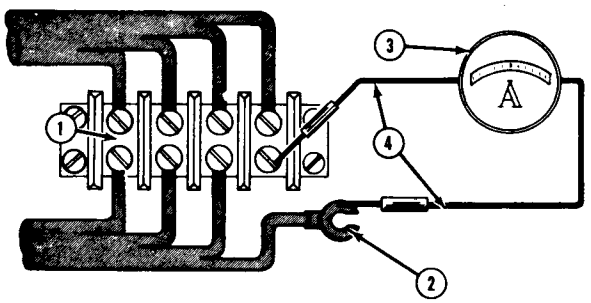


FIGURE L-10. D.C. AMPERAGE TEST

1. Terminal Strip
2. Conductor
3. Test Meter
4. Test Leads

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 right, polarity of the meter is reversed and the test leads must be reversed. The left swing is then changed to right.

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

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.

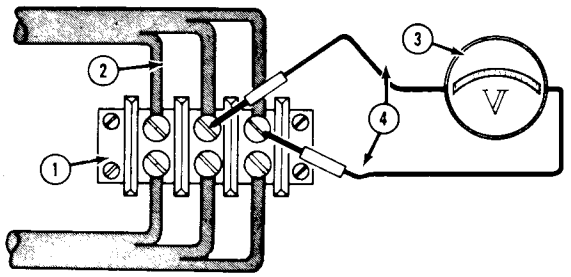


FIGURE L-11. A.C. VOLTAGE TEST

1. Terminal Strip
2. Wire
3. Test Meter
4. Test Leads

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 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 test.

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-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.

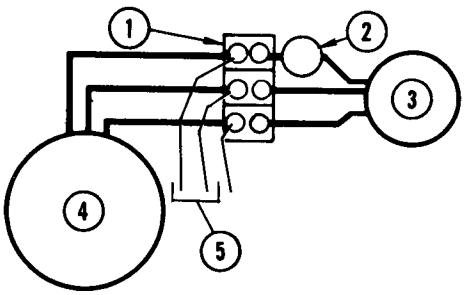


FIGURE L-12. HIGH VOLTAGE READING

1. Terminal Strip
2. Open
3. A.C. Motor
4. A.C. Generator
5. High Reading

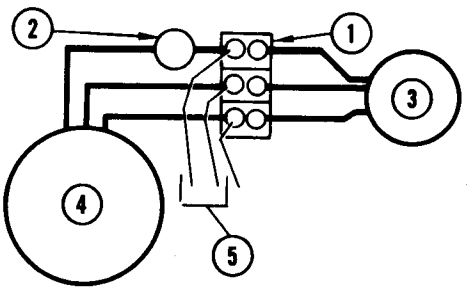


FIGURE L-13. LOW VOLTAGE READING

1. Terminal Strip
2. Open
3. A.C. Motor
4. A.C. Generator
5. Low Reading

Continuity Test

An open in the leads to the motor can be located by a continuity test after the leads to the brake coils have been disconnected.

An open or ground in the stator 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 were 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 the 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 2120 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 tests 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 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 the 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 "M" of this manual for proper electrolyte level and maintenance of batteries.

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.

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 12 to 13 d.c. amps.

Start the engine and after it has warmed up to operating temperature, operate at high idle. The meter should read approximately 16 to 19 d.c. amps.

Do not operate any electric motors during this test.

(VOLTAGE AT 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 12 to 17 volts d.c.

Start the engine and after warm up operate at high idle. Meter should read approximately 28 to 32 volts d.c.

Do not operate any electric motors during this test.

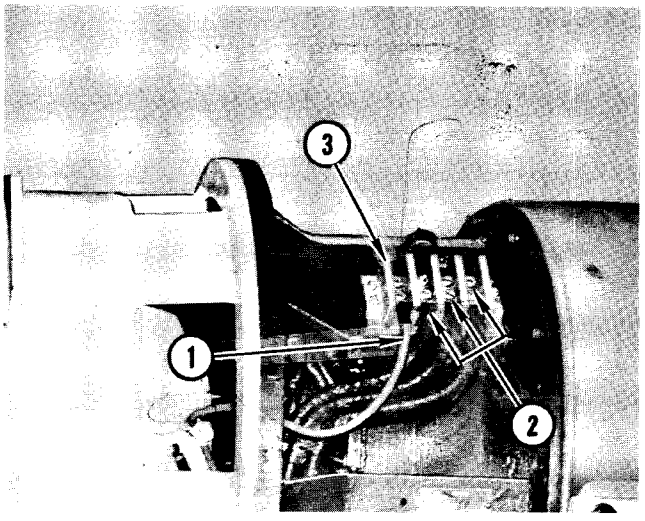


FIGURE L-14. A.C. GENERATOR TERMINAL STRIP

1. Field Lead
2. A.C. Leads
3. Terminal Strip

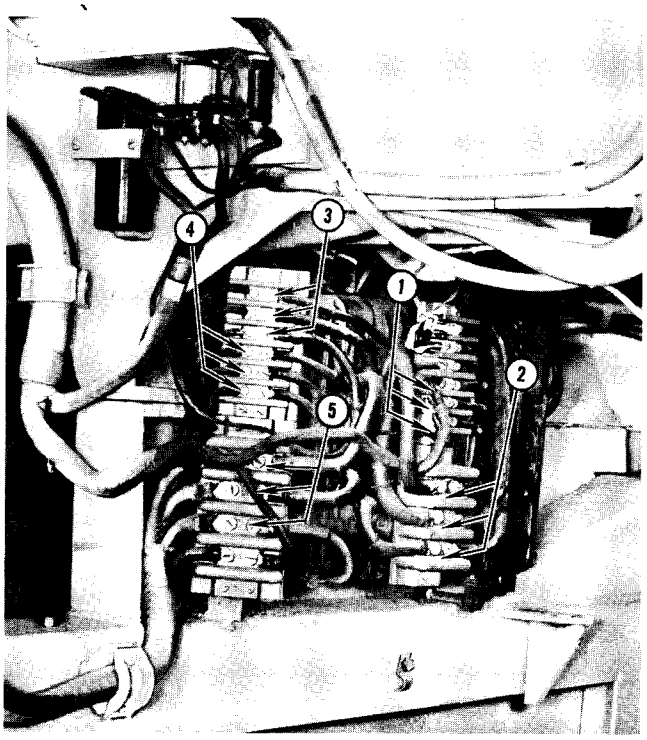


FIGURE L-15. TRANSFORMER TERMINAL STRIPS

1. A.C. Output to Battery Charging Rectifier
2. A.C. Output to Power Circuit
3. A.C. Output to Compensating Rectifier
4. A.C. Output to Booster Rectifier
5. A.C. Input to Voltage Control Transformer

(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 340 to 370 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).

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 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 340 to 370 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 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 330 to 360 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. input 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 340 to 370 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 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 left 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 10 to 11 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 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 right 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 22 to 24 volts a.c.

(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 key switch and the D.C. Main Switch. Start the engine and after warm up operate at high idle. No wires are to be disconnected for this test.

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 main transformer). Make three tests (A to B, A to C, and B to C). Meter should read approximately 20 to 24 volts a.c.

An unbalanced reading indicates possible faulty rectifiers or transformer windings.

(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 26 to 29 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.

(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 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 32 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)

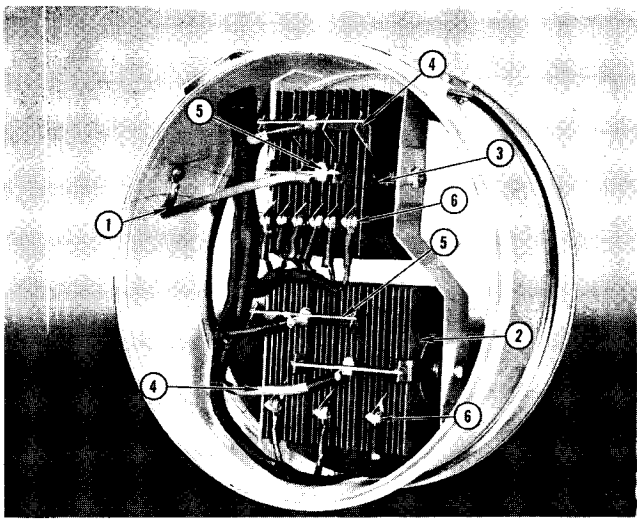


FIGURE L-16. RECTIFIER TERMINALS

1. Ground
2. Booster Rectifier
3. Compensating and Battery Charging Rectifier
4. Negative Terminal (−)
5. Positive Terminal (+)
6. A.C. Terminals
7. Main Transformer

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 booster rectifier, 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. The difference between the two readings should be approximately 5 to 10 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 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 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 340 to 370 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 on the main switch holding coil as the finger tip switch is engaged. A voltage reading on the 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 not register a 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 the 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 test lamp glows, the heat control switch is in operating condition. If the lamp does not 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 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 D.C. Main Switch. Start the engine and after warm up, operate at high idle. No wires are to be disconnected for this test.

Attach one test meter lead to one of the a.c. terminals on the motor terminal strip and the other lead to another a.c. terminal. Close the control switch controlling the motor under test. Make three tests (A to B, A to C and B to C).

Meter should read approximately 340 to 370 volts a.c. Readings should vary no more than 5% between any two readings.

If two of the voltage readings are normal and one reading is considerably below normal, it indicates an open in the stator.

If two of the voltages are considerably below normal and one reading is normal, it indicates an open between the generator and the motor. Proceed with generator, transformer and continuity checks.

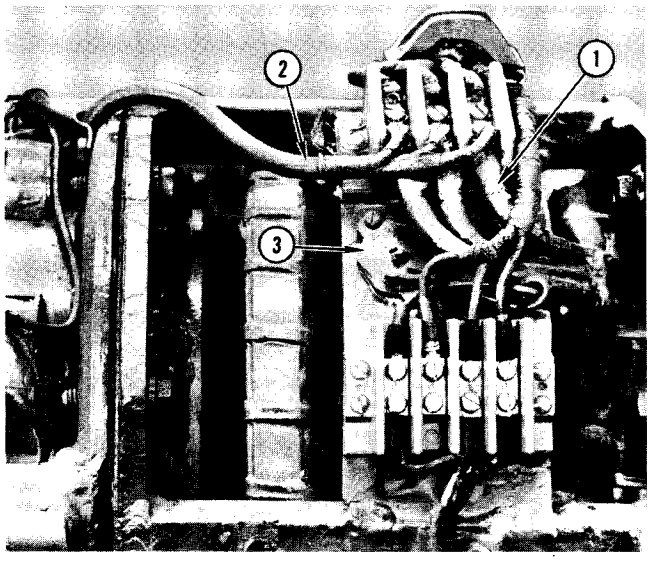


FIGURE L-17. A.C. MOTOR TERMINAL STRIP

1. A.C. Leads
2. Brake Leads
3. Heat Switch

(GROUND TEST)

Turn the test meter selector switch to 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 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 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 lead and the other coil terminal with the remaining test lead. If the coil is in good condition the 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 nor-

mal 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

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.
   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 current is not 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, unbalanced 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 the 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 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.

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 the stator and rotor. The rotor may be filled with dirt causing improper ventilation in the rotor because of the openings 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.

LIST OF ELECTRICAL READINGS

A. ENGINE NOT RUNNING

TEST	READING
1. Battery Voltage	Approximately 24 Volts D.C.
2. Voltage at Field	Approximately 12 to 17 Volts D.C.
3. Amperage to Field	Approximately 12 to 13 Amps. D.C.
4. Voltage Drop (Booster Rectifier)	Approximately 7 to 12 Volts D.C.

B. ENGINE RUNNING AT HIGH IDLE (Approx. 2120 RPM) NO LOAD READINGS

TEST	READING
1. Voltage at Field	Approximately 28 to 32 Volts D.C.
2. Amperage to Field	Approximately 16 to 19 Amps. D.C.
3. Amperage – Battery Charging Circuit	Approximately 25 to 29 Amps. D.C.
4. Voltage of Battery Charging Circuit	Approximately 26 to 29 Volts D.C.
5. A.C. Generator Output	Approximately 340 to 370 Volts A.C.
6. Charge Rate	Approximately 8 to 10 Amps. D.C.
7. A.C. Input to Compensating Part of Main Rectifier	Approximately 23 to 24 Volts A.C.
8. A.C. Input to Battery Charging Part of Main Rectifier	Approximately 22 to 23 Volts A.C.
9. Input to Booster Rectifier	Approximately 10 to 11 Volts A.C.

C. LOADED READINGS (Trail Unit Empty)

TEST	One Motor Only	Two Motors Only
	READING	
1. Voltage at the Field	Approx. 45 to 55 Volts D.C.	Approx. 70 to 75 Volts D.C.
2. Amperage to the Field	Approx. 30 to 35 Amps. D.C.	Approx. 40 to 45 Amps. D.C.
3. Amperage – Generator Charging Circuit	Approx. 35 to 40 Amps. D.C.	Approx 45 to 50 Amps. D.C.
4. Voltage of Battery Charging Circuit	Approx. 24 to 25 Volts D.C.	Approx. 24 to 25 Volts D.C.
5. A.C. Generator Output	Approx. 350 to 370 Volts A.C.	Approx. 350 to 370 Volts A.C.
6. Charge Rate	Approx. 5 to 7 Amps. D.C.	Approx. 2 to 5 Amps. D.C.
7. A.C. Input to Compensating Part of Main Rectifier	Approx. 24 to 26 Volts A.C.	Approx. 24 to 26 Volts A.C.
8. A.C. Input to Battery Charging Part of Main Rectifier	Approx. 23 to 25 Volts A.C.	Approx. 23 to 25 Volts A.C.
9. Input to Booster Rectifier	Approx. 32 to 37 Volts A.C.	Approx. 45 to 50 Volts A.C.

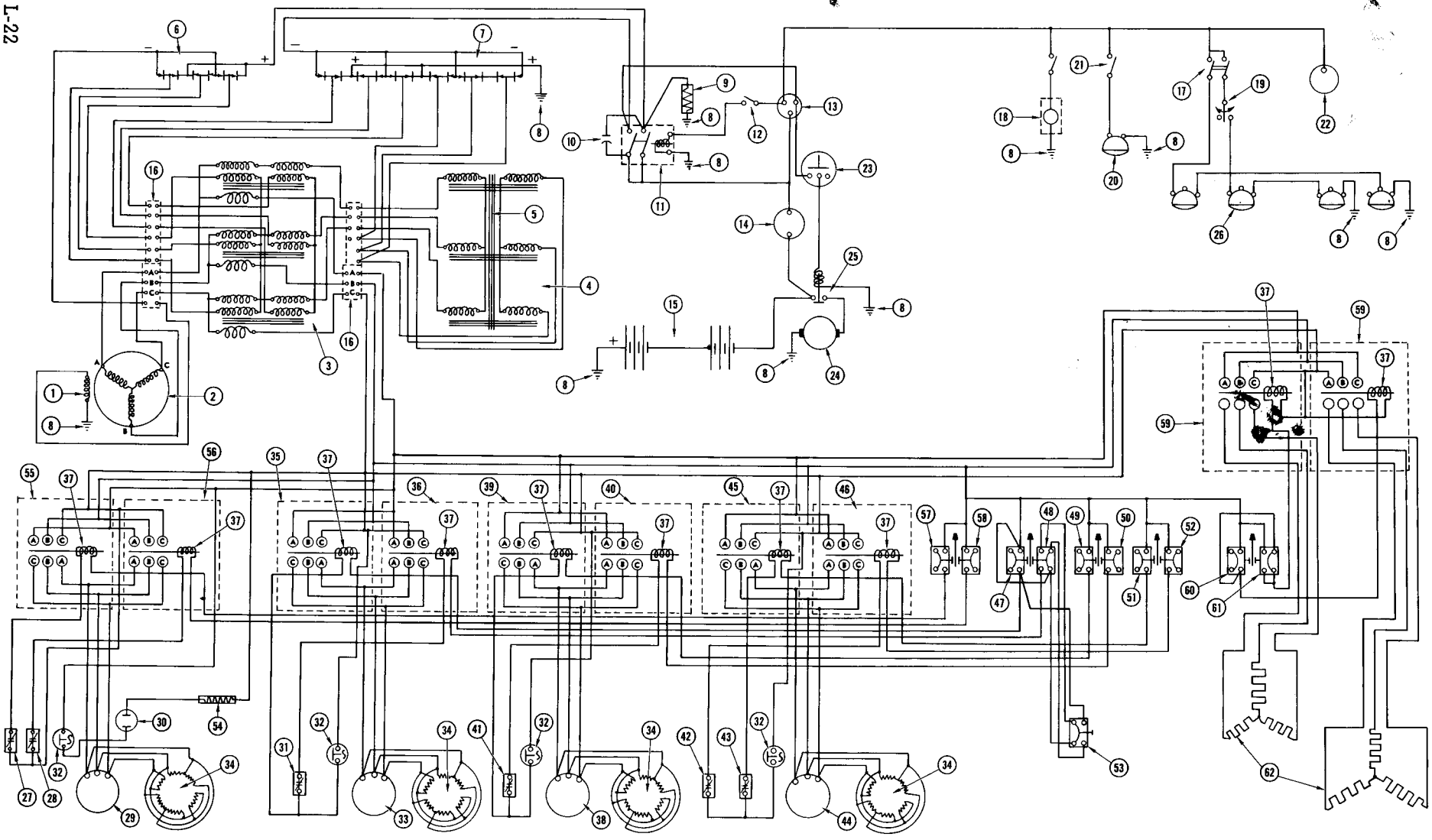


FIGURE L-18. TYPICAL WIRING SCHEMATIC

1. Generator Rotor (Brushes)
2. Generator Stator
3. Voltage Control Transformer
4. Flux Bridge (Main) Transformer
5. Magnetic Flux Bridge
6. Booster Rectifier
7. Battery Charging and Compensating Rectifier
8. Ground
9. 50 Ohm Resistor
10. 100 mfd Capacitor
11. D.C. Field Breaker Switch
12. D.C. Main Switch
13. Key Switch
14. Ammeter
15. Batteries (2-12 volt)
16. Terminal Strip
17. Headlight Switch
18. Panel Light
19. Headlight Dimmer Switch
20. Scraper Light
21. Scraper Light Switch
22. Cockpit Accessories
23. Cranking Motor Switch
24. Cranking Motor
25. Cranking Motor Solenoid
26. Headlights
27. Right Steering Limit Switch
28. Left Steering Limit Switch
29. Steering Motor
30. Steering Motor Warning Light
31. Hoist Up Limit Switch
32. Heat Switch
33. Hoist Motor
34. Motor Brake
35. Hoist Down Main Switch
36. Hoist Up Main Switch
37. Holding Coil
38. Apron Motor
39. Apron Down Main Switch
40. Apron Up Main Switch
41. Apron Up Limit Switch
42. Tailgate Forward Limit Switch
43. Tailgate Back Limit Switch
44. Tailgate Motor
45. Tailgate Forward Main Switch
46. Tailgate Back Main Switch
47. Hoist Up Control Switch
48. Hoist Down Control Switch
49. Apron Up Control Switch
50. Apron Down Control Switch
51. Tailgate Forward Control Switch
52. Tailgate Back Control Switch
53. Quick Drop Interlock Switch
54. 25,000 Ohm Resistor
55. Steering Right Main Switch
56. Steering Left Main Switch
57. Right Steering Switch
58. Left Steering Switch
59. Electrotarder Main Switches
60. Electrotarder "High" Position Switch
61. Electrotarder "Low" Position Switch
62. Electrotarder Grids

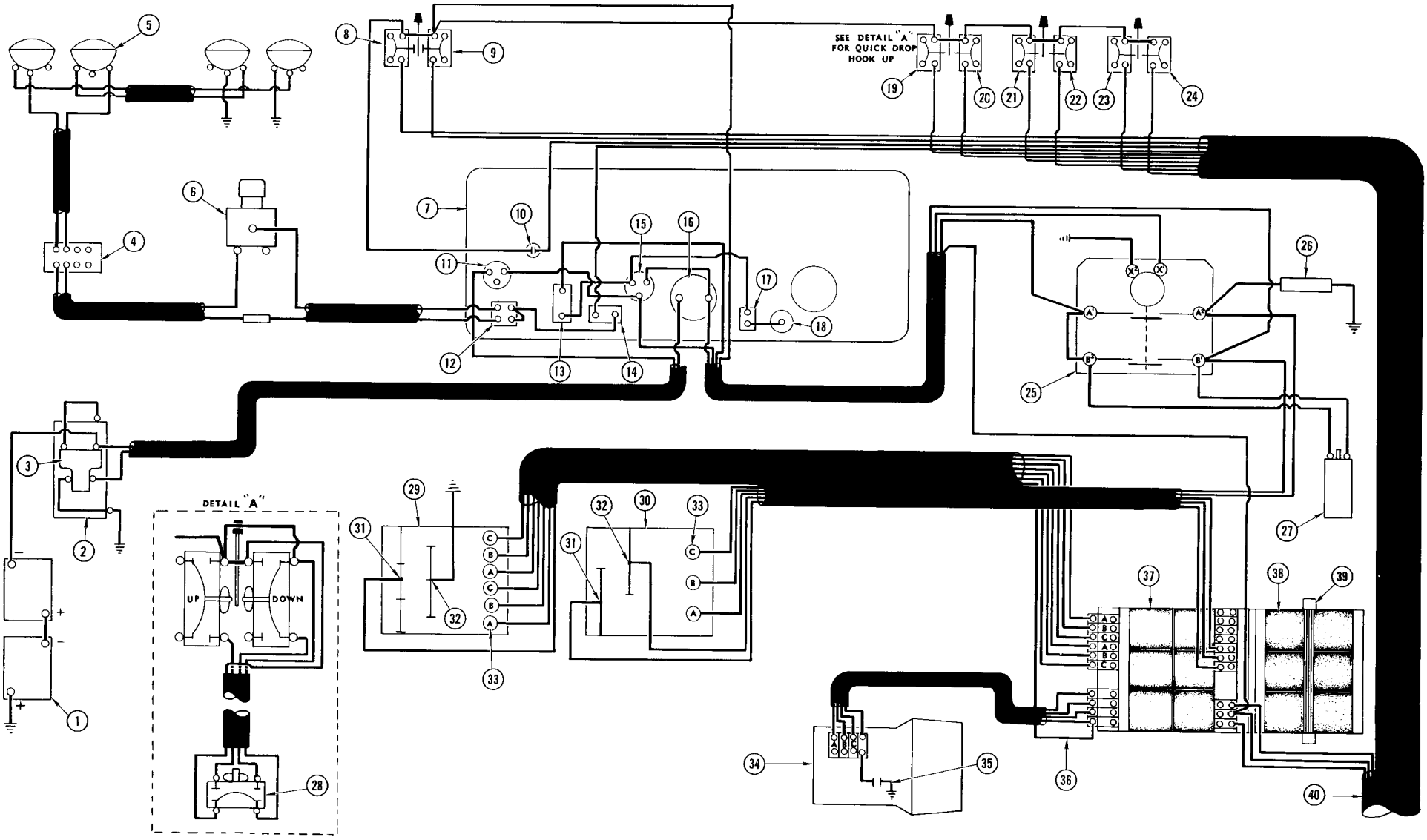


FIGURE L-19. TYPICAL WIRING HOOK UP (TOURNAPULL)

1. Batteries (2-12 volt)
2. Cranking Motor
3. Cranking Motor Solenoid
4. Terminal Strip
5. Headlights
6. Headlight Dimmer Switch
7. Instrument Panel
8. Steering Right Control Switch
9. Steering Left Control Switch
10. Steering Motor Warning Light
11. Cranking Motor Switch
12. Headlight Switch
13. D.C. Main Switch
14. Rear Light Switch
15. Key Switch
16. Ammeter
17. Panel Light Switch
18. Panel Light
19. Hoist Up Control Switch
20. Hoist Down Control Switch
21. Apron Up Control Switch
22. Apron Down Control Switch
23. Tailgate Forward Control Switch
24. Tailgate Back Control Switch
25. D.C. Field Breaker Switch
26. 50 Ohm Resistor
27. 100 mfd Capacitor
28. Quick Drop Interlock Switch
29. Battery Charging and Compensating Rectifier
30. Booster Rectifier
31. Negative Terminal (--)
32. Positive Terminal (+)
33. A.C. Terminals
34. A.C. Generator
35. Generator Brushes (Field)
36. Generator Field Lead
37. Voltage Control Transformer
38. Flux Bridge (Main) Transformer
39. Magnetic Flux Bridge
40. Main Cable To Right Hand Main Switch Box

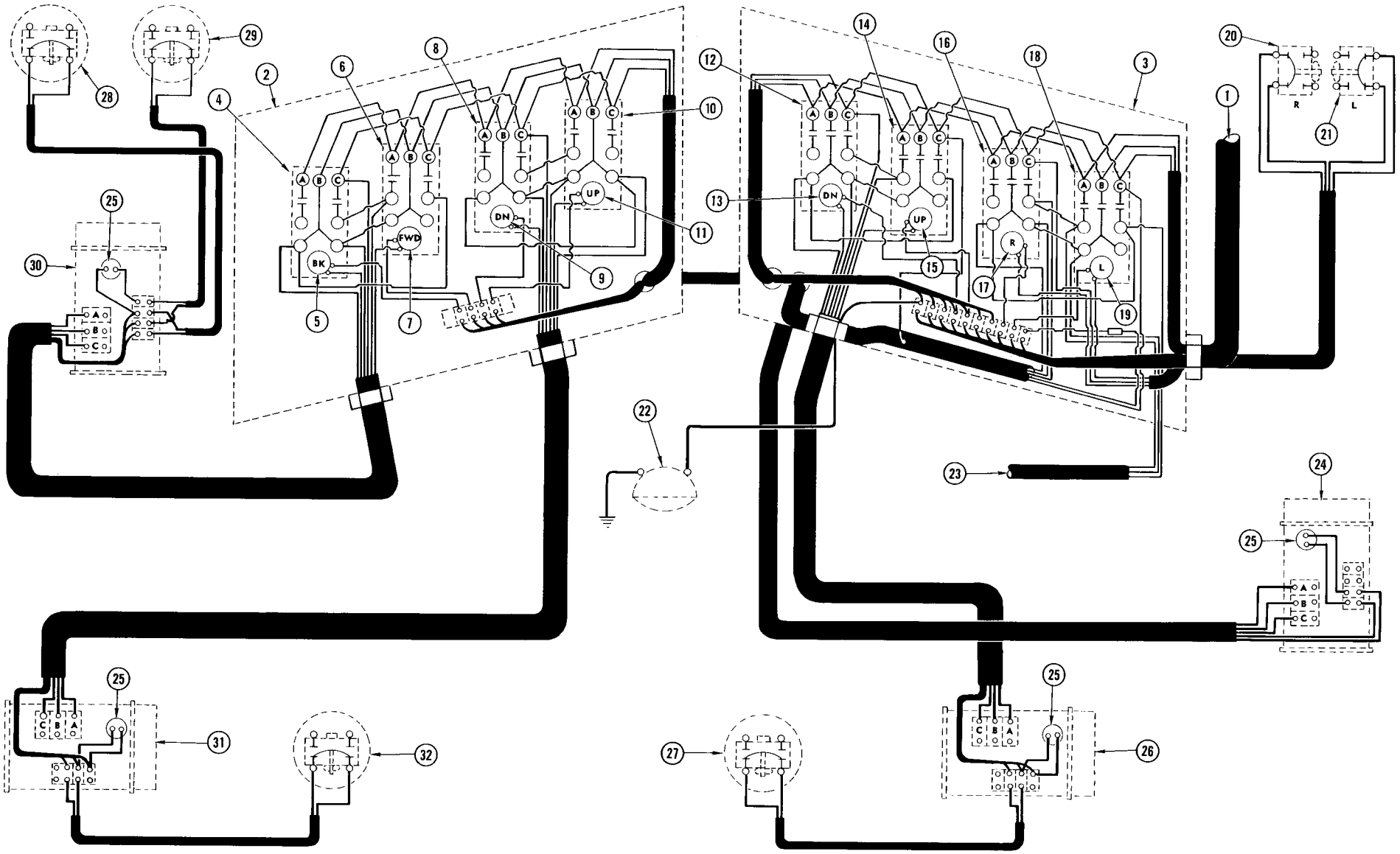


FIGURE L-20. TYPICAL WIRING HOOK UP (TRAIL UNIT)

1. Main Cable From Transformer & Panel
2. Left Main Switch Box
3. Right Main Switch Box
4. Tailgate Back Main Switch
5. Tailgate Back Holding Coil
6. Tailgate Forward Main Switch
7. Tailgate Forward Holding Coil
8. Apron Down Main Switch
9. Apron Down Holding Coil
10. Apron Up Main Switch
11. Apron Up Holding Coil
12. Hoist Down Main Switch
13. Hoist Down Holding Coil
14. Hoist Up Main Switch
15. Hoist Up Holding Coil
16. Steering Right Main Switch
17. Steering Right Holding Coil
18. Steering Left Main Switch
19. Steering Left Holding Coil
20. Steering Right Limit Switch
21. Steering Left Limit Switch
22. Scraper Light
23. To Steering Motor Brakes
24. Steering Motor
25. Heat Switch
26. Hoist Motor
27. Hoist Up Limit Switch
28. Tailgate Back Limit Switch
29. Tailgate Forward Limit Switch
30. Tailgate Motor
31. Apron Motor
32. Apron Down Limit Switch

MODEL C SCRAPER

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MODEL C SCRAPER

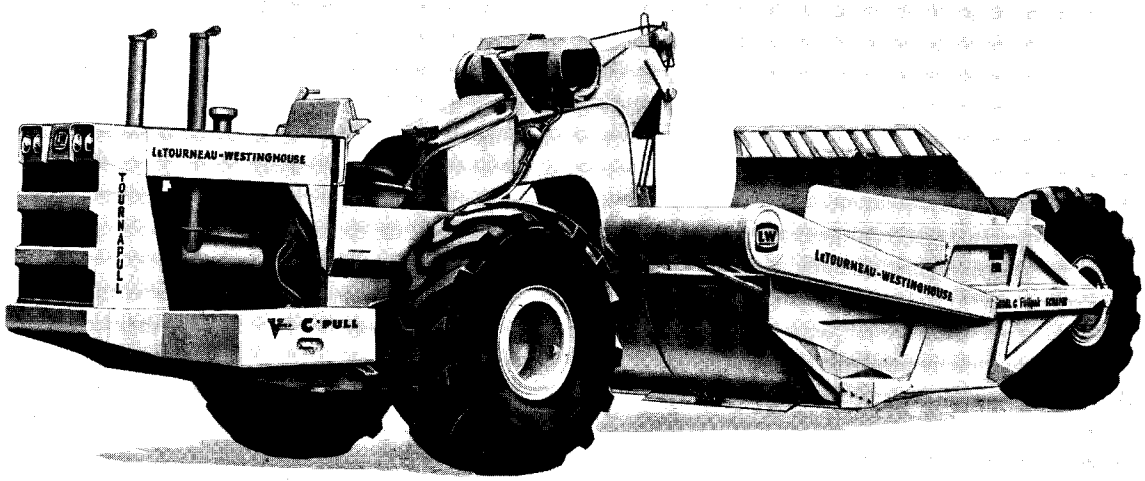


FIGURE M-1. V POWER C TOURNAPULL WITH SCRAPER

SEPARATING TOURNAPULL AND SCRAPER

Lower apron and bowl until wire ropes are slack. Crib up under nose of Tournpull using good, solid cribbing. Construct cribbing carefully. Block Tournapull wheels, front and rear, to prevent movement when the units are separated.

Raise bowl slightly until nose of Tournapull is resting on the cribbing.

Remove covers from main switch boxes on steering trunnion and disconnect the wiring leading back to the scraper.

Bleed the air system and disconnect air lines to the scraper wheel brakes and to the quick release wire rope drum.

Place chain hoist around the yoke structure neck. Position wood blocks along yoke to protect any tubing which may be damaged by the chain hoist. Apply only enough tension to relieve any strain on the yoke connecting bolts.

Position blocks under each side of the steering trunnion to prevent its tipping when the trail unit is removed.

Remoke yoke connecting bolts and lower scraper until both bowl and yoke are resting on the ground.

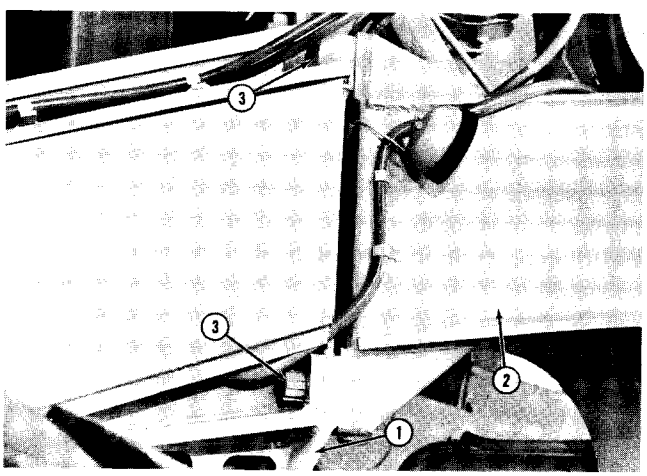


FIGURE M-2. HITCH BOLTS

1. Steering Trunnion
2. Scraper Yoke
3. Hitch Bolts

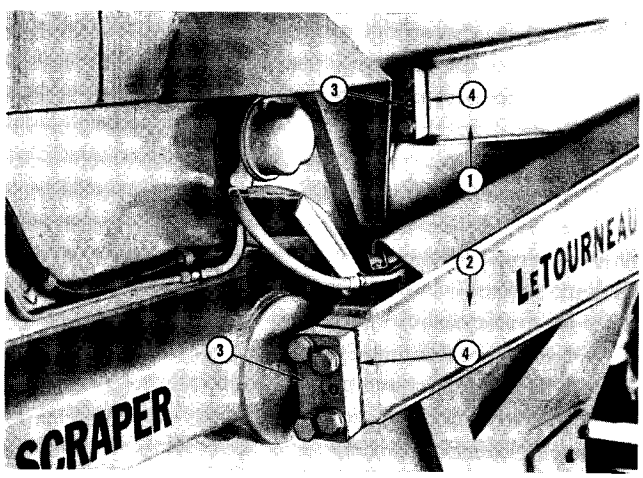


FIGURE M-3. BALL AND SOCKET JOINTS

1. Apron Arm
2. Yoke Arm
3. Cap
4. Shims

YOKE ARMS

Removing

Disconnect the conductor cable to tailgate motor and limit switches; and air lines to scraper wheel brakes.

Free apron hoist wire rope and bowl hoist wire rope from dead ends. Pull bowl wire rope from sheaves on bowl.

Fasten hoist to yoke arm structure (near the ball caps) to prevent yoke dropping when caps are removed. Take up the slack in the hoist.

Remove capscrews and lockwashers securing the yoke arm ball caps to the yoke arms. Remove caps and shims. Keep shims together for replacement. Lift yoke arms away from bowl.

The same procedure is to be used for both apron and yoke ball joints.

Assembling

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 a snug fit. Secure with capscrews and lockwashers. Torque capscrews to 360 ft. lbs. Repeat procedure for other side.

Lubricate thoroughly. See page K-14 for correct type of lubricant.

TAILGATE

Removal

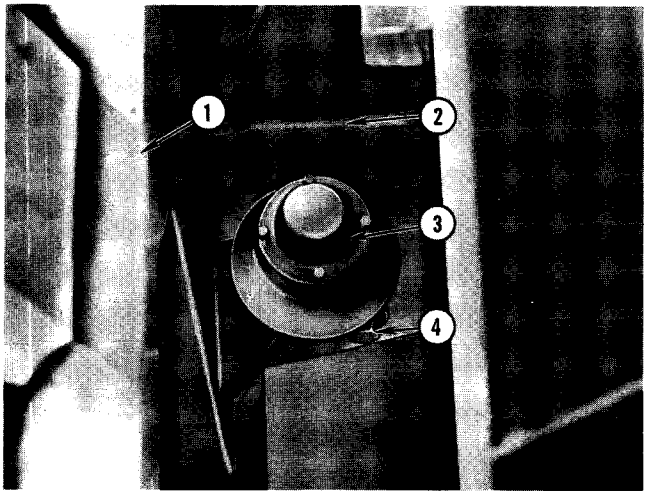


FIGURE M-4. TAILGATE THRUST ROLLER

1. Tailgate
2. Side Sheet
3. Roller Cap
4. Clamping Bolt

Position tailgate for access to the side thrust tailgate rollers. See figure M-4.

Remove the four capscrews and lockwashers securing the cap to top of roller. Remove cap and gasket. Remove cotter and nut from top of roller shaft.

Loosen the bolt clamping the roller shaft to tailgate. With a soft hammer or brass drift, drive the roller shaft down through the roller and the mounting plate. The upper and lower bearings and oil seal will remain in roller.

Remove bearings and oil seal from inside the thrust roller if service is necessary.

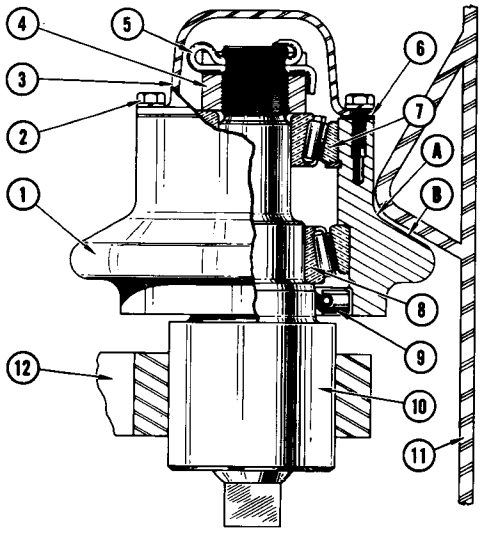


FIGURE M-5. ROLLER CUT AWAY

1. Roller
2. Capscrew
3. Cap
4. Nut
5. Cotter
6. Gasket
7. Bearing Cup
8. Bearing Cone
9. Oil Seal
10. Roller Shaft
11. Side Sheet
12. Mounting Plate

Both thrust rollers must be removed before attempting to remove tailgate.

Remove capscrews and lockwashers fastening the rail scraper to the tailgate beam. See figure M-6.

Back off wire rope tightener and pull tailgate reverse wire rope from dead end and sheave.

Remove tailgate forward wire rope from dead end and pull from sheaves.

Block up under end of tailgate beam. Remove capscrews, lockwashers and nut from upper tailgate roller.

CAUTION: Tailgate may fall free as upper roller is removed.

Place chain about tailgate and pull forward out of bowl. It may be necessary to move tailgate box beam structure to the right to permit clearance at rear and sides of bowl. Remove tailgate.

Installation

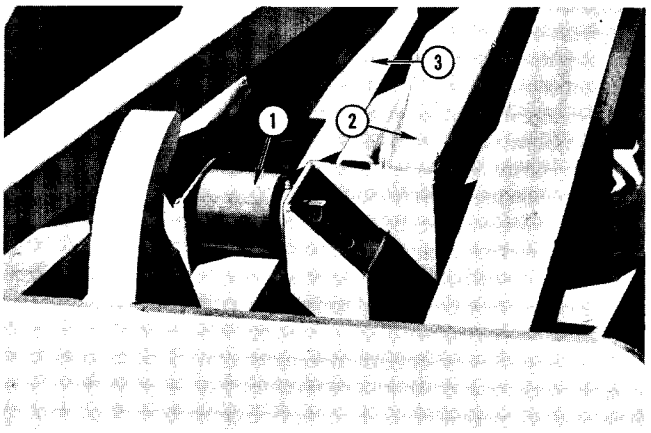


FIGURE M-6. TAILGATE REAR ROLLER

1. Top Roller
2. Tailgate
3. Beam

Install tailgate by reversing the removal procedure.

Replace side thrust rollers in the following manner. Clean all parts thoroughly in cleaning solvent. Check bearing carefully. Inspect oil seals for cracks or dryness. Replace any damaged or worn parts.

Replace bearing assemblies into thrust roller. Install oil seal into bottom of roller with the lip facing in. Pack cavity full of wheel bearing grease.

Position the roller over the clamp and push shaft up through clamp into roller. Replace nut on roller shaft and tighten until a slight drag is felt when turning the roller by hand. Secure with cotter.

Pack cap with wheel bearing grease. Replace gasket and cap on roller and secure with capscrews and lockwashers.

Place a wrench on the bottom of roller shaft and rotate roller shaft on its eccentric to obtain a 1/16" clearance between the side of the roller and the edge of the roller guide. (Make adjustments at points A and B, figure M-5).

Tap roller assembly up or down (as necessary) to obtain a 1/16" clearance between the flanged roller edge and the bottom edge of roller guide.

When these adjustments have been made, lock roller in position by tightening clamp nut to 300 ft. lbs. torque.

AXLE

Removal

Block up side of scraper so that wheel and axle to be removed rolls free.

Bleed the air system (as a safety precaution) and disconnect air line to wheel brake.

Attach sling to tire. Apply enough lift on the sling to relieve any strain on the capscrews fastening the axle blocks to the scraper (figure M-7).

Remove the capscrews and lockwashers fastening the inner axle blocks and brake mount to the scraper.

Remove the two nuts and lockwashers from the "U" bolt securing the scraper block and axle to the outer axle mount (figure M-8).

Lower wheel and axle until it is free from the body. Pull directly to the rear and remove from scraper.

Disassembly

Remove taperhead capscrews securing wheel to axle. Lift wheel and tire from axle. Lift off the brake drum. Remove brake assembly as described in section "H" of this manual.

Remove capscrews, lockwashers and nuts securing inner top and bottom axle blocks together. Remove axle blocks and brake mount from axle.

Remove locking capscrew and washer from axle nut and back axle nut from axle.

Pull axle from housing. Inner bearing cone will come with axle. Inner oil seal, inner bearing cup, outer bearing cup and outer oil seal will remain in housing. Outer bearing cone will be removed from axle as axle is removed from housing. Remove oil seals and bearing cups from axle housing.

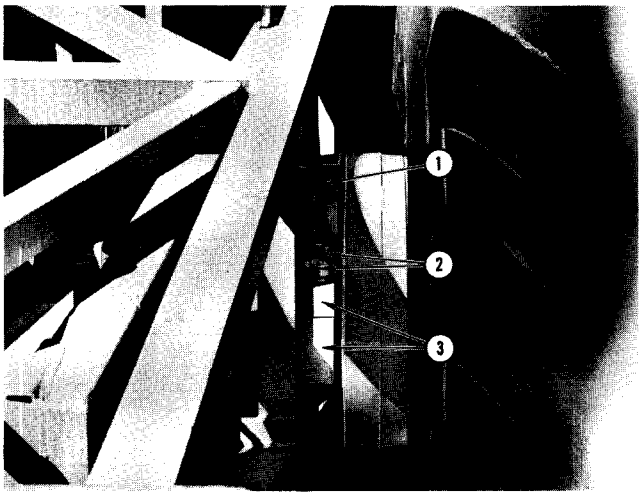


FIGURE M-7. INNER AXLE BLOCK

1. Brake Mount
2. Capscrews
3. Axle Blocks

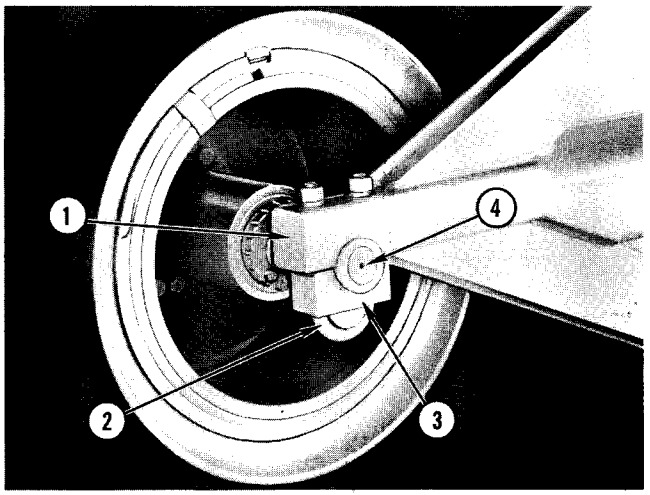


FIGURE M-8. OUTER AXLE MOUNT

1. Axle Mount
2. "U" Bolt
3. Block
4. Axle

Reassembly and Installation

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.

Replace inner and outer bearing cups into axle housing. Press inner bearing cone on axle until it bottoms on oil seal race.

Replace inner oil seal, with lip toward center of axle, and position axle into housing. Install outer bearing cone over axle. Replace outer oil seal, with lip away from center of axle, and axle nut. Tighten axle nut until housing turns with a slight drag on hub. Replace locking screw and lockwasher into axle nut, and tighten.

Position brake mount over axle. Position the top inner axle block against the mounting plate on the scraper bowl. Secure with capscrews.

Replace brake, wheel and tire on axle assembly. Hoist wheel and axle group and position on scraper. Replace the "U" bolt and spacer block at outer axle mount and secure with nuts and lockwashers. Secure brake mount to the mounting plate on bowl with capscrews and lockwashers. Replace inner axle block and secure with capscrews and lockwashers.

Torque wheel capscrews to 900 ft. lbs.

Reconnect air brake line to fitting on brake backing plate.

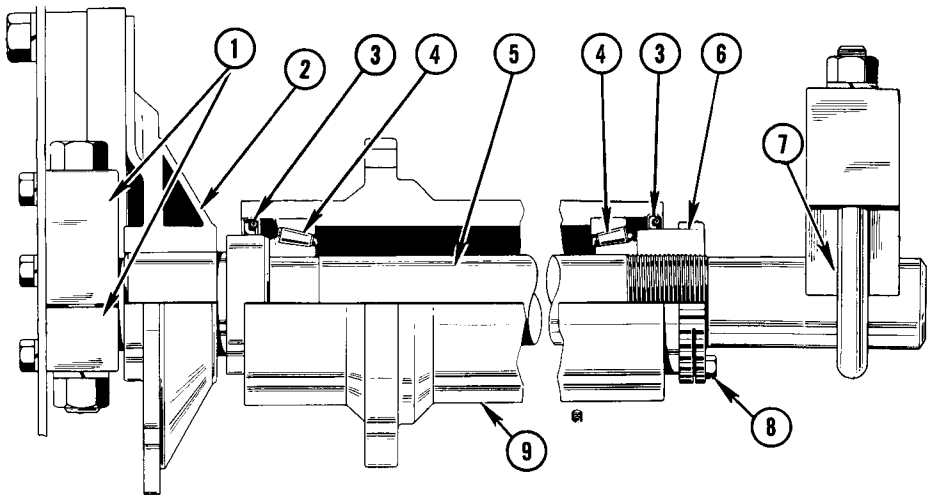


FIGURE M-9. SCRAPER AXLE

1. Inner Axle Blocks
2. Brake Mount
3. Oil Seal
4. Bearing
5. Axle
6. Locknut
7. Outer Axle Block
8. Lock Bolt
9. Hub

QUICK DROP PLANETARY

Removal and Disassembly

Unwind wire rope from wire rope drum and remove from dead end. Drain lubricant from quick drop planetary.

Disconnect linkage from brake cylinder to the brake band, remove band from around brake drum (see figure M-10).

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, gasket and sun gear from the wire rope drum.

Remove roll pins and washers from planet gear axles. Pull planet gears and bearings from shafts.

Press sun gear and shaft from gear support. Remove oil seal, snap ring and bearings from bore in gear support.

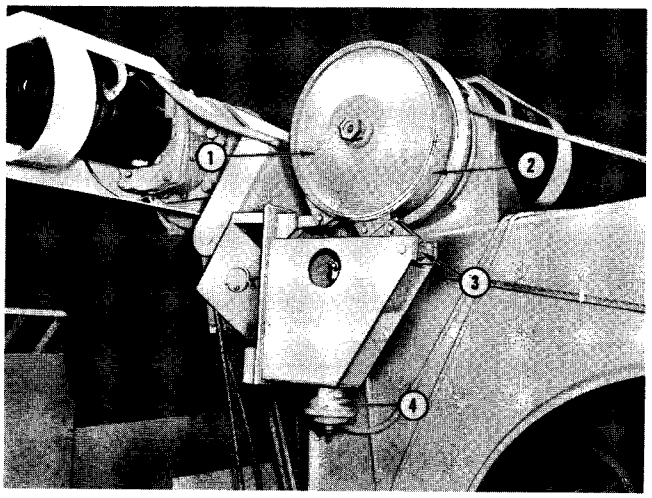


FIGURE M-10. QUICK RELEASE DRUM

1. Brake Drum
2. Brake Band
3. Linkage
4. Brake Cylinder

Remove setscrew from locknut securing the internal gear to the gear box output shaft. Remove locknut and "O" ring. Pull wire rope drum and internal gear from gear box output shaft.

Remove the locking setscrew from the locknut on the gear box side of the wire rope drum. Remove locknut and oil seal. Move to the other side of the wire rope drum and pull internal gear from wire rope drum. Outer bearing cone will come free as internal gear is removed.

Pull inner bearing cone from internal gear hub. Inner bearing cup and outer bearing cup will remain in wire rope drum bore. Remove if necessary.

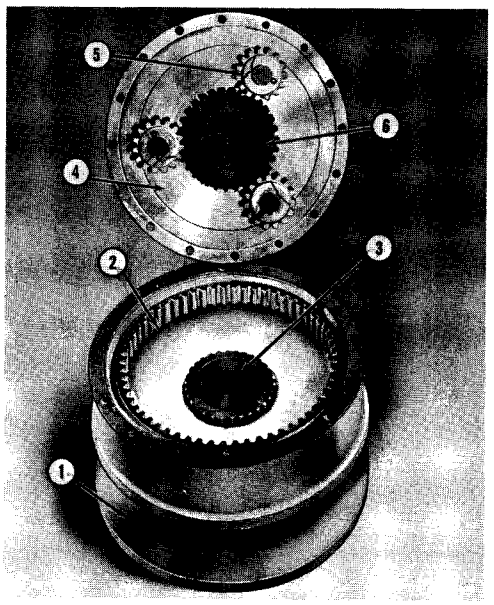


FIGURE M-11. GEAR SUPPORT, REMOVED

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 bearing carefully. Inspect oil seals for cracks or dryness. Replace all damaged or worn parts. Replace all used "O" rings with new ones.

Replace bearing cups in bore of wire rope drum. Position bearing inner cone on hub of internal gear. Place internal gear into wire rope drum bearing bore. Replace outer bearing 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 gear bearings and gears over studs on gear support. Secure with flat washers and roll pins.

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 the "O" ring and position over shaft. Install jam nuts and torque to 750 ft. lbs.

Place brake band around brake drum and reconnect linkage. Fill planetary with proper amount and type of lubricant (see section "K").

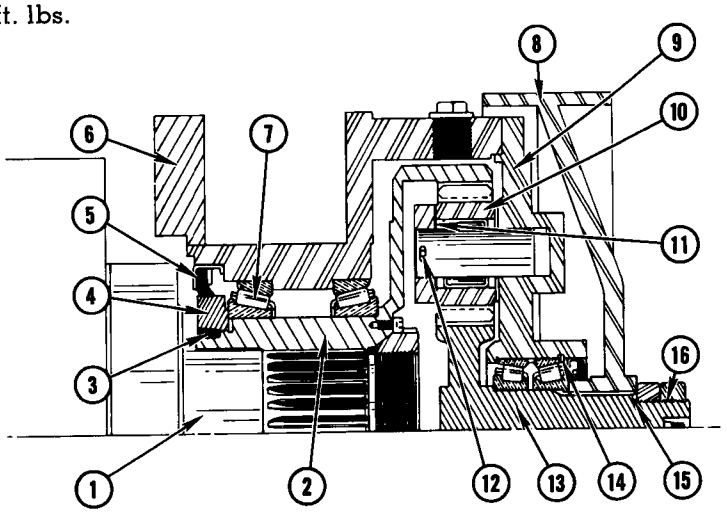


FIGURE M-12. QUICK RELEASE PLANETARY

1. Gear Box Output Shaft
2. Internal Gear
3. Setscrew
4. Locknut
5. Oil Seal
6. Wire Rope Drum
7. Bearing
8. Brake Drum
9. Gear Support
10. Planet Gear
11. Spacer
12. Cotter
13. Sun Gear
14. Snap Ring
15. "O" Ring
16. Jam Nuts

QUICK DROP BRAKE

Removal and Disassembly

Disconnect air line, linkage and remove nuts from mounting studs and push rod from quick drop brake chamber. Remove nut from yoke. See figure M-13.

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 pressure 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 the push rod assembly, the spring, seal and seal ring, from non-pressure plate.

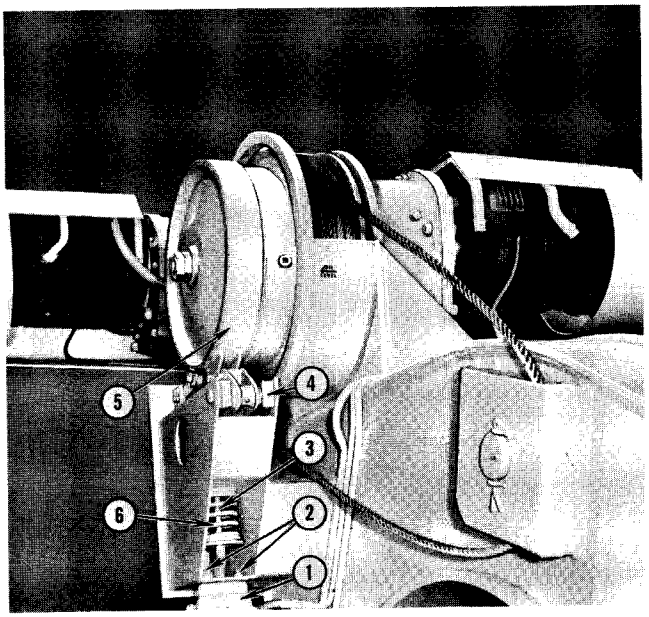


FIGURE M-13. QUICK RELEASE BRAKE

1. Brake Chamber
2. Mounting Studs
3. Push Rod
4. Linkage
5. Brake Band
6. Return Spring

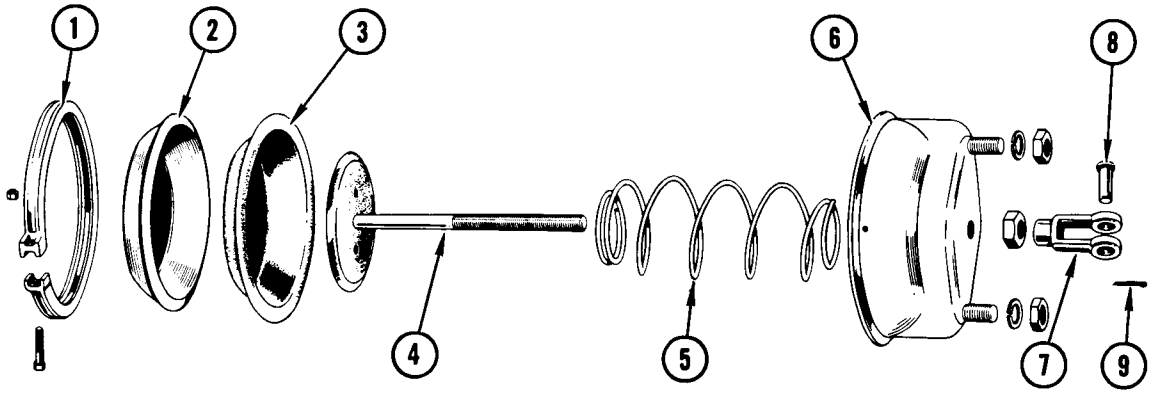


FIGURE M-14. BRAKE CHAMBER, EXPLODED

1. Clamp Ring
2. Pressure Plate
3. Diaphragm
4. Push Rod
5. Spring
6. Non-pressure Plate
7. Yoke
8. Pin
9. Cotter

Reassembly

Clean all metal parts in cleaning solvent. Inspect body, diaphragm and push rod for damage. Replace damaged parts. Be sure push rod is not bent. Inspect release spring. If damaged or permanently set, replace with new one.

Rest the 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 in this position, against the tension of the return spring, clamp the push rod at the 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.

Brake Adjustment

Assemble lower link so that distance between hole centers is approximately 4 1/4".

Reassemble unit completely but do not replace clevis pin (2, figure M-15).

Apply pressure to brake lever arm to obtain a distance of 4 5/8" between center of bottom hole of brake lever arm and the face of spring plate. Block in this position. If this distance cannot be obtained, readjust lower link until distance is 4 5/8".

Measure the spring length and subtract 4 7/8".

Adjust clevis or tapped sleeve on push rod so that the distance from center of push rod clevis to center of lower hole on brake lever arm is equal to the difference between the spring length and 4 7/8".

Apply air to brake chamber and insert clevis pin to connect the push rod to the brake lever arm. Back off adjusting screw to check the length of stroke. Stroke must not exceed 1 1/8". If the stroke

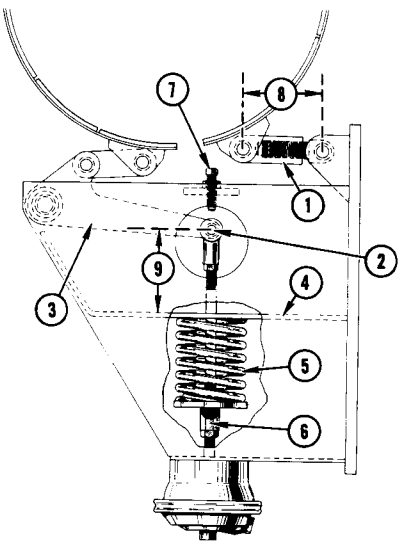


FIGURE M-15. BRAKE ADJUSTMENT

1. Lower Link
2. Clevis Pin
3. Lever Arm
4. Spring Plate
5. Spring
6. Tapped Sleeve
7. Adjusting Screw
8. 4 1/4"
9. 4 5/8"

is greater than 1 1/8", screw the push rod further into the tapped sleeve.

Set the adjusting screw for maximum release by applying air to chamber and setting the setscrew to contact the arm on its maximum stroke.

When making adjustment to compensate for wear, adjustment may be made by lengthening the adjustable lower link (1, figure M-15).

AUTOMATIC WIRE ROPE TIGHTENER

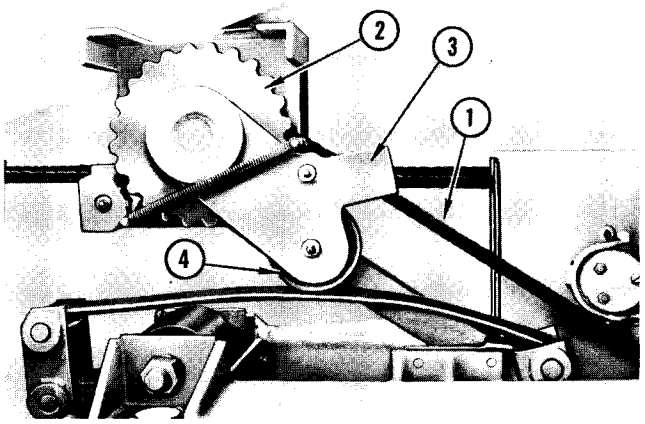


FIGURE M-16. AUTOMATIC TAILGATE WIRE ROPE TIGHTENER

1. Wire Rope
2. Ratchet
3. Cam
4. Roller

The scraper is equipped with an automatic wire rope tightener on the tailgate wire rope. The tightener automatically maintains the proper tension on the wire rope, eliminating slack and increasing rope life.

The tightener housing with spool is attached to the scraper framework and is actuated by a roller cam and ratchet.

As the tailgate moves forward, the cam roller contacts a leaf spring which is attached, horizontally, to the tailgate push structure. As the tailgate moves forward, the roller riding on the spring, raises the cam which rotates the ratchet. This tightens the wire rope.

As the tailgate moves rearward, the spring moves from under the roller allowing it to drop, engaging the next ratchet notch. The ratchet prevents the wire rope spool from unwinding.

When the wire rope tension reaches 1900 pounds on a bare spool, the spring will deflect under the downward force exerted by the cam and roller. This prevents the wire rope from being over tightened.

Figure M-17 shows the cam and roller as the wire rope is being tightened. The dotted lines show their relative positions when wire rope tension is such that the spring is deflected and not tightening the wire rope.

Periodic checks are necessary to be sure roller, ratchet and spring are free of excess dirt, grease and debris. See page K-19 for lubrication instructions.

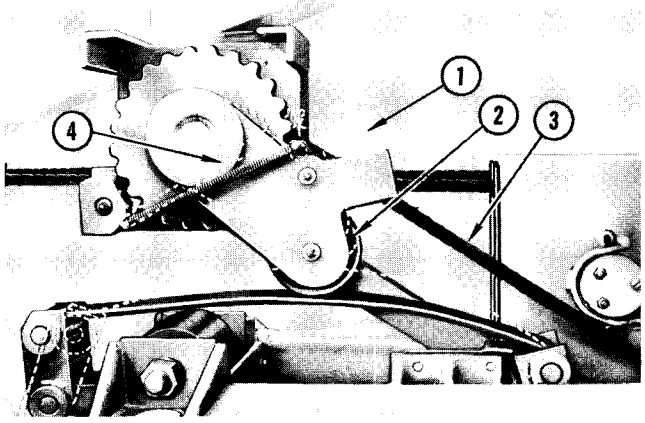


FIGURE M-17. TIGHTENER IN OPERATION

1. Cam
2. Roller
3. Wire Rope
4. Spring

TANDEM SCRAPERS

Separating

Lower bowl and apron of rear unit until wire ropes have a small amount of slack.

Attach chain hoist to rear scraper yoke, or block under yoke to prevent it from falling when hitch pin is removed.

Disconnect air lines at connectors on hitch block.

Disconnect electric power and control leads at plug-in jacks.

Remove cotter pin and castellated nut from hitch pin. Pull out hitch pin and separate the two units.

Lubricating Hitch Joints

Lubricate through pressure fittings every 10 hours of operation. Use chassis grease (medium) for temperatures below 32° F., and chassis grease (heavy) for temperatures above 32° F. To lube one fitting it will be necessary to remove the cover plate on the rear scraper yoke adaptor.

Controls

For tandem operation, the Tournapull instrument panel is equipped with a separate set of scraper controls to operate the rear unit. These controls operate in the same manner as conven-

tional single scraper units.

The foot brake valve controls all wheel brakes at the same time.

Connecting Rear Scraper

Position rear unit yoke adaptor hitch yoke over hitch eye. Insert hitch pin and install castellated nut and cotter.

Connect electric plug-in jacks, and connect brake lines. Screw brake line connectors down firmly to prevent leakage. Do not use wrench on fittings, hand tighten only.

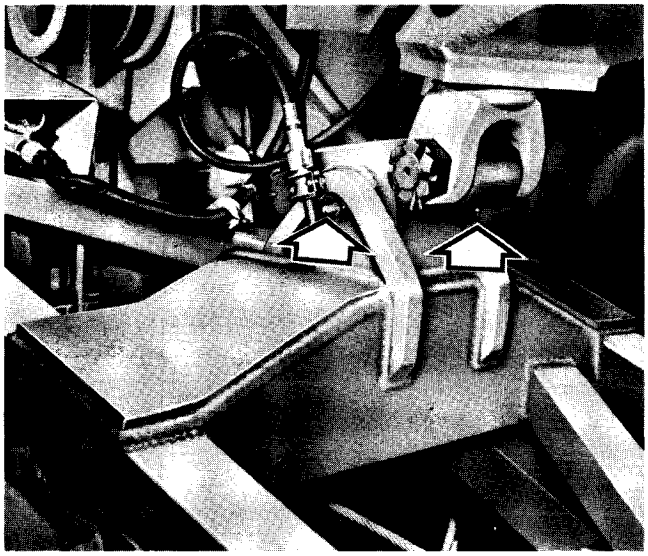


FIGURE M-18. TANDEM HITCH LUBRICATION POINTS

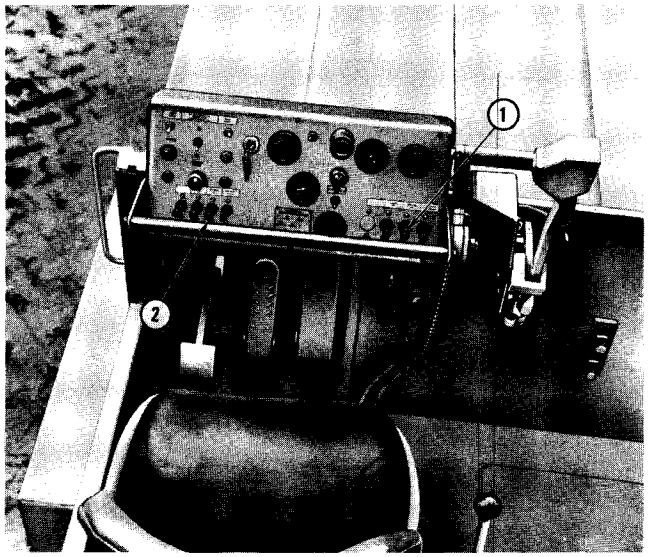


FIGURE M-19. TANDEM SCRAPER CONTROLS

1. Front Scraper Controls
2. Rear Scraper Controls

WIRE ROPE REEVING INSTRUCTIONS

TAILGATE FORWARD

Dead end rope at left side of drum	A
Bring rope off back side of drum, around front side of sheave	B
Back over sheave	C
Forward around left side of sheave	D
Back under sheave	E
Forward and dead end rope at wedge	F

TAILGATE REVERSE

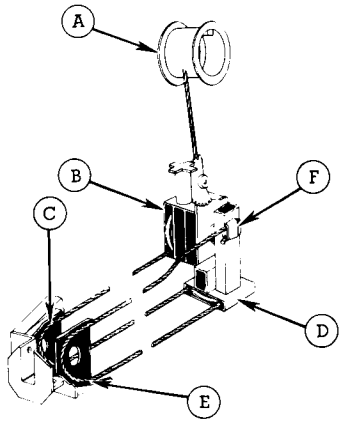
Dead end rope at right side of drum	A
Bring rope off front side of drum, around back side of sheave	G
Forward under sheave	H
Back over sheave	I
Then forward under sheave	J
Back and dead end rope at cable tightener	K

BODY HOIST

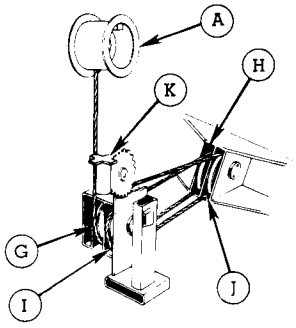
Dead end rope at left side of drum	
Bring rope off top of drum, forward over sheave in housing	L
Back over sheave in housing	M
Down around right side of forward sheave	N
Up over right side of forward sheave	O
Then thread rope down around left side of sheave	P
Up over right side of center sheave	Q
Down around left side of rear sheave	R
Cross over and around side of sheave	S
Then down around left side of rear sheave	T
Dead end wire rope at anchor	U

APRON HOIST

Dead end rope at right side of drum	V
Bring rope off top rear side of drum, down around apron bowl and dead end at anchor	W

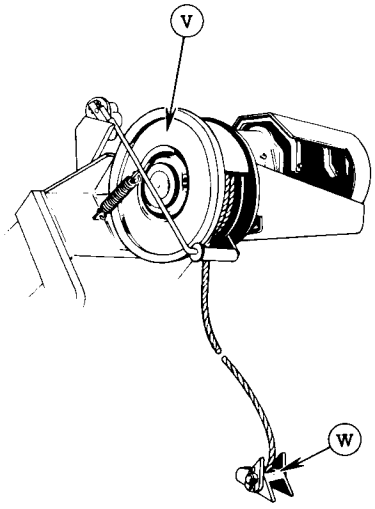


TAILGATE FORWARD

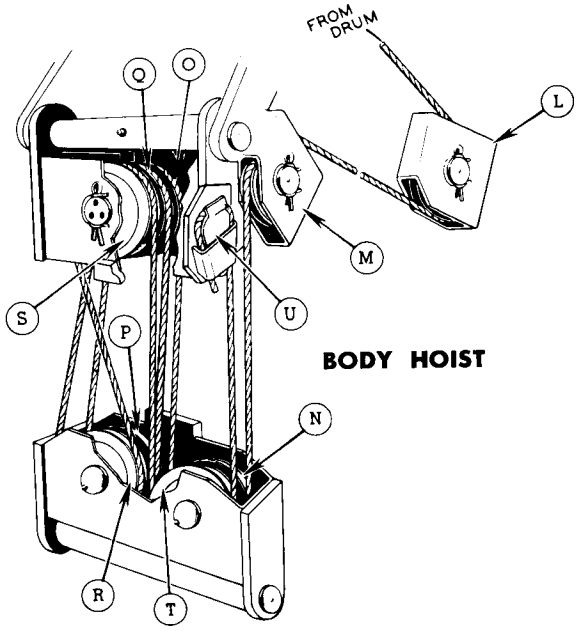


TAILGATE REVERSE

Refer to Parts Catalog for correct wire rope lengths and diameters.



APRON HOIST



BODY HOIST

MODEL C REAR DUMP

INDEX

MODEL C REAR DUMP

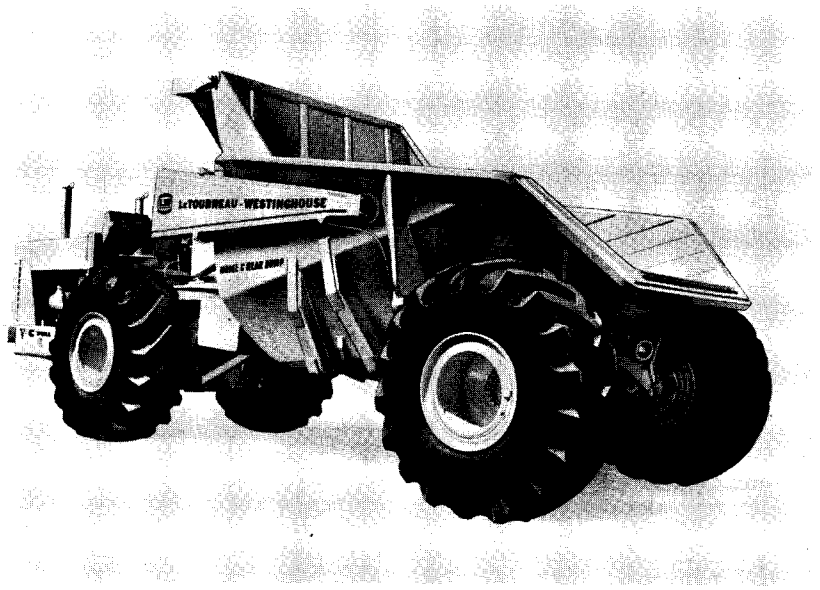


FIGURE N-1. V POWER C TOURNAPULL WITH REAR DUMP

SEPARATING TOURNAPULL AND REAR DUMP

Crib up under nose of Tournapull, using good, solid cribbing. Construct cribbing carefully. Block Tournapull wheels, front and rear, to prevent movement when the units are separated.

Raise bowl slightly until nose of Tournapull is resting on the cribbing and the tension is relieved on the bowl return wire rope.

Remove cotter and pin from wire rope anchor on the front of the bowl and remove return wire rope and anchor. See figure N-2. If wire rope is to be replaced, back out setscrew from wire rope anchor dead end and pull wire rope free.

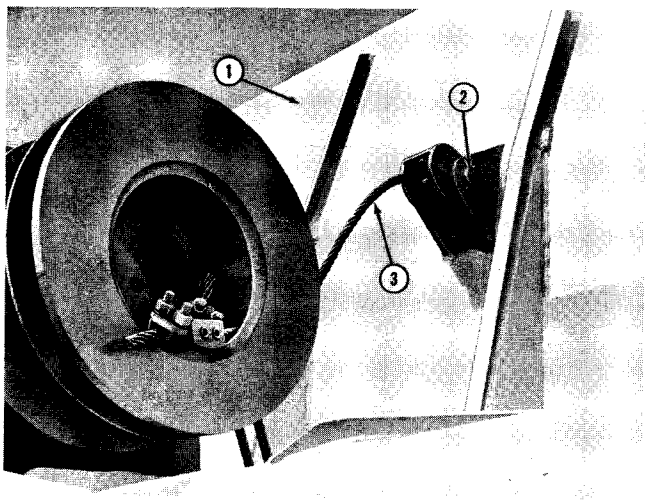


FIGURE N-2. WIRE ROPE ANCHOR

1. Bowl
2. Pin
3. Wire Rope

While bowl is still in the slightly raised position, place blocks between the yoke and the bowl down stops. Start Tournapull engine and depress bowl control down switch on the instrument panel. This will pay out hoisting wire rope and lower the bowl down on the blocks. After bowl has come to rest on the blocks continue to operate motor until wire rope has completely unwound from drum (the blocks will prevent the down limit switch from opening the down control circuit).

Loosen locking setscrews from dead ends on each of the two wire ropes at the wire rope drum. 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 bowl.

Open air tank bleeder valve on the Tournapull (and rear dump, if equipped with emergency braking system) air tank to bleed the air system. Disconnect air lines to the rear dump at the couplings on the yoke structure.

Disconnect the conductor cables to the a.c. electric motor, electrotarder and limit switches at the main switch box. Pull cable from box.

Position blocks under each side of the steering trunnion to prevent its tipping when the trail unit is removed.

Place a chain hoist about the yoke neck and apply only enough tension to relieve any strain on the yoke mounting bolts. Remove bolts and lower yoke until both body and yoke structures are resting on ground.

YOKE ARMS

Removing

Attach hoist to yoke arm structure (near the ball caps) to prevent yoke dropping when caps are removed. Take up the slack in the hoist. Remove the capscrews and lockwashers securing the caps to the yoke arms. Remove caps and shims. Keep shims together for replacement. Lift yoke arms away from bowl.

Assembling

Thoroughly clean ball, socket and cap.

Raise arms with hoist until sockets on arm 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.

Lubricate thoroughly. See page K-15 for correct type of lubricant.

BODY HOIST UNIT

The body hoist unit consists of the electric motor, gear reduction box, No. 5 gear unit and wire rope drum.

To remove the body hoist unit, disconnect leads from electric motor terminal strips.

Fasten a chain hoist about the body hoist unit and remove the mounting bolts fastening hoist assembly to the yoke structure. Lower unit to the ground for further disassembly.

Refer to section "J" of this manual for disassembly and assembly procedures for the a.c. electric motor, gear box and No. 5 gear unit.

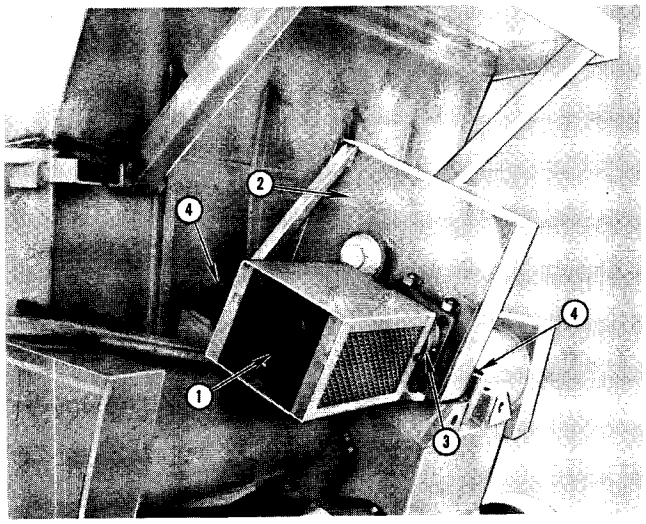


FIGURE N-3. BODY HOIST UNIT

1. A.C. Motor
2. Gear Unit
3. Gear Box
4. Mounting Bolts

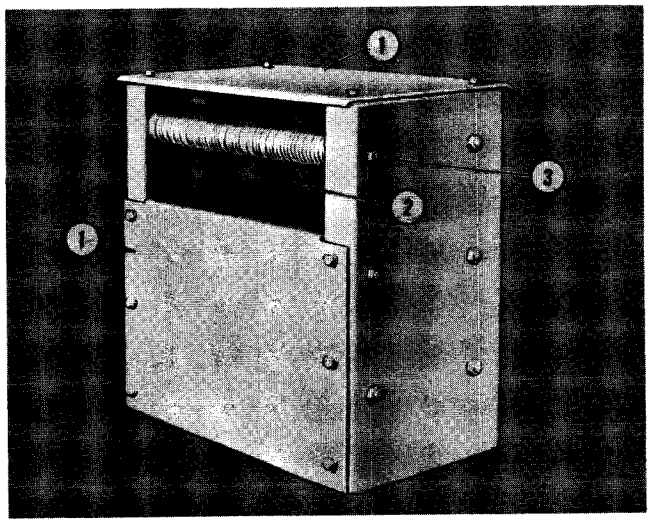


FIGURE N-4. ELECTROTARDER

1. Cover Plates
2. Grid
3. Support Rod

ELECTROTARDER

The electrotarder group is made up of three 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 two main switches. The main switches are operated by a toggle type switch on the instrument panel.

When a loaded machine is operating down grade, the load has a tendency to push the machine. This will force the engine to overspeed, thus causing the machine to go beyond safe operating range 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 on the instrument panel, the electrotarder is a resistance which is added to the generator circuit, placing 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 closed to the point of repair.

Remove nuts, steel spacers and insulation washers from support rods. Slide spacers and resistance grid plates off support rod. Slide mica tube from support rod.

Be sure to note the relative position of spacers, both mica and steel, and grids so they can be replaced in the same order as they were removed.

Repeat the same procedure for each grid assembly.

AXLE

Remove wheel and tire as described in section "H" of this manual. Also refer to section "H" for wheel brake removal and disassembly.

Remove capscrews and lockwashers securing the hub cap to the axle housing. Remove hub cap and gasket.

Pull cotter from axle and locknut. Remove axle locknut. Pull axle from housing. As axle is removed the inner roller bearing assembly will be pulled from axle and remain in housing. Pull bearing assembly from housing.

Remove collar and spacer tube from axle. Pull outer roller bearing race and axle bushing from axle. Felt seal is cemented to bushing and will be removed with bushing.

Loosen the outer bearing race lockbolt in the axle housing and pull the oil seal, seal spacer, bearing, outer race and retainer from housing.

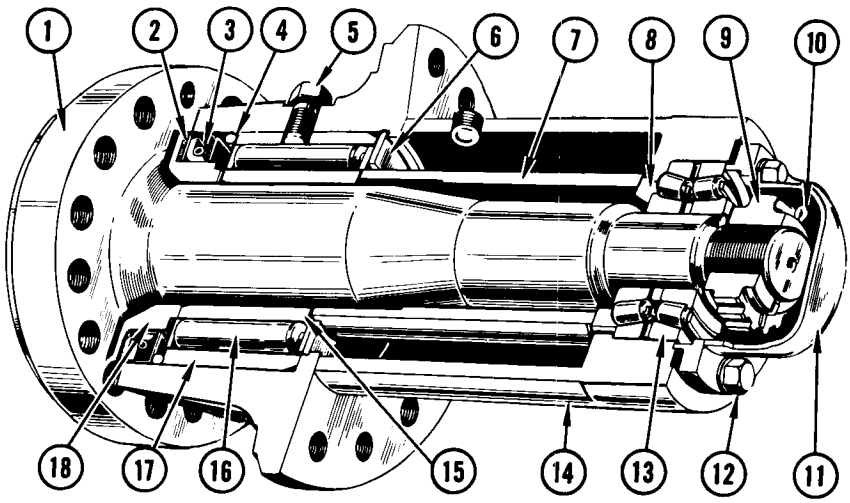


FIGURE N-5. REAR DUMP AXLE

1. Axle
2. Felt Seal
3. Oil Seal
4. Seal Spacer
5. Lockbolt
6. Retainer
7. Spacer Tube
8. Collar
9. Locknut
10. Cotter
11. Hub Cap
12. Capscrew
13. Bearing
14. Housing
15. Inner Race
16. Bearing
17. Outer Race
18. Bushing

Installation

Clean and inspect all parts thoroughly. Replace all damaged or defective parts.

Cement felt seal to axle housing using 3M felt seal adhesive or its equivalent. Press axle bushing and inner race into place on axle until bushing is seated against axle flange and bearing race is seated against bushing. Slide spacer and collar onto axle until they are squarely seated.

Insert bearing retainer into housing and press until it bottoms against housing shoulder.

Press outer bearing into housing. Align hole in race with lockbolt in housing. Tighten lockbolt.

Replace seal spacer and oil seal into axle housing. Lip of seal should be toward centerline of machine.

Replace axle assembly into housing. Replace inner bearing assembly. Replace locknut and torque to 4500 ft. lbs., secure with cotter.

Replace hub cap and gasket. Secure with capscrews and washers.

Replace wheel brake, wheel and tire.

See page K-14 for correct type and amount of lubricant.

EMERGENCY BRAKE SYSTEM

Operation

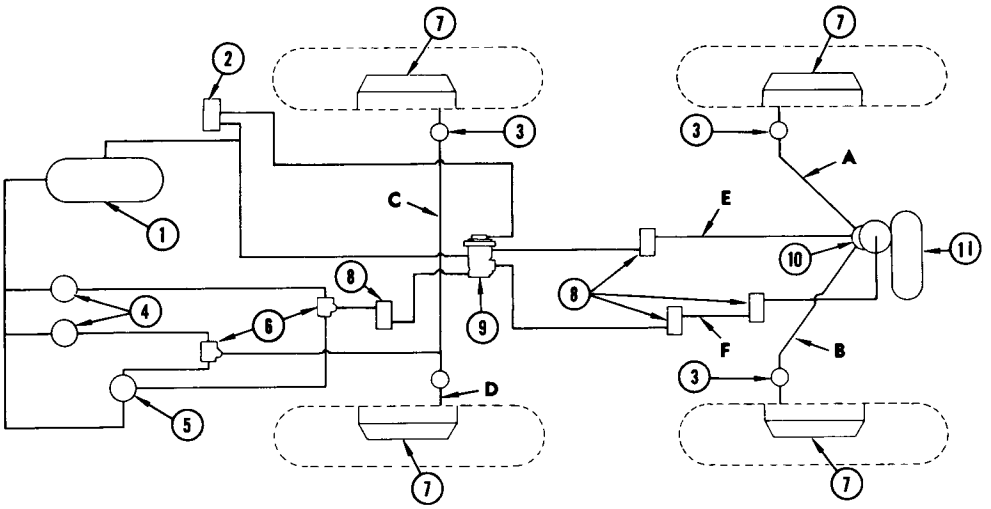


FIGURE N-6. EMERGENCY BRAKING SCHEMATIC

A. Rear Dump Brake Line
B. Rear Dump Brake Line
C. Tournapull Brake Line
D. Tournapull Brake Line
E. Emergency Air Line
F. Service Air Line

1. Main Air Tank
2. Governor
3. Quick Release Valve
4. Hand Brake Valves
5. Foot Brake Valve
6. Double Check Valve
7. Wheel Brake
8. Air Strainer
9. Tractor Protection Valve
10. Emergency Relay Valve
11. Emergency Air Tank

It is assumed in the following situations that the foot treadle valve remains open delivering air to the brakes as in a steady brake application and that leakage through any broken line will sufficiently load the compressor so it cannot build up pressure in the main reservoir.

If either of the lines to the rear dump brakes opens (A and B), the main and emergency air tank pressure will drop to 90 p.s.i. The tractor protection valve will close, closing the emergency and service lines to the rear dump. The main air tank minimum pressure will be 90 p.s.i., the emergency air tank will empty. When the main air tank pressure builds up to 120 p.s.i. the emergency and service lines are opened and the cycle repeats. A minimum of 90 p.s.i. air pressure is available in the main air tank for operation of Tournapull wheel brakes.

If either of the lines to the Tournapull brakes opens (C and D), the main and emergency air tank pressure will drop to 90 p.s.i. at which time the tractor protection valve will close, closing the service and emergency lines to the rear dump. The rear brakes will be applied automatically 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 present in the main air tank to operate the Tournapull brakes.

If the emergency line (E) opens, 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, the rear dump brakes exhaust to the metered pressure applied by the brake treadle valve and the cycle repeats. 90 p.s.i. minimum air pressure is available in the main air tank for the operation of Tourna-

pull brakes.

If the service line (F) opens, 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. The 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., tractor protection valve opens, rear brakes exhaust and the cycle repeats. A minimum of 90 p.s.i. air pressure is available in the main air tank for operation of the Tournapull brakes.

Tractor Protection Valve

REMOVAL AND DISASSEMBLY

Bleed the air system. Disconnect the air lines to the 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 the 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 spring.

Mark springs when disassembling in order to get the right spring in the right location when reassembling.

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 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 install-

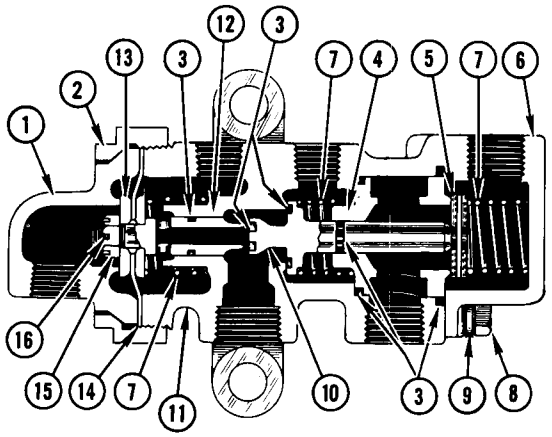


FIGURE N-7. TRACTOR PROTECTION VALVE

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

ing lockwashers and capscrews. Place exhaust valve plunger spring and exhaust valve plunger assembly in body. Position and hold cap over diapraghm 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 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 damaged 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, see figure N-8.

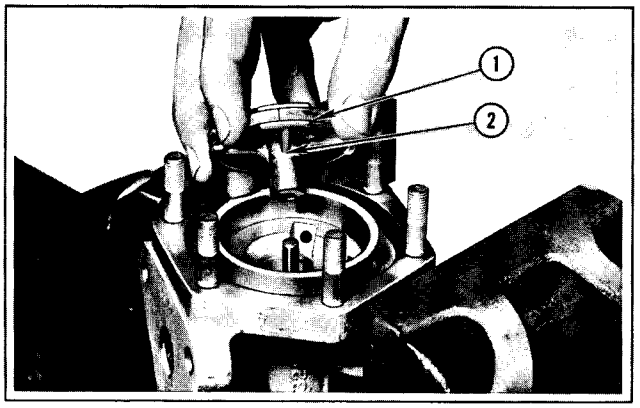


FIGURE N-8. REMOVING DIAPHRAGM GUIDE

1. Dampener
2. Diaphragm Guide

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 bushing 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

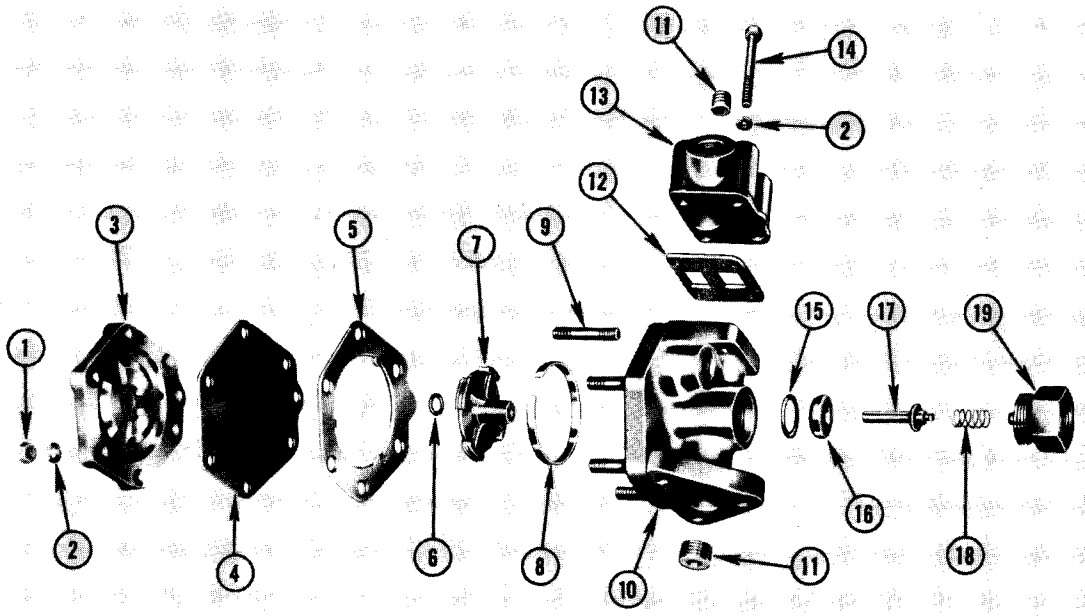


FIGURE N-9. RELAY VALVE, EXPLODED

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

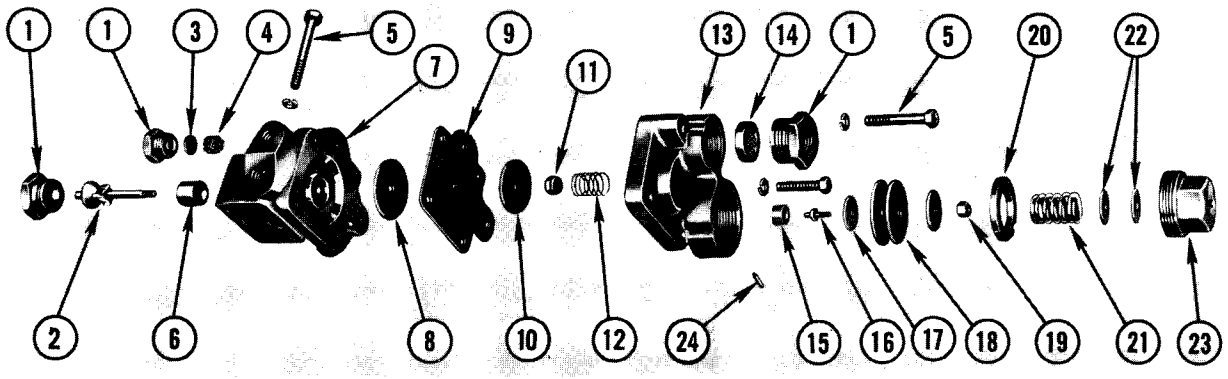


FIGURE N-10. EMERGENCY VALVE, EXPLODED

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. Diahpragm Follower
11. Locknut
12. Emergency Valve Spring
13. Cover Body
14. Air Strainer
15. Valve Seat
16. Valve
17. Follower
18. Diaphragm
19. Locknut
20. Diaphragm Ring
21. Pressure Regulating Spring
22. Shims
23. Cap
24. Pin

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 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 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 with a tap through the emergency valve cap nut hole.

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, push diaphragm guide into place.

Install bleeder passage grommet in body. Install diaphragm rings. Install relay diaphragm. Install cover on body.

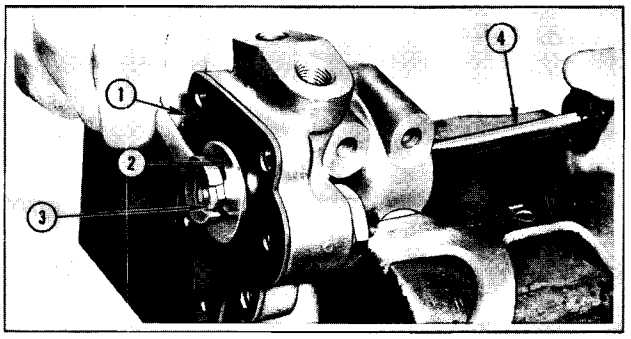


FIGURE N-11. INSTALLING EMERGENCY DIAPHRAGM

1. Diaphragm
2. Diaphragm Follower
3. Nut
4. Screw Driver

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 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. 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 screw driver (figure N-11) and tighten nut 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 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.

MODEL C CRANE

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MODEL C CRANE

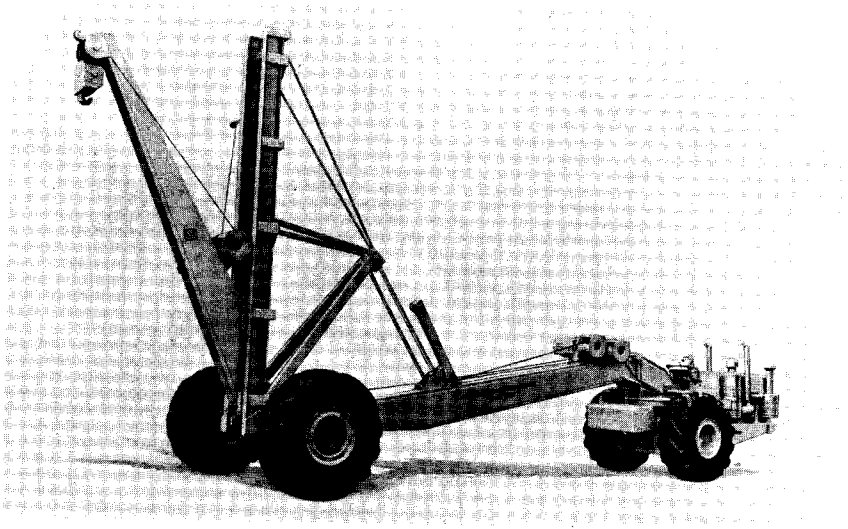

FIGURE O-1. TOURNAPULL AND CRANE

SEPARATING TOURNAPULL AND CRANE

Block up front of Tournapull using good, solid cribbing. Considerable care should be exercised in constructing this cribbing to eliminate the danger of the rig moving forward and off the blocks. Block the Tournapull wheels, front and rear, to further lessen the danger.

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 mounting bolts. Remove the mounting 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 cable from cable dead end along side the sheaves on the end of the boom structure.

Press "hook up" control switch on the instrument panel until the cable has rewound on the drum.

Remove setscrew from cable drum locknut and remove locknut. Pull cable 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 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

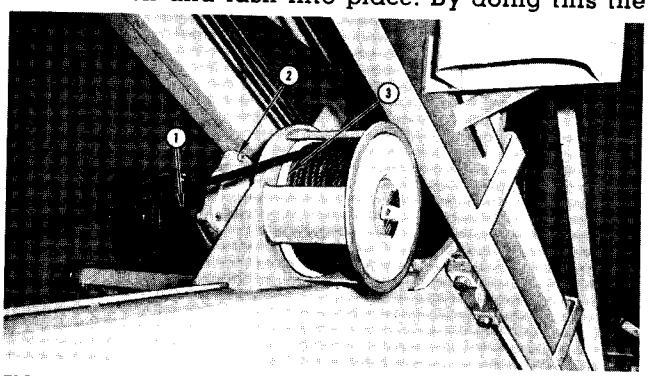

FIGURE O-2. HOOK MOTOR AND GEAR BOX
1. Motor 2. Gear Box 3. Cable Drum

boom motor can still be operated. Press the "carriage down" control switch until the cable has completely unwound from drum. Loosen setscrew from cable dead end and remove cable.

Remove lock setscrew from cable 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 the motor and gear box. Apply only enough tension to relieve any strain on the mounting capscrews. Remove mounting capscrews 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 on the instrument panel until all the cable has unwound from the cable drum. Loosen the setscrew in the cable dead end and pull cable 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.

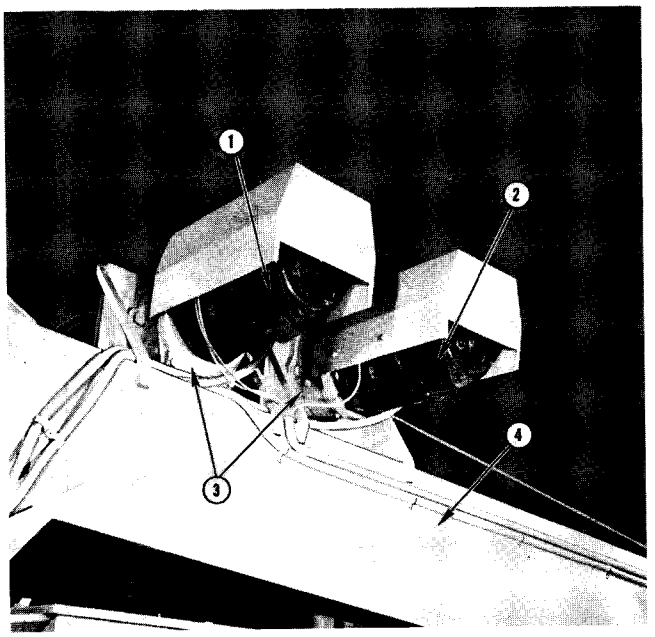

FIGURE O-3. BOOM AND CARRIAGE MOTORS

1. Carriage Motor
2. Boom Motor
3. Gear Boxes
4. Tongue

TRAVELING HOOK

Lower the hook to the ground and free cable from dead end on boom structure. Rewind cable onto drum.

To disassemble sheaves, pull cotter pin and drive out sheave pin. Lift sheave wheel from structure and remove bearing.

The hook is a non-removable swivel-type and does not require disassembly.

WHEELS AND BRAKES

Refer to Section "H" of this manual for removal and disassembly procedures of wheels and 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 the hub cap to the axle housing. Remove hub cap. Pull cotter from axle and back off locknut. Pull

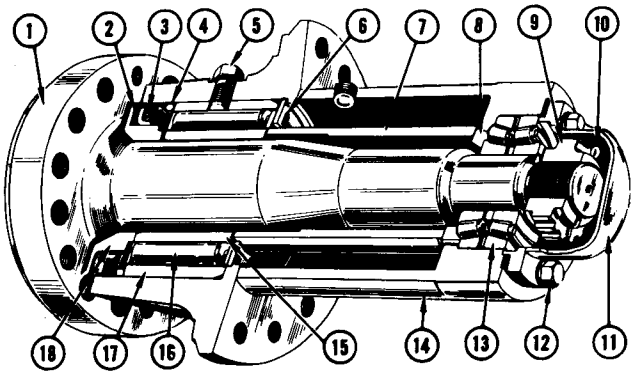

FIGURE O-4. CRANE AXLE

1. Axle
2. Felt Seal
3. Oil Seal
4. Spacer
5. Lock Bolt
6. Retainer
7. Spacer
8. Collar
9. Lock Nut
10. Cotter
11. Hub Cap
12. Capscrew
13. Bearing
14. Hub
15. Inner Race
16. Roller
17. Outer Race
18. Bushing

axle from housing. Pull inner bearing cone and bushing from axle. Felt seal is cemented to axle bushing and will be removed from axle with bushing.

Loosen the outer bearing race lockbolt in the axle housing and pull the oil seal, seal spacer, bearing, outer bearing race and retainer from housing. Remove spacer tube and tapered collar from housing.

Installation

Clean and inspect all parts thoroughly. Replace all damaged or defective parts.

Cement felt seal to axle bushing using 3M felt seal adhesive or its equivalent. Press axle bushing and inner bearing race into place on axle until bushing is seated against axle flange and bearing race is seated against the bushing. Slide spacer onto axle shaft until it bottoms against bearing inner race.

Insert retainer into housing and press until it bottoms against housing shoulder.

Press outer bearing race into housing. Align hole in race with lockbolt in housing. Tighten the lockbolt. Replace bearing, seal spacer and oil seal into axle housing. Lip of seal should be toward centerline of machine.

Replace axle into axle housing part way. Slide tapered collar into axle bore over axle. Slide the inner bearing cone over axle and into housing. Now position bearing cup into housing until it bottoms against shoulder in bore. Force axle the remaining distance into housing, while holding the bearing cup in position.

Replace spacer and outlet bearing cone.

Replace locknut and torque to 4500 ft. lbs. and install cotter. Secure hub cap with capscrews and lockwashers.

Replace brake, wheel and tire. Torque wheel mounting capscrews to 900 ft. lbs.

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 cable from the dead end at top of track. Rewind the cable on drum.

Fasten a chain hoist about the carriage track and boom structure and then release the carriage tilt blade from dead end alongside of crane tongue sheaves. Rewind the cable 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 structure may tilt abruptly.

Lower the boom structure and track to the ground and separate the two units.

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