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WAR DEPARTMENT TECHNICAL MANUAL

U.S. Dept of Army

SCRAPER, ROAD, MOTORIZED, CABLE-OPERATED, 12 CU YD, LeTOURNEAU MODEL SUPER C TOURNAPULL, WITH MODEL LP CARRYALL

★

MAINTENANCE INSTRUCTIONS AND PARTS CATALOG

WAR DEPARTMENT • MARCH, 1944

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SCRAPER, ROAD, MOTORIZED, CABLE-OPERATED, 12 CU YD, LeTOURNEAU MODEL SUPER C TOURNAPULL, WITH MODEL LP CARRYALL

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WAR DEPT. PURCHASE ORDER NO. C-6140
WAR DEPT. PURCHASE ORDER NO. C-6545
WAR DEPT. PURCHASE ORDER NO. C-6562
WAR DEPT. PURCHASE ORDER NO. C-7001

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WAR DEPARTMENT
Washington 25, D. C., (1 Mar. 44)

TM5-1202, Scraper, Road, Motorized Cable-Operated, 12-Cu. Yd., LeTourneau, Model Super C Tournapull, With Model LP Carryall, is published for the information and guidance of all concerned. (A.G. 300.7) 1 Mar. 44)

By order of the Secretary of War:

G. C. MARSHALL
Chief of Staff.

OFFICIAL:
J. A. ULIO,
Major General,
The Adjutant General.

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OPERATION SECTION INDEX

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THE LeTOURNEAU SUPER C TOURNAPULL WITH LP CARRYALL SCRAPER

Designed for high speed, long haul earth moving, the LeTourneau Super C Tournapull and LP Scraper combine the power of a tractor with the speed of a truck. By giving faster hauling speed the Tournapull has extended Carryall Scraper efficiency beyond limited tractor distances. Designed especially for use with the LeTourneau Model LP Carryall Scraper, which has a heaped capacity of 15.0 cubic yards, the Tournapull, when not used in this capacity, can also be used with other tools, such as Tournacranes and Tournatrailers.

The 150 H. P. diesel engine which powers the Super C Tournapull provides plenty of power for all operations. The large, low pressure pneumatic tires provide ample flotation and make for ease of handling and maneuverability in restricted areas. The LeTourneau Model T Power Control Unit mounted on the rear of the Tournapull supplies quick, positive, cable control for the Scraper. Like other LeTourneau equipment the Super C Tournapull is built to stand up under the toughest of job conditions.

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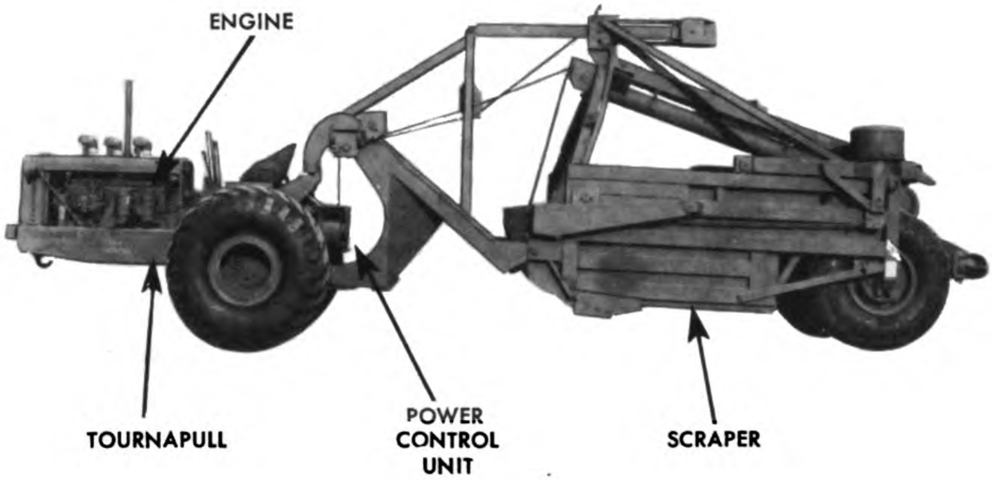

PRINCIPAL UNITS

The Super C Tournapull and LP Carryall Scraper are connected together to form a single, self-propelled, earthmoving machine. It is neither a Tournapull nor a Scraper alone, but is a Tournapull and Scraper combination.

The complete machine is often times incorrectly referred to by many as the Super C Tournapull. Actually, the Super C Tournapull is only the tractive or propelling unit, extending forward from the double universal hitch, while the Scraper is that part of the machine extending to the rear from the double hitch, which, with the assistance of the Tournapull, performs the earthmoving operations of loading, hauling and spreading.

The Scraper is cable controlled by the Power Control Unit mounted on the rear of the Tournapull. The Power Control Unit receives its power from the Tournapull engine, and is operated by the Tournapull operator. The engine, although a part of the Tournapull, is a complete unit within itself and is covered separately in the instructions in various parts of the Manual.

The functions of individual parts and assemblies which make up these four major units—Tournapull, Scraper, Power Control Unit and Engine — are explained between pages 2 and 29 of the Operation Section.

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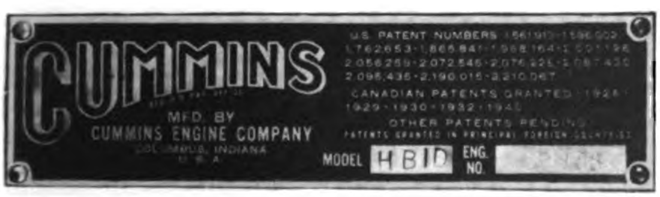
TOURNAPULL NAMEPLATE—LOCATED ON REAR OF DECK PLATE

CARRYALL SCRAPER NAMEPLATE—LOCATED AT REAR OF SCRAPER

POWER CONTROL UNIT NAMEPLATE—LOCATED ON TOP OF GEAR CASE

POWER CONTROL UNIT NECK NAMEPLATE—LOCATED ON LEFT SIDE OF NECK



ENGINE NAMEPLATE—LOCATED ON RIGHT SIDE OF ENGINE

NAMEPLATES

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SECT. 1

OPERATION SECTION

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DESCRIPTION OF SUPER C TOURNAPULL WITH LP SCRAPER

The Super C Tournapull with LP Scraper can load, haul, and unload dirt or other material more efficiently than other types of earthmoving machinery on most earthmoving jobs.

The reasons for this are that the Tournapull and Scraper is self-loading (requiring only the assistance of a pusher tractor), can haul the material for considerable distances at higher than normal speeds when loaded, and can unload or spread the material in smooth, even layers without assistance from other sources. Also, the Scraper's heaped capacity of 15.0 cubic yards is greater than that of most self-propelled earthmoving machines.

The Tournapull and Scraper require the assistance of only one operator. Loading is accomplished by moving forward with the blade lowered into the ground and with the apron at the front of the Scraper bowl raised to permit dirt to enter the bowl.

Hauling is done with the blade raised a short distance above the ground and with the apron lowered to hold the dirt in the bowl. To unload, the apron is raised and the Scraper tailgate, which serves as the rear end of the Scraper bowl and which rolls on rollers, is moved forward.

Complete functions of the machine will be found on the following pages.

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FUNCTIONS

The Tournapull and Scraper are connected together by a double universal hitch. The upper hitch is a ball and socket type connection and the lower hitch is a drawbar type connection having a ball and socket at either end. The double hitch allows side movement for turning (see below) and for travel over unlevel ground, and also supports the front of the Tournapull and Scraper, making the Tournapull and Scraper serve as a single machine, each part dependent on the other.

The principal mechanical functions are performed as follows:

The Scraper is hinged at the yoke hinge pins (A) for raising and lowering the Scraper blade in or out of the ground. The actual raising and lowering of the blade is accomplished by the Power Control Unit which, by spooling or unspooling cable on or off the right cable drum, either increases or decreases the effective length of pushbeam (B), thereby either raising or lowering the Scraper at hinge point (A) and consequently also lowering or raising the blade in or out of the ground. The Scraper apron (C) can be raised to allow dirt to enter the bowl by spooling cable onto the Power Control Unit left cable drum, and can be lowered to hold the dirt in the bowl by releasing the brake for the same cable drum.

Steering is accomplished by means of the Tournapull steering clutches. The machine is propelled or driven by the front wheels, known as the drive wheels. By releasing the steering clutch on either side, the flow of power to the corresponding drive wheel is stopped and that drive wheel ceases to turn, while the opposite drive wheel continues to move forward under power of the engine. This causes the Tournapull to turn, with the double hitch serving as the pivot point. By applying the steering brake, the drive wheel to which the flow of power has been stopped is locked, making possible shorter turns than might otherwise be obtained. The Scraper follows in the path of the Tournapull when a change in the direction of travel is made. By re-engaging the steering clutch and releasing the steering brake, the flow of power will again be delivered in equal amounts to both drive wheels and the Tournapull will then straighten itself out of a turn and continue to travel forward in the direction in which the Tournapull is headed.

For ejecting or unloading dirt or other material that has been loaded into the Scraper bowl, the Scraper is equipped with a tailgate (D) which serves as the rear end of the bowl and which can be moved either to the front or rear inside the bowl on rollers. The forward movement of the tailgate is controlled by the Power Control Unit, while movement to the rear is performed by large coil springs inside the springpipe above the bowl, known as tailgate return springs. The Power Control Unit, by spooling the dump cable onto the left cable drum, raises Scraper apron (C) and pulls tailgate (D) forward to eject the material inside the bowl. Releasing the Power Control Unit brake allows the tailgate return springs inside the springpipe to return the tailgate to the rear and the apron to lower after the material has been ejected.

For further details of the loading and unloading procedures, refer to the "Operating Cycle" on page 46 of Operation Section.

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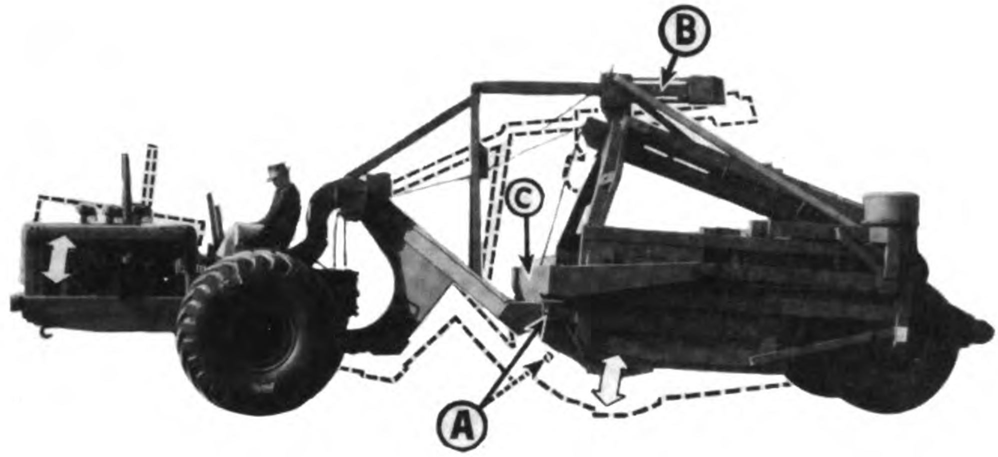
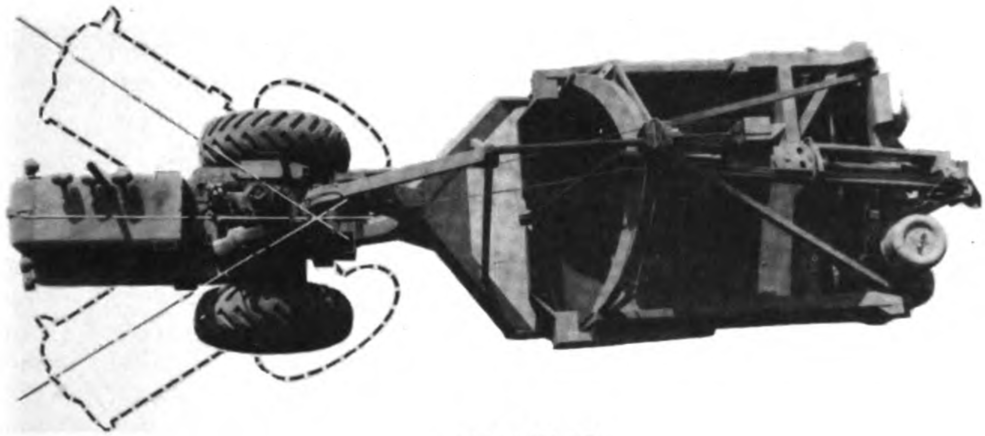
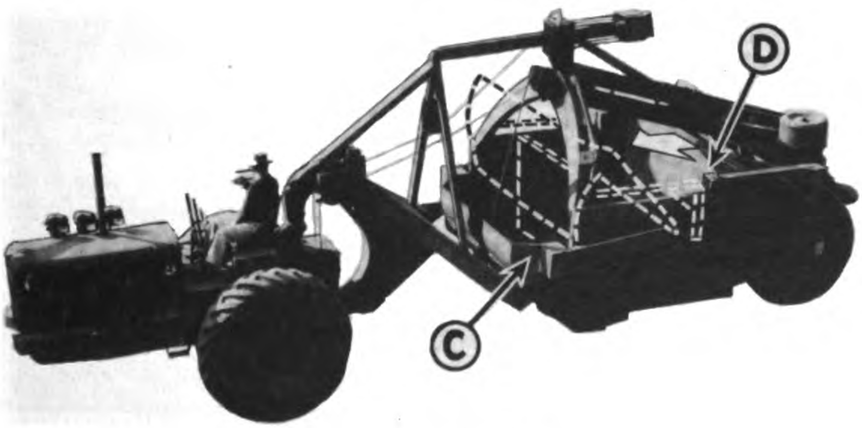


RAISING AND LOWERING BLADE



TURNING



EJECTING LOAD

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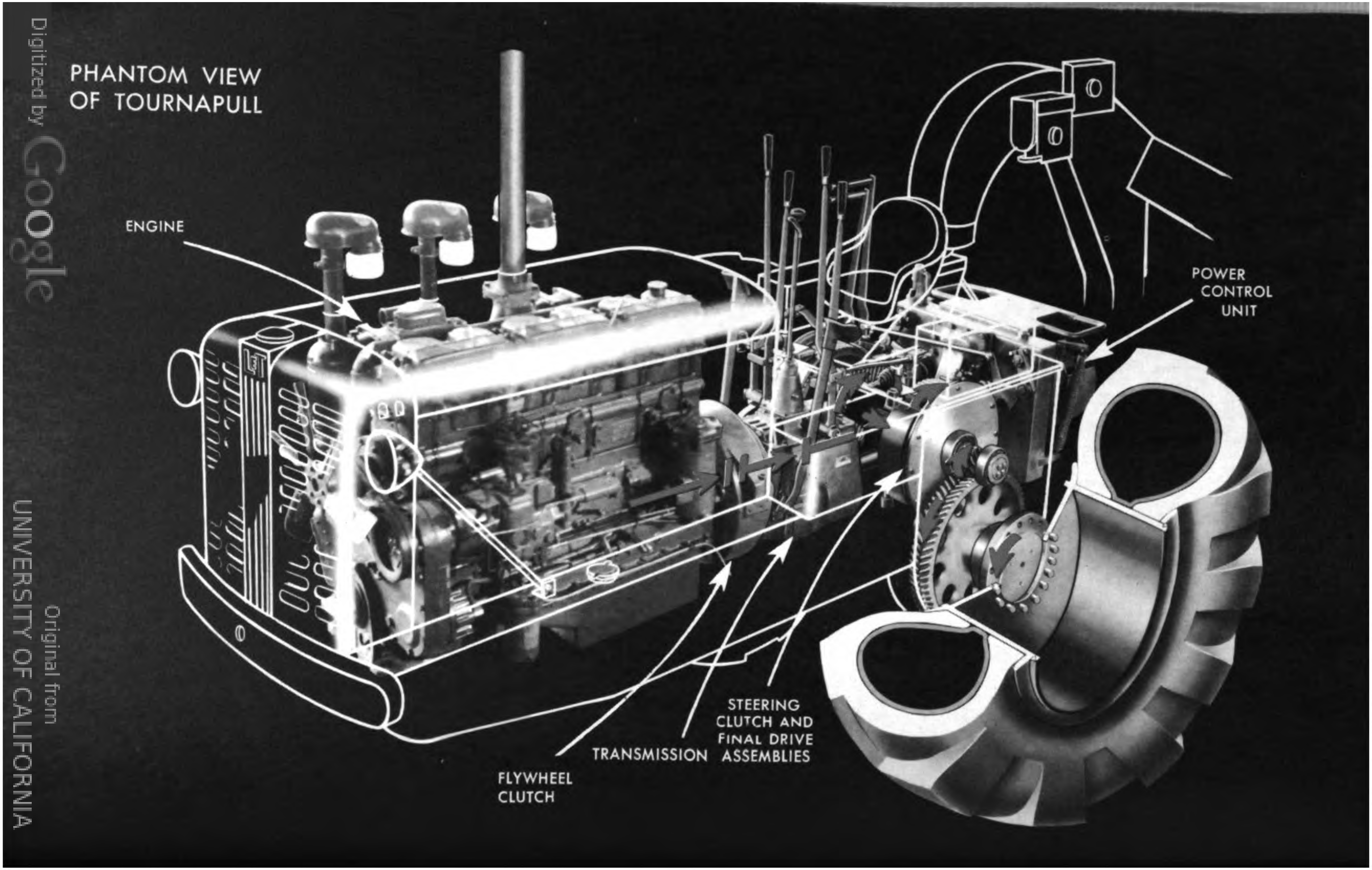

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THE FLOW OF POWER

The Tournapull, being the tractive unit of the Tournapull-Scraper combination, contains the greater number of working parts. Although the functions performed by the many parts and assemblies within the Tournapull may at first seem somewhat involved to those unfamiliar with the machine, it is actually not a difficult machine to understand. In fact, a study of the diagram on the opposite page and the cut-away illustrations and explanations which follow make the Tournapull appear comparatively simple, even to those who have had little previous mechanical experience.

Briefly, the Tournapull consists of an engine, together with the necessary engine accessories, a flywheel clutch, a transmission, and a steering clutch and final drive assembly consisting of a spiral bevel gear and pinion, two steering clutches and steering brakes, and two final drive pinions, gears, axles and drive wheels.

The power is of course developed within the engine. From the engine the flow of power follows to the flywheel clutch, which is mounted to the engine flywheel and which serves as a connecting link between the engine and transmission.

The flywheel clutch is normally in the engaged position, permitting the flow of power to go from the engine to the transmission, through the clutch. When the clutch is disengaged by the operator, the flow of power is broken at the flywheel clutch and no power is delivered to the transmission. The flywheel clutch is usually disengaged only for the purpose of shifting transmission gears, starting and stopping.

The transmission is a gear box containing several different gear ratios. By movement of the gear shift lever, the operator can bring into mesh mating gears within the transmission, thereby selecting any one of four gear ratios for forward travel or one gear ratio for reverse. When the transmission is shifted into any one of these gear ratios, the flow of power is delivered from the flywheel clutch, through the transmission gears, and back to the spiral bevel pinion and gear. When the transmission is in neutral, the flow of power is broken at the transmission.

The spiral bevel pinion and gear serve only to give necessary gear reduction and to change the direction of the flow of power. From the transmission, the power flows through the spiral bevel pinion and gear and to both the left and right steering clutches.

The steering clutches serve as connecting links between the spiral bevel gear and final drive pinions, by means of which the flow of power can be broken on either side for steering purposes. The steering clutches are normally in the engaged position, permitting the flow of power to continue from the spiral bevel gear, through the steering clutches, and to the final drive pinions, gears, and wheels, causing both drive wheels to turn at the same rate of speed for travel in a straight line. By disengaging either steering clutch, the operator stops the flow of power to the corresponding final drive pinion, gear and wheel, causing that drive wheel not to turn with the other wheel, thereby turning the machine.

The steering brakes can be operated in conjunction with the steering clutches, and when engaged assist in steering by stopping or locking the wheel to which the flow of power was stopped.

The final drive pinions, gears, and axles carry the flow of power from the steering clutches to the drive wheels and provide the necessary gear reduction.

The Power Control Unit is a separate unit within itself and, although not actually a part of the Tournapull, is mounted to the rear of the Tournapull main case and is driven from the transmission by means of a connector shaft known as the spline shaft. The Power Control Unit is used in operating the Scraper.

For detailed explanations of the working principles and functions of each of the major units mentioned above, refer to the pages which follow.

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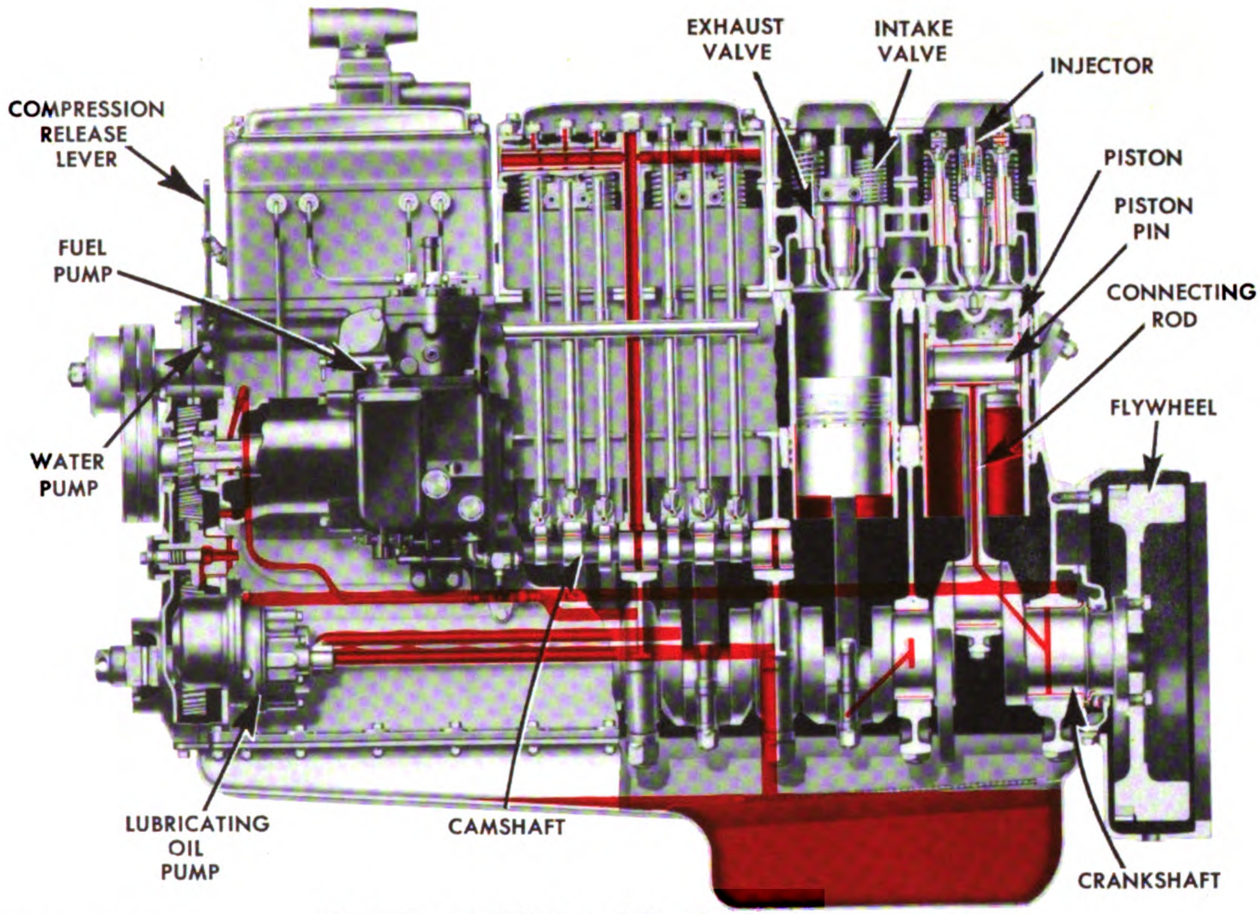

LUBRICATION SYSTEM SHOWN IN RED

CROSS-SECTION OF ENGINE (Side View)

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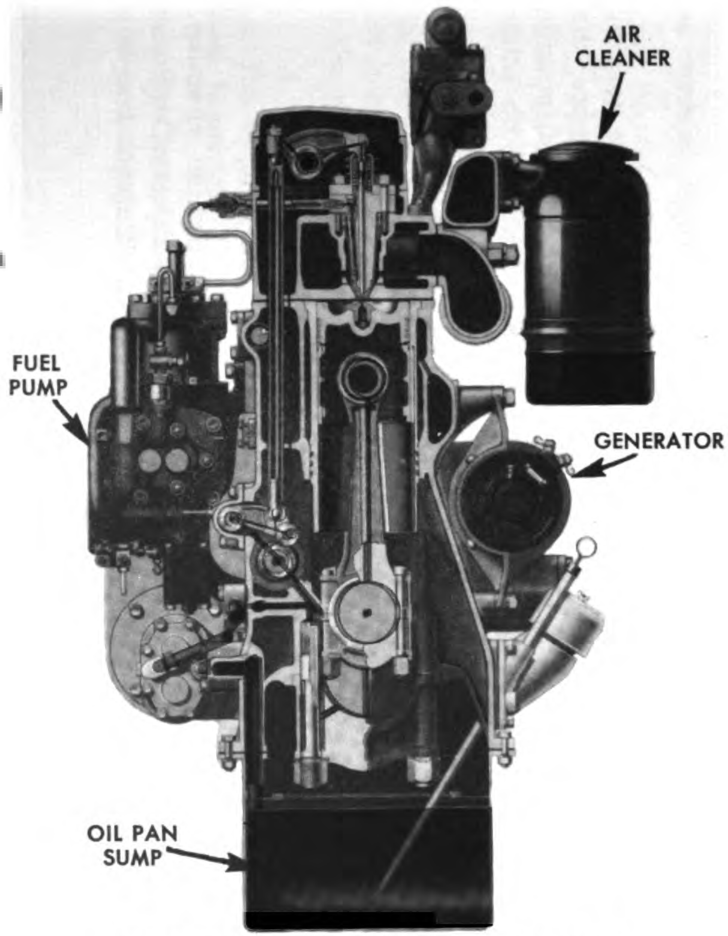

CROSS-SECTION OF ENGINE
(End View)

FUNCTIONS OF ENGINE

The Super C Tournapull is powered by the Cummins Model HB1D-600 Diesel Engine. This engine is a four stroke cycle, high speed, full Diesel engine with a 4⅞" bore and 6" stroke.

The four strokes that complete one cycle are:

1. The INTAKE STROKE, on the down stroke of the piston, when air only is drawn in through the intake manifold and intake valve to the cylinder.

2. The COMPRESSION STROKE, when both valves are closed. The piston travels upward to compress the charge of air taken in during the intake or suction stroke. It is during the last part of the compression stroke that the partially gasified fuel is injected into the combustion chamber. The compression of the air to about seventeen times atmospheric pressure causes it to become heated well above the ignition point of the gasified injected fuel.

3. The POWER STROKE next occurs after the fuel is ignited by the heat of compression. The expanding force of the burning gas drives the piston downward.

4. The EXHAUST STROKE. A few degrees before the piston reaches bottom center the exhaust valve is opened by cam action allowing the burned gases to escape through the exhaust valve and exhaust manifold on the next up stroke of the piston.

The engine camshaft is driven by a cam gear which is directly connected to the crankshaft gear. Since this is a four cycle engine, the camshaft turns at one-half engine speed. There are three lobes on the camshaft for each of the engine's six cylinders. The center lobe of each set of three actuates the injector plunger. The lobes to either side control the opening and closing of the intake and exhaust valves. The intake and exhaust valves and the injector for each cylinder are linked through individual rocker levers and push rods to the camshaft. Thus each injector and valve is actuated each two revolutions, or four strokes of the engine.

The engine operates at a top speed of 1800 RPM and is thus designated as a high speed Diesel.

It is a full Diesel because no spark plugs, glow plugs, or any external means of heating are employed. The engine fires entirely from the heat generated by compression.

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PRINCIPLES OF ENGINE FUEL SYSTEM

The proper operation of the engine requires: First, that the engine be maintained in good mechanical condition to insure proper compression for ignition, proper lubrication, and cooling; and second, that the fuel be measured and injected into the compressed air within the cylinder, in the proper quantity and at the proper time.

The real difference between a gasoline engine and the Cummins Diesel Engine lies in the fuel system. The fuel system can be compared with the electrical system in the gasoline engine. In the gasoline engine, the spark is timed to the spark plug. In the Diesel, the fuel is timed into the injector and then into the cylinder.

Therefore, the problem is to understand the mechanism involved in measuring the charge of fuel so that the proper amount for the speed and power required will be delivered to the engine.

The charge taken in through the intake manifold consists of air only. This charge of air is compressed to about 525 pounds, which causes it to become heated to approximately 1000° F. This temperature is more than sufficient to ignite the partially gasified fuel which is sprayed into the cylinder at the right moment. The air intake manifold has no throttle and therefore, regardless of speed or load, the compression is 525 pounds.

The fuel metering pump is mounted on the side of the engine. The speed of the engine is controlled by varying the stroke of the fuel metering pump, a very short stroke for idling, and a full stroke for a full load.

The Cummins Engine used in the Tournapull differs from other diesels in that the fuel sprayed into the combustion chamber is mainly gaseous, instead of a finely atomized liquid. In the Cummins Engine, the single metering plunger in the fuel pump accurately measures and delivers under low pressure a charge of oil to the proper injector at the proper time by means of a distributor.

The cam-operated injector builds up the pressure of the gasified fuel as it is delivered to the cylinder. Because of this difference, the maximum pressure in the liquid fuel system is only 75 to 150 pounds instead of the 3,000 to 15,000 pounds commonly employed on other types of diesels.

Since one plunger measures the fuel for all cylinders, all receive the same quantity of fuel. The result is an unusual smoothness of operation and lack of vibration.

Features combined in the Cummins Fuel System include:

1. Metering and delivering of fuel at low pressure.
2. Gasifying fuel before injection.
3. Control of the rate of injection.
4. Means of increasing turbulency in the combustion chamber.

How these four distinctive features are incorporated in the Cummins System can be understood from a study of the fuel diagram and the following text.

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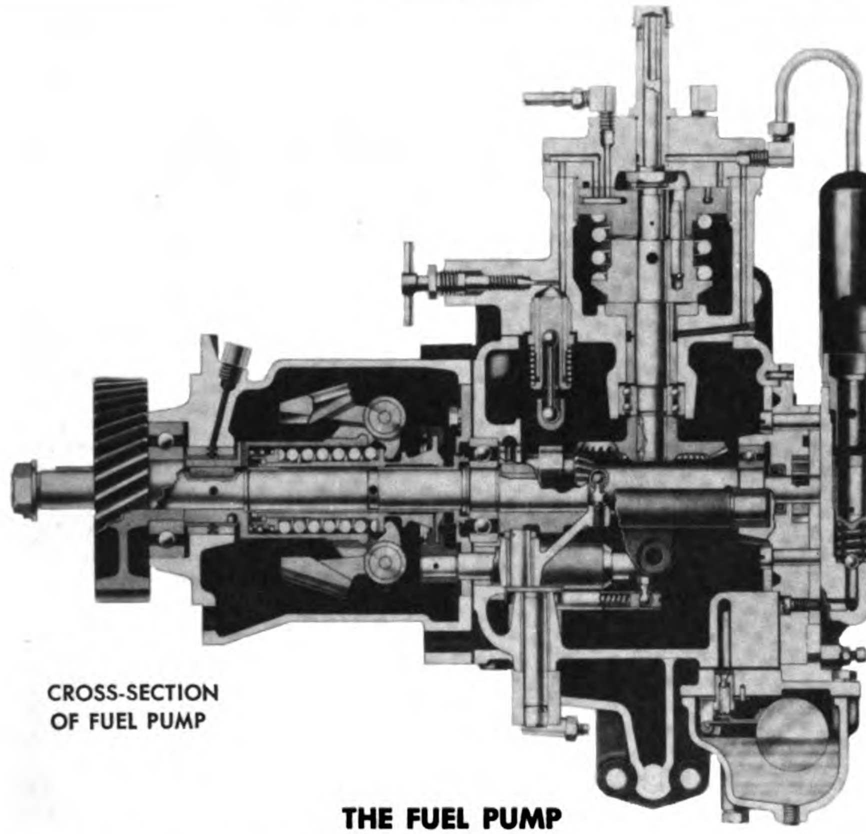

CROSS-SECTION OF FUEL PUMP

THE FUEL PUMP

The fuel pump consists of four distinct units:

1. The **GEAR PUMPS** are located at the rear of the fuel pump and consist of two separate pumps. One draws fuel from the fuel supply tank and the second delivers fuel under low pressure to the distributing unit.

2. The **DISTRIBUTING UNIT** which is located on top of the main housing. The distributing unit has three functions.

   A. It receives the fuel from the gear pump and delivers it at the right time to the metering pump.

   B. It houses the metering pump which accurately measures each charge of fuel before delivery to the injector.

   C. It allows delivery of the metered charge of fuel to the proper cylinder at the proper time.

3. The **MAIN HOUSING** houses the mechanism that actuates the metering pump. The float chamber is attached to the lower part of the main housing and works in conjunction with the gear pumps.

4. The **GOVERNING UNIT** is located between the drive gear and the main housing and acts to control the levers and linkage in the main housing.

The description of the fuel travel and the part that each unit plays is described in detail on the pages which follow.

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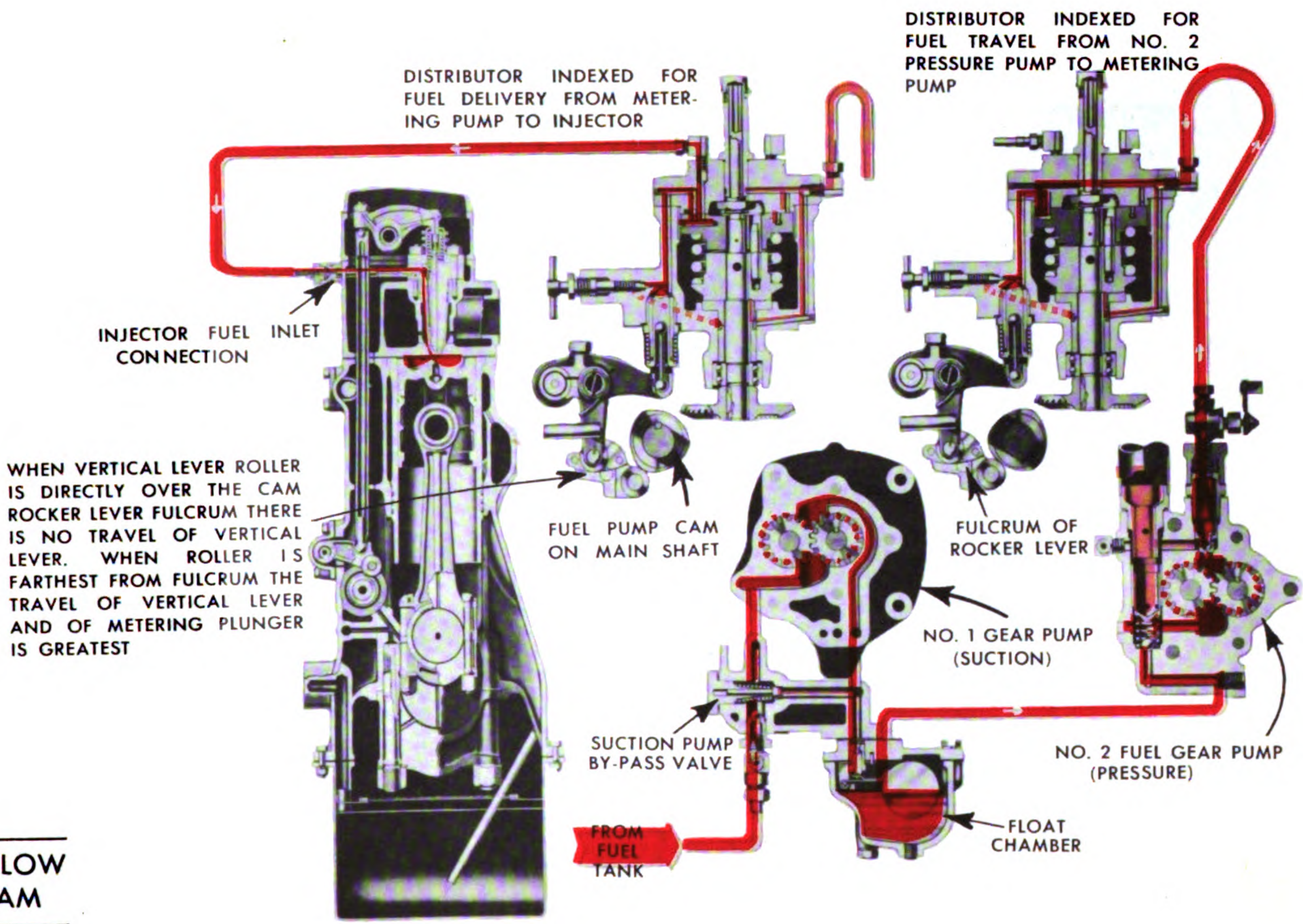

FUEL FLOW DIAGRAM

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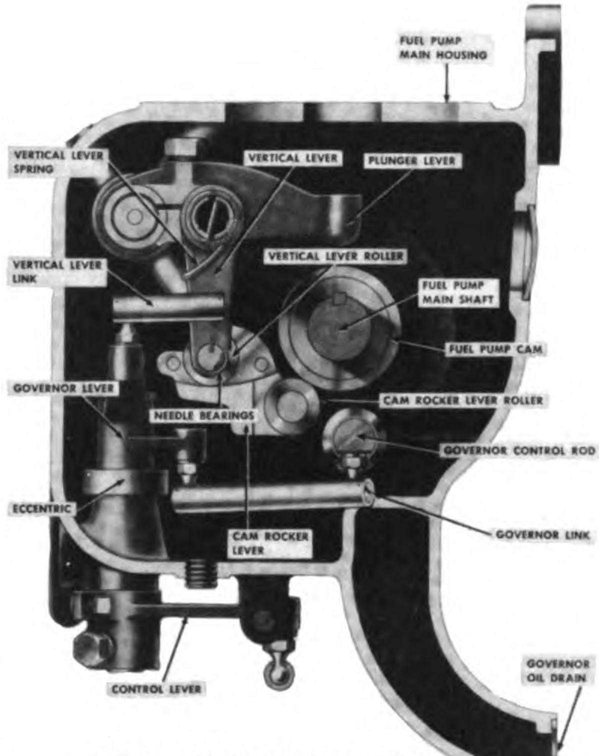

CROSS-SECTION OF FUEL PUMP MAIN HOUSING

METERING PUMP: Control of the engine speed and the load is obtained by varying the stroke of the one common metering plunger.

This is accomplished by changing the position of the actuating vertical lever in the cam rocker lever race. The plunger lever conveys the motion of the vertical lever through a plunger lever link to the metering plunger.

This motion is the same as that obtained by resting a pencil on a vibrating lever hinged at one end. As the pencil is moved closer to the fulcrum, the stroke of the pencil is shortened. As it is moved further from the fulcrum, the stroke is lengthened. To repeat: the length of the stroke of the metering plunger determines the amount of fuel it pumps to the injector.

DISTRIBUTOR: The distributing mechanism at the top of the pump assembly has two functions. First, it allows the fuel from the fuel supply line to pass to the metering pump as the plunger is on its downward stroke.

Second, the distributor provides another passage from the metering pump to the injector next in firing order. This is accomplished by means of the rotating distributor disc and the stationary distributor cover to which the fuel lines to the individual injectors are connected. The distributor works on exactly the same principle as a rotary distributor on a multi-cylinder gasoline engine, except that passages are used instead of wires to provide a path for fuel instead of electricity.

To prevent excessive leakage of fuel between the disc and cover, they are held tightly together by a spring. When the engine is in operation, the fuel pressure furnishes lubrication between the disc and cover and acts similarly to a Kingsbury thrust bearing to prevent scoring.

It must be borne in mind that in the fuel passage, from the distributor to the metering pump, the fuel travels toward the metering pump on the down stroke of the metering plunger, but, on the upstroke of the metering plunger, the fuel travel is reversed and it goes from the metering pump back to the distributor cover and to the proper injector.

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GEAR PUMPS: The fuel is supplied to the distributor by two gear type pumps located at the extreme rear of the fuel pump assembly. They are driven by the main pump shaft. The inner, or Number 1 pump, draws fuel from the fuel supply tank and delivers it to the float chamber. When the float chamber is filled, the pressure against the needle valve in the float chamber is greater than that required to open the suction pump by-pass valve and thus another passage, or by-pass route, is opened.

The check ball drops into its seat, and the fuel is recirculated until such time as the valve at the float chamber is again opened by the lowered float.

The outer, or Number 2 pump, draws fuel from the float chamber past the check valve and supplies pressure through the screen and tube to the fuel distributor. When sufficient pressure is built up in the lines above the gear pump, the check valve closes off the supply of fuel from the float chamber and opens a by-pass route for recirculation of fuel around the gear pump.

The air pressure chamber helps to keep a constant pressure against the fuel at all times. This pressure provides a cushioning effect and prevents excessive wear and chattering of the gears. When enough fuel is used to decrease the pressure against the regulator, the spring pushes it upward, thus shutting off the flow of fuel through the by-pass.

The conical screen helps clean the fuel before it goes to the distributor. The check valve assembly above the conical screen prevents the return flow of fuel after the engine has been shut down.

The emergency control valve can be used in an emergency to bring the speed of the engine under control. It should not be used except in case of engine run-off as there is danger of scoring the distributor disc or cover when the fuel is removed from the lines.

PRIMING PUMP AND VALVE: The hand priming pump draws fuel from a connection just below the fuel inlet check valve and delivers it to a connection on the pressure pump, thus by-passing the gear pump. From this point, it can be forced to the injector when the priming valve is opened. The purpose of the priming pump is to bleed all fuel lines of air, or to provide a solid column of fuel from the fuel tank to the injector.

The priming valve is located on the side of the distributor housing. It provides passage for fuel during priming operations without the use of the metering pump. When the priming valve is open, fuel under pressure from the priming pump by-passes the metering pump. It is most important that the priming valve be closed at all times the engine is running. Otherwise, an excessive charge of fuel will be fed to the injector and the engine will run at an uncontrolled speed.

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GOVERNOR: The Governor has two distinct functions. First, to keep the engine idling speed within 450 to 500 r.p.m. and second, to prevent overspeeding of the engine above the maximum allowable speed. This two speed governing action is accomplished by a flyball governor acting on three springs; an increased torque spring, an idling spring, and a maximum speed spring.

When the engine is started and brought up to idling speed, the governor weights work against the small idling spring. As the throttle is opened by the operator and the engine speed exceeds 500 rpm, the small idling spring becomes inactive and acts the same as a solid sleeve. From this speed to maximum speed, the engine is controlled by the hand control, or accelerator, which is connected by links to the vertical lever. As the maximum speed of the engine is reached the large governor spring takes control, limiting the revolutions to the maximum rated speed of the engine.

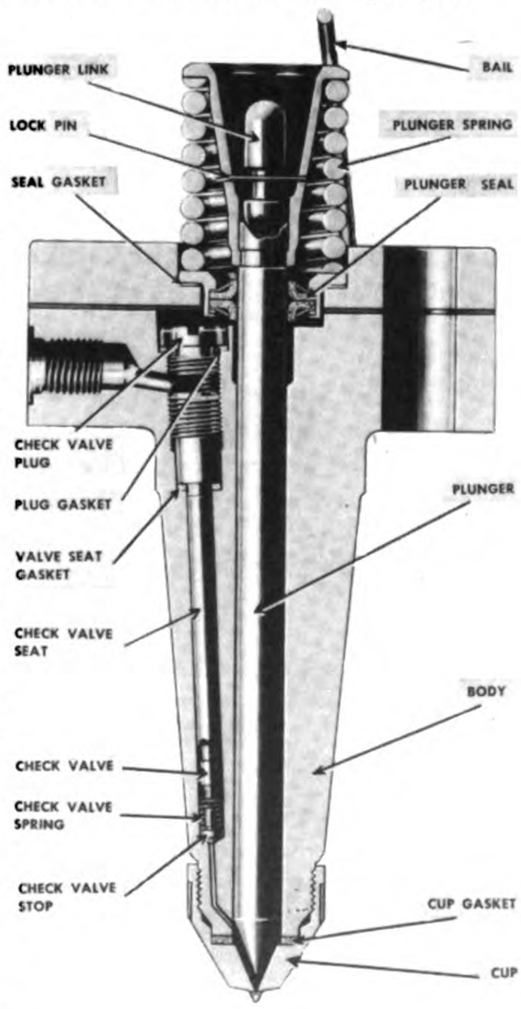
FUEL INLET CONNECTIONS: After the metering plunger forces the fuel in the distributor unit to the proper fuel supply line, it passes through the injector fuel inlet connection before entering the injector. The fuel inlet connection has a ball check valve and spring to prevent any return flow of fuel.

All fuel lines from the fuel tank to the injector remain full of fuel at all times. Any additions of fuel through the metering chamber will push the same amount of fuel through the injector and into the injector cup.

INJECTOR

The injector is mechanically operated, receiving its motion from the camshaft through rocker levers and its push rod. It consists of a forged body with a properly fitted plunger. The length of the stroke of the injector plunger remains constant at all speeds. Mounted on the end of the injector is the injector cup.

On the intake stroke of the engine, the fuel metering pump forces a charge of fuel of the exact amount for the load and speed of the engine into the injector cup past the check valve. The check valve effectively prevents any back flow of fuel during the remainder of the cycle.



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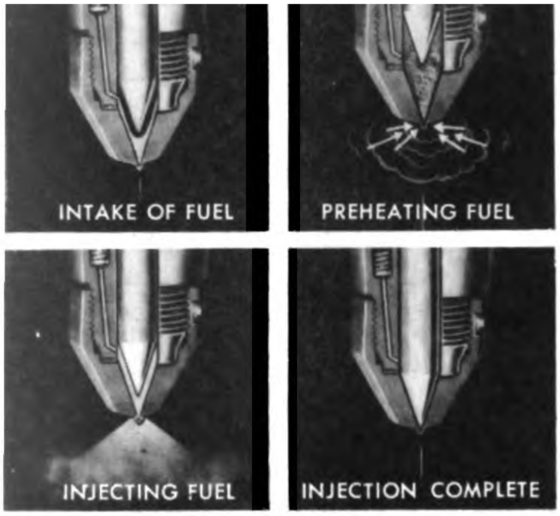


FUEL INJECTION CYCLE

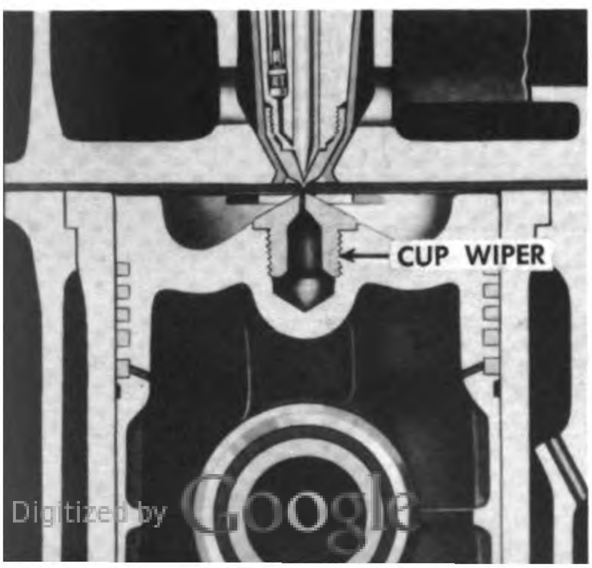
After the fuel is delivered to the injector cup, the injector plunger continues its up stroke. At the same time, the piston moves upward on the compression stroke and forces hot air through the injector cup spray holes. The fuel lies in the cup during a part of the compression stroke of the engine. The fuel oil in the tip of the cup is exposed to the intense heat of the compressed air in the cylinder and thus the fuel is preheated and broken up, or partially gasified. (Second phase of illustration.)

A few degrees above top center, the plunger is forced downward by the action of a cam, transmitted through a push tube and rocker levers, and the preheated fuel charge is driven out through the six small holes in the injector cup into the cylinder. These holes are only .006" in diameter and the effect is to completely break up the fuel charge and distribute it evenly through the compressed air in the top of the cylinder. The air in the top of the cylinder is heated by compression to approximately 1000° F. and the highly combustible fuel charge ignites and forces the piston downward on its power stroke. (Third phase of illustration.)

The injector plunger continues its down stroke during the first part of the power stroke and, as more fuel is added, the pressure remains fairly constant during several degrees of the stroke. The plunger remains in its lowest position during the remainder of the power stroke and during the exhaust stroke. (Last phase of illustration.)

CUP WIPER

The special air chamber provided on the top of each piston is called the injector cup wiper. At the completion of the compression stroke, the injector cup wiper holds from 6 to 7% of the total volume of compressed air in the firing chamber. After the piston reaches a certain point on its downward movement of the power stroke, the compression in the firing chamber decreases somewhat below that of the air in the cup wiper. This air escapes through the small hole in the top of the cup wiper into the firing chamber. Thus, additional oxygen is supplied to the firing chamber around the tip of the injector cup to create additional turbulency and to provide for more complete combustion.



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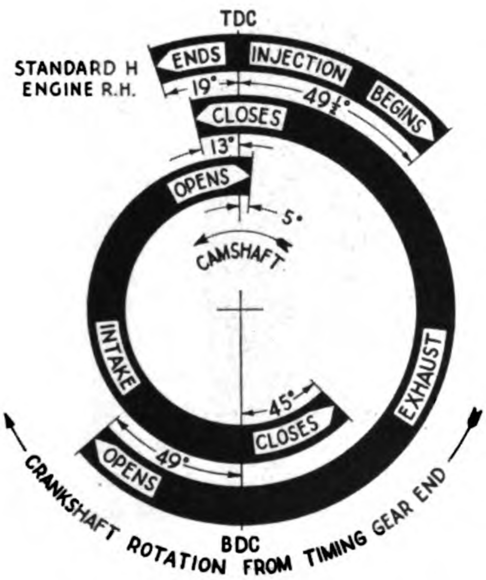
SUMMARY

There are two phases of fuel travel. During the first phase, fuel flows from the fuel tank through the Number 1 gear pump to the float chamber, through the Number 2 gear pump, through the indexed holes of the distributor to the metering pump. The metering plunger is on its down stroke.

During the second, or final phase, the fuel travel is completed when the distributor holes index to allow the fuel from the metering plunger (on its up stroke) to pass to the injector. To this point, the fuel is under low pressure. The injector forces the fuel at high pressure into the cylinder.



6 CYL. FIRING ORDER: 1-5-3-6-2-4

"EXHAUST — OPENS — CLOSES" refers to the opening and closing of the exhaust valve.

"INTAKE — OPENS — CLOSES" refers to the opening and closing of the intake valves.

"INJECTION — BEGINS — ENDS" refers to the downward travel of the injector plunger. The point at which actual fuel injection begins is dependent upon the amount of the metered charge in the fuel cup and other contributing factors.

THE COOLING SYSTEM

Water is circulated by a centrifugal type water pump mounted on the gear cover end of the engine and driven by belts from a drive pulley on the fuel pump main shaft.

The water circulates around each of the wet type cylinder liners, through the cylinder head and around the injector sleeve housing in the head. Special copper sleeves surround the injectors for fast dissipation of heat. Discharge connections between the heads are provided by a water manifold. The water manifold and water by-pass houses three thermostats to control the operating temperature of the engine. The engine cooling water, or solution, is cooled by the Tournapull radiator.

The radiator has 6 cores and a relatively high cooling capacity.

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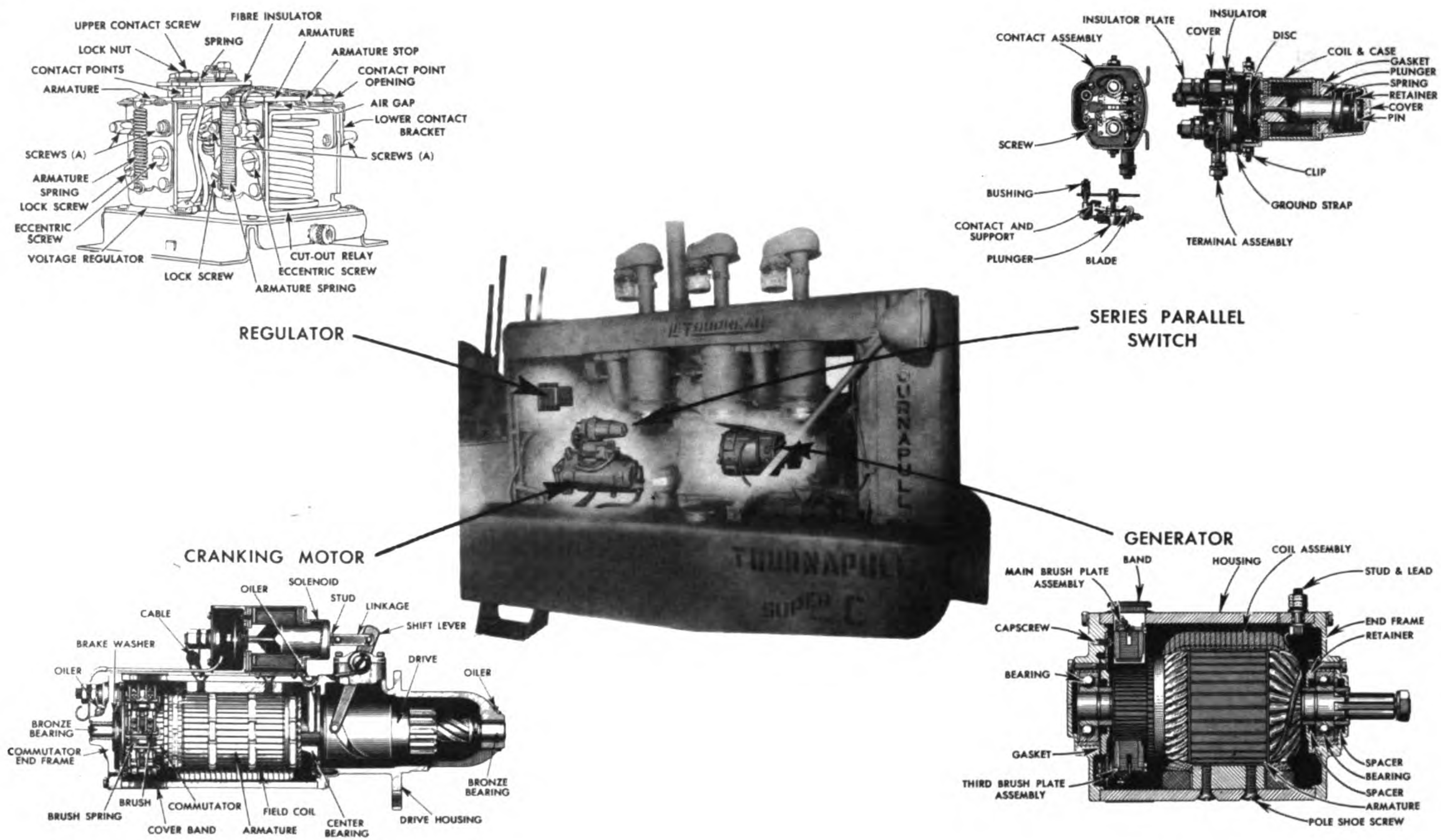

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ENGINE ELECTRICAL ACCESSORIES

BATTERY CHARGING GENERATOR

The generator is a machine for converting mechanical energy into electrical energy. The generator is a three brush, four pole, 12 volt, 25 ampere unit, with over-size ball bearings in both the drive end and commutator end supporting the armature. The generator current output is regulated by means of an adjustable third brush and the voltage is regulated by an external voltage regulator unit, described below.

The function of the generator is twofold. It restores to the batteries the current withdrawn during cranking, thus maintaining the batteries in a charged condition. Second, it carries the connected electrical load up to the capacity of the generator, when the generator is operating at speeds at which substantial or maximum generator output can be obtained, thus preventing undue or prolonged draining of the battery.

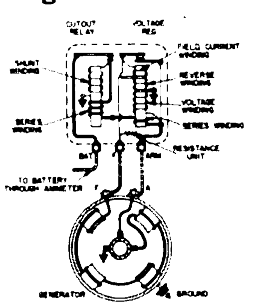
REGULATOR

GENERAL DESCRIPTION—The generator regulator is an electromagnetic device which operates to prevent the line voltage from exceeding a predetermined value. There are two separate units in the regulator, the cut-out relay and the voltage regulator. They are mounted on the same base and under the same cover.

FUNCTION OF REGULATOR—The function of the two units in the regulator is as follows:

(1) *Cut-out relay* —The cut-out relay closes the circuit between the generator and the batteries when the generator voltage has built up to a value sufficient to force a charge into the batteries. The cut-out relay opens the circuit when the generator slows or stops and current begins to flow back from the battery into the generator.

SCHEMATIC WIRING DIAGRAM OF VOLTAGE REGULATOR AND GENERATOR



(2) *Voltage regulator*—The voltage regulator prevents the line voltage from exceeding a predetermined value and thus protects the battery and other electrical units in the system from high voltage. One characteristic of batteries is that as either the specific gravity or charging rate increases, other conditions being the same, the battery terminal voltage increases. If the terminal voltage is held constant as the battery comes up to charge (specific gravity increases), the charging rate will be reduced. The voltage regulator performs this job of holding the voltage constant and it consequently protects the electrical system from high voltage and the battery from overcharge.

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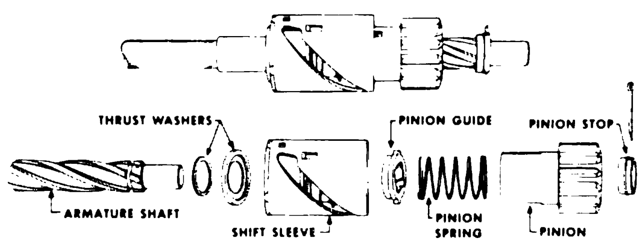
CRANKING MOTOR

GENERAL DESCRIPTION—The cranking motor is a twelve brush 24 volt, six pole, heavy duty unit with the armature supported by three bushings at the drive end, center, and commutator end. The unit has a heavy duty cranking motor solenoid switch mounted on it and employs a Dyer drive to mesh the drive pinion with the flywheel for cranking the engine and to demesh the drive pinion when the engine begins to operate. A shift lever in the drive housing is connected by linkage to the solenoid switch, so that operation of the solenoid switch not only closes the circuit between the battery and cranking motor, it also shifts the drive pinion into mesh. Operation of the shift lever first shifts the drive pinion into mesh and completion of the shift lever movement closes the cranking motor switch so current can flow from the battery to the cranking motor so cranking of the engine can take place. As soon as the engine operates, the engine drives the pinion back out of mesh so excessive speeds cannot be transmitted back to the cranking motor armatures.

FUNCTION OF CRANKING MOTOR—The cranking motor electrically cranks the engine so that the engine will start and run. Current from the Tournapull batteries is utilized to operate the cranking motor; this current being subsequently replaced in the batteries by operation of the Tournapull's electric generator.

Dyer Drive—The Dyer drive provides positive meshing of the drive pinion with the engine flywheel before the cranking motor switch is closed and demeshes the drive pinion as soon as the engine begins to operate. The complete drive is assembled on the spirally splined armature shaft and consists of thrust washers, shift sleeve, pinion guide, pinion spring, pinion stop and cotter pin. The pinion has splines on its inner diameter which are a loose fit on the armature splines. The pinion guide has splines on its inner diameter which are a fairly snug fit on the armature splines. Two lugs on the pinion guide engage into lateral slots in the pinion. A stud on the shift lever engages in a spiral slot in the shift sleeve. When the shift lever is operated, the stud, resting



on a flat portion of the shift sleeve slot, forces the shift sleeve, pinion guide, and pinion, endwise along the armature shaft. If the pinion and flywheel teeth align, meshing takes place and further movement of the shift lever closes the cranking motor switch so that cranking is accomplished. If the pinion and flywheel teeth do not align and the teeth butt, the drive pinion is caused to rotate against the flywheel teeth with-

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out forward movement so that alignment and meshing do take place. This rotation of the pinion is caused by the fact that the pinion is a loose fit on the armature splines, while the pinion guide is a fairly snug fit. As the shift lever movement continues (after the teeth butt) the pinion guide continues to move endwise along the armature shaft, compressing the pinion spring. The pinion guide rotates and transmits this rotational movement through the pinion guide lugs and slots in the pinion, to the pinion so that it rotates without forward movement. The pinion rotates only a few degrees until the teeth align and meshing can take place. Then, further shift lever movement closes the cranking motor switch and cranking is accomplished. As soon as the armature begins to rotate, the shift sleeve spins back out of the way and the driving•torque of the armature through the pinion holds the pinion in mesh with the flywheel. When the engine begins to operate, it attempts to drive the cranking motor armature, with the result that the pinion is driven faster than the armature is turning and the pinion consequently is spun back out of mesh and returns to the demeshed position. The pinion guide drops into a milled section on the armature splines so that it and the pinion are locked in the demeshed position. Before the pinion can again be shifted into mesh, the shift lever must be released so the stud on the shift lever can rotate the shift sleeve, come to rest again on the flat portion of the shift sleeve slot and then move the entire assembly forward as already decribed.

SOLENOID SERIES PARALLEL SWITCH

a. GENERAL DESCRIPTION—The solenoid series-parallel starting switch is an electromagnetic device which makes it possible to use a 24-volt cranking motor with a 12-volt electrical system.

b. FUNCTION OF SWITCH—Four 6-volt batteries are used in the electrical system with the series-parallel starting switch. (These batteries are wired in pairs, each pair serving as one 12-volt battery). For charging and also for furnishing the necessary electrical power to operate the lights and other electrical accessories, the batteries are connected in parallel, furnishing a 12-volt source of supply. When the series-parallel starting switch is operated, the parallel connections are broken and the batteries are connected in series to furnish a 24-volt source of supply for the cranking motor.

The electrical system in which the series-parallel switch is used incorporates the principle of both one and two wire systems. The 12-volt equipment which includes the generator, regulator, lighting and accessory loads, is grounded so that they form a single wire system. Thus, for this part of the system, the frame of the vehicle completes the circuit. The two wire principle is involved only upon cranking of the engine. The cranking motor itself is fully insulated. When the engine is running and the generator is delivering current, the cut-out relay in the regulator is closed and allows the current to flow to the lighting and accessory loads and to the batteries to maintain them in a charged condition.

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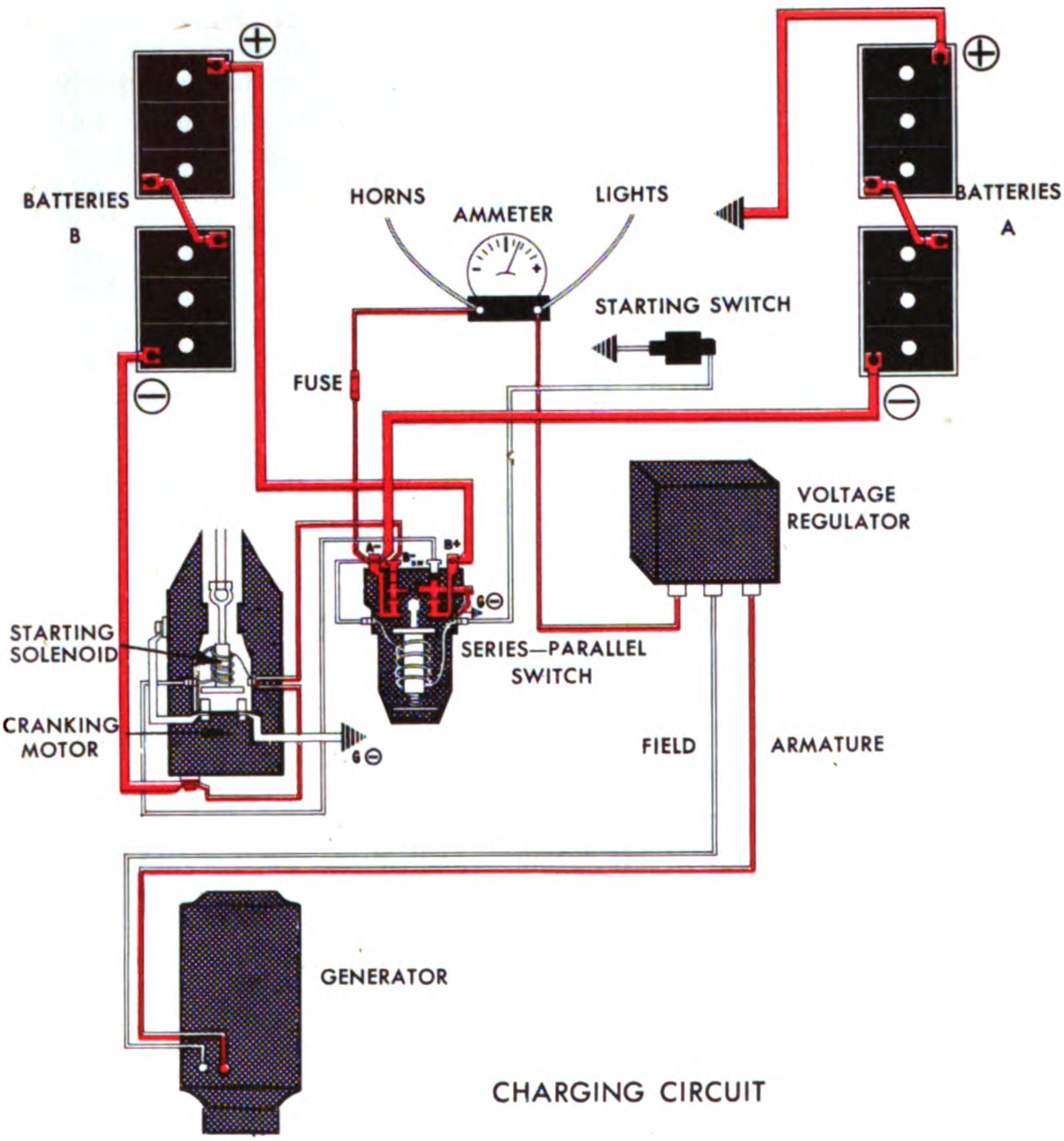

CHARGING CIRCUIT

(1) *Charging Circuit*—When the series-parallel switch is in the position for normal operation of the Tournapull and the batteries are parallel connected, the circuit is as follows: From the generator it leads through the voltage regulator and ammeter, to the "—A" terminal of the series-parallel switch. From this terminal, half the current flows through batteries "A" (left hand batteries). The other half flows through the closed contacts of the series-parallel switch and out at the "—B" terminal. From here it by-passes the cranking motor solenoid and cranking motor and flows through batteries "B" (right hand batteries). From the positive (+) terminal of batteries "B" it enters series-parallel switch through "+B" terminal and is grounded on the case of the series-parallel switch.

(2) *Cranking circuit*—When the starting control switch is operated, the solenoid winding in the series-parallel switch is energized which

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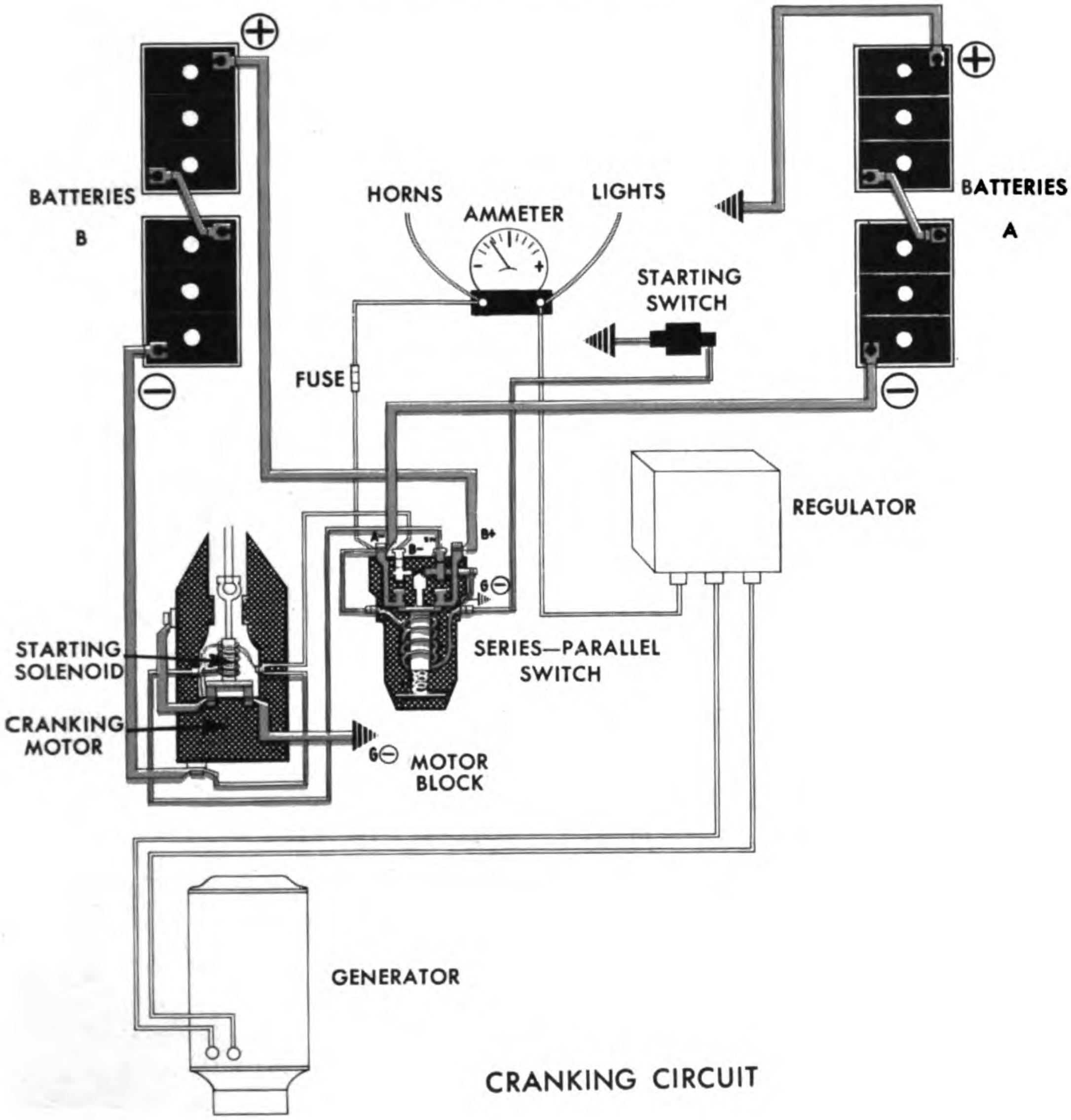

CRANKING CIRCUIT

moves the contact disc toward the switch terminals. Just before the disc makes contact, the movement of the plunger actuates a small secondary plunger inside the switch which breaks the parallel connections. Further movement of the main switch plunger forces the contact disc against the main switch contacts, additional plunger movement connects the cranking motor solenoid to ground through the series-parallel switch so 24 volts is impressed on the solenoid. The cranking motor solenoid operates, shifting the cranking motor drive pinion into mesh and closing the cranking motor switch contacts. The cranking motor now operates on 24 volts. The series cranking circuit is through batteries "A", the closed contacts in the series-parallel switch, batteries "B", the cranking motor, and main switch terminals of the cranking motor solenoid back to batteries "A".

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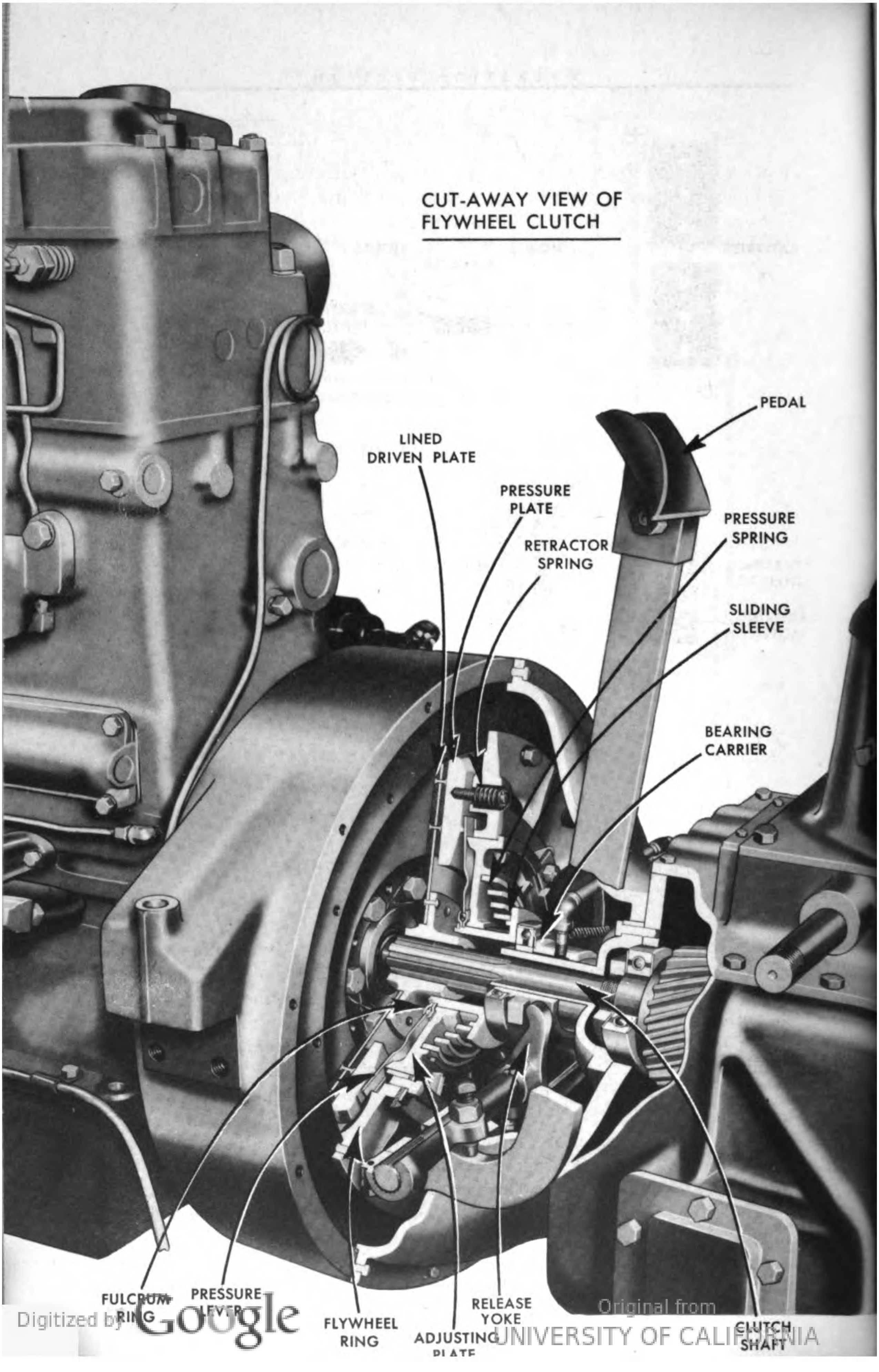

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FUNCTIONS OF FLYWHEEL CLUTCH

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

The flywheel clutch is a heavy duty "push" type, single disc clutch and is mechanically controlled by the foot pedal. It is mounted to the engine flywheel and enclosed within the engine flywheel housing and clutch housing at the front of the transmission case.

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

When the operator presses down on the clutch pedal with the foot, the pedal moves forward, thereby turning the clutch release yoke. The arms extending up from the release yoke bear against the clutch bearing carrier and when turned, move the carrier forward. The clutch release bearing, which rides on the bearing carrier, bears against the floating sleeve and, when moved forward with the carrier, pushes the floating sleeve forward toward the engine flywheel. When the floating sleeve moves forward toward the flywheel, the twenty ball bearing hinged levers in the fulcrum ring, known as pressure levers, also move toward the flywheel at their inner ends. At the same time the outer ends of these hinged pressure levers move in the opposite direction, allowing the retractor springs to pull the pressure plate away from the lined driven plate.

When the pressure plate backs away from the lined driven plate, the driven plate is no longer clamped between the flywheel and pressure plate, and no longer turns with the two. The driven plate is splined with the clutch shaft extending out of the front of the transmission, and therefore the shaft stops turning when the driven plate ceases to turn with the flywheel and pressure plate, and the flow of power from the engine to the transmission is broken.

To re-engage the clutch and thereby renew the flow of power from the engine to the transmission, the foot should be released from the clutch pedal. This permits the pressure spring to return the floating sleeve and bearing carrier to the rear, thereby causing the pressure levers to move forward at their outer ends, and thus forcing the pressure plate forward, tight against the lined driven plate.

The driven plate now turns with the engine flywheel and pressure plate, and the flow of power is delivered to the transmission through the clutch shaft as the shaft turns with the driven disc.

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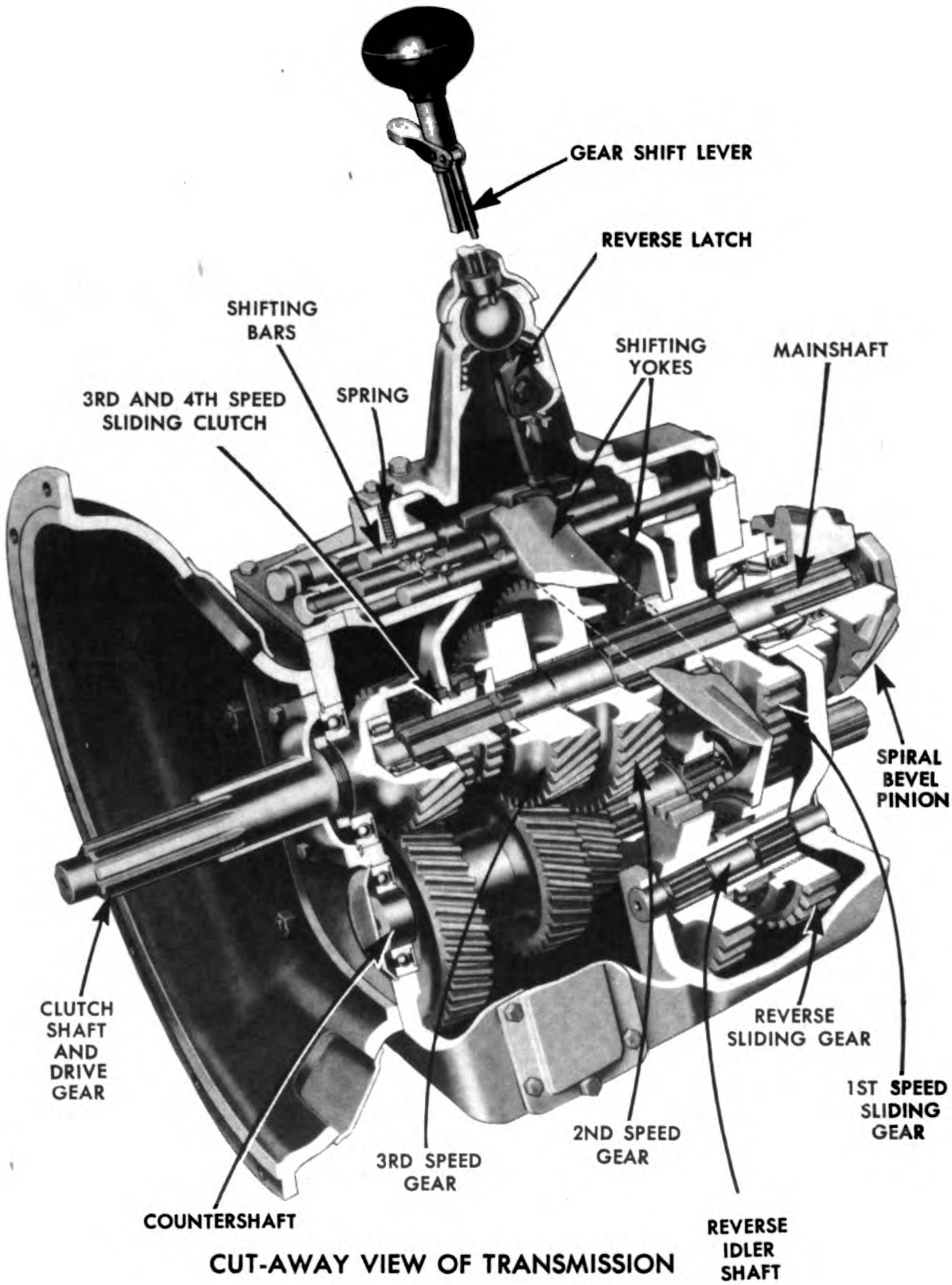

CUT-AWAY VIEW OF TRANSMISSION

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FUNCTIONS OF TRANSMISSION

The Tournapull makes use of a heavy duty transmission having four forward speeds and one speed in reverse. Its principal purpose is to make it possible for the operator to select any one of four gear ratios for forward travel and one for reverse, depending upon the amount of power that needs to be delivered to the drive wheels during the varying phases of operation and the direction in which it is desired to travel—front or reverse.

The transmission has the standard four speed forward shift, and is shifted in the conventional manner.

Shifting gears is accomplished by movement of the gear shift lever by the operator as is explained below.

The lower end of the gear shift lever extends down into horizontal slots in the upper ends of the shifting forks. When the shifting forks are in neutral position, the slots in the forks line up with one another, making it possible to move the gear shift lever sideways, into the slot in any one of the three forks.

The illustration on the opposite page shows the transmission in 1st speed. To obtain 1st speed, the upper end of the gear shift lever should first be moved to the left when in neutral position. This causes the lower end of the gear shift lever to move to the right, into the slot in the 1st and 2nd speed shifting fork. Then, with the lower end of the gear shift lever positioned in the slot in the 1st and 2nd speed fork, move the upper end of the gear shift lever forward, thereby causing the lower end of the lever to move to the rear. This movement of the lower end of the shift lever to the rear forces the 1st and 2nd speed shifting fork also to the rear, moving the 1st speed gear to the rear on the mainshaft, and thus causing the teeth on the 1st speed gear to move into mesh with the corresponding teeth of the rear gear on countershaft. Since the countershaft turns constantly when the engine is running and flywheel clutch engaged, the 1st speed gear is turned by the countershaft gear and in turn the 1st speed gear turns the mainshaft, due to it being splined on the shaft. When the main shaft turns, the spiral bevel pinion also turns, thereby delivering power to the spiral bevel gear and steering clutches.

When the shifting fork is moved to the rear to shift into 1st gear, the shifting bar on which the fork is mounted also moves to the rear. When the shifting bar reaches its rear position, a small spring pushes a steel ball down into a half round seat in the bar, locking the shifting bar and shifting fork and preventing them from moving out of gear of their own accord. The operator overcomes the compression of the spring and causes the ball to raise up out of its seat in the shifting bar when moving the gear shift lever back to neutral position.

The two larger steel balls lying between the shafts and the small interlock pin in the center shaft prevent the transmission from being shifted into two gears at once. The steel balls are forced out of the groove in one shifting bar and into the groove in another when a shifting bar is moved out of neutral, thereby locking the other bars.

2nd, 3rd, 4th and reverse speeds are obtained in somewhat the same manner as 1st speed.

The 2nd, 3rd, and 4th speeds have constant mesh helical gears and are engaged by sliding clutches which require a relatively short shift. Reverse speed, like 1st speed, is a sliding spur gear which requires a longer shift to make full engagement of the mating gears. The reserve latch on the side of the gear shift lever must be raised to permit the shift lever to be moved into reverse speed position.

The flow of power in each of these speeds can be traced on the cut-away illustration on opposite page. When the transmission is in neutral, the flow of power is broken at the transmission.

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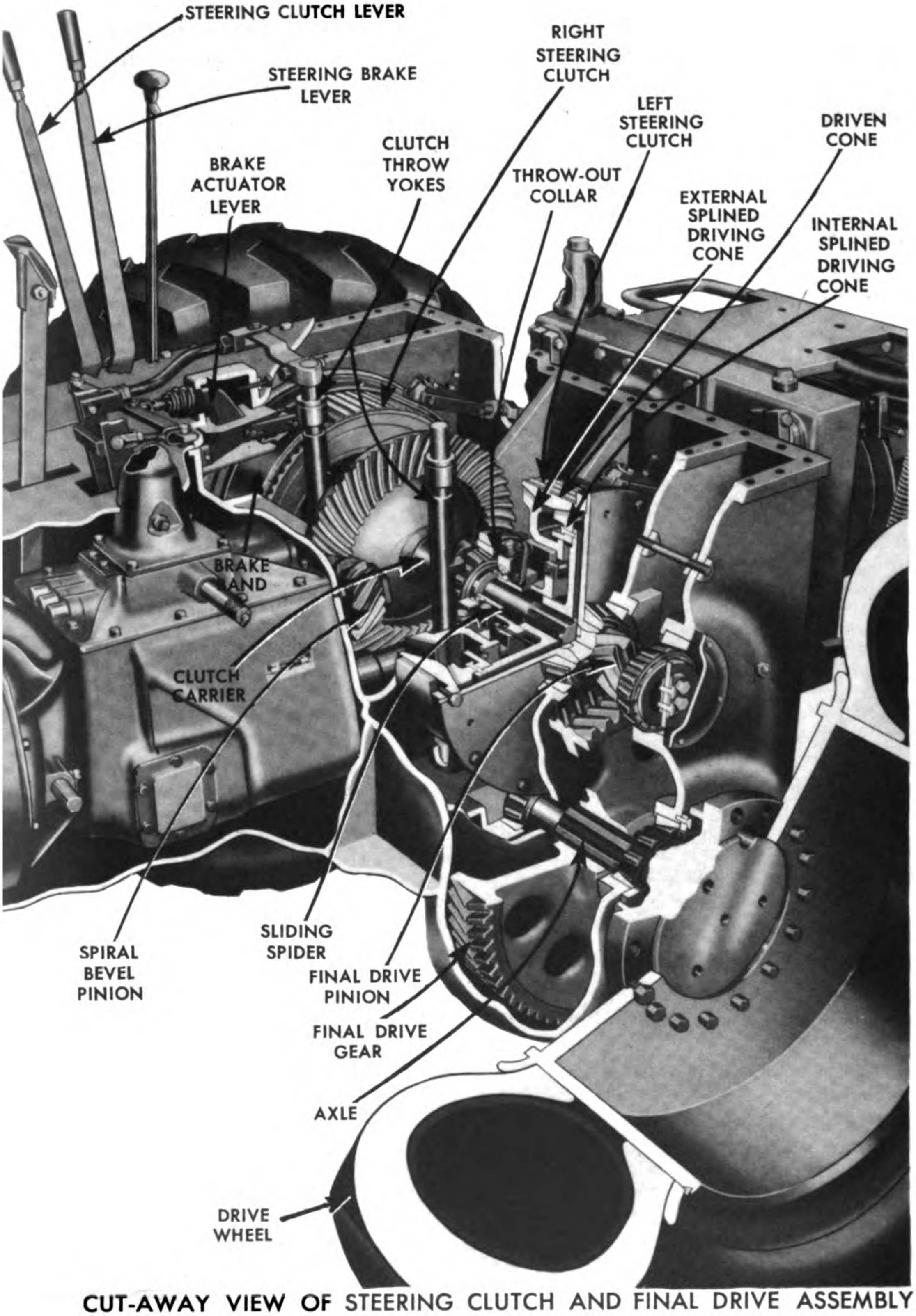

CUT-AWAY VIEW OF STEERING CLUTCH AND FINAL DRIVE ASSEMBLY

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FUNCTIONS OF STEERING CLUTCH AND FINAL DRIVE ASSEMBLIES

The power of the engine is delivered back to the spiral bevel pinion and gear through the flywheel clutch and transmission.

With the flywheel clutch engaged and the transmission in gear, the spiral bevel pinion is turned by the engine. The spiral bevel pinion turns the spiral bevel gear and gear carrier, thus delivering the flow of power to the steering clutches, which ride on the ends of the gear carrier shafts.

When the steering clutches are engaged, the flow of power passes through the clutches to the final drive pinions and in turn to the final drive gears, axles and wheels, causing the wheels to turn and the machine to move.

With both steering clutches engaged, the flow of power is delivered to both drive wheels equally, and both wheels turn at the same rate of speed, causing the Tournapull to move straight ahead or to the rear, depending upon whether the transmission has been shifted into a forward speed or into reverse.

For turning, the operator disengages one of the steering clutches while leaving the other clutch engaged. The flow of power continues to pass through the steering clutch that remains engaged but is broken at the clutch that is disengaged, resulting in one drive wheel continuing to move forward while the other ceases to turn.

The releasing of one of the steering clutches to stop the flow of power to a drive wheel can be supplemented by engaging the corresponding steering brake, thereby locking the wheel.

A steering clutch is disengaged by the operator pulling back on the clutch control lever.

The linkage between the control lever and clutch throw yoke is put in motion when the control lever is pulled back, actuating the clutch throw yoke and causing it to turn in the bushings in the main case and deck plate, in which it pivots. The arms on the clutch throw yoke (broken in the cut-away illustration on opposite page) swing in an arc away from the clutch cones as the yoke is turned, moving the throw-out collar and sliding spider away from the clutch cones. The movement of the sliding spider causes the clutch engaging links and fingers to change their position, with the ends of the engaging fingers moving away from the thrust collar of the external splined driving cone. The driving cones free themselves from the driven cone when these engaging fingers no longer bear against the external splined driving cone, thereby disengaging the clutch and stopping the flow of power from the driving cone to the driven cone, allowing the driven cone to stop turning.

The steering brake levers are linked with the steering clutch levers in such a way that the brake levers travel to the rear with the clutch levers. By moving the clutch lever to the extreme rear position, past the point where the clutch becomes disengaged, the brake lever is moved back far enough to cause the steering brake to take hold. The brake band encircles the outer circumference of the clutch driven cone and when the brake lever is moved to the rear, either with the steering clutch lever or separtaely, the brake linkage and actuator lever also move to the rear, tightening the brake band on the cone. This stops the final drive pinion, gear, axle and wheel from turning and assures shorter turning than might be obtained by disengaging the clutch alone.

When the steering clutch levers and brake levers are moved forward again into normal position the brake releases and the clutch parts move back into their original engaged position.

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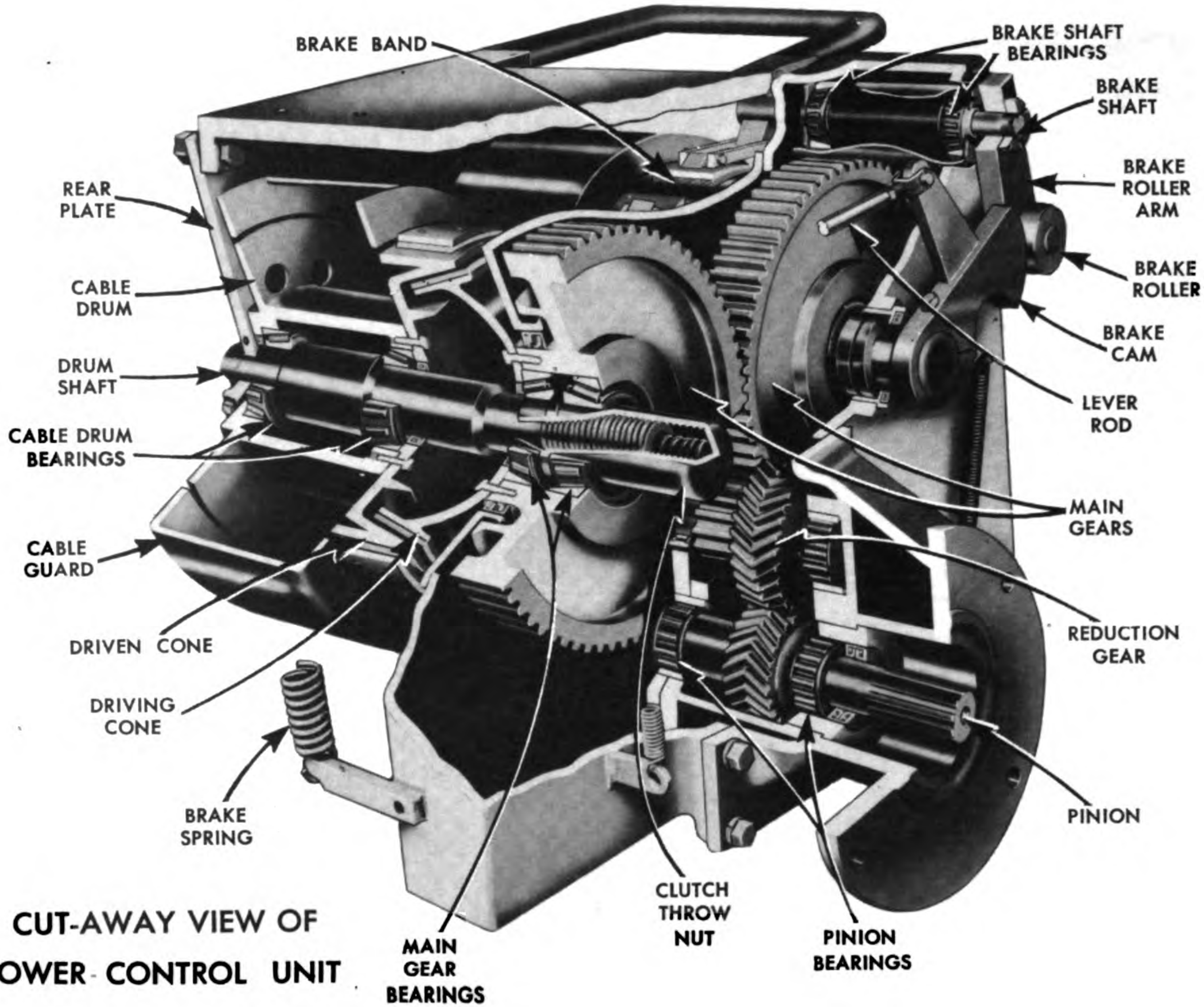

CUT-AWAY VIEW OF POWER-CONTROL UNIT

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FUNCTIONS OF POWER CONTROL UNIT

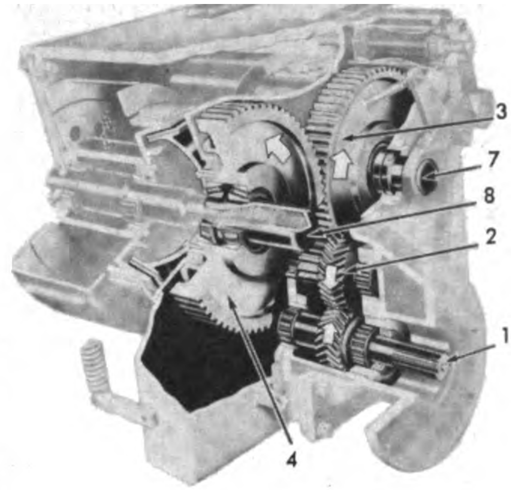
Power Control Unit pinion (1) is connected with Tournapull lower transmission shaft by a splined connector shaft, known as "spline shaft". When Tournapull engine is running with flywheel clutch engaged, the engine turns lower transmission shaft, causing Power Control Unit pinion (1) to turn. Pinion then turns reduction gear (2) which turns left main gear (3) which then turns right main gear (4). Each main gear and driving cone (assembled as one unit) ride on bearings on clutch throw-nuts (7) and (8) and turn constantly when Tournapull engine is running with flywheel clutch engaged.

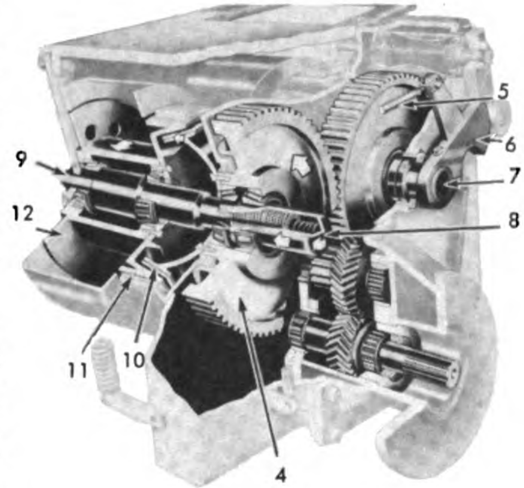
The clutches are engaged by moving control levers (not illustrated). When moved to the left, the shorter control lever causes lever rod (5) to actuate brake cam (6), clamped around throw-nut (7) thereby engaging left clutch. Likewise, when moved to the left, the longer control lever causes a similar lever rod and brake cam (not shown), clamped around throw-nut (8), to engage right clutch. (Inasmuch as both right and left clutch and cable drum assemblies are alike, only the right assembly, shown in cut-away, is explained.) When control lever is moved to engage clutch, throw-nut (8) turns on drum shaft (9), advancing throw-nut to rear on threads on shaft. Rotating main gear (4) and driving cone (10) are carried to rear with throw-nut, and driving cone (10) is brought into contact with driven cone (11), thereby engaging clutch. Driven cone (11) and cable drum (12) now turn, spooling cable onto drum.

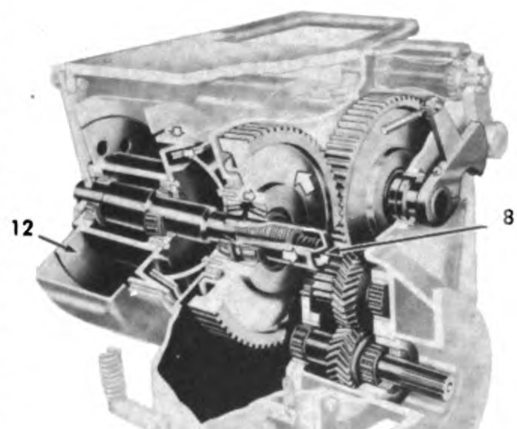
To disengage clutch and thereby stop spooling of cable onto cable drum, the control lever is returned to its original neutral position. As the control lever is returned, brake cam and clutch throw-nut (8) turn with lever, causing main gear and driving cone to be moved forward away from driven cone, thereby disengaging clutch. Cable drum (12) is held by self energizing brake which takes hold when control lever is in neutral.

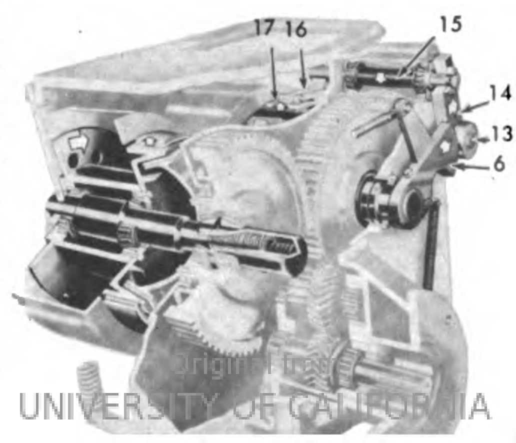
To release brake to permit unspooling of cable off cable drum, control lever is moved to the right out of neutral position. (Inasmuch as both the right and left brake assemblies are alike, only left brake assembly will be explained.) By moving control lever to release brake, brake cam (6) moves against brake roller (13), causing roller and lower end of roller arm (14), to be moved outward. This movement of roller arm, which is clamped to end of brake shaft (15), causes brake shaft to rotate. Rotation of brake shaft (15) causes linkage (16) connecting end of brake shaft with brake band (17) to raise band away from drum, thereby releasing brake.

To re-engage brake, return control lever to neutral position.









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SPECIFICATIONS

GENERAL SPECIFICATIONS

MODEL: Super C Tournapull with Model LP Carryall Scraper and Model T Power Control Unit.

OVERALL MEASUREMENTS

Length	32′ 2″
Width	10′ 2″
Height, Blade on ground	11′ 2″

TIRES

Tournapull	2 (21.00 x 24) 20 ply
Scraper	2 (18.00 x 24) 20 ply

WHEEL BASE	22′ 0″

CLEARANCE

Under Tournapull Drawbar	25″
At rear of Scraper Bowl	17″

WIDTH REQUIRED FOR NON-STOP TURN	40′

GAUGE (Width center to center of tires)

Tournapull	6′ 2″
Scraper	6′ 6″

APPROXIMATE SHIPPING WEIGHT	31,000 lbs.

ENGINE SPECIFICATIONS

MODEL	Cummins HBID-600
TYPE	Valve-in-head Diesel
GOVERNED SPEED	1800 R.P.M. Max.
BRAKE HORSEPOWER	150 at 1800 R.P.M.
NO. OF CYLINDERS	6
BORE	$4\frac{7}{8}$″
STROKE	6″
PISTON DISPLACEMENT	672 cubic inches
COMPRESSION PRESSURE	500-525 lbs.
CYLINDER HEAD—MATERIAL	Cast Iron
CYLINDER HEAD NUT TENSION	430-450 ft. lbs.
MAXIMUM OVERSIZE PERMISSIBLE TO AVOID WEAKENING CYLINDER WALL	.040″
FIRING ORDER	R.H. 1-5-3-6-2-4
COMPRESSION RATIO	17:1
OIL PAN CAPACITY	5 gal.
OIL FILTER CAPACITY	Approx. 1 gal. ea.
HEAD GASKET—MATERIAL	Special Metal Asbestos

VALVES

INTAKE—Angle of Valve Seat	30
Clearance, hot	.014″
EXHAUST—Angle of Valve Seat	30
Clearance, hot	.022″

VALVE SPRINGS

INTAKE—Spring Pressure

Valve Open	129 to 143 lbs.
Valve Closed	83 to 91 lbs.
Free Length	3 19/32″

EXHAUST—Spring Pressure

Valve Open	129 to 143 lbs.
Valve Closed	83 to 91 lbs.
Free Length	3 19/32″

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PISTONS

Available Oversized Pistons	.020", .030", .040", and finished
Clearance, Running:	
Cast Iron	.004" to .005"
Grinding Used	Cam
Fitting	None

PISTON PINS

Diameter	1.9988" to 1.9990"
Oversize Available	.005" and .010"
Method of Fastening	Lock Rings
Fit in Piston—Thumb Push Fit	.0005" to .0007"

PISTON RINGS

	Compression	*Oil*
Number	3	2
Width	1/8"	3/16"-1/4"
Type	1 wedge	
Groove Clearance:		
2 lap joint	.0025" to .0035"	
Butt joint	.0022" to .003"	
Gap Clearance, Wedge:		
2 lap joint	.015" to .020"	
Butt joint	.015" to .018"	

CONNECTING RODS

Bearing Clearance	.004" to .005"
End Clearance	•.006" to .008"
Length (center to center)	11.998" to 12.000"
Undersized replacement bearing available:	
Size	.020", .030", .040", .050", .060"
Rod and Piston Assembly	Removed from top of block
Nut Tension	105 to 115 ft. lbs.

MAIN BEARINGS

Type	Precision Type, Steel Backed
Number	7
Undersized Replacement Bearings Available	.010", .020", .030", .040"
End Thrust	.006" to .008"
Bearing Clearance	.0055"
Bearing Adjustment for Wear	None
Nut Tension	310 to 330 ft. lbs.

TIMING GEARS

Adjustment	None
Valve Timing	*Right Hand*
Intake Opens	5° BTC
Intake Closes	45° ABC
Exhaust Opens	49° BBC
Exhaust Closes	13° ATC

CRANKSHAFT GEAR—No. of teeth	36
CAMSHAFT GEAR—No. of teeth	72
IDLER GEAR—No. of teeth	48
ACCESSORY DRIVE GEAR—No. of teeth	23
FUEL PUMP GEAR—No. of teeth	36
LUBRICATING OIL PUMP GEAR—No. of teeth	30

CAMSHAFT

Type	Steel Forging
Journal Diameter	1.997" to 1.998"
Bearing Clearance	.0015" to .003"

CAMSHAFT BEARINGS

Number	7
Diameter Inside	2.000" to 1.995"

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ENGINE SPECIFICATIONS (Continued)

Length:
- No. 1 .... 2¼"
- No. 2-4-6 .... 1⅞"
- No. 3-5 .... 2⅜"
- No. 7 .... 2 11/16"

Bearing Clearance .... .0015" to .003"

CRANKSHAFT
- Main Journals .... 4.499" to 4.500"
- Connecting Rod Journals .... 3/124" to 3/125"

CRANKSHAFT BEARINGS
- Number 7
- Diameter Inside .... 4½"

FUEL SYSTEM .... Cummins

STARTING METHOD .... Electric Cranking Motor

ELECTRICAL SYSTEM .... Delco-Remy

BATTERIES
- Number 4
- Volts .... 6 ea.
- Amp. hrs. 12
- Plates .... 25 ea.

ENGINE ACCESSORIES

GENERATOR
- Rotation .... Counterclockwise viewing drive end
- Brush spring tension
  - Main brushes .... 25 oz.
  - 3rd brush .... 17 oz.
- Cold output .... 24-26 amps. at 13 volts at 1600 R.P.M.
- Hot output .... 18 amps. at 13 volts at 3000 R.P.M.
- Field current .... 1.39-1.47 amps. at 12 volts

REGULATOR
- Cut-out Relay
  - Air gap .... .057"
  - Point opening .... .020"
  - Closing Voltage .... 13.5 volts
- Voltage Regulator
  - Point opening .... .015"
  - Voltage setting .... 15.0 volts

CRANKING MOTOR
- Rotation .... Clockwise viewing drive end
- Brush spring tension .... 36-40 oz.
- No load .... 85 amps. at 22.0 volts at 6000 R.P.M.
- Lock test .... 25 lb. ft. at 500 amperes at 3.0 volts

TOURNAPULL SPECIFICATIONS

MODEL .... Super C Tournapull

SPEED IN M.P.H.
- 1st gear 2.6
- 2nd gear 4.4
- 3rd gear 8.1
- 4th gear 14.3
- Reverse 2.2

STEERING

Each wheel controlled by heavy duty double cone clutch and contracting brake, using metallic lining and running in oil.

TRANSMISSION
- Model .... Fuller, Model 4-B1-86

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FLYWHEEL CLUTH
- Model .... Lipe, single disc, Model Z-42-SX
- Type disc .... 15" heavy duty

WHEELS
- Axle .... 6" diameter
- Bearings .... Tapered Roller

POWER CONTROL UNIT SPECIFICATIONS

MODEL .... T

CABLE DRUMS
- Number and Mounting .... 2, rear
- Diameter .... 7⅝"
- Length .... 7⅝"
- Flange Diameter .... 13"

OPERATION .... Mechanical from Tournapull Gears

GEAR REDUCTION (Power Control Unit Only) .... 7.74 to 1

GEAR REDUCTION (Including reduction in Transmission) .... 13.83 to 1

LINE PULL
- Bare Drum .... 4000 lbs.
- Full Drum .... up to 2540 lbs.

LINE SPEED
- Bare Drum (ft. per min.) .... 277'
- Full Drum (ft. per min.) .... 409'

CABLE CAPACITY .... 186'

SCRAPER SPECIFICATIONS

MODEL .... LP

CAPACITY
- Struck, cubic yards 12.1
- Heaped, cubic yards 15

BOWL
- Height of sides .... 4' 4¾"
- Dimensions of bottom .... 4' 11" x 8'6"
- Type of bottom .... Double

CUTTING EDGE
- Length .... 8' 6"
- Dimensions
  - Center section .... ⅞" x 16" x 56"
  - Each tip .... ¾" x 13" x 23"
- Type .... Reversible, hard surfaced

WHEELS
- Axle .... 3⅞" diameter, supported both ends
- Bearings .... Tapered Roller
- Brakes .... 17" x 4" Bendix brake assembly actuated by Wagner Electric hydraulic system

CABLE REQUIREMENTS (Type: 6 x 19 Preformed Tournarope)
- Dump Cable (Size ½") .... 126'
- (Furnished in Storage reel) .... 500'
- Tailgate Forward Cable (Size ⅞") .... 51'
- Apron Lift Cable (Size ⅞") .... 14'6"
- Hoist Cable (Size ½") .... 105'
- Springpipe Cable (Size ⅝") .... 17'
- Spiral Sheave-to-tailgate Cable (Size ⅝") .... 13'6"

TYPE OF EJECTION .... Forward, Positive, Mechanical

LIFT OF APRON .... 48¼"

MAXIMUM DEPTH OF SPREAD .... 17"

MAXIMUM DEPTH OF CUT .... 8"

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PREPARATION FOR INITIAL OPERATION

If Tournapull and Scraper arrive partially disassembled, it will first be necessary to assemble the machine. (Refer to assembling instructions in Repair Section.)

After the machine has been completely assembled, thread the cable through the sheave housings as outlined in the cable threading instructions on page 110 of the Operation Section.

Check cable alignment to determine whether it is fouling at any point.

Check all points of lubrication to determine if properly lubricated. (Refer to lubrication instructions on page 67 of Operation Section.) Check oil level in engine crankcase, Power Control Unit gear case, Tournapull main case and transmission. Make sure that the cork is removed from the breather hole in the oil fill plug for the Power Control Unit gear case.

Check fuel level in the fuel tanks. Make sure the supply is adequate to prevent running out of fuel inasmuch as this might result in damage to the fuel pump discs.

Check radiator for water or cooling solution.

Check water in batteries.

Check electrical system and wiring to make sure that all terminals and points of connection are tight, fuses in place, etc. (Refer to instructions on page 84 of Operation Section.)

Make sure engine is free, properly adjusted and primed. Release compression and bar engine over several times to see that it is free before starting. Check fuel pump timing (page 87 of Operation Section). Check injector plunger adjustment (page 87 of Operation Section). Check valve adjustments (page 89 of Operation Section). For instructions for priming the engine refer to page 80 of Operation Section.

If engine is already primed but has not been operated for a long period, pump the fuel pressure to 80 or 90 pounds on the fuel pressure gauge with the hand priming pump. This is done to prevent excessive cranking of the engine and to prevent scoring of the distributor discs.

Make sure Power Control Unit brake bands are not frozen to driven cones, by moving control levers to lock-out position.

Check steering clutch adjustments. (Refer to page 90 of Operation Section.)

Check steering brake adjustments. (Refer to page 92 of Operation Section.)

Check flywheel clutch adjustments. Refer to page 94 of Operation Section.)

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Check Power Control Unit brake adjustments. (Refer to page 98 of Operation Section.)

Check Power Control Unit clutch adjustments. (Refer to page 101 of Operation Section.)

Check hydraulic brake adjustments. (Refer to page 96 of Operation Section.)

Raise and lower Scraper apron and also pull tailgate forward and allow it to return to the rear position, checking for free movement.

Check tire pressures, making sure the correct inflation is used for the particular job conditions under which the Tournapull is to be worked. (Refer to tire inflation instructions on page 105 of Operation Section.)

Make sure safety cable is in place and correctly installed.

OPERATING TERMS

THE CUT—Place where Tournapulls and Scrapers are loading.

THE FILL—Place where Tournapulls and Scrapers are unloading.

FINISHING—Leveling or smoothing the surface of a finished cut, fill, slope, or other plot of ground.

PUSHER LOADING—Loading dirt into Scraper when the power of the Tournapull is being assisted by another tractor pushing from the rear.

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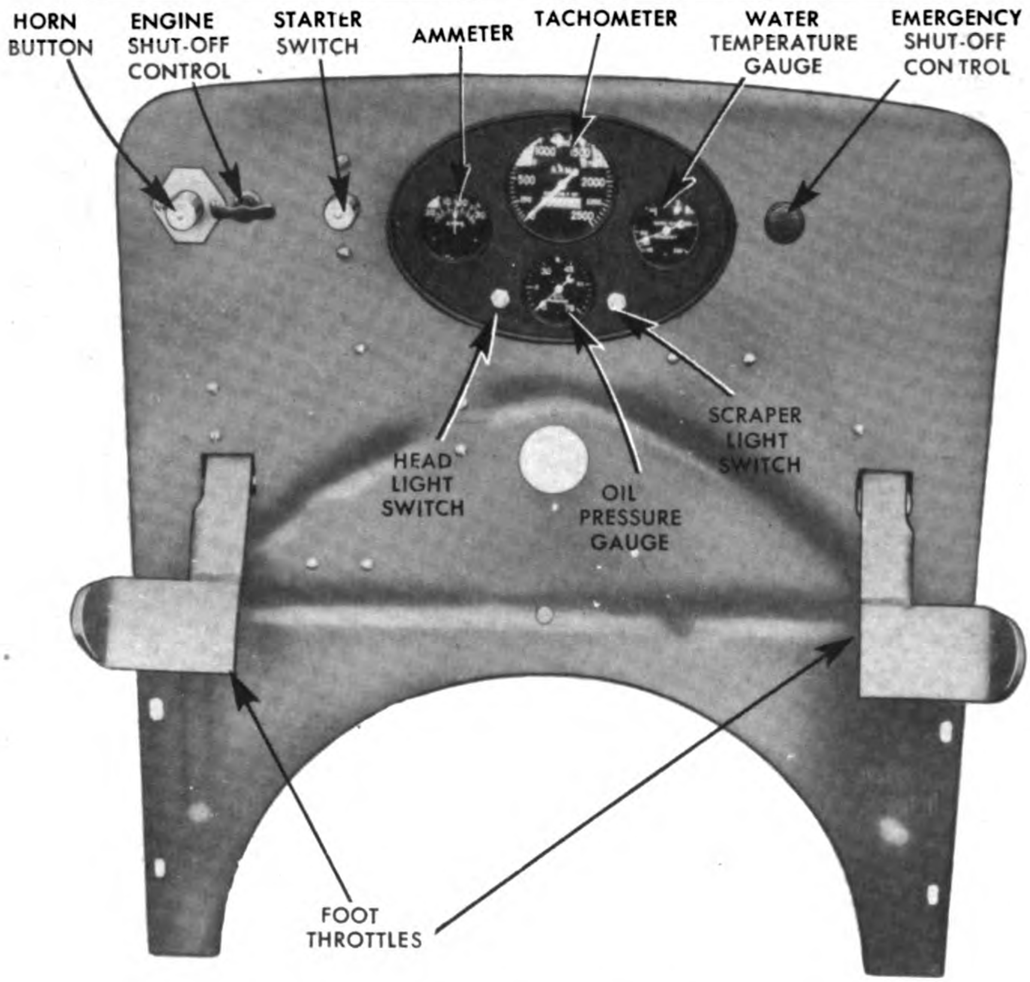

VIEW OF DASH PANEL

OPERATING INSTRUCTIONS

INSTRUMENTS AND CONTROLS ON DASH PANEL

The new operator should acquaint himself with the controls and indicators on the Tournapull dash panel.

For this reason, the following description of each control and indicator is given.

The horn button is the first control on the dash panel, when reading from left to right.

The second control is the engine shut-off control, with which the engine can be stopped. Pull out the engine shut-off control, thereby stopping the flow of fuel to the injectors and shutting off the engine. (Tilting the foot throttle back with the foot also performs the same function.) Turn the engine shut-off control ¼ turn after pulling it out to leave it in the released position.

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The next control from the left is the starter switch. When starting the engine, press in on the starter switch, thereby cranking the engine. The instant the engine starts, the starter switch should be released.

Four instruments or indicators are grouped together in an oval instrument board which is located in the center of the dash panel. These instruments are the tachometer, ammeter, water temperature gauge, and oil pressure gauge.

The water temperature gauge should be watched closely so that if the water temperature should run too high or too low, it will be immediately noticed. (See "Operating Temperatures" on page 39.)

The purpose of the tachometer is to indicate the speed or number of revolutions per minute at which the engine is turning. Also, the tachometer contains a revolution counting odometer which records in hundreds the number of revolutions turned over by the Tournapull engine. From this odometer reading the number of hours that the machine has operated can be obtained by use of the following formula:

$$\frac{\textit{ODOMETER READING}}{840} = \text{HOURS OF OPERATION.}$$

The ammeter indicates to what extent the batteries are charging or being discharged, and the oil pressure gauge indicates, as the name implies, the engine lube oil pressure. The operating pressure should be between 30 lbs. and 50 lbs. If the oil pressure drops to the danger point (below 30 lbs. pressure), the engine should be stopped immediately and the cause investigated and corrected.

The switches for the headlights and Scraper light are located on the instrument board, as shown in the illustration.

Located to the right of the oval instrument board is the emergency shut-off control. By pulling out this control, the engine can be stopped in an emergency in event it should "run-off" and refuse to be stopped by pulling out the engine shut-off control or by tilting back the foot throttle, because of mechanical difficulties. (Refer to instructions for stopping engine on following page.) If the emergency shut-off control is used to stop the engine, the shut-off valve must be re-opened before again starting the engine.

Two foot throttles, or accelerators, are also mounted into the dash panel as illustrated. These foot throttles are within comfortable reach of the operator and are connected together so that either the left or right foot may be used in controlling the engine speed.

In addition to the controls and indicators on the dash panel, there is a fuel pressure gauge on the left side of the engine near the fuel pump which warrants mention. The fuel pressure in a new engine or in one in good condition should normally be 75 lbs. to 150 lbs. maximum when running at operating speed. If the fuel pressure should drop very far below 60 lb. at idling speed, the engine should be stopped and the cause investigated and corrected.

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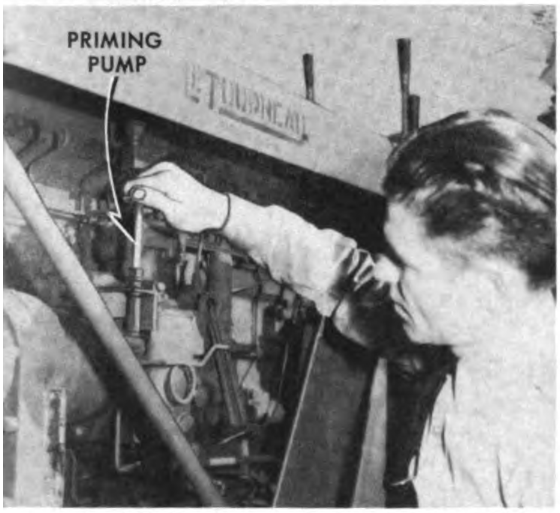

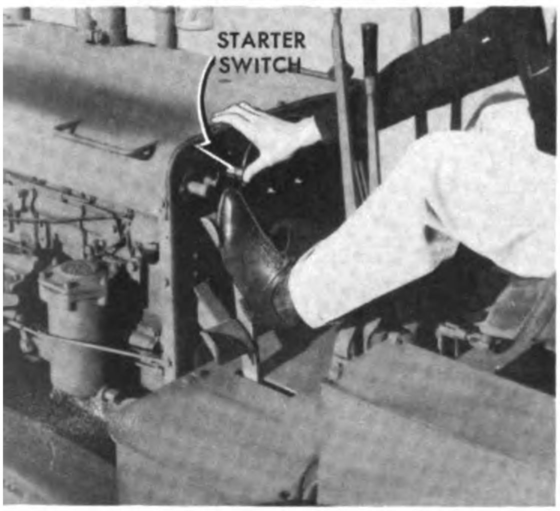

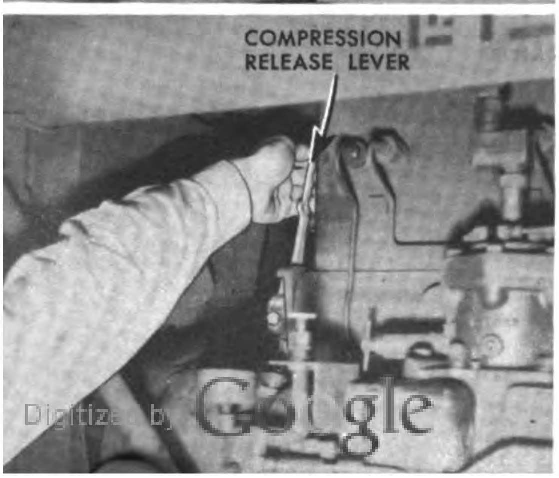

STARTING AND STOPPING ENGINE

To start the engine, first shift the gear shift lever into neutral position. Also push in engine shut-off control. Press the foot throttle down to the point where it catches at low idle speed, thereby opening up the flow of fuel to the injectors. (For starting in low temperatures refer to Cold Weather operating instructions on page 62 of Operation Section.)

If the engine has been idle for a long period, pump the fuel pressure to 80 to 90 pounds on the fuel pressure gauge with the hand priming pump. This is done in order to prevent excessive cranking of the engine and to prevent the scoring of the distributor discs. (If the engine is being started for the first time, refer to "Preparation for Initial Operation" on preceding page.)

For normal starting, push in on the starter switch, thereby cranking the engine with the cranking motor and starting the engine. Release the starter switch the instant the engine starts.

A compression release is provided on the engine to relieve the pressure in the cylinder when turning the engine over to make valve and injector adjustments. This compression release may be used in case of low batteries or in cold weather when engine oil is stiff. Release the compression and start the engine spinning with the cranking motor. When the engine has acquired the highest possible momentum, close the compression release and continue to hold the starter switch down until the engine fires.

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To stop the engine, either tilt the foot throttle back with the foot or pull out the engine shut-off control, thereby stopping the flow of fuel to the injectors. As a safety measure, the engine shut-off control can be turned one quarter turn after it has been pulled out, thereby locking it in the released position.

In event the engine should "run-off" because of mechanical difficulty and refuse to stop running by tilting back the foot throttle or pulling out the engine shut-off control, the engine can be stopped by pulling out the emergency shut-off control. The engine will continue to run for a minute or two after operating the emergency shut-off control, but will then starve of fuel and stop running. The emergency shut-off must be re-opened before the engine can again be started.

(IMPORTANT—Use emergency shut-off only in case of emergency when engine cannot be stopped in conventional manner previously described, because of danger of scoring distributor discs. Do not pull compression release lever when engine is running faster than idling speed or damage will result to the valves.)

When shutting down for the night or for a period of time, always cover the exhaust pipe to keep water from entering.

OPERATING TEMPERATURES

1. Serious damage may be caused to the engine by operating at temperatures either too high or too low. The recommended operating temperature is from 160° to 165° F. for both oil and water.

2. If the oil or water temperatures run over 180°, it is a indication of inefficiency in the cooling system, faulty lubrication or of some other condition that must be corrected. (Consult Trouble Shooter's Guide at rear of Repair Section.)

3. Operating the engine at a temperature below 140° F. will result in loss of power, carbon formation, etc., as listed in Trouble Shooter's Guide.

4. Consult temperature and pressure gauges frequently.

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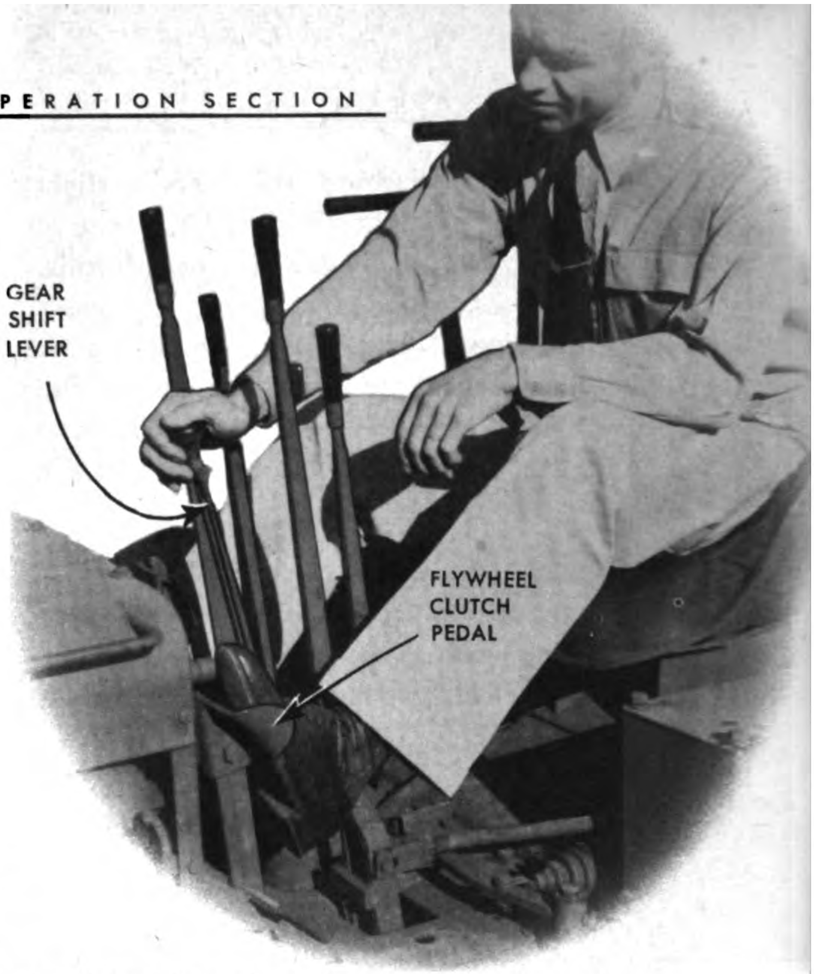

SHIFTING GEARS

The Tournapull transmission has four forward speeds and one speed in reverse. To shift gears, push the flywheel clutch pedal all the way down with the foot, thereby releasing the clutch, and shift the gear shift lever into the position that will obtain the desired transmission speed.

First speed is to the left and forward; second, to the left and rear; third, to the right and forward; and fourth, to the right and rear. (See diagrams on opposite page.)

Bring the Tournapull to a full stop to shift into reverse gear. Press down on the small release latch below the knob on the gear shift lever, and shift to the extreme right and to the rear.

The shifting from one forward speed to another may be done while the Tournapull is traveling.

When shifting into higher speeds, increase the speed of the Tournapull by speeding up the engine. Take the foot off the foot throttle and at the same time release the clutch. Move the shift lever quickly into the next higher speed position and immediately, but gently, engage the clutch. Speed the engine up as soon as the clutch is engaged. In

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order to avoid "clashing" the gears, a slight pause may be necessary in neutral, or it may be necessary to "double-clutch" when shifting. In other words, it may be necessary to depress the clutch pedal and move the gear shift lever into neutral and then let up on the pedal before again depressing the pedal and moving the control lever into the next higher speed.

Whenever the engine labors or slows down due to heavy pulling, shift into a lower speed. To do this, push the clutch pedal down far enough to release the clutch and shift quickly into the next lower gear before the Tournapull loses headway. "Double-clutching" is normally necessary in this operation to avoid clashing gears.

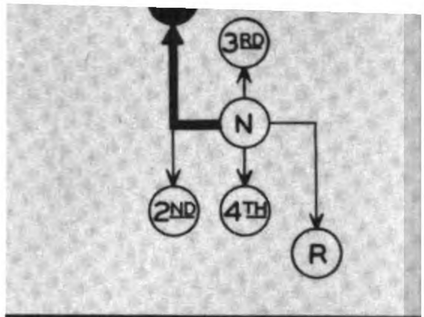
Keep the engine speed up when shifting into a lower speed, as the engine must run faster when pulling in lower gear.

When coasting down hills, leave the transmission in gear and the clutch engaged. Sudden engagement of the clutch under this condition is undesirable.

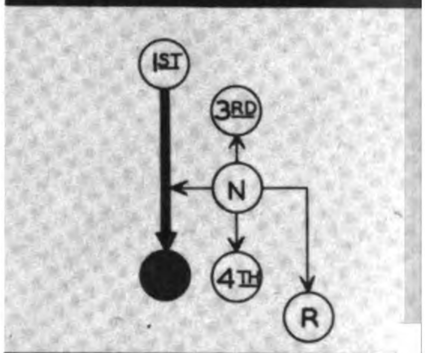
Do not ride the clutch pedal. Any pressure put on the clutch pedal lessens the engagement of the Clutch and tends to create clutch slippage.

When shifting gears, always make sure that the gears are in full mesh by moving the shift lever fully into its position.

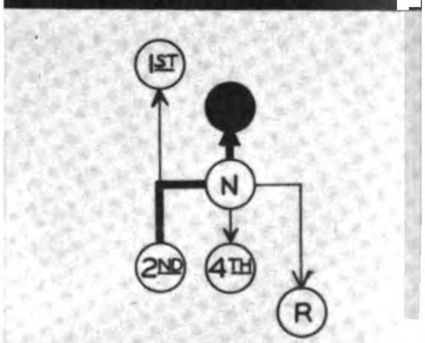
The design of the transmission insures positive engagement with ease in shifting. If the gears become difficult to shift, an inspection should be made to determine the cause. (Refer to "Trouble Shooter's Guide" at rear of Repair Section.)



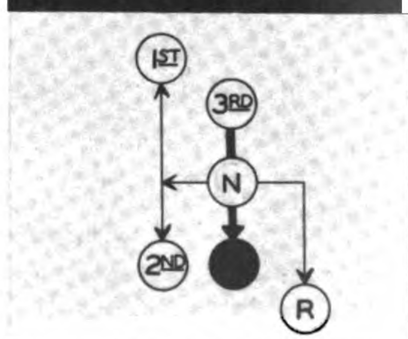
1st SPEED



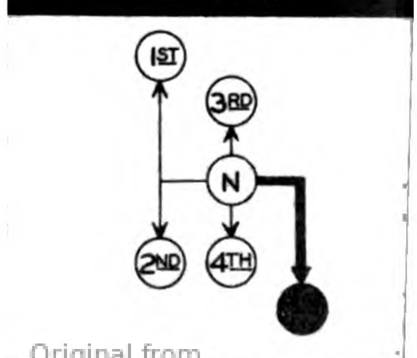
2nd SPEED



3rd SPEED



4th SPEED



REVERSE

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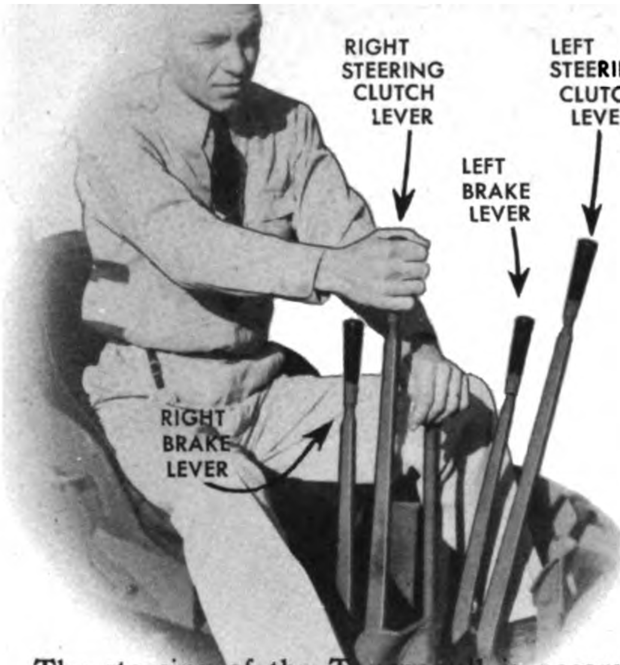

STEERING

The steering of the Tournapull is accomplished by the action of two steering clutches(one for each wheel) and two corresponding steering brakes.

The steering clutches are controlled by means of the two steering clutch control levers and the brakes are controlled by the two brake levers.

The steering clutches are normally in the engaged position. When the steering clutch control levers are brought into play, the clutches are disengaged, thereby stopping the flow of power to the drive wheels. Therefore, when either steering clutch lever is moved back toward the operator, the corresponding drive wheel ceases to turn with the opposite wheel, thus providing the steering action. By instantly opening up the throttle in varying amounts when steering, the experienced operator can accurately control the shortness of the turn.

In addition to using a steering clutch in turning, it is necessary at times to also engage the corresponding steering brake for immediate, positive response and for very short turns.

The brake control levers are linked with the steering clutch controls in such a way that when a clutch lever is pulled back to disengage a clutch, the corresponding brake lever is moved to the rear with the steering clutch lever. By pulling the steering clutch lever back past the disengaged position and to the extreme rear, the brake takes hold. (With the brakes and steering clutches correctly adjusted, there should be a brief interval between the point where the steering clutch becomes disengaged and the point where the brake takes hold.) The brakes can be controlled independent of the steering clutches by pulling back the brake levers alone.

The steering clutches are actuated by over-center linkages and the operator must therefore re-engage the clutch by pushing the control lever forward into the normal engaged position to straighten the machine out after having made the desired turn. The steering clutch levers toggle over-center with a fair amount of pressure when properly adjusted.

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For normal steering the left steering clutch control lever should be pulled back toward the operator to turn to the left, and the right steering clutch lever should be pulled back to turn to the right. Pull the control levers to the extreme rear to apply the brakes for short turns or for immediate response to the movement of the control levers.

When the machine is coasting, applying the hydraulic Scraper brakes to hold back the Scraper also usually helps in bringing about the desired response to the movement of the clutch levers.

In traveling down steep hills where the loaded Scraper is tending to push the Tournapull and is being held back by the compression of the engine, the operator should be alert for any tendency of the Tournapull to "cross-friction". By "cross-friction" is meant the tendency of the machine to turn opposite to the direction it normally does when releasing a steering clutch. The reason for this action is that when the loaded Scraper is pushing and the speed of travel is being held back by the compression of the engine, releasing a steering clutch will tend to speed up the corresponding drive wheel, rather than slow it down, giving an action opposite that which is obtained under normal conditions when traveling forward under the power of the engine.

Steering under the above conditions can usually be accomplished by releasing the right steering clutch to turn to the left and releasing the left steering clutch to turn to the right—exactly opposite the manner in which steering is normally accomplished. This is known as "cross-frictioning." Applying the steering brake on the side opposite the steering clutch that is disengaged often helps to bring about the desired response.

However, because of the confusion and safety hazard that is likely to result when steering by "cross-frictioning", especially with inexperienced operators, it is a good practice to operate the machine in such a manner that the necessity for "cross-frictioning" is avoided as much as possible. In other words, when traveling down hill with a fully loaded Scraper, shift into lower gear and apply the Scraper brakes in order to keep the machine under control. Operate the engine with the throttle only partially opened in order to have sufficient reserve engine speed to pull the machine around when turning by instantly opening up the throttle.

By operating the machine in this manner, the tendency for the machine to "cross-friction" when going downhill can be eliminated, and the Tournapull can be steered in the conventional manner.

An operator will learn from experience how the Tournapull responds to the movement of the control levers. Until such time as he is sure of himself, he should avoid traveling and steering over hazardous terrain.

A precaution to watch when steering is to avoid turning so short that the drive tires strike the yoke. This practice not only causes unnecessary damage to the tires but also subjects the yoke to undue side strains and places harmful shock loads on the teeth of the final drive gears and pinions.

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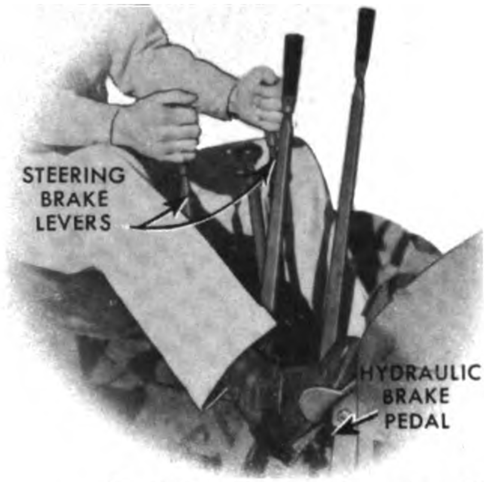

APPLYING THE BRAKES

The Tournapull is equipped with mechanical steering brakes for the drive wheels and hydraulic brakes on the Scraper wheels, either or both of which can be used for slowing down or stopping the machine.

It depends largely upon the operator as to which of these brakes are used for slowing down and making normal stops. It should be kept in mind, however, that the main purpose of the steering brakes is for steering and that the hydraulic brakes can be used only for slowing down or stopping. Therefore, when it is necessary to apply the brakes to slow down the machine and also have the steering brakes free for steering purposes, the hydraulic brakes should, of course, be used.

For sudden, abrupt stopping, the combined use of both the steering brakes and the hydraulic brakes is sometimes required, especially when the Scraper is fully loaded. Also, in case of an emergency, a very effective method of stopping is to supplement the power of the brakes by dropping the Scraper blade to the ground.

When traveling with a loaded Scraper down long steep inclines which might cause over-heating of the brakes or when operating over hazardous terrain, the blade can be lowered to the ground and dragged down the hill to serve as a brake, providing that the haul road is not paved or strewn with large rocks, boulders, etc., which would be injurious to the blade and bottom of the Scraper.

Always apply the brakes or lower the blade to the ground to hold the Tournapull back when going down a steep hill. Otherwise the machine might roll at faster than normal speeds, causing a safety hazard and also causing the engine to turn over faster than governed speed, thereby adding unnecessary abuse to the engine.

To apply the hydraulic brakes to the Scraper wheels, depress the brake pedal with the foot. Since most operators operate the foot throttle with the right foot, leaving the left foot free for use on the flywheel clutch pedal, the operator must remove his right foot from the foot throttle to depress the brake pedal in applying the brakes. Inasmuch as the operator should at all times have one foot on the foot throttle in order to have control over the machine, it is important that the left foot be placed on the foot throttle before the right one is removed for applying the brakes. (The dual foot throttles make this action possible)

To apply the steering brakes for slowing down or stopping, pull the brake control levers to the rear. Movement of the brake levers in this case should be independent of the steering clutch levers—not with the clutch levers as is done when steering.

For instructions for lowering the blade to the ground to serve as a brake, refer to the instructions for controlling the Scraper on the following page.

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CONTROLLING SCRAPER WITH POWER CONTROL UNIT

The Scraper is controlled by means of the Power Control Unit on the rear of the Tournapull.

The longer control lever controls the raising and lowering of the bowl. Moving the lever toward the center of the Tournapull (to the left) engages the right clutch and raises the Scraper bowl. Returning the lever to neutral position applies the brake to the cable drum and holds the bowl in the raised position.

Moving the longer control lever away from the center of the Tournapull (to the right) releases the brake from the cable drum and allows the bowl to lower. Returning the lever to neutral position applies the brake to the cable drum and holds the bowl at the level to which it was lowered.

The shorter Power Control Unit control lever controls the apron and tailgate. Moving the lever toward the center of the Tournapull (to the left) engages the left clutch and raises the apron. When the apron is raised to its full height, the tailgate is then pulled forward and the tailgate return springs inside the springpipe are compressed. Returning the control lever to neutral position applies the brake to the cable drum and holds the apron and tailgate in the position desired.

Moving the control lever away from the center of the Tournapull (to the right) releases the brake from the cable drum, allowing the tailgate return springs to return the tailgate to its original position at the rear of the Scraper bowl, and also permits the apron to lower.

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THE OPERATING CYCLE

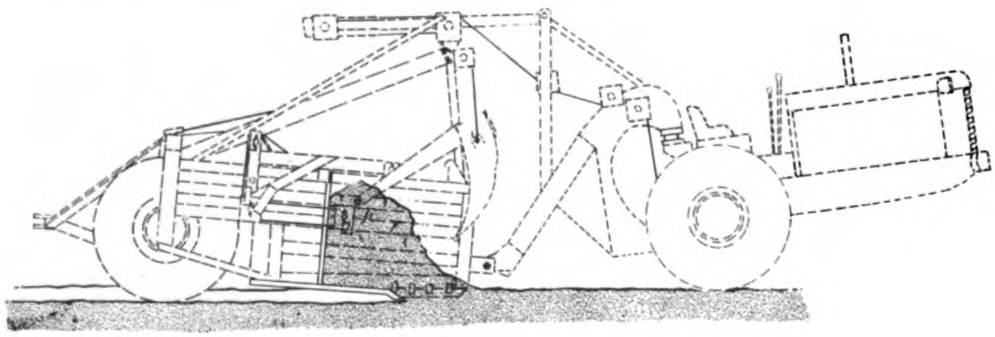
The operating cycle of the Tournapull Scraper includes the operations of loading, hauling, unloading or spreading, and returning to the cut, as illustrated below.

The power for each of these operations is supplied by the Tournapull engine.

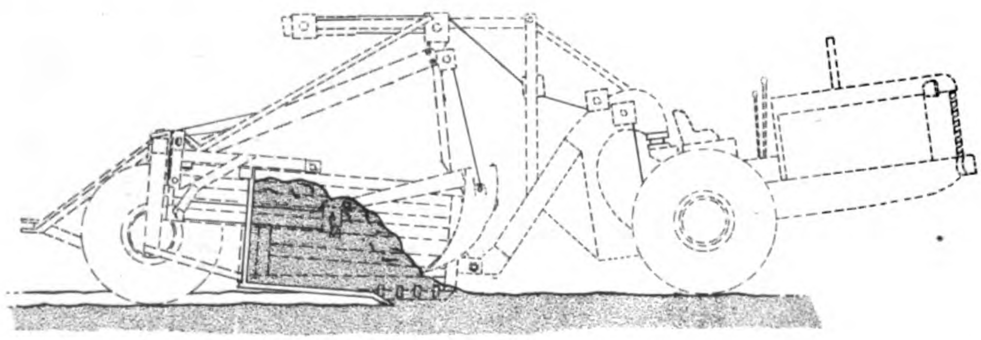
The Tournapull is usually assisted by a pusher tractor in loading. However, in hauling, spreading, and returning to the cut, the Tournapull operates without the aid of a pusher.

The Power Control Unit, in controlling the working parts of the Scraper, either spools or unspools the cable on or off the cable drums, depending upon the movement of the control levers by the operator.

The operating cycle is explained below.



1. To load the Scraper enter the cut with the tailgate at the extreme rear of the bowl and with the apron raised four to eight inches above the blade. Release the hoist brake and lower the blade into the ground to the desired depth. As the Scraper is moved forward the blade cuts into the ground and the dirt is forced up into the Scraper bowl.



2. As the bowl is being filled the material will roll back against the tailgate and forward against the apron, thereby assisting in closing the apron. When the bowl is filled release the Power Control Unit dump brake to close the apron and at the same time engage the hoist clutch and raise the bowl one or two inches above the surface of the ground.

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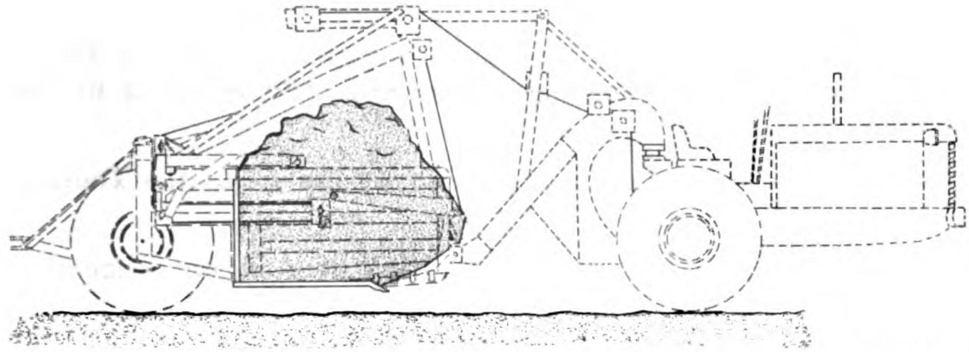
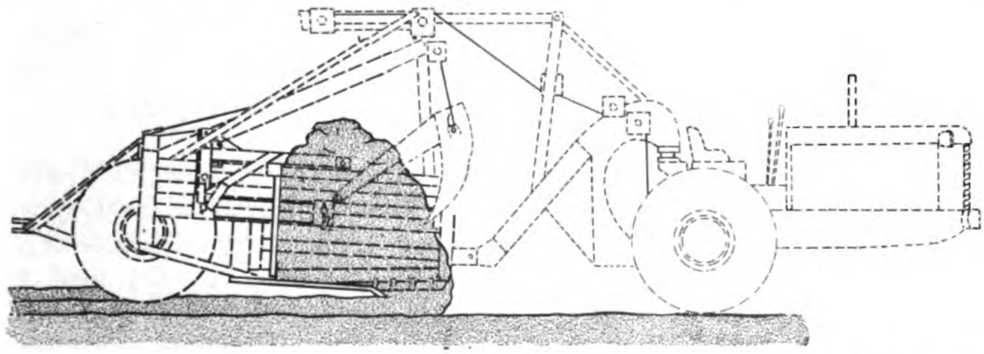
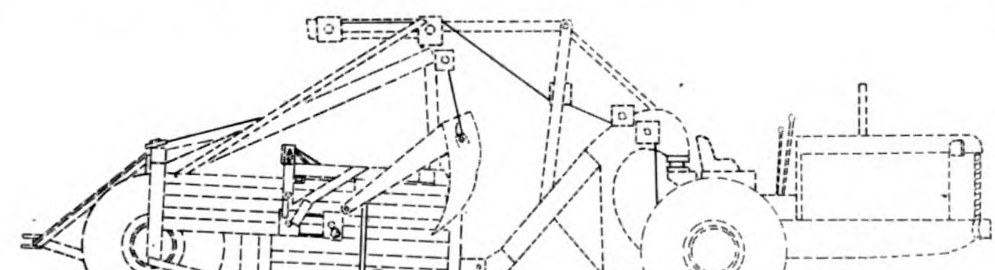


3. After pulling the Scraper ahead a few feet, spreading the material which was in front of the blade, raise the bowl to the desired traveling position and proceed to the fill. The bowl should be carried at a height that will keep the Tournapull motor level or raised slightly at the front.



4. Upon arriving at the fill raise or lower the blade to the desired depth of spread. Raise the apron to its full height by engaging the dump clutch, allowing the dirt to fall out. Shake any sticky material from the back of the apron by releasing the brake, dropping the apron about twelve inches, and then immediately engaging the clutch to raise the apron again. Repeat this procedure in sticky material if necessary.



5. After the dirt has fallen out with the apron raised, re-engage the Power Control Unit dump clutch, thereby pulling the tailgate forward to eject the remainder of the load. Pull the tailgate forward approximately 12" at a time and then allow it to return a few inches before pulling it forward again. When the bowl is completely emptied release the Power Control Unit dump brake, allowing the tailgate return springs inside the springpipe to return the tailgate to its rear position and also lowering the apron about six or eight inches. The Scraper is now in traveling position.

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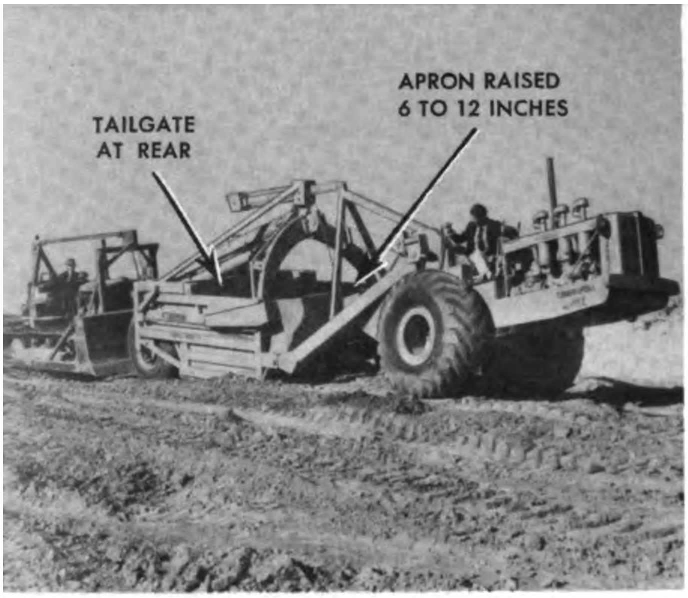


LOADING

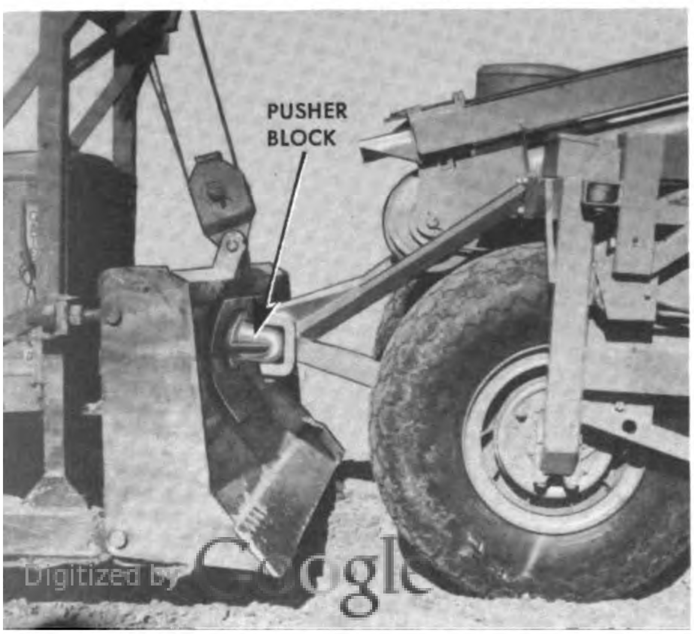
Although the Tournapull has sufficient power and traction in most types of soil to load the Scraper, the use of a pusher tractor to assist in loading is recognized by both the manufacturer and user alike as one of the necessities for Tournapull-Scraper operation.

The reasons that the assistance of a pusher tractor is required in loading are that it makes possible larger loads, reduces loading time and, last but not least, it lengthens immeasurably the life of the traction tires. Pusher loading also lengthens Tournapull life.

The pusher tractor as referred to above is a tractor equipped with an Angledozer or Bulldozer, which assists the Tournapull in loading by pushing against the pusher block on the rear of the Scraper. Because of the size of the Scraper and the horse-power required to fully load it, it is recommended that nothing smaller than a Caterpillar D7 Tractor be used in pushing, but a Caterpillar D8 tractor or tractor of similar size is preferred.

To load the bowl of the Scraper and fully utilize its capacity, enter the cut with the tailgate in the extreme rear position and with the apron raised approximately 6 to 12 inches.

Move forward with the pusher tractor pushing and lower the blade into the ground, allowing it to penetrate to the desired depth. Keep the apron low, leaving an opening just large enough for the dirt to enter, but not so low as to cause the dirt to bank up in front of the blade.



Loading is normally done with both the Tournapull and pusher tractor operating in first gear. In this operation, the Tournapull should not be operated at wide open throttle. Let the pusher tractor do the greater amount of work. This will enable the Tournapull operator to open

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up the throttle, if needed, to straighten the machine out of a turn or "Jack knife", and will also reduce tire and mechanical wear. It is highly important that the Tournapull and tractor move along together in a straight line. Avoid spinning the Tournapull drive tires during the loading process.

As the Tournapull and tractor move forward, loading the dirt into the bowl, the material will fall forward against the apron as well as back against the tailgate.

When the Scraper is fully loaded, lower the apron and raise the blade an inch or two above the surface of the ground. Travel several feet before raising the blade to a higher position. This will spread the loose material in front of the blade and thereby leave the cut smooth to pull in and out of.

The operator of the pusher tractor should ease the 'Dozer bowl up to the pusher block on the rear of the Scraper when making contact to start pushing. The pusher tractor should not stop pushing until the blade has been raised out of the ground and the Tournapull operator has shifted into traveling gear.

Extreme care should be used to prevent the 'Dozer blade from contacting the rear tires and possibly cutting them. The operator of the pusher tractor should try to avoid raising the rear tires off the ground.

A pulling tractor is sometimes used instead of a pushing tractor in loading.

If possible, arrange the work so that loading can be done while traveling down hill and in the direction of travel. Extra yardage can sometimes be obtained by leaving a ridge about 3 feet wide between successive cuts when loading. Straddling this ridge on the next trip makes it possible to obtain larger loads in less time.

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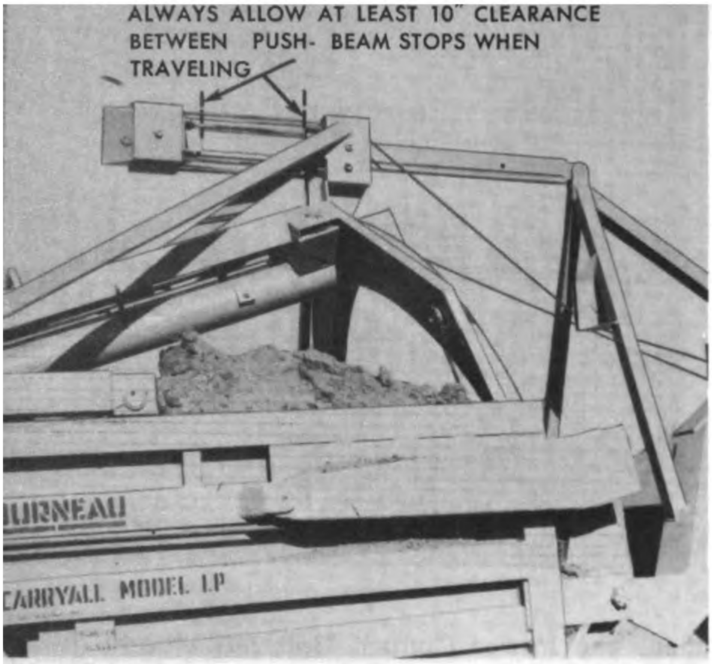

TRAVELING TO THE FILL

Traveling to the fill with a loaded Scraper is done in the highest gear possible, depending upon the condition of the haul roads. Inasmuch as maintenance of haul roads is one of the important parts of efficient Tournapull operation, Tournapull jobs are usually such that traveling to the fill can be done in fourth gear.

Ruts, soft spots, or holes in the haul roads call for reduced speeds and unnecessary gear shifting. Good haul roads not only make possible increased speeds but also reduce the wear and tear on the equipment.

When traveling to the fill, the bowl of the Scraper should be carried fairly close to the ground but high enough to clear any objects on the haul road without having to continually raise and lower the bowl. When carried at this height, the Tournapull engine will normally be in a level position or only slightly raised at the front. With the Tournapull engine lower in front, difficult steering would be experienced.

Carrying the Scraper bowl comparatively close to the ground prevents danger of upsetting the Scraper. It also prevents traveling with the pushbeam stops together which might cause breakage of the hoist cable or upsetting the Scraper when making short turns to the left. Provide several inches of clearance between the pushbeam stops at all times when traveling.

When turning sharply to the right or left, the operator should be careful not to damage the drive tires by bringing them into contact with the Scraper yoke.

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SECTION

UNLOADING OR SPREADING


APRON RAISED TO FULL HEIGHT TO PERMIT DIRT TO FALL OUT

Spreading is usually done in the highest gear possible. This, of course, is dependant upon material and conditions. Keep moving when unloading —do not stop.

Upon arriving at the fill with the loaded Scraper, either raise or lower the bowl as required to give the desired thickness of spread. Then engage the Power Control Unit left clutch, raising the apron to its full height and allowing the dirt in the apron to fall out. When the apron reaches its full height, disengage the clutch and release the brake, allowing the apron to drop about twelve inches. Then immediately engage the clutch and raise the apron again. If operating in sticky material it may be necessary to repeat this operation once or twice to dislodge the dirt from the back side of the apron. After the dirt has fallen out of the apron re-engage the clutch and bring the tailgate forward about twelve inches at a time, letting it move back a few inches after each forward movement, until the bowl is empty. If possible, stop the forward movement of the tailgate just before the tailgate sliding sheave housing above the springpipe reaches the stop block at the rear of the channel in which it slides.

It starting a new spread, the blade should be lowered slightly as the rear wheels come up onto the dirt that is ejected, in order to maintain an even depth of spread.

The operator should be careful not to force the load out too rapidly, as this causes unnecessary strain on the tailgate and cable. Also, it might cause the dirt to stack up in front of the blade, thereby adding additional draft on the Tournapull. As the tailgate nears its forward position and the load decreases, it is advisable to use less pressure on the Power Control Unit control lever, unless the pressure is actually required to pull the tailgate forward. By exerting less pressure as the tailgate nears its forward position, the clutch would slip rather than the cable breaking, in event the tailgate should accidently be brought

TAILGATE PULLED FORWARD TO EMPTY SCRAPER

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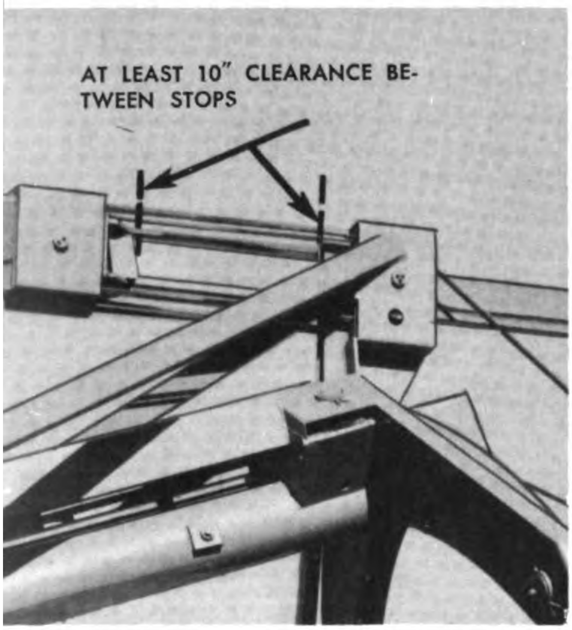
so far forward that the tailgate sliding sheave strikes against the stop block at the rear of the channel above the springpipe. Remember, however, that the clutch should not be allowed to slip during operation unless this extreme forward position is reached, and in this case it is done only to prevent cable breakage. The operator should always disengage the clutch immediately whenever the tailgate sliding sheave strikes the stop block.

When the Scraper is completely emptied, return the tailgate to its rear position and lower the apron. Then raise the bowl to the desired traveling position and return to the cut. The operator should at no time return to the cut with the apron raised and the tailgate in the extreme forward position, because cable breakage would occur when turning or when traveling over unlevel ground.



RETURNING TO THE CUT

Returning to the cut is done in as high a gear as possible, depending on the condition of the haul road. Efficient Tournapull operation is dependant upon good haul roads and it is therefore important that the haul roads be maintained to permit returning in high gear.

When returning, the bowl should be carried at a height that will keep the Tournapull motor level or with the front slightly raised. Never carry the bowl so low that it will not clear rocks or obstructions in the path of travel. Carrying the bowl reasonably low to the ground prevents upsetting.

Always allow several inches clearance between the pushbeam stops. This will prevent cable breakage when traveling over rough, unlevel ground and when turning.

It is sometimes advisable to smooth up the haul road with the empty Scraper by dragging the blade on the ground. With the apron raised and the tailgate within approximately 8" of the extreme forward position, an action similar to that of a 'Dozer or grader is obtained. The tailgate should never be in the extreme forward position during this operation or cable breakage might occur when traveling over unlevel ground and when turning.

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DRAGGING HAUL ROAD ON RETURN TRIP

MAINTENANCE OF HAUL ROADS

One of the requirements for efficient Tournapull-Scraper operation is smooth, well maintained haul roads that will permit travel in high gear.

Maintenance of roads and patrolling to throw off large boulders, etc. pay big dividends in the way of production, reduction in wear and tear on the machine, and tire conservation. Maintained haul roads also add to the riding comfort of the operator.

Night operation increases the need for road maintenance.

It depends partly on the job and available equipment as to the type of equipment that should be used for maintaining the haul roads.

Motor graders are normally very effective tools for this kind of work.

On some jobs motor graders are used in finishing and on these jobs the grader can be used intermittently for maintaining the haul roads.

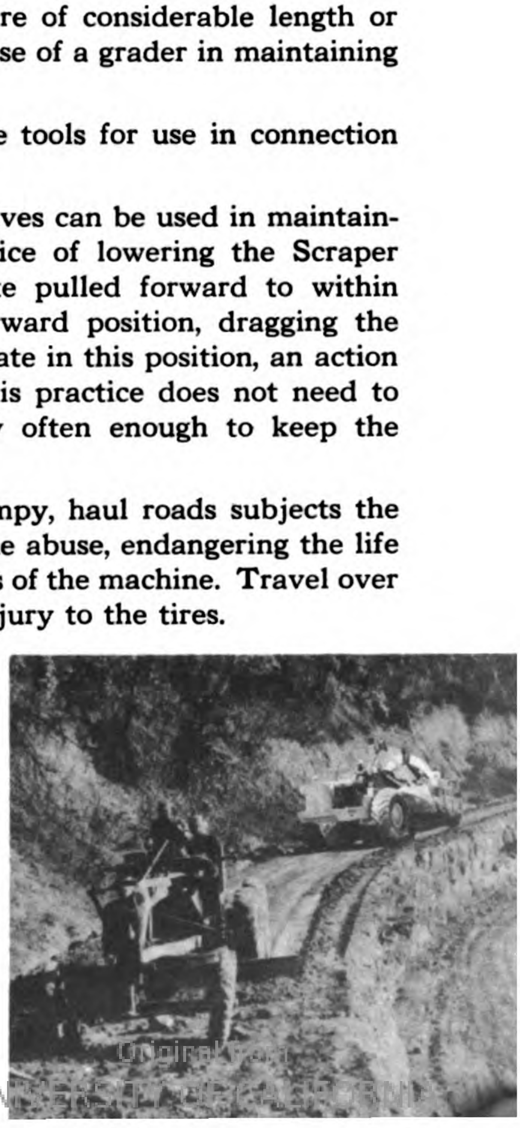
On other jobs where the haul roads are of considerable length or where soft conditions prevail, the constant use of a grader in maintaining the roads will pay dividends.

'Dozers and Scrapers are also effective tools for use in connection with road maintenance.

The Tournapulls and Scrapers themselves can be used in maintaining the haul roads by following the practice of lowering the Scraper blade to the ground and, with the tailgate pulled forward to within approximately 8 inches of its extreme forward position, dragging the haul road on the return trip. With the tailgate in this position, an action similar to that of a 'Dozer is obtained. This practice does not need to be followed on each return trip, but only often enough to keep the haul road in good shape.

Travel at high speeds over rough, bumpy, haul roads subjects the mechanical parts of the Tournapull to undue abuse, endangering the life of gears, bearings and other mechanical parts of the machine. Travel over sharp rocks, stones, etc. is likely to cause injury to the tires.

Inasmuch as dusty haul roads necessitate reduced hauling speeds for the sake of safety, the practice of oiling or sprinkling the haul roads is often resorted to in order to increase production. In cases of this kind, the cost of sprinkling or oiling can often be disregarded in view of the additional yardage that will result from the increased hauling speeds.



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HANDLING SPECIAL MATERIALS

Wet or Sticky Materials

When operating in wet or sticky material difficulty may be experienced in unloading or spreading unless certain precautions are observed.

When unloading do not stop or try to make too thin a spread. Keep the bowl high enough to allow the material to pass under the Scraper. Material not having room enough to pass under the Scraper will roll up inside the bowl into a solid mass that will be difficult for the tailgate to eject.

Do not try to force the load out too fast as that too will cause the material to roll up in front and might result in cable breakage.

Sometimes the condition of the material in the fill is so muddy and sticky that it is necessary to use a tractor to push the Tournapull during the unloading procedure.

For best results in unloading wet or sticky material, bring the tailgate forward about twelve inches at a time. After each forward movement permit the tailgate to return approximately six inches, allowing the material inside the bowl to settle back and loosen up. Repeat this operation until the bowl is emptied.

Loose Sand

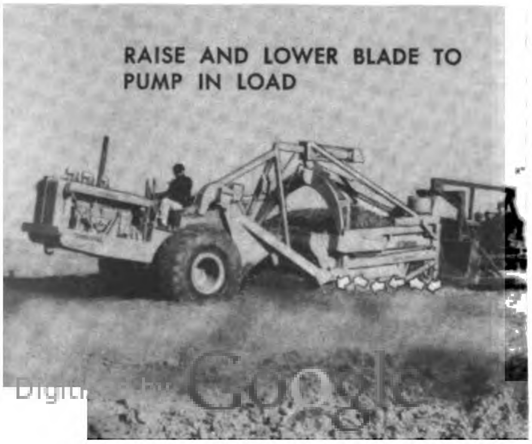
Because of the tendency of loose sand to float ahead in front of the blade rather than entering the bowl when loading, the following procedure should be used when loading loose sand.

Start to load with the apron raised 6 to 12 inches and with the tailgate in the rear position. Move forward with the blade in the ground, loading in the conventional manner with a pusher tractor assisting in loading. When the bowl has become approximately half filled, lower the apron into the pile of sand that will have stacked up in front of the blade and then raise the bowl approximately 2 or 3 inches. Then, while moving forward, release the hoist brake, permitting the bowl to drop about 3 to 4 inches. This will force more sand up into the bowl. By repeating this operation the Scraper can usually be fully loaded.

The above method of raising and lowering the bowl to obtain a load is sometimes referred to as "pumping in a load". When lowering the bowl in this operation, do not leave the hoist brake released long enough to allow the cable to become slack on the drum as that would cause unnecessary cable wear and possible cable breakage.

In unloading loose sand, make the spread as thin as possible. This will give better compaction and will make traveling over the fill less difficult.

Reduced tire pressures are often necessary for best performance in loose sand. (Refer to tire inflation instructions.)



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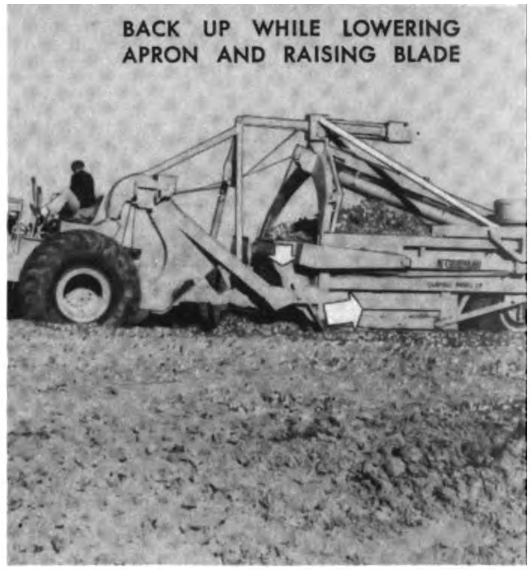


Gravel

When loading gravel, it may be necessary to follow a procedure similar to that for loading loose sand in order to obtain a full load. However, little difficulty should be experienced except occasional failure of the apron to completely close due to interference by large stones, resulting in a partial loss of the load.

If encountered, this difficulty may be overcome by backing up a few inches and at the same time lowering the apron and raising the bowl. As the bowl is raised, the apron will usually drop into the completely closed, carrying position.

To prevent damaging the tires, avoid striking large, sharp rocks or stones and avoid tire slippage as much as possible. Also keep the tires inflated to the pressures recommended for operation in this type of material. (Refer to tire inflation instructions.)

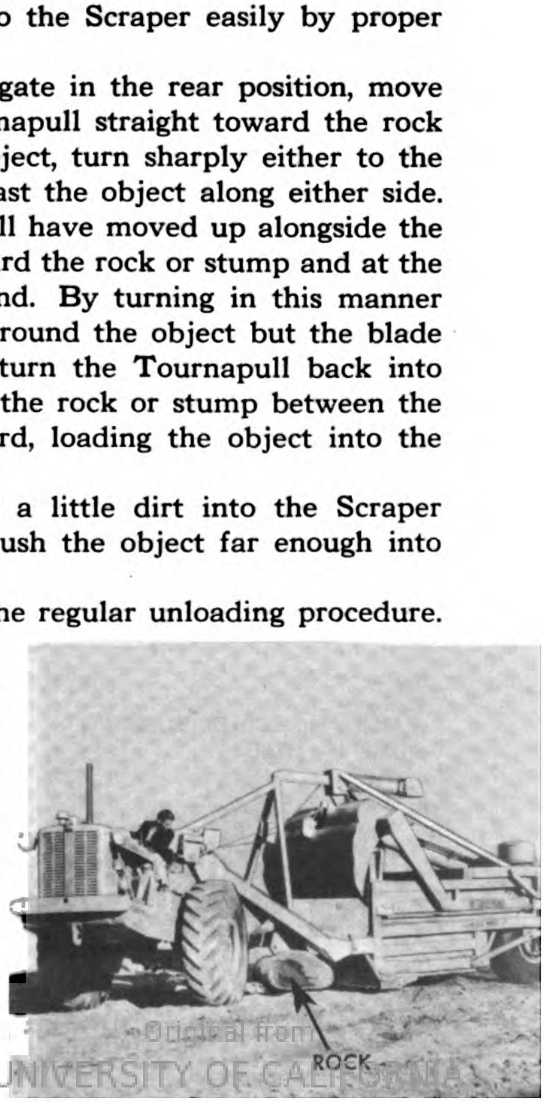
Large Rocks and Stumps

Rocks and stumps that are too large for the Tournapull and the Scraper to pass over can be loaded into the Scraper easily by proper handling of the Unit as follows.

With the apron raised and the tailgate in the rear position, move the machine forward, heading the Tournapull straight toward the rock or stump. Just before it reaches the object, turn sharply either to the right or to the left and start to move past the object along either side. When the drive wheels of the Tournapull have moved up alongside the object, turn the Tournapull sharply toward the rock or stump and at the same time lower the blade to the ground. By turning in this manner the Tournapull drive wheels will pass around the object but the blade will swing in behind it. At this point turn the Tournapull back into its original direction of travel and with the rock or stump between the drive wheels and the blade, pull forward, loading the object into the bowl of the Scraper.

It is sometimes necessary to load a little dirt into the Scraper after the object is loaded in order to push the object far enough into the bowl to allow the apron to close.

To unload the rock or stump use the regular unloading procedure. If in unloading, a large rock should be tilted up inside the bowl so that it will not pass under the apron, it is necessary to return the tailgate to the rear to allow the rock to settle back to its flat position before pulling the tailgate ahead again. After the object has fallen out through the apron opening, turn the Tournapull and back up so that the drive wheels will not hit the object when pulling away.



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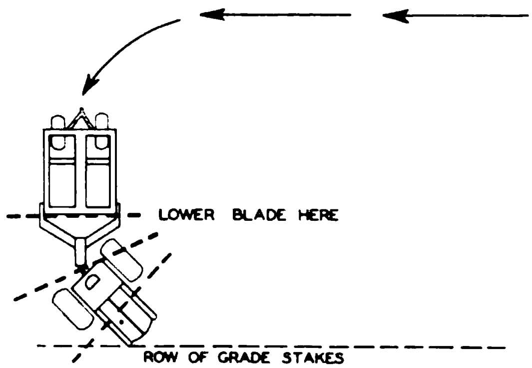
DOING SPECIAL JOBS

Making Side-Hill Cuts



In making side-hill cuts, the cut is usually first opened up or started by means of LeTourneau 'Dozers or similar tools. The Tournapulls and Scrapers can then continue with the cut after a level shelf has been built upon which they can operate.

Always keep a side-hill cut low next to the bank and high on the outside. The result will be a neat, easily controlled slope with a minimum of finishing necessary.

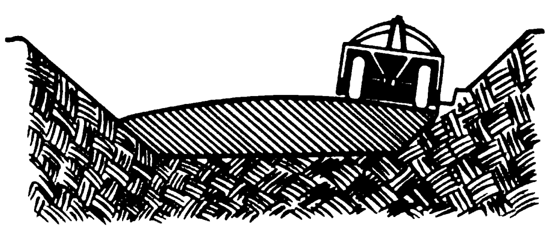
To make the side of the cut slope down at the desired angle, follow the practice of "stepping" in away from the bank or slope with each successive depth of cut, as is outlined in the following instructions for making through-hill cuts. Also, if finishing the slope with the Tournapull, perform the finishing operation as the work progresses as per the instructions on the following page.

The operator should be careful when operating on soft shoulders with a loaded Tournapull because of the danger of running or sliding off over the edge of the bank or shoulder. It is a good practice to stay in at least a foot or two from the edge where possible unless you are sure of good, solid footing.

Making Through-Hill Cuts

In making through-hill cuts, always keep the cut low next to the slopes or sides of the cut ana high in the center. This will help maintain better slopes and also make the loads larger and more uniform.

Plan the work so that the sides of the cut slope down at the desired angle. This can be done by "stepping" in away from the bank or slope with each successive depth of cut, just enough to cause the slope to taper down at the desired angle. The slope can be finished by 'Dozer, Scraper, or by other accepted methods of back-sloping. If the slopes are not too steep, they can also be finished by Tournapulls and Scrapers. If finishing with the Tournapull, the slope should be finished as the work progresses, or, in other words, the newly cut part of the slope should be finished each time that the unfinished part reaches a width equal to or nearly equal to the width of the Scraper blade. (Refer to Finishing instructions on following page.)



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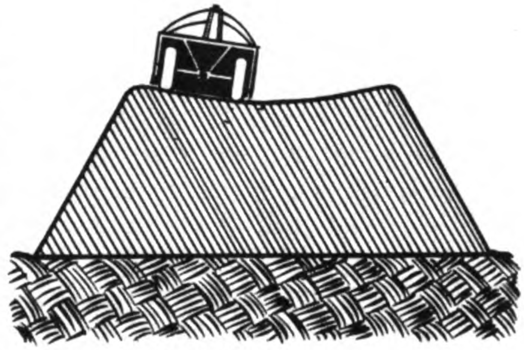
Building A Fill



In building a fill it is highly essential to keep the outside or shoulders of the fill higher than the center. This prevents the Tournapull from sliding over the shoulder while dumping close to the edge and also helps make the side of the fill slope at the correct angle as the fill is built up.

When the shoulders have reached grade level, the center can be filled quickly just before final leveling and finishing. Also, before closing down the job for the night or for any period of time, fill in the low center for better drainage in event it should rain.

Finishing

Tournapull drawn Scrapers are often used for leveling or finishing airports, roads, building sites, etc.

LEVEL GROUND—For preliminary finishing where it is necessary to skim off dirt in some spots and fill in at others, the Tournapull and Scraper can be operated in somewhat the normal manner, picking up part of a load at one spot and spreading it at another. For final finishing, however, the Scraper tailgate should be brought forward to within approximately 8″ of its extreme forward position to give an action similar to a 'Dozer or grader. Keep the tires inflated to equal air pressures or the blade will cut low on one side.

SLOPES—Slopes that are fairly level can be finished with a Tournapull if desired. For best results and greater safety, the slope should be finished as the work progresses. In other words, each time that the Scraper has cut the slope down far enough to cause the unfinished part of the slope to equal the approximate width of the Scraper blade, it should then be used to finish the unfinished part by running one of the Tournapull and Scraper wheels up onto the slope with the other wheels running along the bottom of the slope. Then, with the tailgate pulled forward to within approximately 8″ of its extreme forward position, the machine can travel along the side of the slope, skimming off the surplus dirt, thus finishing the slope as you go.

When finishing, do not attempt to load the bowl on a slope or the dirt will fall to the low side of the bowl, causing that side of the blade to cut deeper than the other and as a result dig a ditch in the slope.

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BOOSTING PRODUCTION

Eliminating Lost Time

One of the most inexcusable examples of inefficiency on earthmoving jobs is that of Tournapulls and Scrapers having to wait on the pusher tractor when coming into the cut to start loading.

To eliminate this lost time, it is important that there be a proper ratio between pusher tractors and Tournapulls on the job. In other words, the amount of equipment on the job should be such that neither the Tournapull nor the pusher tractors have to wait on one another, both keeping busy all the time. If the pusher tractor is equipped with an Angledozer or Bulldozer, it can of course be used in leveling up the cut in event there are lulls or moments of free time between Tournapulls and Scrapers coming into the cut to be pushed.

In coming into the cut, the operators of the Tournapulls should give some thought as to the efficiency of the pusher tractor. This efficiency can often be increased if the operator of the empty Tournapull drawn Scraper will pull up alongside the pusher tractor as the pusher tractor finishes loading the one that is already in the cut. By doing this, the pusher tractor can then pull over behind the empty Tournapull drawn Scraper and again start pushing. This eliminates the delays that result when the pusher tractor must back up or travel a considerable distance to reach the machine that is to be pushed.

By following the above procedure, the pusher tractor can often assist in loading three or four Tournapull drawn Scrapers before the end of the cut is reached. It can then turn around and return to the opposite end of the cut and then repeat the pushing operations as outlined above, or, if the job is such that the Tournapulls can load traveling in either direction, the pusher tractor can turn around when it reaches the end of the cut and then start pushing Tournapull drawn Scrapers going back in the opposite direction.

Using The Rooter

The loading efficiency of Tournapull drawn Scrapers in hard materials can be greatly increased by using a Rooter to break up the material.

LeTourneau Rooters can tear through such materials as decomposed shale, decomposed granite, tough clay, boulder strewn ground, black top, etc., all of which can be easily loaded into a Scraper if properly rooted.

LeTourneau Rooters are equipped with either three or five teeth as standard.

The fewer the teeth the deeper the penetration can be in tough ground and the larger the breakage will be; and vice-versa, with more teeth the shallower the penetration and the more pulverizing the action will be.

For best Scraper loading the material should not be broken up too fine. Therefore, it is often advisable to remove one or more shanks from the Rooter to prevent fine breakage. This is dependent, of course, upon job conditions, type of material, etc.

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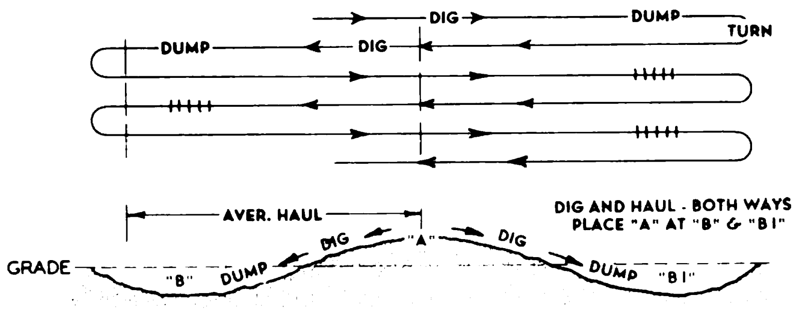
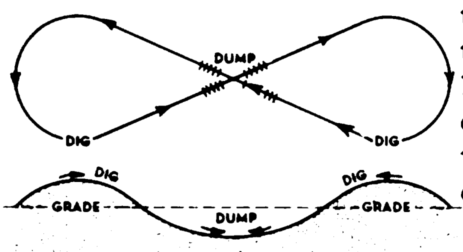
When rooting in a side-hill or through-hill cut, always root parallel with and close to the slope and work away from the slope. This allows the Scrapers to maintain proper slopes as the work progresses. Plan the work to avoid congestion and interference of the Scrapers with the Rooter.

Eliminating Turns

Wherever possible, plan the work to eliminate all unnecessary turns. By so doing, an accumulated saving of turning time in the course of a day's work will result in several additional yards of material being moved.



Many jobs can be laid out so that there is a fill on each side of the cut or a cut on each side of the fill. With a job of this type, either a job lay-out of the type illustrated above or the figure 8 loading and hauling cycle can be used to great advantage.

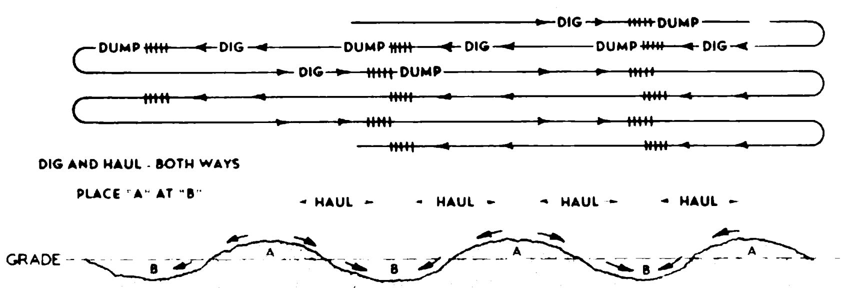


In the first example, load going down the hill and continue with the load to the fill. When unloaded, turn and come back to the hill and this time load going down the opposite side of the hill, continuing on to the second fill, etc., as diagrammed.

The figure 8 lay-out is very effective where there are two cuts on either side of the fill.

By using either method, only two turns are required while two full loads are delivered, whereas normally two turns are required for each load.

On jobs where there are a series of cuts and fills, a lay-out of the type illustrated below can be used.



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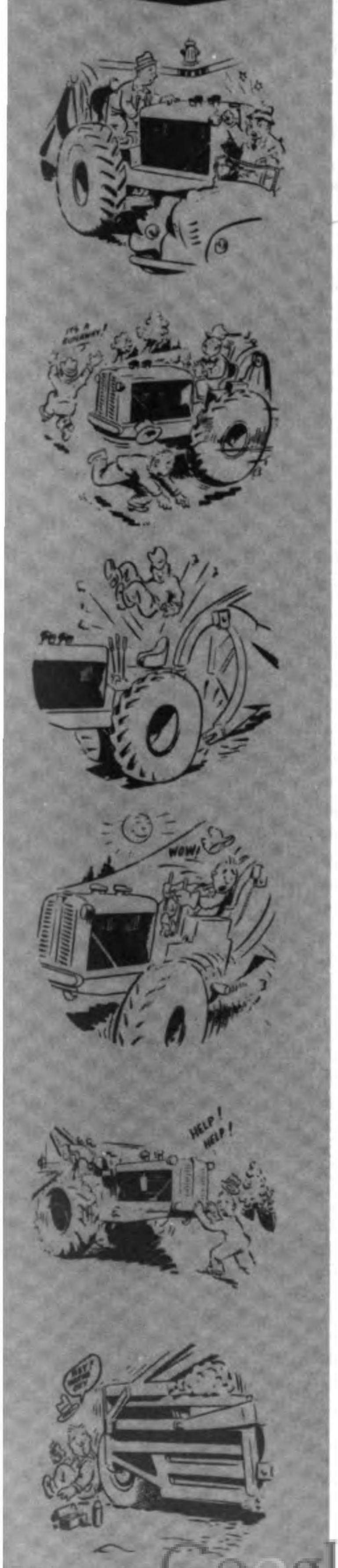
DON'T LET THIS HAPPEN TO YOU



SAFETY PRECAUTIONS

As with all heavy equipment, reasonable precautions must be taken when operating or servicing the Tournapull or Scraper. By observing the following precautions, difficulties similar to those illustrated by cartoon can be avoided.

Do not travel at reckless speeds, especially when in congested traffic. Keep the machine under control at all times.

Do not kick the Tournapull out of gear when traveling downhill. When traveling downhill make sure that the machine is under control and steer carefully (refer to Steering instructions on page 42). On steep hills, be prepared to drop the blade to supplement the power of the brakes if needed. Keep the brakes in good working condition.

Have good lights when working at night. Travel slowly in extreme dusty conditions where vision is obstructed.

Make sure the safety cable connecting bottom of yoke with bottom of main case is installed when operating.

Make sure the Tournapull wheel bolts are kept tight. Raise the wheel off the ground and use a long extension on the wrench when installing to make sure they are drawn up tight. Check bolts regularly to prevent them from loosening.

Keep the deck-plate clean of mud, tools, and other obstructions.

When stopping and crawling off the machine, always lower the Scraper blade to the ground. This prevents the chances of anyone becoming injured in event the blade should be lowered by accident. It also prevents the Tournapull from rolling downhill if parked on an incline. Also pull out the engine shut-off control and turn it ¼ turn when leaving the machine, to prevent it from being started by accident.

Stay out from in front or rear of the Tournapull wheels, even when parked. Someone might start the machine, either by accident or by not knowing anyone is in the path of the wheels. Know the whereabouts of your fellow workers at all times when working on the machine.

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Keep the hands free of cable and working parts when in operation. Also keep hands and clothing away from water pump belts and all moving parts of the engine.

Do not stand directly in front of a wheel when inflating the tire, because of the danger of the locking ring and sliding ring blowing off if not properly seated.

Do not use weak frayed cable. When handling frayed cable, always wear gloves.

Do not attempt to make adjustments on the engine while it is running. Shut off engine when making Power Control Unit clutch or steering clutch adjustments. Keep hands free from the steering clutches when turning them over in making an adjustment.

When changing blades or working underneath the Scraper, always block up under the bowl to prevent it from dropping in event someone should accidentally release the Power Control Unit hoist brake. Likewise, do not work under the apron when in the raised position without first placing blocks between the apron arms and Scraper sides to prevent the apron from dropping.

Do not attempt dangerous operations or those requiring the assistance of others without presence of enough help and tools to handle the job.

Do not work behind the tailgate when it is pulled forward without first blocking it in the forward position.

When replacing springpipe cable or tailgate return springs, use care to avoid being injured in any manner by the springs, which have considerable pressure behind them.

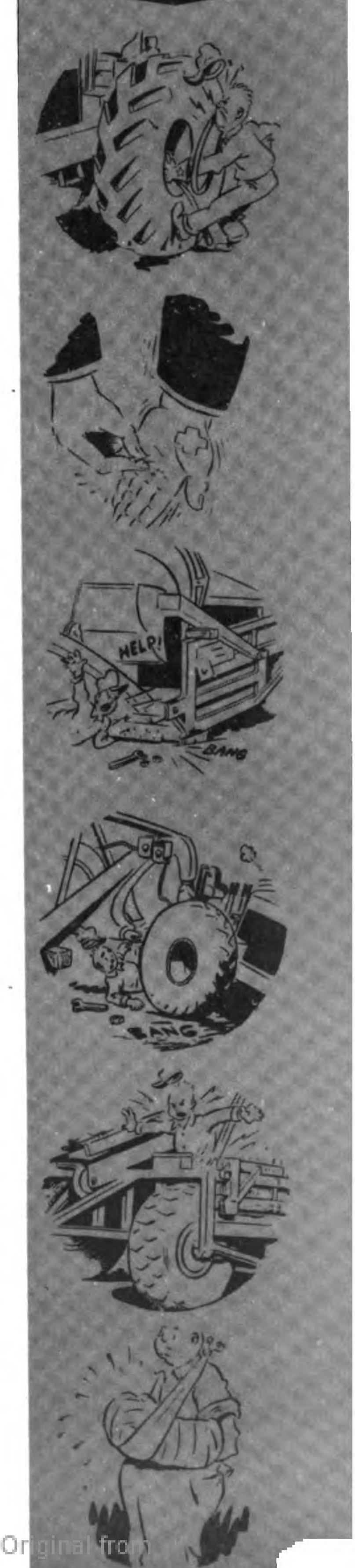
When barring the engine over by hand, always be sure the compression release is open. Otherwise the fuel might be injected, causing the engine to fire.

Never attempt to run the engine while the priming valve is open. This would cause dangerously high speeds. The emergency shut-off control located on the dash panel can be used in an emergency to bring the engine speed under control.

Always be sure the engine is free before attempting to start it.

Keep the rocker housing covers on the engine.

DON'T LET THIS HAPPEN TO YOU



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OPERATION UNDER DUSTY, MUDDY, LOW TEMPERATURE, HIGH TEMPERATURE AND OTHER ABNORMAL CONDITIONS

Although the Tournapull and Scraper are designed to meet adverse job or weather conditions, there are a few special instructions that should be exercised in other than normal conditions.

DUSTY AND MUDDY CONDITIONS:

1. When operating under extremely dusty conditions, it will be necessary to shorten the periods for changing engine lubricating oil, cleaning air filters, cleaning air breathers, etc.

2. The engine should be washed off outside and cleaned regularly of accumulations of any kind of dirt.

3. Belts should be kept free of dirt and oil.

4. Extreme care must always be exercised when parts are replaced to the engine or other units under dirty conditions. Dirt of one form or another is responsible for a high percentage of engine failures and costly repairs.

5. In extreme dusty conditions it is very important that the Scraper be lubricated at the specified intervals. Unless this is done fine particles of dirt and grit will work into the sheave and roller bearings and working parts of the Scraper. By lubricating regularly, the dust and dirt that accumulates around the bearings is forced out and away from the bearings by the new grease.

6. Watering or oiling the haul roads is often resorted to in order to keep the dust down.

7. In extreme dusty conditions do not apply lubricant to the cable. The reason for this is that the particles of dust, when mixed with the lubricant on the cable, may become abrasive, acting similar to a cutting compound and damaging the cable.

8. In extreme muddy conditions try to keep the Power Control Unit clutches, brakes, brake springs, and cable drums free of mud. Remove all mud from unit after completing day's work.

9. When working in muddy conditions, it is important that the mud be kept out of the sheaves. In some muddy conditions, it may be necessary to stop the Scraper once or twice a shift and clean the mud out of the Scraper bowl, as the mud will gather on the bottom and sides of the bowl, making it hard for the tailgate to come fully ahead, and in some cases breaking the cable.

COLD WEATHER CONDITIONS:

1. Use lighter grades of oils and greases when working in cold weather than those used in warm weather. (Refer to Lubrication instructions.) If the engine oil is too stiff for proper lubrication it should

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be heated before attempting to operate the engine to avoid a damaged unit.

2. In freezing weather, make sure that the radiator is protected with anti-freeze in the proper percentages for the weather. Ethylene Glycol type coolant, used by the Army, is a suitable anti-freeze.

3. It may be necessary to partly cover the radiator to keep the lubricating oil temperature in the proper operating range of 140°-180°.

4. It may be necessary to protect the batteries by heated coils, etc. in extreme cold weather. To make it easier to crank the engine pull back the compression release. Start the engine spinning, and when it has attained its greatest momentum release the compression lever and allow the engine to fire.

5. In cold weather always make sure the Power Control Unit brake band is not frozen to drum before starting operation. Do this by moving control lever into lock-out position, freeing band from drum.

6. When operating in cold weather the use of a Rooter may be necessary to break up the frozen top soil ahead of the Tournapull and Scraper.

7. Be sure there is no dirt left in the Scraper bowl at the end of the shift in cold weather, as it will be frozen tight by morning and it would then be necessary to thaw it out before the load could be ejected.

8. When shutting down for the night, lower the bowl onto planks rather than onto the ground, to prevent the Scraper bottom from freezing tight to the ground. Also, as at all other times when shutting down for the night, place a tin can or some similar object over the exhaust stack to prevent rain, snow, etc. from entering.

9. When the engine is to be left idle for any period of time all the cylinder block drain plugs must be opened. Failure to remove any one of these plugs may cause serious damage in freezing weather. It will also be necessary to remove the drain plug from the water cooled manifold.

HOT WEATHER CONDITIONS:

1. The operating temperatures of the water and lubricating oil in the engine should not exceed 180° F.

2. Keep the radiator air passages clean and unobstructed. Keep the radiator full of clean, fresh water.

3. See that the water pump belts are not slipping. They may be tightened by loosening the water pump clamp ring and turning the water pump (which is on an eccentric) counterclockwise to give the belts proper tension. Belts have proper tension when they can be pushed down approximately ¾″ with normal thumb pressure.

4. Keep the outside of the engine wiped off clean. No engine will operate properly under a blanket of dirt.

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OPERATOR'S MAINTENANCE

DURING OPERATION

Observe oil pressure gauge. Pressure should be 30 to 50 lbs.

Observe water temperature gauge. Water temperature should be 140° F. to 180° F.

WHENEVER NEEDED (As Evidenced by Operator)

Adjust Power Control Unit clutches.

Adjust steering clutches.

Adjust steering brakes.

Adjust flywheel clutch.

Adjust hydraulic brakes.

EVERY 8 HOURS

Check Power Control Unit brake adjustment.

Check tire pressures.

Check crankcase oil level.

Clean and change oil in crankcase breather.

Check water level in radiator.

Remove and clean pre-cleaner jars on air cleaner. (Oftener if required.)

Look for leaks of lubricating oil, fuel oil, and water from around engine connections.

Lubricate sheave bearings.

Lubricate fairlead sheave housing pivot bearings.

Lubricate tailgate roller bearings.

Lubricate spiral sheave wheel bearings.

Lubricate hinge pins.

Check batteries and add water if needed.

Check air cleaners to see if oil in sumps need replenishing.

EVERY 64 HOURS

Clean engine thoroughly on outside.

Clean air passages in radiator.

Drain, flush and refill engine crankcase to proper height with proper oil.

Change oil in air cleaners. Also clean air passages.

Drain off condensation from fuel supply tank.

Drain two or three tablespoons of fuel oil from the float chamber of the fuel pump to remove water, especially in cold weather.

Check oil level in Power Control Unit gear case.

Lubricate Tournapull control levers.

Lubricate flywheel clutch release yoke.

Lubricate hydraulic brake pedal.

Clean main case breather.

(continued)

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Lubricate ball and socket hitch.
Lubricate Power Control Unit brake rollers.
Change lube oil filter bag.
Change cartridge in DeLuxe lube oil filter.
Check oil level in main case.
Check oil level in transmission.
Check and correct tension of water pump drive belts.

EVERY 128 HOURS

Change fuel oil filter bag.

EVERY 256 HOURS

Lubricate generator.
Lubricate flywheel clutch release bearing.
Lubricate drawbar.
Clean fuel pump screen.
Adjust injectors.
Adjust intake and exhaust valves.
Clean air cleaners thoroughly.

EVERY 512 HOURS

Change oil in Tournapull main case.
Change oil in Transmission.
Hand-pack Scraper wheel bearings with grease.
Lubricate Scraper springpipe.
Clean and oil cranking motor bearings and screw shaft of Dyer drive.

EVERY 1024 HOURS

Lubricate water pump.
Change oil in Power Control Unit gear case.
Lubricate Power Control Unit cable drum bearings (hand-pack).
Check fuel inlet connection check values.
Check, clean and repair all electric connections.
Check Power Control Unit brake shaft bearings.

EVERY 2048 HOURS

Hand-pack brake shaft bearings with grease.
Hand-pack Power Control Unit control lever bearings.

PERIODICALLY, AS REQUIRED

Hand-pack flywheel clutch pilot bearing with correct grease whenever clutch is disassembled, for replacing lined disc, etc.

Lubricate Scraper pushbeam and sliding sheave channel.

Lubricate cable.

Keep hydraulic brake master cylinder supply tank at least half full of hydraulic brake fluid (HB).

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DONT'S

DON'T run the engine too cool. Keep water temperature between 140° F. and 180° F.

DON'T run the engine idle for long periods. Shut it off unless it is working.

DON'T operate engine on kerosene.

DON'T tamper with governor setting.

DON'T tamper with fuel pump or governor.

DON'T race the engine.

DON'T run engine with loose bearings.

DON'T repeatedly strike drive tires against yoke.

DON'T try to cut too deep when loading.

DON'T try to eject sticky material too quickly.

DON'T leave Power Control Unit clutch engaged after tailgate stops or pushbeam stops have been brought together.

DON'T spin drive tires unnecessarily when loading. Let the pusher tractor do the greater amount of work.

DON'T ride flywheel clutch pedal.

DON'T travel at excessive speeds over rough haul roads or in congested traffic.

DON'T be reckless. Keep the machine under control at all times.

DON'T slip Power Control Unit clutches unnecessarily.

DON'T use weak frayed cable.

DON'T use cable larger than that specified.

DON'T permit a blade to wear back into the blade base before changing.

DON'T permit ground plates to wear back into bolt holes before changing.

DON'T operate Tournapull without safety cable in place.

DON'T install magnetic type drain plugs in sumps below final drive gears on models having serial numbers below C3T-3114-C1G. Use only non-magnetic plugs at this point because magnetic plugs will not clear gear teeth.

DON'T wait till a crack or break becomes serious before repairing.

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LUBRICATION

Proper lubrication is one of the most important parts of the preventive maintenance program. The importance of lubricating with the correct weights and types of lubricants at the specified intervals can not be over-emphasized. More engines, for example, have been ruined by the use of inferior oil than from any other cause. Somewhat the same thing applies to the other units of the machine.

The working parts of the Cummins Engine used in the Tournapull are lubricated by force-feed. The force is supplied by a gear type pump located on the fuel pump side of the engine. Lubricating oil pressure is controlled by a regulator in the gear cover end of the camshaft. The injector plunger in the injector and the working parts of the fuel pump are lubricated by fuel oil. The fuel oil used in the lubrication of the injector plunger is returned to the fuel pump through the drain lines.

The working parts within the transmission case, main case, and power control unit case run in oil and are lubricated therefrom.

Detailed lubricating instructions will be found on the pages which follow.

The general instructions below apply to each of the lubrication charts found on the following pages:

PRESSURE LUBRICATING—Always clean grease fittings before applying gun, whether fittings are hydraulic or button-head types. Use correct type and weight lubricant at each point (see following charts).

HAND-PACKING—Wash bearings and housing with kerosene to remove old dirt. Dip bearings in lubricating oil. Hand-pack with grease, forcing grease in around rolls or balls, and spreading around sides of bearings.

CHANGING OILS—When checking, draining, flushing, and refilling oil compartments, do so with machine on level ground. Drain immediately after operation. Clean magnetic plugs.

KEY TO LUBRICANTS

	TEMPERATURE		
LUBRICANT	Above +32° F.	+32° F. to 0° F.	Below 0° F.
CG—Grease, general purpose	No. 1	No. 0	No. 0
WB—Grease, general purpose	No. 2	No. 2	No. 2
GO-Lubricant, gear, universal	S.A.E. 90	S.A.E. 80	Grade 75
OE—Oil, engine	S.A.E. 30 (For use in Engine	S.A.E. 10 See Note B)	S.A.E. 10 See Note (A)
HB—Fluid, brake, hydraulic	—	—	—

NOTES (A) In extreme cold temperatures dilute OE, S.A.E.-10, with diesel fuel (up to 30% as needed to cause oil to pour at prevailing temperature. Mix just before shutting down. Re-dilute as needed to replace oil that boils off. Also cut change period in half. (For Engine manufacturers recommendations see note B.)

(B) *Engine manufacturers recommendation for engine crankcase*—"Use S.A.E. #40 engine oil in extra hot weather with well worn engine, S.A.E. #30 in hot weather (+80° F. to +100° F.), S.A.E. #20 in average weather (+20° to +80° F.) and S.A.E. #10 in cold weather (+20° F. and below). These S.A.E. numbers should be adhered to closely. It would not be satisfactory, for instance, to substitute an S.A.E. #30 light grade, or S.A.E. #20 light grade, for the corresponding straight S.A.E. #30, or S.A.E. #20." Of the four grades of lubricating oil listed above, only SA.E. #10 and S.A.E. #30 are available for U. S Army use. For best results with these grades, use OE, S.A.E. #30, in temperatures above +32° F. and OE, S.A.E. #10, in temperatures of +32° F. and below.

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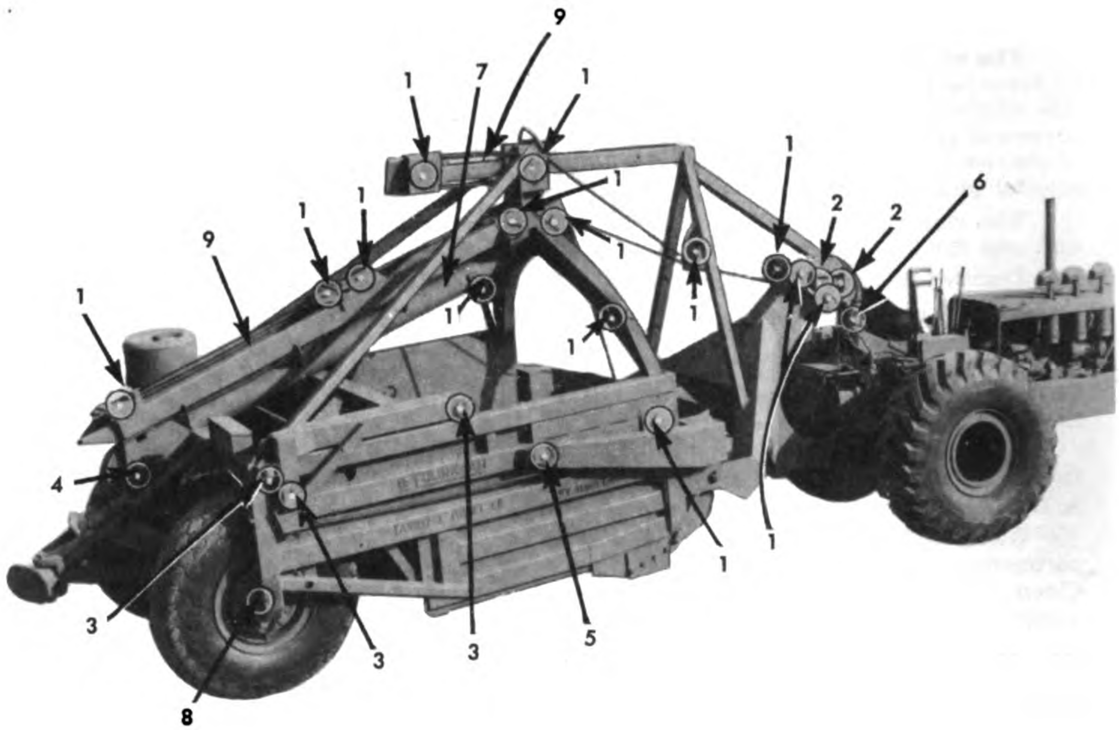

Scraper LUBRICATION

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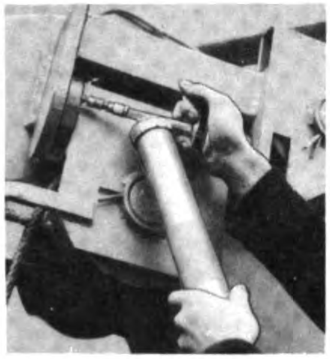
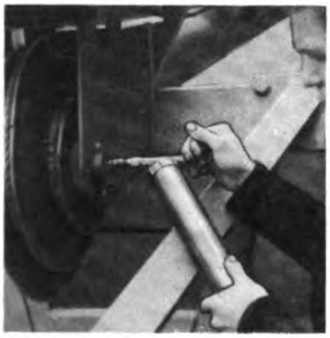
1. SHEAVE BEARINGS
Every **8** hours operation lubricate with **CG**, forcing out small amount of old grease around sheave hub.



2. FAIRLEAD SHEAVE HOUSING BEARINGS
Every **8** hours operation lubricate with **CG**, forcing out small amount of old grease.

3. TAILGATE ROLLER BEARINGS
Every **8** hours operation lubricate with **CG**, forcing out small amount of old grease.



4. SPIRAL SHEAVE WHEEL BEARINGS
Every **8** hours operation lubricate with **CG**, forcing out small amount of old grease.

5. HINGE PINS
Every **8** hours operation lubricate with **CG**, forcing out small amount of old grease.

6. BALL AND SOCKET HITCH
Every **64** hours operation lubricate with **CG**, forcing out small amount of old grease.

7. SPRINGPIPE
Every **512** hours operation remove cover plate from springpipe and pour in approximately 1 quart of **GO** to lubricate springs.

8. WHEEL BEARINGS
Every **512** hours operation remove wheel and hand-pack bearings with **WB**. Install oil seals with leather cupped inward.

9. PUSHBEAM AND SLIDING SHEAVE CHANNEL
Apply **CG** whenever needed to sides of pushbeam and sheave channel above springpipe in which apron and tailgate sheaves slide.

10. CABLE LUBRICATION
Coat cable (wire rope) sparingly at infrequent intervals with **OE** to serve as a rust preventative. Avoid coating that portion of cable which wraps onto cable drums because of danger of oil getting on facings and causing clutch and brake slippage.

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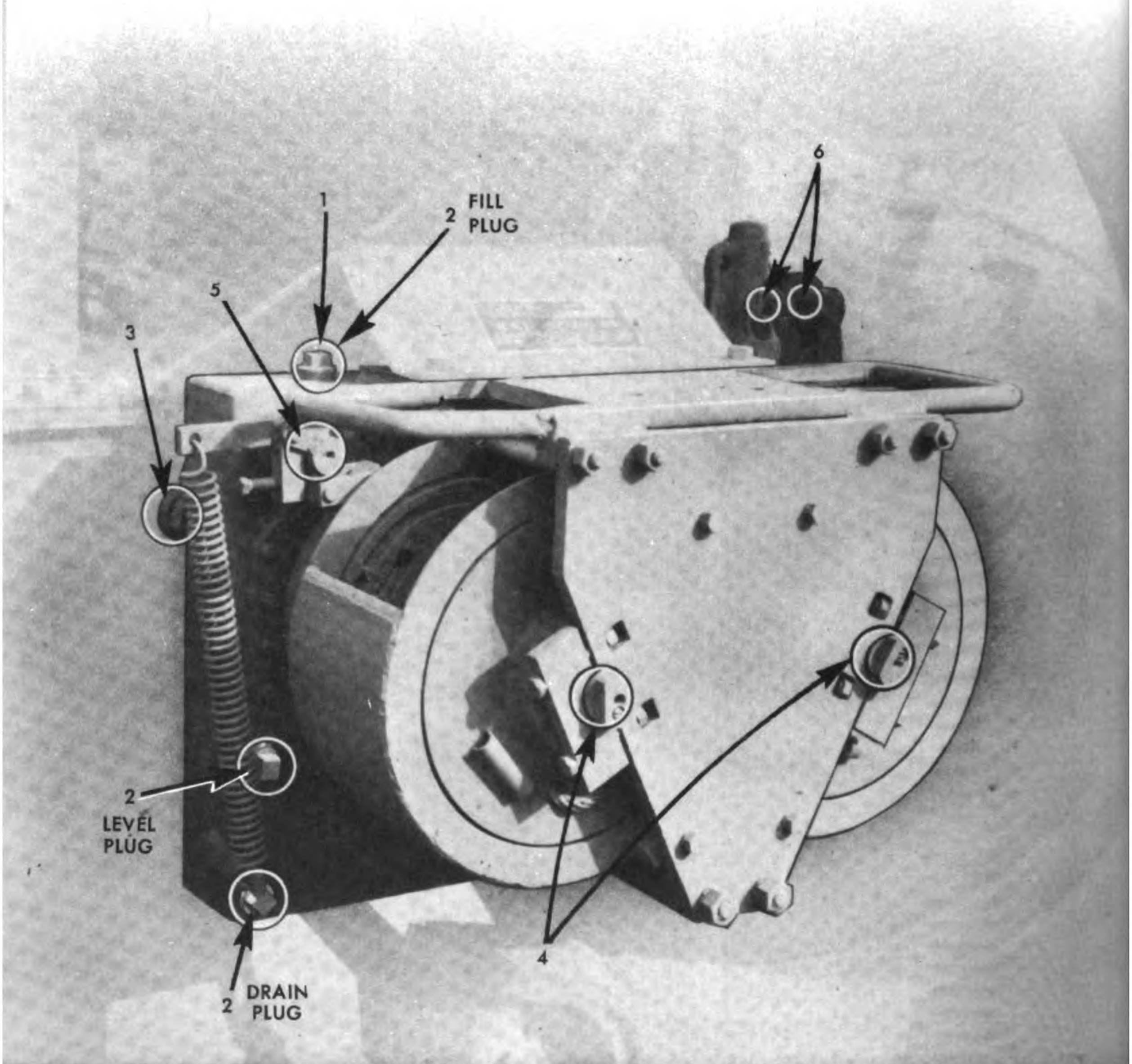

Power Control Unit LUBRICATION

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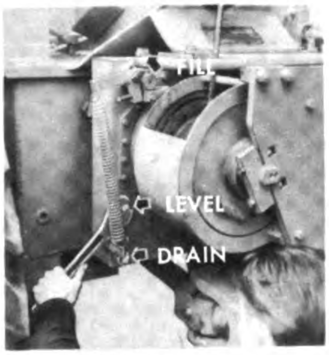
1. BREATHER HOLE
When delivered remove cork from breather hole in oil fill plug. Keep hole open at all times.



2. GEAR CASE
Every **64** hours check oil level in gear case by removing oil level plug. Always keep filled to level plug. Drain, flush, and refill with **GO** every **1024** hours operation. (Capacity 15 quarts.)

3. BRAKE ROLLERS
Every **64** hours operation lubricate brake rollers with **OE**, using oil can.

4. CABLE DRUM BEARINGS
Every **1024** hours operation (or when disassembled) remove cable drum, hand-pack bearings and fill drum 2/3 full of grease, using **WB**. (See note A)

5. BRAKE SHAFT BEARINGS
Every **2048** hours operation remove brake shaft bearings and hand-pack with **WB**.

6. CONTROL LEVER BEARINGS
Every **2048** hours operation remove Power Control Unit control lever bearings and hand-pack with **WB**.

NOTES: (A) After hand-packing cable drum bearings, reassemble cable drum assembly, leaving out two of the capscrews which secure the driven cone to the cable drum. Then, with the cable drum standing on end, insert recommended grease through one of capscrew holes, filling the drum only 2/3 full of grease. In this operation, use a conventional pressure grease gun or any other suitable means of inserting the grease through the capscrew hole. Also, insert a measuring stick or wire down through the other capscrew hole to serve as a guide in determining when cable drum is 2/3 full of grease.

For emergency lubrication, a drilled grease duct is provided in the drum shaft, extending from rear of shaft to grease chamber inside cable drum. In event an excessive amount of grease is lost around cable drum oil seals and for some reason it is impractical to disassemble the unit until after a few more hours of operation have been completed, the bearings may be temporarily supplied with lubricant by removing plug from end of drum shaft and inserting a grease fitting in its place. Then inject enough grease through grease fitting to replace that which was lost around the seals, using a conventional pressure grease gun. As soon as possible thereafter, disassemble cable drum assembly to replace leaky oil seals and again hand-pack bearings and fill cable drum 2/3 full of recommended grease.

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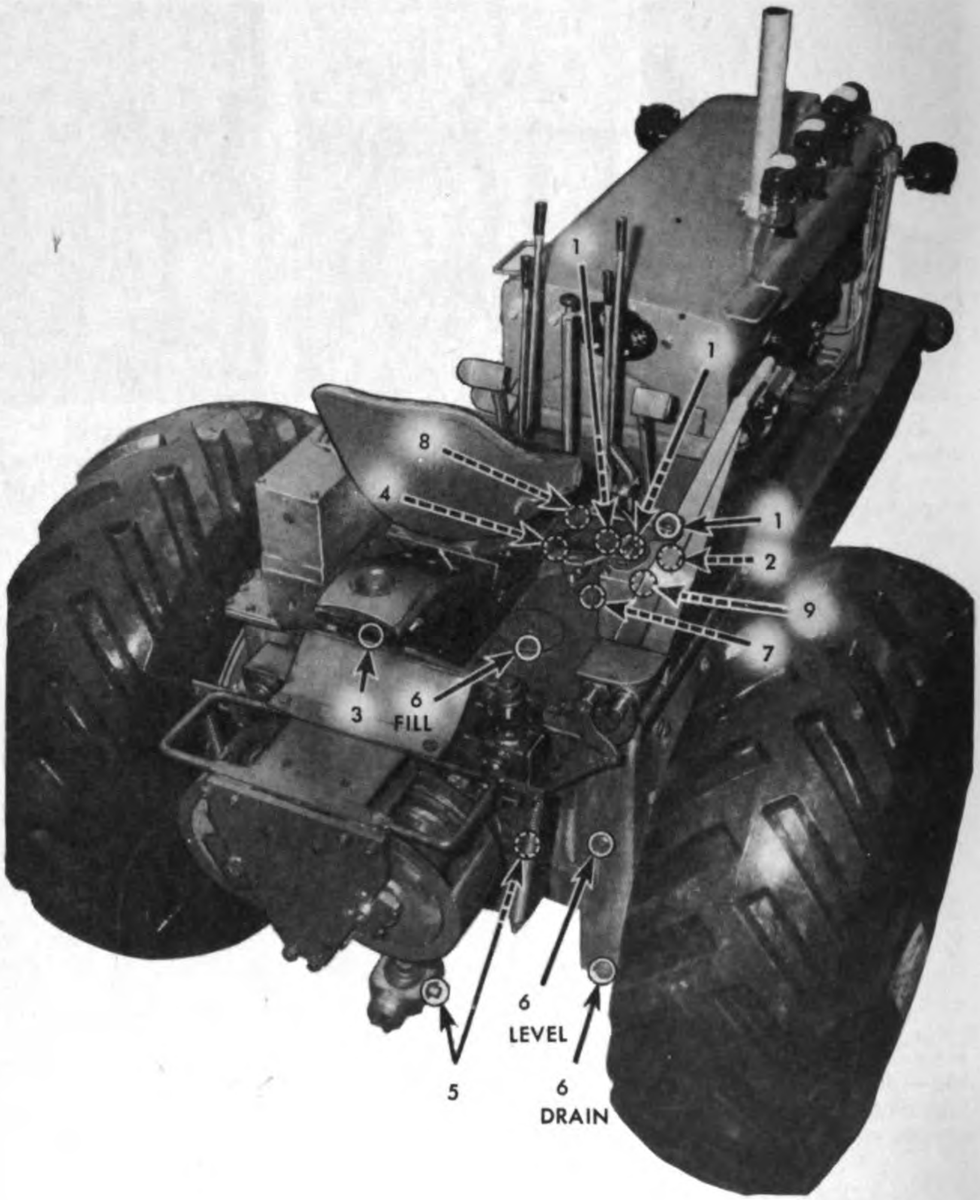

Tournapull LUBRICATION

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1. CONTROL LEVERS AND LINKAGE

Every **64** hours operation lubricate control levers and linkage with **CG.** Reach control lever fittings through floor board openings.

2. FLYWHEEL CLUTCH RELEASE YOKE

Every **64** hours operation lubricate both ends of flywheel clutch release yoke with **CG.** Reach fittings from below, along both sides of clutch housing.

3. MAIN CASE BREATHER

Every **64** hours operation remove main case breather, wash elements in SOLVENT, dry cleaning or oil, fuel, diesel, oil with **OE** and re-install. Reach breather through opening at rear of seat bracket.

4. FLYWHEEL CLUTCH RELEASE BEARING

Every **256** hours operation lubricate flywheel clutch release bearing with **CG.** Be careful to not over-lubricate. Reach fitting thru floor board opening.

5. DRAWBAR

Every **256** hours operation lubricate with **CG** through button-head fittings at both ends of drawbar. Avoid blowing out rubber boots through over-lubrication.

6. MAIN CASE

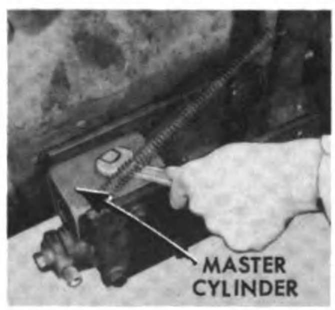
Every **64** hours check oil level by removing oil level plug. Keep oil up to level plug at all times. Drain, flush, and refill with **OE** every **512** hours. (Capacity approximately 35 gal.) See Note (A).

7. TRANSMISSION

Every **64** hours check oil level by removing combination level and fill plug. Keep level up to plug at all times. Drain, flush and re-fill with **GO** every **512** hours. (Capacity 11 quarts.)

8. FLYWHEEL CLUTCH PILOT BEARING

Whenever clutch is disassembled for replacing lined disc, etc., remove flywheel clutch pilot bearing and hand-pack with **WB.** (IMPORTANT—Never use CG at this point.)



9. HYDRAULIC MASTER CYLINDER AND HYDRAULIC BRAKE PEDAL

Keep hydraulic master cylinder supply tank at least ½ full of **HB** at all times. Lubricate brake pedal with **CG** every **64** hours. Reach fitting from below as with flywheel clutch release yoke.

NOTES: (A) Do not install magnetic drain plugs below final drive gears in Tournapulls having serial numbers below C3T-3114-C1G due to insufficient clearance below gears.

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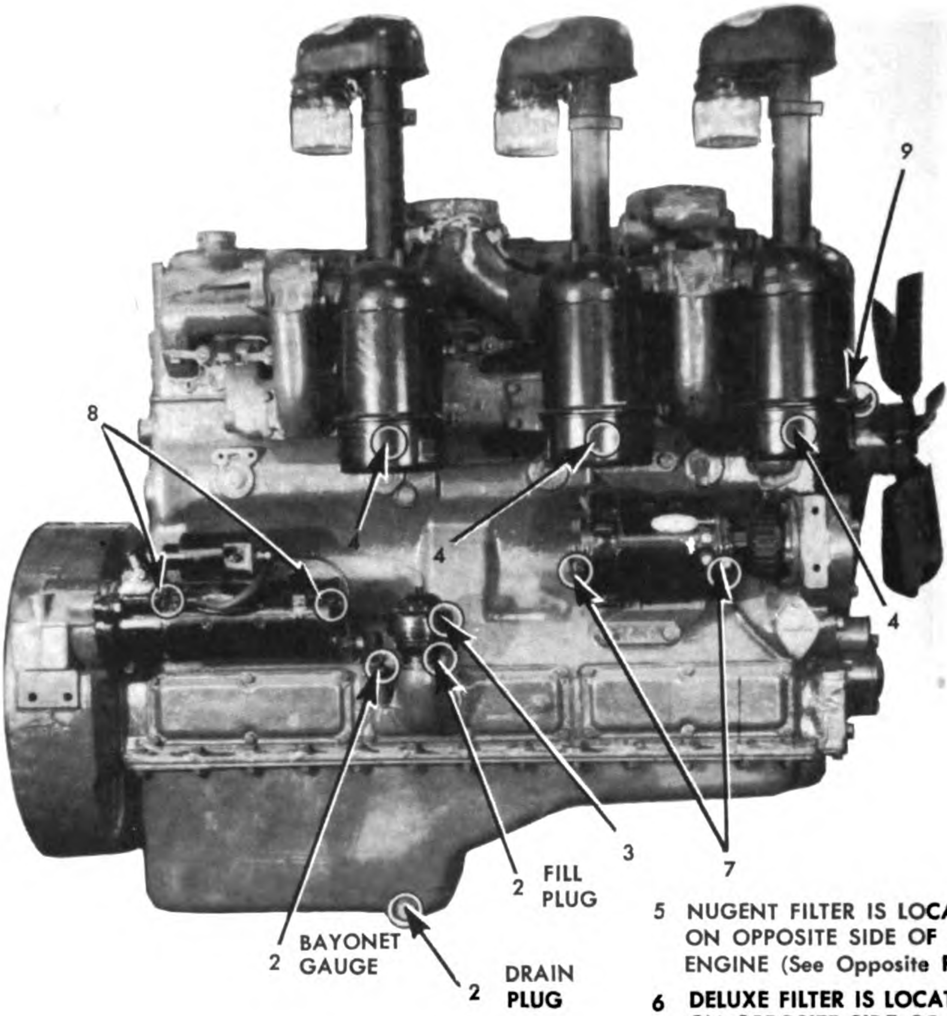

5 NUGENT FILTER IS LOCATED ON OPPOSITE SIDE OF ENGINE (See Opposite Page)

6 **DELUXE FILTER IS LOCATED ON OPPOSITE SIDE OF ENGINE (See Opposite Page)**

Engine LUBRICATION

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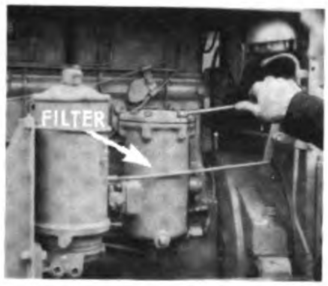
1. OIL PRESSURE GAUGE
Observe engine oil pressure frequently as indicated on oil pressure gauge. Oil pressure should be within range of 30 to 50 lbs. Should not vary much in day's work.

2. CRANKCASE
Every 8 hours operation check oil level with bayonet gauge. Every 64 hours drain, flush and refill with **OE** (see Note B on page 67) to high mark on bayonet gauge. Capacity 7 gals., including filters. (See note A.)

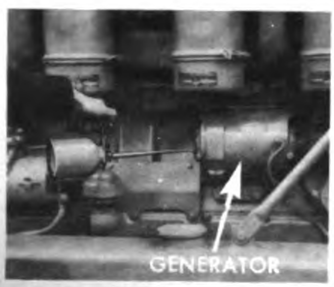
3. CRANKCASE BREATHER
Every 8 hours remove wing nut from top of crankcase breather and disassemble. Drain oil from cup and wash thoroughly. Wash screen. Refill with **OE** to oil level bead around cup, re-assemble and install.

4. AIR CLEANERS
Every **64** hours operation remove oil cup from air cleaner. Drain, clean, re-fill with **OE** to oil level bead and re-install. Every **8** hours check oil level in oil cup. (See "Care of Air Cleaners", page 82, Operation Section.)

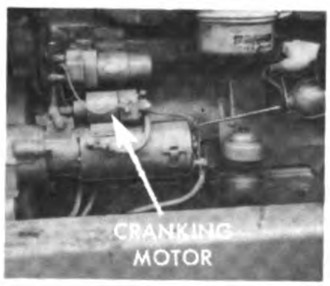


5. NUGENT LUBRICATING FILTER
Every **64** hours operation change lubricating oil filter bag. (See note B.) CAUTION —Add lubricating oil after engine has run for a few minutes to compensate for oil absorbed by new filter bag.

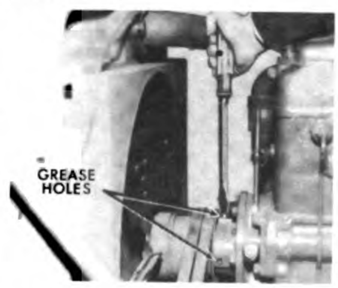
6. DELUXE LUBRICATING OIL FILTER
Every **64** hours operation unscrew cover on DeLuxe oil filter and discard dirty cartridge. Drain dirt from sump, insert new cartridge, replace cover and tighten by hand only. Observe some caution as with Nugent Filter.



7. GENERATOR
Every **256** hours operation fill oil wells on both commutator and drive end frames up to level of oil holes with **OE**, not while unit is in operation because the bearings tend to carry oil and the unit would be excessively oiled.



8. CRANKING MOTOR
Every **512** hours operation clean and oil cranking motor bearings. Also clean and oil screw shaft of the Dyer drive.



9. WATER PUMP
Every **1024** hours operation lubricate water pump with **WB** grease. Remove top plug and one side plug covering lubricating holes. Insert fitting in top plug and lubricate until grease extrudes from side opening. Then replace plugs.

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(A) CHANGING LUBRICATING OIL

Drain oil from oil pan, lubricating oil filters and oil lines. Remove filter bag and cartridge from lube oil filters and replace with new filter bags and cartridges. Drain immediately after shutting down.

After the oil has all drained out, re-fill to proper level with the recommended oil. (See recommendations.)

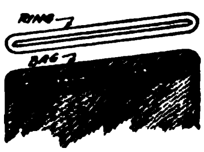
IMPORTANT—Each time new filter bags and cartridges are installed, it is necessary to put an additional amount of lubricating oil into the crankcase since a large amount of oil is retained in the filters.

(B) CHANGING LUBRICATING OIL FILTER BAGS—To change filter bags from bag type filter, remove cover by taking off nuts holding it. Lift filter element from the case. With clean cloths (not waste) wipe the case clean. Remove filter bag from spool and throw it away. (WARNING—Do not attempt to wash old filter bags. In trying to wash a filter bag, dirt will accumulate on the outside of the bag and this, in turn, will go through the oiling system of the engine before it is returned to the filter. Serious trouble will result.)

Wash all parts thoroughly except the filter bags. Inspect the gasket on the spool and the filter bag clamp. If they are not in good condition, replace them.

Inspect the spool arms carefully for cracks or breaks. If one or more of these arms are broken, the filter bag will work out over the discharge hole in the filter housing, shutting off the oil pressure to the engine.

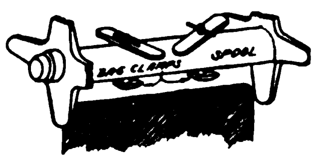
Spool arms can be broken by careless assembly of the filter element. Inside cleanliness is most essential to the long and trouble-free operation of the engine.



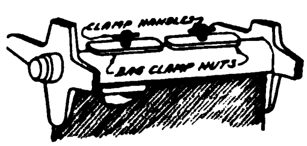
Bag & Ring ready for assembling.

Place ring inside of bag.

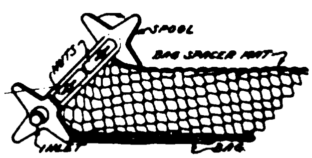
Fold top of bag inward over ring about ½", starting with the ends and then the sides.



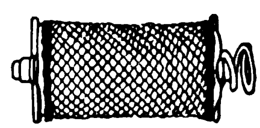
Before applying bag to spool turn bag-clamps lengthwise so that they will enter bag opening.



Hold bag firmly against spool & give ¼ turn to bag-clamp handles which brings them into lengthwise position. Hold handles thus while turning bag-clamp nuts to a hand tight lengthwise position.



With inlet end facing you, place spool with bag on a clean flat surface, then lay bag spacer mat on bag making sure they are flat & that the left end of the mat comes up close to the spool. Then roll mat with bag around spool clockwise.



Assembled filtering element ready to insert into shell.

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FUEL, AND CARE OF FUEL SYSTEM

The use of a good grade of clean fuel oil and proper care of fuel filters, strainers, etc. are important parts of engine care and maintenance. Failure to keep fuel filters and strainers clean will cause excessive wear on the fuel pump. (For fuel pump and injector cleaning and repair, see Engine Repair Section.)

FUEL OIL SPECIFICATIONS

Fuel oil should be a neutral distillate petroleum oil, free from suspended matter and not a mixture of light oil and heavy residue.

Chemical properties should approximate the following requirements:

Viscosity (Saybolt Universal Viscosimeter at 100 degrees Fahrenheit) not less than 34 seconds.

Gravity from 26 to 36 A. P. I.

Viscosity is more important than gravity. If gravity is higher than 32, be sure viscosity is at least 34 seconds.

The fuel to be free from water—not over 1% asphaltum content.

Cetane rating preferably not under 50.

Not less than 10% should distill below 460° F.

Not less than 90% should distill below 675° F.

End point not to exceed 725° F., minimum recovery 98%.

FILLING THE FUEL TANKS

The Tournapull has two fuel tanks which are connected together by a fuel line to serve as a single tank. The combined capacity of the fuel tanks is approximately 75 gal.

When filling the fuel tanks, caution must be used to prevent dirt, water or lint from going into the tank. The strainer screen should always be in place below the fuel tank cap when filling the tanks.

Once every 64 hours of operation drain off condensation from the fuel tanks.

CARE OF FUEL FILTER

Change the fuel oil filter bag every 128 hours of operation.

The fuel oil filter is a Nugent filter of the same general type as the Nugent lubricating oil filter.

For instructions for changing the fuel oil filter bags, refer to the instructions on page 76 of the Operation Section covering the changing of the corresponding filter bags in the lube oil filter.

It is necessary to drain the sediment and water from the bottom of the fuel filter frequently. Due to different grades and quality of fuel, it is impossible to make any definite statement as to when this should be done. This must be determined by the operator, according to the fuel used.

When the filtering elements become saturated with water, it will be necessary to replace the elements. Draining the filter case will not remove water from the filter bags.

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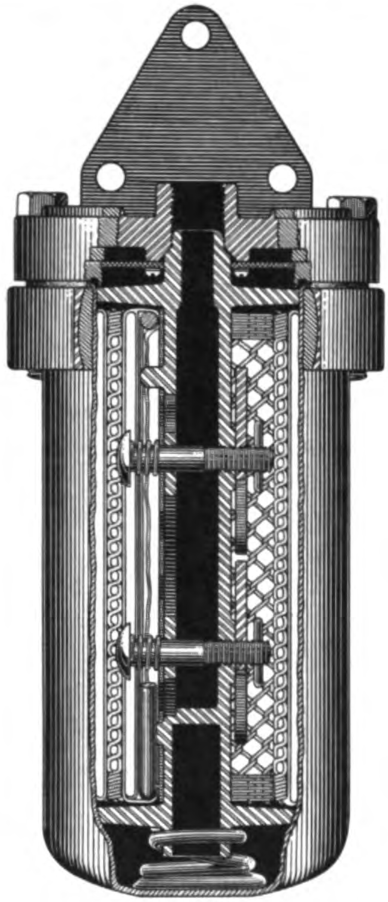

CUT-AWAY DRAWING OF
FUEL FILTER

If water or sediment is allowed to stay in the filter, it collects on the filtering element and will stop the fuel from passing through. In cold weather the water will freeze, completely shutting off all fuel going to the engine. If the fuel lines have any low point and the engine is allowed to remain idle for a short period of time, any water in the fuel lines will find the low spots and freeze in cold weather. This will immediately cut off the fuel flow to the fuel pump.

DRAINING FUEL PUMP FLOAT CHAMBER

Once every 64 hours of operation drain two or three tablespoons of fuel oil from the float chamber of the fuel pump to remove water. It is especially important that this be done in cold weather.

CLEANING FUEL PUMP SCREEN

The small conical screen in the fuel pump should be cleaned every 256 hours. It should also be cleaned in any instance where the engine refuses to start or gives indications of not developing full power. Cleaning of this screen is performed as follows:

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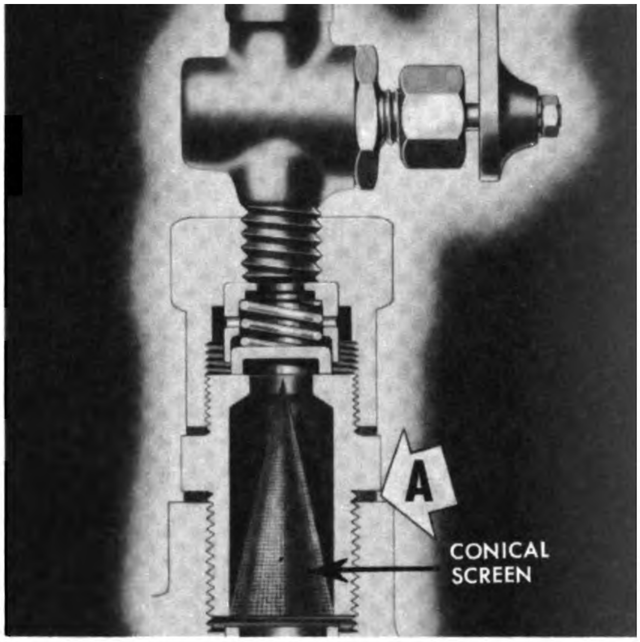

FUEL PUMP SCREEN AND CHECK VALVE ASSEMBLY

1. Unscrew the pressure chamber dome from the pressure pump assembly, taking care not to lose the copper asbestos gasket on which it seats.

2. Remove the fuel supply tube from the distributor top to the emergency control valve.

3. Unscrew the small hexagonal housing into which the control valve is assembled, applying the wrench to the lower of the two hex areas of the housing. Be careful not to mislay the copper gasket for this opening.

4. Place the control valve end of the housing in a vise and unscrew the other half of the housing. The conical screen is located in this part.

5. Wash the screen carefully with cleaning solvent and blow out with compressed air in the opposite direction of the fuel flow.

NOTE: Do not remove the small valves in the emergency control valve part of the housing. If they should accidently be removed, they should be replaced as follows:

1. Clamp the control valve half of the housing in a vise with the cup upward.

2. With the cup end up, drop the small valve cage into the housing.

3. Drop the small spring into the cup.

4. Insert the valve with the flat face next to the spring. This should collapse into the cup when pushed down.

5. Reassemble the two parts of the housing and then proceed with reassembly to the pump.

6. Prime the pump before attempting to start the engine.

INJECTOR FUEL INLET CONNECTION CHECK VALVES

Check the fuel inlet connection check valves every 1024 hours of operation. Re-seat or replace if worn or not seating properly. If the check valves leak, trouble may be experienced in the way of a weak cylinder or engine missing or smoking.

The check valves should break at not less than 35 pounds and not more than 50 pounds fuel pressure. This can be checked by applying fuel pressure to the regular fuel line connection from the priming pump to the pressure pump, and reading from the fuel pump pressure gauge.

The operation of the fuel inlet check valves is very important.

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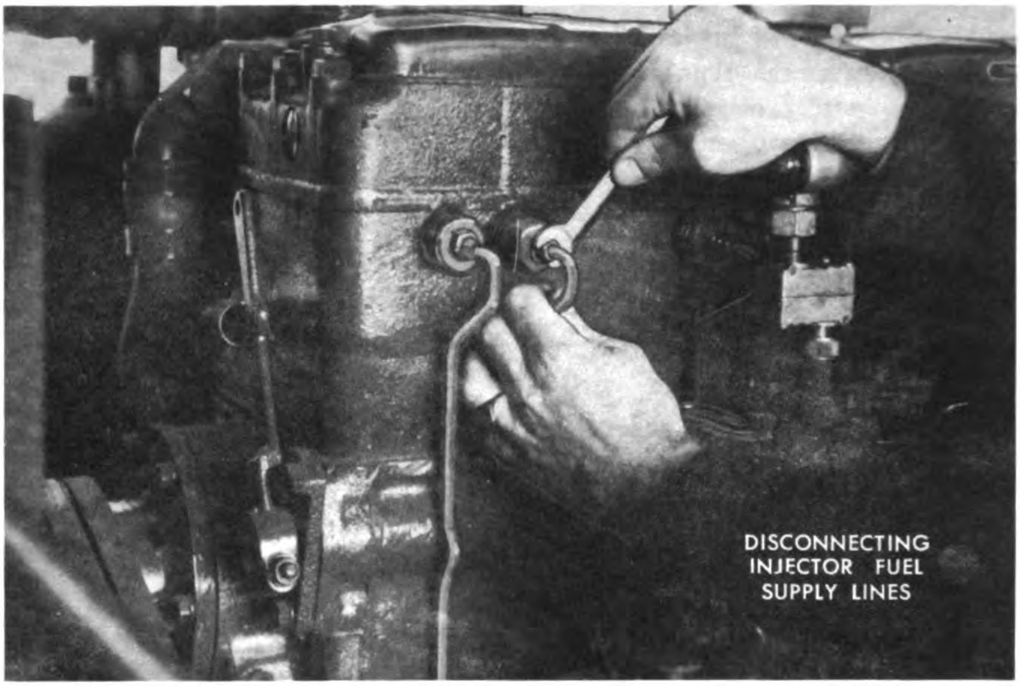


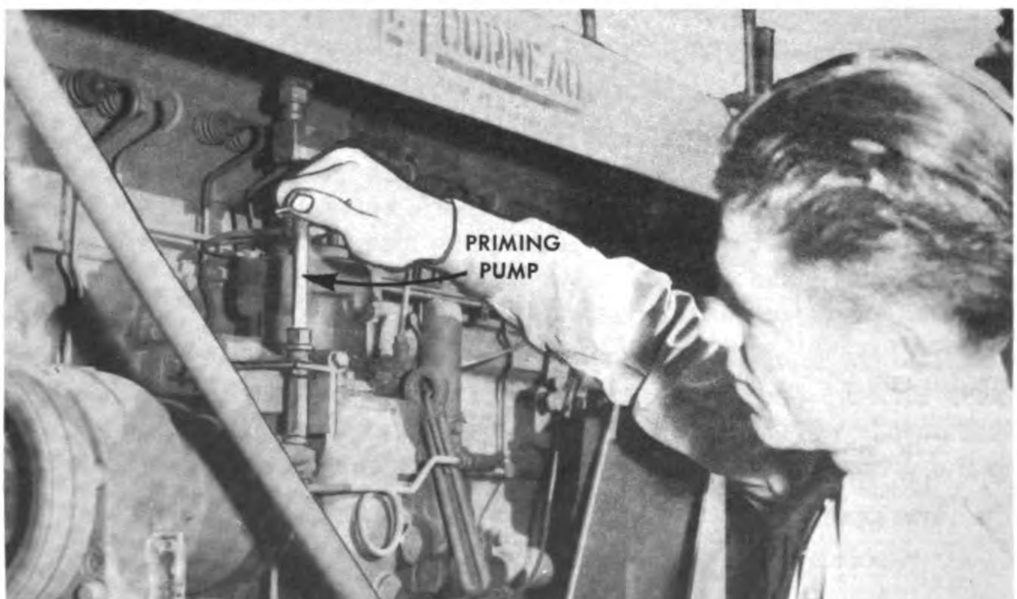
PRIMING THE ENGINE

(NOTE: Cylinders are numbered from the gear cover end of the engine, i.e. Number 1 cylinder is on the gear cover end of the engine and the direction of rotation is determined from this point.)

When the engine is started for the first time or after it has been overhauled, the fuel system will be dry and it will be necessary to prime all supply lines with clean fuel.

1. Check all lines leading to the engine to detect any leaks.
2. Disconnect all the injector fuel supply lines.

NOTE: Be sure the overspeed stop is in the open, or running position, before attempting to prime the engine.



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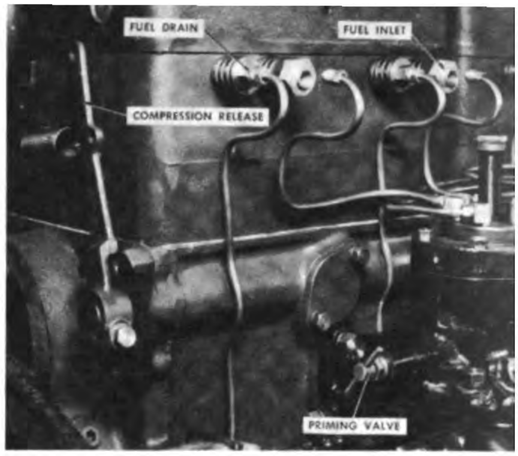


POSITION FOR PRIMING ENGINE

3. Open the priming valve approximately two turns. This valve is solely for the purpose of priming, as it by-passes the fuel around the metering pump.

4. With the hand crank or other suitable means, turn the engine over until the intake valve on Number 1 cylinder starts to open. Continue to turn the engine over until the next "PR" mark on the water pump drive pulley indexes with the timing mark on the gear cover.

5. Work the priming pump until solid fuel appears at the loosened injector fuel inlet connection.

6.- Tighten the fuel line on the cylinder just primed and give the primer one or two (no more) strokes. This pushes the solid fuel to the injector cup to prevent excessive cranking when ready to start the engine.

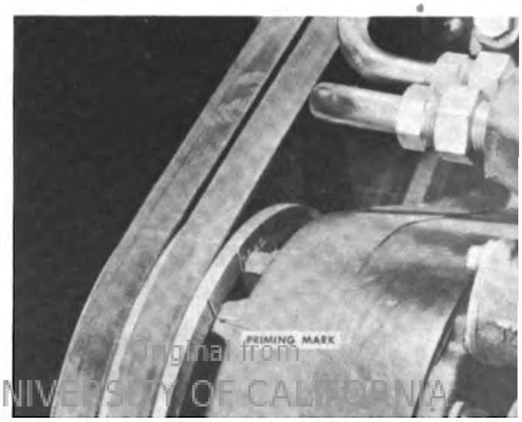
7. Turn the engine over until the next "PR" mark on the water pump drive pulley indexes with the timing mark on the gear cover. This brings the cylinder listed next in the firing order to the correct position for priming. Prime this cylinder as previously instructed. It is necessary to prime each cylinder separately. The fuel passages in the distributor index for only one cylinder at a time.

8. After the injector supply lines are primed and tightened, close the priming valve. *Caution*: *Close the priming valve by hand only. If the valve turns with difficulty, loosen the packing nut. Otherwise, the point of the valve may be broken.*

WARNING: DO NOT ATTEMPT TO RUN THE ENGINE WITH THE PRIMING VALVE OPEN OR SERIOUS DAMAGE WILL RESULT.

With the priming valve open, a passage is formed directly from the fuel pressure pump to the injector. Since the fuel is coming directly from the pressure pump to the injector, the governor has absolutely no control over the fuel system. The pressure pump gives the injector an excessive charge of fuel each time the passages in the distributor index to supply fuel to each cylinder. This, in turn, makes the engine run at an excessive speed.

The only means of shutting the fuel off when the priming valve is open is by the emergency shut off.



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CARE OF ENGINE AND ACCESSORIES

In addition to observing closely the instructions covering engine lubrication (page 75 of Operation Section) and the use of the proper fuel oil and care of the fuel system, (page 77 of Operation Section), the following points of periodic adjustment and engine care also require the attention of the operators or those entrusted with periodic maintenance.

Neglect of one or more of the following suggestions covering routine maintenance of the Cummins diesel engines has been found to cause most service troubles. See to it that these items, in addition to those covered in the Lubrication and Fuel Sections, are included in your regular maintenance check-up.

CLEANLINESS

By keeping the Cummins diesel engine clean—inside and out—you can eliminate a high percentage of the causes of poor engine performance and costly repairs. Clean the engine thoroughly on the outside every 64 hours of operation. Check air passage in radiator every 64 hours and clean if necessary. Use a good grade of clean fuel oil at all times. (See page 77 of Operation Section.) Failure to keep the fuel filter and strainers clean will cause excessive wear on the fuel pump. The fuel pump screen should be cleaned regularly. Ventilating holes should be kept clean and open to permit proper air intake.

CARE OF AIR CLEANERS

The Tournapull engine is equipped with three air cleaners and pre-cleaners.

Each pre-cleaner and air cleaner should be serviced as follows:

Pre-Cleaners

The pre-cleaner is an attachment fastened to the top of the air cleaner for the purpose of collecting excessive dust going into the intake of the air cleaner. A small jar is screwed on the pre-cleaner for collecting dust and must be cleaned every 8 hours of operation when working in extremely dusty conditions. (Oftener if required.)

Remove pre-cleaner and inspect fins every 8 hours. When fins become dirty or oily, wash entire pre-cleaner in SOLVENT, dry cleaning or OIL, fuel, diesel.

Air Cleaners

Careful attention to the air cleaners will prolong engine life. Check the oil in the sumps of the air cleaners every 8 hours of operation and replenish if necessary.

The air cleaner takes the dust from the air but the operator must take the dust and dirt from the cleaner. An oil of the same grade as that in the crankcase should be used in the cleaner; however, in extremely cold weather a lighter grade may be necessary. (Refer to lubrication instructions.)

WARNING: NEVER USE CRANKCASE DRAININGS.

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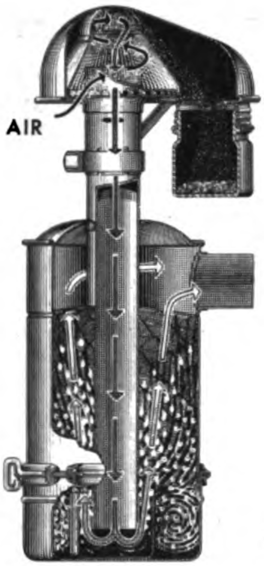

Remove the oil cup by loosening the wing nuts or clamp screw that holds the cup in place on the lower part of the cleaner. Empty the oil from the cup and wash thoroughly with cleaning solvent.

With clean cloth or brush (not waste) and cleaning solvent wash the inside surface of the air inlet tube. If this is neglected dirt will gradually build up on inside of tube. This will prevent the passage of a sufficient quantity of air which is necessary for proper combustion and good engine performance.

Fill the oil cup to the level indicated by the bead on its side with clean fresh oil and assemble to cleaner.

After every 256 hours of operation, the screens inside the body of the cleaner must be cleaned. Remove the entire cleaner from the engine. When it has been disassembled for the regular cleaning job as described above, flush the inside of the cleaner body with SOLVENT, dry cleaning or OIL. fuel, diesel.

After thoroughly flushing, blow the screens out well with compressed air. When cleaner is replaced on the engine, be sure all connections are air tight.

Each time the air cleaners are serviced the crankcase breather should be cleaned. (Refer to lubrication instructions.)

HOW OVERSPEEDING AFFECTS THE AIR CLEANERS

Air cleaners are designed to handle a certain maximum volume of air. As engine speed increases or decreases the volume of air traveling through the cleaner varies proportionately. Overspeeding will pull the oil from the oil cup into the intake of the engine in a very short time, thus making the filter useless.

Do not allow the engine to operate at speeds higher than that for which the governor is adjusted.

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CARE OF COOLING SYSTEM

Check level of water or cooling solution in radiator every 8 hours of operation. Keep the radiator full. The capacity of the cooling system, including radiator is approximately 12 gallons.

Water used in the cooling system should be soft, or as free as possible from scale forming minerals.

The cooling system should be drained occasionally to remove dirt and sediment which accumulates. The radiator is drained by opening the petcock in the bottom of the radiator. To assure complete draining of the cylinder block it will be necessary to remove the drain plugs in the engine block and water manifold. Failure to drain any one of these plugs may cause serious damage in freezing weather.

Clean the air passage in the radiator every 64 hours of operation.

For operating temperatures, refer to page 39 of Operation Section.

Check battery with a good hydrometer every 8 hours operation (before operation). Battery is sufficiently charged if specific gravity of electrolyte is 1.225 to 1.300 (1.075 to 1.230 in hot or torrid climates). If specific gravity is below 1.225 or the variations between specific gravity readings of cells is more than 25 points, remove battery for recharge or inspection.

If necessary add distilled water to maintain electrolyte level about 3/8" above the plates. Also inspect battery cables for cleanliness or tightness. Remove corrosion from and around terminals and then coat with vaseline or grease.

Make operational maintenance checks regularly.

Operational maintenance checks may be defined as the checks which may be made during the operation of the equipment. These checks give the operator some idea as to the condition of the cranking motor so that if some abnormal condition of operation is noted, corrections may be made before complete failure of the unit takes place, with a consequent failure to start the engine. During starting, the action of the cranking motor should be noted. The cranking motor should take hold promptly and spin the engine at normal cranking speeds. If the cranking motor cranks the engine slowly or not at all, the equipment should be checked and the necessary corrections made. (Refer to pages 257 thru 262 of Repair Section.) Failure to crank normally can be due to a low battery, defective battery cables, poor connections in the cranking motor to battery circuit (including solenoid switch circuit), defective cranking motor, low temperatures, or various conditions in the engine.

CAUTION: The cranking motor must never be used for more than 30 seconds at any one time without a pause of several minutes to wait until the cranking motor cools off. The cranking motor must never

(Continued on page 86)

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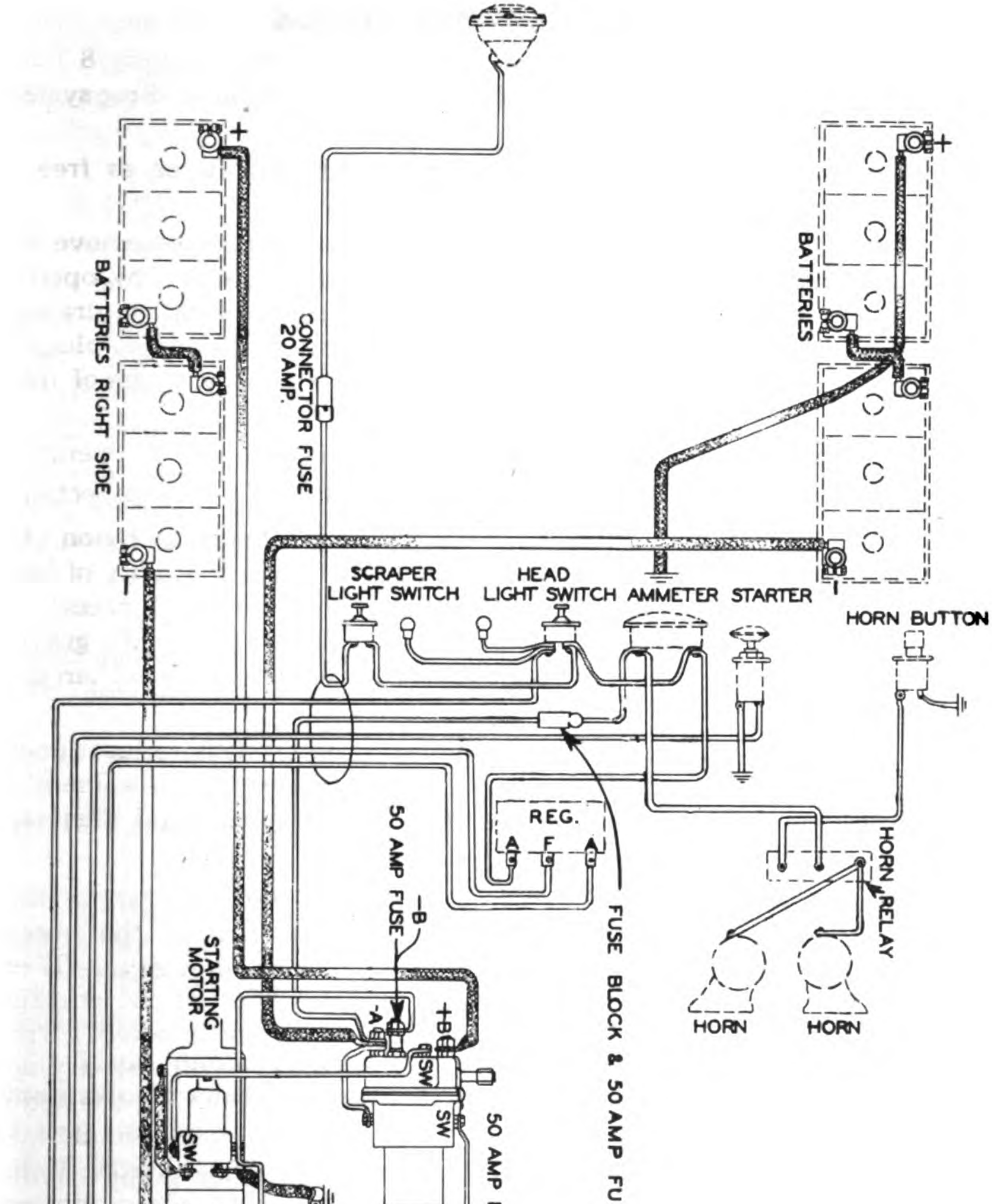

WIRING DIAGRAM

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(Continued from page 84)

be used to move the vehicle. Failure to observe these rules may result in complete failure of the cranking motor.

Generator charging rate should be checked regularly. Frequently the rate of charging is stepped up when all that is needed is an adjustment of the generator and regulator. Over-charging causes excessive wear on the generator brushes and shortens the life of your battery.

Periodic inspection and good maintenance will prevent service interruption.

Keep connections clean and tight. Prevent wire and lugs from touching each other or any metal except screw terminals to which they are attached. Replace broken or worn out wires and their terminals.

Do not spray washing solutions against generator, cranking motor and control unit because if forced into the interiors, certain deposits may accumulate to cause service interruptions. Keep aluminum or other metallic paints away from terminals to avoid possible shorts and grounds. Shield generator and cranking motor from dripping, spilled oil or other liquids. Keep brush opening band on generator.

NOTE: Care must be taken in installing band to see that ventilating louvers are facing down to prevent water running into the generator.

Lubricate bearings as per lubrication instructions on page 75 of Operation Section.

Make sure at all times that the proper fuses are in place. (Refer to wiring diagram on previous page.)

For further instructions pertaining to adjustments and care of the electrical equipment (points not normally taken care of by operators) refer to pages 257 thru 262 of Repair Section. Functions of electrical equipment will be found on page 17.

DRIVE BELTS

Check tension of water pump belts every 256 hours of operation and correct if needed.

The belts may be tightened by loosening the water pump clamp ring and turning the water pump (which is on an eccentric) counter-clockwise to give the belts proper tension. The belts have proper tension when they can be pushed down approximately 3/4" with normal thumb pressure.

Belts are often neglected because a poorly adjusted belt does not bring an immediate penalty. A belt which is too tight puts a strain on gears, shaft and belt grooves. Loose belts slip, overheat and wear out more quickly.

You can not cool the water in your radiator efficiently if the belts on the water pump are slipping. In replacing worn belts, use standard V belts of the right length and shape to fit the grooves properly.

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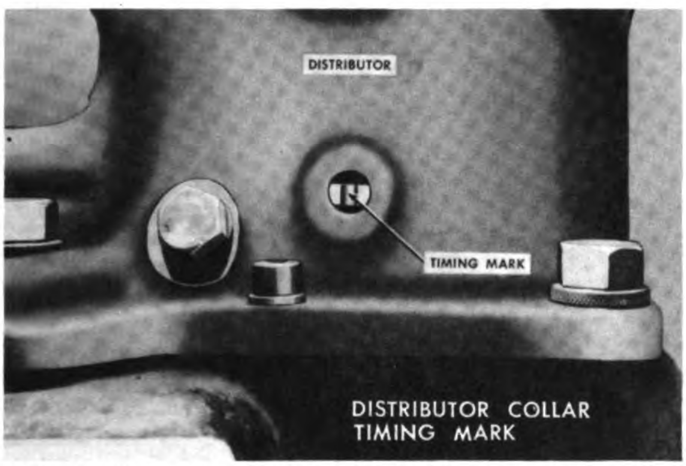
FUEL PUMP TIMING

Check the fuel pump timing before initial operation and before operating the engine following overhaul jobs which might affect the fuel pump timing .

1. Bar the engine over to Number One top center. The engine is on Number One top center when the top center mark on the flywheel lines up with the mark on the flywheel housing through the inspection plate and if both intake and exhaust valves on Number One cylinder are closed. If the top center mark shows on the flywheel and Number One exhaust and intake valves are not closed, the engine is on Number Six top center and it will be necessary to turn the crankshaft one complete revolution.



DISTRIBUTOR COLLAR
TIMING MARK

2. Check the fuel pump timing marks on the water pump drive pulley and the gear housing. This should show one and six top center.

3. Check the distributor collar timing mark through the distributor housing inspection hole as shown.

These checks on fuel pump timing are only necessary, (1) after the fuel pump has been removed from the engine, (2) or if the camshaft timing has been changed, (3) or the fuel pump distributor has been lifted from the fuel pump. The engine cannot get out of time by itself.

INJECTOR PLUNGER ADJUSTMENT

Never operate the engine when the valves are improperly adjusted.

Check the injector adjustment before initial operation and once every 256 hours of operation thereafter. Also check injector adjustments after an overhaul or at any time when the operator is not sure that the engine is ready to be operated.

1. To set the injector, pull the compression release lever as far back as possible and hold it in this position. This allows the intake valves to remain open. The engine may then be turned over without working against compression.

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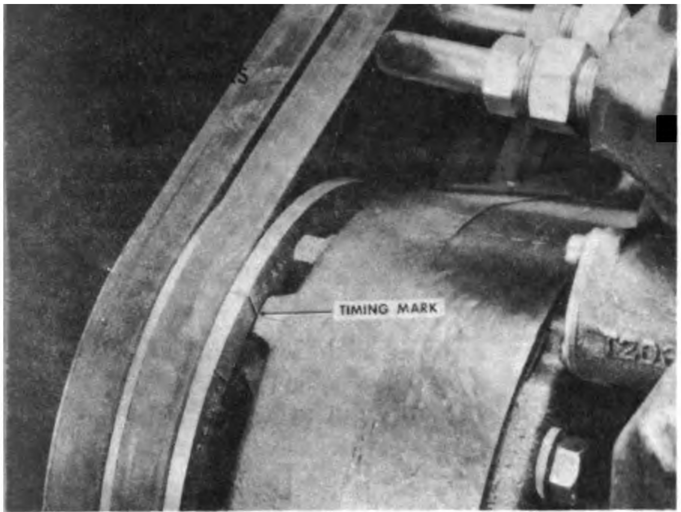

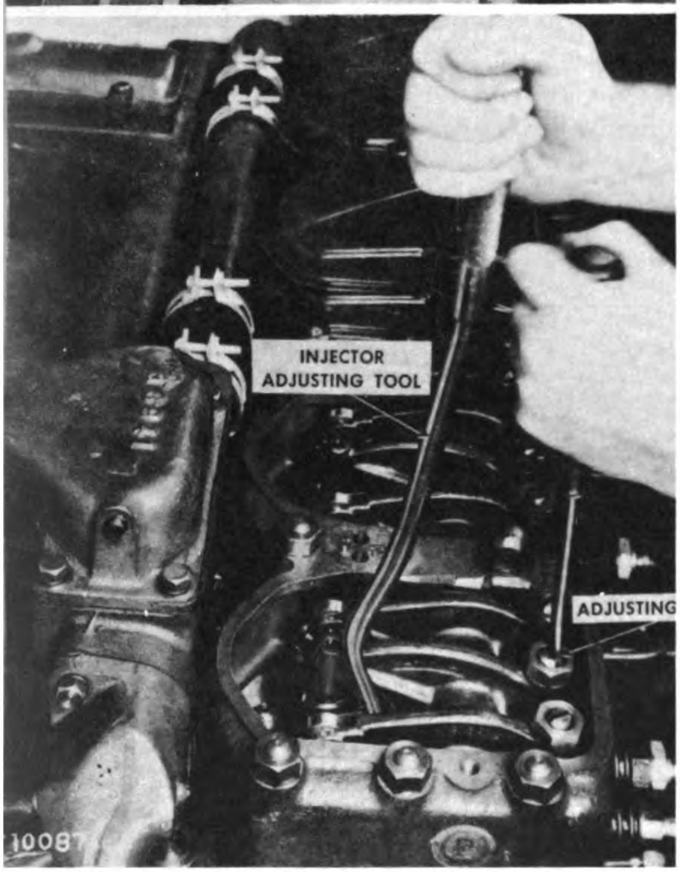

2. Rotate the engine in its operating direction until Number 1 cylinder comes up on the compression stroke. (On the compression stroke both the intake and exhaust valves will be closed with the compression release in running position.) As the piston approaches top center, the injector rocker lever (the center lever) will start moving downward, pushing the injector plunger down with it.

3. When the injector rocker lever starts its downward movement, continue to turn the engine (approximately ⅛ turn) until the notch marked "1 & 6 VS" on the water pump drive pulley registers with the top center mark on the gear housing. Number 1 cylinder is now in position to adjust the injector.

4. Make sure that both intake and exhaust valves are in closed position before adjusting the injector plunger.

5. With an injector adjusting tool, push the injector plunger firmly in its seat. Then with a screwdriver, turn the adjusting screw down until it just bottoms. Now tighten the lock unit. Do not tighten further or back off the adjusting screw.

Caution: *Be careful not to adjust the injectors too tightly, as this throws an overload on the camshaft and cam rollers, ultimately damaging these parts.*

The injectors for only one cylinder can be adjusted at one setting. Two complete revolutions of the crankshaft are necessary to adjust the injectors for all cylinders.

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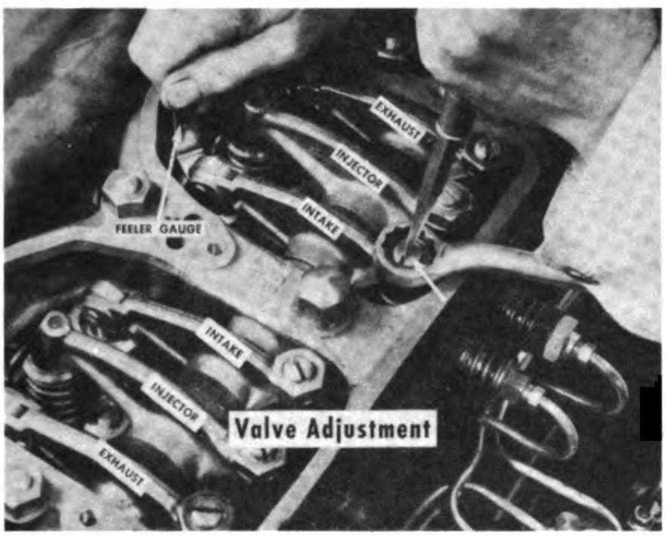
VALVE ADJUSTMENT

Never operate the engine when the valves are improperly adjusted.

Check the valve adjustment before initial operation and once every 256 hours of operation thereafter. Also check valve adjustments after an overhaul or at any time when the operator is not sure that the engine is ready to be operated.

1. Make sure the compression release is in running position before setting the intake valves.
2. Always make final valve adjustments when the engine is hot.
3. Set the intake valves at .014" and the exhaust valves at .022".
4. Turn the engine over until the next "VS" notch in the water pump drive pulley indexes with the top center mark on the gear housing. This brings the cylinder next in the firing order to the correct position for injector and valve adjustments.
5. Following this procedure, continue until all injectors and valves have been set.

CAUTION: The valves for only one cylinder can be adjusted at one setting. Two complete revolutions of the crankshaft are necessary to adjust the valves for all cylinders.



ADJUSTING VALVES

ADJUSTMENT OF IDLING GOVERNOR

After the fuel pump is installed on the engine and the engine is running, the low speed or idling governor stop screw should be adjusted.

This adjustment is made by loosening the locknut and turning the idling screw until the engine idles at between 450 and 500 RPM.

If more adjustment is required than the screw permits, readjustment of the linkage to the idling control may be made. Make sure this adjustment is made so that the idling lever holds the screw against the stop on the pump body when in idling position.

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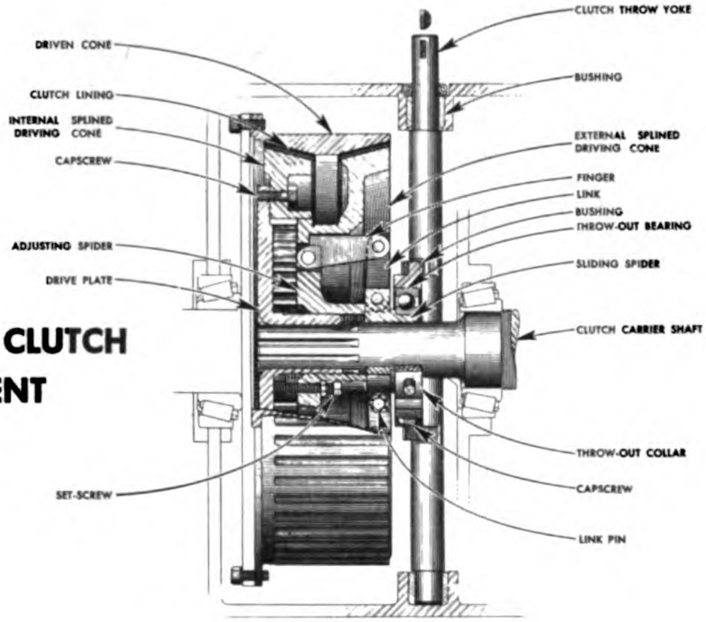
STEERING CLUTCH ADJUSTMENT



CROSS-SECTION DRAWING OF STEERING CLUTCH

There is no set interval for checking the steering clutches for adjustment.

Instead, the operation of the machine serves as a constant check on the adjustment.

Adjust the steering clutches only when troubled with clutch slippage.

Do not tinker with the clutches. Normally, the clutches should not be bothered so long as they are functioning properly and responding to the movement of the control levers. However, in event the adjustment has been turned up so tight that the operator has difficulty in moving the control levers to engage and disengage the clutches, backing off or loosening the clutch is permissible, providing that this amount of tightness is not needed in overcoming clutch slippage.

Normally, a good firm pull or push of the control lever is required to disengage or re-engage a clutch when correctly adjusted, with more force required for re-engaging than for disengaging. The amount of force needed in engaging and disengaging clutches when correctly adjusted varies somewhat with different machines, however, due to mechanical condition of the machines, weight of oil in which the clutches are running, etc.

As the steering clutch levers are moved to engage or disengage the clutches, the clutch engaging mechanism "snaps" or "toggles" overcenter, and this action can be both heard and felt by the operator. With a clutch correctly adjusted, this "snap" becomes very definite, and to operators or mechanics who are familiar with the machine, this serves as an indication as to whether the clutches are correctly adjusted.

The clutches should be adjusted only tight enough to prevent slippage when under load. Additional tightness is unnecessary and causes more effort to be required by the operator in engaging and disengaging the clutches than should be needed.

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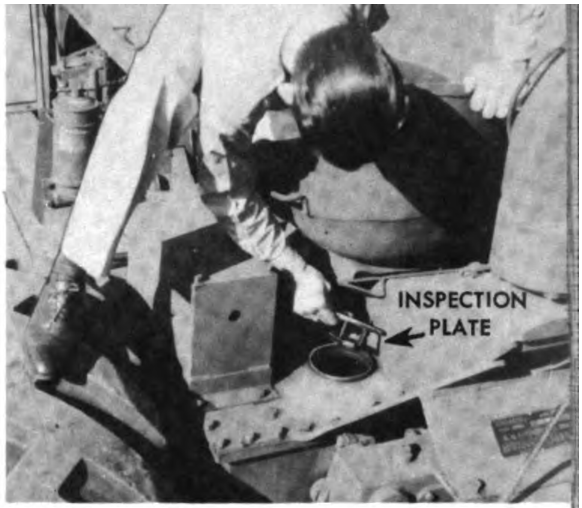
HOW TO MAKE CLUTCH ADJUSTMENT

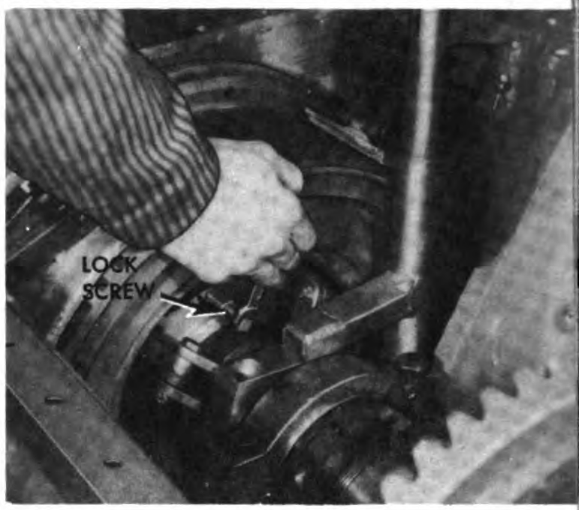
To adjust a steering clutch, first stop the engine and remove the round inspection plate from the deck plate, on the side nearest the clutch that is to be adjusted.

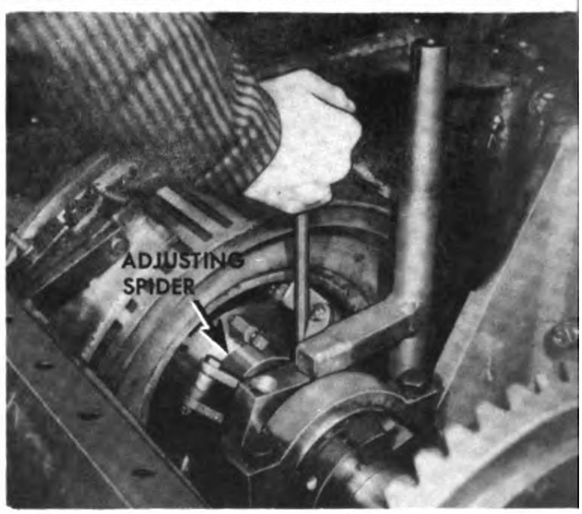
Reach through the inspection hole with a wrench and back off the two lock screws which lock the adjustment, thereby freeing the adjusting spider so that it can be turned. In doing this, first back off the lock nuts located on the lock screws. It may be necessary to disengage the steering clutch and turn the clutch over with the starter to be able to reach both lock screws. Make sure the lock screws are turned far enough out of the adjusting spider to compensate for inward movement of the adjusting spider which takes place in the following operation.

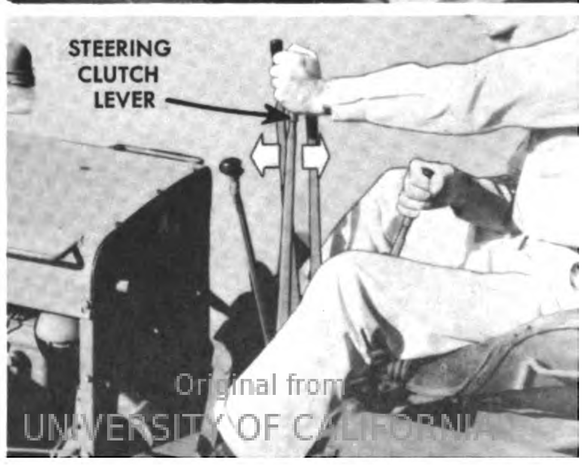
With the clutch disengaged, turn the adjusting spider on the threaded hub of the clutch drive-plate by hand or by prying lightly against one of the clutch fingers with a bar if it can not be turned by hand. Turn the adjusting spider clockwise to tighten the adjustment and counterclockwise to loosen the adjustment. (The amount of a turn required to reach the desired adjustment will be easily learned after having adjusted the clutches once or twice. Only a very small part of a turn is normally required—sometimes only ¼″ to ½″ of movement.)

Without starting the engine, test the adjustment by feeling the control lever movement. The feel of the clutch engaging mechanism as it "snaps" over center will be very evident to the operator when moving the control levers to engage and disengage the clutches if correctly adjusted. If a definite "snap" is both heard and felt in this operation, lock the adjustment by turning the lock screws in *tight* against the drive plate. Also turn the lock nuts on the lock screws up tight against the adjusting spider. Then re-install the inspection plate and road test the machine. If slippage still occurs when under load, another take up in the adjustment will be necessary.









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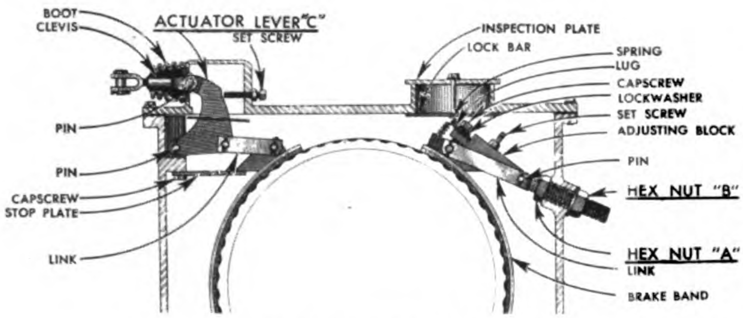


STEERING BRAKE ADJUSTMENT

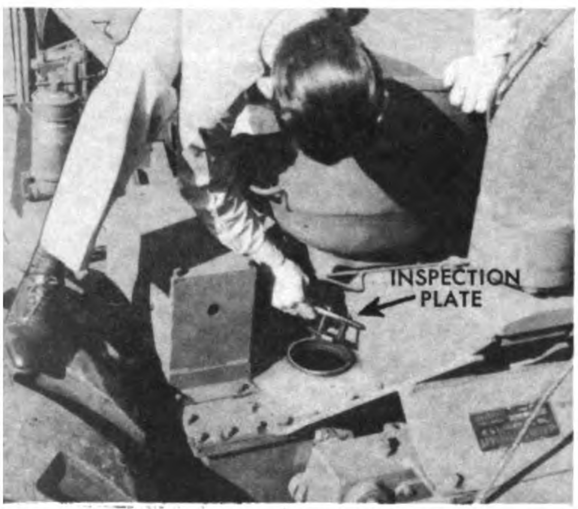
There is no set interval for checking the steering brakes for adjustment. Instead, the operation of the machine serves as a constant check on the adjustment.

The steering brakes can be applied by means of either the brake levers or the steering clutch levers. Adjust the brakes whenever troubled by them not holding properly when using the brake levers, or when the proper engaging or releasing of the brakes is not obtained when using the steering clutch levers.

When actuating the brakes with the steering clutch levers, there should be a brief interval or distance of travel between the point where the steering clutch releases and the point where the brake takes hold as the clutch lever is moved to the rear. Unless this brief interval is obtained, the brakes are incorrectly adjusted and an adjustment should be made.

HOW TO MAKE ADJUSTMENT

To adjust the steering brakes, first remove the round inspection plate from the deck plate, on the side nearest the brake that is to be adjusted.



To tighten a brake, turn hex nut "B" (see illustration above) counter-clockwise. Then reach through deck plate opening and turn nut "A" clockwise with the brake adjusting wrench, far enough to adjust brake to desired tightness. Then turn nut "B" clockwise, tight against the case, to lock the adjustment. To loosen brake, turn nut "A" counter-clockwise and then turn nut "B" clockwise, as needed to bring brake into correct adjustment.

Turn nuts "A" and "B" only a small amount at a time until the point is reached where maximum leverage is obtained from actuator lever "C" when engaging the brakes; or, in other words, to the point where the actuator lever approaches the over-center position (not quite over-center). It can usually be determined when this point is reached by the "spongy" feel obtained on the brake lever when engaging the brake.

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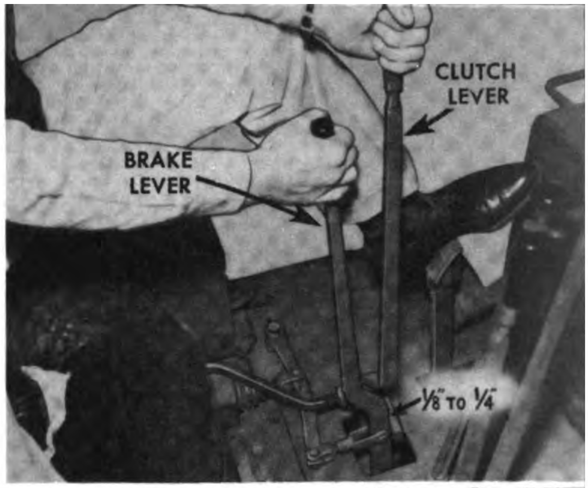
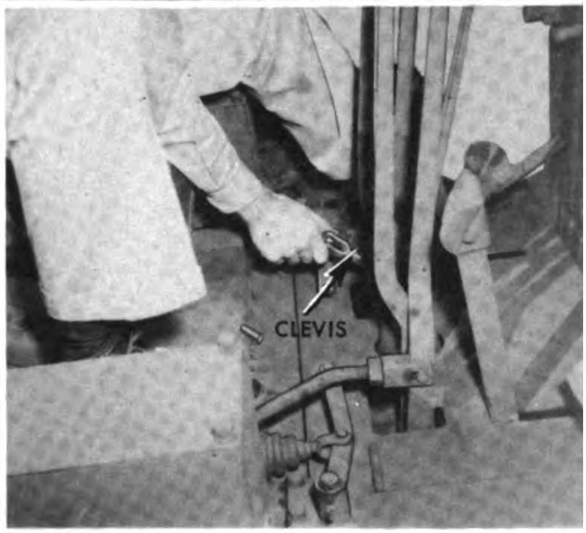




Each time that a brake is either tightened or loosened by turning hex nuts "A" and "B" as outlined on the previous page, check the travel of the clutch lever between the point where the clutch releases and the point where the brake takes hold. To do this, pull back the brake lever to the point where the brake first engages and pull back the clutch lever to the point where the clutch releases. Then measure the clearance between the lower end of the levers at the point illustrated. The clearance at this point should be approximately 1/8" to 1/4". If greater or less than 1/8" to 1/4" make the following adjustment.

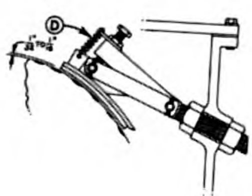
Adjust brake control linkage as required to bring about the correct distance of travel of the clutch lever between the clutch release position and the brake engaged position. To do this, turn the clevises at the ends of the brake links far enough to bring about the specified 1/8" to 1/4" travel as outlined above.

After having completed the brake adjustment, road test the machine.

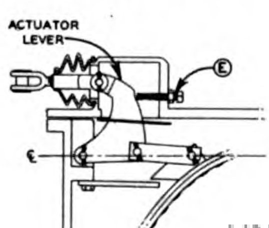
MINOR ADJUSTMENTS

In addition to the points of adjustment covered above, the following points which affect the brake action also require infrequent attention.

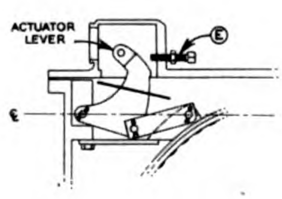
1. Release spring (D) lifts rear end of brake band away from drum (outer circumference of driven cone) when brake is disengaged. A clearance of 1/32" to 1/16" should be maintained at this point. (This can only be adjusted with deck plate removed.)



2. Set screw (E) in rear of brake actuator housing on deck plate is intended to prevent actuator lever and linkage from dropping over-center when engaging brake. Turn the set screw in to the point where it stops actuator lever just before dropping over-center. It can be determined when this point is reached by "feel" of brake lever. This adjustment is usually necessary only after installing deck plate.



3. When removing deck plate, set screw (E) must be backed out far enough to permit actuator lever to be moved back into brake actuator housing as illustrated after disconnecting brake linkage. This will permit deck plate to be lifted off over actuator lever.



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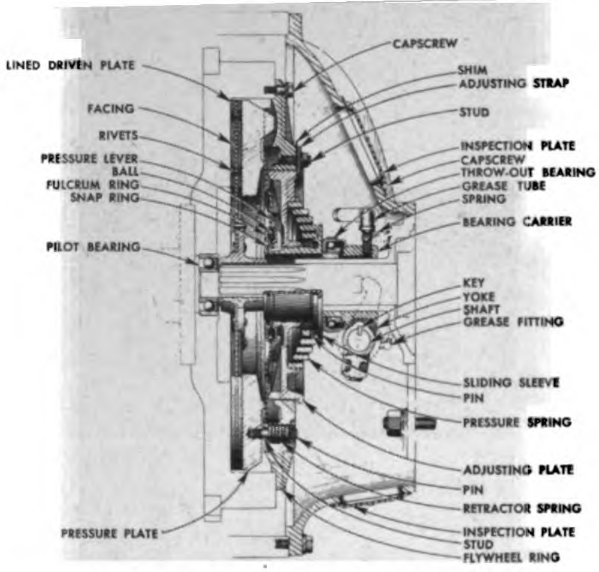

CROSS-SECTION DRAWING OF FLYWHEEL CLUTCH

FLYWHEEL CLUTCH ADJUSTMENT

There is no set interval for checking the flywheel clutch for adjustment.

Instead, the operation of the machine serves as a constant check on the adjustment.

Adjust the flywheel clutch only when the pedal "lash" is reduced to ½", or when troubled with clutch slippage. It is not always necessary to adjust a clutch immediately when slight slippage occurs under extreme heavy loads. In this case, the slippage may be due more to momentary overload than to incorrect adjustment, and a take up in the adjustment may not be necessary for normal operation. If continued slippage should occur, however, an adjustment should be made (unless the slippage is caused by oily clutch facing or other sources of clutch slippage as outlined in Trouble Shooter's guide at rear of Repair Section.)

HOW TO MAKE ADJUSTMENT

To adjust the clutch, first shut off the engine. Then remove the inspection plate from the bottom of the clutch housing. This can be reached from below the Tournapull.

Have a helper hold clutch pedal in the "released" position. This is necessary because otherwise the adjusting straps and studs might become bent or the threads on the studs or nuts might become stripped.

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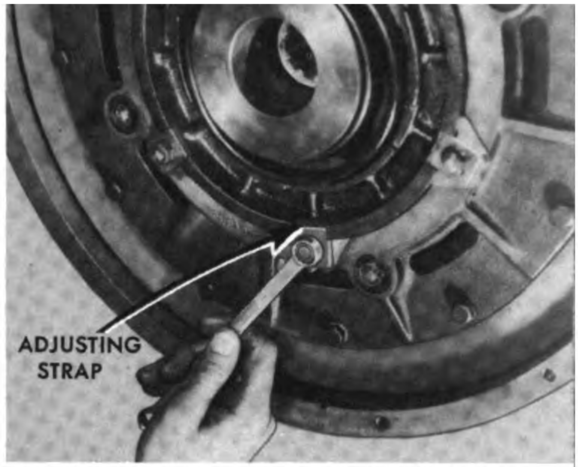
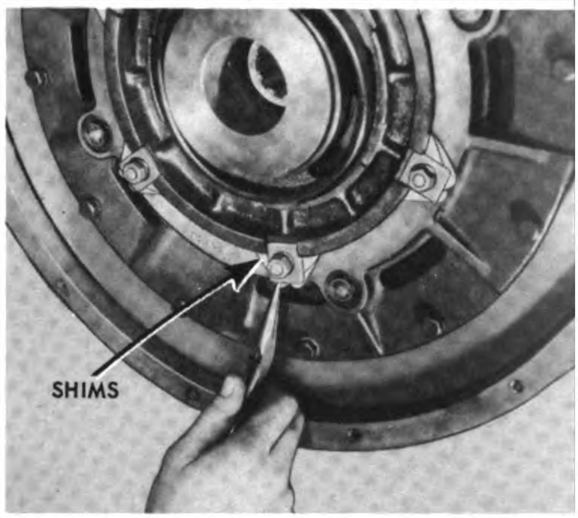
Back off the adjusting nuts five full turns each. There are six adjusting strap nuts on the clutch. To reach all six nuts, turn the engine over by hand (with compression released.)



Re-engage the clutch by removing the foot from the pedal. This will permit the adjusting plate to move out of contact with the adjusting shims. Remove one shim from under each of the adjusting straps with a pair of sharp nosed pliers, or insert cotter pin puller in small hole of shim. Be sure no portion of the shim is left between the adjusting plate and flywheel ring; also that the same number of shims are removed from under each strap. Release the clutch by again holding the pedal in the disengaged position. Then tighten all adjusting strap nuts.

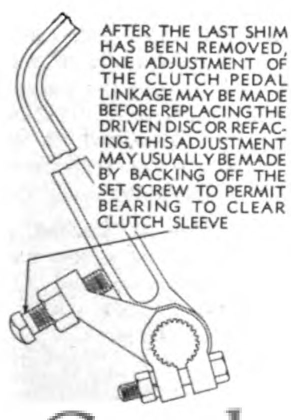


Re-install the inspection plate and road test the machine.

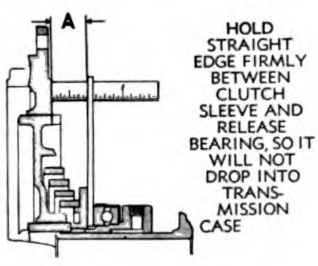
MINOR ADJUSTMENTS

In addition to the above adjustment, the following points also require infrequent attention.

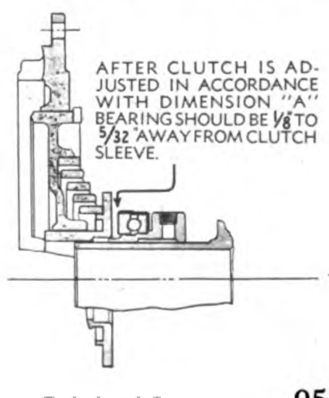
1. After all shims have been removed, it is possible to make one pedal adjustment. However, we would advise against doing this and suggest instead that new facings, or preferably a new driven disc assembly, be installed.



2. Occasional checks on the distance from machined surface which supports the shims to face of clutch sleeve should be made with clutch engaged. This can best be done when transmission is removed from engine. Use a straight edge and scale as illustrated. Hold the straight edge in place by pushing release bearing into contact with straight edge. Distance "A" should be 1⅛", minus 7/64" for each shim that has been removed.



3. When distance "A" (see step 2) is correct, check the distance from the release bearing to the clutch sleeve. This should not be less than ⅛" and not more than 5/32". It may be necessary to adjust the pedal linkage to obtain proper clearance of ⅛" to 5/32", because of wear or improper initial adjustment; otherwise, do not adjust pedal linkage.



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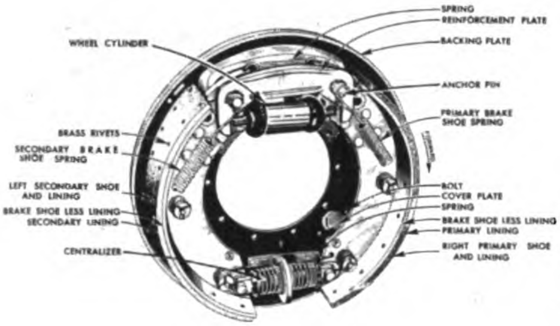

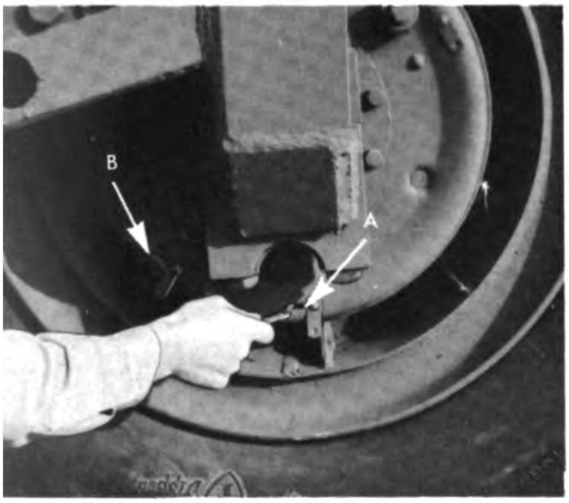

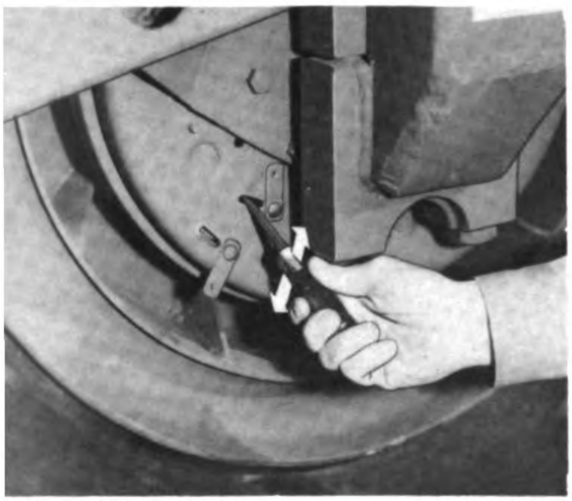

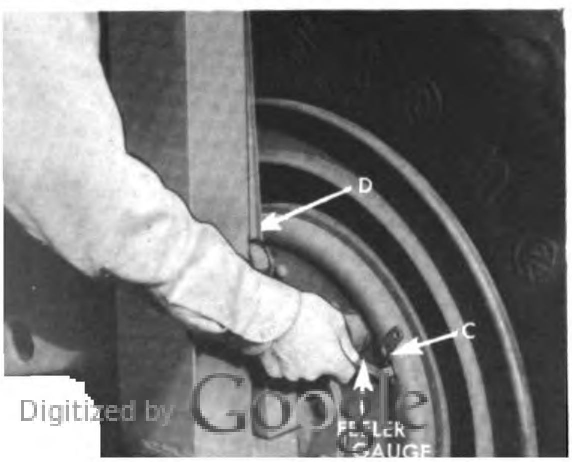

HYDRAULIC BRAKE ADJUSTMENT

There is no set interval for checking the hydraulic brakes for adjustment. Instead, the operation of the machine serves as a constant check on the adjustment.

Adjust the brakes whenever troubled with brake slippage or with overheating of the brake drum due to brake drag. Tighten the brakes when slipping (unless caused by greasy facings, loose wheel bearings, or other causes of brake slippage. Refer to Trouble Shooter's Guide). Back off adjustment when troubled with over-heating.

The brakes should be atmospheric or room temperature when making adjustments.

HOW TO MAKE ADJUSTMENT

1. First raise rear wheels by placing blocks under rear of Scraper bowl and then lowering bowl to the ground. Check the lining to drum clearances at the adjusting screw ends of primary and secondary shoes, using a feeler gauge through holes (A) and (B) as illustrated. The clearance should be approximately .020" at the end of both shoes.

2. If in making the above check, a clearance of approx. 020" (within :003") is not found at each shoe, uncover the adjusting hole and turn the notched wheel on the brake adjusting screw as needed to obtain this clearance, using a screw driver or brake adjusting tool. Move handle of screw driver or adjusting tool upward to decrease clearance—downward to increase clearance. If equal clearance is not obtained at both shoes, adjust centralizer as in step 5 and then adjust to .020" clearance.

3. Now check clearances at anchor pin ends of primary and secondary shoes, using feeler gauge through holes (C) and (D). The clearance should be approx. .008" at the anchor pin end of both shoes.

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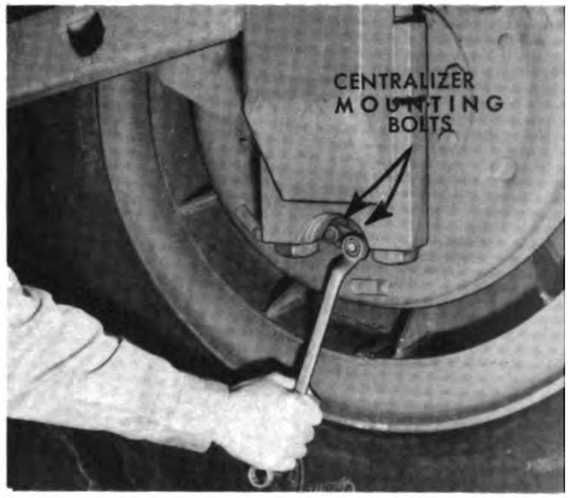
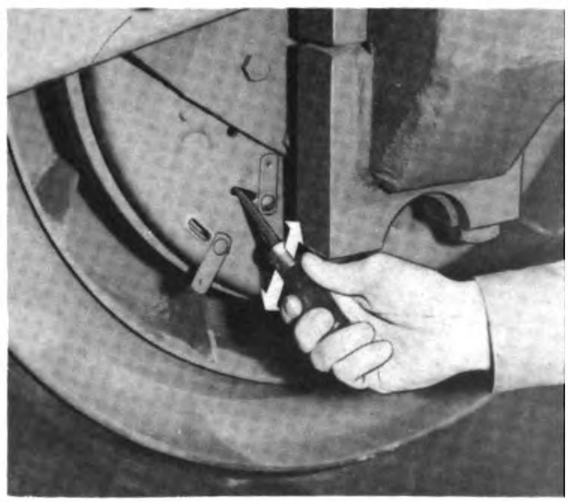
4. If in checking clearances at anchor pin ends of shoes a clearance of approx. .008" (within .003") is not found at each shoe, loosen the anchor pin nuts about one turn each and turn anchor pins as needed to obtain the proper clearances. Turning the arrow point (on nut end of anchor) away from center of axles moves anchor end of shoe lining toward the drum and decreases lining to drum clearances. Turn anchor pin in opposite direction to increase clearances. Tighten anchor nuts after obtaining correct clearances, using a 16" wrench. Each shoe is adjusted independent of the other.

5. If anchor pins are turned (step 4), it is necessary to center the centralizer assembly as follows. Back off shoe centralizer bolt nuts enough to make them just free of lockwasher tension so that the centralizer can float freely. Then turn the brake adjusting screw until brake shoes are expanded tightly against drum. Tap backing plate near centralizer with a light hammer to insure centralizer taking correct position between shoe ends. Tighten centralizer mounting bolts.



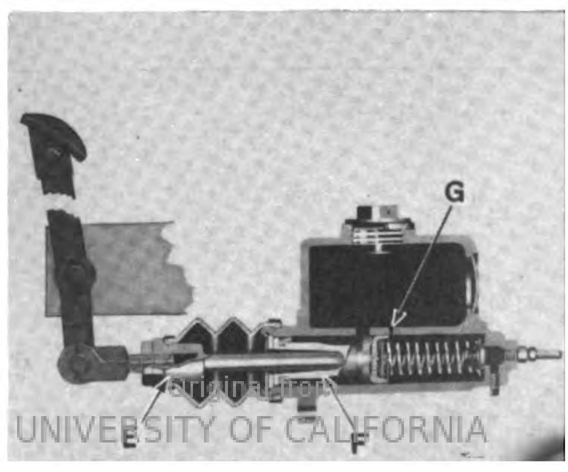
6. Back off adjusting screw only far enough to permit wheel and brake drum to turn freely. Cover adjusting hole in backing plate and lower wheels.



7. The brake pedal which operates the hydraulic master cylinder should be adjusted as follows.

It is important that rod (E) be adjusted for clearance where it seats in piston (F). There should be ¼" to ½" of free movement of brake pedal pad before the pressure stroke starts. Make adjustment if necessary by turning compression rod (E) with wrench. Reach compression rod from below machine, along right side of transmission. The above clearance will permit piston (F) to return all the way, leaving port (G) open through which brake fluid can pass to perform compensating action of master cylinder.

Road test machine after completing adjustment.



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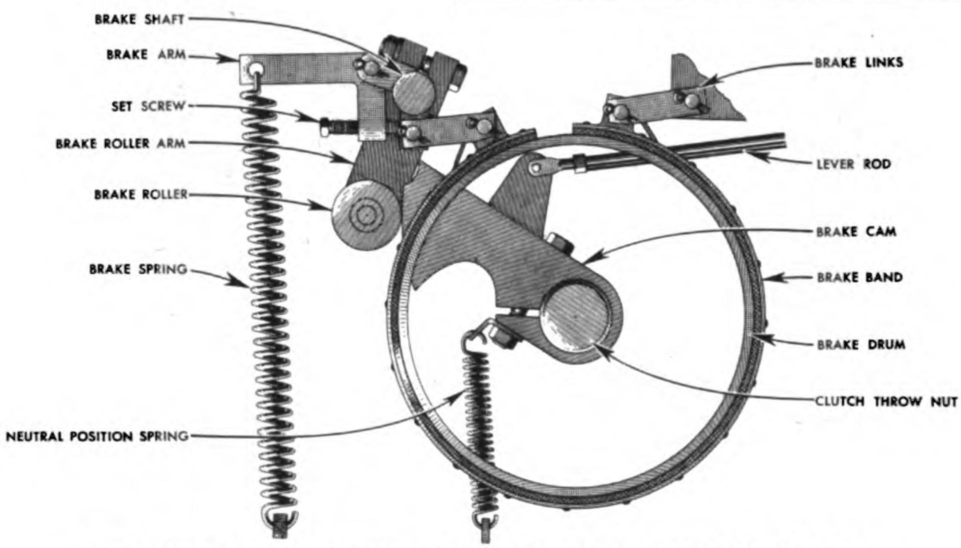


POWER CONTROL UNIT BRAKE ADJUSTMENT

Occasional adjusting of the Power Control Unit brakes is necessary because of brake lining wear.

There are two points to consider in checking or making the brake adjustment.

1. The position of the brake roller against the brake cam when the control lever is in neutral position.

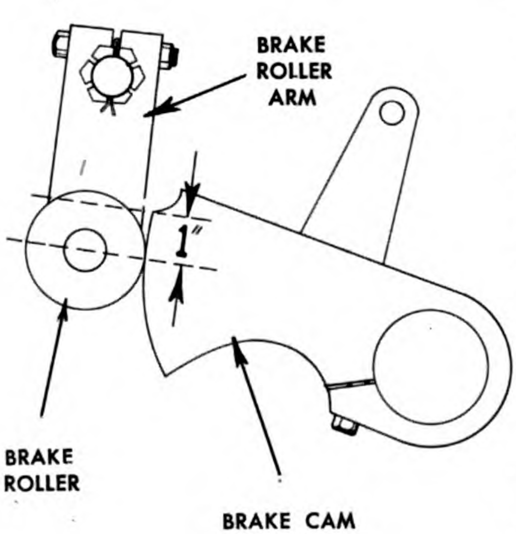
2. The tension of the brake spring.

Check the position of the brake roller against the brake cam every 8 hours of operation. The operation of the Unit serves as a constant check on the brake spring tension.

HOW TO CHECK ADJUSTMENT

With the control lever in neutral position, check the position of the brake roller against the brake cam.

The accompanying drawing illustrates the correct relative position of the brake roller against the cam when the control lever is in neutral position (with slack in cable). If the position of the roller against the cam is not approximately as illustrated, an adjustment should be made to bring it into the correct position.



Also, if brake slippage should occur when the brake is under load, an adjustment should be made to increase the tension of the brake spring.

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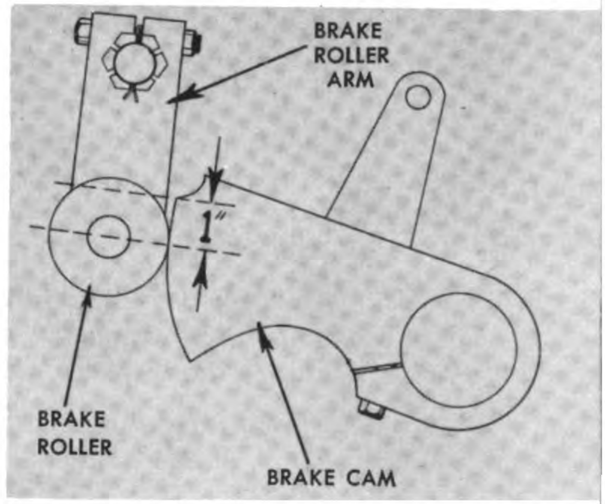
HOW TO MAKE ADJUSTMENT

If the brake roller is incorrectly positioned against the brake cam, make the adjustment by first loosening the clamp bolt at the upper end of the brake roller arm.

Move the brake roller arm by slipping it on the brake shaft, either to the left or to the right as is required to bring the brake roller into the correct position against the brake cam (approximately 1" down from the lockout position).



When the brake roller is correctly positioned against the cam, tighten the clamp bolt at the upper end of the brake roller arm.

To increase the brake spring tension in event brake slippage occurs, turn the set screw on the brake arm in a clockwise direction. This will raise the arm, thereby changing the length of the spring and increasing the spring tension. To decrease the spring tension, turn the set screw counterclockwise. The brake spring should be adjusted only tight enough to prevent the brake from slipping when under load since added tension causes more effort to be required in disengaging the brakes than should be necessary.

IMPORTANT — Always adjust clutch after changing position of brake roller against brake cam.

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POWER CONTROL UNIT BRAKE SHAFT BEARING ADJUSTMENT

Since the brake shafts rotate only a part of a turn during operation, there is very little wear on the bearings. Therefore, the adjustment does not require frequent attention.

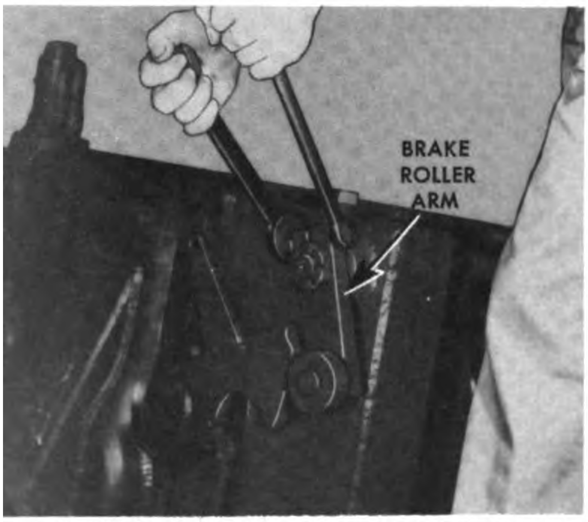
Check the brake shaft bearings for correct adjustment every 1024 hours of operation or when brake slippage is experienced and cannot be traced to any other source.

HOW TO CHECK ADJUSTMENT

To check for bearing looseness, insert a pry bar or similar tool between brake roller arm and gear case, and by prying in and out, detect any end movement of shaft. If end movement is noticeable, the bearings are loose.

To check for bearing tightness, remove brake spring and disconnect brake band from brake shaft. Then rotate shaft by hand. If shaft does not turn freely, the bearings are adjusted too tight.

If bearings are adjusted too tight or if there is noticeable looseness, an adjustment should be made.



HOW TO MAKE ADJUSTMENT

To make adjustment, first remove brake spring. Then proceed as follows:

1. Loosen clamp bolt at upper end of roller arm. Then remove cotter pin from castellated nut at end of brake shaft.

2. To tighten the bearings, turn the castellated nut located at the upper end of the roller arm clockwise on the brake shaft. To loosen the bearings, turn the nut counter-clockwise.

The adjustment is correct when bearings are free rolling and without end play.

When correct adjustment is reached, re-install cotter pin and tighten clamp bolt. Also install brake spring.

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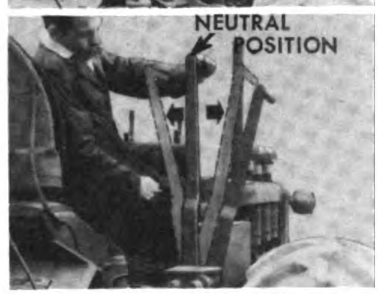
POWER CONTROL UNIT CLUTCH ADJUSTMENT

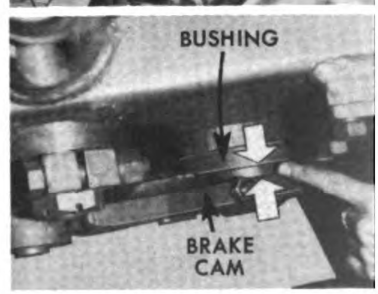
There is no set interval for checking the clutches for adjustment. Rather, the operation of the unit by the operator serves as a constant check on the adjustment.

If operating a Power Control Unit having an incorrectly adjusted clutch, the operator will have difficulty in making the Power Control Unit function properly, and there will be symptoms which will indicate to the operator that the clutch is incorrectly adjusted. These symptoms are: (1) Travel of control lever from neutral to the fully engaged position too great for efficient operation, (2) Clutch won't fully engage, (3) Clutch slippage, (4) Clutch won't release, (5) Clutch dragging, (6) Brake won't fully release, (7) Overheating as a result of the above.

If troubled by one or more of the above symptoms when operating the unit, it is an indication that the clutch is probably incorrectly adjusted and an adjustment should be made

There are three factors which affect the clutch adjustment and which cause the symptoms listed above:





1. *Incorrect amount of clearance between driving cone and driven cone when control lever is in neutral.* This clearance regulates the distance the driving cone must travel to fully engage the driven cone. Since this clearance cannot be measured accurately without difficulty, it is usually thought of in terms of the distance the control lever travels between neutral and the fully engaged position. If the cones are spaced too far apart, the travel of the control lever from neutral to the fully engaged position will be so great that it will be difficult for the operator to efficiently operate the unit. If spaced too close the driving cone may drag on the driven cone when the control lever is in neutral position. The clearance between the driving and driven cone is correct when the travel at the top of the control lever from the neutral to the fully engaged positions is approximately 9".

2. *Main gear incorrectly spaced inside gear case.* If spaced too far to the rear the gear will strike reduction gear inside gear case as control lever is moved to engage clutch, preventing the clutch from fully engaging. If spaced too far to the front it will strike against front side of gear case as the control lever moves in the direction that releases the brake, preventing control levei from being moved into lock-out position, and possibly preventing the brake from fully releasing.

3. *Insufficient clearance between the brake cam and throw nut bushing.* If there is insufficient clearance at this point, the brake cam will ride against the throw nut bushing before the driving cone becomes fully engaged in the driven cone, thereby preventing the clutch from fully engaging. With the control lever in the fully engaged position there should be some clearance at this point.

By making the clutch adjustment as outlined on the following pages, the three possible sources of trouble listed above will be corrected. If the same symptoms are present after making the adjustment, the difficulty is caused from some other source, and a different correction must be made. (Refer to Trouble Shooters Guide in Repair Section.)

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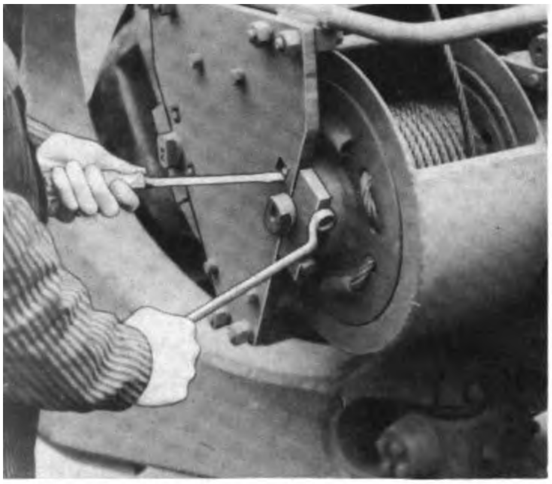


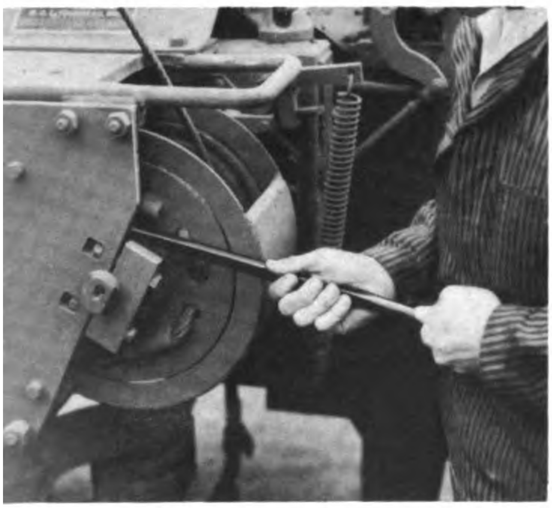
HOW TO MAKE POWER CONTROL UNIT CLUTCH ADJUSTMENT

To adjust either clutch, first make sure that the brake roller is correctly positioned against brake cam (refer to brake adjustment instructions on Page 98).

Then proceed as follows:

1. Move control lever into the lock-out position (extreme brake released position). Leave lever in this position and loosen drum shaft clamp bolts at rear end of drum shaft.

2. With control lever in lock-out position, turn drum shaft with a wrench, bringing the driving cone and driven cone together tight. (If adjusting the right clutch turn the right shaft in a clockwise direction. If adjusting the left clutch turn the left shaft in a counter-clockwise direction.)



3. Insert a pry bar between rear plate and cable drum and pry drum assembly toward the Tournapull as far as it will go.

4. Insert the bar between the driving cone and gear case cover plate and pry the assembly in the opposite direction ⅛″ to 3/16″. This will correctly space main gear inside gear case.

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5. Place a wrench on end of drum shaft and move control lever from lock-out position, back to a point approximately 7" past neutral position, allowing the wrench to turn with drum shaft as control lever is moved. (If unit is hot, 7" movement should be increased slightly, due to expanded condition of driven cone.) The drum shaft will turn with the control lever in making this part of the adjustment. (The above 7" travel of control lever from neutral to fully engaged position will give approximately 9" travel of lever in actual operation after adjustment has been completed. This amount of travel will provide proper clearance between driving cone and driven cone when in neutral position.)

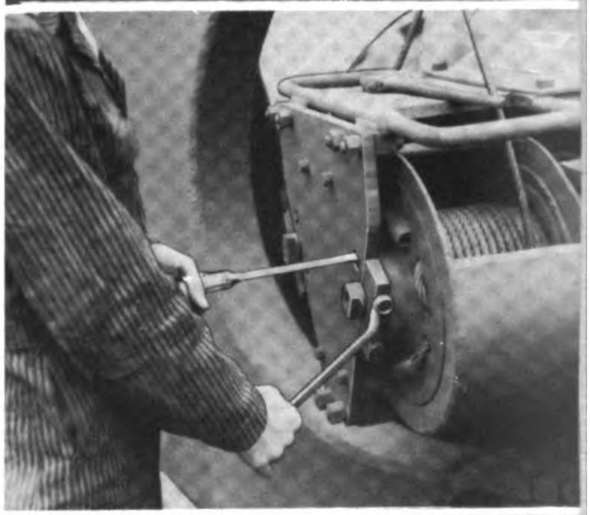
6. Hold the drum shaft from turning by holding the wrench stationary, and return the control lever to neutral position.

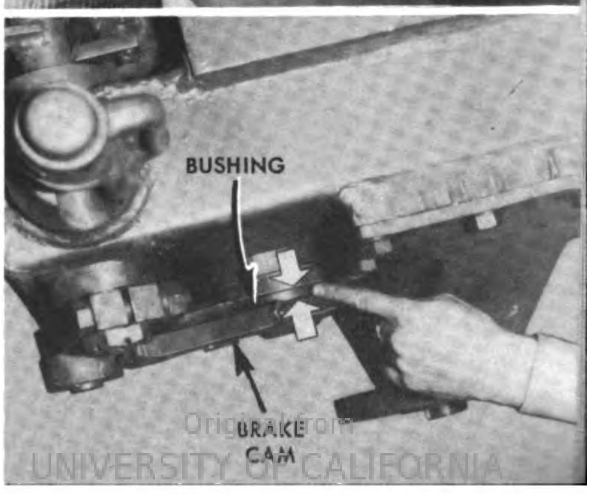
7. Then, without turning the drum shaft, clamp the drum shaft to the rear plate by tightening the drum shaft clamp bolts, turning them down evenly.

8. Fully engage clutch and check for clearance between brake cam and throw nut bushing. There should be some clearance at this point. If there is no clearance, release clamp bolt from brake cam and space cam further out on clutch throw nut, without changing the relative position of the cam. Then re-tighten the clamp bolt.

Important:

The above steps in making the clutch adjustment must be made in the order given and no steps can be eliminated.





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BLEEDING HYDRAULIC LINES

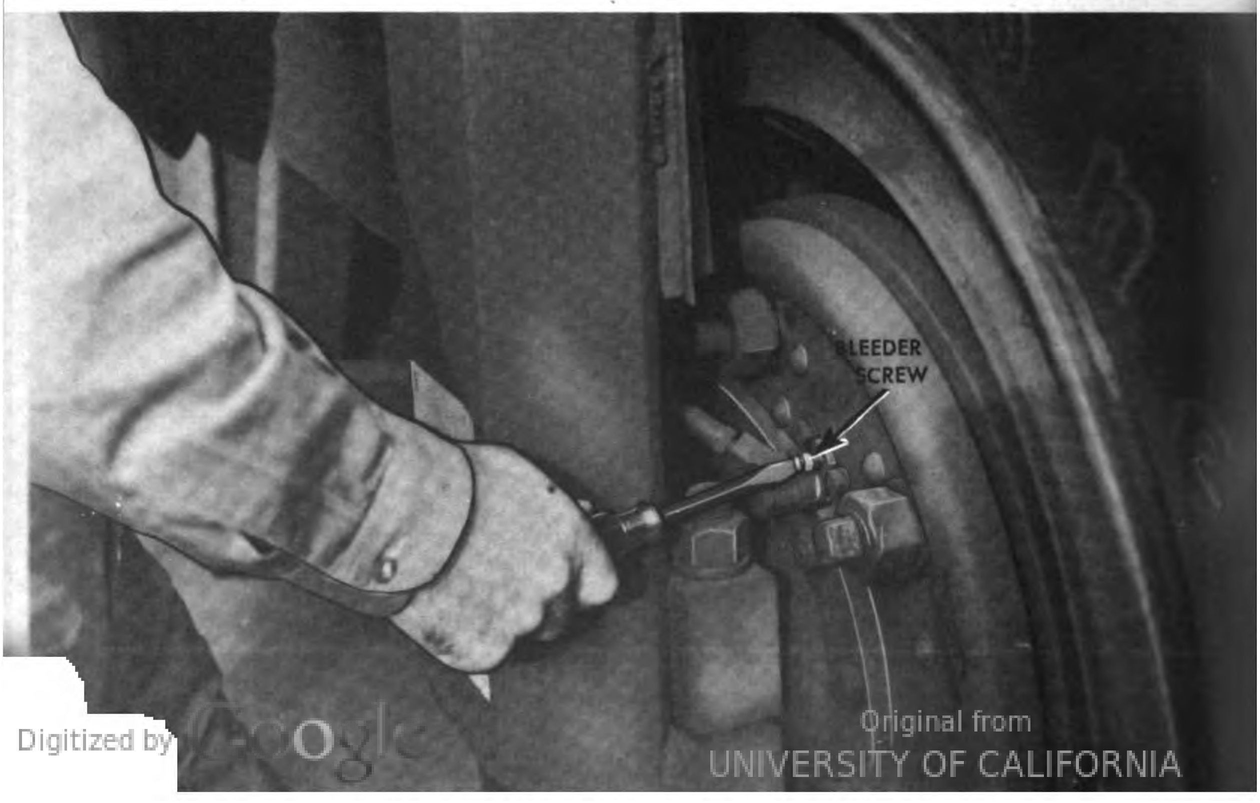
Whenever a hydraulic brake line has been disconnected at the master cylinder, it is necessary to "bleed" the hydraulic system at both rear wheels to expel all air. Whenever a line is disconnected from the wheel, that wheel cylinder only must be bled.

Fill the master cylinder supply tank with a high quality hydraulic brake fluid (HB), before beginning this operation, and keep the tank at least half full of fluid at all times. Remove capscrew from end of bleeder connection and screw in standard bleeder drain tube. Allow tube to hang in clean container, such as a pint Mason jar. Unscrew the bleeder connection three-quarters of a turn and depress foot pedal slowly by hand, allowing return spring to return pedal slowly to "off" position. This produces a pumping action which forces fluid through tubing and out at wheel cylinder, carrying with it any air that may be present.

Watch flow of fluid from hose, the end of which should be kept below surface of fluid; when all air bubbles cease to appear and when fluid stream is a solid mass, close bleeder connection. Remove bleeder drain tube, and replace capscrew.

Fluid withdrawn in "bleeding" operation should not be used again. Fluid should be replenished in supply tank after each cylinder is bled. Should supply tank be drained during bleeding operation, air will enter the system, and "re-bleeding" will then be necessary. When bleeding operation is completed, supply tank must be refilled.

To prevent brake drag, it is necessary that the small port in the master cylinder be open when the brake pedal is in release position. (See pedal adjustment instructions on page 97.)



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TIRE INFLATION

Keep the tires correctly inflated at all times.

Check the tire pressures every eight hours of operation if possible—never when tires are hot.

"Bleeding" tires (reducing pressures to recommended levels when they are hot) is not recommended. If the hot tire is bled, it is allowed to deflect more and the increased flexing continues to increase the heat. This in turn increases pressure. If the pressure is again relieved by bleeding, the cycle of increased flexing and overheating is repeated. When the air in the tire has cooled to atmospheric temperature, it contracts and as a result of bleeding, the tire is far below correct pressure. Thus bleeding leads to two extremes of harmful operation. One—excessive uncontrolled heating which causes deterioration and results in tire separation and blowout. The other—underinflation with the resultant damage as described previously.

The following table gives the recommended pressures for the tires when operating in different job conditions. Both the performance of the machine and the life of the tires are dependent upon the maintenance of the air pressures shown in the chart. Make sure that they are closely followed.

RECOMMENDED PRESSURES

TIRES	Job Condition A	Job Condition B	Job Condition C
TRACTION TIRES 2 (21.00 x 24) 20 ply	35 lb.	30 lb.	40 lb.
SCRAPER TIRES 2 (18.00 x 24) 20 ply	50 lb.	45 lb.	55 lb.

JOB CONDITION "A"—Average Scraper Conditions.

JOB CONDITION "B"—Loose, sandy soil, or soft underfoot conditions, with no large boulders, on short hauls under 2500 ft. one way, where lots of flotation and traction are required. (A variation of job condition "B" might be loading blasted or scarified rock or rotten shale, with the effective loads a few yards less than the heaped capacity.)

JOB CONDITION "C"—Long, one way hauls of from 2500 ft. to 10,000 ft. or over, on compacted and maintained haul roads with normal loading conditions in the pit or cut.

NOTE: Watch drive (traction) tires closely for slippage on the rim when they are inflated to pressures under 35 lbs. If slippage occurs, go to higher pressures. To help prevent slippage on the rim, inflate tires to 15 or 20 lbs. above recommended working pressure when mounted and then reduce to recommended pressure. This will help seat the tire on the rim base and flanges.

To cause the Scraper blade to cut level, it is important that the rear tires be inflated to equal pressures.

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CARE AND MAINTENANCE OF TIRES

Too much emphasis cannot be placed upon the importance of proper tire care and maintenance. In removing and installing tires, follow closely the instructions on page 124 and 165. Always keep the tires correctly inflated, because incorrect inflation may cause damage to the tires.

INFLATION:

Inflation relates, of course, to the air under pressure in the tire. The properly inflated tire cushions the bumps and adjusts itself to surface and load. If the air pressure is kept at the proper amount, the tire will give long trouble-free service under normal load and road conditions.

Both overinflation and underinflation will in time bring about irreparable damage to the tire body. Air is the primary load carrier and shock absorber, and the Tournapull tires are built to give maximum load-carrying capacity, maximum strength and maximum resistance to shock *at the recommended air pressure.*

Normal deflection of tires used on earthmoving equipment is wider than that used on cars and trucks.

Many a careful, but uninformed operator, upon seeing the wide deflection peculiar to an earth-mover tire, will jump to the conclusion that it is under-inflated and proceed to add air pressure until the tire assumes the shape he is accustomed to see on highway tires. This mistake is directly responsible for hundreds of ruined tires.

Overinflation: A tire that is properly inflated is like a well-tempered spring. But if the pressure is increased and the tire becomes over-inflated, instead of a spring at correct tension, it acts as a stiff spring and the air will not cushion the shocks properly. Some of the blow will be transmitted to the axle but the major part will be concentrated on a relatively few cords of the tire casing already strained by excess air pressure. It is likely that the cords will give way, and leave an X-break as illustrated.

Overinflation also causes a too narrow contact with the ground, resulting in a narrow strip in the center of the tread taking all of the wear. It is obvious that a given load on a smaller surface wears that area of tread much faster than if the same load were distributed over a larger area. Much good rubber remains on the outer edges of the tread.

Continual maintenance of the proper air pressure will distribute the wear evenly over the full tread area and add many hours of service life to the tire.

Underinflation: The Tournapull and Scraper tires are designed to work at low pressures, but they must be the correct low pressures, those specified in the preceding instructions.

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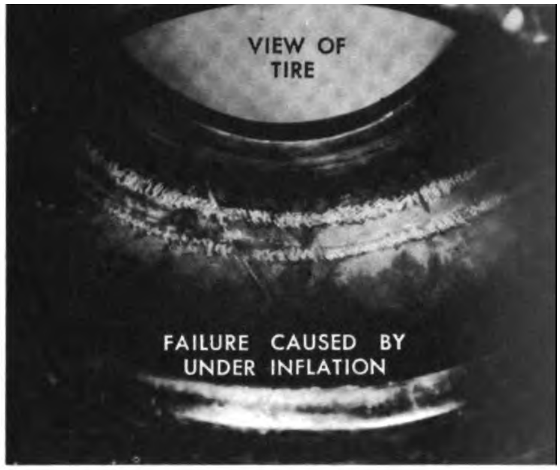

Underinflation is even more harmful than overinflation. The accompanying illustration is an actual photograph of the inside of a comparatively new tire, showing the damage caused by too low air pressure. The fabric breaks run clear around both sides. Heat is generated by excessive flexing in the under-inflated tire. Excessive heat deteriorates the tire, and results in separation within the tire and blowouts. Keep air pressures at levels recommended.

The tires on the Tournapull and Scraper are built to give good service at recommended lower pressures within certain speed and load limits. If run at too low pressure, there isn't enough air to support the load and the unsupported sidewalls are irreparably damaged.

SPINNING THE DRIVE OR TRACTION WHEELS

This is caused by the driver's attempt to pull too heavy a load or to start too quickly. It results in excessive tread wear.

SQUIRMING A TIRE:

This means locking one drive wheel to make a short, sharp turn. The grinding, twisting action which results from this practice damages the tread and materially reduces the life of the tire.

DRIVING OVER OBSTACLES:

Rolling a tire over an obstacle which can just as easily be avoided is another common abuse which takes a toll in tires. A sharp rock or edge concentrates the blow in such a way that it may weaken or break the fabric, particularly in an overinflated tire. Reasonable care in avoiding obstacles will minimize the hazard and eliminate much premature tire failure. Maintenance of haul roads also reduces this hazard. Where a grader is not patrolling regularly, occasionally drop the Scraper blade and drag the road on the return trip, as the road becomes littered with sharp stones and spillage from the Scraper.

"NICKING" THE TIRE:

When pusher loading with a Bulldozer or Angledozer, don't allow 'Dozer blade to gouge rear tires.

TIRE BOOTS:

A boot should be used only to get a little additional service from a tire beyond repair.

TREAD ABRASION:

To prevent destructive abrasion of tread or sidewall the tire must have clearance for free rotation without rubbing against any part of the Tournapull or any attachment thereon. Avoid striking the drive tires against the yoke when turning.

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DAMAGE TO RIM:

Damage to a rim may cause abnormal strain in the bead region of the tire. If the flange of the rim becomes bent it should be straightened at once. Otherwise it provides no support for the tire bead, which will finally give way under abnormal distortion and strain.

SLOW LEAKS:

Obviously, slow leaks cause underinflation. It is not sufficient to inflate the tire every day to the proper pressure after slow leak loss. Whenever a loss of as much as 5 pounds in 24 hours is discovered, the cause of the leak should be determined and corrected immediately. Defective valves should be replaced at once. Except in emergency, tires should be inflated only when they are at atmospheric temperature.

VALVE CAPS

A valve without a cap picks up sand, gravel, dirt and water. This is easily avoided. Keep valve caps on all valves.

OIL, GREASE AND GASOLINE:

Oil and grease, if allowed to remain on the tire, will ruin it by making the rubber soft and spongy. If oil and grease can not be avoided, they should at least be kept wiped off. Do not use gasoline to clean a tire, as gasoline likewise softens the rubber.

REPAIRS:

Repair at once any deep injuries which penetrate to the cord body of the tire, allowing dirt and water to enter. Single small cuts which do not gap or bulge, but leave only a hair line opening, will cause no damage. However, when a cut shows any sign of a gap or bulge, it should be repaired.

CABLE

LeTourneau Tournapulls and Scrapers are designed for use with Tournarope or other high quality wire rope meeting the following specifications: 6 x 19 wire rope of Warrington construction with strand center, preformed, Langlay, and made from improved plow steel. It should be internally lubricated during the manufacturing process. (Different cable of equal construction can be used without harmful results.)

For sizes of cable (diameter and length) refer to the Parts Catalog. Do not use larger diameter cable than that specified in the Parts Catalog or damage to the equipment may result. If smaller cable than specified is used, frequent cable breakage may occur.

CARE OF CABLE

Proper care and treatment of cable is very important and will pay big dividends in the way of longer cable life. Listed below are a few helpful suggestions along this line.

(1) Use the recommended sizes of cable, as the design of the sheave wheels vary somewhat for cables having different diameters.

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(2) Check cables every 8 hours of operation for excessive wear, kinks, etc., that might result in cable breakage or failure.

The dump cable normally wears faster than the other cables. To obtain maximum life from this cable, it is necessary to occasionally cut off the end of the cable that wraps onto the cable drum and to feed through enough cable from the spare cable reel to replace that which was cut off. If in checking the cable at the above interval, it is found that the part that wraps onto the cable drum has become frayed with possibly one or more of the six main strands broken, it is then necessary to cut off the bad portion back to the point where the cable is not damaged.

Due to difference in operators, job conditions, etc., the time intervals at which this cable must be cut off varies considerably.

(3) When installing new cables on the Power Control Unit cable drums, make sure the cables reeve evenly onto the drums. Do not permit the cable to criss-cross or stack up on the drum.

(4) Replace sheave wheels having badly worn cable grooves, especially those having a rope lay impression worn into them.

(5) Always make sure that the sheave wheels and tailgate rollers are turning and that none are broken, because if either of these is not functioning properly, the cable will wear extremely fast.

(6) Do not allow an excessive amount of slack in the cables, thereby causing the cables to become kinked.

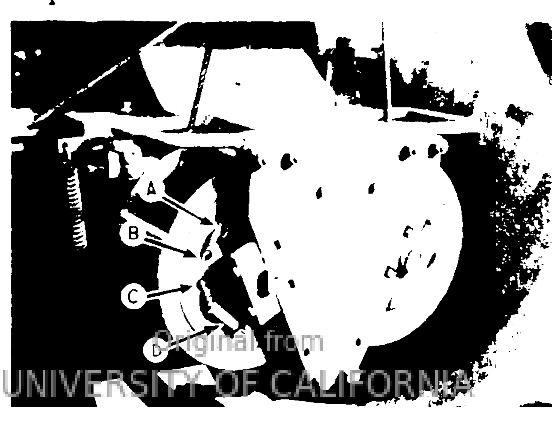
(7) Apply OE-10 or OE-30 to the cable sparingly at infrequent intervals to serve as a rust preventative.

THREADING CABLE ONTO POWER CONTROL UNIT

As a safety measure, the Tournapull engine should be shut off before attempting to thread the cable onto the Power Control Unit cable drums.

To correctly thread the cable onto either the left or right cable drum, first pull several feet of slack in the cable. Then insert the end of the cable out through hole (A) in the cable drum flange, pulling a few feet of cable through the hole. Insert the cable back through hole (B) and out through hole (C), not drawing cable tight through holes. Extend the end of the cable through loop (D), allowing approximately 1" of the cable to protrude from end of loop.

Hold the cable in this position and pull all slack between loop (D) and hole (C) back through hole (C). Then pull all slack between holes (C) and (B) out through hole (B) and all slack between holes (B) and (A) out through hole (A), drawing the cable tight. Start the Tournapull engine. Then, with the engine idling, engage the Power Control Unit clutch and spool the slack cable evenly onto the cable drum.



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CABLE THREADING

The following cable threading instructions, together with the accompanying cable threading diagram, give complete information needed for threading the cable through the Scraper.

HOIST CABLE

(Cable extending from Power Control Unit right cable drum to hoist sheaves on pushbeam.)

From right drum of Power Control Unit, cable extends up and over fairlead sheave in housing .... A
Then back and under sheave in housing .... B
Then back through housing C and then up and enters outside sheave in housing .. D
Cable then goes back and enters outside sheave in pushbeam housing .... E
Then forward to the center sheave in housing .... D
Then back and over the inside sheave in housing .... E
Then forward and enter bottom of inside sheave in housing .... D
Then back and around sheave in housing .... F
Then forward and enter inside sheave in housing .... G
Then back and over inside sheave in housing .... H
Then forward to the outside sheave in housing .... G
Then back and over the outside sheave in housing .... H
Then forward and anchor cable at cable wedge on the side of housing .... G

APRON LIFT CABLE

(Cable extending from apron sliding sheave, above springpipe, to apron.)

The apron lift cable is first anchored in sliding sheave housing K (located in channel above springpipe) at cable wedge .... T
Then cable goes up and over sheave in housing .... U
Then down and anchor cable at apron cable wedge V

IMPORTANT: Raise apron to make sure that sheave housing K strikes stop block at front of sheave housing J before apron strikes against top of arched A-frame. If apron strikes A-frame, let out on cable at wedge T or V enough to prevent apron from striking A-frame when in extreme raised position.

DUMP CABLE

(Cable extending from Power Control Unit left cable drum to sliding sheave housings above springpipe.)

From cable spool at rear of Scraper, unspool approximately 126 feet of cable, leaving extra cable wrapped on reel.
Take end of cable and extend from left to right around top sheave in sliding sheave housing .... M
Then back and around top sheave in housing .... J
Then forward and around center sheave in housing .... M
Then back and around second sheave from top in housing .... J
Then forward and around bottom sheave in housing .... M
Then back through housing J and around sheave in housing L
Then forward and around the top sheave in housing .... K
Then back and around second sheave from bottom in housing.......... J
Then forward and around lower sheave in housing .... K
Then back and around bottom sheave in housing .... J
Then forward and over sheave I at top of A-frame.
Then down and enter bottom of sheave on left side of yoke and then over fairlead sheaves on left side of yoke and down to left drum of Power Control Unit. Place two wraps of cable on drum.
With tailgate in rear position and apron lowered, take slack out of cable and anchor cable at wedge N on rear sheave housing J.
Spool excess cable onto cable spool and tighten the wing bolt to keep cable spool from turning.

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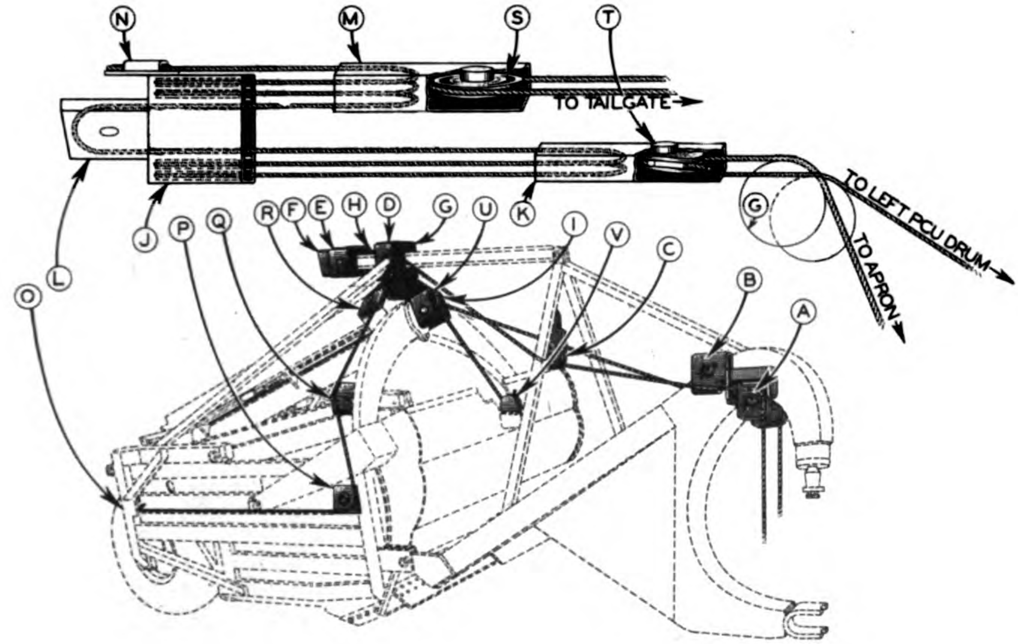

LEFT AND RIGHT DETERMINED BY STANDING AT REAR OF SCRAPER AND LOOKING FORWARD

TAILGATE FORWARD CABLE

(Cable extending from tailgate sliding sheave above springpipe to either side of tailgate.)

Tailgate forward cable is anchored to cable wedge .... O
Then forward and around sheave in housing .... P
Then up and around lower A-frame sheave .... Q
Then up and enter at top of A-frame sheave .... R
Then back to sliding sheave housing M (located above springpipe) and around equalizer sheave .... S
The cable is then carried down around the sheaves on the opposite side of Scraper in the manner just described for the right side and then anchored to the left side of the tailgate at a cable wedge corresponding with wedge ... O
IMPORTANT: Pull tailgate ahead to make sure that the tailgate moves to the front of the Scraper and also that sheave housing M strikes against stop block on front of sheave housing J before tailgate roller arms strike against structural members at front of Scraper side sheets near A-frame. If tailgate roller arms strike structural members at front of side sheets, let out on cable at cable wedge O enough to prevent tailgate from striking when pulled into extreme forward position. If tailgate does not move to front of Scraper bowl take up cable at wedge .... O

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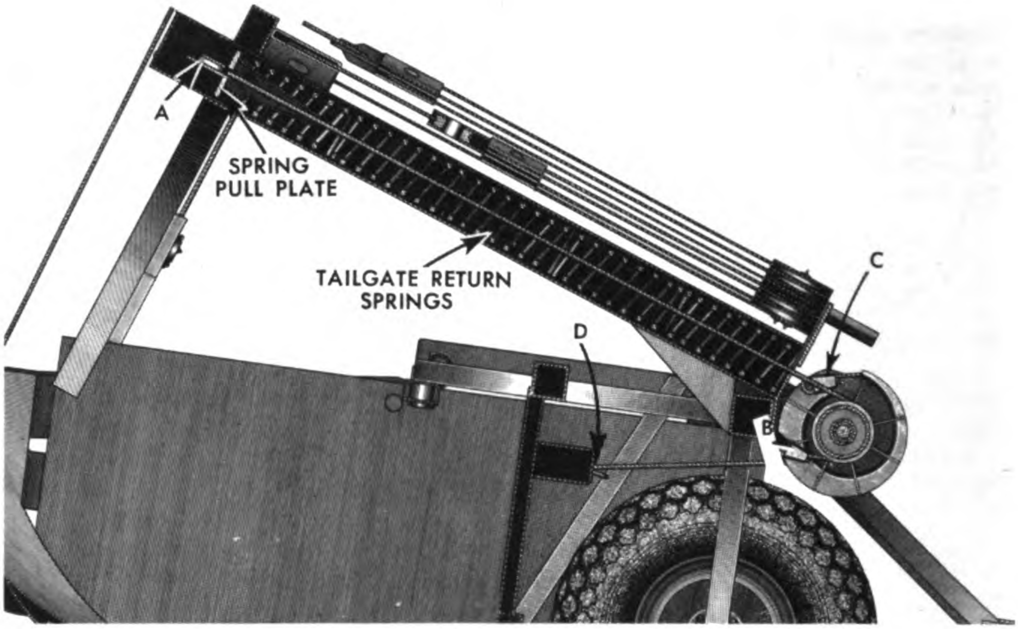
REPLACING SPRINGPIPE CABLE

If the springpipe cable breaks, it can be replaced by the following procedure:

First pull through several feet of slack on the dump cable above springpipe and pull the tailgate sliding sheave to the top of sliding sheave channel by hand. Then pry tailgate to its extreme rear position, using a bar.

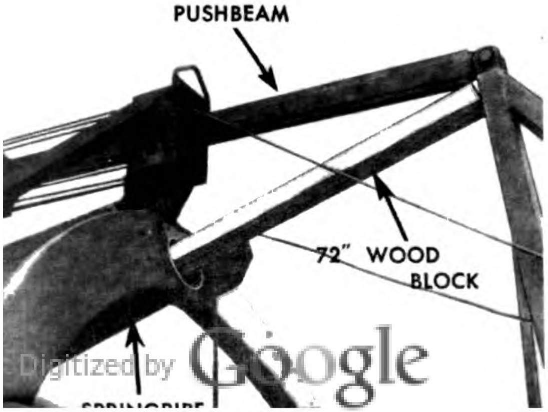


Remove the two 1¼" pipe plugs located on the sides of the springpipe near the upper end. Insert a pry bar through one of pipe plug holes and part way through springpipe to hold tailgate return springs in a slightly compressed condition, keeping them from coming out end of springpipe when performing the following step.

Disconnect apron lift cable from apron and place one end of a 4"x4"x72" block against apron lift sheave at front of springpipe and other end against the A-frame at top of yoke where pushbeam hinges, and then lower the bowl. By doing this, the spring pressure is relieved from the capscrews which hold the sheave housing plate to the springpipe, and the capscrews can then be removed without them binding and without danger to the workman.

After the capscrews have been removed, raise the Scraper bowl, relieving spring pressure from the 72" block, and also from the sheave housing plate, permitting both the block and plate to be removed. Now remove the old springpipe cable and insert new cable through spring pull plate and down through springpipe, rotating cable to prevent it from catching on springs. Fasten upper end of cable to spring pull plate with cable wedge (A). Then go to rear of Scraper and extend remaining end of new cable out through hole at bottom of springpipe.

Then, with the Scraper bowl in the raised position, place the 72" block against the spring pull plate and yoke A Frame where the pushbeam hinges, and gradually lower Scraper bowl, at the same time removing the bar from pipe plug hole in the side of springpipe, thereby compressing springs until the distance between cable wedge (A) and the end of springpipe



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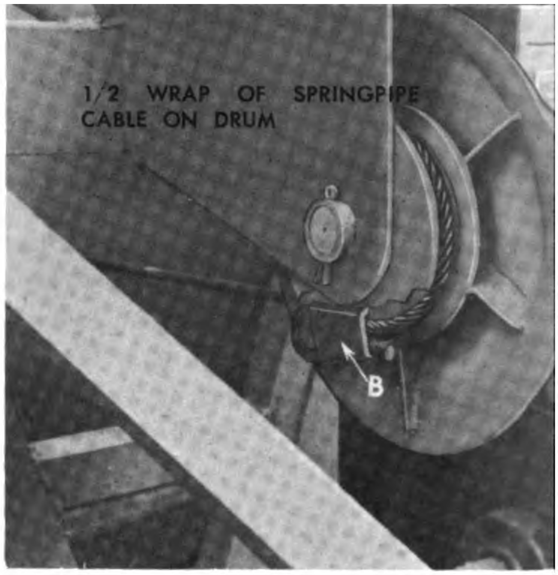

is approximately 23". With the tailgate in the extreme rear position, take all the slack out of spiral sheave-to-tailgate cable and wrap the springpipe cable ½ wrap on the drum on the left side of the spiral sheave, dead-ending it at cable wedge (B), with all the slack taken out of the cable by hand.

Raise the Scraper bowl, releasing the spring pressure from the 72" block and transferring it onto the cable. Remove the 72" block. With the apron lowered and the tailgate in the rear position, there should be a distance of approximately 14" to 16" between cable wedge (A) and end of springpipe. Re-install the sheave housing plate, apron lift cable and pipe plugs to complete the cable replacement.

If after a long period of operation the spring tension should decrease enough to permit the tailgate to move forward before the apron raises or if the spring tension should not be great enough to return the tailgate all the way to the rear, the above mentioned 14" to 16" distance between cable wedge (A) and the end of the springpipe should be increased to give additional spring tension.

To do this, compress the tailgate return springs by use of the 72" block as outlined above, leaving a slightly greater distance than the above 23 inches between cable wedge (A) and the end of the springpipe. Then pry the tailgate to the rear, as outlined above, and increase the spring tension by taking up enough slack springpipe cable at wedge (B) to give the desired spring tension, and retighten the wedge.

NOTE: Never attempt to increase the spring tension by taking up on the spiral sheave-to-tailgate cable as this would change the timing of the spiral sheave.

REPLACING SPIRAL SHEAVE-TO-TAILGATE CABLE

If the spiral sheave-to-tailgate cable breaks, it can be replaced by the following procedure.

Remove the old cable from the spiral sheave and tailgate. Then rotate spiral sheave wheel by hand, taking all slack out of springpipe cable. Anchor the new cable at spiral sheave with wedge (C). Place one wrap of cable around the spiral sheave wheel. Then, with all the slack taken out of cable, anchor the remaining end to the tailgate with wedge (D).

Remove the two 1¼" pipe plugs located on either side of springpipe near the upper end. Then pull tailgate forward with Power Control Unit enough to allow a bar to be inserted ahead of the spring pull plate, through the two pipe plug holes in the springpipe.

Then, with the bar in place, release Power Control Unit dump brake slowly until spring pull plate presses against bar. The bar will now hold the springs in a compressed condition. Then pry the tailgate to its extreme rear position.

Remove cable wedge (D) from the tailgate and take all slack out of spiral sheave-to-tailgate cable, leaving 2" distance between the end of the groove and cable. (This 2" dimension will decrease to approximately 1½" as illustrated after completing following step when cable is under tension.) Re-install cable wedge (D) and pull tailgate forward with Power Control Unit. Then remove pry bar from springpipe. Check for 1½" dimension between cable and groove on spiral sheave, and if correct, replace pipe plugs.

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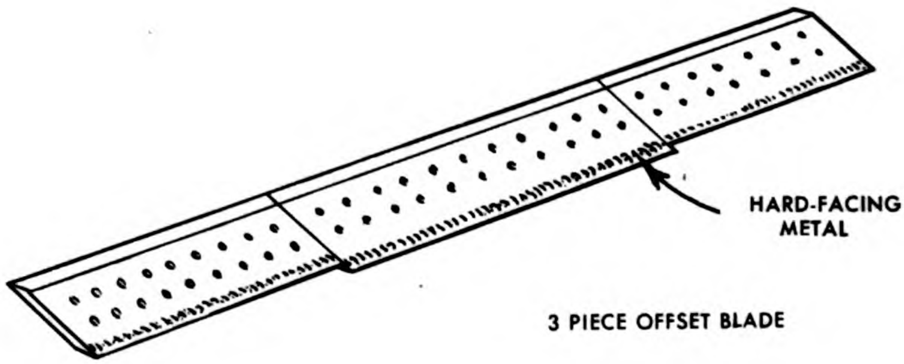
BLADES

The Scraper is equipped with a 3 piece offset blade as standard. Each of the three sections of blade is self sharpening and reversible.

The off-set center section makes possible easier loading. The self sharpening feature is brought about by the hard-facing metal welded along the edges of the blades. With the blades correctly installed, the hard-facing metal along the front edge of the blade is on the top side, as illustrated. Because the softer heel of the blade wears away more rapidly than the hard-faced top side, the blade will grow sharper with use.



3 PIECE OFFSET BLADE

By being hard-faced along both edges, the blades are reversible. Therefore, when a blade has become worn along one edge, it can be reversed rather than replaced, and the blades will therefore last approximately twice as long as blades that are non-reversible.

In addition to the 3 piece off-set blade, a one piece straight blade is also available for use on jobs where fine finishing is to be done with the Scraper. This blade also is self-sharpening and reversible. Although finishing can be done with the three piece off-set blade, it can normally be done more efficiently with this straight blade.

CHANGING BLADES

The Scraper blades should be changed before they wear back into the blade base. When worn back to the point where they should be changed, the procedure below should be followed.

Hoist the Scraper bowl to its full height and place blocks under the bowl to prevent it from dropping in case some one should acci-

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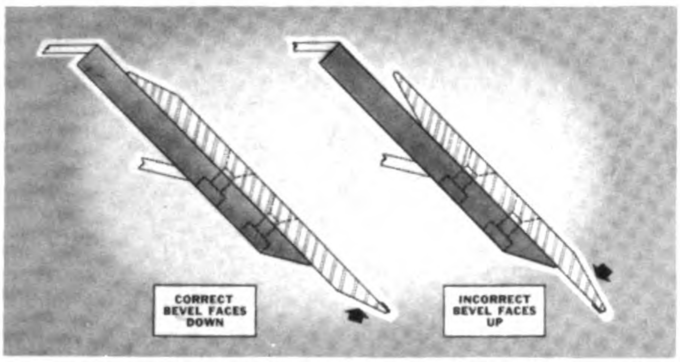
dentally release the power control unit hoist brake. The apron should likewise be raised to its full height and blocks placed between the apron arms and side sheets to keep it from dropping in case the brake on the dump cable is accidentally released. Then, using the blade wrench, remove the bolts that secure the blades to the blade base. If the blades have not already been reversed, they can be used again by turning them over and wearing them along the other edge. If reversing the end blades, it is necessary not only to turn them over but also to move them from one side of the Scraper to the other.

After laying the blades in place, the use of a round drift punch will be very helpful in lining up the holes. Re-install the blade bolts, tightening them down evenly and making sure they are all tight.

When installing new blades instead of reversing worn ones, the same procedure as outlined above should be used.

When installing blades, make sure that they are turned with the beveled edges positioned as illustrated.



CHANGING GROUND PLATES

The Scraper ground plates should be changed before they wear back into the base to which they are bolted. When they have worn to the point where it is necessary to change them, the procedure outlined below should be followed.

First, block the apron arms and bowl in the raised position as when changing blades.

Remove bolts which secure ground plates to Scraper side sheets. If the ground plates have not already been reversed, they can be used again by turning them over and wearing them along the other edge.

If reversing a ground plate, turn it over and end for end. After reversing, insert the bolts and draw them up tight.

Use the same procedure when installing new ground plates.

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PREPARATION FOR STORAGE

For instructions for preparing the machine for storage, refer to Tentative Technical Manual TM5-9715, "Storage of Engineer Equipment", issued by Engineer Field Maintenance Office, P.O. Box 1679, Columbus, Ohio, (superseding Tentative Preventative Maintenance Manual, "Storage of Engineer Equipment", April 28, 1943).

PREPARATION FOR EXPORT SHIPMENT

For instructions covering the preparation of the Tournapull for export shipment, refer to Technical Bulletin TB5-1202-1, Preparation for export of "Scraper, Motorized, Cable Operated, Model Super C Tournapull, with Model LP Carryall," issued by Engineer Field Maintenance Office, P. O. Box 1679, Columbus, Ohio.

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REPAIR SECTION

SECT. 2

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REPAIR SECTION

The instructions in this part of the manual give complete information for servicing, overhauling and repairing the machine. It includes instructions for all servicing procedures other than those performed exclusively by Operators, which are contained in the Operation Section.

The Repair Section is divided into the following four parts: (1) Tournapull Repair Section, (2) Engine Repair Section, (3) Power Control Unit Repair Section, and (4) Scraper Repair Section. Included in each of these four parts are instructions for disassembly, inspection of parts for replacement or repair, re-assembly, the making of adjustments, and other necessary servicing procedures.

A "Table of Clearances and Tolerances of Bearings and Adjustable Parts" and a "Trouble Shooter's Guide" will also be found at the rear of the Repair Section.

The chart below gives a complete list of hour intervals for servicing the machine.

DURING OPERATION

Observe oil pressure gauge. Pressure should be 30 to 50 lbs.
Observe water temperature gauge. Water temperature should be 140° F. to 180° F.

WHENEVER NEEDED (As evidenced by operator).

Adjust Power Control Unit clutches.
Adjust steering clutches.
Adjust steering brakes.
Adjust flywheel clutch.
Adjust hydraulic brakes.

EVERY 8 HOURS

Check Power Control Unit brake adjustment.
Check tire pressures.
Check crankcase oil level.
Clean and change oil in crankcase breather.
Check water level in radiator.
Remove and clean pre-cleaner jars on air cleaner. (Oftener if required)
Look for leaks of lubricating oil, fuel oil, and water from around engine connections.
Lubricate sheave bearings.
Lubricate fairlead sheave housing pivot bearings.
Lubricate tailgate roller bearings.
Lubricate spiral sheave wheel bearings.
Lubricate hinge pins.
Check air cleaners to see if oil in sumps need replenishing.
Check batteries and add water if needed.

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EVERY 64 HOURS

Clean engine thoroughly on outside.
Clean air passages in radiator.
Drain, flush and refill engine crankcase to proper height with proper oil.
Change oil in air cleaners. Clean air passages.
Drain off condensation from fuel supply tank.
Drain two or three tablespoons of fuel oil from the float chamber of the fuel pump to remove water, especially in cold weather.
Check oil level in Power Control Unit gear case.
Lubricate Tournapull control levers.
Lubricate hydraulic brake pedal.
Lubricate flywheel clutch release yoke.
Clean main case breather.
Lubricate ball and socket hitch.
Lubricate Power Control Unit brake rollers.
Check Scraper wheel bearing adjustment.
Change lube oil filter bag.
Change cartridge in DeLuxe lube oil filter.
Check oil level in main case.
Check oil level in transmission.
Check tension of water pump drive belts.

EVERY 128 HOURS

Change fuel oil filter bag.

EVERY 256 HOURS

Check Scraper fairlead sheave housing bearing adjustment.
Lubricate generator.
Lubricate flywheel clutch release bearing.
Lubricate drawbar.
Clean fuel pump screen.
Adjust injectors.
Adjust intake and exhaust valves.
Check Power Control Unit cable drum bearing adjustments.
Check Power Control Unit main gear bearing adjustments.
Clean air cleaners thoroughly.

EVERY 512 HOURS

Lubricate Scraper springpipe.
Change oil in Tournapull main case.
Change oil in transmission.
Hand-pack Scraper wheel bearings with grease.
Clean and oil cranking motor bearings and screw shaft of Dyer drive.

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Service generator and cranking motor.
Check the injectors for clean spray holes.
Check final drive pinion bearing adjustments.
Check final drive axle bearing adjustments.

EVERY 1024 HOURS

Lubricate water pump.
Change oil in Power Control Unit gear case.
Lubricate Power Control Unit cable drum bearings.
Check fuel inlet connection check valves.
Check, clean and repair all electric connections.
Check Power Control Unit brake shaft bearings.
Check the fan assembly.
Check transmission mainshaft bearing adjustment.
Check spiral bevel gear carrier bearing adjustment.

EVERY 2048 HOURS

Hand-pack brake shaft bearings.
Hand-pack Power Control Unit control lever bearings.
Test the compression by barring the engine over. If necessary grind valves.
If valves are being ground at this period, check the ball and socket links at the push rods, rocker arms, and injector links. These parts must always have a good seat; otherwise there will be an excessive loss of lubricating oil.

EVERY 4096 HOURS

Clean the oil pan. Remove the screen and remove all sludge and accumulated dirt.
While the oil pan is off, check the connecting rods and main bearings without removing. If necessary to replace any of the connecting rod and main bearings, it is best to replace the entire set.
Check the piston pins and bushings.
If the pistons are pulled, replace piston rings with new ones.
Check and record cylinder liner wear.
Check the lubricating oil pump and rebuild if badly worn.
This period is generally chosen as the one for a major overhaul. If a major overhaul is to be undertaken at this time, all the six operations described above will, of course, be covered in addition to repair of all the engine units as described in the Engine Repair Section.

PERIODICALLY, AS REQUIRED

Hand-pack flywheel clutch pilot bearing with grease wherever clutch is disassembled.
Fill hydraulic brake master cylinder with hydraulic brake fluid.
Lubricate Scraper pushbeam and sliding sheave channel.
Lubricate cable.
Adjust drawbar.

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TOOLS SUPPLIED WITH MACHINE

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REPAIR SECTION

Part One

The TOURNAPULL

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DISCONNECTING TOURNA-PULL FROM SCRAPER

To remove the deck plate for disassembling certain parts of the Tournapull, it is first necessary to disconnect the Tournapull from the Scraper. This can be done as follows:

1. Block up the front of the Tournapull, with the front raised only slightly above level, as shown. Use only good, solid cribbing, with the top members turned lengthwise as shown. The top members should also be spaced inside the steps. Both the construction of the cribbing and the level of the front of the Tournapull are important.

2. Disconnect the Scraper yoke from the drawbar by disconnecting the safety cable and removing the capscrews which secure the drawbar clamp blocks to the yoke.

3. Engage the Power Control Unit hoist clutch, and raise the Scraper bowl to the point where there remains approximately 3″ to 4″ space between the pushbeam stops. Then, with the Scraper raised in this position, block up under the Scraper blade as shown. The use of good, solid cribbing reduces the hazards of this operation. Also block the rear wheels to keep the Scraper from rolling or sliding off the blocks.

4. In hoisting the Scraper, the lower end of the yoke will move to the rear, away from the drawbar as shown.

5. Remove the wires from the heads of the capscrews which secure the retainer plate to the lower end of the hitch ball, and then remove the capscrews and retainer plate. Also disconnect the Scraper light wire and the hydraulic brake line at the points of connection near the ball and socket hitch.

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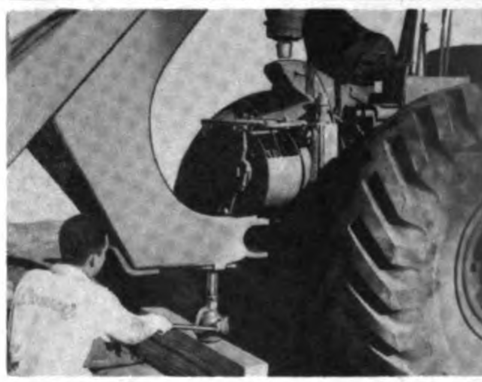
6. Place a jack of at least 5 ton capacity below the yoke as shown, and raise the yoke a few inches.

7. It is usually necessary to strike the rear of the deck plate a few blows with a sledge at the point shown to free the tapered shank of the hitch ball from the taper in which it seats.

8. After the hitch ball has been broken free from its tapered seat, raise the yoke high enough to permit the lower end of the hitch ball to clear the deck plate.



9. If available, blocks should be placed under the yoke as shown. The Tournapull can now be driven forward on the cribbing, away from the Scraper yoke. In moving the Tournapull ahead, shift the transmission into low gear and then ease out on the flywheel clutch pedal a little at a time. Be very careful to avoid knocking over the cribbing.

CONNECTING TOURNAPULL TO SCRAPER

To re-connect a Tournapull to a Scraper, reverse the procedure outlined above for disconnecting. After re-connecting the brake lines, the brakes should be bled as outlined in the "bleeding" instructions on page 104 of the Operation Section.

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DISASSEMBLING TOURNAPULL

The instructions on the following pages give complete instructions for disassembling the Tournapull, except disassembly of the engine, which is covered in the Engine Repair Section. Engine removal is covered on the following pages, however, inasmuch as it is necessary to remove the engine to disassemble certain other parts of the Tournapull.

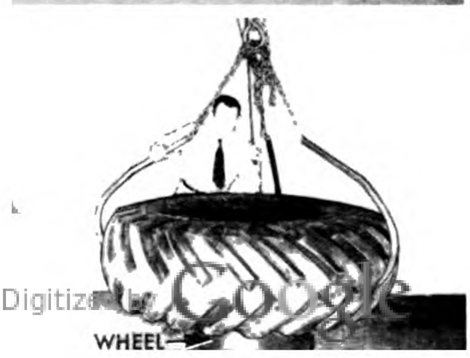
REMOVING WHEELS

To remove the Tournapull drive wheels, first raise the wheels off the ground. Block up under the Tournapull and then remove the wheel capscrews as illustrated, using the special wrench supplied with the Tournapull.

REMOVING TIRES

To remove the tires, first remove the locking rings as illustrated.

Then remove the sliding ring from the wheel rim.



The tire can now be raised off the wheel, using a hoist. A lifting hook of the type illustrated or a rope sling can be used to good advantage in handling these large tires.

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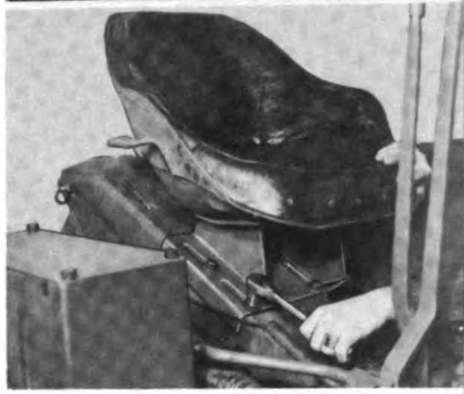
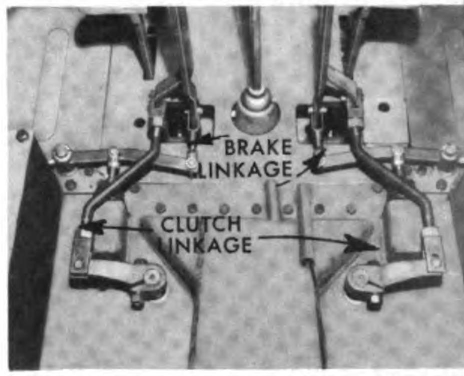
REMOVING DECK PLATE

To remove the Tournapull deck plate, it is first necessary to disconnect the Tournapull from the Scraper as per preceding instructions. Then proceed as follows:

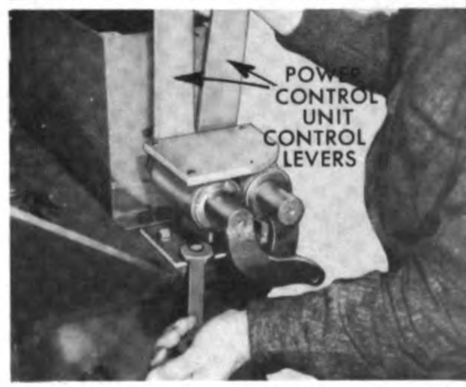
Remove the operator's seat by removing the capscrews which secure the seat bracket to the deck plate.



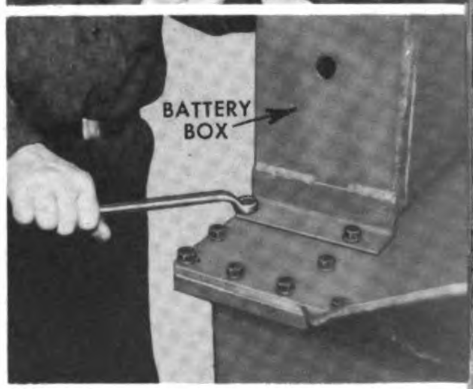
Disconnect and remove the steering clutch and brake linkage shown in the illustration.



Then remove the Power Control Unit control lever assembly by removing the capscrews which secure it to the deck plate.



Also, remove the batteries, battery cables, and battery boxes from the top of the deck plate.



Back out the set screws in the rear of the brake actuator housings as shown, and push the brake acuator levers back into the actuator housings. Also disconnect the hydraulic brake line at the connection just below the floor boards, in front of the deck plate, and disconnect the Scraper light wire.

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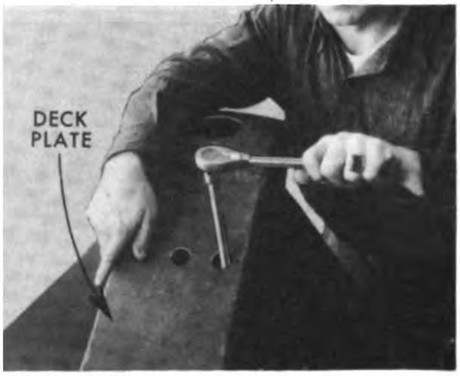
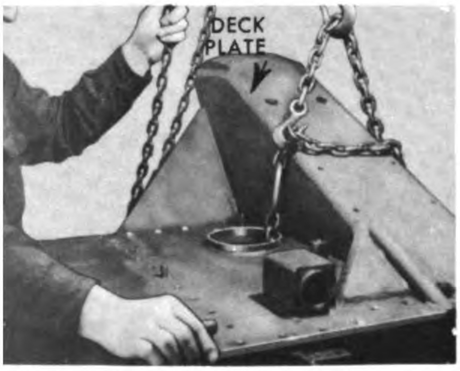


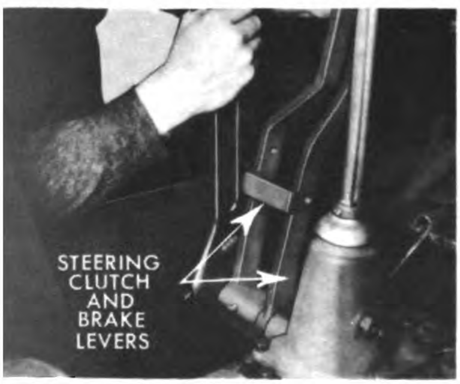
Remove the capscrews which secure the deck plate to the main case. Don't overlook the three capscrews located below the seat bracket, which can be reached through the three holes shown in the illustration.



Attach a hoist chain to the deck plate as shown and raise the deck plate off the case, raising it straight up until it clears the tops of the clutch throw yokes.

REMOVING FLOOR BOARDS

To remove the floor boards, first remove the capscrews which secure the floor boards in position. Remove the pedal pads from the flywheel clutch and hydraulic brake pedals and then raise the floor boards off over the control levers, pedals, etc.



REMOVING STEERING CLUTCH LEVERS AND BRAKE LEVERS

To remove the steering clutch and brake control levers, first remove the floor boards. Then remove the nut from the end of the control lever shaft and remove the control levers off the end of the shaft.

REMOVING DRAWBAR

To remove the drawbar from the Tournapull, remove the wires from the heads of the clamp block capscrews and then remove the capscrews and clamp blocks, thereby freeing the drawbar from the bottom of the Tournapull case.

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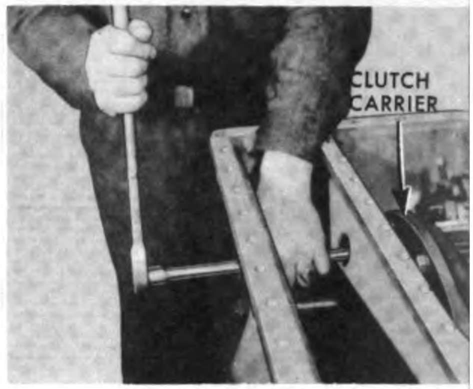
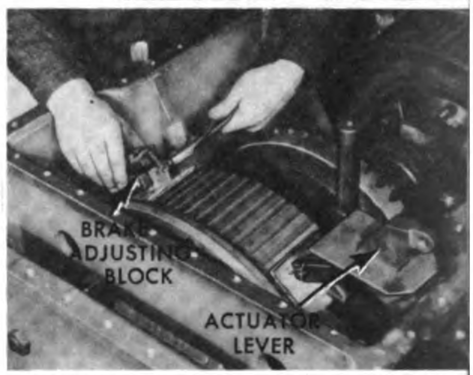
REMOVING STEERING CLUTCH AND SPIRAL BEVEL GEAR ASSEMBLY

To remove the steering clutch and spiral bevel gear assembly, it is first necessary to remove the deck plate as previously outlined. Then proceed as follows:

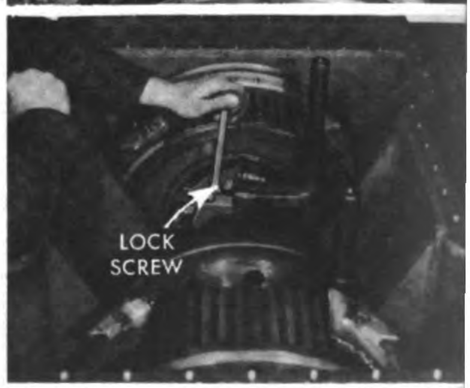


Remove the capscrews which secure the steering clutch driven cone to the clutch carrier plate. This can best be done by removing the pipe plug from the side of the main case and then inserting a wrench through the hole and through a corresponding hole in the partition wall to reach the capscrews, as illustrated. Rotate the steering clutch and spiral bevel gear assembly to reach all the capscrews.



Disconnect and remove the brake adjusting block and linkage at the rear end of each brake band. Also, disconnect and remove the brake actuator lever, linkage, etc., from the front end of each band.

Back off the spiral bevel gear carrier right bearing adjusting nut by first loosening the clamp screw and then backing off the adjusting nut, using the special spanner wrench. A wrench placed on one of the spiral bevel gear carrier capscrews can be used to hold the assembly from turning. Move the gear carrier assembly to the right as far as possible by loosening the clamp bolt on the left adjusting nut and turning the adjusting nut clockwise.



Back off the adjustment on both steering clutches. To do this, first loosen the lock nuts and lock screws from the clutch adjusting spiders.

Then turn the adjusting spiders counterclockwise on the threaded hubs of the clutch drive plates, thereby backing off the adjustments. Slide clutches toward center on gear carrier.

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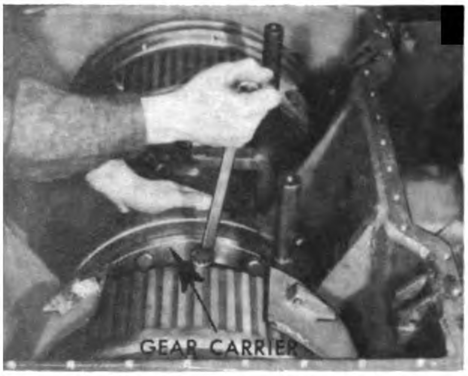
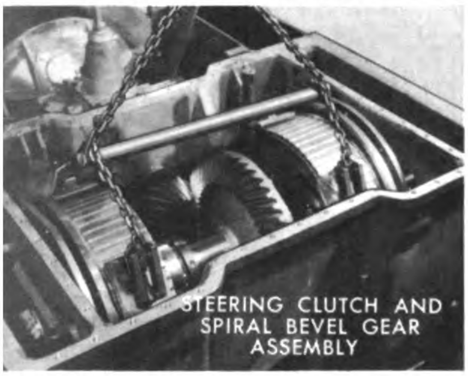
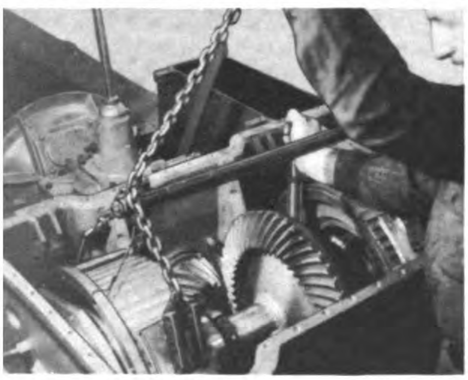


Remove five of the capscrews which secure the spiral bevel gear to the gear carrier, in consecutive order. Then rotate the gear carrier so that the holes from which the five capscrews were removed are on bottom. (This is necessary to provide clearance when raising the assembly out of the case.)

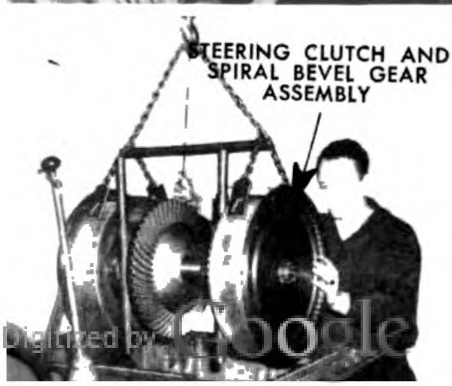
Remove the gear carrier bearing clamp blocks from the case. (IMPORTANT—Do not lose or mix bearing clamp blocks or shims, because they are machined with the case and must be re-installed in the same position from which they were removed.)



Attach a chain hoist to the steering clutch and spiral bevel gear assembly with which to raise it out of the case. Care should be used to make sure the assembly is balanced. A lifting arrangement of the type shown, connected to the ends of both brake bands, is very well suited for this use. If other means of hoisting is used, the steering clutch driven cones should be wired in some manner to prevent the clutches from sliding off the carrier shaft while hoisted in the air. Wire the clutch throw yokes to the clutch cones.



Raise the assembly slowly with the chain hoist, working the clutch throw yokes to free them from the bottom of the case. CAUTION—Extreme care should be used when hoisting to prevent the teeth of the spiral bevel gear and pinion from binding and chipping. The transmission should be in neutral to permit the pinion to turn, and the gear and pinion should roll and slide out of mesh. Move the right side to the rear and left side forward while hoisting.



After the spiral bevel gear is out of mesh with the pinion, continue to hoist the assembly out of the case.

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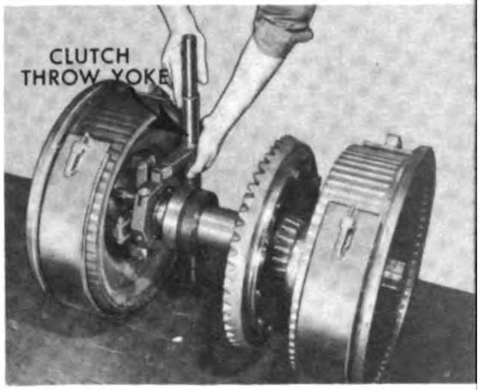
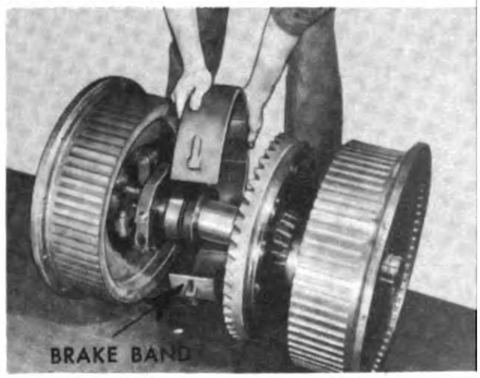
DISASSEMBLING STEERING CLUTCH AND SPIRAL BEVEL GEAR ASSEMBLY

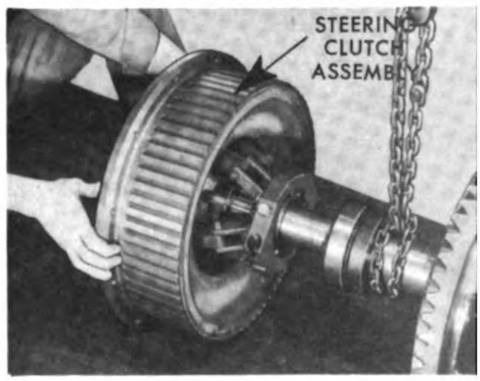
To disassemble the steering clutch and spiral bevel gear carrier assembly, first slide the clutch throw yokes off the throw-out collars, being careful not to lose the small square pivot bushings from the throw-out collars as the yokes are removed.



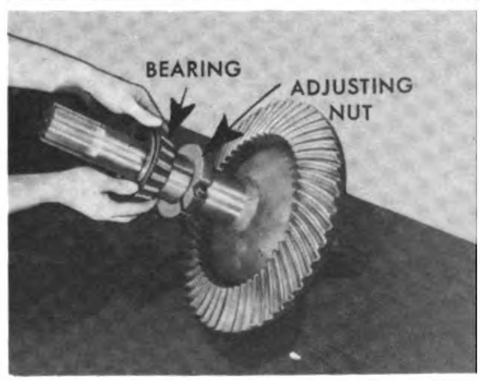
Remove the brake bands by sliding them off the clutch cones as illustrated.



The steering clutch assemblies can now be slipped off the ends of the gear carrier shaft.



Remove the bearings from the gear carrier, being careful not to lose the keys located under the bearings. Also remove the keys. It may be necessary to use a puller in removing the bearings from the gear carriers in some machines. After removing the bearings and keys, the adjusting nuts can be removed by loosening the lock screws and turning them off over the threads on the shaft.



To remove the spiral bevel gear from the gear carrier, remove the capscrews and lockwashers which secure the gear to the gear carrier.

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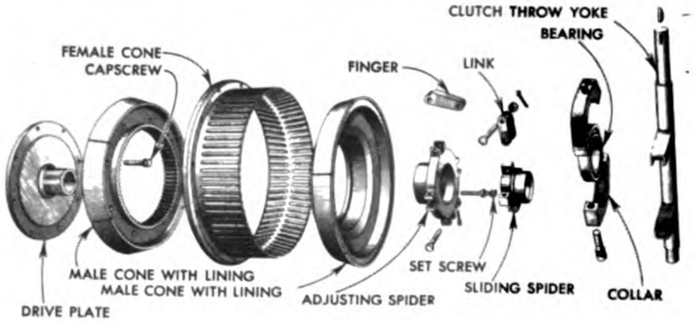

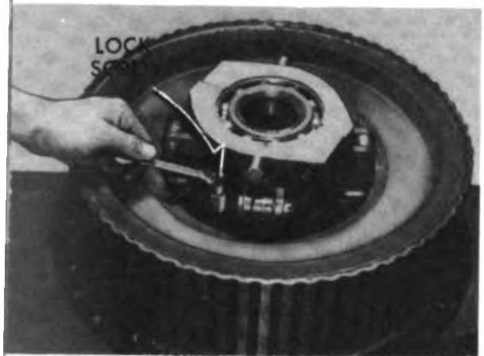

DISASSEMBLING STEERING CLUTCH

To disassemble either steering clutch, first back out the lock screw as illustrated. The lock nut must be loosened before the lock screw can be backed off.

Turn the clutch spider assembly off the threaded hub of the clutch drive plate.

Then lift the spider assembly off the drive plate.

The external splined driving cone can now be lifted out of the steering clutch driven cone.

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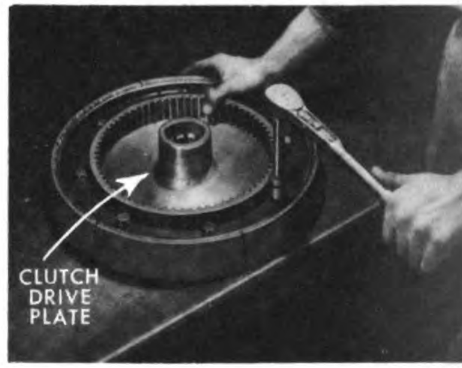
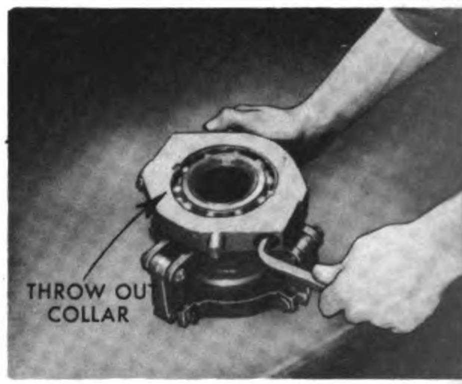
The driven cone can be lifted off the internal splined driving cone as illustrated.

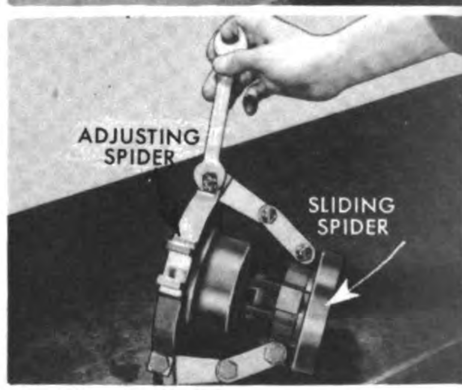
To remove the internal splined driving cone from the clutch drive plate, remove the capscrews and lockwashers that secure the cone to the drive plate.



Remove the throw-out collar from the throw-out bearing by removing the capscrews which hold the two halves of the throw-out collar together.



Disassemble the spider assembly by removing the cotters and castellated nuts from the pins connecting the fingers, links, adjusting spider, and sliding spider.



The throw-out bearing can be removed from the sliding spider by bending back or cutting the peened edge of the spider and then pulling the bearing off the spider.

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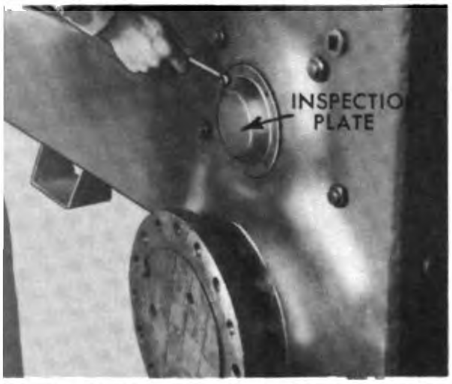
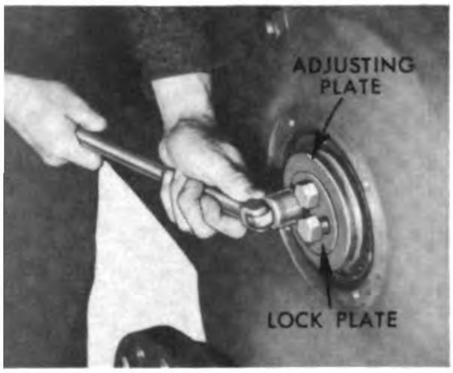
REMOVING AND DISASSEMBLING FINAL DRIVE PINION ASSEMBLY

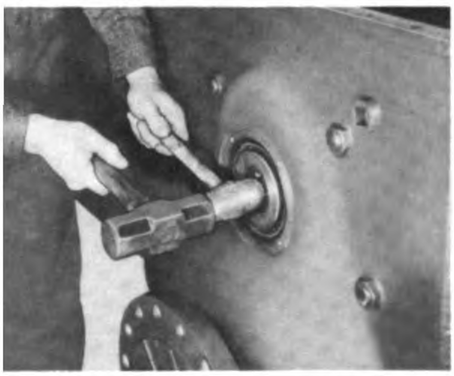


To remove a final drive pinion assembly, it is first necessary to remove the deck plate and the steering clutch and spiral bevel gear assembly, as per previous instructions. Then proceed as follows:

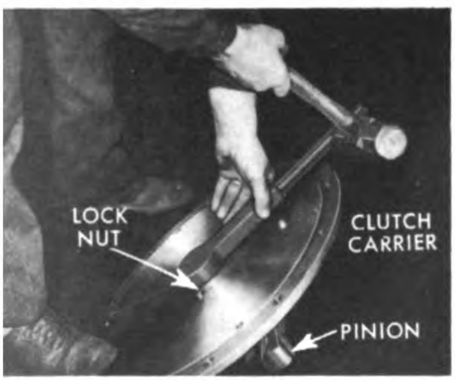
Remove the pinion bearing inspection cap from the side of the case.



Then bend back the bent edges of the lock plate and remove the capscrews which secure the lock plate and adjusting plate to the end of the pinion. Remove the lock plate and adjusting plate from the pinion.



Rotate the pinion to the point where the flat surface of the clutch carrier plate is on bottom, to provide necessary clearance when removing. Then drive against end of pinion only enough to break bearing cone loose from pinion. Then pull bearing cone off end of pinion, and remove pinion assembly through inner side of case, tilting and raising it out of mesh with herringbone teeth of final drive gear while moving it inward.



To disassemble the pinion assembly, bend back peened edge of lock nut and then turn lock nut off end of pinion, using special wrench supplied with Tournapull as shown. The clutch carrier can then be driven off the end of the pinion.

To remove the bearing cone from the clutch carrier, set the carrier face-down on blocks and then drive the bearing off the carrier hub, as shown, making use of the two holes provided for that purpose.

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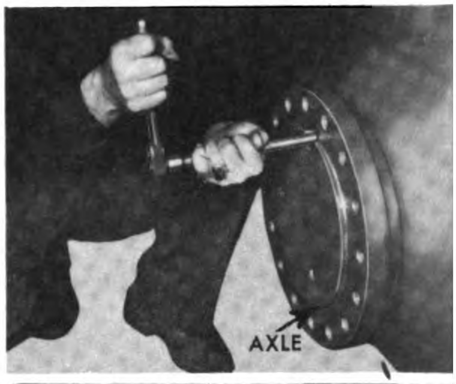
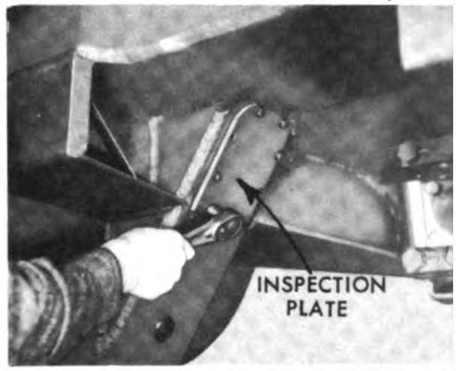
REMOVING AXLES AND FINAL DRIVE GEARS

To remove the Tournapull axles and final drive gears, it is first necessary to remove the wheels, deck plate, steering clutch and spiral bevel gear assembly, and final drive pinion. If only the axles are to be removed, the final drive can be supported by a rope or metal band and the final drive pinion and the steering clutch and spiral bevel gear assembly left in position.

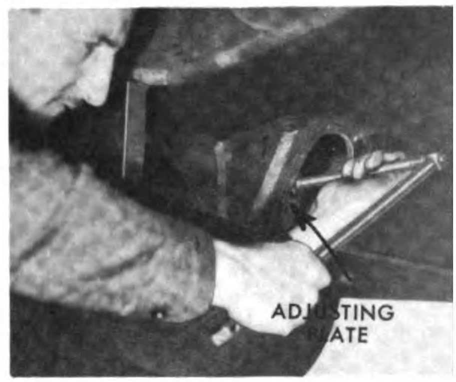


Drain oil from main case. Then remove capscrews which secure oil seal retainer plate to the case by reaching capscrews through hole in axle flange. Rotate axle to reach all the capscrews. Also remove the four stay-bolts from the case.

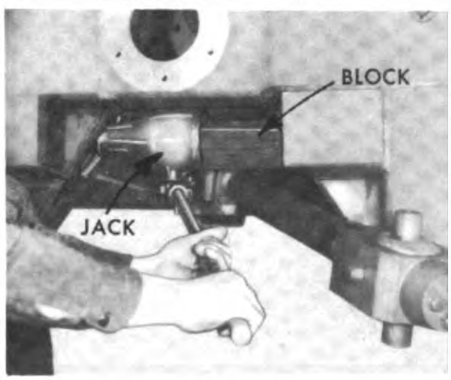
Remove axle inner bearing inspection plate from bottom of main case as shown.



Then reach through inspection plate opening and remove lock plate, adjusting plate and shims from inner end of axle by bending back corners of lock plate and then removing the four capscrews which project through lock plate and adjusting plate and into end of axle.



With the final drive gear supported in the case, preferably by attaching a hoist chain to either a metal band or heavy rope extended around the gear, force the axle out of the case, using a jack as shown. For this operation, the opposite inner axle bearing inspection plate has been removed and a block placed against the end of opposite axle to provide something solid to jack against. The axle inner bearing can be removed through the inspection plate opening.



The final drive gear can now be hoisted out of the case, and the axle outer bearing cone, oil seal, and oil seal boss, pulled off the axle, if desired.

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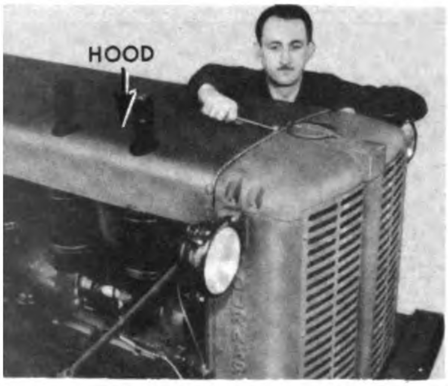
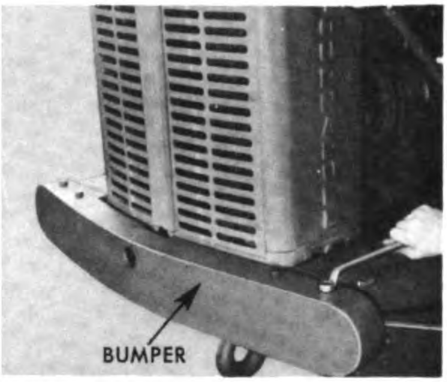


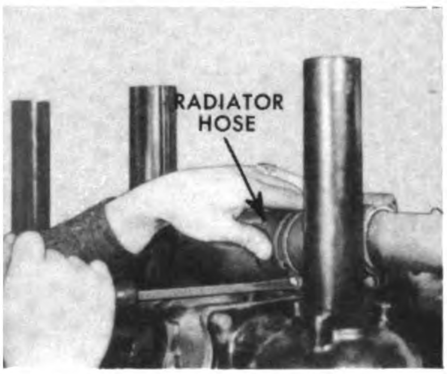
REMOVING HOOD

To remove the hood from the Tournapull, first remove the pre-cleaners from the air cleaner stacks. Then remove the bolts that secure the hood to the radiator and dash panel and lift off the hood.



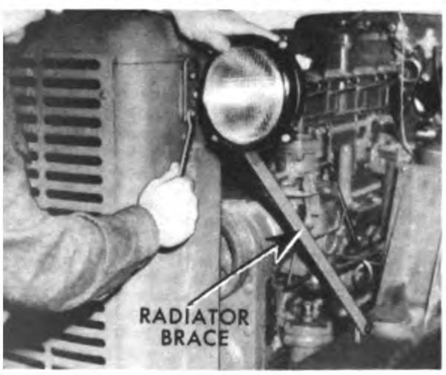
REMOVING BUMPER

To remove the bumper, merely remove the eight bolts that secure the bumper to the frame.

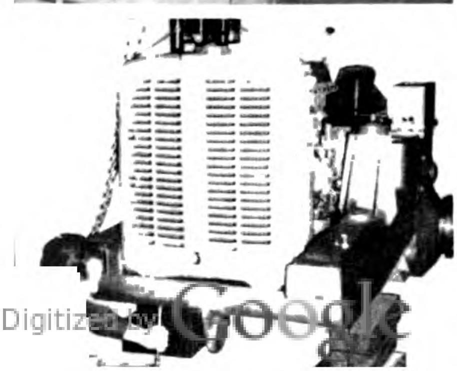


REMOVING RADIATOR

To remove the radiator, first remove the hood. Also disconnect both the upper and lower hose connections.



Disconnect the head light wires and remove the radiator brace and headlight.



Attach a hoist chain to the radiator and then remove the two bolts that hold the radiator in place by inserting a wrench through the holes in the bottom of the frame. The radiator can now be removed. (Do not misplace the fibre and metal shims or spacers on which the radiator sets as they will be needed when re-installing.)

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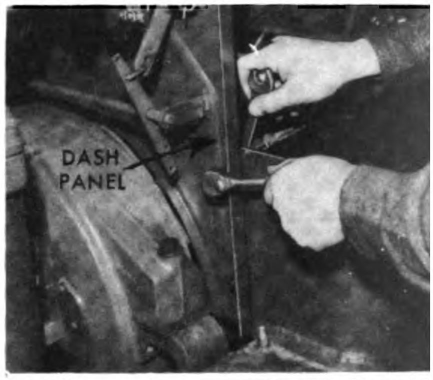
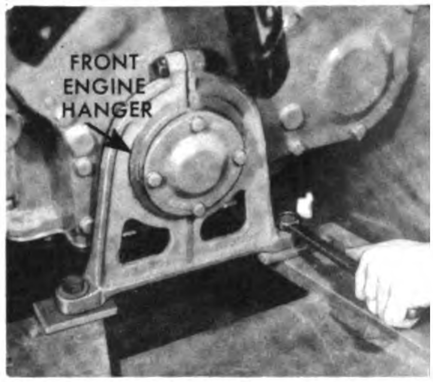
REMOVING DASH PANEL

To remove the dash panel, first remove the hood. Then remove the two bolts that secure each side of the dash panel to the frame. Unless a dash panel has been damaged in some manner and needs to be replaced, it is seldom removed excepting when the engine is to be removed, and in this case the wires and controls are left connected and the dash panel removed with the engine.

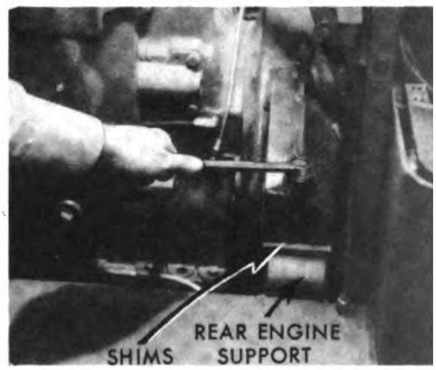


REMOVING ENGINE

To remove the engine, first remove the hood and radiator, and disconnect the fuel line from the fuel tank. Then remove the capscrews which secure the front engine hanger to the frame as shown.

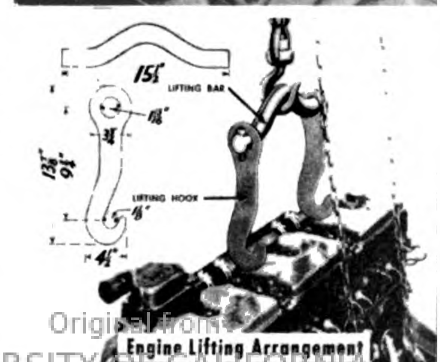


Also remove the capscrews from the rear engine support lugs. (IMPORTANT — Do not misplace shims at either the front engine hanger or at the rear support lugs because the same shims must be re-installed at each point, unless a different engine is installed.)



If the transmission is not to be removed, remove the capscrews which secure the transmission clutch housing to the engine flywheel housing. (If the engine and transmission are both to be removed, the two can be removed together and these capscrews then removed, if desired.)

Use a special lifting arrangement of the general type shown in lifting the engine. Move engine forward a short distance before hoisting to permit flywheel clutch to move clear of the transmission clutch shaft.



Engine Lifting Arrangement

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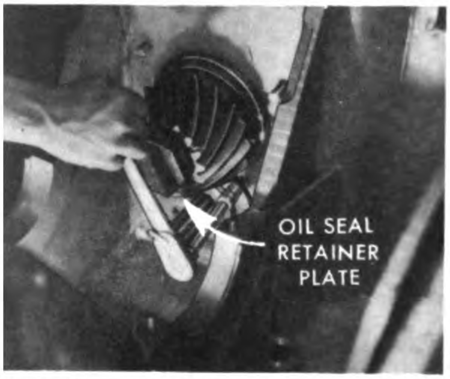
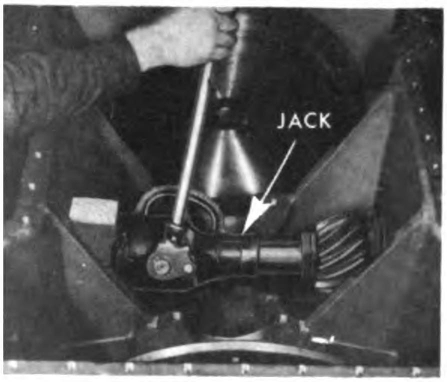
REMOVING TRANSMISSION

To remove the Tournapull transmission, first remove the deck plate, floor boards, hood and radiator. The engine can be removed either with the transmission, removed separately before removal of the transmission, or moved several inches ahead on the frame to permit removal of the transmission without actually removing the engine.

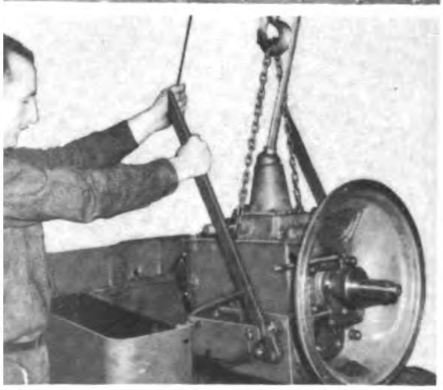
Remove the nuts from the four large stud bolts at either side of the spiral bevel pinion.



Then remove the capscrews from the oil seal retainer plate and slide the retainer plate off the end of the transmission countershaft. (Leave retainer plate loose on shaft, if Power Control Unit has not been removed.)



With the transmission supported with a chain hoist and the engine either removed, slid ahead on the frame, or loosened from the frame and supported with a chain hoist to be removed with the transmission as one unit, force the transmission ahead far enough to free the bearing adaptor from the main case, using a jack as shown. (Do not drive with sledge against pinion lock screw.) This operation can be done with steering clutch and spiral bevel gear assembly in position by tilting jack or jacking against carrier shaft.



When bearing adaptor and pinion are free of the main case, lift out the transmission with a hoist.

REMOVING FLYWHEEL CLUTCH PEDAL

To remove the flywheel clutch pedal from the transmission, loosen the clamp bolt on the pedal adjusting arm and then slide the adjusting arm and pedal off the pedal shaft.

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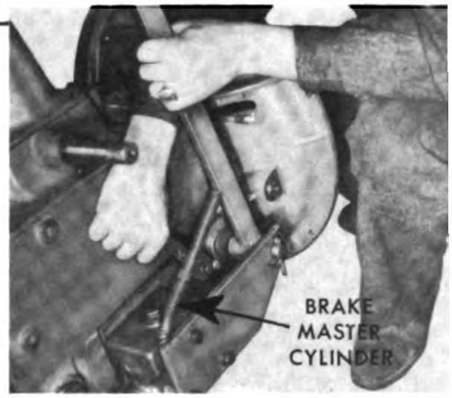
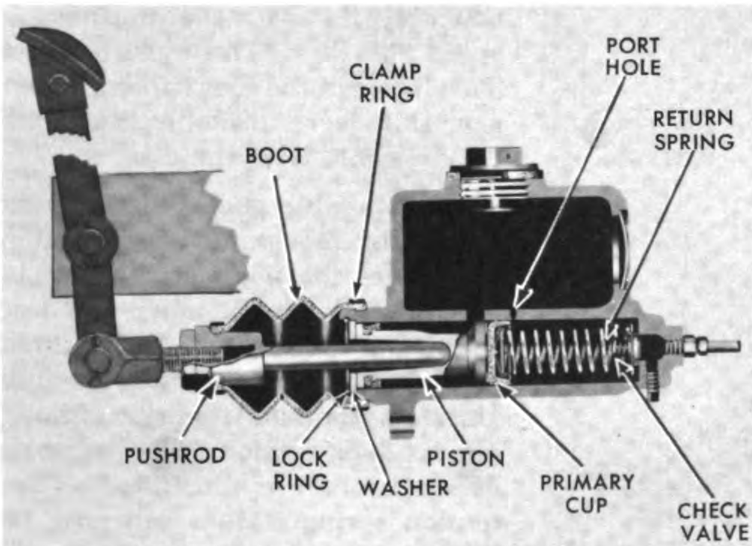
REMOVING AND DISASSEMBLING HYDRAULIC BRAKE MASTER CYLINDER

To remove the hydraulic brake master cylinder from the side of the transmission case, remove the capscrews which secure the master cylinder mounting brackets to the case. The mounting brackets and pedal can then be removed from the master cylinder.



To disassemble the master cylinder, first remove large clamp ring fastening boot to cylinder. Remove push rod and boot assembly. Remove internal parts in this order; first lock ring, then washer. Use care in removing lock ring as this piece is made of spring steel. The piston, primary cup, return spring, and check valve may then be removed.



CROSS-SECTION OF MASTER CYLINDER

After dismantling the cylinder, the following items should be inspected:

(a) Port hole must be open. If closed, run a wire through hole.

(b) Primary cup must be smooth around outer edge. If grooved by passing the port hole the sharp edges of the cylinder wall may be removed by the use of a burring tool. Discard used cup.

(c) Cylinder bore must be smooth and not pitted or scratched.

(d) If mineral oil is present in the system the rubber parts will be enlarged and very soft. They cannot be used and it is necessary to replace the primary cup, secondary cup, check valve and valve seat.

Cylinder and parts must be washed in clean alcohol and dipped in hydraulic brake fluid before assembling. Do not wash cylinder or parts in gasoline, kerosene or oil.

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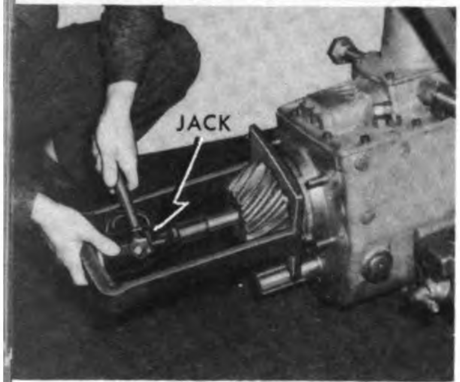

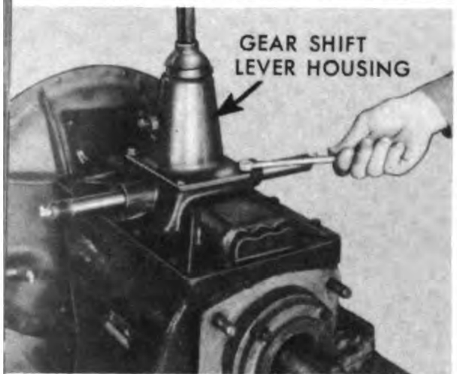

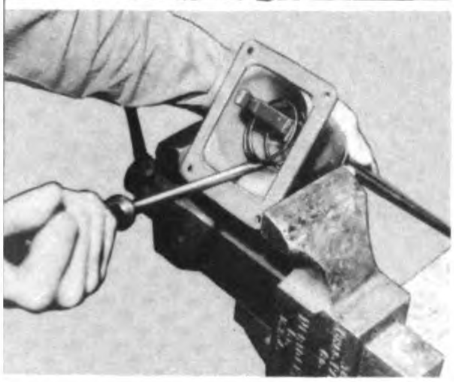

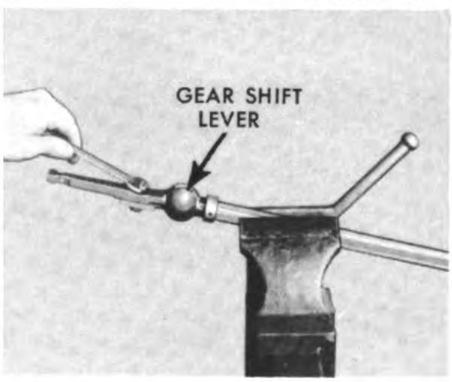

DISASSEMBLING TRANSMISSION

Before attempting to disassemble the transmission, its exterior should be carefully cleaned. It is important that no dirt or foreign matter be allowed to enter the case. Dirt is particularly detrimental to bearings, sleeves, and bushings.

To remove the spiral bevel pinion from the rear of the mainshaft, first bend back or cut the peened edge of the head of the pinion lock screw with a punch or chisel. Then turn the screw out the end of the shaft and pull the spiral bevel pinion off the shaft.

To remove the gear shift lever housing assembly, first shift the transmission into first speed position. (This must be the first step.) Then remove the four capscrews by which the gear shift lever assembly is attached and lift the assembly from the case.

Disassemble gear shift lever housing assembly by first removing from upper end of shift lever the hand grip, finger latch rivets and finger latch. Remove small screw from shift lever dust cover (bell) directly above pivot ball and slide cover up and off lever. Unscrew stop bolt from side of housing. Then remove lever tension spring, using screw driver or similar tool as illustrated. The lever and tension spring washer can now be removed through bottom of housing.

Dismantle remainder of shift lever assembly by removing bolt from latch as shown. The latch rod can be removed from bottom of lever and latch and spring removed by unscrewing latch.

Remove shifting bar housing by removing capscrews which secure it to the case and then lifting housing from the case. In lifting housing off case, guide edge of reverse shifting yoke into and up through the yoke slot in first speed sliding gear. Do not spring yokes out of alignment by forcing housing off transmission. If transmission was shifted into 1st speed in Step 2, little difficulty should be experienced.

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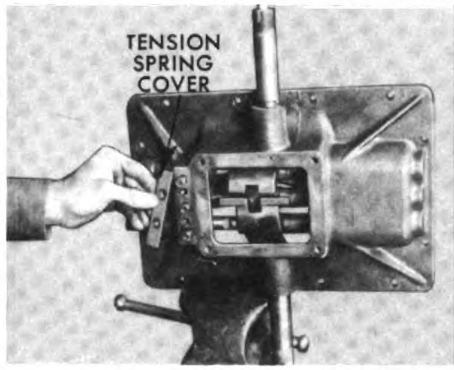
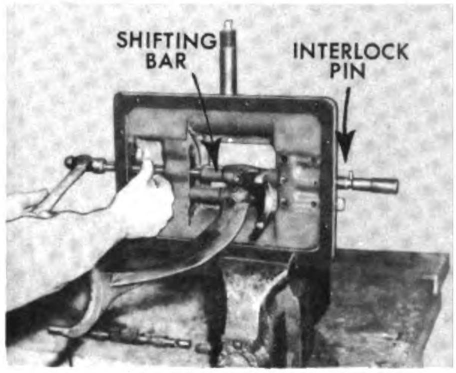
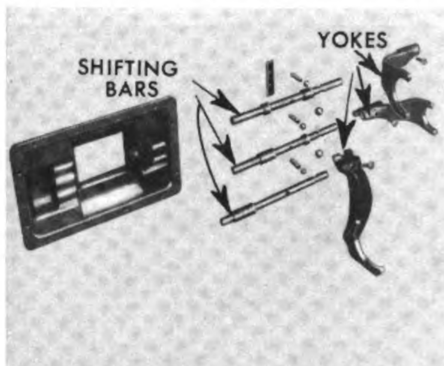
To dismantle shifting bar housing, first shift it into neutral (slots in yokes line up). Remove tension spring cover by removing two capscrews. Springs located under spring cover can be removed from top side and ½" steel balls (assembled under springs next to yoke bars) from bottom side of housing.



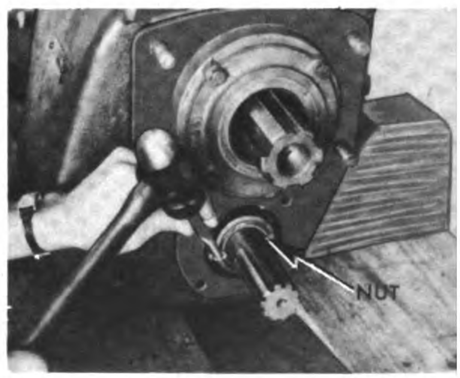
Remove yoke bars from top down, as illustrated. To do this, remove retaining screw from shifting yoke and drive yoke bar out through thimble end of housing. Thimbles will not be damaged when carried out of housing by bars. With springs removed there is no tension on the bars and it may be necessary to adjust them to neutral position before upper bar will move. Avoid loss of small interlock pin and balls, for transmission may be shifted into two speeds at once if re-assembled without them, causing serious damage.



The accompanying exploded view of shifting bar housing assembly shows the parts in their correct relationship.



Before removing the gears and shafts from the case, first loosen the countershaft rear bearing nut with a punch. To prevent the shaft from turning as this is done, shift the transmission into two speeds by engaging both the high speed sliding clutch and the first speed sliding gear. The shafts will then be locked.



Remove the mainshaft rear bearing cover. This is done by removing the four capscrews by which it is attached.

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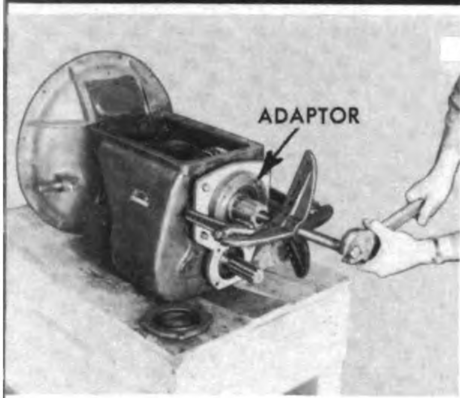
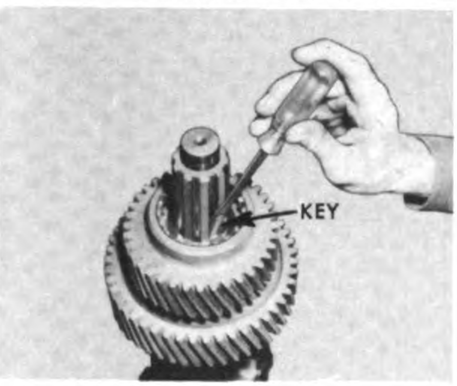


With the capscrews and nuts which hold the adaptor to the case removed, the adaptor can be removed by use of a puller, as illustrated. The tapered roller bearings can then be removed from the adaptor. In event there are any shims located between the bearing cones, save them for use at the same point when re-assembling.

Pull the complete mainshaft assembly to the rear until the pilot bearing clears its bore in the clutch shaft and drive gear. The assembly is then tilted and withdrawn through the top of the case in the manner shown. The first speed sliding gear is left inside the case until after the shaft has been removed.



Remove the pilot bearing from end of mainshaft by pulling sharply against it with the high speed sliding clutch, and then slide the sliding clutch off end of shaft. Then remove the key by which the mainshaft gears are retained on the shaft, as illustrated.

Remove mainshaft washer by turning it in its groove until the lugs on its inside diameter line up with the grooves in the shaft. The lugs on the outer diameter will pass through the internal teeth of the gear.

The upper bushed gear can now be lifted off the shaft. The sleeve on which it operates can be removed by pulling sharply against it with the lower gear if necessary. If it is bound, bump pilot end of shaft lightly against floor, causing weight of large bushed gear to start the sleeve. The small key under the sleeve can now be removed. The large bushed gear can then be lifted off the shaft.

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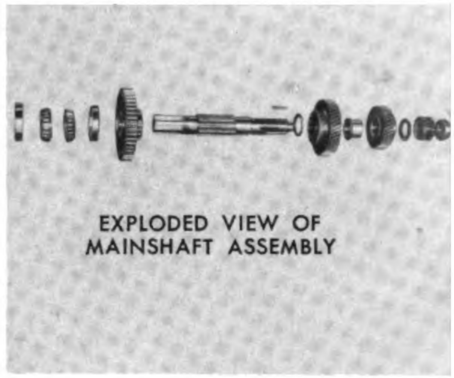
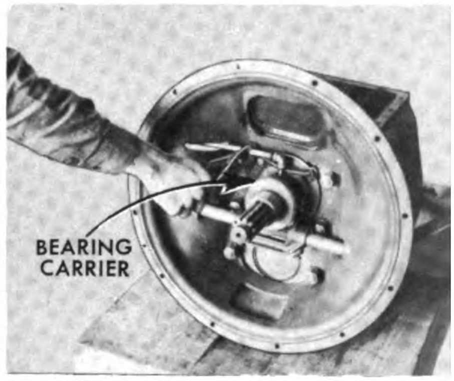
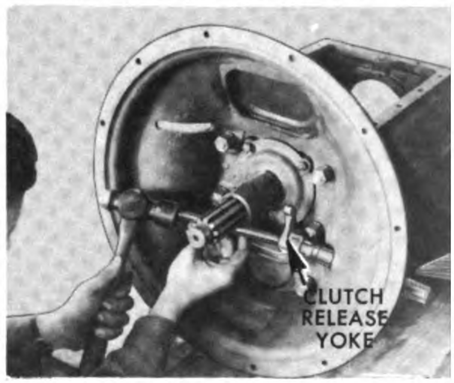
The accompanying exploded view of the mainshaft assembly shows the parts in their correct relative positions.



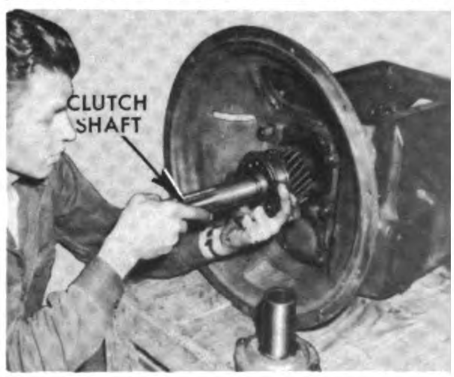
The flywheel clutch release mechanism can be removed by first removing the grease pipe assembly as shown, and detaching the two small springs which control the endwise movement of the clutch release bearing and bearing carrier. The carrier and bearing can then be withdrawn from the extended bearing cover as a single unit and the bearing then removed from the carrier.



Remove lock wires assembled into screws in the clutch release yoke and turn screws partially out of yoke. Then drive out pedal shafts as illustrated. The long pedal shaft cannot be removed until the Woodruff key, which is assembled to the inside end, is removed. Always make sure shafts are free before attempting to drive them out of yoke to avoid bending yoke fingers. Next remove extended bearing cover by removing the four capscrews and withdrawing over end of shaft.



The clutch shaft and drive gear with bearing and nut still attached is withdrawn in the manner illustrated. The bearing can then be removed from the clutch shaft.



To remove the reverse gear shaft, first remove the small shaft lock, which is attached to the rear of the case by a capscrew. Then remove the reverse gear shaft, using a special puller. The puller illustrated consists of a large socket and a capscrew having threads the same size as those tapped into the idler shaft.

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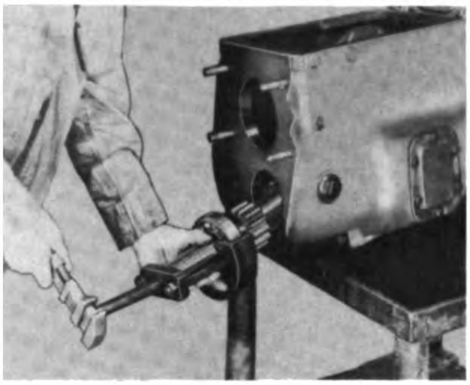
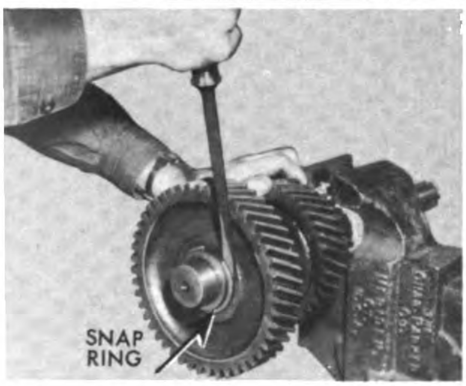
After the idler shaft has been removec the two sections of the reverse idler gearir can be lifted from the case as a single un The two roller bearings and spacer can easily be withdrawn from the bore of the idler gear proper.

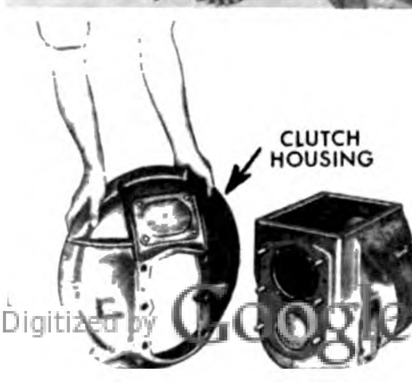


The rear bearing nut, which was previously loosened, can now be turned off the countershaft. Then pull the rear bearing off the countershaft, using a puller as illustrated.

With the rear bearing removed, the countershaft assembly can be tilted and removed through the top of the case



The first step in dismantling the countershaft is removal of the bearing from front end of shaft and then removal of the gear retaining snap ring. The gears can then be removed from the countershaft one at a time and the Woodruff keys removed from the shaft.



Unless absolutely necessary, the clutch housing should not be removed from the transmission case. To remove the clutch housing, remove nuts and lockwashers from studs assembled into case. Also drive out the two dowel pins from inside the case. Punch mark the clutch housing and transmission case at three or four points before removing to assure proper alignment when re-installing.

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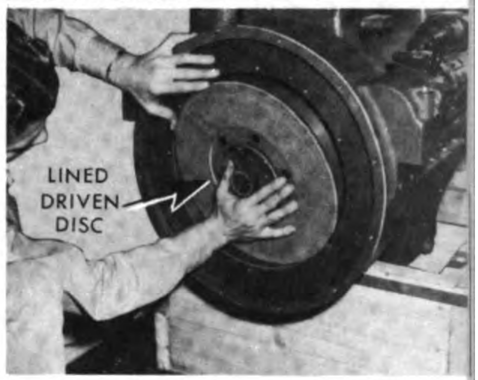
REMOVING AND DISASSEMBLING FLYWHEEL CLUTCH

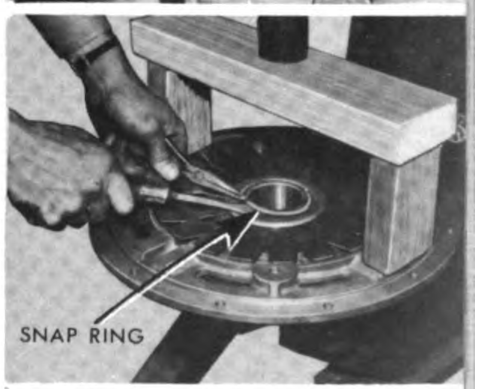
To remove the flywheel clutch, first remove the engine from the transmission as previcusly outlined. (Removal of the clutch release yoke, bearing carrier, bearing, and pedal are covered with disassembly of transmission.) To remove the clutch assembly from the flywheel, remove the capscrews which secure the cover plate assembly to the flywheel. The assembly can now be lifted out of the flywheel.

Remove the lined driven disc from the recess in the flywheel.



The clutch pilot bearing can now be removed. This bearing is pressed or driven into its seat in the flywheel and it is therefore usually necessary to pull the bearing from the flywheel to effect its removal.

Remove the pressure plate from the assembly by removing the pins which retain the retractor springs in place. Then place the assembly on an arbor or drill press with the assembly resting on the clutch sleeve. Place blocks on the flywheel ring as illustrated so that they rest over the driving lug slots. Compress the assembly and lock the press in position. Then remove the snap ring as shown.



Remove the fulcrum rings, levers, and balls. Then slowly release the assembly, which will make the spring, sleeve, and remaining parts removable.

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INSPECTION OF PARTS FOR REPLACEMENT OR REPAIR

Before re-assembling the Tournapull, the following inspection and care of parts should be made:

1. Carefully examine oil seals before re-installing. Replace any oil seals which do not appear to be in good condition.

2. Make new oil seals pliable by soaking in light weight oil and by running a round object, such as a hammer handle, around the inner circumference of the seal, thus working the leather.

3. Replace all working parts that are excessively worn.

4. Examine bearings before re-installing. Use none that may have become Brinelled, pitted, or excessively worn.

5. Replace bearing cups when replacing bearing cones and vice-versa.

6. Examine clutch and brake facings before re-installing driving cones or brake bands. If driving cones have been newly relined with metallic facings, the facings should be machined or ground to a 15° taper to take off any high spots.

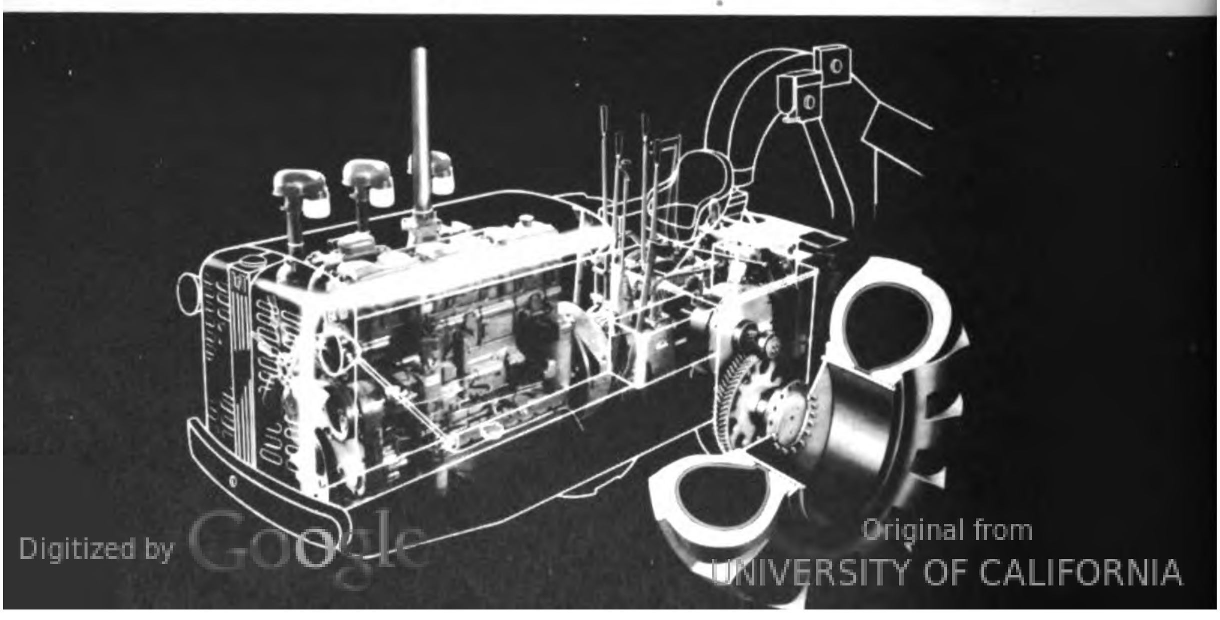
7. Flywheel clutch pressure plates dished in excess of .015" or badly scored should be replaced with new plates.

8. Check the flywheel clutch fulcrum rings for flatness, or excessive wear. Select two good fulcrum rings before re-installing.

9. If "used" flywheel clutch pressure levers are to be used, be sure that they are straight and not excessively worn.

10. Check flywheel clutch retractor springs for size. If shorter than 1⅜" replace with new springs.

11. During inspection and repair of parts use extreme care to keep all bearings, gears, and all other working parts free of dirt, grit, or other foreign matter.



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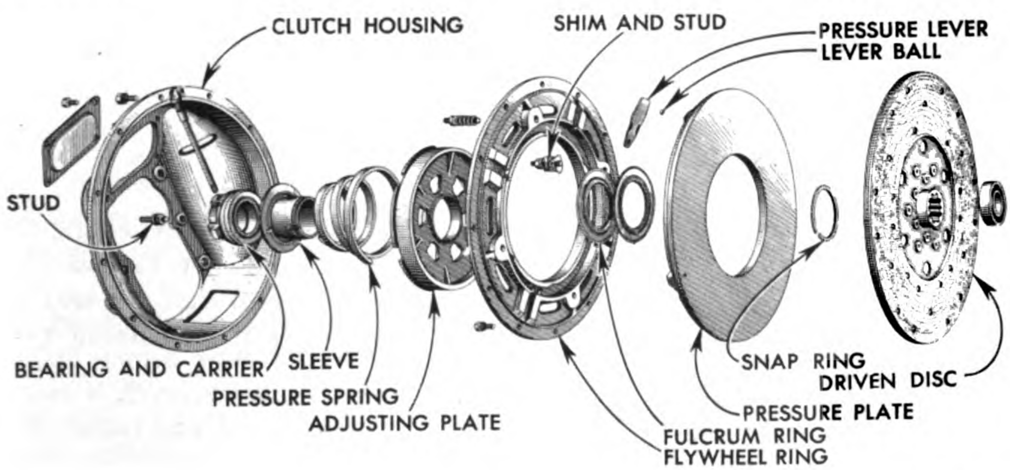
ASSEMBLING TOURNAPULL

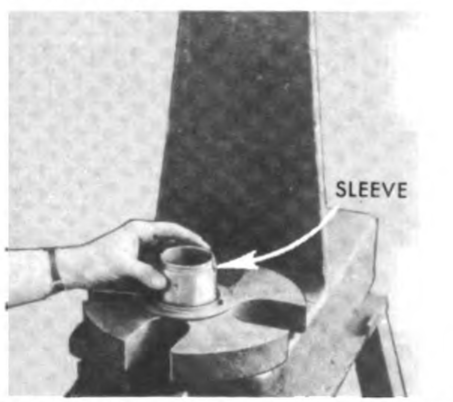
With the exception of a few specific points, the general instructions for assembling the Tournapull are simply the reverse of the instructions for disassembling, covered on Pages 124 to 143 of this section. The specific points to be given careful attention during the assembling process are covered on this and the succeeding pages.

The order in which the various units are covered is the reverse of the order in which they are covered in the Disassembly Instructions.

ASSEMBLING FLYWHEEL CLUTCH

The instructions which follow give full information needed for assembling the flywheel clutch cover plate assembly. The clutch release yoke, bearing carrier, bearing and pedal are assembled with the transmission and will therefore be found in the Transmission Assembly instructions.





ASSEMBLING COVER PLATE ASSEMBLY

Place sleeve on table of drill or arbor press as illustrated. If face of sleeve is scored, use a new sleeve.

With large coil of the pressure spring abutting the small boss in the adjusting plate, place the flywheel ring, adjusting plate, and spring above the sleeve. The sleeve must be a "free-fit" in adjusting plate.

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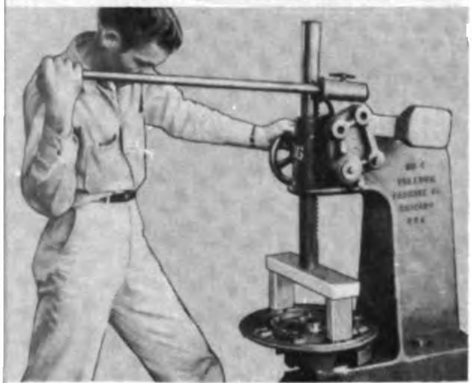
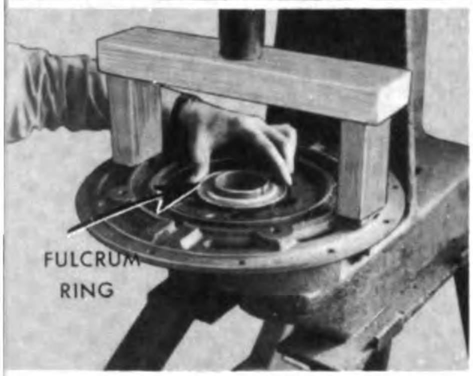
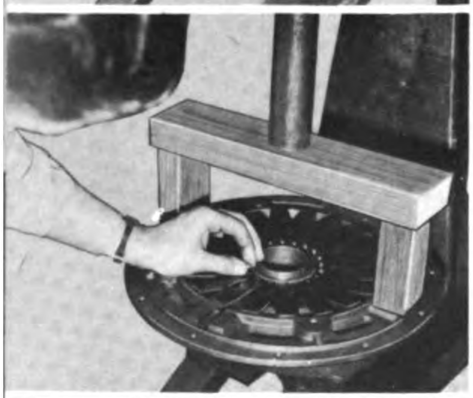


Arrange two blocks and a bar on the assembly as illustrated. Compress the assembly carefully and lock the press.



Check the fulcrum rings for flatness or excessive wear. Select two good fulcrum rings and place one of them, cupped side up, over the sleeve.

Arrange the 20 levers (if used levers, be sure they are straight and not excessively worn) on the fulcrum ring so that the end of the levers nest just inside the retaining rim of the flywheel ring.



Place one ball in each of the holes in the small end of the levers.

Assemble the remaining fulcrum ring firmly and carefully over the sleeve. **Be sure** no ball bearings become displaced, nor that the levers overlap each other.

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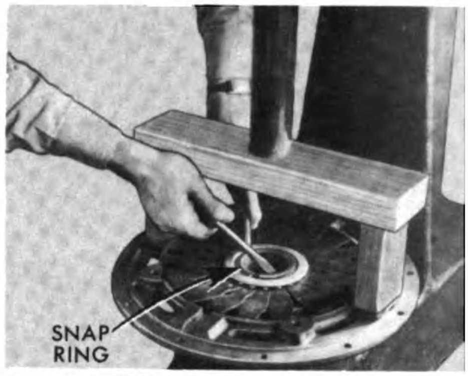
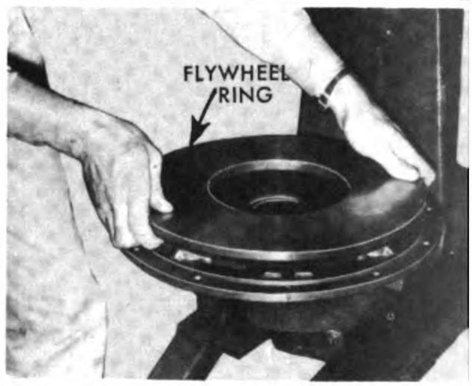
Place a new snap ring on the sleeve, slipping it down into its groove around the upper end of the sleeve.

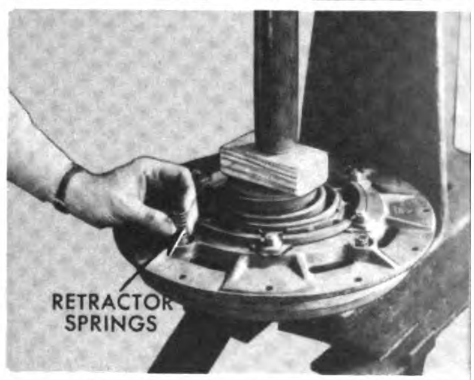


By use of a hammer and punch, chisel, or similar tool, tap the snap ring back firmly into its seat. The ends of the snap ring should not be in line with the keyways in the sleeve. Best results are obtained if this operation is started opposite the snap ring ends and from this point work toward the ends.

Test each of the 20 levers to see that they are locked in place by a ball bearing. Then remove blocks and assemble pressure plate in the four driving slots of the flywheel ring. (Pressure plates dished in excess of .015″ or badly scored should be replaced with new plates.) Pressure plate must be free in slots in flywheel ring. Approximately .004″ to .006″ looseness must be provided. If old plate is used, assemble with "0" marked driving lug in "0" marked driving slot.



Turn assembly over and compress large coil spring. Install small retractor springs. The coils should be open, not closed. Use new springs if old ones are shorter than 1⅜″.



Install the special washer over the top of each spring and insert the small lock pin to hold the spring in place.

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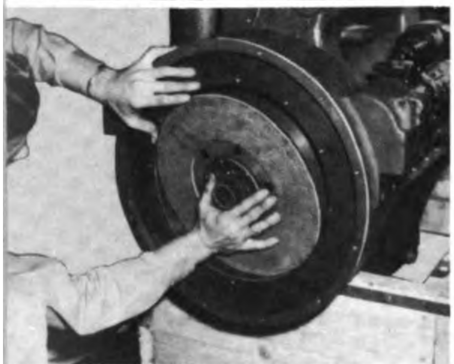

INSTALLING FLYWHEEL CLUTCH

(The clutch release yoke, bearing carrier, bearing, and pedal are assembled with the transmission and will therefore be found in the Transmission Assembly instructions.)

To install the clutch pilot bearing, lined driven plate and cover plate assembly on the engine flywheel, first hand-pack the pilot bearing with recommended lubricant. (See lubrication instructions in Operation Section.)

Install pilot bearing in flywheel bore, making sure covered side faces outward. It may be necessary to drive bearing into its seat.

Install lined driven disc in position in recess in flywheel, with pointed ends of splines in hub of driven plate facing outward. For best results, replace old, worn lined driven plates with new ones rather than trying to reface, since refaced plates are often bent and otherwise impaired so that difficult clutch action results.

Install the cover plate assembly in position on the flywheel. If a new lined driven plate has been installed (or new facing assembled to the old driven plate) the adjusting straps should first be removed from the cover plate assembly and the required number of shims (approx. 7) placed under each adjusting strap. Install an equal number of shims under each strap.

Secure the cover plate assembly to the flywheel by installing the capscrews and lockwashers. Before drawing the cover plate assembly down tight, it is important that the lined driven disc be centered with the pilot bearing to cause them to line up with the clutch shaft in the front of the transmission when installing the transmission on the engine. The use of a spare splined clutch shaft or a universal clutch hub aligning tool is recommended for this "centering" operation, as illustrated.

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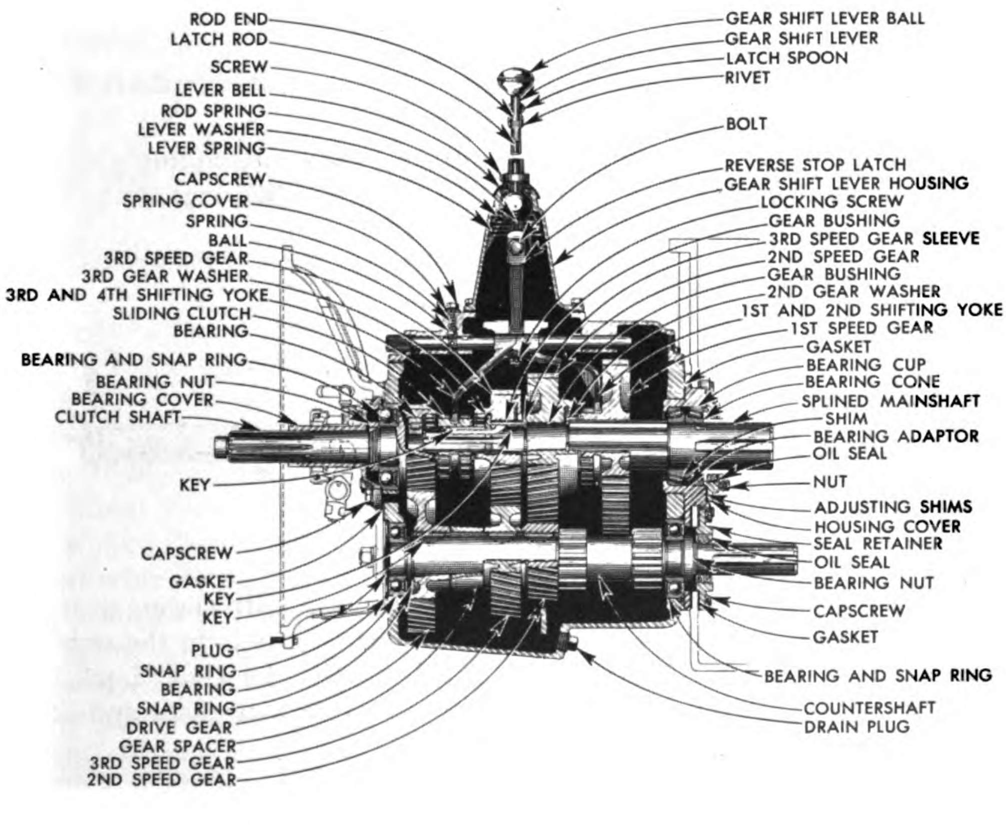
ASSEMBLING TRANSMISSION

Inasmuch as the general instructions for assembling the transmission are merely a reversal of those for disassembly, the transmission disassembly instructions and illustrations on Pages 138 to 142 of the Repair Section can be referred to as a guide in re-assembling the transmission.

The parts of the transmission should be assembled in the following order:

1. If the clutch housing has been removed from the transmission case. re-install it on the case, making use of the dowel pins by which the housing is located. Extreme care should be taken to maintain the alignment between the machined face of the housing and the mainshaft bores of the case; also the concentricity of the mainshaft bores and the flange pilot. Tighten the nuts gradually on the studs when installing. The clutch housing should be marked for alignment with punch marks before removing and then re-installed in the same position.



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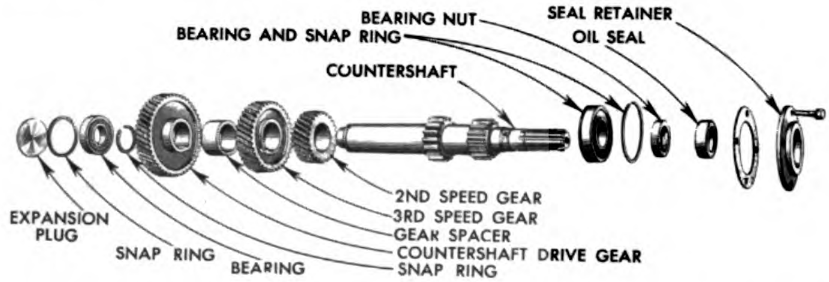
2. Install the gears, etc., on the large end of the countershaft as follows: small gear, medium gear, spacer, large gear, snap ring, and bearing, in the order listed. Don't overlook the Woodruff key in the hub of each gear. The gears should be installed on the shaft with the teeth on the gears pointing in the direction shown in the illustration.

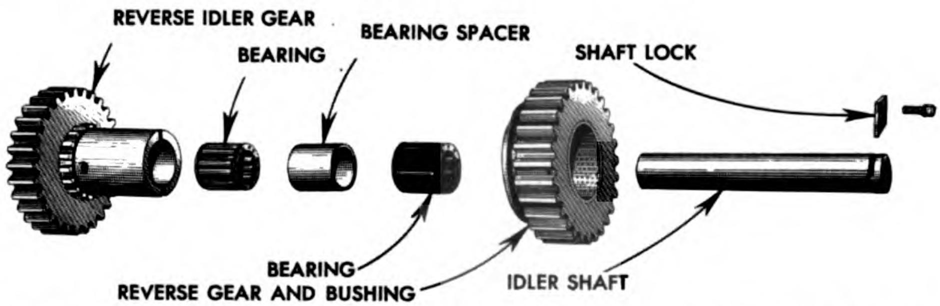


3. Lower the countershaft assembly into position in the case, inserting the splined end of the shaft out through the lower bearing bore in the rear of the case.

4. Press (or drive) the rear bearing (with snap ring) into position on the countershaft and then install the rear bearing nut on the shaft The nut can be turned up tight against the bearing after the mainshaft is installed in the case.

5. Install the plug and snap ring at front end of countershaft if removed.

6. Assemble the reverse idler assembly by installing sliding gear on extended hub of idler gear. Also install the two roller bearings in the hub of the idler gear, placing the spacer between the two.



7. Lower the reverse idler assembly into the case, with sliding gear to the rear, and insert the reverse idler shaft through its hole in the rear of the case and through the bearings in the hub of the idler gear. Lock the reverse idler shaft in position by installing the small lock plate and capscrew at the rear end of the shaft.

8. Install the bearing and bearing nut on the clutch shaft and drive gear and install it in position in the case, positioning the bearing in the upper bore at the front of the case. Then slide the extended bearing cover and gasket back over the shaft and install the capscrews and lockwashers which secure it to the case.

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9. The flywheel clutch release mechanism can be installed at the front of the case either now or later. This group consists of release bearing, bearing carrier, grease tube, springs, release yoke, and yoke shafts. The bearing carrier should be installed over the extended bearing cover with the bearing facing front. Do not forget Woodruff key on left yoke shaft. Wire heads of yoke set screws after tightening.

10. Install the rear bearings and bearing adaptor on the rear end of the mainshaft before installing the shaft. This can best be done in an arbor press, if available. Install between the bearing cones any shims that were removed at this point during disassembly. Also install the oil seal in the rear bearing cover and install the rear bearing cover on the adaptor, inserting between the two enough shims to correctly adjust the bearings. Bearings are correctly adjusted when the mainshaft will turn in the adaptor, without end play and without heavy drag). The bearing cover and shims should be installed with the oil return holes on bottom. The spiral bevel pinion can be installed on the end of the shaft either now or later, as desired. If installed now, the pinion retainer screw in the end of the shaft should be left only partially tightened, and the final tightening done after the transmission is installed in the Tournapull.

11. Place the gasket on the studs at the rear of the case and then insert the mainshaft through the upper bore in the rear of the case. As the front of the shaft enters the case, assemble the gears, etc., on the shaft in the following order: 1st speed sliding gear, round washer, 2nd speed gear, small Woodruff key, bushing, 3rd speed gear, slotted washer, large key, sliding clutch, and pilot bearing. The 1st speed gear should be installed with clutch teeth forward, 2nd speed gear with clutch teeth to the rear, and 3rd speed gear with clutch teeth forward. Also, the recessed end of the sliding clutch should face the rear. Extreme care should be taken to line up keyway in 2nd gear bushing with small key in shaft before installing bushing on shaft.

The end play of the mainshaft bushed gears on the shaft should be checked after installation. The end play in both gears should be held to a minimum of .006″. If excessive end play is found, new washers should be installed to help maintain the original fit. Excessive radial clearance of the gears on the shaft can be eliminated by replacing worn bushings with new ones. Excessive radial clearance can be established by a com-

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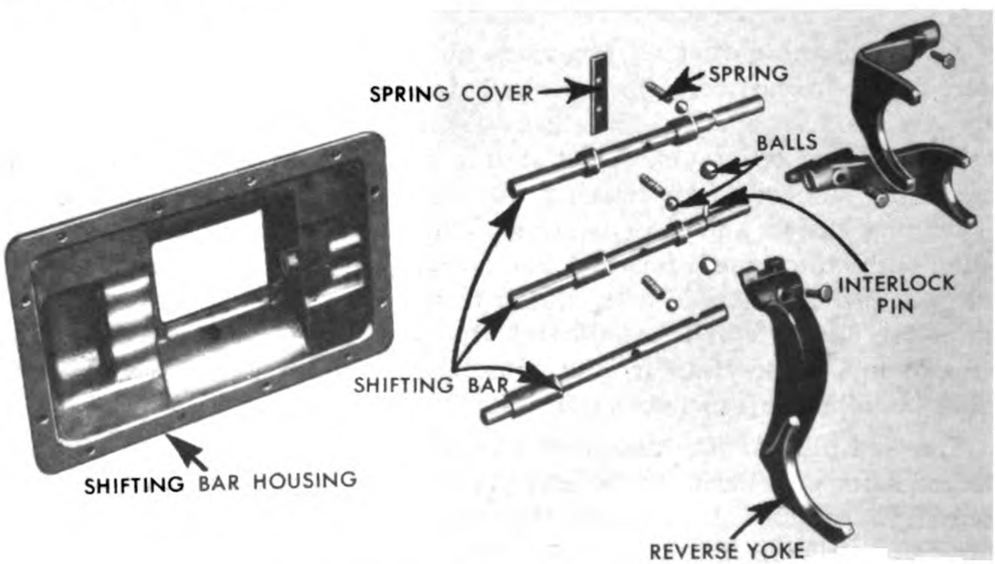
parison with the total clearance of .002"-.003" provided in new transmissions. When assembling new or re-bushed gears on shaft, make sure that they move freely after being assembled in their proper places. Coat shaft with oil before installing bushed gears on shaft.

12. Press or drive the bearing adaptor into its bore in the rear of the case, thereby moving the mainshaft forward, into its final position. Guide the front of the shaft and bearing into the recess at the rear of the clutch shaft and gear.

13. Now shift the transmission into two speeds by engaging both the high speed sliding clutch and the first speed sliding gear, thereby locking the shafts and preventing them from turning. Now turn the rear bearing nut up tight on the countershaft and lock the nut by peening an edge down against the shaft.

14. Install shifting bars and shifting yokes in shifting bar housing. The relative positions of the parts are as illustrated. Do not forget to install the two larger steel balls between the shifting bars and also the small interlock pin in the pin hole in the middle shifting bar. These parts are important and must not be overlooked or else serious damage may result by shifting into two gears at once. Locate the shifting yokes on the shifting bars and tighten and lock the shifting yoke set screws in the notches in the shifting bars. Install the three small steel balls and tension springs in the three vertical holes above the shifting bars and install tension spring cover. Also install the thimbles and Whelch plugs in position in the shifting bar housing.

15. Install shifting bar housing and gasket in position on top of case, positioning lower ends of shifting yokes into the yoke slots in the first speed sliding gear, reverse speed sliding gear, and the third and fourth speed sliding clutch.



EXPLODED VIEW OF SHIFTING BAR HOUSING

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16. Assemble the gear shift lever assembly by first installing the reverse latch, spring, and rod on the side of the gear shift lever. Then insert the shift lever into the housing from the lower side and install the washer and spring in the housing, also from bottom side. Then install the bell (dust cover), spoon, rod end, and gear shift ball on upper end of gear shift lever. Also install small pivot pin in upper end of housing.

17. Install gear shift lever assembly and gasket on top of shifting bar housing. Locate lower end of gear shift lever in slots in top of shifting yokes.

18. Turn reverse latch set screw into tapped hole in side of gear shift lever housing, only far enough to prevent shift from moving into reverse position without operating the reverse latch.

If the spiral bevel pinion has not yet been installed on the rear of the mainshaft, this can now be done, but the pinion retainer screw should not be given its final tightening until after the transmission is installed in the Tournapull.

INSTALLING TRANSMISSION

To install the transmission in the Tournapull, reverse the procedure for its removal.

1. If the steering clutch and spiral bevel gear assembly is in place in the case, the spiral bevel gear should be backed off as far to the right as possible. Also, with the assembly in place, it is necessary that the spiral bevel pinion be installed on the transmission mainshaft before the transmission is installed. Because it is difficult to sufficiently tighten the pinion retainer screw in the end of the mainshaft without the transmission being held solidly in position in the Tournapull, the retainer screw should not be given its final tightening until after the transmission has been installed.

For convenience, the flywheel clutch pedal and the hydraulic brake master cylinder and pedal should be installed in place on the transmission before the transmission is installed in the Tournapull.

2. Place the transmission to main case gasket on the rear of the transmission case and then hoist the transmission into position, using a chain hoist, lining up the stud bolts on the rear of the transmission with the corresponding holes in the main case. (IMPORTANT: Machines having serial number C3T-2922 CIF and up use a .010" thick gasket; machines below that serial number use a .032" gasket.)

3. If the Power Control Unit has not been removed from the Tournapull it will be necessary to slide the oil seal retainer plate (with oil seal and gasket) over the end of the transmission countershaft as it moves back into the case. Also, the Power Control Unit spline shaft must be in position, so that the countershaft will slip back into the internal splines at the front end of the spline shaft.

4. Draw the transmission up tight against the main case, using the hex nuts on the end of the transmission stud bolts which project into the main case. (A copper washer and two nuts must be installed on the end of each stud bolt.)

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5. If the oil seal retainer plate has not already been slipped over the countershaft, install the retainer plate (with gasket and oil seal), being careful to avoid damaging oil seal. Install and tighten the four capscrews and lockwashers in the retainer plate.

6. The spiral bevel pinion should now be installed on the end of the mainshaft (if not already installed).

Give pinion lock screw its final tightening by placing the transmission in low gear and using a wrench with a long extension, such as a pipe, on the head of the screw, while holding the countershaft from turning. (If no suitable wrench is available for holding the countershaft without damaging the splines, the tightening of the retainer screw can be left until after the engine has been installed, and then tightened against the compression of the engine.) Tighten the retainer screw as tight as possible. Then lock the screw by peening back the edge of the screw head into the slot in the end of the pinion. It is usually necessary to heat the edge of the screw head before it can be bent or peened back into the slot in the pinion.

7. If the steering clutch and spiral bevel gear assembly is in place and the engine is installed, adjust the gear carrier bearings and spiral bevel gear and pinion lash, as outlined in the Tournapull adjustment instructions. Also, as a precautionary measure,. paint the teeth of the spiral bevel gear and pinion with red lead and rotate the gear to determine the point of contact between the two. If the gear and pinion are in correct alignment, the print of the teeth will be located approximately 1/3 of the way up from the small end of the teeth. If not as specified, possibly the incorrect thickness of gasket is used between the transmission bearing adaptor and the main case or an incorrect number of shims are used at the front engine hanger.

INSTALLING ENGINE

Before installing the engine in the Tournapull, the flywheel clutch lined driven disc and cover plate assembly should be installed on the engine flywheel and the clutch release mechanism installed in the clutch housing of the transmission. (See instructions for "Installing Flywheel Clutch" and "Assembling Transmission.") Also, the transmission must first be installed as outlined in preceding instructions. Then proceed as follows:

1. Raise engine into position, using a chain hoist and lifting hooks of the type illustrated in engine removal instructions. Line flywheel clutch at rear of engine flywheel up with clutch shaft on front of transmission, rotating either shaft or flywheel, if necessary, to cause alignment of splines on shaft and in hub of clutch driven plate. Then move engine to the rear, until clutch shaft is inserted in clutch pilot bearing in flywheel and engine flywheel housing is positioned against clutch housing.

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2. If the same engine is being re-installed, place the same shims under the front engine hanger and at the rear engine support lugs as were removed. This is important in order to assure proper alignment of spiral bevel pinion with spiral bevel gear.

If a replacement engine is being installed, it will be necessary to first install the amount of shims under the front engine hanger that is needed to cause the face of the flywheel housing to align perfectly with the bolt circle of the clutch housing. This can best be determined by carefully supporting the engine with the chain hoist while installing, so that none of the weight of the engine is thrown on the clutch shaft or transmission. When the engine flywheel housing is brought within approximately ¼" of the clutch housing, check the space between the housings to see if it is equal at both the top and bottom sides. Insert enough shims under the front engine hanger to cause the space between the clutch and flywheel housings to be equal at both the top and bottom sides of the housings. Also insert enough shims at the rear engine support lugs to fill the space between the lugs and brackets.

3. With the engine moved back into position so that the clutch and flywheel housings are brought together, install the capscrews and lockwashers which secure the engine to the transmission.

4. Install the engine mounting bolts at both the front engine hanger and the rear engine support lugs.

5. The fuel line can now be connected with the fuel pipe between the fuel tanks, and the lube oil lines connected with the lube oil filter.

INSTALLING DASH PANEL

Unless the dash panel has become damaged through accident and requires replacing, it is normally removed with the engine in order to eliminate the necessity for re-connecting the controls. Thus, after re-installing an engine, all that is required in installing the dash panel is correctly positioning it on the frame and then re-installing the bolts and lockwashers which secure it to the frame.

If the dash panel was separated from the engine, it will be necessary to re-install the controls, wires, etc.

INSTALLING RADIATOR

To re-install a radiator, raise it into position at the front of the frame with a chain hoist. Place below the radiator the same metal and fibre shims or spacers that were removed, or enough new metal and fibre spacers to equal the same thickness. Install the two radiator mounting bolts up through holes in the bottom of the frame. Then connect the radiator with the engine by installing the upper and lower hose connections. Also re-install the radiator braces and head lights.

INSTALLING BUMPER

To install the bumper at the front of the Tournapull, merely raise it into position and re-install the bolts which secure it to the frame.

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INSTALLING HOOD

To install the hood, lower it into position (with pre-cleaners removed from air cleaners) and then install the bolts which connect it with the radiator and dash panel.

INSTALLING DRAWBAR

To install the drawbar on the Tournapull, raise it into position below the main case and install the two clamp blocks which secure the upper and lower extended ends of the drawbar ball structure to the hitch bracket on the case. In installing these clamp blocks, use shims or spacers between the clamp blocks and U shaped hitch bracket, of sufficient thickness to eliminate any space between the two when the clamp block is drawn up tight against the drawbar hitch ball. Wire the heads of the clamp block capscrews after tightening.

INSTALLING FINAL DRIVE GEARS AND AXLES

1. To install the final drive gears and axles, first install the inner oil seal boss on the axle, if removed. Also install the oil seal in the oil seal retainer, with the heavy leather cupped toward the inner side of the retainer, and slip the retainer and oil seal over the axle and onto the oil seal ring.

2. Heat the axle outer bearing cone in hot oil and then press or drive it on the axle, up against the shoulder.

3. Install the bearing cups in the bores in the case, if removed.

4. Lower the final drive gear into the gear and pinion compartment of the case, using a metal band or heavy rope sling, as illustrated in the gear removal instructions. The teeth on the gear should point forward when looking down at the top of the gear.

5. Place a gasket in position against the outer oil seal retainer, cementing it to the retainer with a gasket sealer of some kind. Then, with the final drive gear supported in place, insert the outer end of the axle through the axle bore in the side of the case, through the hub of the gear, and on through the axle inner bearing bore. In installing the axle through the gear hub, it may be necessary to rotate the axle to bring the axle splines into alignment with the corresponding splines in the hub of the gear.

6. Install the axle inner bearing cone on the end of the axle through the axle inner bearing inspection hole, lining up the slot in the cone with the keyway in the end of the axle, and install the key in the keyway.

7. Install the adjusting plate and capscrews on the end of the axle, and tighten the capscrews a little at a time until the point is reached where all axle end play is eliminated without placing a heavy drag on the bearings. Then remove the adjusting plate, lock plate and capscrews and insert enough shims between the end of the axle and the adjusting plate to just fill the space between the end of the axle and the plate, when compressed. Then install the adjusting plate, lock plate and capscrews,

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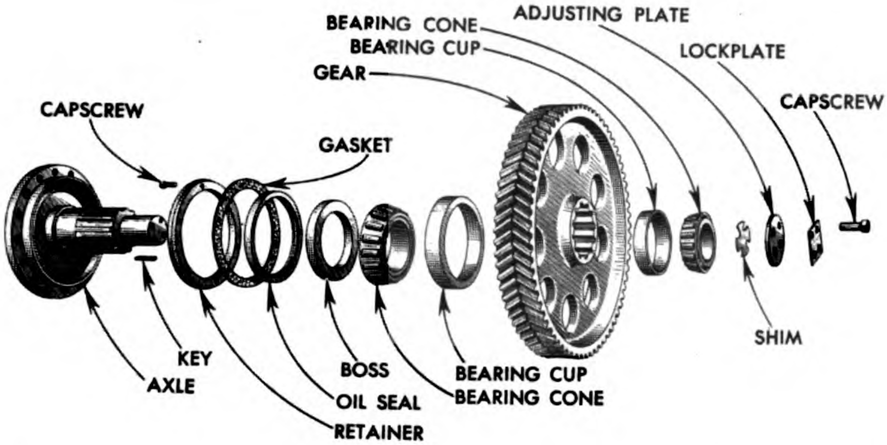
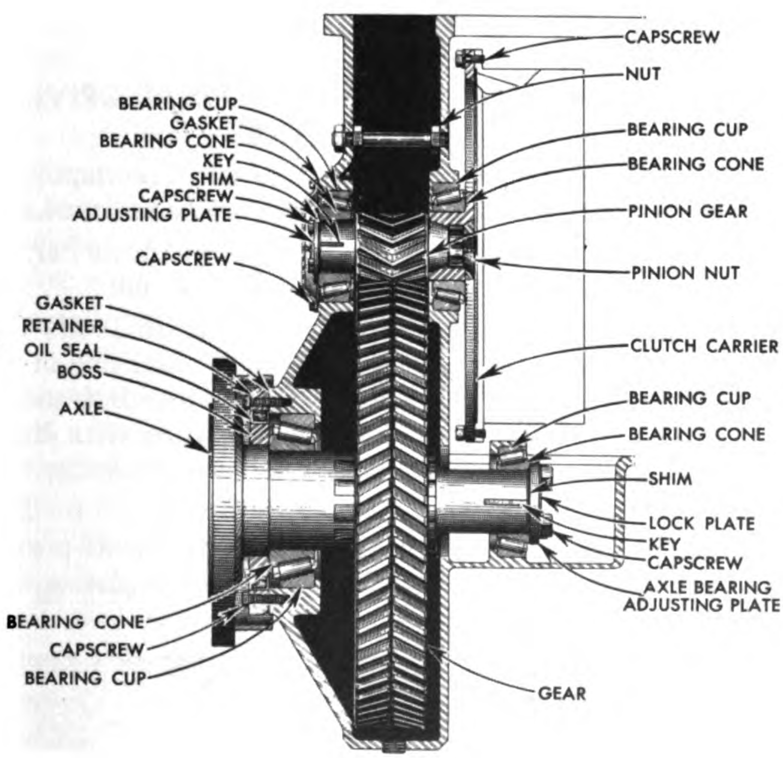


turning the capscrews up tight. Again check the bearings for end play or drag, and make any necessary corrections in the adjustment by removing or adding shims, as required. Make final check by use of a small piece of .002" shim stock as outlined in Axle Bearing Adjustment instructions. Lock the capscrews by bending the corners of the lock plate back against the heads of the capscrews.

8. Install the capscrews which secure the oil seal retainer to the case, using a wrench through the hole in the axle flange. Rotate the axle to reach all the capscrew holes.



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INSTALLING STAY-BOLTS

The stay-bolts must be removed from the case before removal of the final drive gear and should be re-installed after installing a final drive gear.

1. To install the stay-bolts, first measure accurately the distance between the outer and inner partition walls at each of the stay-bolt holes. This is done in order that a similar check after the stay-bolts have been installed will show whether the case has been spread in installing the stay-bolts.

2. Insert the stay-bolts through the holes in the side of the case. As the stay-bolt enters the case, slip one of the large hex nuts over the stay-bolt. Also turn the small hex nut all the way onto the threads at the inner end of the stay-bolts and then turn the end of the stay-bolt into the tapped hole in the inner partition. Then turn the larger nut (that was slipped over the stay-bolt) up onto the threads at the outer end of the bolt. Tighten the nut up tight against the case, but not tight enough to spread the case.

3. Install and tighten the hex nut and washer on the outer end of the stay-bolts.

4. Measure the distance between the side of the outer and inner partitions at each stay-bolt as before, to make sure that the case has not been spread or distorted. Re-adjust the nuts on the stay-bolts, if necessary, in order to maintain the original measurement. Distortion of the case would cause final drive axle and pinion bearing misalignment.

5. Check the axle bearing adjustment, and, if affected by the installation of the stay-bolts, correct as needed. Do likewise with the pinion bearings if pinion has been installed.

ASSEMBLING AND INSTALLING FINAL DRIVE PINION ASSEMBLIES

To install a final drive pinion assembly in the Tournapull, it is first necessary to assemble the clutch carrier on the pinion as follows:

1. Install the bearing cone on the hub of the clutch carrier. This can best be done by first heating the bearing cone in hot oil.

2. Heat the clutch carrier plate (with bearing installed) in hot oil. Then, while hot, press or drive the splined end of the pinion tight into the hub of the clutch carrier, and turn the tapered nut onto the threaded end of the pinion, using the special wrench supplied with Tournapull. Turn the nut as tight as possible, using a small sledge on the end of the wrench.

3. When the pinion nut has been tightened as tight as possible, lock the nut by peening an edge of the nut back into the slot in the clutch carrier.

4. If the bearing cups have been removed, press new ones into the bearing seats in the case.

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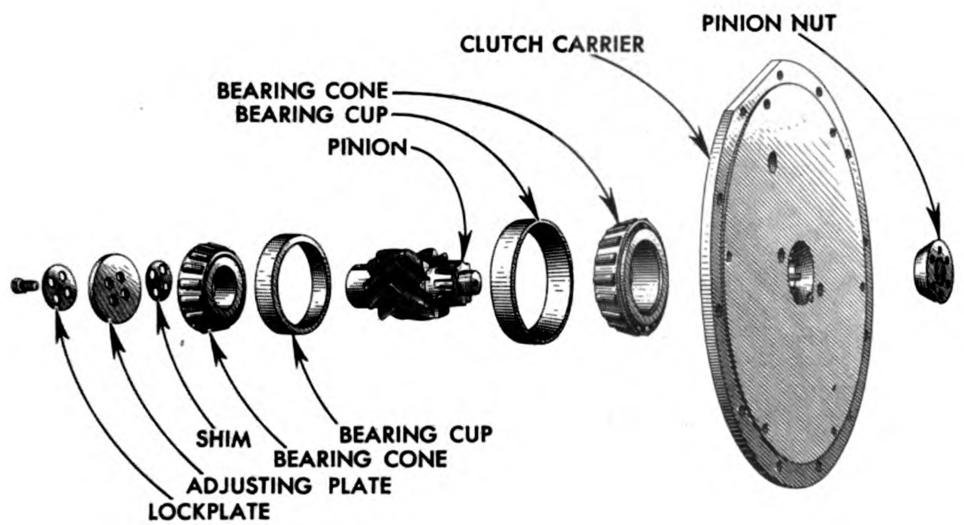

5. Lift the pinion into the center compartment of the main case, and with the flat side of the clutch carrier at the bottom, insert the pinion through the inner bearing cup, and on through the outer bearing cup, keeping the pinion raised high enough to clear the herringbone teeth of the final drive gear. Lower the pinion into mesh with the final drive gear as it passes through the outer bearing cup.

6. Install the outer bearing cone on the end of the pinion, lining up the slot in the bearing with the keyway in the pinion, and install the key in the keyway.

7. Install the adjusting plate and capscrews on the end of the pinion and turn the capscrews, a little at a time, until the bearing has been drawn up tight enough to eliminate pinion end play without placing a heavy drag on the bearings. Then remove the adjusting plate and install enough shims at the end of the pinion to just fill the space between the pinion and adjusting plate when compressed.

Then install the adjusting plate, lock plate and capscrews at the end of the pinion and turn the capscrews up tight.

Again check the pinion bearings by seeing if all end play of the pinion is eliminated without the bearings being drawn up so tight that the pinion cannot be turned by hand. Remove or add shims if needed.

Make final bearing check by use of a small piece of .002″ shim stock as outlined in Final Drive Pinion Bearing Adjustment Instructions.

With the bearings correctly adjusted, lock the capscrews by bending the edges of the lock plate back against the heads of the capscrews.

Then install the pinion bearing inspection plate and gasket at the end of the pinion.

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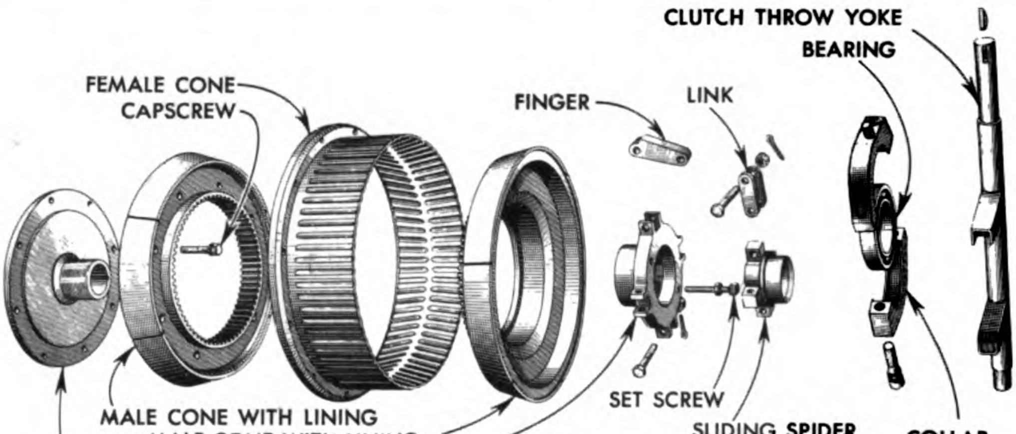

ASSEMBLING STEERING CLUTCHES

The procedure for assembling a steering clutch is the reverse of that for disassembly, and the illustrations in the disassembly instructions may therefore be used for reference when re-assembling the clutches.

To assembly a steering clutch, assemble the parts in the following order:

1. Install the clutch throw out bearing on the sliding spider, if removed. After pressing or driving the bearing onto the spider, peen the edge of the spider back against the bearing to hold it on the spider.

2. After installing the bearing, install the throw out collar by placing the two halves of the collar around the bearing and then installing the capscrews and lockwashers. The throw out collar should be installed with the off-center pivot points located away from the clutch.

3. Turn the lock screws and lock nuts a short distance into the adjusting spider.

4. Install the fingers and links which connect the adjusting spider with the sliding spider.

5. Install the internal splined driving cone on the clutch drive plate, if removed, by installing the capscrews through the cone and into the tapped holes in the clutch drive plate.

6. Lay the drive plate and internal splined driving cone on a bench, with the cone facing upward.

7. Lower the driven cone down on the driving cone, with the bolt circle on the driven cone facing downward.

8. Position the external splined driving cone inside the driven cone, lining up the splines with the corresponding splines on the internal splined driving cone.

9. Install the clutch spider assembly in position, turning the adjusting spider a short distance onto the threaded hub of the clutch drive plate.

10. The clutch throw yoke is usually installed just before installing the steering clutch and spiral bevel gear assembly in the case.

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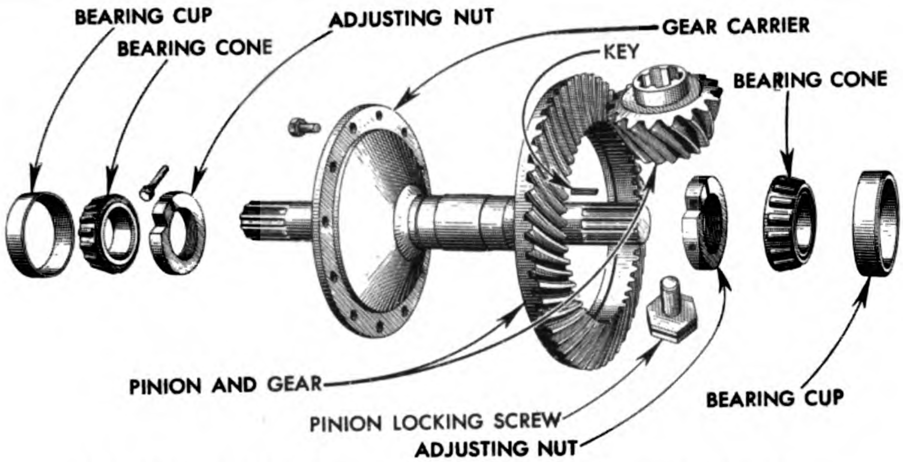

ASSEMBLING STEERING CLUTCH AND SPIRAL BEVEL GEAR ASSEMBLY

To assemble the steering clutch and spiral bevel gear assembly, install the parts in the following order:

1. Install the spiral bevel gear on the gear carrier (if removed) leaving out five consecutive capscrews and lockwashers until after the assembly has been installed in the case. (NOTE:—The spiral bevel gears and pinions come in matched sets and it should therefore be made certain that the gear that is installed is a mate to the pinion.)

2. Turn the bearing adjusting nuts onto the threads on the gear carrier. Install the Allenhead capscrews in the adjusting nuts, but do not tighten.

3. Install the keys in the keyways in the gear carrier and then install the bearing cones over the ends of the gear carrier shaft, lining up the slots in the bearing cones with the keys in the gear carrier.

4. Slide the bearing cups over the ends of the gear carrier and onto the bearing cones.

5. Then slide the steering clutches onto the ends of the gear carrier, lining up the splines on the gear carrier with the corresponding splines in the hub of the clutch drive plate.

6. Install the brake bands over the steering clutch driven cones. The rear end of the brake band is the end that has the small spring clip welded to the lug at the end of the band.

7. Place the small pivot bushings on the pivot arms extending vertically from the throw-out collar, and slide the ends of the clutch throw yoke onto these bushings. Be very careful not to lose the bushings in this operation. Extend a wire from the top of the clutch throw yoke to one of the upper capscrew holes in the flange of the clutch driven cone, to wire the yoke to the cone and thereby prevent the yoke from sliding off the throwout collar when installing.

The steering clutch and spiral bevel gear assembly is now ready to be installed in the case.

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INSTALLING THE STEERING CLUTCH AND SPIRAL BEVEL GEAR ASSEMBLY

To install the steering clutch and spiral bevel gear assembly, the final drive pinions, gears, and axles should first be installed in the case.

Then, with the steering clutch and spiral bevel gear assembly completely assembled as outlined in the preceding instructions, proceed as follows:

1. Install the clutch throw yoke bushings in the bottom of the case, if removed.

2. Connect a chain hoist to the assembly with which to raise it into position in the case. In raising the assembly, care must be exercised to keep it balanced and to keep the steering clutches from sliding off the ends of the clutch carrier. Therefore, a special lifting device of the type illustrated in the disassembly instructions should be used, if available. If not available, the hoist chain should be wrapped around the gear carrier, up against the left side of the spiral bevel gear, and the assembly balanced by hand when being raised into the case. Also, the two clutch driven cones should be wired together to keep them from sliding off the gear carrier.

3. With the gear carrier turned so that the five capscrew holes from which the capscrews were omitted are located on the bottom, raise the assembly into the case. While lowering it into position in the case, guide the gear carrier bearing cups into their seats in the case, and also guide the lower ends of the clutch throw yokes into the bushings in the bottom of the case. If the transmission is installed in the Tournapull, extreme care must be taken when lowering the assembly into position in the case, to prevent the teeth on the spiral bevel gear from binding and chipping the teeth on the spiral bevel pinion. In lowering the assembly, the left side should be slightly forward and the right side slightly to the rear, to permit the gear and pinion to roll into mesh without binding the teeth. The transmission should be shifted into neutral for this operation.

4. Remove the hoist chain and also the wires connecting the driven cones and clutch throw yokes. Then install the bearing clamp blocks (and shims) over the gear carrier bearing cups. (NOTE:—These bearing clamp blocks and shims are machined with the case and are not interchangeable from one side to the other or from one Tournapull to another. They are stamped "L" and "R" to indicate whether they are to be installed on the left or right sides.) If the dowel pins came out during removal, they must be re-installed.

5. Rotate the spiral bevel gear one half turn and install the remaining five capscrews and lockwashers which were omitted from the gear carrier.

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6. Turn the bearing adjusting nuts as required to obtain the correct lash between the spiral bevel gear and pinion, and also the correct adjustment on the gear carrier bearings. (Refer to "Spiral Bevel Gear Carrier Bearing Adjustment and Gear and Pinion Lash Adjustment," for instructions.

7. Install the capscrews and lockwashers which secure the clutch driven cones to the clutch carriers. The capscrews can be reached with a wrench by inserting the wrench through the pipe plug hole in the side of the case. Rotate the steering clutch to reach all the capscrews.

8. Install the brake adjusting blocks at the rear of the brake bands and the brake actuator lever assemblies, including actuator stops, at the front of the brake bands. The nuts on the brake adjusting blocks can be turned into an adjustment that is approximately correct, but the final adjusting can be done only after the deck plate is installed and the clutch and brake levers and linkage connected with the clutches and brakes. Adjust the small release spring as in step 1, page 93, before installing deck plate.

INSTALLING DECK PLATE

1. To install the deck plate, first place the gasket in position on top of the case. In order to hold the gasket in position on the case, stud bolts can be inserted in some of the bolt holes. These stud bolts also help in correctly positioning the deck plate on the case. The stud bolts can be removed after the deck plate has been positioned on the top of the case.

Another effective method of holding the gasket on the case is to tie the gasket to the case by means of strings extended through the capscrew holes in the top of the case.

2. For convenience, remove the clutch throw yoke bushings and oil seals from the deck plate before installation. Also move the brake actuator back over-center as outlined in step 3, page 93.

3. Using a chain hoist, raise the deck plate in position over the case, lining up the holes in the deck plate with the upper ends of the clutch throw yokes, and lower the deck plate in position on the case.

4. Install the taper head capscrews in the deck plate first. Then install the remaining capscrews, not overlooking the three capscrews at the rear of the deck plate which can be reached with a wrench through the three holes in the pyramid section of the deck plate.

5. Install the bushings and oil seals over the top of the clutch throw yokes, into the holes in the deck plate.

5. Install the bushings and oil seals over the top of the clutch throw yokes, into the holes in the deck plate.

6. The battery boxes, batteries, operator's seat, and Power Control Unit control levers can now be installed on the deck plate.

7. The Scraper light wire and hydraulic brake line should now be installed on the deck plate, if removed.

8. If the steering clutch, brake levers and floor boards are in place, the clutch and brake linkage can now be installed, connecting the clutch and brake levers with the clutch throw yoke and brake actuator levers. Also, the steering clutch and steering brake adjustment instruc-

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tions in the Operation Section. Do not overlook the correct positioning of the set screws in the rear of the brake actuator housings, as outlined in the steering brake adjustment instructions in the Operation Section.

9. The main case, transmission and engine should be filled to the oil level plug with the recommended oil before starting the engine and turning over the transmission and final drive gears.

INSTALLING STEERING CLUTCH LEVERS AND BRAKE LEVERS

To install the steering clutch and brake levers, first slide the brake levers onto the ends of the lever shafts which extend out the side of the transmission case, and then slide the clutch levers on over the lower ends of the brake levers. Turn the castellated nuts over the ends of the lever shafts and install the cotter pins.

INSTALLING FLOOR BOARDS

1. To install the floor boards, the steering clutch levers, brake levers, flywheel clutch pedal and hydraulic brake pedal should first be installed in place. The pedal pads must be removed from the pedals to permit the center section of the floor board to be lowered into position. Also, both the flywheel clutch pedal and the hydraulic brake pedal should be adjusted as follows before installing the center floor board:

(a) The flywheel clutch pedal arm and set screw should be positioned so that the clutch pedal first starts to work against the clutch at a point 8¼" back of the dash panel, when measured from the dash panel to the rear of the clutch pedal, along the top of the front battery box.

(b) The hydraulic brake pedal should be adjusted so that it first starts to move the piston in the master cylinder at a point 8½" back of the dash panel, when measured from the dash panel to the rear of the pedal, along the top edge of the front battery box. The pedal position can be adjusted by turning the hex head on the end of the push rod which extends out in front of the boot.

2. Before lowering the floor boards in position, make sure the hydraulic brake line is connected at the connection in front of the deck plate (if the deck plate is in position on the case).

3. Lower the floor boards in position and install the capscrews and lockwashers which hold them in place.

4. The pedal pads can now be installed, and the pedals checked to make sure that the necessary pedal lash is present. Pedal lash can be defined as the first free movement of the pedals before the pedals start to act against the clutch or against the piston in the brake master cylinder. The brake pedal lash should be ¼" when measured at the slot in the floor board, while the clutch pedal lash should be approximately 1/2" to ¾" when measured at the same point.

If there is insufficient pedal lash at either pedal, the necessary corrections must be made at the points mentioned above.

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INSTALLING TIRES

The procedure for mounting a tire on a wheel is simply the reverse of that for removing a tire, as outlined in the Disassembly Instructions.

Clean the rim before installing the tire, and paint it if rusty. Place the inner tube and flap in the tire and inflate the inner tube only enough to hold it in place. Then place a round valve cap on the valve stem and lower the tire onto the wheel rim, lining up the valve stem with the valve stem hole in the rim. Then install the sliding ring and locking ring on the wheel, making sure that the locking ring is well seated in its groove. The tire can now be inflated to the correct pressures. In order to properly seat the locking ring and sliding ring, it is usually advisable to overinflate the tire at first and then deflate it to the recommended pressures.

NOTE: *The tires should be installed so that when placed on the machine, they will rotate in the direction indicated by the arrow on the sidewall of the tire, when traveling forward. This is necessary if maximum traction is to be obtained.*

INSTALLING WHEELS

A simple, easy method of installing the wheels on the Tournapull is to roll the wheel up against the axle, lining up one of the capscrew holes in the wheel with a capscrew hole in the axle.

Then turn the axle with the starter until the capscrew hole in the wheel is located the same number of holes from the half-round notch in the inner circumference of the wheel as the corresponding hole in the axle is from the round hole in the axle through which the oil seal retainer capscrews are tightened. Then install one of the wheel capscrews through the capscrew hole in the wheel and into the corresponding tapped hole in the axle, first placing white lead on the capscrew threads.

Now turn the axle so that the capscrew that was just installed is on top, thereby raising the wheel off the ground. The wheel will now be concentric with the axle, permitting installation of the remainder of the taper head capscrews. Use white lead on each capscrew.

Use the special wrench supplied with the Tournapull and a sledge as illustrated in turning the capscrews up tight.

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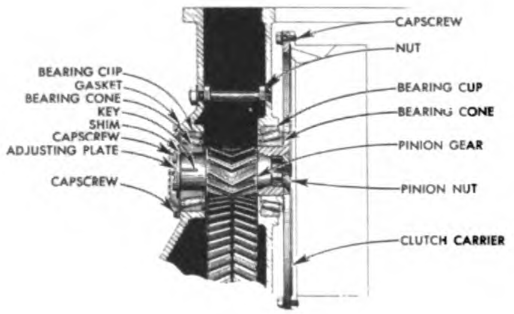


ADJUSTMENTS

Inasmuch as the steering clutch, steering brake, flywheel clutch, and hydraulic brake adjustments can be taken care of by operators, these adjustments are covered in the Operation Section of the manual.

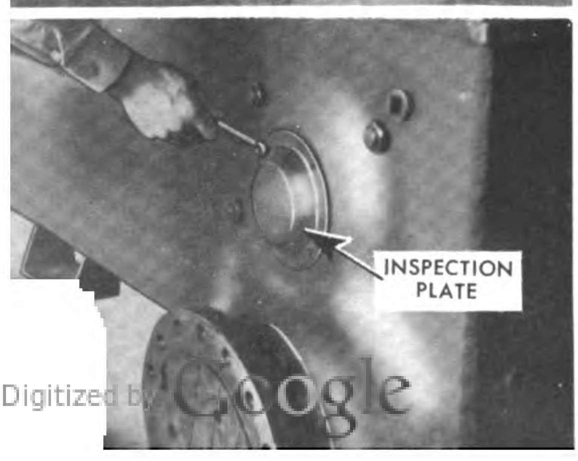
All other Tournapull adjustments are covered on this and the following pages.

FINAL DRIVE PINION BEARING ADJUSTMENT

Occasional adjusting of the final drive pinion bearings is necessary because of bearing wear. It is important that the bearings be kept in the correct adjustment at all times, not only because of the harm that might result to the bearings, pinions, and final drive gears, but also because the alignment of the steering clutch driven cone might be affected if the bearings were loose, thereby possibly affecting the clutch action.

Check the final drive pinion bearings for looseness every 512 hours of operation.

To check the bearings for looseness, first raise the corresponding drive wheel off the ground. This can easily be done by first blocking the rear wheels to keep the Tournapull from rolling, and then blocking up under the fuel tanks near the front, with the Scraper blade resting on the ground. Then engage the Power Control Unit hoist clutch, thereby raising the front wheels off the ground. Also disengage the corresponding steering clutch. In this operation, keep the Tournapull straight with the Scraper and block up under the Scraper blade when raised.



Remove the round pinion bearing inspection plate from the side of the main case.

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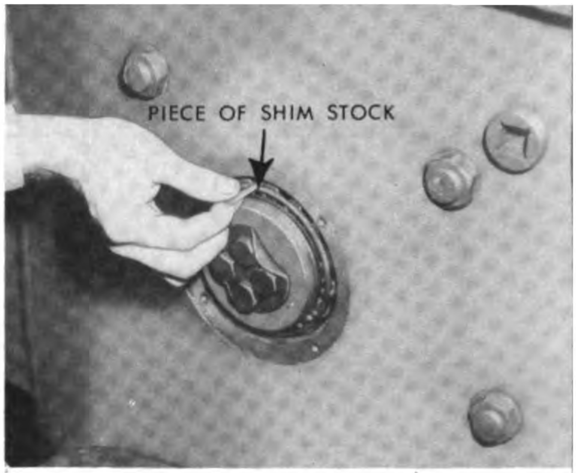
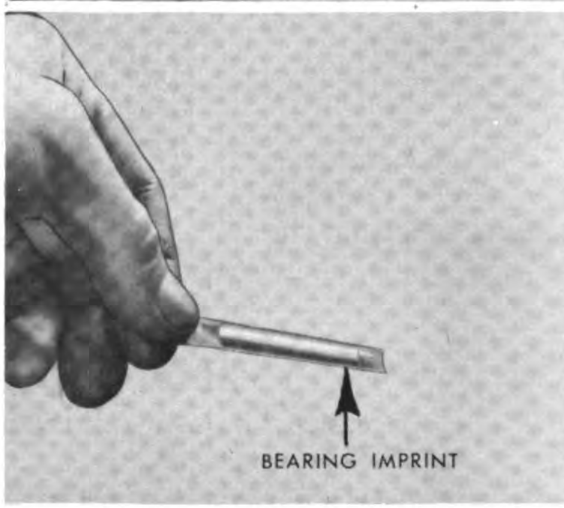
Then, using a small piece of .002" shim stock (brass preferred) approximately 1/4" in width and 2½" or 3" long, check bearings for looseness as follows:

Insert the piece of shim stock between the bearing cone and cup, placing it between the rolls. In doing this, hold the piece of shim stock between the thumb and forefinger of one hand, and insert the shim stock between the rolls, to a depth equal to the length of the rolls. Make sure the piece of shim stock is parallel with the rolls. Rotate the pinion a part of a turn, enough to cause one of the bearing rolls to roll over the piece of shim stock.

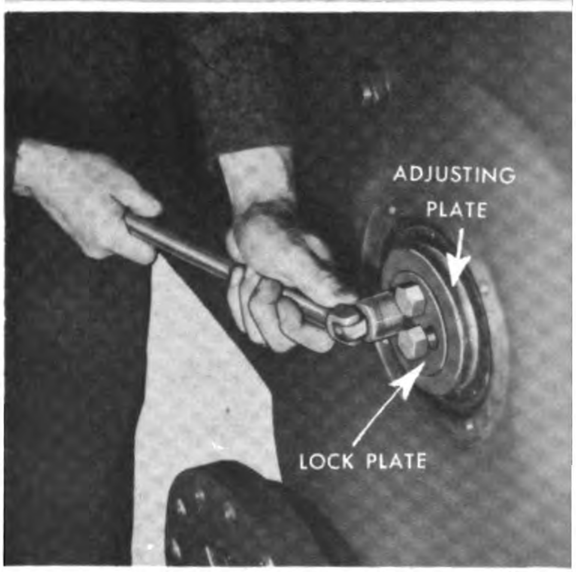


Remove and examine the piece of shim stock, being very careful not to tear off and leave in the bearing any particle of the shim stock, because of the damage that might result to the bearings. If the bearing rolls leave an impression or imprint in the shim stock, the bearings have not reached a looseness great enough to make a take-up in the adjustment necessary, and no adjustment needs to be made. However, if no imprint is left, it is an indication that the bearings are loose and an adjustment should be made.



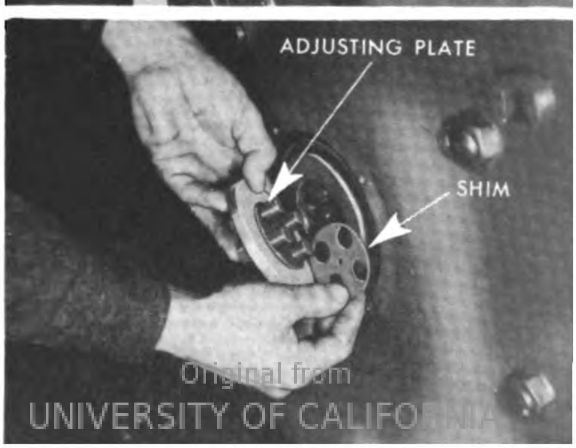
To prevent obtaining a false check from radial loads applied upon the bearings, make the above check at four points—top, bottom, and two sides. Failure of the bearing to make an imprint in the shim stock at any one of these four points is an indication that an adjustment should be made.

Make the adjustment by bending back the corners of the lock plate and then removing the four capscrews from the adjusting plate as shown.



Then remove shims totaling approx. .012" in thickness from between the adjusting plate and end of pinion and re-install adjusting plate, lock plate, and capscrews, turning capscrews up tight and thereby tightening the bearings. (Shims are of three thickness — .004", .0085", and .007".) Before bending back the corners of the lock plate and re-installing the inspection plate, re-check the bearings by again running a piece of .002" shim stock through the bearing and examining it for imprint as before. Remove another shim if no imprint is made.

When making the original adjustment after the Tournapull has been torn down for an overhaul, remove shims one at a time until a good imprint is made in a piece of .002" shim stock.



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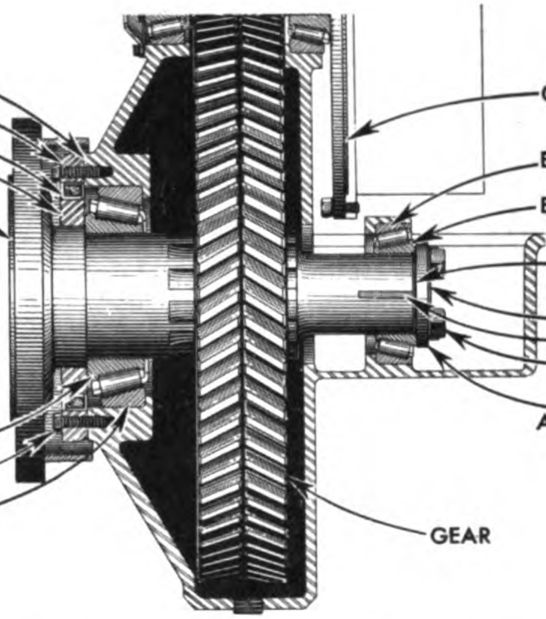

FINAL DRIVE AXLE BEARING ADJUSTMENT

Occasional adjusting of the final drive axle bearings is necessary because of bearing wear.

Check the axle bearings for looseness every 512 hours of operation.

To check the bearings for looseness, first raise the corresponding drive wheel off the ground. This can easily be done by first blocking the rear wheels to keep the Tournapull from rolling and then blocking up under the fuel tanks near the front, with the Scraper blade resting on the ground. Then engage the Power Control Unit hoist clutch, thereby raising the front wheels off the ground. Also drain the oil from the main case. In this operation, keep the Tournapull straight with the Scraper and block up under the Scraper blade.

Remove the axle bearing inspection plate from below the main case as illustrated.

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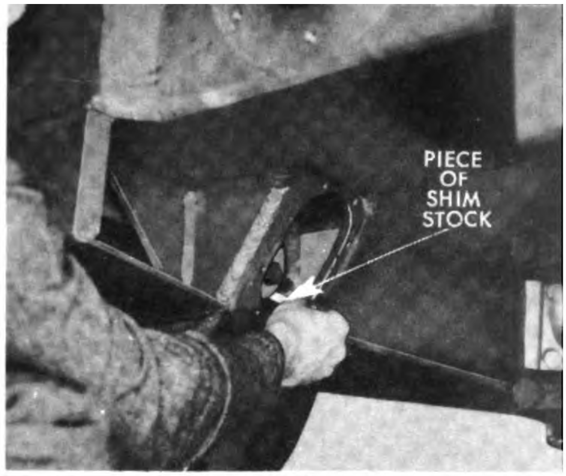
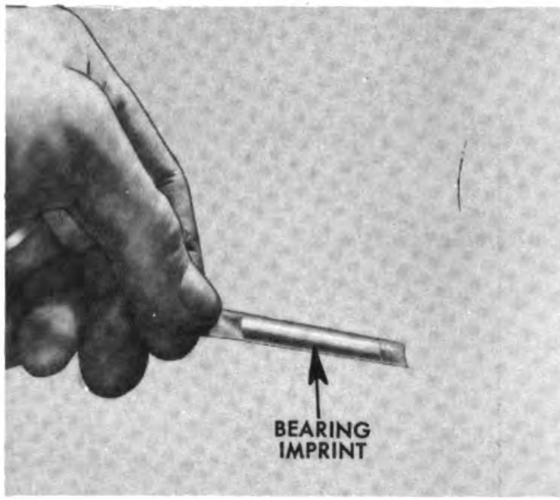
Then, using a small piece of .002" shim stock (brass preferred) approximately ¼" in width and 2½" or 3" long, check bearings for looseness as follows:

Insert the piece of shim stock between the bearing cone and cup, placing it between the rolls. In doing this, hold the piece of shim stock between the thumb and fore-finger of one hand, and insert the shim stock between the rolls to a depth equal to the length of the rolls. Make sure the piece of shim stock is parallel with the rolls and rotate the axle a part of a turn, enough to cause one of the bearing rolls to roll over the shim stock.

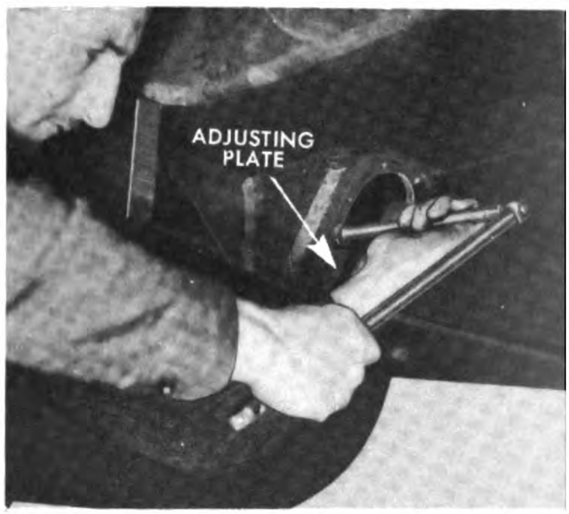


Remove and examine the piece of shim stock, being very careful not to tear off and leave in the bearing any particle of the shim stock, because of the damage which might result to the bearings. If the bearing rolls leave an impression or imprint in the shim stock, the bearings have not reached a looseness great enough to make a take-up in the adjustment necessary and no adjustment needs to be made. However, if no imprint is left, it is an indication that the bearings are loose and an adjustment should be made.



To prevent obtaining a false check from radial loads applied upon the bearings, make the above check at four points—top, bottom, and two sides. Failure of the bearing to make an imprint in the shim stock at any one of these four points is an indication that an adjustment should be made.

Make the adjustment by bending back the corners of the lock plate and then removing the four capscrews from the adjusting plate as shown.



Then remove shims totaling approx. .012" in thickness from between the adjusting plate and end of axle and re-install adjusting plate, lock plate, and capscrews, turning capscrews up tight and thereby tightening the bearings. (Shims are of three thicknesses—.004", .0625", and .008.") Before bending back the corners of the lock plate and re-installing the inspection plate, recheck the bearings by again running a piece of .002" shim stock through the bearing and examining it for imprint as before. Remove another shim if no imprint is made.

When making the original adjustment after the Tournapull has been torn down for an overhaul, make the adjustment by removing shims one at a time until a good imprint is made in a piece of .002" shim stock.

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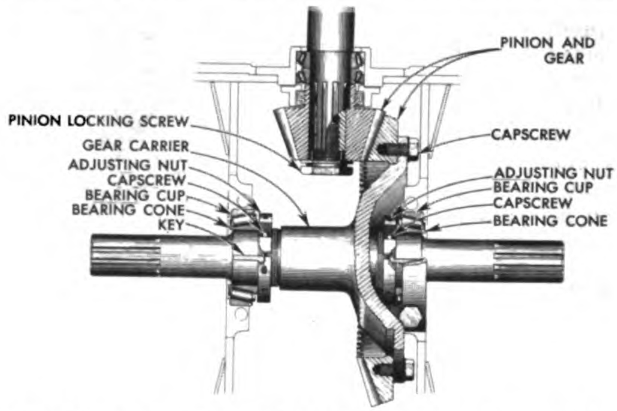

SPIRAL BEVEL GEAR CARRIER BEARING ADJUSTMENT AND GEAR AND PINION LASH ADJUSTMENT

Occasional adjusting of the spiral bevel gear carrier bearings is necessary because of bearing wear. The lash between the spiral bevel gear and pinion also requires adjusting each time the gear carrier bearings are adjusted.

Check the spiral bevel gear carrier bearings for looseness approximately every 1024 hours, at some interval when the deck plate is removed. Also, if a change is made in the bearing adjustment, the lash tween the gear and pinion must also be checked and an adjustment made, if needed.

To check the bearings for looseness, insert a small piece of .002" shim stock (brass preferred) approximately ¼" in width and 2½" or 3" long, between the bearing cone and cup, placing it between the rolls. In doing this, hold the piece of shim stock between the thumb and fore-finger of one hand, and insert the shim stock between the rolls, to a depth equal to the length of the rolls. Make sure the piece of shim stock is parallel with the rolls. Rotate the gear carrier a part of a turn, enough to cause one of the bearing rolls to roll over the piece of shim stock.

Remove and examine the piece of shim stock, being careful not to tear off and leave in the bearing any particle of the shim stock, because of the damage that might result to the bearings. If the bearing rolls leave an impression or imprint in the shim stock, the bearings have not reached a looseness great enough to make a take-up in the adjustment necessary, and no adjustment needs to be made. However, if no imprint is left, it is an indication that the bearings are loose and an adjustment should be made. Make the above check at top, bottom, and two sides of each bearing, as with final drive pinion and axle bearings.

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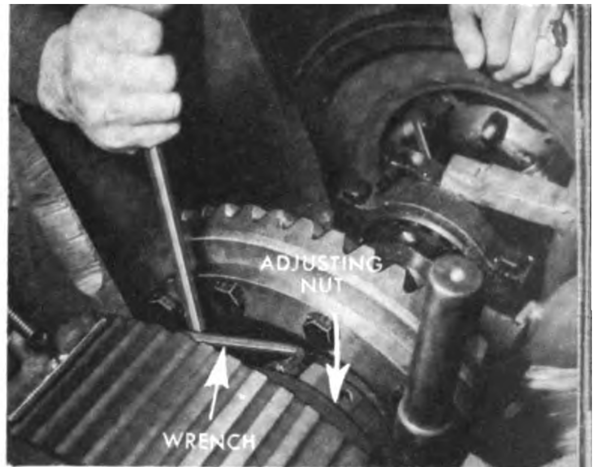
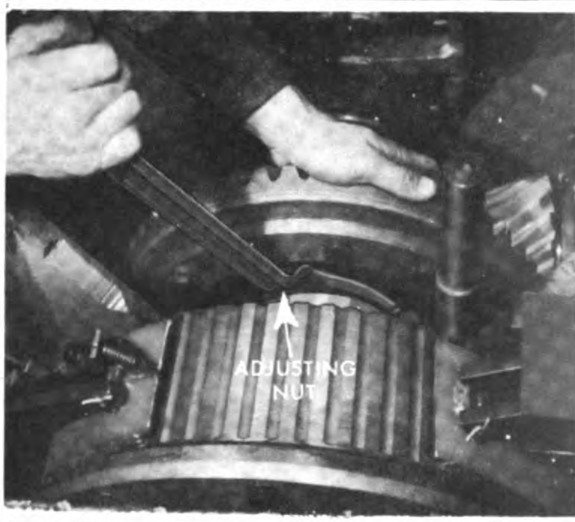
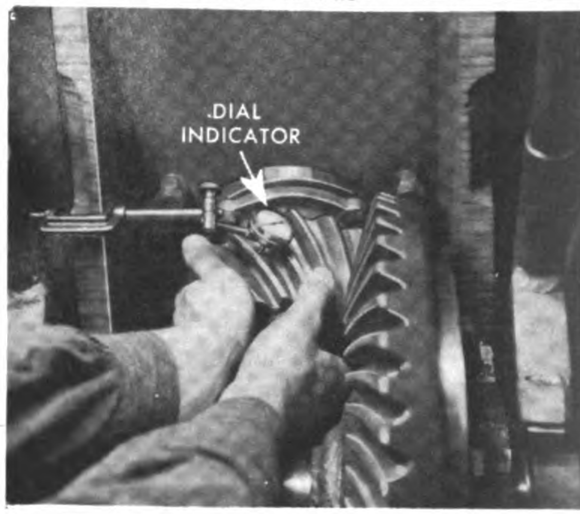


To adjust the bearings, first loosen the lock screw in the right bearing adjusting nut. Also block the spiral bevel gear to keep it from turning. This will prevent the spiral bevel gear carrier from turning while the adjustment is being made.



Using the special spanner wrench, turn the right adjusting nut to the rear only a very small part of a turn at a time, until the point is reached where the bearing rolls just begin to leave a good imprint in the shim stock when checking as outlined on opposite page. Then tighten the adjusting nut lock screw.



In adjusting the bearings, the lash between the spiral bevel gear and pinion is usually affected. Therefore, each time a change is made in the bearing adjustment, the lash between the gear and pinion should be checked with a dial indicator as illustrated. By moving the pinion back and forth to check the lash between the gear and pinion, the amount of lash will be recorded on the dial indicator.

The correct amount of lash is stamped on the outer circumference of the spiral bevel gear. If the lash is not as specified (within .002"), adjust the lash by loosening the lock screws in both the left and right adjusting nuts and then turning both adjusting nuts an equal amount either to the front or to the rear, thereby either increasing or decreasing the lash as required. Make final check for lash after locking both adjusting nuts. Also, make a final bearing check by seeing if an imprint is still made in a piece of .002" shim stock.

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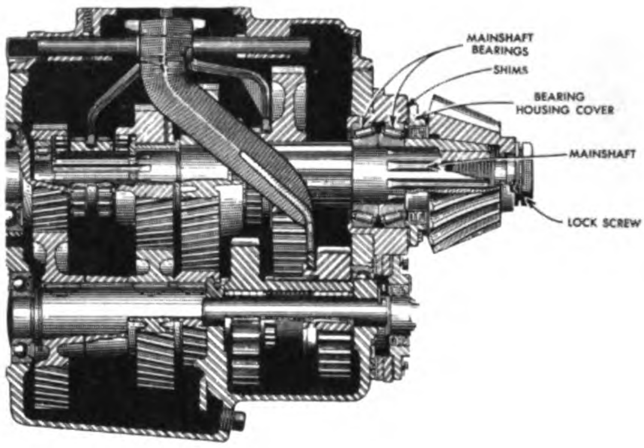


TRANSMISSION MAINSHAFT BEARING ADJUSTMENT

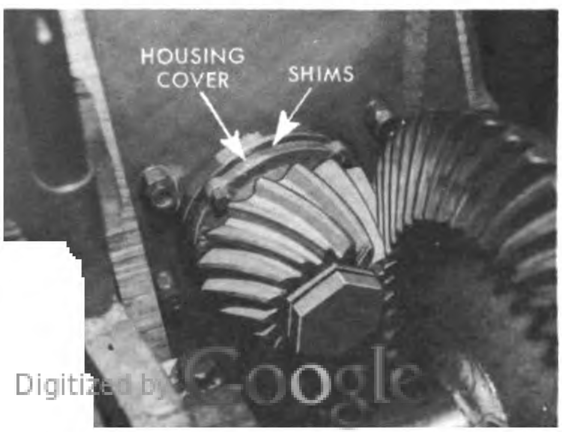
Occasional adjusting of the transmission mainshaft bearings is necessary because of bearing wear.

Check the bearings for looseness approximately every 1024 hours of operation, at intervals when the deck plate is removed.

To check the bearings for looseness, insert a pry bar between the spiral bevel pinion and the housing cover and, by prying back and forth with the bar, detect any end movement of the pinion. If available, a dial indicator can be used to good advantage in measuring the end play of the shaft.

If noticeable end play is found, make adjustment by first backing off gear carrier right adjusting nut and then shifting spiral bevel gear and carrier to the right as far as possible. Bend back peened edge of pinion lock screw and turn lock screw out of end of shaft. Slide pinion to rear on transmission mainshaft and then loosen four capscrews securing housing cover to transmission case.

Remove one or more of the shims from behind the housing cover, as needed to bring bearings into correct adjustment. (Shims are of two thicknesses, .005" and .0079" to make possible a fine variation in adjustment.) Make sure no small pieces of shims are left under housing cover. Re-tighten the four capscrews in the housing cover, turning them up tight. Slide the pinion forward and tighten and lock the pinion lock screw.



The adjustment is correct when all mainshaft end play is eliminated, without a heavy drag on the bearings. After completing the adjustment, re-adjust spiral bevel gear carrier bearings and correctly set the lash between the spiral bevel gear and pinion. (See preceding page.)

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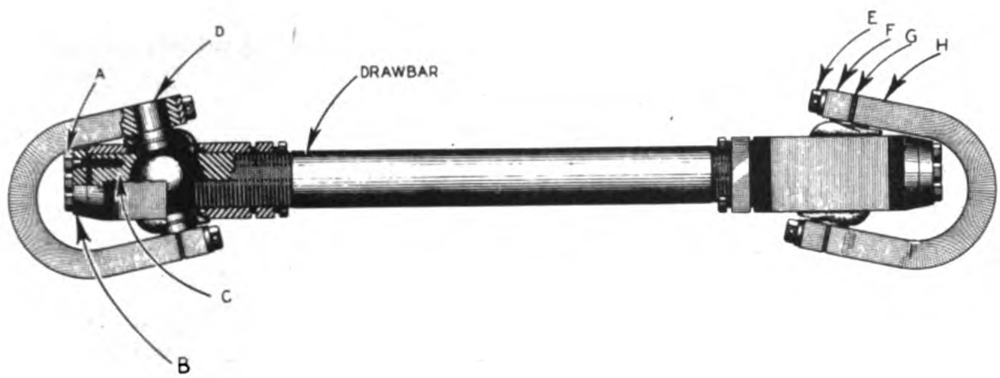

DRAWBAR ADJUSTMENT

Occasional adjusting of the Tournapull drawbar is necessary because of the wear that takes place in the drawbar ball and sockets.

When the drawbar has become worn to the point that there is noticeable end play in the ball and sockets, an adjustment should be made.

To make the adjustment, turn the Tournapull into the extreme cramped position, thus turning the drawbar to one side and exposing the rear end of the drawbar as illustrated, making ample room to reach the point of adjustment.

Remove the four capscrews (A) and end plug keeper (B) which lock end plug (C) (See drawing above). To tighten universal ball (D) turn end plug (C) clockwise until there is a noticeable amount of drag on the universal ball (D).

When the correct adjustment is reached, replace end plug keeper (B) and four capscrews (A), drawing capscrews up tight, thus completing the adjustment.

The same procedure should be used in adjusting the front ball and socket. However, a different procedure must be used in reaching the point of adjustment, as is explained below.

First lower the Scraper blade to the ground and block both rear wheels. Remove the four capscrews (E), two hitch clamps (F) and shims (G), thus unhooking the drawbar from the Tournapull. Raise the front of the Tournapull by means of a hoist or jack, high enough to permit the drawbar to drop down out of hitch (H), which is a structural part of the Tournapull main case. The point of adjustment for the front ball and socket can now be reached from beneath the Tournapull. After the adjustment has been made, raise the front end of the drawbar back into position and lower the front of the Tournapull. Then re-install shims (G), hitch clamps (F), and capscrews (E), completing the adjustment.

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LUBRICATION

Complete instructions for lubricating the Tournapull are covered in the Operation Section. (Refer to pages 72 and 73 of the Operation Section.)

RELINING DRIVING CONES

With the steering clutches completely disassembled, cut the worn bi-metallic lining loose from the driven cone with a grinder or chisel, thus removing the old lining.

To re-line the clutch, clamp the lining segments in place on the cone, allowing the lining to extend beyond the surface of the cone about ⅛" on both sides. Weld the lining by making a fillet weld on each side of the cone, between the back side of the base metal of the lining and the edges of the cone.

Use coated electrodes of ⅛" size or smaller in doing this welding, and keep the welding heat as low as possible.

The lining comes in segments, each about 10" in length. Leave about 1/16" space between the ends of the segments when welding the lining to the cone. Do not weld across the ends.

Before installing the re-lined cone in the steering clutch, the cone must be chucked in a lathe, and the lining machined down until the surface is perfectly smooth. Machine off only enough of the lining to remove any high spots caused by thick and thin lining segments. This lining must be machined to a 15 degree taper.

The bi-metallic lining on these clutches run in oil, and withstand wear exceptionally well. However, like all clutch facings, eventual replacement is necessary.

RELINING BRAKE BANDS

The bi-metallic brake lining on the Tournapull brakes does not wear rapidly. However, all brake facings will wear, and occasional replacement of the brake lining on this machine is necessary.

To reline the brakes, it is necessary to first remove the brake bands from the Tournapull.

The worn lining must then be cut loose from the brake band by cutting with a grinder or chisel through the weld metal along the edges of the lining.

Install the new brake lining by clamping the segments to the brake band, and welding them in place.

Leave a small amount of space between the brake lining segments when welding them to the brake band. Make a fillet weld between the base metal of the lining and the brake band, along the two edges of the segments, and not across the ends. The welding should be done with nothing larger than ⅛ inch coated electrodes, and the welding heat should be kept as low as possible. One bead or pass along each side of the lining is sufficient to secure the lining to the brake band.

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REPAIR SECTION

Part Two

The ENGINE

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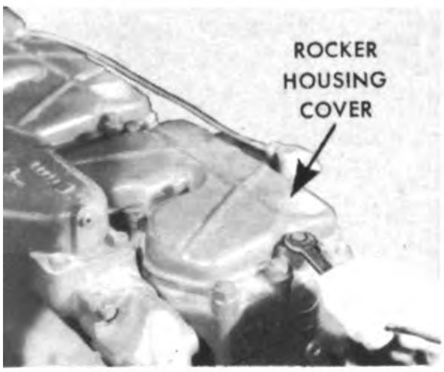
DISASSEMBLY OF ENGINE

It depends largely upon how completely the engine is to be disassembled as to whether it is necessary to remove the engine from the Tournapull. Many parts can be removed from the engine without difficulty with the engine in position in the Tournapull, while other parts can be removed more easily with the engine removed. Normally, for major overhauls it is advisable to first remove the engine from the Tournapull. For minor disassembly operations, however, the amount of time and work required in removing the engine might make its removal impractical.

The instructions which follow outline the correct procedures for disassembling the engine. (For instructions for removing the engine from the Tournapull, refer to disassembling instructions in Tournapull Repair Section.)

Keep Engine and Parts Clean

Before disassembling the Cummins Diesel engine, clean the exterior thoroughly with a good cleaning solvent or steam jet. A high percentage of poor engine performance and costly repairs can be traced to lack of cleanliness.



ROCKER HOUSING COVERS

Remove the rocker arm housing covers by taking out the three cap screws holding each cover to the housing.

AIR CLEANERS

Next, remove the air filter cups from the air cleaners and drain the oil. By removing the mounting cap screws holding the air cleaners to the intake manifold the cleaners can be lifted from the engine. Remove the spacing adapters from the intake manifold.

Intake and Exhaust Manifolds

INTAKE AND EXHAUST MANIFOLDS

Loosen the manifold stud nuts just enough to allow the intake manifold to be lifted from the engine. Turn the clamps and the exhaust manifold can be removed.

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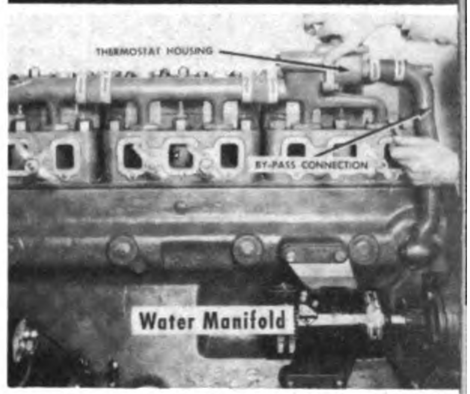
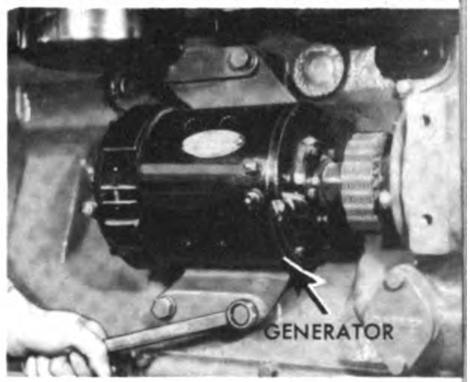
WATER MANIFOLD

Remove the two cap screws from the water by-pass connection at the cylinder block. Then remove the two cap screws from each foot on the water manifold, and lift the manifold assembly from the engine.



GENERATOR

Remove the four cap screws from the generator bracket and lift the generator from the drive coupling.



GENERATOR DRIVE

Remove the cap screws holding the generator drive unit to the cylinder block and remove the unit.

It is sometimes necessary to tap the unit lightly with a soft hammer or pry with a screwdriver, to loosen.

CRANKING MOTOR

The cranking motor is mounted on the flywheel housing with three capscrews. By removing these three capscrews, the motor with its mounting spacer may be pulled from the housing.

WATER PUMP

Loosen the capscrews in the water pump clamp ring. With a screwdriver inserted into the hole in the pump body, rotate the pump to the bottom point of its eccentric to loosen the water pump drive belts.

Remove the cap screws and pull the water pump assembly from the gear housing.

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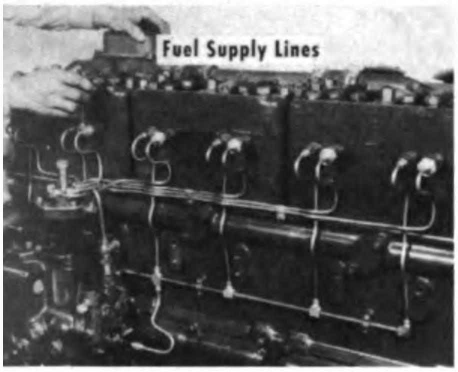
WATER PUMP DRIVE PULLEY

Remove the nut and lock plate holding the water pump drive pulley to the keyed fuel pump shaft. This pulley fits very tightly on the shaft, and it will be necessary to use a puller to remove it.

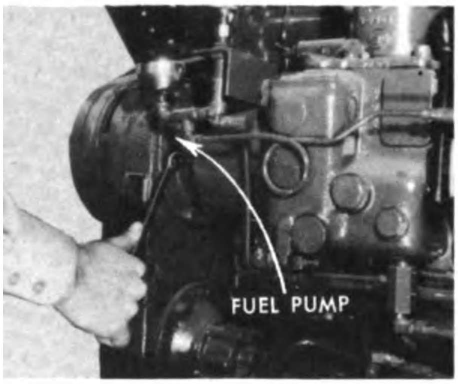


FUEL SUPPLY LINES

Disconnect and remove all fuel lines leading from the fuel pump to the injector fuel inlet connections.

FUEL DRAIN LINE

The fuel drain line leading from the drain manifold to the fuel pump should next be taken off.



FUEL PUMP

In removing the fuel pump, the three cap screws holding the fuel pump to the gear case should be taken out first, and the two bottom screws holding the pump to the block next. Hold the pump while removing the two top capscrews, and with a slightly backward motion to disengage the drive gear, lift the pump from the engine.

INJECTOR DRAIN MANIFOLD

Disconnect the fuel drain lines from the fuel drain connections. With a screwdriver remove the clamp screws and lift the injector drain manifold from the engine.

LOOSENING INJECTOR ADJUSTING SCREWS

Loosen all injector adjusting lock nuts and with a screwdriver, back out adjusting screws three turns.

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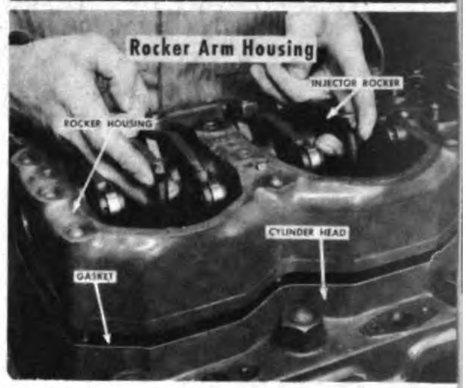
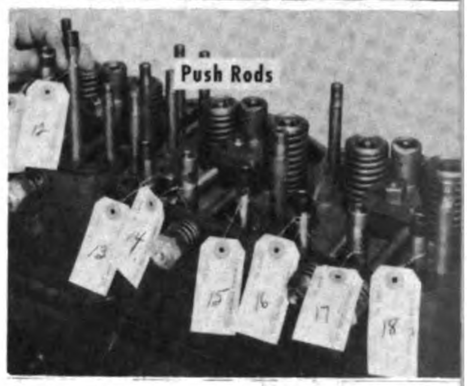
ROCKER ARM HOUSING

Remove the lubricating oil pipe cap and gasket. Remove the seven stud nuts from each rocker housing assembly and lift the assembly from the engine by grasping the end of each injector rocker.



PUSH RODS

Remove the push rods, starting at the front end of the engine. Tag them from 1 to 18 respectively so that they may be re-installed in exactly the same position.



FUEL INLET AND DRAIN CONNECTIONS

Unscrew and remove the fuel inlet and fuel drain connections from the cylinder heads.

INJECTORS

After removing the injector hold down nuts lift the injector from the cylinder head. Be extremely careful not to bruise the tip.

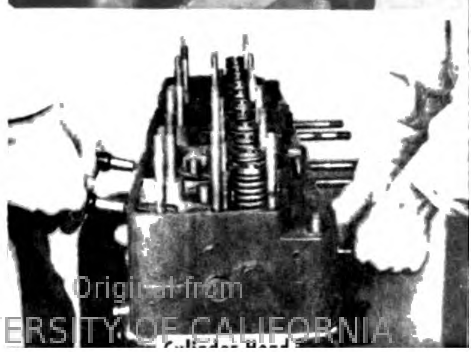
COMPRESSION RELEASE SPRING

The compression release spring can be removed from the front cylinder head by taking out the cap screw securing it to the block.

CYLINDER HEAD

Remove the cylinder head stud nuts with a heavy duty socket wrench and lift the cylinder head assembly from the studs.

This can best be done by two men since it is necessary to lift the head straight up to clear the studs. The manifold studs and two screwdrivers inserted in the fuel connection holes can be used as lifting handles.



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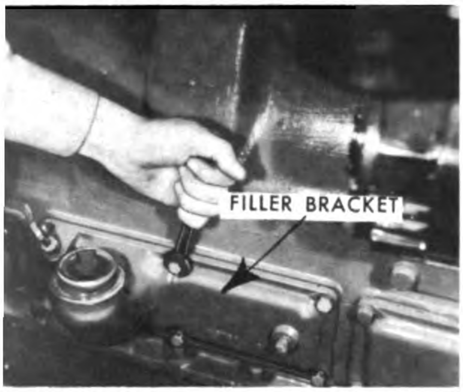

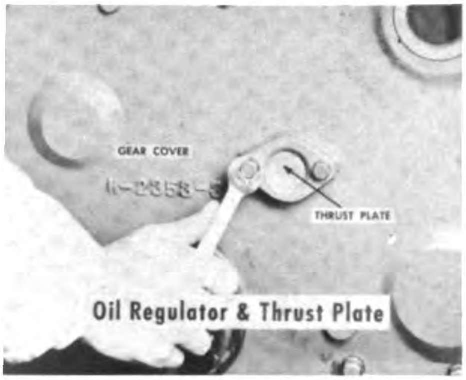

Oil Regulator & Thrust Plate

COMPRESSION RELEASE SHAFT

To remove the compression release shaft, first remove the lock screw at the rear end of the cylinder block and pull the shaft from the block at the lever end. Remove the packing gland and old packing.

Remove the cap screws from the compression release bearings, and pull the bearings from the block.

OIL FILLER AND GAUGE BRACKET

Remove the four mounting cap screws from the oil filler and gauge bracket and lift the bracket from the engine.

OIL REGULATOR AND THRU$T PLATE

Remove the two capscrews from the thrust plate on the face of the gear cover, and remove the oil pressure regulator plate, sleeves and spring.

LUBRICATING OIL LINES AND OIL PAN

Lay the engine on the manifold side. It should be blocked up slightly on the top edge of the cylinder block.

Remove the oil suction line and the oil pressure line from the lubricating oil pump to the block. The pressure line is in two sections; one from the pump to the oil filter and one from the oil filter to the cylinder block.

Remove all mounting bolts and cap screws from the oil pan and lift it from the engine.

FILTER CASES

Remove the cap screws from the mounting brackets of the filter cases and lift them from the engine.

LUBRICATING OIL PIPE

Unscrew the lubricating oil pipe by inserting a pin punch in the hole drilled through the pipe. Remove the pipe, pipe packing and cylinder head gasket.

LUBRICATING OIL PUMP

There are four nuts and lock washers holding the lubricating oil pump to the block. It is necessary to unscrew the lower inside nut as the lubricating oil pump is being pulled from the studs holding it to the gear housing.

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GEAR CASE COVER

Remove all capscrews from the face of the gear case cover and with a large screwdriver pry the gear case cover from the dowel pins.

CAM ROCKER LEVER BOX

Remove the cam rocker housing capscrews and with a small screwdriver pry the cam rocker housing from the dowel pins. Lift the assembly from the engine and mark to insure replacement in the same position.

IDLER GEAR

After removing the lock screw and plate, slip the idler gear off its shaft.

CAMSHAFT AND GEAR

Rotate the camshaft gear slightly while pulling the camshaft from the engine. Do not remove the gear from the camshaft.

CLEANING CYLINDER LINERS

Scrape all carbon from the top of the cylinder liners. Pistons on the Cummins Diesel are closely fitted to the liners and failure to clean the liners thoroughly may cause the pistons to stick.

PISTONS AND CONNECTING RODS

Remove the connecting rod bolt nuts and tap the bolts from the cap and the rod. Failure to remove the bolts may cause the head of the bolt to catch on the bottom side of the cylinder liner before all the rings clear the liner and thus lock the piston.

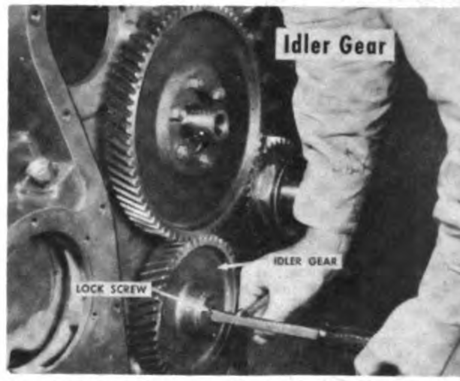
With a small wooden stick push the piston and connecting rod from the cylinder liner. Hold the piston as it is being pushed from the liner so that it will not be dropped and damaged.

Re-assemble connecting rod bolts, cap, bearings and nuts as they are taken out since bearing caps are not interchangeable.

PULLING CYLINDER LINERS

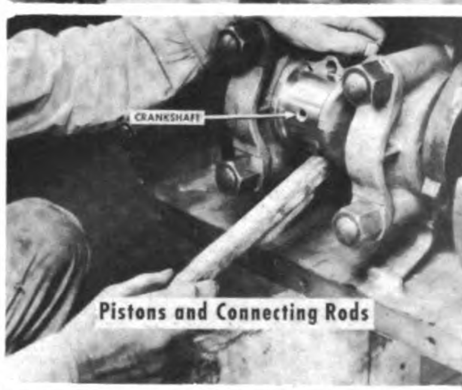
A puller should be used to remove the cylinder liners to prevent damage to the liners and block.

Cam Rocker Lever Box

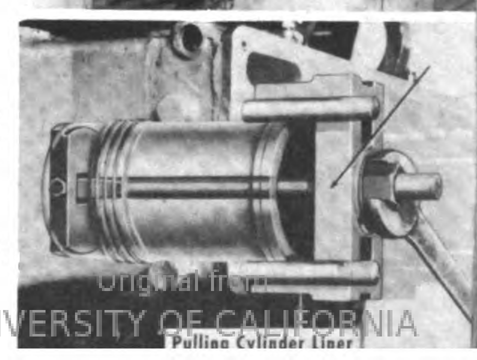


Idler Gear

Camshaft and Gear



Pistons and Connecting Rods



Pulling Cylinder Liner

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FLYWHEEL

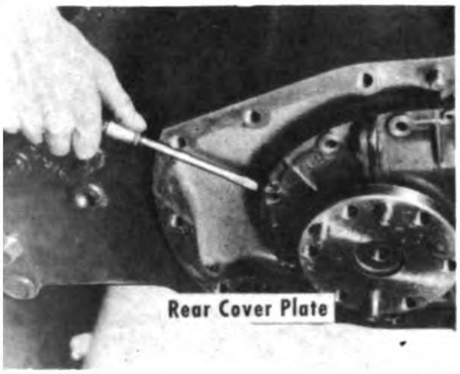
Remove the lock wires and take out the flywheel cap screws. Insert two manifold studs through two opposite cap screw holes in the flywheel and screw them into the crankshaft flange. These will provide a support for the flywheel during its removal.

In the two holes provided, place ½" cap screws 2½" long, threaded their entire length. By alternately turning in these cap screws, the flywheel will be pulled from the crankshaft.


Flywheel Housing

FLYWHEEL HOUSING

Remove the cap screws from the flywheel housing and with a block of wood or a soft hammer, tap the housing on each side to remove from the dowel pins.


Rear Cover Plate

REAR COVER PLATE

Remove the nuts from the two dowel bolts holding the rear cover plates together, and tap out the bolts. The mounting cap screws on the cover plates may then be removed and the plates pried from the dowel pins with a screwdriver.

Removing Main Bearing Caps

REMOVING MAIN BEARING CAPS

Before attempting to remove the main bearing caps it is best to turn the engine upside down on the skid.

Remove the main bearing stud nuts and with a small pry bar loosen each main bearing cap from the dowel grooves and lift from the main bearing studs.

Lifting Crankshaft

CRANKSHAFT

With a ¾" rope lift the crankshaft from the cylinder block. Be very careful to remove the lower main bearings from the crank before lifting.

Remove all upper main bearings and dowel rings from the cylinder block.

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INSPECTION AND REPAIR OF ENGINE UNITS

INSPECTION OF UNITS

DRIVE BELTS: Drive belts are often neglected because defective belts may not lead to an immediate penalty. However, the temperature of the engine is largely dependent upon proper operation of the fan and the water pump. Drive belts should be kept tightened to the proper tension at all times and replaced whenever edges are worn or frayed.

ELECTRIC WIRING: It is essential that electric connections be properly made and that conductors be of the right size and well insulated. Do not neglect inspection and proper replacement of defective wiring.

GASKETS: Leaking gaskets will immediately manifest themselves by loss of lubricating oil, fuel oil, water, or air. New gaskets of the proper design and supplied by the manufacturer should be used when parts are removed or after a general overhaul of the engine. This applies to all kinds of gaskets, whether copper, asbestos, steel, or composition.

MAIN AND CONNECTING ROD BEARING SHELLS: The type of work the engine performs, its loads and operating speeds will determine to a large extent how long bearing shells may safely be used. For instance, main bearings worn .005" oversize might not be considered useable in an engine operating at high speeds and pulling heavy loads, whereas the same bearings in an engine operating at lower speeds and pulling lighter loads might give several thousand hours additional service. In general, main bearings and connecting rod bearings may be re-installed as long as the bearing shells show good bearing surfaces. Bearing wear can be measured on the old bearing by comparing the thickness of the shell with that of a new one. In general, when one or two sets of main or connecting rod bearings are so badly worn that they need replacement during an overhaul, the entire set should be replaced.

CYLINDER LINERS: The wear on cylinder liners and out of round conditions should be checked and recorded at the first overhaul period. The working conditions will determine the rate of wear on liners as well as bearings. One large equipment owner has made it a practice to rebore cylinder liners after 8000 hours operation.

PISTONS: These pistons are cam ground, consequently are not round at the skirt. The piston ring wear and cylinder liner wear all contribute to eventual blow-by. Measurement of both piston and cylinder liners should help determine whether oversize liners and pistons should be used.

PISTON RINGS: Piston rings should be replaced whenever the piston is pulled.

INSPECTION OF OTHER ENGINE BEARINGS, BUSHINGS, ETC: The speed and load on any bearing or bushing or moving part determine the rate of wear. It is well to keep a record of the wear of various moving parts between the overhaul periods and replace all

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those parts that might conceivably fail before the next overhaul period. Lubricating oil pressure must be maintained at 30 to 50 pounds (engine at full speed). Most bearings in the Cummins engine are lubricated from the bottom which tends to provide for maintenance of oil pressures and proper lubrication throughout longer than the usual periods.

CAMSHAFT: Camshaft lobes should not show any bad scored marks. These would result (in the case of the injector cam lobes) in poor fuel delivery.

GEARS: As long as gears do not show visible wear and broken teeth, etc. they may be safely reinstalled.

OIL SEALS: At any time that oil seals allow an appreciable leak of lubricating oil, they should be replaced. This applies to all kinds of oil seals: injector links, push rods, etc.

WATER SEALS: Whenever water seals are scratched or broken or worn unevenly, they must be replaced.

FUEL PUMP: Before removing the fuel pump from the engine, determine the cause of failure. This can be done by inspection as follows:

1. Remove the inspection plug on the side of the distributor housing. If fuel runs out, the distributor cover and disc may be scored and, if scored, they should be replaced.
2. If fuel spurts or foams out, (with engine running) the thrust bearing may be worn and not seating properly.
3. If the pump is overflowing at the drain hole, check the following:
   a. The distributor disc may be scored or the thrust bearing worn.
   b. Remove the by-pass valve and check to see that it is not sticking, and that it is seating properly.
   c. Remove the float chamber and wash thoroughly. Replace the float valve if it sticks.

   Note: Never plug the drain hole. Find the cause of leakage and correct. Otherwise, dilution of the lubrication oil will result.
4. Check the gear pump pressure to see that it is not below 60 pounds at idling speed. This can be caused by:
   a. Worn gear pump.
   b. Pressure regulator worn or stuck.
5. Defective seal on the drive shaft in the No. 1 body.

When rebuilding the fuel pump many of the fits are so close that only by careful observance of the step by step procedure in the service section can a satisfactory job be attained. Many parts of the fuel system are supplied by the factory only in pairs (as outlined in the service section) and are not interchangeable with other parts. No inspection can be made of the fuel pump parts except as it is torn down piece by piece.

Caution: Never remove the fuel pump until it has been checked on the engine as outlined in the preceding instructions.

CYLINDER HEADS: Inspect the cylinder heads for cracks, warps, broken or weak valve springs, badly worn valve guides and valves.

THERMOSTATS: Thermostats should be inspected by testing water. They should start to open at 140° F. and should open fully at 160° F. As the water is cooled to 140° F. they should close.

SCREENS AND FILTERS: Screens and filters should be cleaned as a natural procedure at all overhaul periods. They should be replaced whenever defective.

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REPAIR OF ENGINE UNITS

All disassembled units and parts must be thoroughly washed with good, non-explosive cleaning solvent and dried with clean, compressed air. A large percentage of engine failures are directly traceable to a lack of cleanliness. Cleanliness and care in handling the parts as removed, repaired and reassembled will pay dividends in satisfactory service.

As the units are inspected, cleaned and repaired, they should be laid out in an orderly arrangement on clean paper or on a clean bench, so the machined surfaces will be protected from contact with other parts.

CRANKSHAFT

1. Clean out the drilled oil holes in the crankshaft with a rod and cleaning solvent and dry with compressed air.
2. Inspect the bearing journals for scored marks, excessive wear or an out of round condition.
3. Consult the engine specifications for bearing clearances and undersize bearings available for reground crankshafts.

MAIN BEARING CAPS

1. The main bearing caps are finish machined in the block, with the caps in position, and tightened in place with the prescribed foot pounds torque tension.
2. The main bearing caps must never be filed, interchanged or turned end for end. No shims are provided.
3. Inspect the bearing caps closely and remove all burrs and embedded dirt.

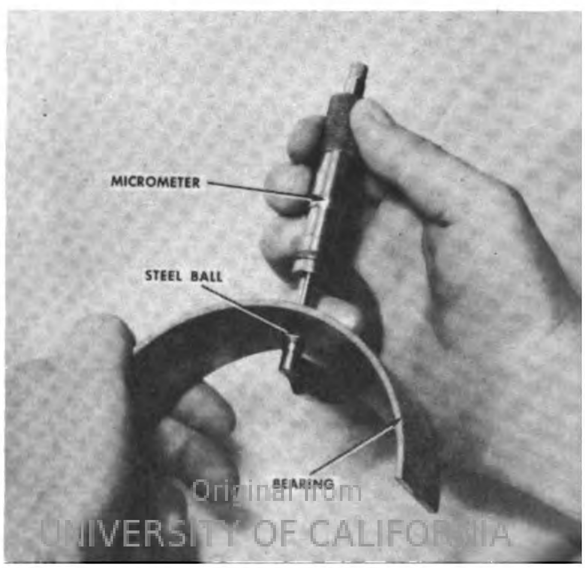
GENERAL BEARING INSTRUCTIONS

The main and connecting rod bearing shells are steel backed and lined with suitable bearing metal. Adjustments are unnecessary.

Main and connecting rod bearings, either standard or under size, are precision type and are provided with the recommended clearance for the oil film on the shaft.

Warning: Under no circumstances should any attempt be made to ream these bearings.

The method of measuring a bearing shell as shown is to use a micrometer in conjunction with a steel ball. The latter will rest on the inside of the bearing shell. Bearing wear can be determined by checking the dimensions of a new bearing shell against that of the old one. As bearing shells are in halves, it will be necessary to take the worn dimension of the bottom half of the bearing shell.



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A properly fitted bearing, after a reasonable period of service, will show a dull gray or copper color, depending upon the type shell used. Bright spots indicate metal contact and black spots, excessive clearance.

FLYWHEEL AND FLYWHEEL HOUSING

1. Inspect the joining surfaces of the flywheel and flywheel housing. Clean and remove all burrs, etc.

2. Inspect the teeth on the ring gear.

CYLINDER LINERS

1. Clean the outside of the cylinder liners with a wire brush and cleaning solvent to remove all scale and lime or rust deposits, being very careful to clean the packing ring grooves thoroughly.

2. Clean the shoulders of the flange. Remove all carbon and gum from inside the cylinder liners.

3. Check the wear of the cylinder liner with inside micrometers or cylinder guage.

PISTON RINGS

1. Remove the piston rings with expanding type pliers. Clean the piston ring grooves thoroughly of all carbon deposits. Open the oil drains. Remove all carbon from the head of the pistons.

CHECKING PISTON RING GAP CLEARANCE

ASSEMBLING PISTON RINGS

2. The ¼" oil ring fits in the lower groove of the piston, next to the piston pin. The 3/16" oil ring is next. Gap clearances of these rings should be .015" to .018" when new.

3. The next two rings are lap joint compression rings and should be installed with the word "TOP" facing up. No attempt should be made to file or fit lap joint rings.

4. The top ring is a wedge type compression ring and must be fitted with a gap clearance of .015" to .025".

5. To check the piston ring gap clearance, place the rings in the cylinder liners and push down evenly about 4" with the head of a bare piston. Check the gap clearance with a feeler gauge.

6. To assure better performance from the piston rings, stagger the ring gaps so they are not in line with each other or with the piston pin.

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INJECTOR CUP WIPER

The injector cup wiper is screwed into the head of the piston at the factory with a special tool and is not subject to replacement or service.

FITTING PISTONS

It should not be necessary to replace the pistons and to regrind or replace the cylinder liners as long as the engine starts easily, and blowby is not excessive.

Replacement pistons should not only fit the new or reground cylinder liners with .004" to .005" clearance for cast-iron pistons, and .005" to .006" clearance for aluminum pistons, but they should also be the same weight as the replaced pistons. The piston oversize number, stamped on the head of the piston, must correspond to the size stamped on the top edge of the cylinder liner.

NOTE: The piston diameter must be checked at right angles to the piston pin hole on the skirt of the piston for the largest diameter, due to the piston being cam ground.

The piston pin in the standard piston is fitted to the piston with .0005" clearance, or so that it can just be pushed in with the hand. Reinstall the snap ring at each end of the pin and test for fit. The pins should be just free enough to turn in the piston.

REPLACING CONNECTING ROD BEARINGS

1. When replacing the piston pin bushings, ream the piston pin hole to 2.001" to 2.0015". The length between the centers of the pin hole and crank bearing hole must be held to 12.000"

2. The hole in the large end of the rod is finished by grinding to provide a smooth backing support for the bearing shells and accurate alignment with the piston pin holes.

3. The rod cap is assembled with no adjustment provided.

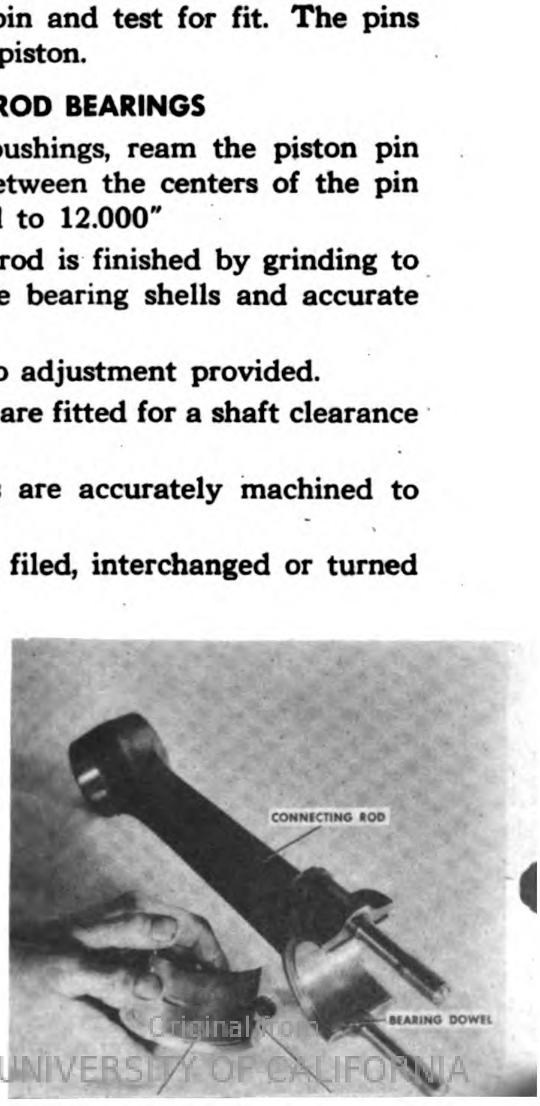
4. The connecting rod bearing shells are fitted for a shaft clearance of .004" to .005".

5. For rod side clearance, the sides are accurately machined to provide .006" to .008" clearance.

6. Connecting rod caps must not be filed, interchanged or turned end for end. The connecting rod bolts likewise must not be interchanged.

7. Before fitting new bearings, clean the crank pin carefully. The back of the bearings and the bearing seats must be smooth and clean or the bearings will not fit the shaft properly. Make sure the oil feed holes are open and clean.

8. Check the condition of the crank pin surfaces for out of round, wear and



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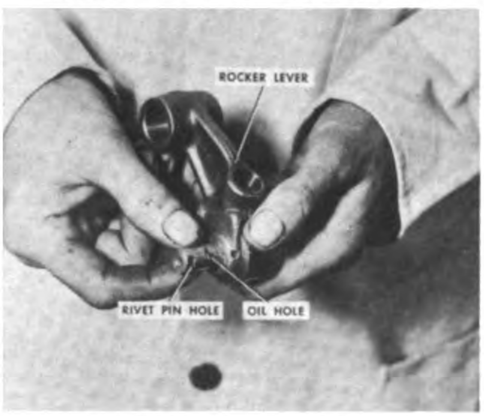
taper. When replacing one or more rod bearings in service, all other rod bearings should be examined and replaced if necessary.

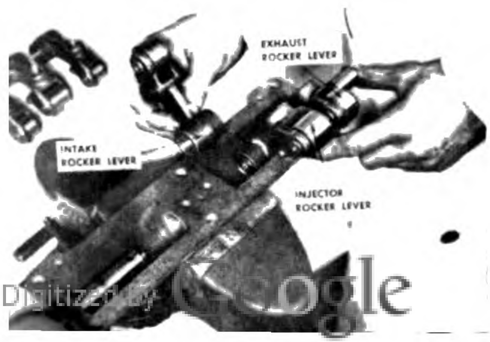
CAMSHAFT AND GEAR

1. Inspect the camshaft bushings in the cylinder block and the camshaft bearing surfaces. If the camshaft bushings must be replaced, drive them out with a suitable drift and hammer and install new camshaft bushings, being very careful to line up the oil holes correctly.

2. Refer to Engine Specifications (Page 30 of Operation Section) for position of various length bushings.

3. It is not often necessary to remove the cam gear, but if it is removed, replace and time with the camshaft, indexing the two timing marks.





CAM ROCKER LEVERS

DISASSEMBLY: 1. Remove the set screws holding the shaft in the housing.

2. Use a punch to drive through the expansion plug and remove the plug.

3. Drive the shaft from the housing.

4. To remove the rollers and roller pins, first tap out the pin rivet, then tap the pin from the lever.

ASSEMBLY: 1. Inspect the bushings and if necessary to replace, drive the bushings from the rockers with a suitable drift. Install new bushings, making sure the oil holes in the new bushings are lined up properly. Ream to .750".

2. Assemble new pins to the rollers in position.

3. Tap the pin through the roller and lever, and rivet in place.

4. Assemble the levers and shaft in position, with the injector lever in the center of each assembly.

5. Assemble the shaft lock screws.

6. Install new expansion plugs in each end of the shaft housing, seating into the bore of the housing.

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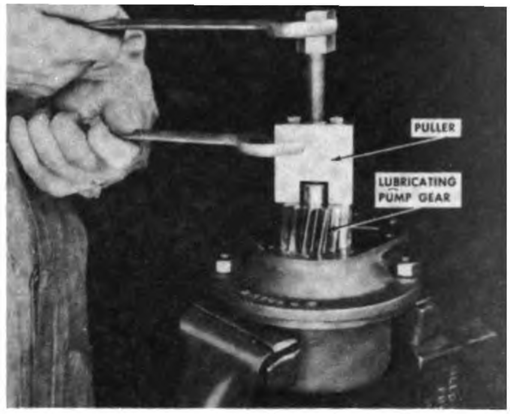

LUBRICATING OIL PUMP

DISASSEMBLY: 1. Remove the eight capscrews and lock washers that hold the pump body to the bracket.

2. Press the idler gear stud from the pump body.

3. To remove the pump drive gear, use a puller with puller studs screwed into the two threaded holes in the gear.

4. Remove the Woodruff key from the shaft.

5. To remove the bracket, tap the edge with a soft hammer.

6. Remove the cotter pin from the hex nuts on the end of the drive shaft, and remove the nut and retaining washers from the shaft.

7. Press the pump drive gear and shaft from the ball bearing.

8. Press the drive gear from the shaft and remove the Woodruff key.

9. Remove the snap ring from the bearing cage and tap the bearing from the cage.

ASSEMBLY: 1. Install the Woodruff key in the drive end of the drive shaft and press the driving gear on the shaft until it is snug against the shoulder.

2. Press the ball bearing into the bearing cage and lock in place with the snap ring.

3. Insert the end of the shaft in the cage and install the retaining washer, nut and cotter pin on the end of the shaft.

4. Press a new bushing in place in the pump bracket and ream to .875".

5. Using a new gasket, insert the pump bracket over the bearing cage. Install the Woodruff key in the shaft and press the pump gear on until the shaft gear has a clearance of .0015" between the gear and the bracket.

6. Press the idler gear shaft into the pump body until the shaft is just below the face of the gear body.

7. Attach the pump body to the pump bracket with eight cap screws and lock washers, using a new gasket to avoid leakage. Turn the drive gears to see that the pump gears are free.

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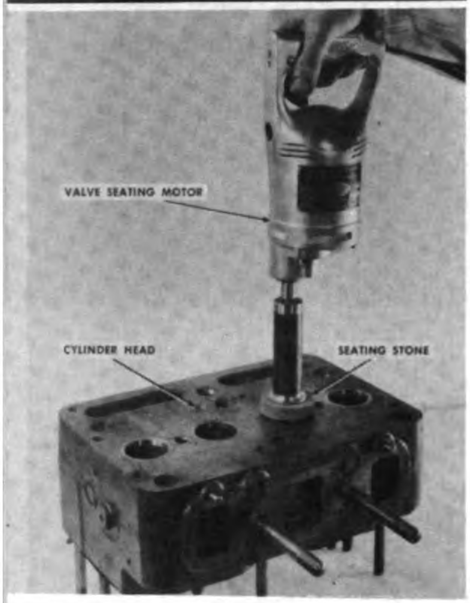

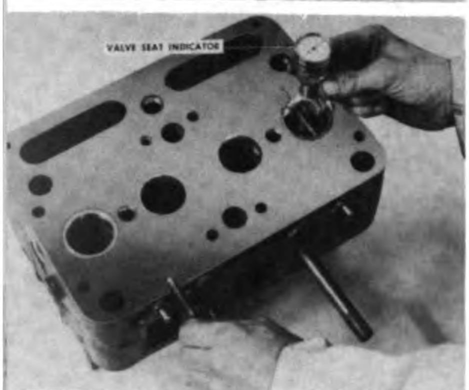

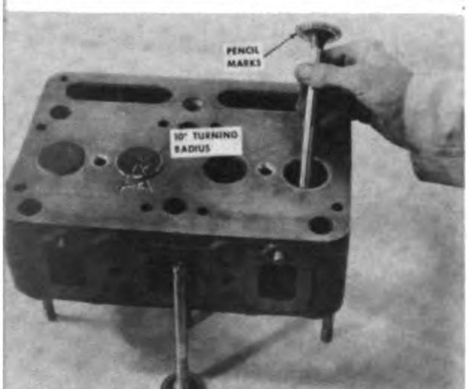

CYLINDER HEADS

DISASSEMBLY: 1. Place the cylinder head on a bench and compress the valve spring with a suitable tool. Take out the valve spring locks, retainers, springs and valves.

2. If valve guide bushings require replacement, drive them out from the under side of the head.

3. The valve guide bushings are installed by driving them in from above. Use a hardwood block to prevent distortion. Ream to .500".

ASSEMBLY: 1. The valves should be refaced only when warped or leaking. If they are only slightly pitted, but still show a good seat, they should not be ground.

2. To secure the best results, the valves must be refaced by removing them from the head and refacing them individually with precision refacing equipment. The seats in the heads should be refaced with a precision stone grinder.

3. Reface all valves to a 30° true seat.

4. Reface all valve seats to a 30° true seat.

5. Use an indicator to check the alignment of the valve guides with the valve seats.

6. Place light pencil marks on the valve face and seat as shown and rotate the valve approximately 10°. A true seat will be indicated if all the pencil marks are broken by the turning of the valve.

7. Reinstall the valves, springs, retainers and locks, using a valve spring compression tool.

NOTE: Always make sure you use Cummins Engine Company valves, marked **CECO.** Use valves marked **"EX"** in the exhaust.

8. Inspect the gasket face on the head and the copper injector seat for scratches.

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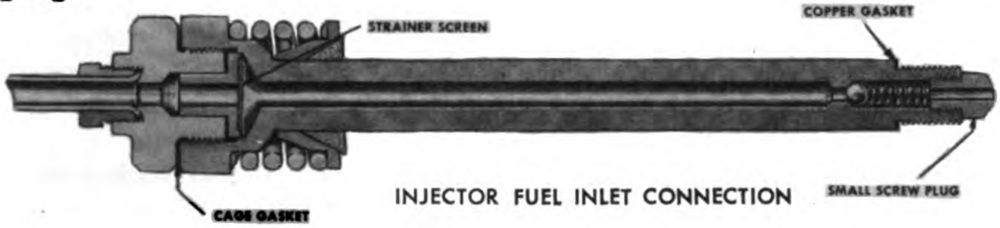
INJECTOR FUEL INLET CONNECTIONS

1. There are two check valves in the fuel line between the fuel pump and the injector cup. One is in the injector fuel inlet connection.

2. The check valves are opened by fuel pressure from the metering pump and are closed when pump delivery is finished. The operation of the injector fuel inlet connection valve is very important and it should be checked occasionally for leaks and breaking point.

3. The check valve should break at not less than 35 pounds and not more than 50 pounds fuel pressure. This can be checked by applying fuel pressure to the regular fuel line connection from the priming pump to the pressure pump, and reading from the fuel pump pressure gauge.



INJECTOR FUEL INLET CONNECTION

SERVICE: 1. To service the check valve, ball and spring, remove the small screw plug.

2. The strainer screen should be cleaned occasionally. When the screen is cleaned, replace the cage gasket.

3. The copper gasket on the check valve must be replaced if found to be damaged.

UPPER ROCKER HOUSINGS

DISASSEMBLY: 1. Take out the set screw that holds the rocker arm shaft in the housing.

2. Remove the expansion plugs at each end of the housing. Using a sharp pointed punch, drive through the expansion plug on one end and drive the shaft far enough to remove the plug from the opposite end.

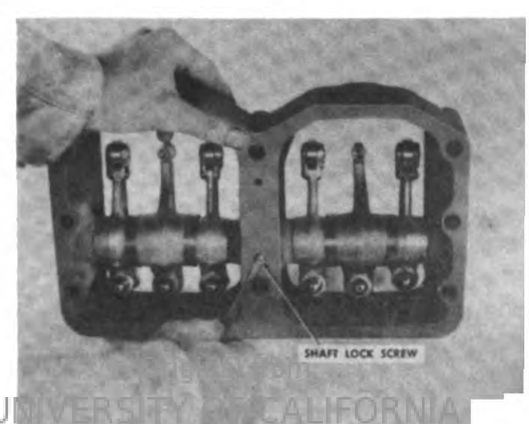
3. Drive the shaft out of the housing from either end and remove the rocker arms and bushings.

4. Drive the bushings out of the levers with a suitable drift.

5. To remove the rocker arm roller, tap out the rivet and remove the pin and roller.

6. To remove the injector rocker socket, press it out from the top side of the lever.

NOTE: If the injector rocker socket is cracked, lubricating oil will leak down the injector and drain to the fuel pump where it will be recirculated and burn as fuel.



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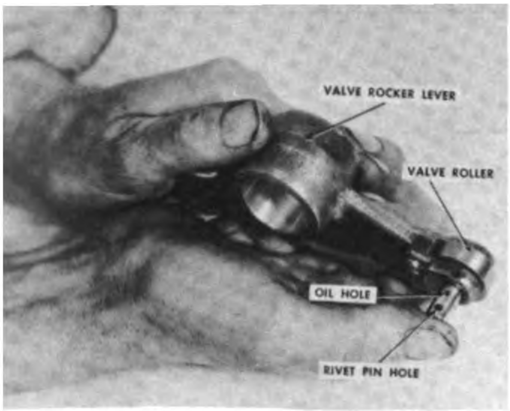

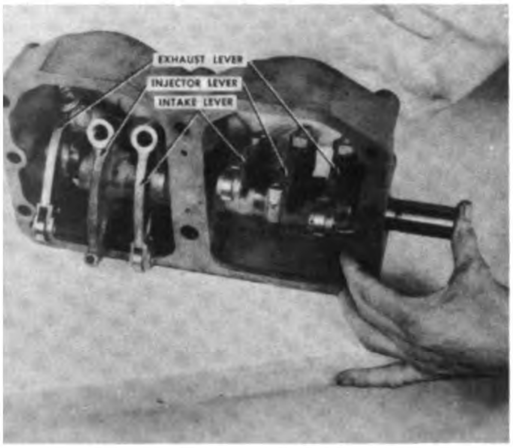

ASSEMBLY: Inspect the disassembled parts and replace worn or damaged parts with new ones and proceed as follows:

1. Assemble the jam nuts and adjusting screws to the rocker arm levers, if removed.

2. Install rollers and roller pins and rivets in place with the new rivets.

NOTE: Only the exhaust rocker levers are drilled for lubrication to the valve rollers.

3. Press new bushings into the rocker levers and ream to 1.125". *Observe that the bushings used for the levers must be installed so that the holes for the lubrication are correctly indexed.*

4. Assemble the injector rocker lever sockets.

5. Assemble the levers in the housing, and push the rocker shaft in place.

6. Install the lock screw to hold the shaft and tighten securely.

7. Install new expansion plugs in each end of the housing and tighten.

8. Install circlips between the rocker levers.

FUEL AND OIL LINES

1. Inspect the flared ends of all fuel and oil lines for breaks and repair by reflaring, or replace if needed.

2. Inspect the connections for cross threads and faulty seats, and replace if necessary.

CAUTION: Care must be used not to bend the lines unnecessarily, nor to disassemble further than necessary for repair.

WATER MANIFOLD AND THERMOSTATS

1. Remove the by-pass connection from the water manifold and take out the thermostats.

2. Remove the cap screws from the thermostat housing cover and remove the cover.

3. Inspect the themostats to see that they are in good working condition by immersing them in a pail of water heated to 140° F. At this temperature they should start to open. When the water is further heated to 160° F., they should fully open. As the water is cooled to 140° F., they should close.

4. Replace the thermostats in the housing and in the by-pass connection.

5. Use new gaskets and assemble the thermostat housing cover and the by-pass connection to the water manifold.

6. Replace the hose connection.

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GEAR CASE COVER

1. If the old oil seal around the water pump drive pulley has not been removed from the gear case cover, tap it out from the inside with a small punch.

2. Install a new oil seal against the shoulder provided, with the small spring to the inside of the gear cover. A mandrel must be used to prevent damage to the seal.

3. Replace the crankshaft oil seal in the gear case cover. This seal must always be in good condition. It is replaced by driving in with a mandrel. Use a pilot to keep the seal from turning the wrong way.

4. Inspect the camshaft ball bearing in the gear case cover. Replace if worn and lock with snap rings.

WATER PUMP

DISASSEMBLY: 1. Using a suitable puller, pull the impeller from the shaft.

2. To remove the seal assembly, remove the small lock ring.

3. Remove the cotter pin, nut and washer and pull the drive pulley with a suitable puller.

4. Remove the lock ring from the pump housing and screw out the retainer.

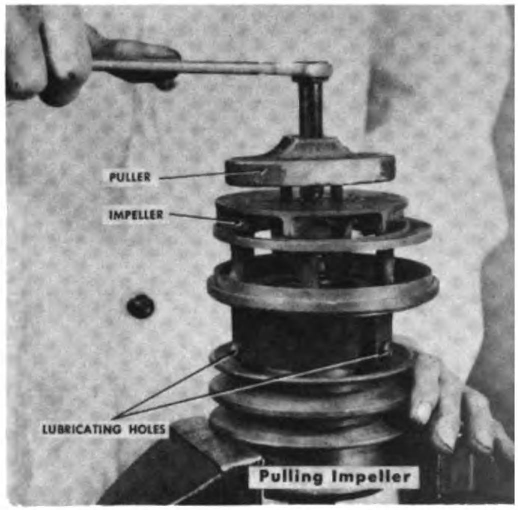
5. Press the shaft and bearing assembly from the impeller side of the housing.

ASSEMBLY: 1. Assemble the bearings to the shaft with the lock ring and retainer.

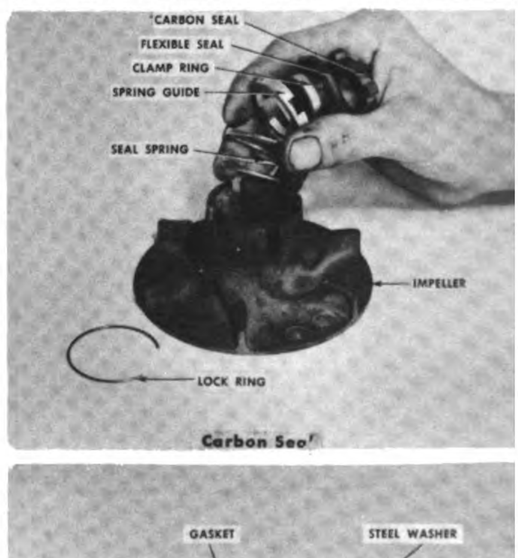
2. With the gasket and washers inserted, screw the retaining nut down flush with the face of the housing, lining up the lock ring hole and inserting the lock ring in place.

3. Assemble the Woodruff key to the shaft. Press the driving pulley on the shaft and lock in place with the nut and cotter pin.

NOTE: Inspect the face of the carbon seal and the face of the impeller on which the carbon seal rides for any nicks or



Pulling Impeller



Carbon Seal

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scratches. If any scratches or marks are present, it will be necessary to face the impeller to a smooth flat surface to prevent water leaks from the carbon seal.

4. Assemble the carbon seal assembly to the impeller and secure in place with the lock ring.

5. Check the seal over the shaft to see that it fits freely on the shaft before assembling. This is very important to insure proper operation of the seal.

6. Press the impeller in place until it is down against the shoulder of the shaft.

LUBRICATION: The water pump bearings should be lubricated after assembly and periodically thereafter. For this purpose, lubricating holes are provided as shown.

OIL PAN

Remove the oil pan screen and with cleaning solvent and a brush, wash the oil pan and the screen thoroughly. Replace the screen to the oil pan.

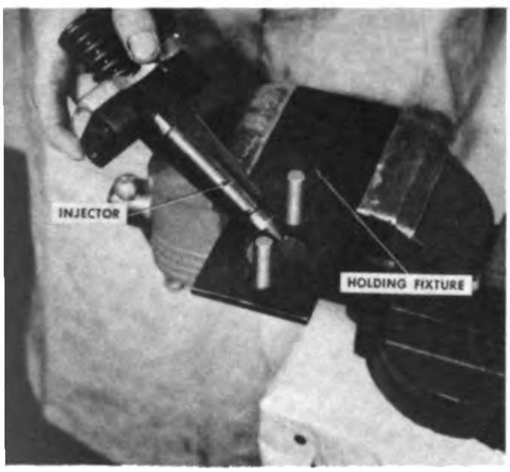
EXHAUST AND INTAKE MANIFOLDS

1. Clean both manifolds of all rust, scale, or other foreign matter, inside and out.

2. Clean all carbon from the exhaust piping.

THE INJECTOR

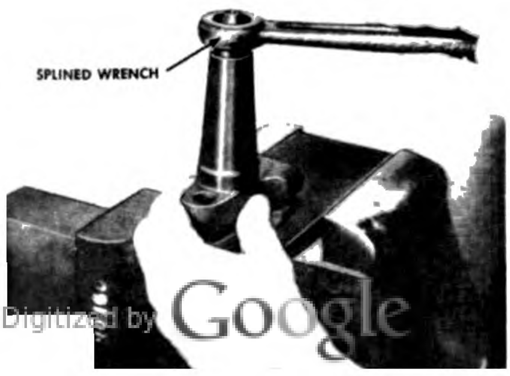
In servicing the injector, close adherence to the following recommendations is essential to the engine's functioning at maximum efficiency.



First, have separate clean containers in which to wash the injector and its working parts. Use clean, suitable, cleaning solvent and wash the outside of the injector thoroughly. Dry the injector with clean compressed air.

When servicing the injector, never clamp the injector body in a vise. Clamping in a vise usually causes distortion of the body and ultimately a sticking plunger. It is recommended that a simple fixture, as shown, be used.

INJECTOR CUP: 1. Inspect the injector cup spray holes as described on page 196 of Repair Section. If any of the spray holes are stopped up, or other injector trouble is apparent, disassemble as further explained.



2. Place the injector in the holding fixture with the cup end up. With the spline wrench, remove the cup from the body.

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INJECTOR PLUNGER: 1. Place the injector in the holding fixture with the plunger spring up.

2. With a screwdriver pry the injector plunger retaining bail from the body.

3. Pull the plunger seal and spring from the body.

4. Remove the cover gasket.

INJECTOR CHECK VALVE: 1. With a screw driver, remove the two fillister head screws from the top plate or housing and gasket.

2. With a large screwdriver, remove the body plug.

3. With an Allen wrench, remove the injector check valve and seat.

4. Turn the injector body over and tap in the palm of the hand to remove the check valve spring and stop.

5. If the check valve is stuck in the valve seat, it indicates that the valve has worn through the hardness of the seat and must be replaced. Attempting to reseat this valve would mean only short life for the injector.

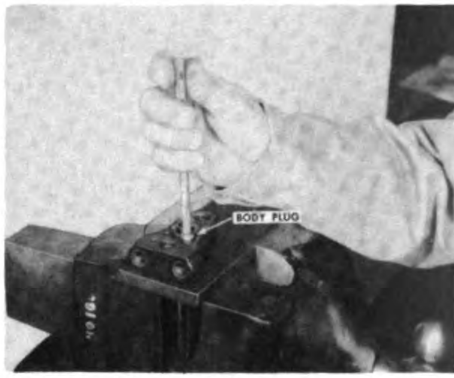
Caution: Check valve and seat are supplied only in pairs and must be installed that way.

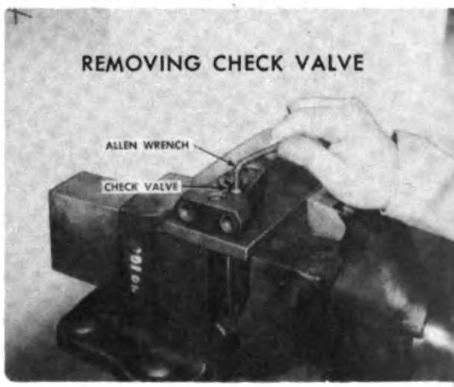
6. The check valve gasket must be replaced each time the check valve is removed. The gasket can be removed with a tool made from an old check valve seat.

7. It may be necessary to tap and tool a few times with a bronze punch and hammer to loosen the gasket.

Warning: Do not use a chisel to remove gasket or damage will result to the injector body.

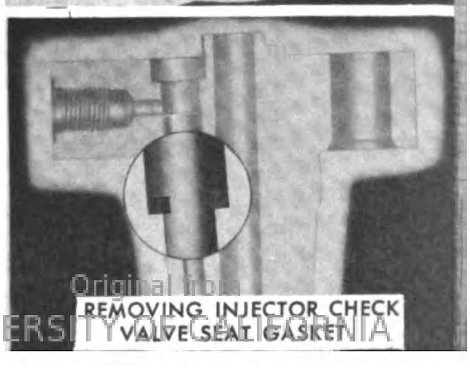
8. Wash the injector body thoroughly in cleaning solvent and dry with clean compressed air.





REMOVING CHECK VALVE


REMOVING INJECTOR VALVE SPRING AND STOP


REMOVING INJECTOR CHECK VALVE SEAT GASKET

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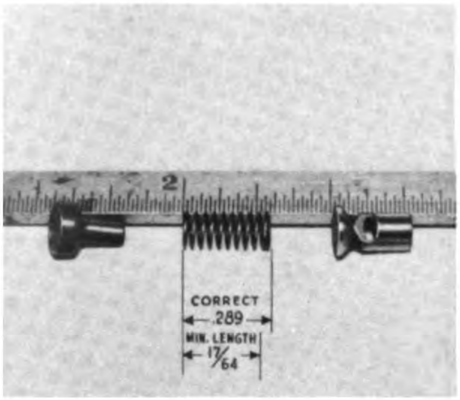
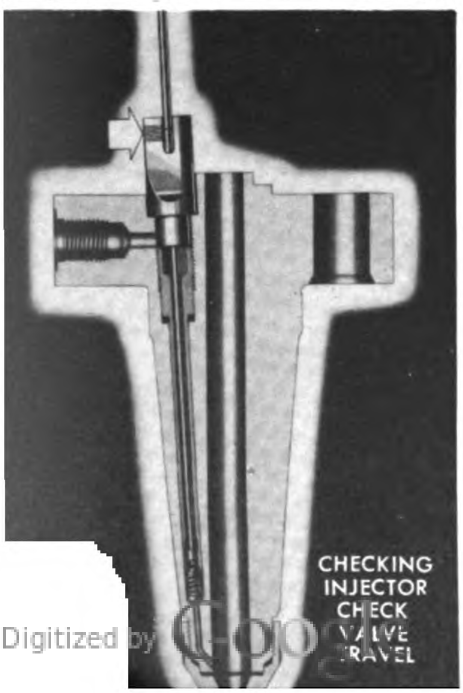
9. The check valve spring should be .289" long. If it is shorter than 17/64", it must be replaced.

10. With the check valve spring and stop in position, hold the injector upside down and then insert the check valve spring and stop to its working position. Use a small inserting tool as shown.

11. Reverse the position of the injector and remove the tool. Be sure the tool and parts are free from oil or the stop and spring may pull out of place when the tool is removed.



INSERTING CHECK VALVE SPRING AND STOP



CHECKING INJECTOR CHECK VALVE TRAVEL

12. Place a new gasket on the check valve seat. With a little clean cup grease or vaseline on the check valve, assemble it very carefully to the body. Tighten securely in place with an Allen wrench.

CHECK VALVE TRAVEL: 1. The check valve travel should be checked carefully to determine the check valve opening. Limits are from .015." to .025". Too much travel will cause early failure of the check valve spring and too little will deprive the cylinder of fuel.

2. If the travel is less than .015", it may be that the check valve seat gasket is too thin, and it will be necessary to replace it with a new gasket. If there is too much travel, the seat should be tightened further.

Replacing Body Plug and Top Plate

1. With a new gasket, assemble body plug. If this plug leaks, dilution will occur in the lubricating oil.

2. Using a new gasket, assemble the top plate or housing to the injector body with the fillister head screws.

INSPECTION OF INJECTOR CUP SPRAY HOLES: The accompanying illustrations show what to look for when inspecting the injector cup. It is recommended that a magnifying glass be used to give the cup the inspection it should have, and to determine whether or not any of the conditions illustrated on the opposite page.

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Fine abrasives in fuel, such as dust, dirt, etc., have a sand blasting effect and usually cause the type of cup failure illustrated. This can also be caused by the improper use of a cup cleaning drill of the wrong size for the spray hole. Such a condition is frequently caused by breaking the drill off in the spray hole and failing to remove it before putting the injector back in the engine. The extreme pressures that are created in the injector cup have a tendency to start cutting out some place around the drill, wearing the metal away.

The center illustration shows the effect of high acid or sulphur content in the fuel, as well as the effect of excessive heat which could be caused by an overload condition. On the bottom of this cup at "A" the metal has been eaten away.

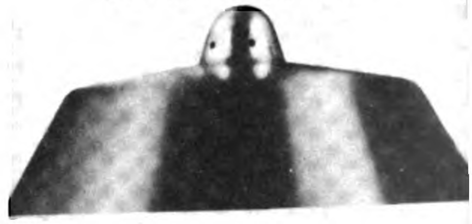
The spray holes of the injector cup must be kept free and open at all times. To continue to operate with the holes obstructed would cause damage to the engine and loss of power.

The cup is so designed that the preheated charge of fuel is injected into the cylinder in a fan shaped spray in order to bring the fuel into contact with all available air.

The two lower illustrations show that in case one injector cup spray hole is plugged with dirt or metal, part of the available air in the cylinder chamber is not in contact with fuel and an over-rich mixture is present in the other part of the cylinder. This causes a falling off in power because of the slow burning of the fuel. The additional burden is then put on the remaining cylinders. To make up for this loss of power in one cylinder, more fuel is fed to the other cylinders than can be burned with the available air. This excess fuel runs down the cylinder walls, causing piston rings to become gummy and to stick. This in turn causes dilution of the lubricating oil in the crankcase.

***Warning*: Never alter the size of the injector cup spray holes.**

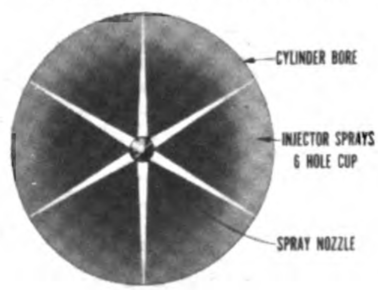
NEW INJECTOR CUP TIP



DEFECTIVE INJECTOR CUP TIP

DEFECTIVE INJECTOR CUP TIP

INJECTOR SPRAY DIAGRAM



INJECTOR SPRAY DIAGRAM

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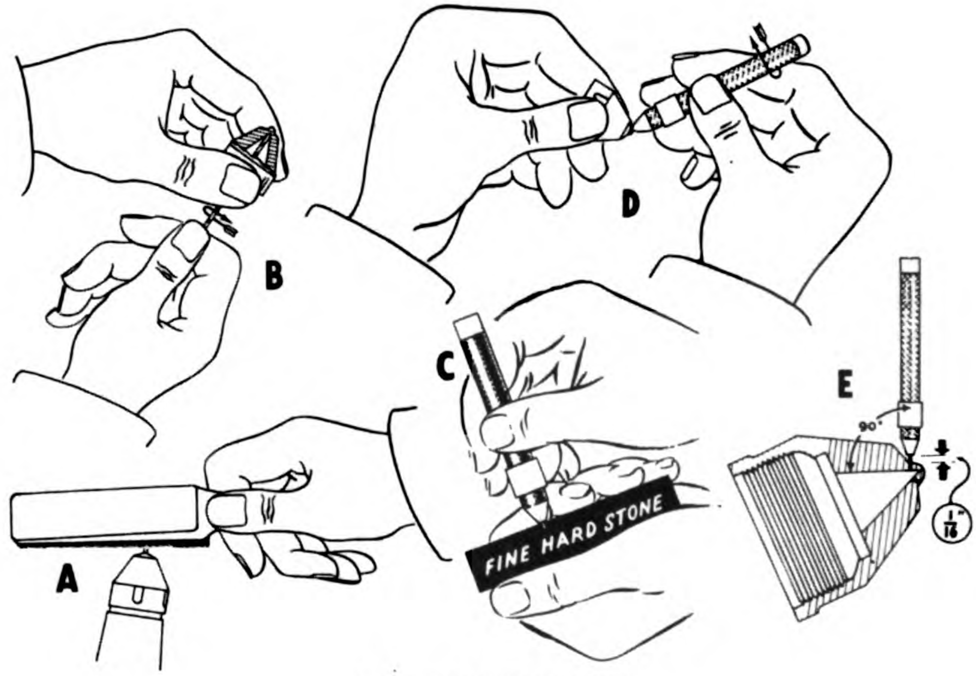

CLEANING INJECTOR CUP

CLEANING INJECTOR CUP: Place the injector in the holding fixture with the cup end up. Place the splined wrench (furnished with each engine) on the injector cup, and, with a sharp rap of the hand—counter-clockwise—loosen the cup.

When starting these operations, it is very important to have a separate clean container with cleaning solvent to wash all parts as they are removed from the injector.

If the fine fuel spray holes of the injector cup become clogged, it is usually caused by improper setting of the injector plunger, dirt in the fuel, operating the engine at overload, or an overheated engine. A cup cleaning kit is furnished, consisting of the file card brush "A", with two openings in the brush end in which will be found a small drill, several very small wire drills, and a pin vise to hold the small wire drills.

As indicated by "B", hold the injector cup upside down when using the large drill so that any foreign matter will fall out of the cup.

Warning: Never use a drill other than the one furnished by the Cummins Engine Company. This drill is ground to the proper taper to fit the cup.

Before using the small wire drills that are furnished for cleaning the spray holes, place the wire in the pin vise, letting it project about 1/16" from the end of the vise. With a very fine hone, "C", sharpen the end of the drill to a wedge. This must be done every time a new drill is used or the old one is broken. When a wire drill is cut off or broken,

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burrs are always present to scratch the inside of the spray holes in the cup. This will cause deflection of the spray and poor combustion.

Hold the cup in the fingers as shown by "D". Be sure to hold the drill to the proper angle as indicated by "E". This will be at right angles to the tip so that the drill will follow the hole as it was originally drilled.

Placing the injector cup in a good penetrating compound helps to loosen the carbon in the holes and saves time in cleaning.

Do not use the cup cleaning drill except when the spray holes become clogged. A .001" or .002" variation in the size of the spray holes will cause considerable trouble.

ASSEMBLING INJECTOR CUP: Never assemble an injector cup to the body unless a new cup gasket is used. A tool similar to the one shown will make it possible to remove the gasket without damage to the cup.

Place a new gasket in the cup, coating it with clean cup grease so that it will stay in place while assembling to the injector body.

Caution: *Use only gaskets furnished by the Cummins Engine Company. Old or improper type gaskets will result in leakage around the cup and cause dilution of lubricating oil.*

Remove the spring from the injector plunger. Lubricate the plunger with clean oil and assemble it in place in the body. With the injector body on the fixture and with the cup end up, hold the plunger against the body and screw the cup in place. The injector plunger must seat squarely in the taper of the injector cup to prevent the plunger from sticking.

Inspection for Check Valve Leak

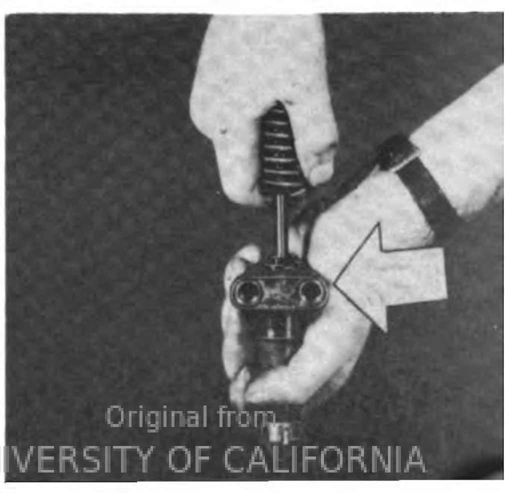
1. Remove the plunger, seal and spring from the injector.

2. Inspect the plunger for carbon or varnish caused from poor fuel and incorrect adjustment. Clean the plunger with cleaning solvent and clean cloths.

3. Fill the injector plunger hole two-thirds full of clean fuel oil.

4. Hold the injector spray tip against a piece of clean rubber.

5. Insert the plunger in the body and exert as much hand pressure on the plunger as possible. If the check valve leaks, it will show in the fuel inlet of the injector.



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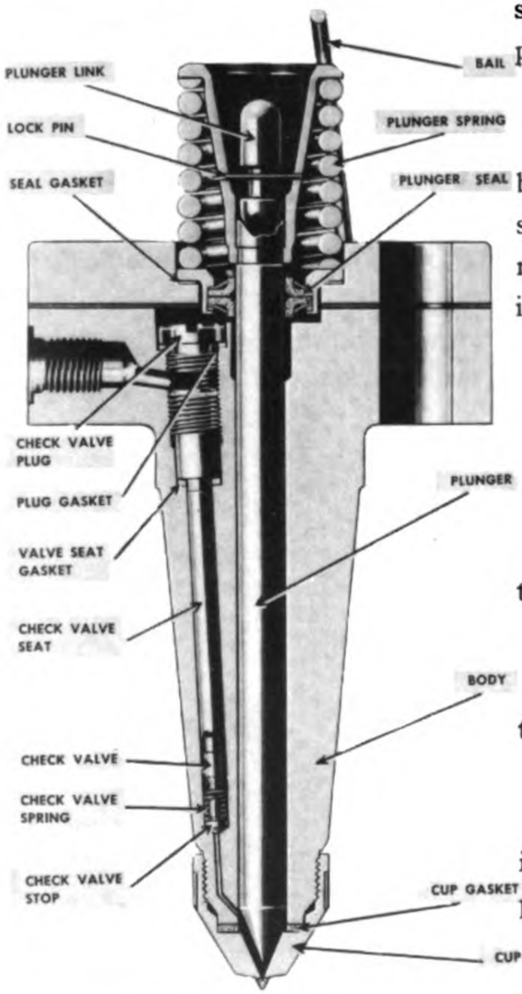
Inspecting Injector Fuel Spray

Partly fill the injector plunger hole with clean fuel oil. Hold the injector in the hand and push the fuel out with the injector plunger while checking the fuel spray at the injector tip. If six clean even sprays can be seen, the injector cup is properly cleaned.

NOTE: This check should be made before the injector cup is removed. If six clean even sprays can be seen, it is needless to remove the cup unless the injector has been removed due to dilution.



Assembling the Injector Plunger

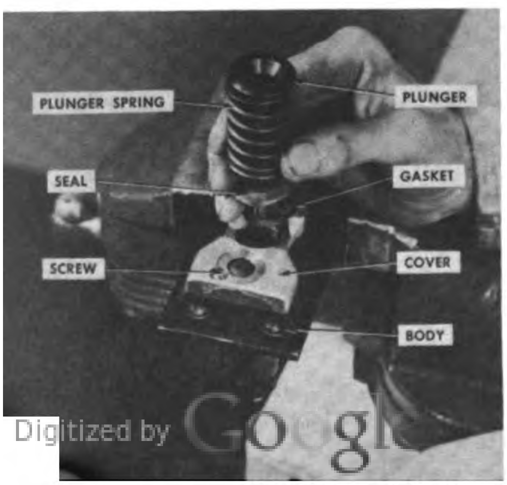
1. Assemble the cover to the body with the fillister head screws.

2. Assemble the plunger spring over the plunger.

3. Inspect the plunger seal to see that it is not damaged and assemble to the plunger as shown.

4. Assemble the plunger retaining bail over the plunger.

5. Never interchange injector plungers and bodies. Injector plungers are not sold separately as the fit required is so close that it is impractical to make them interchangeable.



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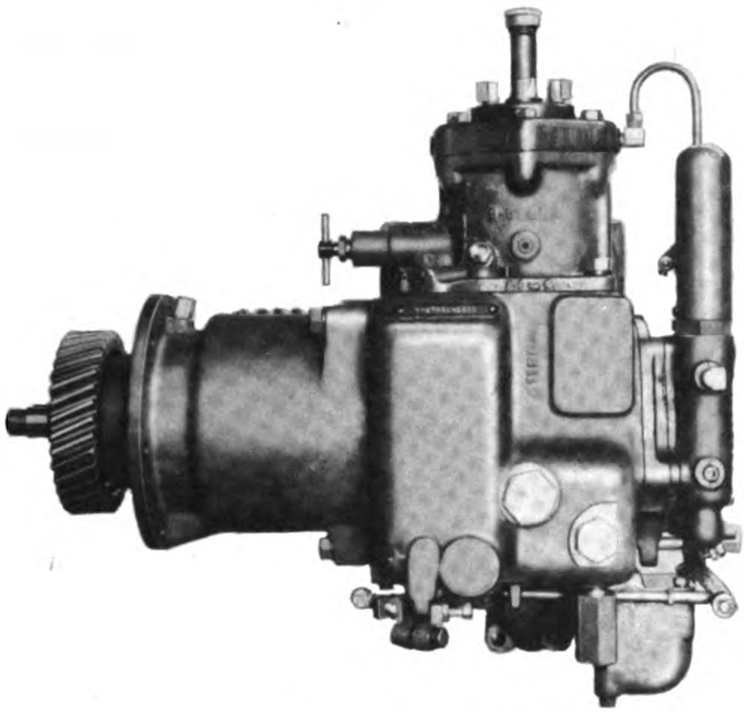

THE FUEL PUMP

A suitable holding fixture should be provided to receive the fuel pump. The fixture should revolve on a pivoted joint and the pump should be bolted to it at the bracket holes on the main housing. The separate pump units can then be removed or repaired from the main housing.

Many of the working parts of the fuel pump are machined to extremely close tolerances. Cleanliness is particularly important when working on any part of the fuel pump. Most fuel pump trouble is caused by dirt being carried into the working parts of the pump by dirty fuel or by some other means.

Before attempting any work on the fuel pump, wash it on the outside with a good solvent and, as the parts are removed, wash and dry each one carefully. Then place them on a clean bench so they will not be nicked or marred from contact with other parts.

Distributor

1. Disconnect and remove all the fuel lines from the pump. Drain the float chamber.

2. Disconnect and remove the tachometer shaft cable, if used.

3. Six capscrews hold the distributor cover to the housing. Remove every other one, and then remove the last three by loosening them one-half turn at a time to maintain an even spring pressure and prevent the distributor disc from catching in the distributor housing and scoring the bearing surfaces.

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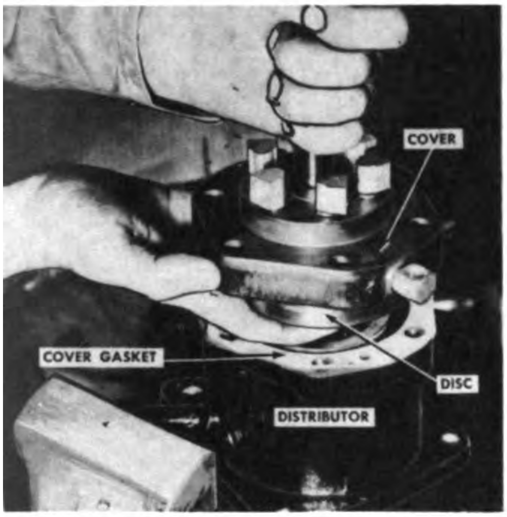
4. Lift the disc cover up far enough to insert the hand under the disc and remove the disc and cover together. The film of oil will hold the disc to the cover until the hand can be inserted.

Caution: Never lay the face of the disc or cover on anything but clean cloth or clean paper. Even a small invisible scratch would probably cause future trouble. Be careful to prevent the metering plunger from falling as the cover and disc is removed.



5. Wash each part in solvent as removed and dry with compressed air.

6. Remove the distributor spring from the housing.

7. After removing the cap screws and the Allen screw that hold the distributor housing to the main housing, lift the distributor housing, shaft and gear from the main housing.

8. The metering plunger barrel can be removed from the distributor housing by unscrewing the retaining nut. Also remove the copper gasket. In repairing this and all other units of the pump, it is well to lay out the parts in an orderly fashion as they are removed to insure their proper replacement during assembly operations.

9. Pull or press the gear from the distributor shaft, being careful to support the gear close to the shaft to prevent warping the gear. Remove the Woodruff key from the shaft.

10. Tap the lower end of the distributor shaft on a block of wood and remove the shaft and collar from the housing.

11. Remove the double ball bearing from the lower end of the housing.

12. Remove the priming valve from the inside of the housing and check the point to see that it has not been broken from overtightening. If it has been broken, remove all the particles from the housing. If the valve seat has been damaged, the distributor housing must be replaced.

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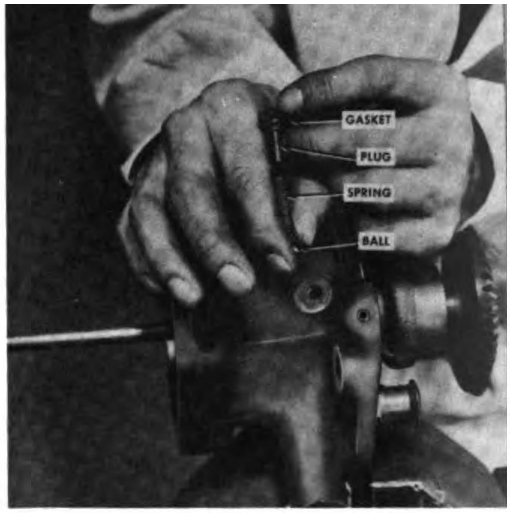


13. Replace the priming valve and tighten the packing nut so the valve turns normally by finger pressure.

14. Remove the distributor check valve screw, spring and ball. Clean and replace them in the housing.

15. Inspect the distributor drive collar and shaft. If they are worn in the thrust bearing fuel will leak by the shaft to fill the main housing and run out the overflow. If the shaft is badly worn, it can be detected by "shake" or excessive play in the thrust bearing. In that case the shaft must be replaced.

16. Now follows one of the most particular operations in the rebuilding or repairing of the fuel pump, that of replacing the thrust bearing. It must never be pressed from the housing unless inspection shows that it is worn or scored. If it is excessively worn in the shaft hole, it will be necessary to press it from the housing, from the bottom side, and replace it with a new one.

17. Clean the housing thoroughly and check to see that there are no burrs on the shoulders of the bearing. Be very careful to press the new bearing in straight to avoid cutting. Protect the face of the bearing with a piece of leather between the bearing and the tool.

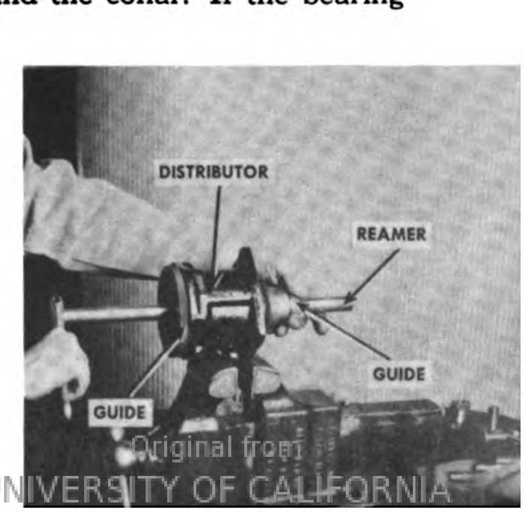
18. It will be necessary to ream the new thrust bearing with a line reamer to .8125″ while supporting the bearing with proper guides to insure a straight hole.

19. The face of the thrust bearing must be refaced, after it is pressed into the housing, square with the shaft hole and absolutely smooth. Never cut away more than the .001″ to .002″ needed to cut off the high spots or "clean up".

20. The inner diameter of the thrust face should be .0002″ lower than the outer diameter, or a difference of one-half degree. Check with Prussian blue between the thrust bearing and the collar. If the bearing has been properly faced, it will be indicated by an even wiping of the Prussian blue around the outer two-thirds diameter of the thrust bearing.

21. Clean all shavings from the housing with compressed air.

22. Inspect the ball bearing from the lower end of the shaft and replace it if worn.



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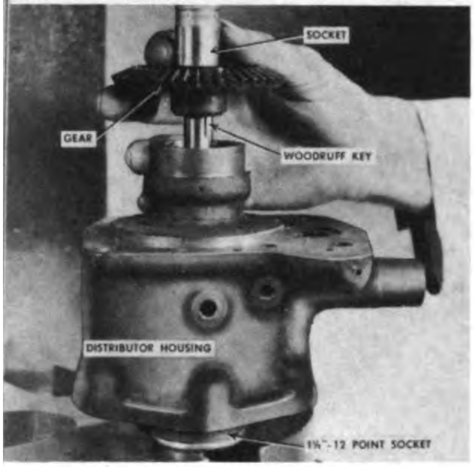
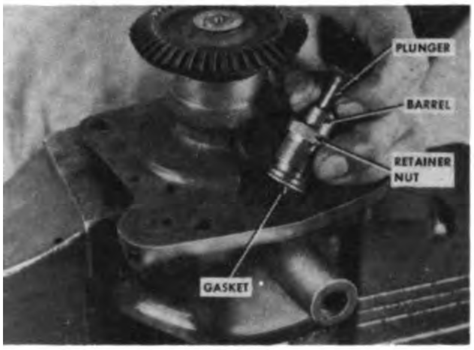
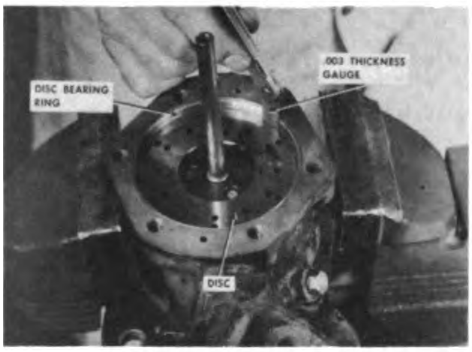
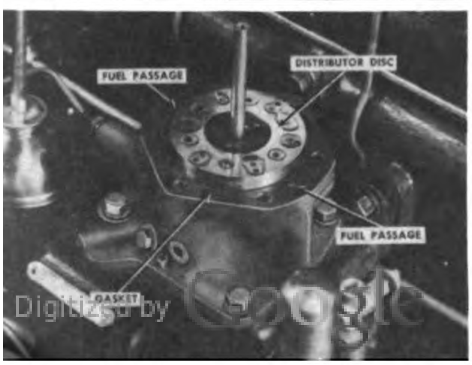







WORN DISTRIBUTOR
DISC AND HOUSING



23. Assemble the distributor, drive shaft and collar assembly to the housing and press the gear in place over the key. Use a 1½" 12 point socket over the drive pins in the collar while pressing the gear in place.

24. Inspect the metering plunger and barrel for wear or scratches. If either part is worn, it will result in a loss of pressure and inaccurate metering to the injectors. Replace them if worn. Always use a new copper gasket on the end of the barrel when replacing.

25. Place the distributor housing temporarily in place on top the main housing. Turn the drive shaft to see that the tachometer drive shaft is running true.

26. If the distributor disc bushing or bearing ring is distorted, it will be necessary to replace it. Press a new bushing into the housing. To check the clearance between the disc and bushing, place the distributor disc on the drive pin without the thrust spring. If the disc does not rotate freely in the bushing, it will be necessary to use a bearing scraper to relieve the bushing. A smooth bearing must be maintained and clearance held to .003". Check with a feeler gauge.

27. If the disc or cover show scored marks, or if they are badly worn, it will be necessary to replace them with a new or reground, disc and cover set. Regrinding and lapping is strictly a factory operation because the tolerance required is so close that it is impossible to maintain except with very special equipment.

28. New discs and covers are supplied only in pairs. If the old disc and cover are to be replaced, the new ones should be carefully and thoroughly washed in solvent and all passages blown out with compressed air.

29. Place the disc thrust spring on the collar and locate the rotary disc in posi-

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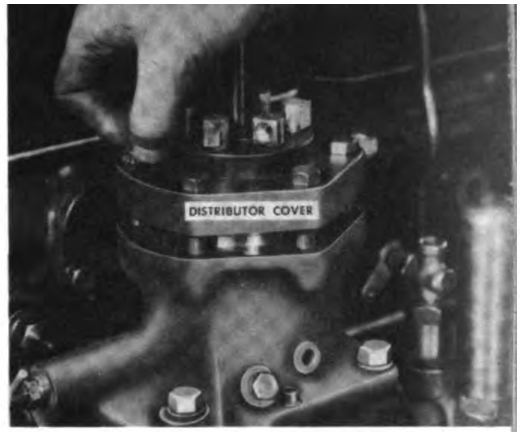

tion on the driving pins. (This cannot be put on wrong due to one pin being offset.) Fill the holes in the distributor disc with a medium light grade of clean lubricating oil. Also oil the face of the distributor cover. A new gasket of proper design and thickness must be used each time between the distributor top and the housing. Be sure to properly index the holes in the gasket and the housing.

30. It will be necessary to compress the distributor spring by pushing on the distributor tachometer guide to start the cap screws that hold the distributor top in place.

31. When all the capscrews are started by hand, tighten each one alternately, one-half turn at a time, until the cover is down against the gasket and distributor housing. If the distributor cover is not tightened down evenly, it will catch the distributor disc bushing and push it down on one side. This would break the seal between the distributor top and disc, and after starting the engine, the flow of fuel to the metering pump would be disrupted.

32. Remove the distributor assembly from the main housing and lay it aside until the other units are repaired.

Gear Pumps

REMOVAL: 1. Remove the cam rocker lever spring retainer and spring from the side of the fuel pump housing. This is the larger of the two hexagon head screws on the outer side of the housing.

2. Remove the four capscrews holding the gear pump bodies to the main housing. (Do not remove the three nuts from bolts at this time.)

3. Pry the gear pump assembly from the dowel pins and, while holding to the pressure chamber and the idling control lever, pull the gear pump assembly from the main housing.

DISASSEMBLY: Do not disturb the gear pumps unless the pump pressure is below 60 pounds of pressure on the gauge at idling speed. For purposes of identification, the gear pump supplying fuel from the fuel tank to the float chamber will be designated as the No. 1 pump. The gear pump supplying fuel from the float chamber to the distributor and metering pump will be designated as the No. 2 pump.

1. If necessary to disassemble, remove the three bolts holding the two pump bodies together.

2. Tap the bolts from the bodies with a bronze punch. The No. 2 body should slip off, leaving the gears on the shafts with the spacer plate.

3. Remove the fillister head screw from the front of the No. 1 body

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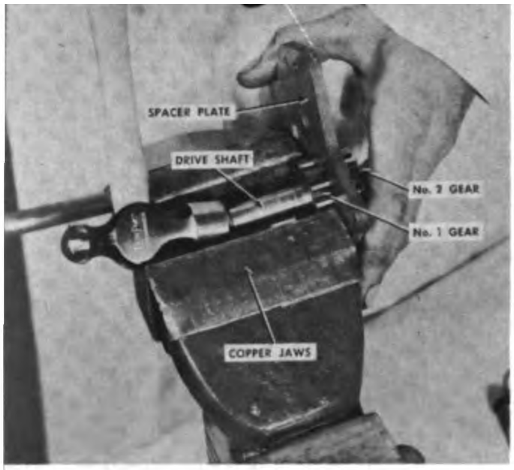


and slip the body from the shaft, leaving the gears on the shaft with the spacer plate.

4. Pull or drive the idler shaft from the gears, being very careful not to lose the oil seal and washer between the spacer plate and the No. 2 pump gear.

5. Place the No. 1 pump drive gear in a vise fitted with copper jaws, gripping the gear by the teeth and tightening the vise only enough to hold.

6. Tap lightly on the slotted end of the shaft to drive it out of the gear. Pull the Woodruff key from the shaft.

Caution: Any other method of removing this gear will cause the small Woodruff key to be driven through the spacer plate, making the spacer plate unfit for further use.

7. Slide the gear and shaft out of the spacer plate, being careful not to damage the oil seal and washer between the gear and spacer plate.

8. Press the gear away from the lock ring to remove it from the pump shaft. Remove the Woodruff key and lock ring from the shaft.

9. Remove the idling control lever after taking out the cotter pin and washer on the end of the shaft. Check the idler lever shaft to see that it is tight.

10. Unscrew the pressure chamber and remove the chamber and gasket.

11. Remove the pressure regulator valve and take out the spring and check ball.

12. Remove the fuel supply check valve housing by screwing out the check valve seat.

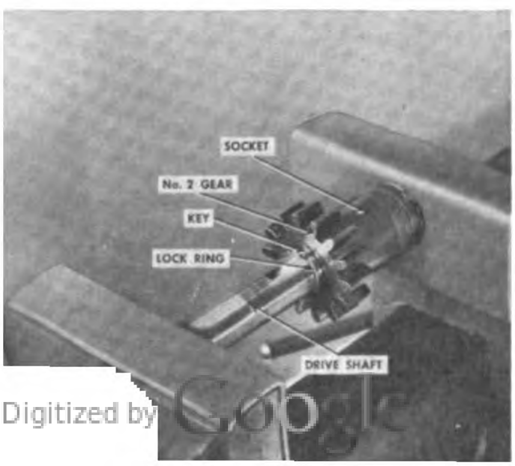
13. Place the emergency control valve end of the housing in a vise and unscrew the check valve seat. Remove the housing from the vise and take out the check valve, spring and guide.

ASSEMBLY: In repairing and rebuilding the gear pumps, the working dimensions given must be adhered to closely to assure satisfactory results.

1. Wash all the disassembled parts thoroughly in cleaning solvent and dry with clean compressed air.

2. Check all the gears for burrs on the teeth and, if present, remove them with a small hone.

3. Place the No. 1 gears in their pockets and check the clearance between the gears and pockets. If the clearance is as much as .004", it will be necessary to use new gears. Recheck with new gears and



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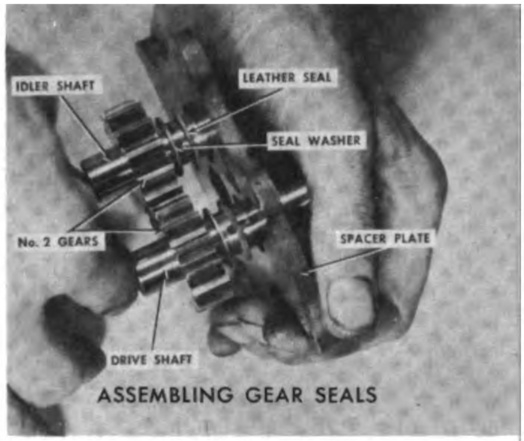


ASSEMBLING GEAR SEALS

if the clearance is still as much as .004", it will be necessary to replace both the gears and the body. Follow the same procedure for the No. 2 gears and pockets.

4. Place the No. 1 gears in their pockets again to check the depth of the pockets. Place a straight edge across the gears and body. The straight edge should touch both gears and body. If the gears are more than .001" low in their pockets, it will be necessary to remove the gears and accurately lap the face of the body on a good lapping plate until the gears fit flush with the body.

Warning: Wash the body thoroughly of all lapping compound and dry with air before fitting the gears to the body.

5. Follow the same procedure for the No. 2 gears and pockets.

6. Assemble the No. 2 pump gear, Woodruff key and snap wire. Press the gear over the snap wire into the recess on the gear.

NOTE: Inspect the milled end of the drive shaft where it engages the fuel pump main shaft, and if it shows any wear, replace it with a new one.

Caution must be used when assembling new gears to the spacer plate and shaft that the shaft seals are assembled properly. These seals are assembled on the No. 2 side of the spacer and with the seal washers working against the No. 2 pump. The No. 2 pump is the one with the one-half inch gears.

8. Assemble the gears to the spacer plate.

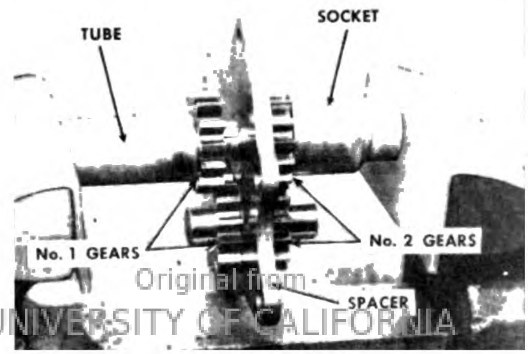
9. Inspect the drive shaft oil retainer in the No. 1 body to see that it is in good condition. When assembling the No. 1 body on the shaft, care must be used to see that this retainer is not damaged.

10. When assembling the No. 1 gear body, use only a .0015" body gasket. Brush a thin coat of shellac on the spacer plate gasket surface only. Assemble the gasket in the proper position, always being careful not to get the shellac in the gear pockets and fuel passages. Put a thin coat of shellac on the gasket.

11. With the No. 1 body on the shaft against the gasket, insert the fillister head screw.

12. Shellac a gasket to the No. 2 side of the spacer and place the body over the gears in position.

13. Insert the mounting capscrews through both pump bodies and attach the 3/8" nuts to the protruding ends. Draw these nuts up to pull the pump bodies together, at the same time turning the drive shaft to see that the pump gears continue to turn freely. If necessary, tap the edges of the bodies to free the gears.



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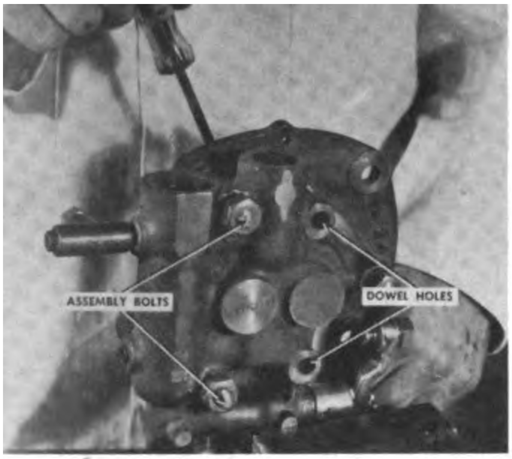


14. If a new body or spacer has been used, it will be necessary to ream the two dowel holes to .375". Insert the two threaded dowel bolts and attach the nuts.

15. Reinstall the idling lever, washer and cotter pin. Drop the check ball into the housing and seat into place with a small copper punch.

16. If the pressure regulator shows wear on the lower part around the by-pass holes, it will be necessary to replace with a new regulator or low pressure will result at slow speeds.

NOTE: It is sometimes necessary to add 1/64" washers below the pressure regulator spring to increase the spring pressure. One washer adds approximately 10 pounds fuel pressure.

17. Place the pressure regulator spring in the housing.

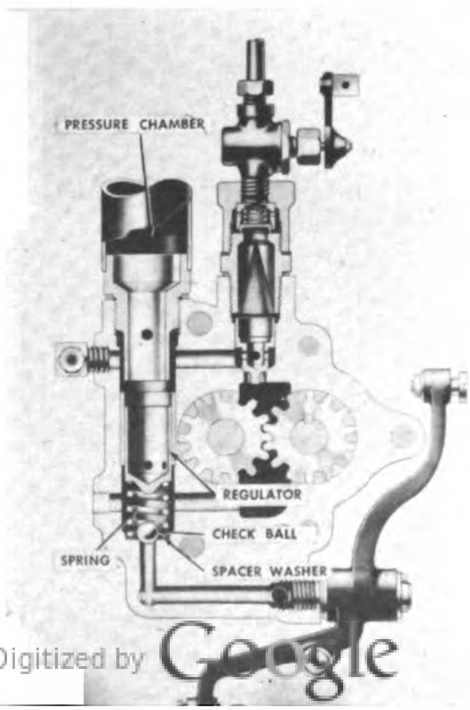
18. Slide the pressure regulator into place with the point down toward the check ball. Check to be sure the regulator works freely.

NOTE: If the pressure regulator sticks and remains open, it will cause a drop in the fuel pressure. If it sticks and remains closed, it will cause excessive fuel pressure.

19. Screw the pressure chamber into the body, making sure that the gasket is in good condition

Float Chamber

DISASSEMBLY: 1. Remove the two cap screws holding the float chamber to the fuel pump housing. Remove the float chamber from the housing.



2. Remove the two cap screws holding the top plate to the float chamber and remove the plate and float assembly from the float chamber.

3. Remove the nut and washer from the float bearing pin and remove the pin. This allows the float, float stop and float valve to come free.

4. With a small wrench, remove the float valve seat from the top plate. Be careful not to lose the gasket under the seat.

5. If necessary, remove the check valve seat at the main fuel inlet, being careful not to lose the ball check.

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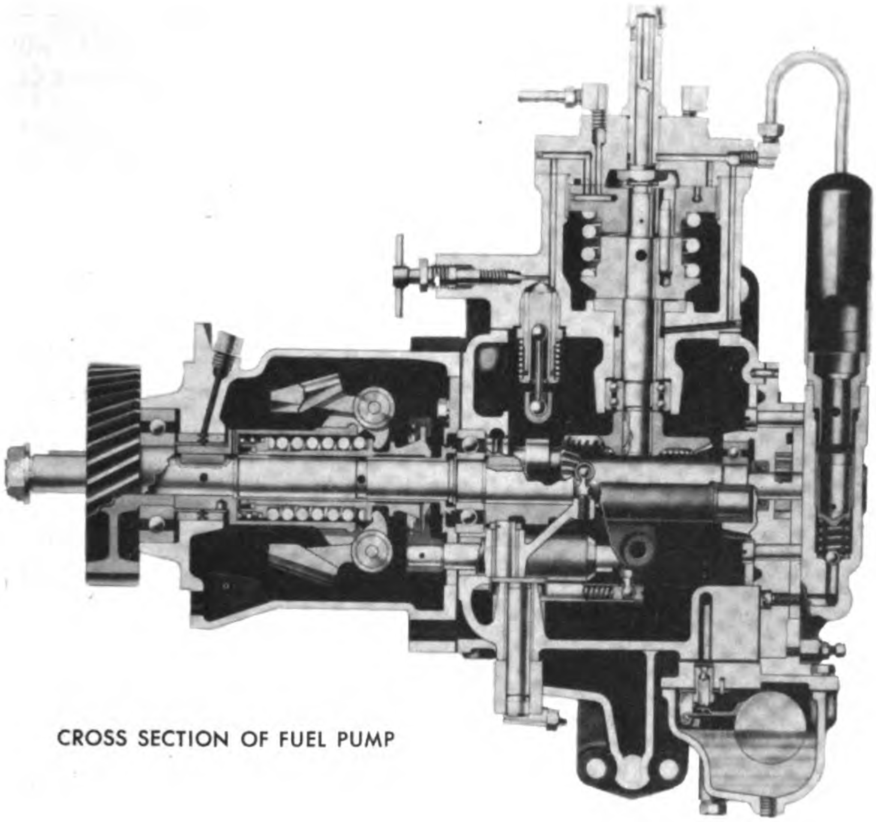
CROSS SECTION OF FUEL PUMP

ASSEMBLY: 1. Install the check valve and seat at the main fuel inlet, if removed.

2. Place the small dowel pin in the float chamber top plate, making sure that it is tight enough not to drop out.

3. Place the gasket in position on the top plate.

4. Place the float bearing bracket in position on the dowel pin.

5. Install the float valve seat with a new gasket and tighten securely.

6. Make sure the float valve is free of burrs and in good condition. Drop it into place and seat with a copper punch.

7. Place the float in position and insert the bearing pin. Place the float stop in position and assemble lock washer and nut to the bearing pin.

8. Make sure the float and valve are absolutely free and that the float contacts the head of the valve, holding it firmly on the seat in closed position. Otherwise the fuel will overflow at the bottom of the pump.

9. Assemble the float chamber to the top plate, making sure that the float has adequate clearance in the chamber.

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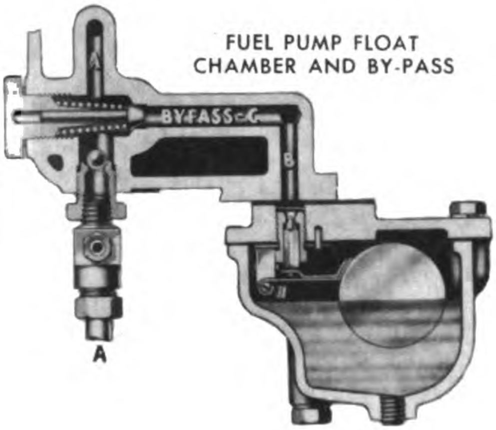


FUEL PUMP FLOAT CHAMBER AND BY-PASS

10. Assemble the float chamber with a new gasket to the fuel pump housing and bolt securely in place.

11. Install and tighten the drain plug.

12. The by-pass valve spring must exert enough pressure to insure a supply of fuel to the float chamber, but if it is too strong, the fuel will overflow at the main housing. Assemble the by-pass valve, spring and retainer.

Governor Unit

DISASSEMBLY: 1. Remove the hex nut and lockwasher from the drive gear end of the main shaft, and remove the drive gear with a suitable puller.

2. Remove the three cap screws and lockwashers that hold the governor housing to the main housing, and take off the governor housing.

3. Using an end wrench, disconnect the small ball joint screw from the governor control rod.

4. Remove the governor weights by first tapping the weight pins far enough to one side to permit grinding or filing off the riveted heads. Drive the pins out, taking care not to damage the small ball bearings in the weights.

5. Pull the governor yoke from the main shaft.

6. Remove the governor collar and rod assembly, the spring assembly and the ball bearing shield from the main shaft.

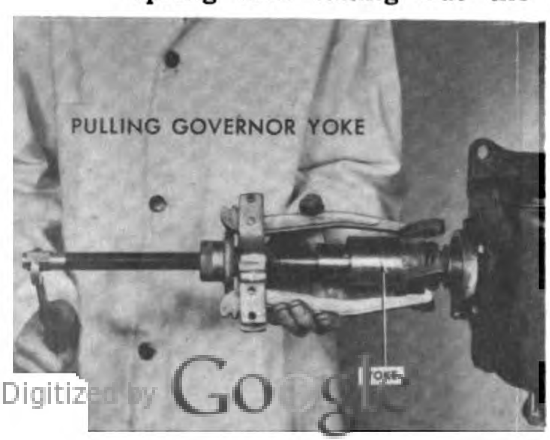
7. Remove the four capscrews from the governor ball bearing shield. Tap the governor and main shaft out of the main housing.

8. Inspect the governor yoke bushing in the governor housing. The inside diameter should be 1.626" to 1.627". If it is worn oversize, or scored, the bushing must be replaced and the new one reamed to 1.626".

9. Clean the oil hole in the governor housing that leads to the yoke bushing.

10. Remove the snap ring that holds the governor sleeve collar and the thrust washer, and remove the sleeve collar and thrust washer from the spring assembly.

11. The governor spring can be removed by compressing the spring and taking out the split lock ring in the governor sleeve.


PULLING GOVERNOR YOKE

12. Hold the main shaft in a vise with copper jaws so the keyways of the shaft are to the top and remove the keys with side cutters or with a chisel.

13. Remove the snap ring from the main shaft.

14. Pull the governor sleeve tube from the shaft.

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15. Remove the lock ring and press the cam ball bearing from the shaft.

16. Inspect the fuel pump cam. If it is worn or rippled it will be necessary to replace the cam. Place the main shaft in an arbor press with the distributor drive gear teeth resting on copper parallels or on a piece of hard wood. Press the cam from the main shaft.

Main Housing

DISASSEMBLY AND SERVICE: 1. Use a small wrench to disconnect the ball joint on the short vertical lever link from the vertical lever.

2. Insert a socket wrench through the hole in the top of the housing to loosen the capscrew which holds the plunger lever shaft and plunger lever pin in place.

3. Using a small punch, indent one expansion plug and then drive through the expansion plug on the opposite end of the plunger lever shaft until the first expansion plug falls out. Drive the shaft from the opposite end, being careful not to damage the bushings.

4. Lift the vertical lever assembly from the housing.

5. Remove the vertical lever spring and the capscrew in the plunger lever.

Warning: Place the parts on clean paper or cloth only.

6. Push the pin from the plunger lever, making sure not to lose any of the 56 needle bearings in which it is mounted. If the plunger lever is placed on a 1¼" socket during this operation, the socket will catch the needle bearings.

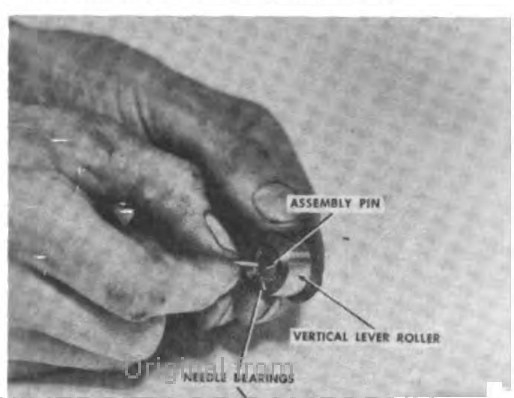
7. Use a small punch and a socket to drive the pin from the vertical lever roller, making sure not to lose any of the 22 needle bearings.

Warning: Keep these long needle bearings separate from the 56 removed from the plunger lever pin.

8. Inspect the vertical lever, pin, roller and roller pin. If they are worn, replace them. If parts are worn or pitted, poor governor action will result.

9. It is always best to replace the needle bearings if the pins and lever are found to be corrugated or pitted.

10. Spread a clean cloth on the work bench and on it place the parts of the vertical lever to be assembled. Place the roller on the index finger and put a piece of ⅜" rod, 7/16" long, in the hole. Fill the hole with 22 long needle bearings.



11. Place the roller pin through one pin hole in the vertical lever until it is flush on the inside. Insert the roller with

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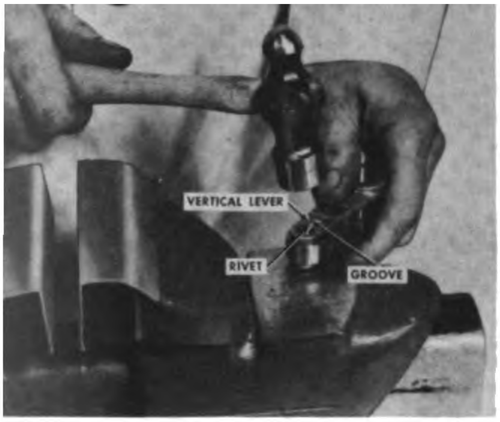


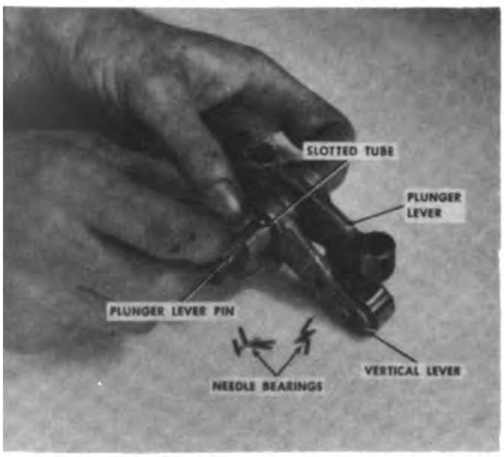
the plug and needle bearings in position and push the roller pin through the roller. This will cause the small plug to fall out on the opposite side.

12. Lock the pin in position by riveting the copper rivet into the grooves on both sides of the vertical lever, and file flush with the sides of the vertical lever.

13. When assembling the plunger lever pin, use a piece of ⅝" inside diameter copper tubing with a slot to receive the needle bearings. Place the plunger lever between the arms of the vertical lever in position.

Caution: The vertical lever must be assembled to the plunger lever so the flat side will be next to the ball joint link to insure the roller of the vertical lever link engaging properly in the cam rocker radius.

14. Tap the plunger lever pin through the vertical lever and plunger lever, leaving the needle bearing race open on one side. Place the slotted tubing over the pin and insert 28 short needle bearings. Tap the plunger lever shaft through far enough to allow the opposite bearing race to be filled with the same number of needle bearings. Tap the plunger into position and turn the groove in the pin to match the cap screw hole in the plunger lever. Run the cap screw down loosely to hold the pin in place.



15. Inspect the plunger lever shaft bushing in the main housing for wear. If worn, replace in proper position to index with the oil holes in the housing. Ream to .750".

16. Lay the vertical lever aside until ready to install in the main housing later.

17. Remove the cam rocker lever from the housing.

18. Mount the lever firmly in a vise between copper jaws.

19. Remove the rivet pin with a small punch.

20. Using a small brass rod as a driver, remove the roller pin.

Caution: It will not be necessary to remove the stop pins as they never encounter wear. Removal of these pins will result in serious damage to the pump and the engine.

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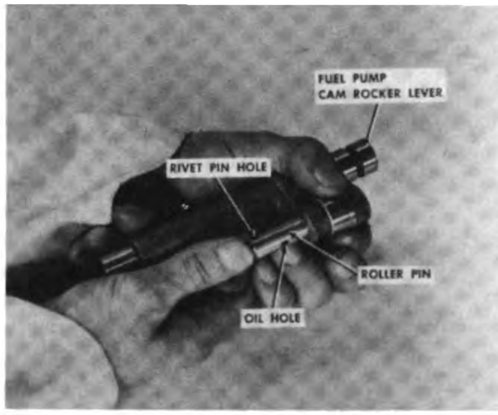

21. Inspect the cam rocker lever for wear on the ground radius where the roller operates. If the lever is rough, it will cause bad governor action and therefore must be replaced.

22. Inspect the roller pin for wear and replace if worn.

23. Inspect the roller and replace it, if worn.

24. Start the roller pin into the lever, making sure the oil hole in the pin is open.

25. Assemble the roller in place and tap the pin through the roller, indexing the lubricating hole in the pin with the hole in the lever.

26. Peen the roller pin rivet in place.

27. Make sure the roller is free and has .006"-.008" end thrust to allow it to turn freely under tension. If the roller should stick, it would cause excessive wear and faulty governor action.

28. Inspect the cam rocker lever bushings in the main housing and in the No. 1 gear pump body. Replace if worn. When replacing the main housing bushings, be sure the oil hole is lined up properly for lubrication. Ream to .8125" with a bottom reamer. Ream the bushings in the No. 1 gear pump body to .625" with a bottom reamer.

29. Drive out the rivet from the fuel control lever that locates it in place on the serrated shaft.

30. Loosen the capscrew and tap the fuel control lever from the eccentric shaft.

31. Remove the cotter pin from the collar with a pair of diagonal cutters and remove the collar while working from inside the main housing.

32. Turn the eccentric shaft until the governor lever can be lifted from the eccentric shaft.

33. Lift the eccentric shaft from the housing.

34. Inspect the eccentric shaft bushing in the main housing. Replace if worn and ream to .5625". Remove the burrs around the top and bottom edges with a scraper.

35. Inspect the governor lever bushing for wear. If worn, replace it and ream to .500".

36. Inspect the ball joints in the vertical lever link and in the governor lever link for wear. Replace them if they are worn or pitted to prevent bad governor action.

37. Inspect the eccentric shaft for wear. If worn out of round replace with a new shaft.

ASSEMBLY AND ADJUSTMENTS: 1. Install the eccentric shaft.

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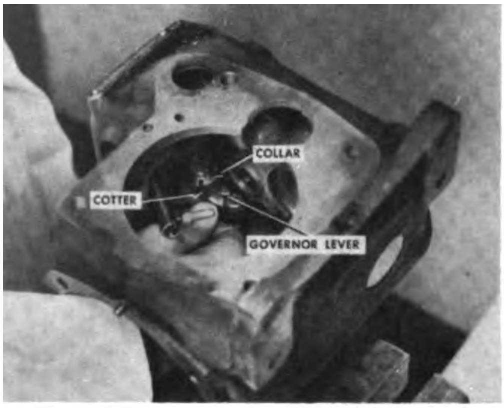


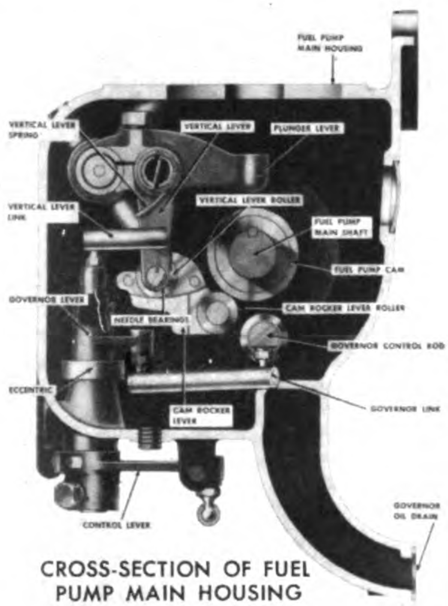
2. Install the governor lever — assembled with the vertical lever link and the governor lever link—to the eccentric shaft.

3. Assemble the collar over the governor lever and insert a new cotter pin. Make sure that there is no more than .002″ thrust on the governor lever when the assembly is completed, and that the governor lever works freely on the eccentric shaft.

4. Install the cam rocker lever assembly in the housing.

5. Assemble the gear pressure pump assembly to the main housing to make the test for the cam rocker lever assembly. Be sure to use the proper gasket between the main housing and the gear pump housing. Bolt the gear pump in position to the body.

6. Check the cam rocker lever to see that it rocks freely and that it has at least .006″ end thrust. If the lever does not rock freely, it will affect the fuel pump delivery. Scrape the bushings slightly, if necessary.



CROSS-SECTION OF FUEL PUMP MAIN HOUSING

7. Remove the gear pump assembly.

8. Place the vertical lever in position in the housing. Insert the plunger lever shaft.

9. Be careful to properly index the oil holes on the plunger lever shaft and bushings.

10. It is necessary that the vertical lever and roller be spaced in the center of the cam rocker lever race for the proper working position. To space the vertical lever it may be necessary to shift the plunger lever shaft bushings.

Caution: ***Be sure the needle bearings have not been shifted.***

11. Tighten the lock screw with a socket wrench. Test the action of the plunger lever. It should have a side thrust of .001″.

12. Insert new expansion plugs on each end of the plunger lever shaft. Use a large, flat end punch to wedge the plugs in place. A good sealing compound should be used on the edges of the expansion plugs.

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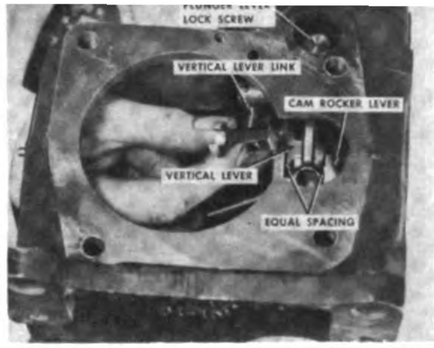
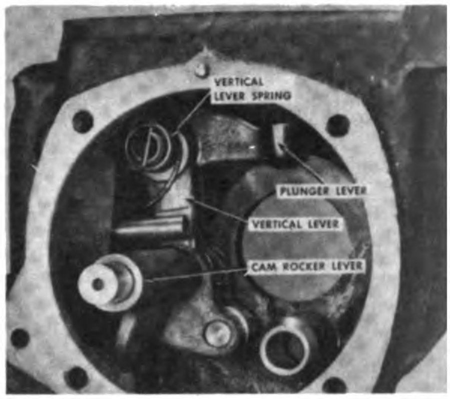


13. Check the position of the vertical lever and the roller in the cam rocker lever race to see that it has not shifted while inserting the expansion plugs. Check to see that the plunger lever and vertical lever work freely.

14. Place the vertical lever spring in position.

15. Assemble the vertical lever link with a new lock washer to the vertical lever.

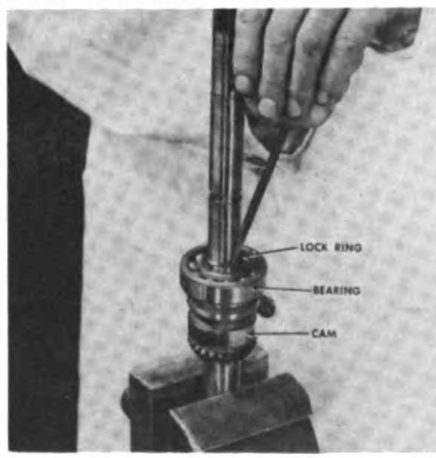


Governor Unit

ASSEMBLY: 1. Inspect the ball bearing on the gear pump end of the main shaft for wear or "shake" and replace if it is worn.

2. Inspect the gear pump drive pin. If it is worn at all, replace by driving the old pin out and, while inserting the new one, line it up in place and test with a gear pump drive shaft before peening the ends of the pin to tighten. Clean the shaft of any burrs or scored marks.

Caution: This pin must fit freely in the gear pump drive shaft slot to insure proper alignment and prevent scoring in the gear pump.



3. Lubricate the shaft with heavy oil where the cam fits the shaft. Be sure the key is in place for the cam. Start the cam, with the distributor drive gear toward the gear pump end of the shaft, over the drive gear end of the shaft.

4. Line up the keyway and key and press the shaft into the cam and gear all the way to the stop.

5. Inspect the large ball bearing for wear and, if worn, replace with a new one. Press the bearing into place with the sealed side next to the cam. Lock in place with the lock ring.

6. Assemble the governor sleeve tube to the main shaft. Assemble the lock ring to the shaft. Insert a new key in the slot of the main shaft.

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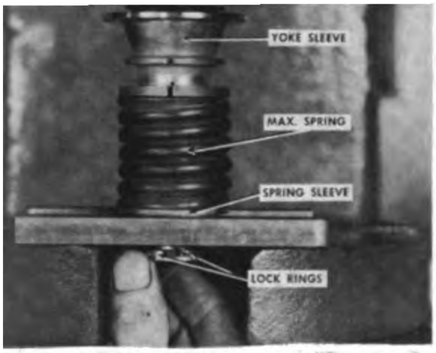
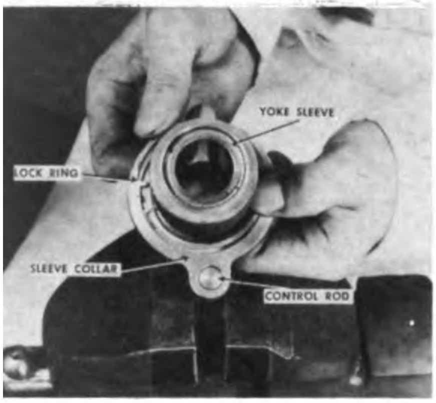




7. Before assembling the maximum speed spring to the governor sleeve, it is very important to have the proper matched weight and spring combinations. Always keep the spring and weight combinations together, also the spacer gaskets, when used.

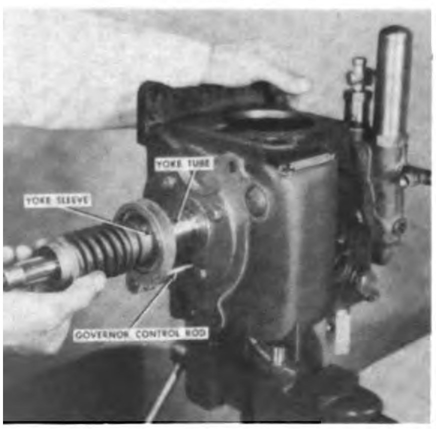
8. Assemble the maximum speed spring to the yoke sleeve. Assemble the spring sleeve to the yoke sleeve making sure it will work freely on the shaft. Compress the maximum speed spring in an arbor press and assemble the lock rings.

9. Assemble the control rod and sleeve collar to the yoke sleeve and place the thrust washer in position. Secure the assembly with the lock ring.

10. Check the governor control rod bushing for wear by inserting the governor control rod in the bushing. If any "shake" is apparent it must be replaced and line reamed to .5625".

11. Assemble the governor shaft to the main housing.

12. Lubricate all parts with clean oil and assemble the governor sleeve unit over the tube on the main shaft. The governor sleeve and control rod must work freely on the shaft and in the housing or poor governor action will result.



Caution: Always have the gear pump assembled to the main housing when making this check.

13. Inspect the governor weight bushings in the governor yoke. Wear in these bushings can be checked with a new weight pin. If worn, replace and ream to .256".

14. Place the torque spring in the governor yoke with the prongs of the spring toward the open end of the governor yoke and the idling spring in place over the torque spring.

15. Remove the main shaft and governor assembly from the main housing.

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16. Assemble the governor yoke over the key on the main shaft and press the yoke over the shaft in place.

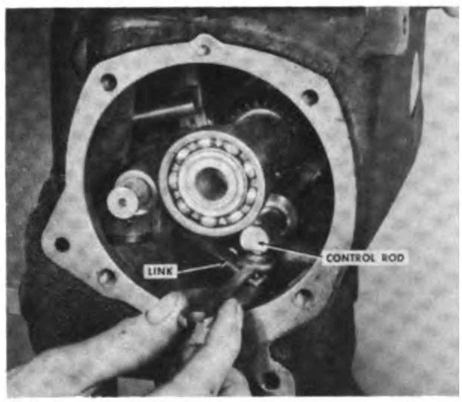
17. Inspect the working radius on the governor weights for wear. If flattened or worn, replace with new weights having the same number as stamped on the old weights. This assures the same governed speed. Inspect the ball bearings in the weights. If they are pitted or worn install new bearings with the shielded side out.

18. Attach the weight assemblies to the governor yoke with new weight pins. When the weights are properly assembled the working radius must not ride on the governor sleeve, and the turning fins must be free in the slot in the governor sleeve. Peen each end of the governor weight pins.

Final Assembly and Adjustments

1. Using a new .003" gasket, install the main shaft with the governor assembly in place on the main housing and secure the ball bearing shield with cap screws and lockwashers.

2. Assemble the link to the governor control rod.



3. While pushing down on the top of the eccentric shaft with a screw driver from inside the main housing, assemble the control lever to the eccentric shaft in stop position.

4. Turn the stop screw in, to the stop on the housing, and lock it in place with the jam nut.

5. If a new control lever or eccentric is being used it will be necessary to drill a new pin hole in the lever and shaft.

6. To set the maximum fuel setting stop and avoid any stress on the governor and fuel control mechanism, proceed as follows:

a. Use a small wooden wedge under the governor weights and compress the idling spring.

b. Open the hand control to the maximum fuel delivery position and turn the adjusting screw in to the stop on the housing.

c. Give the screw one and one-half more complete turns from this point and lock in place with the jam nut.

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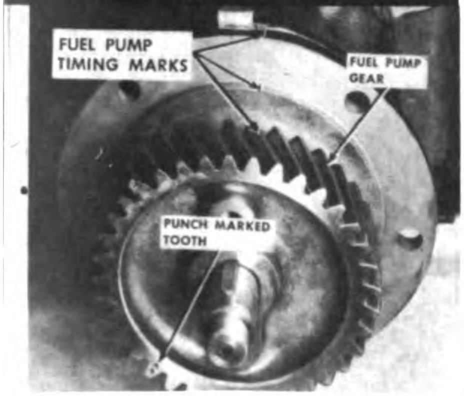

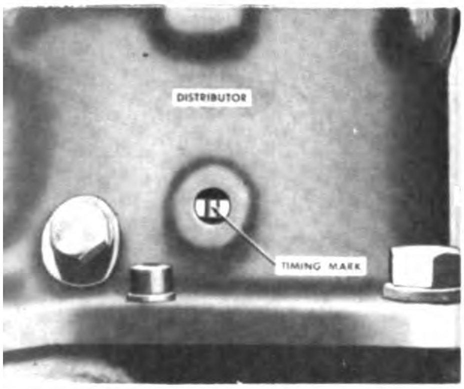

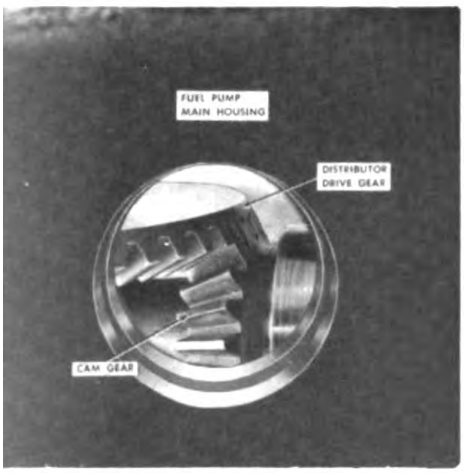

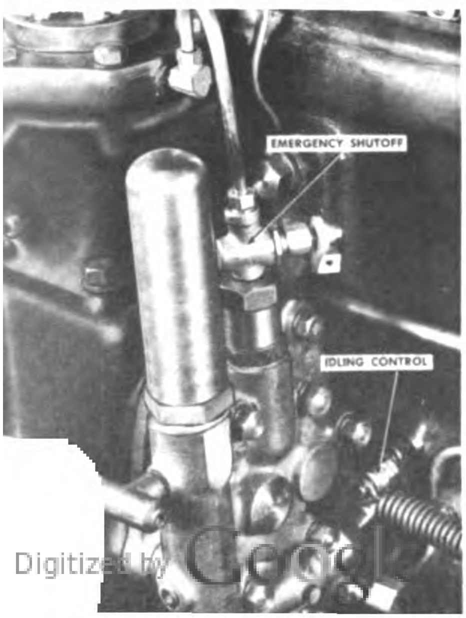

7. Assemble the governor housing to the main housing, using a new gasket in proper position, and secure with lockwashers and cap screws.

8. Guide the drive gear over the key on the main shaft, and press against the end of the main shaft while resting the drive gear on the arbor press plate.

9. Assemble the gear pressure pump to the main housing, making sure that the right gasket is used.

10. Assemble the cam rocker lever spring, gasket and spring retainer.

11. Set the timing mark on the drive gear to match the timing mark on the governor housing.

12. Set the timing mark in the distributor housing to line up with the inspection hole.

13. Install the metering plunger link, spring and metering plunger in place on the plunger lever.

14. Place a gasket of the proper thickness on top of the fuel pump main housing. Assemble the distributor housing to the main housing while carefully guiding the metering plunger into position in the plunger barrel. Mesh the gears by turning the drive shaft.

15. The thickness of the gasket between the distributor housing and the main housing determines the gear lash of the distributor drive gear. The distributor drive gear lash should be .004". This can be checked by rocking the main shaft gear by hand. Turn the distributor gear one complete rotation, checking at various positions.

16. Connect the fuel line from the distributor to the emergency control valve.

17. Install the fuel lines from the gear pump and the main fuel inlet to the priming pump.

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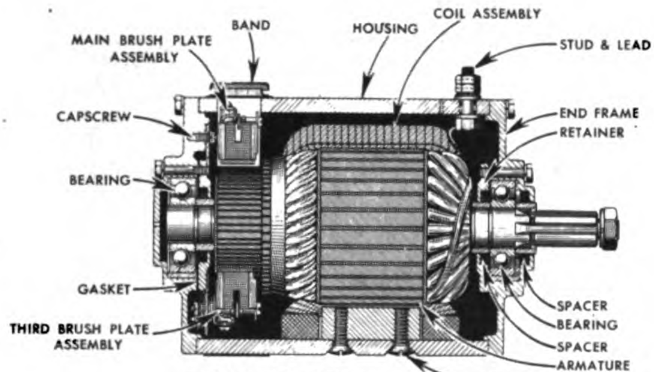
REPAIR OF ELECTRICAL EQUIPMENT

GENERATOR

The generator can be disassembled, serviced and reassembled as outlined in the following instructions.



CROSS-SECTION DRAWING OF GENERATOR

Disassembling Generator

DISASSEMBLY INTO MAIN SUB-ASSEMBLIES: Loosen cover band screw and remove cover band. Note relationship of leads and brushes.

Disconnect leads to the insulated and third brush holders by removing one each screw and lockwasher. This disconnects lead from "A" terminal stud and lead from field winding.

Remove commutator end frame by removing six attaching screws and lockwashers and detaching commutator end frame from field frame. It may be necessary to loosen the end frame with a soft hammer. The collar is pressed on the armature shaft and need not be removed unless to replace.

Detach field frame from drive end frame by removing six attaching screws and lockwashers. Use soft hammer to loosen.

Remove pulley nut and lockwasher by placing armature in soft jaws of vise.

With the armature still in soft jaws of vise, use puller to remove pulley from splined armature shaft.

Remove drive end frame from armature. While it normally slips off fairly easy, it may have to be pressed off in an arbor press. Remove two collars, one from each side of drive and frame. (These collars are different and should be marked in some way for correct reassembly.)

DISASSEMBLY OF DRIVE END FRAME: Detach bearing retainer plate and gasket by removing five screws and lockwashers. The felt washer and felt washer retainer are staked in place on the bearing retainer.

Remove ball bearing from end frame. While this may normally be done with a few light taps, it may have to be pressed out in an arbor press. A felt washer and felt washer retainer are staked in place in the drive end frame on the pulley side of the bearing which serves with the other felt washer to seal the bearing and oil passage.

Remove oiler and pipe plug from opposite ends of oil passage. Wash out passage and oiler and dry with compressed air.

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DISASSEMBLY OF COMMUTATOR END FRAME: Remove two round head screws, lockwashers, and plain washers holding the main brush plate to the commutator end frame. The two hold down screws, lockwashers and plain washer should be detached. This entirely frees the third brush plate and main brush plate from the commutator end frame.

Remove the five screws and lockwashers which hold the ball bearing retainer plate and gasket in place. The felt washer and felt washer retainer are staked in place in the ball bearing retainer plate.

Remove ball bearing from end frame. It may be necessary to use a bearing puller.

Disassemble the brush assemblies as follows: Remove one each pigtail lead holding screw and lockwasher from each brush holder and lift out brushes. Detach from each brush holder assembly one each round head screw and lockwasher, brush holder stud, nut, and lockwasher. This completely dismantles the brush rigging. The brush holder side of plate should be identified for correct reassembly.

Remove oiler and pipe plug from opposite ends of oil passage. Wash out passage and oiler and dry with compressed air.

DISASSEMBLY OF FIELD FRAME: Detach terminal studs by removing from each terminal stud two each nuts and one each lockwasher, plain washer, and insulation washer. The "A" terminal stud may be removed from frame, together with insulating bushing and washer, and main brush lead. The "F" terminal stud is soldered to the field winding lead.

Remove field windings by removing eight pole shoe screws (pole shoe screwdriver), pole shoes, and windings. Stud and clip on field winding leads may be unsoldered and replaced, if required. Be careful in handling field windings to avoid damaging leads or insulation.

Generator Inspection

GENERAL: After disassembly, all parts should be cleaned, examined, and defective parts replaced. The procedure of cleaning and inspecting parts is given in following paragraphs.

ARMATURE: Do not clean the armature by a degreasing method, since this would damage the insulation and might ruin the armature. Wipe with a clean cloth *slightly* dampened with carbon tetrachloride or similar solvent. If commutator is rough, out of round, worn, has high mica, filled slots, or is burned, it must be turned down in a lathe and the mica undercut. Make cut no deeper than necessary. Minimum diameter of commutator should be 2.80 inch. If it is necessary to turn the commutator below this diameter, discard the armature. Undercut mica 1/32 inch. Armature may be checked for open, grounded, or short circuits as follows:

1. *Ground*—Check with test lamp and test points from the commutator to the armature shaft or lamination. If the lamp lights, indicating a ground, and if the ground is not readily apparent and repairable, the armature must be replaced.

2. *Open*—Some bars badly burned, with other bars fairly clean, indicates an open circuited armature. The open will usually be found at the commutator riser bars and is often a result of generator overload—the consequence of an excessively high generator output resulting from a too advanced third brush adjustment. If the bars are not too badly burned, the armature may sometimes be saved by resoldering the leads in the riser bars with rosin flux, turning the commutator down and undercutting the mica. Make sure the third brush is adjusted according to specifications.

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3. *Short*—A shorted armature may be detected on a growler. The growler is a strong electromagnet connected to a source of alternating current. When shorted armature is placed on the growler, and a hacksaw blade held above the shorted coils in the armature, the blade will be alternately attracted to and repelled from the armature, causing the blade to buzz against the armature. Before discarding an armature testing shorted, inspect the commutator slots carefully, since copper or brush dust sometimes collects in the slots and shorts adjacent bars.

FIELDS: The fields should not be cleansed by any degreasing method, since this would damage the insulation and might ruin the windings. Clean by wiping with a clean, dry cloth. Be careful in handling the winding assembly to avoid breaking or weakening the connecting lead between the windings. Test the field current draw by connecting a 12-volt battery and an ammeter in series with the four fields. The current draw should be 1.39-1.47 amperes at 12 volts. Replace windings if they do not meet specifications. The field insulation should be in good condition. If it is charred or worn away so that the wire is exposed, it is sometimes possible to rewrap the windings with insulating tape and paint them with insulating compound. All soldered connections should be made with rosin flux solder. If the terminal stud or clip is damaged, replace.

BRUSHES: If the main brushes are worn down to ¾ inch and third brush is ⅝ inch (original length 1 3/32, third brush 1 inch), replace. Make sure that the pigtail leads are firmly in place in the brushes and that the clip is properly soldered to the lead. New brushes may be seated with a brush seating stone. The brush seating stone is an abrasive material which, held against a revolving commutator, disintegrates, carries under the brushes, and seats them in a second or two.

BRUSH SPRINGS: The brush springs should have sufficient tension to provide the proper pressure between the brushes and commutator after the unit is assembled. This may be checked by assembling the brushes, brush springs, and arms to the commutator end frame, placing the commutator in position in the end frame and then checking with a spring gauge the amount of pull required to raise the brush arms from the brushes. Replace springs if tension is not correct.

BEARINGS: If the bearings appear to roll roughly, or sloppily, replace them.

BRUSH RINGS: If the brush rings, brush arm studs, brush holders, are damaged (bent, warped, cracked, insulation burned, etc.) replace.

Assembling Generator

ASSEMBLY OF FIELD FRAME ASSEMBLY: Place field winding assembly with pole shoes in field frame. Insert pole shoe spreader and tighten shoes against frame. Install and tighten eight pole shoe screws with pole shoe screwdriver. Winding with stud soldered to lead must be so placed that stud can be inserted through hole in frame.

Insert stud on winding lead, with insulating washer and bushing, through "F" terminal hole in frame and secure with insulating washer, plain washer, lock washer and two nuts. Place stud with lead attached and insulating washer and bushing, through "A" terminal hole in frame and secure with insulating washer, plain washer, lock washer, and two nuts.

ASSEMBLY OF COMMUTATOR END FRAME: Reinstall oiler and pipe plug in opposite ends of oil passage.

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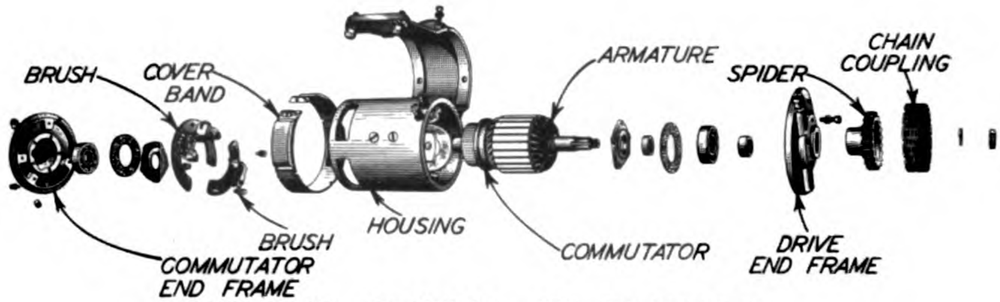

EXPLODED DRAWING OF GENERATOR

Assemble the insulated main brush assembly to main brush plate and insulated third brush assembly to third brush plate as follows:

a. Slide spring on brush arm sleeve and hook in notch on arm.

b. Push stud through side of brush holder into space sleeve, through brush arm, and into bushing in other side of holder.

c. Place brush terminal bracket, space washer, and insulating washer on threaded end of stud. (The third brush assembly does not use the space washer.)

d. Insert stud through proper hole in plate end place on stud, one small insulating bushing washer, followed by one insulating washer (2 hole—large), one space washer (2 hole—large), lock washer, and nut. Draw nut finger tight.

e. Place small insulating bushing washer in the other brush mounting screw hole of the plate and swing brush terminal bracket, space washers and insulating washers into position.

f. Line up holes in holder, plate, and washers. Insert and fasten screw with lockwasher.

Assemble the grounded brush assembly to the main brush plate as follows:

a. Slide spring on brush arm sleeve and hook in notch on arm.

b. Push stud through side of brush holder into space sleeve, and brush arm into bushing in other side of holder.

c. Place brush terminal bracket and two space washers on threaded end of stud.

d. Insert stud through small hole, of a group of two holes, in brush plate.

e. Place space washer, lock washer and nut on stud and draw finger tight.

f. Swing brush terminal bracket into place so that holes align in bracket, washers, and brush plate.

g. Secure with screw and lockwasher.

Install ball bearing in end frame.

Install the ball bearing retainer plate, including felt washer and its cup retainer, and gasket to the end frame with the five attaching screws and lock washers.

Attach the main brush plate assembly to the end frame with two screws, lock washers, and plain washers. Attach the third brush plate to the main brush plate and end frame with the two hold down screws, lock washers and plain washers. (The upper hold down screw uses a spring washer instead of lock washer).

Install brushes and attach pigtail leads to brush holders with one each screw and lock washer.

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ASSEMBLY OF DRIVE END FRAME: 1. Install oiler and pipe plug in opposite ends of oil passage.

2. Install ball bearing in drive end frame. It may be necessary to use an arbor press.

3. Attach ball bearing retainer (which includes felt washer and felt washer cup retainer) and gasket to end frame with the five attaching screws and lock-washers.

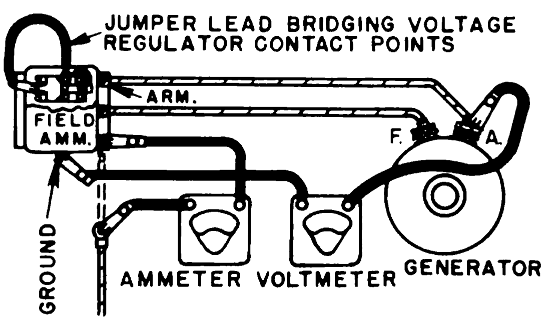
ASSEMBLY OF GENERATOR: 1. Place the correct collar on the armature shaft and slip drive end frame on shaft. It may be necessary to use an arbor press.

2. Place the collar and pulley on the splined shaft, and with the armature in the soft jaws of a vise, secure in place with pulley nut and lockwasher.

3. Attach field frame assembly to drive end frame with six attaching screws and lockwashers.

4. Attach commutator end frame to field frame with six attaching screws and lockwashers.

5. Connect leads to the insulated and third brush holders with one each screw and lockwasher. This connects the "A" terminal to the insulated main brush and the "F" terminal, through the field windings to the insulated third brush.



TESTING AND ADJUSTING OF GENERATOR: Mount generator on test stand, connect to test stand ammeter and voltmeter in accordance with the diagram. Connect the ammeter in the charging circuit at the regulator "AMM" terminal. Connect the voltmeter leads from the generator "A" terminal to ground, and bridge the voltage regulator contact points with a jumper lead. Operate generator at speed at which maximum output is obtained. If output exceeds 24-26 amperes with generator cold, immediately remove cover band, loosen third brush hold down screw in commutator end frame with off-set screwdriver and move third brush away from main brush to obtain 24-26 amperes. Generator at specified voltage must be checked, since the output varies with the voltage. If specified voltage cannot be attained 1/4 ohm variable resistance of sufficient current carrying capacity should be inserted into the charging circuit and resistance cut in until the specified voltage is attained. Operate until generator reaches operating temperature (about 30 minutes). At operating temperature, the generator should produce 18 amperes at 13 volts, at 3000 r.p.m. (read speed if an indicator is available). Adjust by moving the third brush toward the main brush to increase output, or move third brush away from main brush to lower output. After adjustment is complete, tighten the hold down screw and replace cover band. Avoid twisting off hold down screw through excessive tightening.

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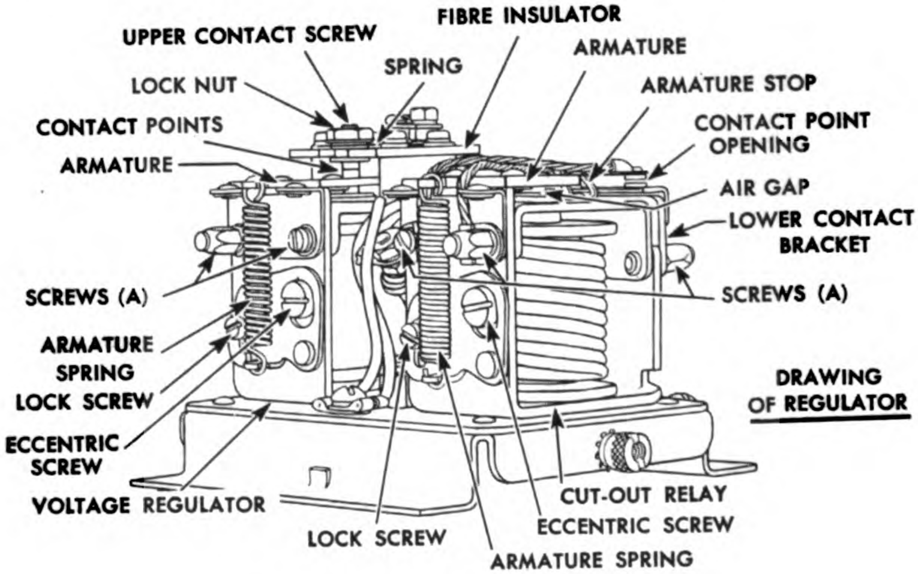
GENERATOR REGULATOR

The generator regulator can be disassembled, serviced, and reassembled as outlined in the following instructions.



Disassembling Generator Regulator

DISASSEMBLY INTO MAIN SUB-ASSEMBLIES: 1. Remove cover by unscrewing the two cover locking nuts.

2. Remove the screw and lockwasher holding the resistance unit and voltage regulator series winding lead (enclosed in yellow insulation) to base.

3. Remove the screw and lockwasher holding the cut-out relay shunt winding lead (enclosed in yellow insulation) and voltage regulator main winding lead (enclosed in red insulation) to the grounded terminal on the base.

4. Disconnect heavy relay and regulator leads by removing in order named, lead clamping screw, lockwasher and flat washer and then unsoldering the two leads.

5. Remove voltage regulator from fibre mounting plate by removing nut and lockwasher from stud on under side of plate.

6. Remove cut-out relay from fibre mounting plate by removing nut and lockwasher from stud on under side of plate.

7. Disconnect lead from resistance assembly by removing nut and lockwasher.

DISASSEMBLY OF VOLTAGE REGULATOR: 1. Remove voltage regulator spiral armature spring by holding it with pliers and unsoldering from armature. Avoid crushing spring with pliers.

2. Disconnect lead from contact bracket assembly by removing nut and lockwasher.

3. Remove contact bracket assembly by removing four screws, four lock washers and four flat washers.

4. Disassemble contact bracket assembly by first removing contact screw, locking nut and lockwasher. This operation may be performed at any time that the contact screw requires cleaning or replacement. Extreme care must be used

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during this operation to avoid bending the contact screw supporting spring. This flat spring raises up off the fibre bracket when the contact points come together to provide a wiping action between the points. Distorting the spring may cause severe damage to the regulator and generator as well as other electrical equipment. The correct procedure for removing the contact screw is as follows: Place wrench on locking nut. Place screwdriver in contact screw slot. Hold contact screw stationary with screwdriver. Loosen locking nut with wrench. The contact screw, locking nut and lockwasher may now be removed with the fingers. Remove contact terminal screw, nut and two lockwashers.

5. Remove armature by removing two screws (one serving as an insulated bumper to protect the unit when removing or installing the cover), lockwashers, and flat washers.

6. Remove contact bracket support by removing the remaining two screws and lockwashers. These two screws and lockwashers, together with the two original armature mounting screws, lockwashers, and flat washers on the opposite side of the frame, hold the contact bracket support in place.

7. Remove winding assembly from frame by removing nut.

8. The three-fourths turn of heavy wire which is the series coil may be bent back slightly to permit removal of the winding assembly from the frame. It need not be unsoldered from the frame.

9. If it should ever become necessary, the adjustment locking screw, lockwasher, and flat washer may be removed from the frame.

DISASSEMBLE CUT-OUT RELAY: 1. Remove cut-out relay armature spiral spring by holding with pliers and unsoldering from armature. Avoid crushing spring with pliers.

2. Remove contact bracket by removing two screws (one of the insulated bumper type), lockwashers, and flat washers. Unsolder end of series winding from bracket.

3. Remove armature by removing two screws and lockwashers.

4. The armature stop bracket may now be lifted out.

5. Remove winding assembly from frame by removing nut.

6. The winding assembly may be further disassembled by removing the fibre insulator from the serrations on the winding core, and then removing the heavy series winding.

7. If it should ever become necessary, the adjustment locking screw, lockwasher, and flat washer may be removed from the frame.

Generator Regulator Inspection

GENERAL: After disassembly, all parts should be examined, cleaned as necessary, and defective parts repaired or replaced. Particular attention should be given insulators; any found cracked, burned, or otherwise damaged should be replaced. Details of inspection of the parts are given below.

WINDING ASSEMBLIES: Winding assemblies should be handled with care, since they contain very fine wire which could be broken by rough treatment. The leads must not be twisted or pulled for the same reason. Make sure that the lead clips are well soldered to the leads and that the insulating tape on the outside of the windings is in place.

ARMATURES: The cut-out relay armature and voltage regulator armature have contact points which should be examined for roughness and pits. Contact

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points which are pitted, excessively rough, burned, or dirty, may be cleaned with a clean, fine-cut contact file or on a fine emery wheel or stone. Do not remove more contact material than is absolutely necessary. Make sure all traces of emery or filings are removed from the point surfaces. Do not use emery cloth or sand-paper, since particles of emery or sand may embed and cause point burning. Do not touch point surfaces or get any grease or oil on them after cleaning, since traces of oil or grease will cause the points to burn in operation. Care must be taken in handling the armatures, since they have a flat armature spring which must not be bent or distorted. Damaging the flat spring will cause defective operation of the unit after assembly.

Contact Screw: The contact screw of the voltage regulator has a contact point which should be examined for roughness or pits. It should be cleaned as outlined under Armatures in the preceding paragraph.

CONTACT SUPPORT BRACKET: The flat spring on the contact bracket of the voltage regulator must not be distorted and must have sufficient tension to rest firmly against fibre at free end. This provides a wiping action between the points in operation. Replace if defective.

Assembling Generator Regulator

ASSEMBLY OF CUT-OUT RELAY: 1. Place relay series winding over winding assembly and secure by pressing on fibre insulator. The straight lead on the series winding should be next to the fibre insulator and almost in line with two leads passing through fibre washer at opposite end of winding.

2. Install winding assembly into frame and secure with nut. With frame held upright so short side is toward operator, all leads should be to right of operator.

3. Install adjustment locking screw, lockwasher and flatwasher into frame and tighten only loosely.

4. Place the armature stop bracket in place.

5. Install contact bracket with two screws, lockwashers and flat washers. Screws go through frame and fasten armature stop bracket in place. Solder heavy series lead and red insulation covered lead from the winding assembly to the contact bracket arm.

6. Fasten armature with two screws and lockwashers to frame. Clips from leads which are riveted to armature contact points should fasten under lockwashers and screws to frame. Screws go through frame into armature stop bracket. Armature must be pushed down tight against frame so there is no air gap between frame and armature. Use care to avoid damaging armature flat spring.

7. Put spiral spring in place, with pliers, hooking ends to armature and lower spring support.

ASSEMBLY OF VOLTAGE REGULATOR: 1. Place winding assembly into frame and secure with nut. With frame held upright so short side is toward operator, the two leads attached to a single clip should be to right of operator.

2. Install adjustment locking screw, lockwasher, and flat washer into frame and tighten only lightly.

3. Put contact bracket support into place.

4. Fasten armature to frame with two screws, lockwashers, and flat washers. Armature must be pushed down tight against frame so there is no air gap between frame and armature. Use care to avoid damaging flat armature spring. Screws go through frame and fasten into contact bracket support.

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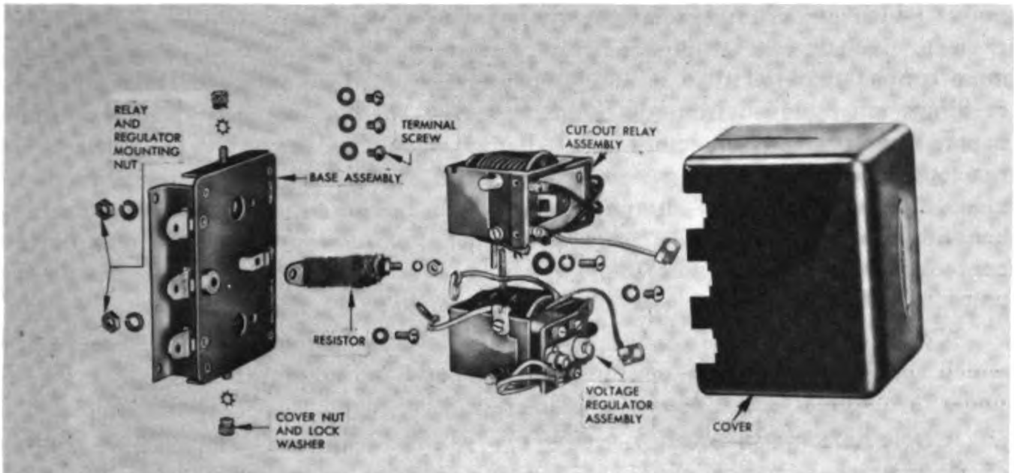

EXPLODED DRAWING OF REGULATOR

5. Install other two screws and lockwashers to hold contact bracket support in place. Clip on lead to resistance unit goes under screw and lockwasher on left-hand side.

6. Assemble contact bracket assembly as follows: Assemble lead attaching screw with lockwasher through contact bracket assembly and secure with lockwasher and nut. Place contact screw locking nut on contact screw. Place lockwasher under nut and run screw down lightly into place in collar on flat contact spring on contact bracket assembly.

7. Fasten contact bracket assembly to regulator with four screws, lockwashers and washers.

8. Fasten lead clip (with two leads) to contact bracket terminal screw with nut and lockwasher.

9. Put spiral spring in place with pliers, hooking ends to armature and lower spring support.

ASSEMBLY OF REGULATOR: 1. Fasten cut-out relay to fibre mounting plate with nut and lockwasher on stud.

2. Fasten voltage regulator unit to fibre mounting plate with nut and lockwasher on stud.

3. Connect heavy relay and regulator leads as follows: Place heavy leads in place in lead clamp in fibre mounting plate between the relay and regulator unit. Solder the connections securely with rosin, *not acid,* flux and secure with large washer, lockwasher and screw.

4. Install screw and lockwasher holding the cut-out relay shunt winding lead (yellow insulation covering) and voltage regulator main winding lead (red insulation covering) to the grounded terminal on the fibre mounting plate.

5. Connect resistance unit to clip of lead from the voltage regulator contact bracket support mounting screw with lockwasher and nut.

6. Install the lockwasher and screw holding the resistance unit and voltage regulator series winding lead (with yellow insulation) to base.

7. Solder spiral springs to armatures of cut-out relay and voltage regulator. This holds springs on armatures and prevents possibility of their coming off in service.

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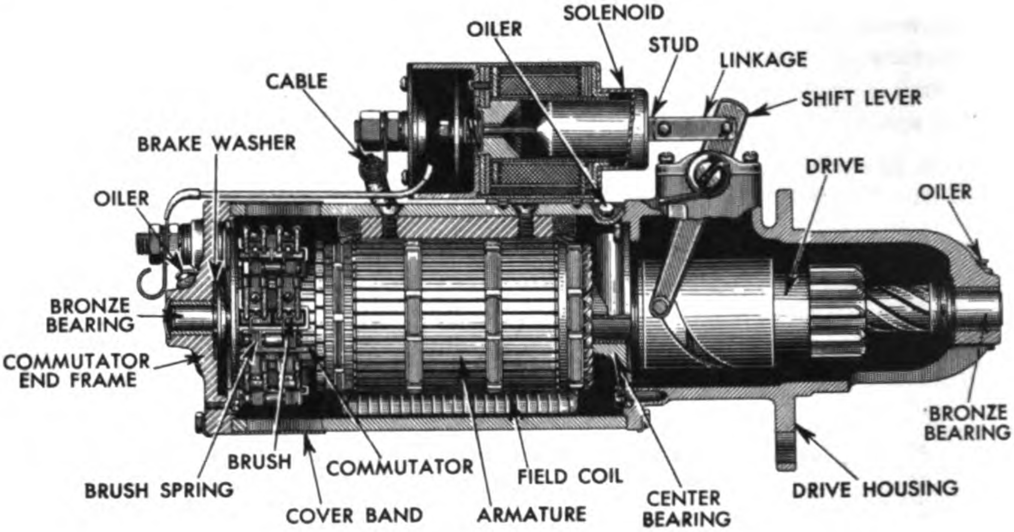
CRANKING MOTOR

The Cranking Motor can be disassembled, serviced, and re-assembled as outlined in the following instructions.



Disassembling Cranking Motor

DISASSEMBLY INTO MAIN SUB-ASSEMBLIES: 1. Detach cranking motor solenoid switch by removing nut and lockwasher attaching heavy lead to switch terminal and nut and lockwasher attaching smaller lead to side of solenoid switch. With pliers, remove cotter pin and pin attaching link assembly to shift lever and unscrew link stud from solenoid plunger. Remove four screws and lock washers attaching solenoid to field frame and lift off solenoid switch.

2. Detach drive housing assembly by bending up tangs on five locking washers and removing five screws, washers and locking washers. Tap housing, with armature away from field frame (soft hammer). Discard locking washers as they must not be used a second time.

3. Lift armature, with center bearing and Dyer drive assembly, out of drive end frame after cutting safety wire and removing four screws and lock washers.

4. To detach commutator and frame assembly: Remove cover band by unsnapping catch. Note relationship of brush leads and brushes. Disconnect three leads from field coil conductors by removing three screws and lock washers. Bend up tangs on locking washers and remove six screws, washers, and locking washers. Tap commutator and frame assembly free (soft hammer). Discard locking washers.

DISASSEMBLY OF COMMUTATOR END FRAME ASSEMBLY: 1. Remove brush plate assembly as follows: From terminal, remove nut, lockwasher, two lead clips, nut, lockwasher and flat washer and two insulating washers. Remove three screws, lockwashers and flat washers and lift brush plate assembly from commutator end frame assembly. Remove from terminal 8 insulating washers (small) and 2 insulating washers (large).

2. Disassemble brush plate assembly as follows: Remove 9 brush lead attaching screws and lockwashers, lift up on brush springs and remove 12 brushes. (NOTE: Further disassembly will not be required normally unless insulators, brush holders, springs, or plates require replacement.) Remove three insulated brush holders to

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which were attached field coil leads by unscrewing brush spring pin and brush holder screw. Two springs will come off with each brush spring pin. There are one each lockwashers under the pin and screw. Parts will come off in this order: brush holder, thin space plate, brush holder insulating plate, four insulating washers, and (from opposite side for all three insulated holders are detached) brass brush holder support plate and brush plate insulating plate. Remove other three brush holders from brush plate and stud assembly by unscrewing brush spring pin and brush holder screw. Under each will be a lockwasher. Brush holders and thick spacer plate will come off. Two brush springs will come off on pin.

3. If the bushing is worn, it may be pressed out and a new one installed (arbor press). The plug must first be removed. Install new oil wick and oiler as required.

4. Remove old brake washer and install new one (shellac in place), if necessary.

DISASSEMBLY OF FIELD FRAME ASSEMBLY: 1. Disconnect field coils from field terminal by unsoldering three leads. Terminal stud may be removed by removing nut, lockwasher, nut, lockwasher, flat washer, two insulating washers (large), and four insulating washers, two insulating strips, washer, and stud.

2. Remove field coils from field frame by removing 12 pole shoe screws (pole shoe screwdriver) 6 pole shoes and coils. Be careful with coils to avoid bending lead connections or damaging insulation. Note how the long insulating strips are placed to avoid grounding of the field coil leads against frame.

DISASSEMBLY OF DRIVE HOUSING ASSEMBLY: 1. Remove shift lever assembly by unscrewing four screws and removing four lockwashers, cover, shift lever assembly and shift lever return spring.

2. If the bushing is defective, it may be pressed out and a new one installed (arbor press). Install new wick and oiler as required.

DISASSEMBLY DYER DRIVE ASSEMBLY: 1. Remove Dyer drive parts from armature shaft. Remove cotter pin, pinion stop, pinion, pinion spring, shift sleeve, two thrust washers and center bearing assembly from armature shaft, in order named. After cotter pin has been removed, pinion stop must be rotated until notches register with shaft splines before it can be removed. Rest of assembly slides off easily (press against shift sleeve.)

2. Replace bushing in center bearing, if necessary. (Arbor press). Replace wick and oiler, as required.

DISASSEMBLY OF CRANKING MOTOR SOLENOID SWITCH: 1. Unsolder lead from clip under "motor" terminal and remove four screws and lock washers. Lift off terminal plate assembly and gasket.

2. Remove cotter pin (pliers) unscrew castellated nut and lift off, in the order named, contact disc, cupped washer, spring, flat washer and cupped washer. Remove plunger and rod from opposite end of housing.

3. Disassemble terminal plate assembly further, if necessary, by removing from each terminal stud, nut, lockwasher, nut, lockwasher and flat washer. From MOTOR terminal, remove clip, flat washer, insulating washers (large and small). From BAT terminal, remove large insulating washer, shield with several small insulating washers, and small insulating washer. Studs, insulation plate, and terminal plate may now be separated.

4. If required, the two terminal studs in the sides of the contact housing may be removed by removing from back, nut, lockwasher, nut, lockwasher, flat washer, insulating washer, small insulating washers, insulating strip, and stud. Clip may be unsoldered from lead, if necessary.

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Cranking Motor Inspection

GENERAL: After disassembly, all parts should be cleaned, examined, and defective parts replaced. The procedure of cleaning and inspecting parts is given in the following paragraphs.

ARMATURE: Do not clean the armature by any degreasing method, since this would damage the insulation and might ruin the armature. Wipe with a clean cloth *slightly* dampened with carbon tetrachloride or similar solvent. If commutator is rough, out of round, has high mica, filled slots, or is burned, it must be turned down in a lathe and the mica undercut. The shaft splines should not be worn excessively and the undercut into which the pinion stop fits must provide a snug fit for the pinion stop. Armature may be checked for ground, open, or short circuit as follows:

a. Ground—Check with test lamp and test points from the commutator to the armature shaft or lamination. If the lamp lights, indicating ground, and if the ground is not readily apparent and repairable, the armature must be replaced.

b. Open—An open circuited armature is often easy to detect, since this condition produces badly burned commutator bars. The bars connected to the open armature windings soon burn in operation since every time they pass under the brushes they interrupt a flow of current so that heavy arcing occurs. If the bars are not too badly burned, the armature may often be saved.

c. *Short*—A shorted armature may be detected on a growler. The growler is a strong electromagnet connected to a source of alternating current. When a shorted armature is placed on the growler, and a hacksaw blade held above the shorted coils in the armature, the blade will be alternately attracted to and repelled from the armature, causing the blade to buzz against the armature. Before discarding an armature testing shorted, inspect the commutator slots carefully, since copper or brush dust sometimes collects in the slots and shorts adjacent bars.

FIELDS: The fields should not be cleaned by any degreasing method, since this would damage the insulation and might ruin the windings. Clean by wiping with a clean, dry cloth. Be careful in handling the windings to avoid breaking or weakening the connecting straps between windings. If the field insulation is charged or chaffed so that the windings are exposed, it is sometimes possible to rewrap them with insulating tape and paint them with insulating compound. It must be remembered that if the wrapping is done carelessly so the insulation bulks up too large, it will be impossible to reassemble the coils under the pole shoes. All soldered connections should be made with rosin flux solder.

BRUSHES: If the brushes are worn down to 5/16 inch (original length ½ inch), replace. Make sure that the pigtail leads are tight in the brushes and that the clips are fastened well to the leads.

BRUSH SPRINGS: The brush springs should have sufficient tension to provide the proper pressure between the brushes and commutator after the unit is assembled. This may be checked by placing the armature and commutator end frame together in their normal operating position and then placing the brushes in their holders with the springs in place so that the tension of the springs against the brushes can be measured with a spring gauge. Replace springs if the tension is not correct.

BUSHINGS: If the bushings are worn, they should be replaced. Wear will not be even, but on the side which sustains the greatest thrust during cranking.

BRUSH HOLDERS: If the brush holders, spacer plates, insulators, etc., are bent, warped, cracked, burned, or otherwise damaged, replace.

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CRANKING MOTOR SWITCH: The switch contacts should be clean, and the springs sufficiently strong to provide normal pressure between the contact disc and terminals.

DYER DRIVE PARTS: Pinion stop must not be worn and on assembly must fit in shaft under cut snugly. Pinion teeth must not be worn, burred, or chipped excessively. Shift sleeve assembly must be in good condition, with parts tightly fastened together.

MISCELLANEOUS: Any defective insulator, screw, washer, lead, stud, plate, etc., should be replaced. Cracked, bent, worn, burned insulators or washers are defective. Studs or screws which are bent, battered, broken, or which have crossed or damaged threads, are defective. Leads which have broken strands, frayed insulation, are defective.

ARMATURE: Conditions in the armature requiring repair are:

a. *Commutator worn, dirty, etc.*—If the commutator is worn, dirty, rough, out of round, has high mica, filled slots, burned spots, place the armature in a lathe and turn down the commutator. Make cut no deeper than necessary. Minimum diameter of commutator should be 2 inch (original 2⅛ inch). If it is necessary to turn commutator down below this diameter, discard armature. Undercut mica 1/32 inch.

b. *Armature banding wire loose*—If the banding wire has loosened, it may sometimes be repaired by rewrapping tightly and resoldering (silver solder).

c. *Armature open*—Some bars badly burned, with other bars fairly clean, indicate an open circuited armature. The open will usually be found at the commutator riser bars and is often a result of excessively long cranking periods which overheat the unit and cause the connections to become bad. Since the armature is of a welded construction, such a condition will be rare.

FIELDS: Conditions in the field windings requiring repair are:

a. *Defective insulation*—If the insulation is charred, or worn away, so the field coils are, or could become, grounded, repair may sometimes be made by rewrapping the coils with insulating tape and painting them with insulating paint. This operation must be executed with care and neatness, since excessive bulkiness of the tape will prevent reassembling the windings under the pole shoes in the proper manner. Make soldered connections with rosin flux.

BUSHINGS: After a bushing is pressed in and reamed to size, the oil wick hole must be drilled out. This throws up a burr, which must be removed with a burnishing tool of the same size as the reamer. Bushings must be reamed concentric with machined registers on castings.

Assembling Cranking Motor

ASSEMBLY OF CRANKING MOTOR SOLENOID SWITCH: 1. On terminal studs, place in the order named, terminal insulation plate, terminal plate and small insulating washer. Contacts on stud leads should be turned so that maximum area will contact the contact disc. Place on "bat" terminal stud, several small washers, large insulating washer. Place on "motor" terminal stud, insulating washer, flat washer, clip. Then place a lock washer, nut.

2. Attach two small terminal studs as follows. Solder clip to two solenoid leads, attach terminal stud with clip, insulating strip, small insulating washers, insulating washer, flat washer, lock washer, nut, lock washer, and nut.

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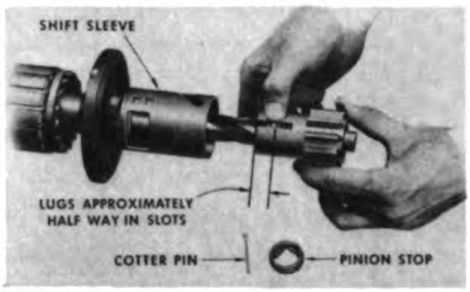
3. Put plunger and rod in housing. On threaded end of rod, place cupped washer, flat washer, spring, cupped washer, contact disc, nut and cotter pin. Cups in washers must face spring. Run nut down until castellations clear cotter pin hole in push rod.

4. Attach terminal plate assembly with 4 screws and lock washers after threading lead through bushing in plate. Solder lead to clip under "motor" terminal and pull sleeve over connection. Place Permatex in bushing to seal it.

ASSEMBLING DYER DRIVE. Place center bearing plate, plain thrust washer, cupped thrust washer, and shift sleeve on armature shaft. The cupped out section of the cupped thrust washer should face the shift sleeve. The pinion guide, spring, and pinion may be assembled on the armature shaft but all three parts must be in position before they may be correctly assembled. Place the pinion guide on the armature shaft being careful to note that the lugs on the pinion guide are toward the pinion, but do not twist the pinion guide on the splined armature shaft farther than the groove which is about 1¾ inches from the end of the armature shaft. Place the spring on the



armature shaft immediately behind the pinion guide. Then put the pinion on the shaft over the spring with the spring compressed in the pinion skirt. Align the lugs on the pinion guide with the slots which are cut in the skirt of the pinion. With the thumb and forefinger hold the pinion guide stationary on the shaft and push the pinion onto the shaft with the spring between the two. When the lugs on the pinion guide are about half way into the slots on the pinion skirt, rotate the pinion and pinion guide with respect to the shaft until the pinion splines and shaft splines align. The thumb and forefinger may then be removed from the pinion guide lugs and the assembly, consisting of the pinion guide, spring, and pinion may be twisted on the spline grooves of the armature shaft into the shift sleeve. Twist on the spline grooves until a click is heard. This click results from the pinion guide dropping into the undercut section of the shaft splines, which locks the entire assembly consisting of the shift sleeve, pinion guide, spring, and pinion into place on the armature shaft, immediately next to the center bearing assembly plate. The only way that this lock is released is by pushing the shift sleeve toward the end of the shaft.

The pinion stop has two holes through which the cotter pin slips to fasten the pinion stop to the armature shaft. Align the pinion stop with the spline grooves and twist onto the armature shaft (place the end of the pinion stop which is the farther from the two holes on first). When the stop hits the groove, which is about 1¾ inches from the end of the armature shaft, the pinion stop is free to rotate on the shaft. Rotate the stop until the holes in the armature shaft are in line with those in the pinion stop. Insert the cotter pin and bend ends down close around the stop or interference may be encountered between pinion and stop.

ASSEMBLE DRIVE HOUSING ASSEMBLY. 1. Place cover on shift lever and assemble to drive end frame with four screws and lockwashers. Place spring on shift lever shaft with long tang on drive end frame boss. Catch other end of spring, twist it in a clockwise direction and drop end into slot in end of shaft.

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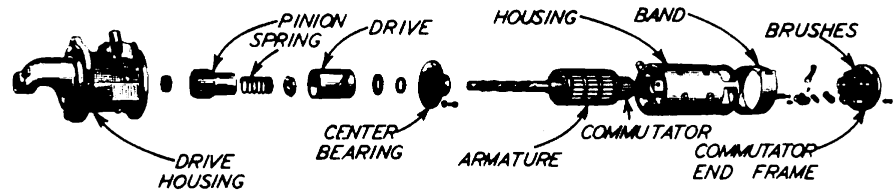

EXPLODED DRAWING OF CRANKING MOTOR

ASSEMBLE FIELD FRAME ASSEMBLY. 1. Put insulating washer and long and short insulation strips on terminal stud, put stud in position in frame and secure with small insulating washers, large insulating washers, flat washer, lock washer, nut, lock washer, nut. Slot in stud lead must be aligned with frame, and insulating strips so placed as to protect the coil leads from grounding to the frame.

2. Place field coils in position in frame with pole shoes, insert pole shoe spreader, tighten, and with pole shoe screwdriver, tighten pole shoe screws (two per pole shoe). Solder three field coil leads into slot in stud. Long insulating strip and two short insulators should be placed so as to protect coil leads from grounding to field frame.

ASSEMBLE COMMUTATOR END FRAME ASSEMBLY. 1. Fasten three brush holders to brush plate and stud assembly with brush spring pins and brush holder screws. One brush holder is assembled directly above stud, while other two are assembled 120° from it. Use pins and screws with short threaded sections. Thick spacers go under holders and lock washers go under screws and pins. Springs should go on pins with hooked ends toward brush plate and down in holders. Put insulating plate in position on opposite side of brush plate and stud assembly, and place brass brush holder support plate next to it. Secure by fastening other three brush holders with pins and screws. Two insulating washers go in each screw hole to insulate pins and screws from plate and stud assembly. Above these go the insulating plate, thin spacer washer, brush holder, lock washers, pin and screw. Springs should go on pins with hooked ends toward brush plate and down in holders. Place twelve brushes in holders and secure nine of the brush lead clips to brush holders with screws and lock washers. Do not install the three screws which also fasten field leads to holders. (These are the insulated holders 60° and 180° from stud.)

2. Attach brush plate assembly as follows. Place 2 insulating washers (large) and eight insulating washers (small) on terminal stud. Put brush plate assembly in position to commutator end frame and secure with three screws, flat washers and lock-washers. Place on terminal stud two insulating washers, flat washer, lock washer, nut, lead, lead clip, lock washer, and nut.

ASSEMBLE CRANKING MOTOR. 1. Place commutator end frame and field frame together in correct relationship so that terminal or commutator end is 30° to left of center as viewed from commutator end. Fasten with six screws and washers and locking washers. Use *new* locking washers. Bend one tang up against screw head. Bend other tang down against frame. Connect three field coil leads to brush holders with screw and lock washer. This also fastens brush lead clips to brush holders. Replace cover band.

2. Armature, with center bearing and Dyer drive, may be placed in position in the drive end housing. Bring in housing at an angle so the stud on the shift lever can engage the slot in the shift sleeve. Establish correct relationship of center bearing and drive housing as determined by oiler on field frame. Secure with four screws and locking washers. Thread .032" safety wire through holes in screw heads and twist together.

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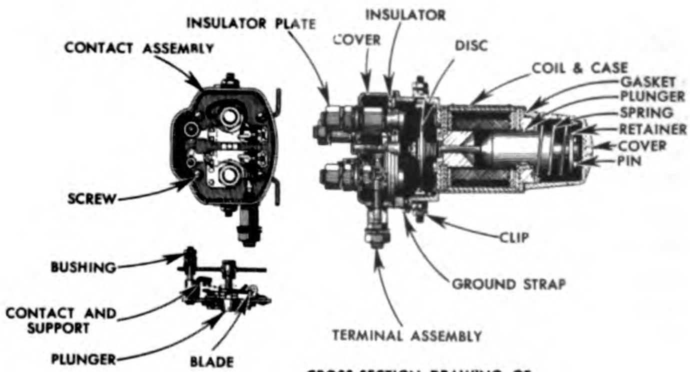
3. Bring field frame with commutator end and the drive housing with armature together. Lift brushes and lock them in their holders so they will clear commutator. Secure with five screws, washers, and locking washers. Use *new* locking washers. Bend one tang up against screw head and other down against frame.

4. Attach solenoid switch to field frame with four screws and lockwashers. Attach small lead to cranking motor and solenoid terminal studs with lockwasher and nut, also large lead from solenoid BATTERY terminal to field terminal of motor. Screw stud partly into plunger, fasten links to shift lever temporarily with pin and cotter pin and adjust.

SOLENOID SERIES PARALLEL SWITCH

The series parallel switch can be disassembled, serviced, and reassembled as outlined in the following instructions.



CROSS-SECTION DRAWING OF SERIES PARALLEL SWITCH

Disassembling Series Parallel Switch

DISASSEMBLY INTO MAIN SUB-ASSEMBLIES. 1. Remove from each of the two large terminals (+ "B" & —"A") in the order named, the following parts: nut, lockwasher, large terminal lead clip (also small clip on the "—A" terminal), nut, lockwasher, plain washer and insulation washer.

2. From the "SW" terminal, remove nut, lockwasher, plain washer, lead clip, nut, lockwasher, plain washer, and insulating bushing.

3. Disassemble the large terminal on the side which is marked "FUSE" and the "—B" terminal which is also marked "FUSE" by removing from each the following: large nut, lockwasher, plain washer, terminal lead clip, fuse terminal assembly, lockwasher and fuse (or connector). In addition, remove from the side terminals plain washer.

4. Remove ground screw and lockwasher holding the ground strap.

5. Lift off terminal cover, large insulating plate, and two terminal insulating bushings.

6. Remove four screws, lockwashers, and plain washers and lift off terminal plate and contact assembly and two gaskets.

DISASSEMBLY OF TERMINAL PLATE AND CONTACT ASSEMBLY. 1. Remove the large nut and lockwasher from one of the large studs (the stud without the lead clip on it). Contact assembly will then slip out. From the other, remove in order named, large nut, lockwasher, and plain washer.

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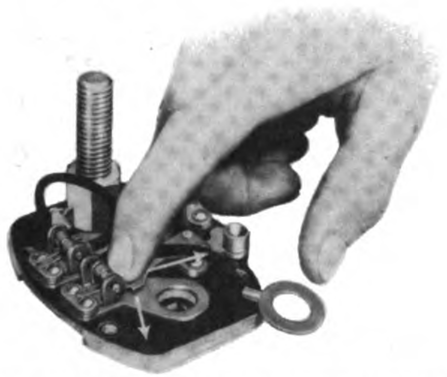
2. Remove two large terminal studs, insulating plate, metal plate and two insulating bushings.

3. Unsolder lead from fuse socket.

4. To remove contact plunger and contact point arrangement, press down at the hinged end, and move it slightly toward the contacts.



DISASSEMBLY OF COIL AND PLUNGER ASSEMBLY. 1. Unscrew plunger cover and remove gasket.

2. Remove cotter pin from end of plunger rod and slip off retainer washer and spring.

3. Remove cotter pin and nut from other end of plunger rod and remove contact disc, cup washer, spring, plain washer, cupped slot washer and plain washer. Plunger may now be removed.

4. Remove from each of the two side terminals in order named, nut, lockwasher, lead clip, nut, lockwasher, plain washer, insulation washer, three small insulating bushing washers. Remove the terminal screws and slip off insulating washer and lead attaching clip.

5. Remove terminal housing by removing two screws.

Inspection of Series Parallel Switch

INSULATION: Due to the high voltage of the cranking circuit and the great amount of power available from the two batteries, it is imperative that every precaution be observed in guarding against the possibility of a short circuit or a ground. Use stranded wire and cable throughout the installation to guard against breakage due to vibration. Keep all joints clean and tight and solder all terminal clips and other electrical connections. Use only a rosin flux in soldering electrical connections; an acid flux induces corrosion and may cause a high resistance.

Extra heavy insulation must be used on all wires and the wires must be supported at enough points to keep them from moving about and chafing through their insulation.

CONTACTS: The contacts should be inspected to determine if any are excessively burned or damaged. Clean, if necessary, by filing or by use of a wire brush. Remove no more material than is necessary. The secondary plunger which actuates the contacts should be free to move without interference.

MISCELLANEOUS INSPECTION: Any defective insulator, screw, washer, lead, stud, plate, etc., should be replaced. Cracked, bent, battered, worn, burned, insulators and washers are defective. Screws or studs which are bent, battered, broken or which have crossed or damaged threads, are defective. Leads which have broken strands, badly frayed insulation, are defective.

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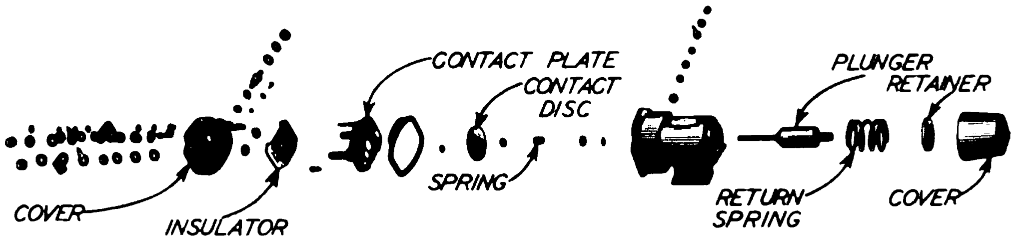

EXPLODED DRAWING OF SERIES PARALLEL SWITCH

Assembling Series Parallel Switch

ASSEMBLY OF COIL AND PLUNGER ASSEMBLY. 1. Attach terminal housing to winding assembly with two screws.

2. Place proper winding lead clips on switch control terminal screws and also insulation washer and three insulation bushings. Insert terminals in terminal housing and place on each insulation washer, plain washer, lockwasher, nut, lead clip, lockwasher, and nut.

3. Insert plunger and place on terminal end the following parts: plain washer, cupped slot washer (in groove), plain washer, spring, cup washer (cupped side facing spring), contact disc, and nut. Secure with cotter pin.

4. Install return spring and cup washer retainer and secure with cotter pin.

5. Replace gasket and screw on plunger cover.

ASSEMBLY OF TERMINAL PLATE AND CONTACT ASSEMBLY. 1. Install contact plunger and contact point arrangement.

2. Resolder lead to fuse socket.

3. Insert the two large terminal studs through insulating plate, metal plate support and insulating bushings.

4. Insert the large terminal studs through the terminal plate and place on one (the one without the lead clip on it) the following: Contact assembly, lockwasher and nut. On the other, place the following: plain washer (this goes on top of the lead clip which the stud was placed through), lockwasher, and nut.

ASSEMBLY OF SOLENOID SWITCH. 1. Install two gaskets and contact plate assembly and secure with four plain washers, lockwashers, and screws.

2. Install large insulating plate, two insulating bushings and terminal cover.

3. Secure the ground strap in place with screw and lockwasher.

4. Insert the two fuses in their sockets. Place on the fused terminal (side) a plain washer and then install at each fused terminal the following parts: lockwasher, fuse terminal assembly, (inspect the socket end that the fuse fits in, it should offer good contact) terminal lead clip, plain washer, lockwasher, and nut.

5. Install on the "SW" terminal insulating bushing, plain washer, lockwasher, nut, lead clip, plain washer, lockwasher, and nut.

6. Place on each of the two large terminal studs the following: insulating washer, plain washer, lockwasher, nut (also place a small lead clip on the "—A" terminal), large terminal lead clip, lockwasher, and nut.

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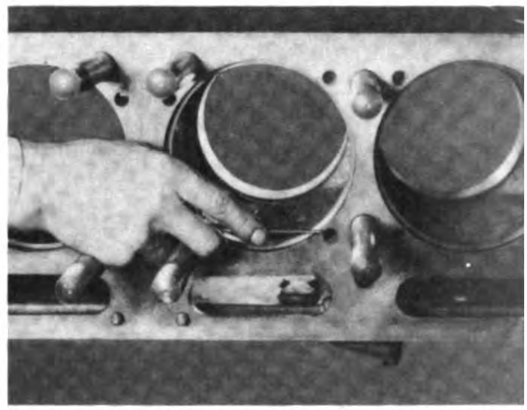
ASSEMBLY OF THE ENGINE

"Keep it clean" . . . is the first rule when working on any part of the Cummins Diesel engine. After cleaning the cylinder block with clean solvent and compressed air, place it bottom up on a skid or frame of heavy timbers. Use only clean, washed cloths to prevent lint from entering the engine. Never use cotton waste.

CYLINDER BLOCK

CYLINDER BORES: Clean the bores in the cylinder block at the point where the rubber pack rings of the cylinder liners seat and the counter bores that receive the flanges of the cylinder liners. These points must be thoroughly clean before attempting to install a cylinder liner. Scrape away scale and finish with fine emery cloth. Wash thoroughly.



DRILLED OIL HOLES TO MAIN BEARINGS: 1. With a small rod, clean out the oil holes leading from the oil header to the main bearings.

2. One oil hole, to the front or Number 1 main bearing, leads on to the idler gear.

3. All the main bearing studs on the camshaft side of the engine are slotted or drilled for lubrication to the main bearing caps. These slots must be thoroughly cleaned.

OIL HEADER: An oil header, or drilled hole for distributing the lubricating oil, runs the full length of the cylinder block. It can be inspected and cleaned by removing the small plugs on each end of the cylinder block. Swab it out in the same manner you would clean a rifle barrel. *Never use waste.*

MAIN BEARING DOWEL RING GROOVES: When assembling new main bearings, be sure the dowel ring groove, or lock groove, on one end of the bearing, is assembled to the manifold side of the engine.

UPPER MAIN BEARINGS: 1. Main bearings, Numbers 1, 3 and 5 are alike. Numbers 2 and 6 are also alike, with no oil holes or grooves provided. Main bearing Number 4 has one oil hole and this hole must be assembled to register with the oil hole in the cylinder block. This is necessary because the crankshaft is not drilled for lubrication to the Number 4 main bearing as it is to the other bearings.

2. Main bearing Number 7 is designed with a thrust flange to take the end thrust of the crankshaft and no oil holes are provided.

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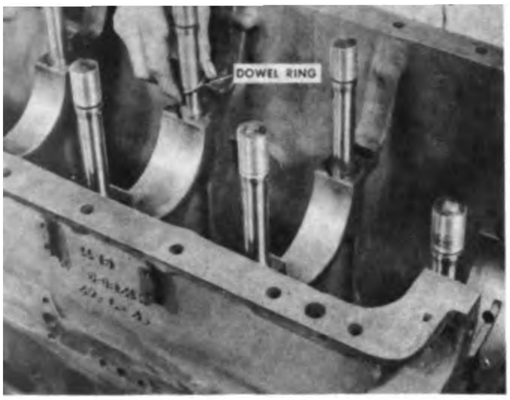


3. Before inserting the shells in the block, any burrs must be removed. Any particles of dirt or metal under the shell will cause distortion and, ultimately, bearing failure. Shells should be firmly seated in the block.

MAIN BEARING DOWEL RINGS: Main bearing shells are locked in place with dowel or lock rings. When assembling these main bearing lock rings to the main bearing studs (on the manifold side of the engine), make sure that the dowel rings fit down into the cylinder block freely and that each groove in the main bearing is fitted around the dowel ring. If the ring does not fit into the bearing groove properly, the main bearing will be distorted and ultimately fail.

CRANKSHAFT

1. Make sure that all oil holes and bearing journals on the crankshaft are absolutely clean. *Don't use waste.*

2. Lubricate each main bearing with good, clean lubricating oil before attempting to lift the crankshaft into place.

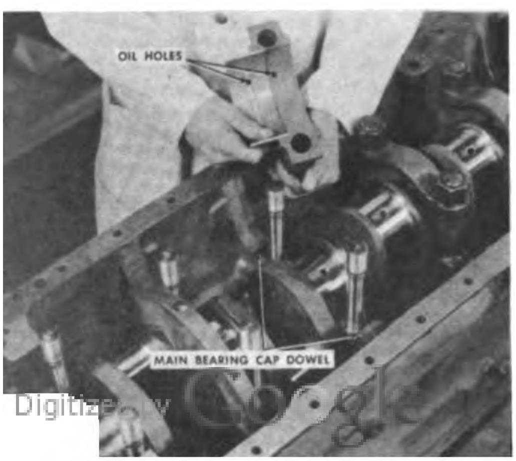
3. For lifting the crankshaft, use a clean piece of rope, connected between two crank throws. It is very important that the crankshaft be lowered squarely into place. Make sure that the flange on the crankshaft does not bind on the thrust faces of the rear, or Number 7, main bearing.

4. All journals on the crankshaft are drilled for lubrication except the center main bearing.

LOWER MAIN BEARINGS: 1. Number 1, 3 and 5 lower main bearings are alike, and Number 2, 4 and 6 are alike. Oil holes and grooves are provided in all lower main bearings.

2. Before assembling the lower main bearings to the crankshaft, make sure each shell is thoroughly lubricated with clean oil, and all burrs removed.

3. The back of the bearing shell and the bearing seat must be carefully cleaned of even the smallest particles of dirt or metal. Be sure that the small groove on one side of the bearing is placed toward the manifold side of the engine.



MAIN BEARING CAPS: 1. Each main bearing cap is numbered to correspond with an upper main bearing.

2. Place each cap over the stud with the number to the camshaft side of the engine. Main bearing caps are not interchangeable.

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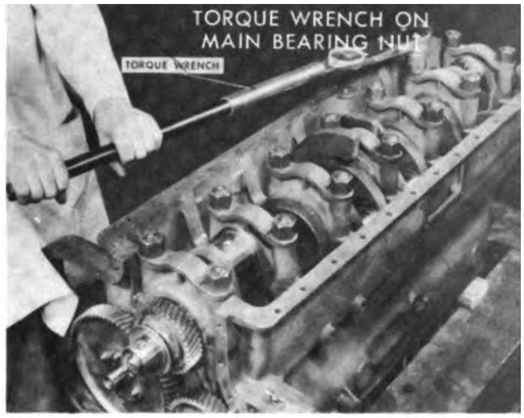

3. The cylinder block is precision machined for the cap to fit into its correct position. After each main bearing shell has been put in position by hand, use a small hammer to tap the caps down securely into place.

4. Never file the caps to reduce the clearance.

LOCK PLATES AND STUD NUTS: 1. Lubricate the threads on each main bearing stud. Place new lock plates in position before installing the stud nuts.

2. Tighten the bearing stud nuts alternately, a little at a time, using a heavy duty socket wrench with a 36" handle. Pull all the nuts evenly and securely in place. If a torque wrench is available, the main bearing stud nuts should be pulled to 310 to 330 foot pounds.

CRANKSHAFT END CLEARANCE: 1. Check the end thrust clearance on the Number 7 main bearing between the thrust face of the bearing and the thrust flange on the crankshaft.

2. Use a small bar to pry the crankshaft toward the rear end of the engine and check with a feeler gauge around the entire thrust face of the bearing. Clearance should be .006" to .008".

3. If the clearance is less than .006", it will be necessary to remove the bearing shells and, using a mill file, carefully relieve each thrust face of the main bearing until proper clearances are obtained.

MAIN BEARING LOCK PLATES: Using a small bar, bend up one corner of the lock plate. Then with a flat end punch, lock securely in place against the flat side of the main bearing nuts.

MAIN BEARING REPLACEMENT WITHOUT PULLING THE CRANKSHAFT: Main bearing shells are positioned in the block and caps by a dowel ring on each stud opposite the camshaft side of the engine. This permits the replacement of the upper shells without dismantling the engine. Check the registry of the oil holes in the shells with corresponding holes in the bearing caps.

NOTE: Main bearing caps are assembled so the marks are on the camshaft side of the engine. Should a bearing burn out, the metal should be carefully removed from all oil passages in the crankshaft and the cylinder block. Improper cleaning of these passages will result in another bearing failure. If the remaining bearings have

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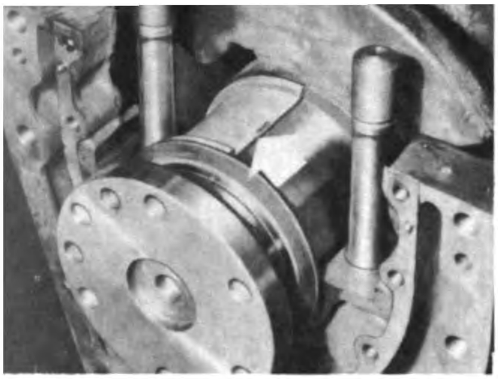
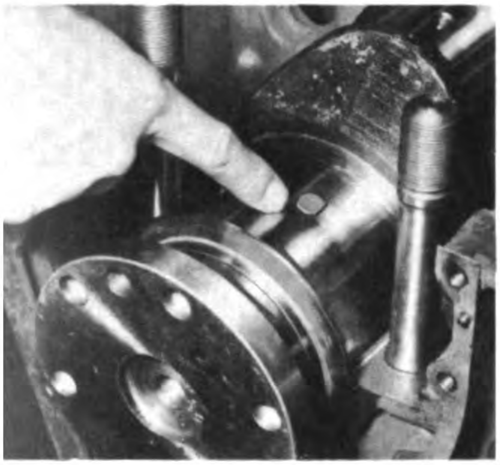




had considerable service, it is recommended that all be replaced. Replacing one bearing when the others are badly worn means that the new bearing will take the load until it has attained the same diameter as the old ones. Another bearing failure usually results before this occurs.

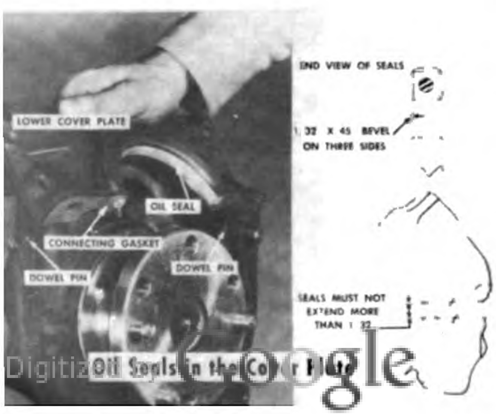
To change the main bearing shells, first remove the bearing cap, bearing and dowel ring. Turn the crankshaft slightly and the upper bearing shell should roll out with the crank as it turns. Should the bearing be stuck in the block, a flat head pin may be used in the oil hole in the crankshaft. Be sure that the pin head does not project from the crankshaft more than 3/32" or damage will result to the block.

Roll the pin against the bearing shell. It will turn out when the crank is revolved.

OIL SEAL AND COVER PLATE: 1. Shellac a new gasket over the dowel pins on the rear of the cylinder block. Assemble the upper cover plate over the dowel pins and tighten down the four cap screws and lock washers. With the crankshaft pried toward the cover plate, check the clearance between the crankshaft flange and the opposing face of the cover plate. Clearance should be .004" to .006".

2. The .004" to .006" clearance between the crankshaft flange and the opposing face of the cover plate can be obtained by the use of .005" and .010" gaskets to move the cover plates to or from the cylinder block.

3. Also check the clearance between the crankshaft and the bore of the cover plate. This should be .006". When installing new cover plates this clearance must be correct before the dowel pin holes are reamed to oversize.



Oil Seals in the Cover Plate

4. Remove the cover plate and install new asbestos seals into the recess of both upper and lower cover plates. New asbestos seals must be beveled on three sides of each end, 1/32" by 45°, leaving the inside edge square. The ends of the seal should not extend more than 1/32" above joining surfaces of cover plates. The seals

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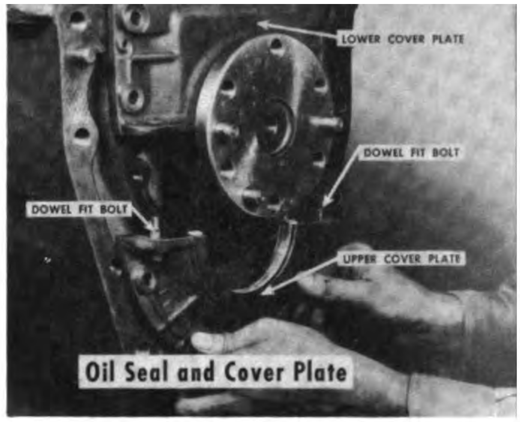


Oil Seal and Cover Plate

must be thoroughly oiled, as an oil leak will develop if dry seals are run on a dry shaft. Make sure that asbestos seals are well seated in grooves.

5. Shellac new connecting gaskets to the lower cover plate. Assemble the lower plate to upper plate and bolt together tightly with dowel fit bolts, lock washers and nuts. Install cap screws and lock washers to the cover plates, and pull up evenly to the cylinder block over the dowel pins.

FLYWHEEL HOUSING

1. The gasket on the flywheel housing is a seal for the camshaft bore. This gasket should be put on the housing. Use gasket cement and allow it to dry so it will not slip. Any slipping of the gasket will allow oil to leak out of the back end of the cam bearing.

2. After the housing is bolted in place, the bore of the housing should be checked with an indicator. Maximum total run-out must be held within .008". If a greater variation shows, pilot bearing and coupling wear will be excessive.

3. The face of the flywheel housing should be checked in the same manner as the bore. The maximum total run-out on the face must also be held to within .008".

THE FLYWHEEL: 1. Clean and remove all burrs from the flange of the crankshaft and the face of the flywheel.

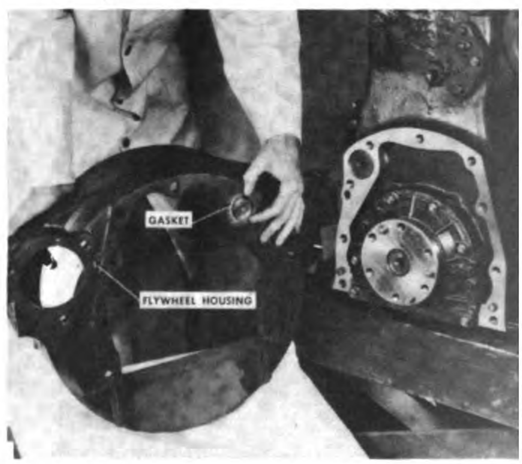
2. Place a new gasket over the dowel pins on the flange of the crankshaft.

3. Installation of the flywheel can be simplified by using two manifold studs screwed into the flange of the crankshaft as guides.

4. Assemble the flywheel over the dowels to the crankshaft and secure in place with lock washers and cap screws.

5. Indicate the clutch or coupling face and bore of the flywheel. Maximum run out should not exceed .004".

6. Lock the cap screws in the flywheel in pairs to assure full benefit from the lock wires.



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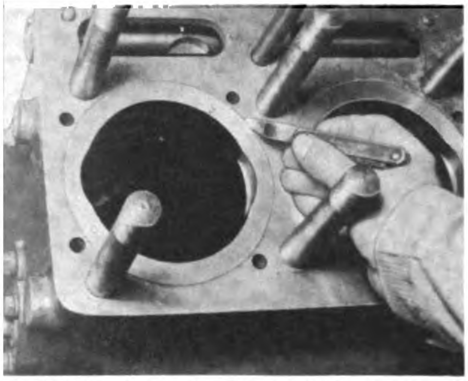
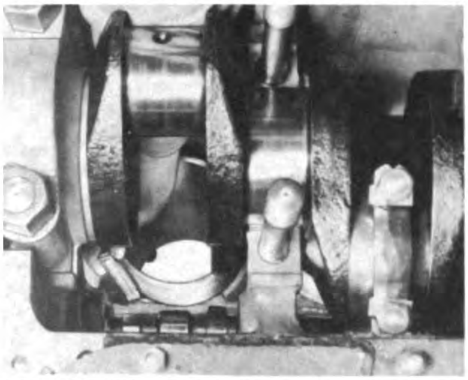
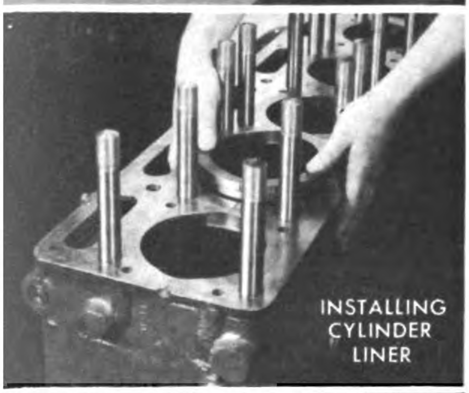
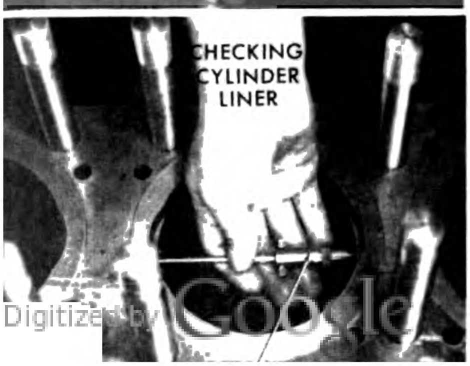






INSTALLING CYLINDER LINER



CHECKING CYLINDER LINER

CYLINDER LINERS

1. Before installing the rubber pack rings, make sure that the cylinder liner fits freely in the cylinder block. This can be done by checking as follows:

Place the cylinder liner in the block. Pass a .0015″ feeler gauge around the entire circumference of the cylinder liner flange at the top. If this necessary clearance is not present, remove the cylinder liner and scrape the counterbore in the top of the cylinder block at the points of binding until the .0015″ clearance is obtained.

2. The liner must also fit freely in the cylinder block at the point where the pack rings seal the liner in place. Check at this point by the method described above, using a .003″ feeler gauge. If .003″ clearance is not present around the entire circumference, scrape the block at the binding points as outlined previously.

NOTE: If the cylinder liner does not fit freely at both points mentioned, it will be distorted when the cylinder head is assembled and tightened in place. This would result in a scored cylinder.

3. Rubber rings are used to seal the base of the water jacket around the bottom of the cylinder liners. Remove the cylinder liners from the block and roll the seal rings into the three grooves at the bottom of the liners, being careful not to stretch the rings.

4. Rub a thin coat of liquid soap on the surface of the block on which the rings will seat. This lubricant should be put on the block only, and not on the cylinder liners or rings. An excessive amount of lubricant may force the rubber rings out of the grooves and ruin them when the liner is installed.

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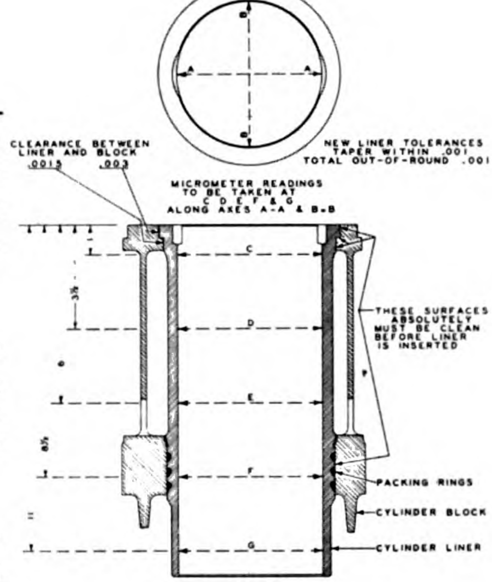

CYLINDER LINER GAUGE MARKS

5. Insert the cylinder liner in place so the marks on the liner and the block will coincide. If this is not done, the valve will strike the liner.

Warning: The liner must enter the block with hand pressure only. Do not force the liner into the block, as forcing will cause distortion.

6. Using a gauge, check the inside diameter of the liner for out of round, as soon as it is placed in the cylinder block. If it is more than .001" out of round, or tapered from the top to the bottom, pull the liner from the block and check the bore in the cylinder block for dirt or scale. Clean and reinstall the liner and check with the gauge at all the points shown. The inside diameters of a standard cylinder liner are 4.875" to 4.876".

7. In measuring oversize liners, add the oversize to the standard dimensions. Four gauges are available—standard and one for each of the following sizes—.020", .030", .040".

PISTONS AND CONNECTING RODS

INSTALLING THE PISTON ASSEMBLY: A simple ring compressor can be made from the upper half of an old cylinder liner by taper-grinding the top inside 10° to accommodate the uncompressed rings, or use the standard compressor as shown.

1. Assemble the bolts to the connecting rod with the heads in locked position. The connecting rod bolts must not be interchanged. Clean the bearing seat in the connecting rod. Oil thoroughly and insert the piston rod assembly, rod first, through the top of the ring compressor. Be very careful to align all rings with the taper in the ring compressor or broken rings will result.

2. Place the connecting rod and piston assembly in the cylinder liner with the numbered side of the rod toward the

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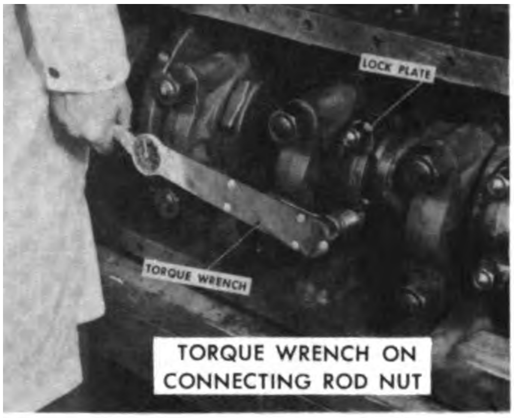


TORQUE WRENCH ON CONNECTING ROD NUT

camshaft. Connecting rods are numbered to correspond with their respective cylinders and it is most important that they be assembled accordingly.

3. From the bottom, pull the connecting rod and the piston toward the crankshaft.

CONNECTING ROD BEARINGS: 1. Before fitting new connecting rod bearings, clean the crankshaft carefully. The back of the bearing and its seat in the connecting rod must be smooth and clean or the bearing will not fit the shaft properly. Oil the bearing in the shaft thoroughly.

2. The small lip projecting from the back of the bearing shell fits into the groove in the connecting rod to dowel it in place. It must be lined up correctly.

3. Insert the bearing shell and roll it into position in the connecting rod.

Warning: Connecting rod caps must not be interchanged, filed or turned end for end.

4. Oil the bearing thoroughly. The matched numbers stamped on the connecting rods and on the caps must face the camshaft side of the engine.

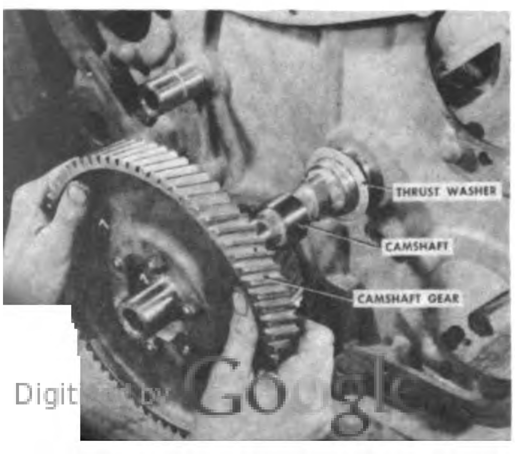
5. A small lip projecting from the back of the bearing shell fits into the groove in the rod cap. This holds the bearing shell in place and keeps it from turning.

6. Install the lock plates and nuts and pull up tightly with a 14" box wrench, or to 105-115 foot pounds if a torque wrench is available.

7. Lock the projecting lip of the lock plate against the flat side of the connecting rod bolt nut. The rods are machined to provide a side clearance of .006" to .008". Check the clearance around the full circumference of the crankshaft with a feeler gauge.

CAMSHAFT

1. A thrust washer is provided to take the end thrust of the camshaft. There are three small oil grooves in the thrust washer, and these small grooves must face the camshaft gear.



2. Before installing the camshaft, see that all cam bushings are clean and properly lubricated.

3. The camshaft has three cams for each cylinder. These operate the three

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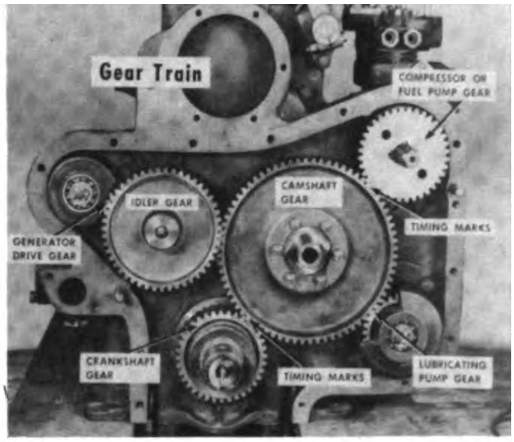

push rods which lead to the exhaust valve, the fuel injector and the intake valve.

4. The camshaft is drilled its full length for lubrication and this oil passage should be carefully cleaned. Rotate the camshaft slightly while installing it in the block. This permits the lobes of the cam to pass through the camshaft bearings and allows the camshaft to enter easily.

5. Index the zero on the camshaft gear with the zero on the crankshaft gear. (Timing will be correct if the number on the camshaft gear is indexed with the number on the camshaft, and if the zeros on the crankshaft gear and camshaft gear are indexed.)

IDLER GEAR

1. Place the idler gear on its shaft, being careful to mesh the gears properly, and check to see that the gear teeth of the idler gear are flush with the camshaft gear teeth. It is possible to install the idler gear backwards, but this would be noticeable because the gear teeth would not be flush with the camshaft gear teeth.

2. The idler gear does not need to be timed with the camshaft gear.

GEAR COVER

1. Shellac a new gasket to the gear cover and assemble the cover to the cylinder block over the dowel pins.

2. Assemble the oil pressure regulator and install it in the end of the camshaft. Two lock washers and cap screws hold the oil pressure regulator thrust plate to the gear case cover.

LUBRICATING OIL PUMP

1. Using a new gasket, install the lubricating oil pump to the rear of the flange on the cylinder block. Match the drive gear to the camshaft gear carefully.

2. It will be necessary to start the lower inside nut before assembling the oil pump securely.

3. Secure the pump in place with lock washers and cap screws.

OIL PAN

1. Remove the screen in the oil pan and clean it thoroughly before replacing.

2. Clean the gasket face on both the cylinder block and the oil pan. Shellac

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a new gasket to the oil pan and assemble the pan to the cylinder block with capscrews and bolts

Caution: Three sizes and types of capscrews and bolts are used in this installation.

3. After the engine has been brought up to operating temperature, always retighten all oil pan nuts and capscrews to prevent oil leaks.

CAM ROCKER LEVER ASSEMBLIES

1. The cam rocker assemblies work directly on the camshaft and actuate the valve and injector push rods.

2. Using a new gasket exactly .015" thick, install the cam rocker assemblies to the cylinder block in exactly the same order as removed.

Caution: A gasket of any other thickness would change the timing of the engine.

LUBRICATING OIL PIPES

1. The lubricating oil pipe carries oil from the camshaft to the upper rocker housing. There is one oil pipe for each pair of cylinders.

2. With the small hole drilled through the pipe at the top, install the pipe between each pair of cylinders.

3. Tighten the pipe by inserting a small pin punch through the hole.

COMPRESSION RELEASE SHAFT

1. With new gaskets, assemble the compression release shaft bearing to the side of the block and secure with lock washers and cap screws.

2. The compression release shaft runs the full length of the engine on the camshaft side. It contains a lifting notch for each intake valve push rod. Insert the shaft into the cylinder block and install the packing and packing glands.

3. Tighten in place with lock washers and cap screws.

4. Lock the compression release shaft in place with the small lock screws in the flywheel end of the engine.

5. Place the intake push rod in position in the lower lever socket. With the engine on Number 1 top center (on the firing stroke), turn the compression release shaft until the lifting notch on the shaft is within 1/32" of the collar of the intake valve push rod.

6. Assemble the compression release lever to the shaft so that it is against the stop nearest the water pump and lock in place.

7. Install the expansion plug and tighten.

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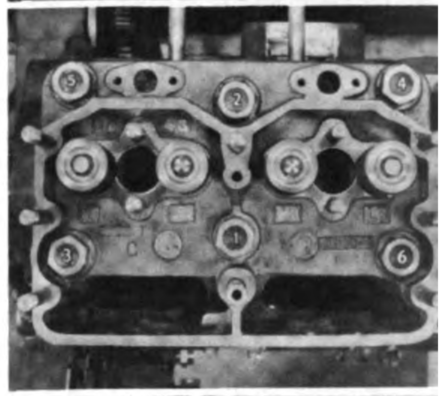
CYLINDER HEADS

1. Place a new cylinder head gasket on the cylinder block and liner.

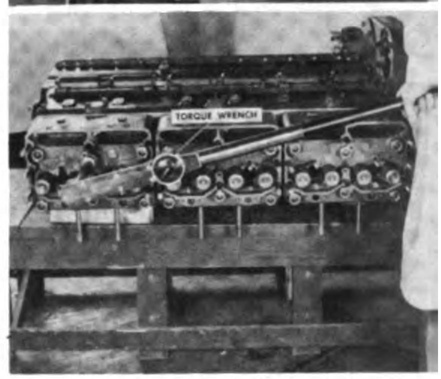
2. Install two new leather packing rings on each lubricating oil pipe and pull them down against the cylinder head gasket.



3. Thoroughly clean the faces of the cylinder heads and install the heads over the studs and dowels on the block.

4. Tighten each nut slightly in the correct order, using a 1¼" socket with a handle 46" long.

Continue tightening in rotation until all nuts have been secured. If a torque wrench is available, tighten the cylinder head nuts to 430-450 foot pounds.



INJECTORS

1. Before installing the injectors, wrap a clean cloth around a wooden stick. Clean out the injector sleeve in the cylinder head and carefully wipe the injector cup seats.

Warning*: *Never use a metal rod or waste in this cleaning operation. Never attempt to scrape or ream the Cummins Diesel Injector Seat because the copper sleeves and seats are easily scratched or marred.

2. Place the injector in its proper position in the cylinder head, being very careful not to hit or bruise the injector tip.

3. Place new gaskets on the fuel inlet and drain connections and screw the connections into the injector three turns.

4. The right-hand hole is for the inlet fuel connection and the left-hand hole is for the drain connection.

5. Oil the injector hold down studs. Install the nuts and tighten to 10-15 foot pounds with a torque wrench, or, tighten by

CLEANING

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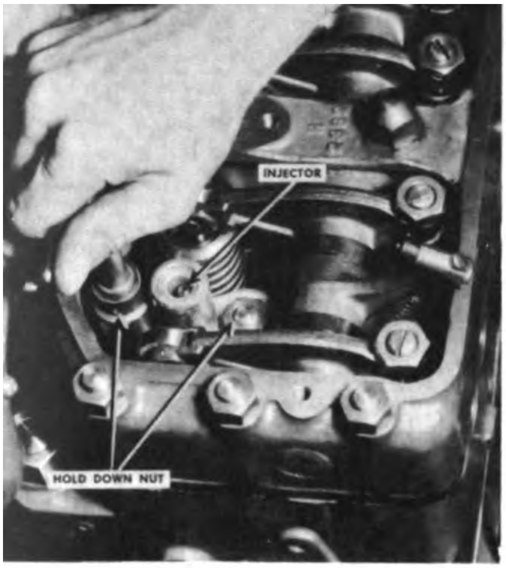

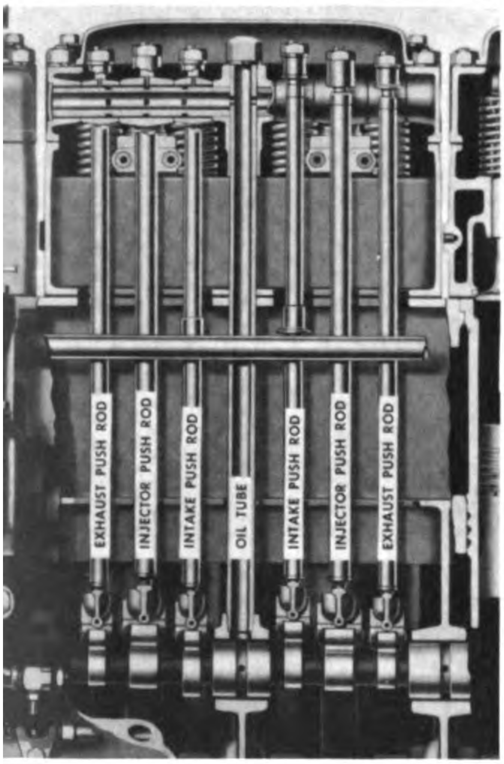

holding a T-wrench so that no leverage can be applied as shown.

Warning: Tightening these nuts to excess will distort the valve seats and crack the cylinder heads.

6. Tighten the fuel inlet and drain connections, being careful not to apply so much pressure that the copper gaskets may be ruined.

PUSH RODS

1. Insert the injector, intake and exhaust push rods into their sockets.

Caution: The push rods must be replaced in the exact order in which they were removed and numbered.

2. The injector push rods are the largest. The intake rods have collars for the compression release. Exhaust push rods are plain.

ROCKER ARM HOUSINGS

1. Loosen the lock nuts on the injector adjusting screws and back out the screws.

2. Rocker arm housings are numbered on the cover face and must be installed in numerical order, starting with Number 1 to the front of the engine.

3. Install new rocker arm housing gaskets over the studs to the cylinder heads.

4. As the rocker housings are assembled over the studs, align the push rods with the rocker lever adjusting screws.

5. Tighten down the housing nuts evenly.

6. Check the push rods with a light to be sure they are correctly installed in their respective sockets.

7. Put new gaskets on the lubricating oil pipes and install and tighten down the pipe caps.

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LUBRICATING OIL LINES

1. With new gaskets, assemble the oil suction and oil pressure lines from the lubricating oil pump to the cylinder block.

Caution: Immerse the sleeve in lubricating oil before making the joint. If the tube and rubber packing rings or washers are not lubricated, the nut is liable to roll the rubber and ruin the seal.

2. The fittings have a definite stop at the end of the thread, and it is only necessary to tighten the nut until this stop is reached to make a perfect joint.

WATER MANIFOLD

1. Shellac a new gasket to each of the water manifold feet and secure the manifold to the cylinder heads.

2. There are three thermostats that control the temperature of the cooling solution in the engine. Place the two manifold thermostats in the water manifold and assemble the thermostat cover with a new gasket.

3. Install the water by-pass, or third thermostat, in the by-pass connection.

4. Using a new gasket, secure the by-pass connection to the water manifold.

The water by-pass thermostat is normally open until the operating temperature is reached. At this point, the manifold thermostats open, and the by-pass thermostat closes.

INTAKE AND EXHAUST MANIFOLDS

1. Assemble new gaskets over the manifold studs and dowel pins.

2. Place the clamps on the studs and start the lock washers and nuts to hold them in place.

3. Fit the exhaust manifold over the dowel pins in the cylinder head and turn the stud nuts down just enough to hold the manifold on the dowels.

4. Turn down the two clamps on the Number 1 cylinder head so that the intake manifold may be slipped into position.

5. Line up all the clamps and tighten the nuts evenly, securing both manifolds in place.

COMPRESSION RELEASE SPRING

Hook the compression release lever spring into the lever and, with a small cap screw, install the other end to the front cylinder head. This spring holds the compression release continuously in running position, unless the lever is pulled open by hand.

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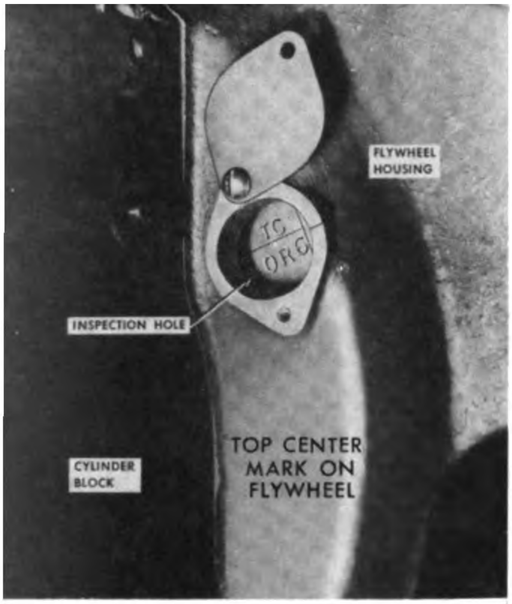


INJECTOR DRAIN MANIFOLD

1. The injector drain manifold is provided to drain the fuel which has by-passed the injector plunger and carry it back to the fuel pump. This fuel is allowed to by-pass to lubricate the injector plunger.

2. Assemble the injector drain manifold to the cylinder block and secure it in place with small clamps and screws.

3. Assemble and tighten each drain line to its injector drain connection.

FUEL PUMP

1. Check the fuel pump drive gear to see that the timing mark on the gear lines up with the mark on the governor housing, and that the timing mark appears in the middle of the inspection hole in the side of the distributor housing.

Warning: Unless these two sets of timing marks appear, it will be impossible to time the pump to the engine.

2. Turn the crankshaft to Number 1 top center. The two center punch marks on the back side of the camshaft gear will appear through the fuel pump mounting flange.

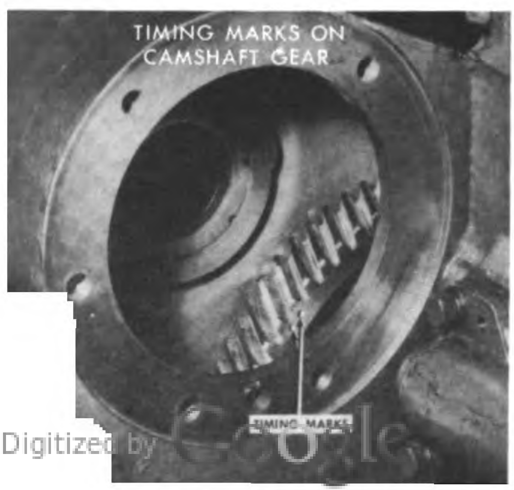
3. Put chalk on the top of each center punched tooth on the cam gear and on the marked tooth on the fuel pump gear.

4. Install the fuel pump and gasket to the cylinder block. Index the one center punched tooth on the fuel pump drive gear between the two center punched teeth on the cam gear.

5. Check through the inspection hole of the gear case cover to see that the fuel pump gear is properly indexed to the camshaft gear.

6. Install and tighten the cap screws to the governor flange.

7. Install and tighten the two capscrews in the lower mounting flange on the fuel pump housing and the two cap screws on the upper mounting flange of the pump housing.



FUEL DRAIN LINE

Assemble the fuel drain line leading from the drain manifold to the fuel pump and clamp to the cylinder block.

FUEL SUPPLY LINE

All fuel supply fittings are numbered on the fuel pump distributor. Assemble the lines from the distributor to the proper injector fuel inlet connection and clamp in place.

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WATER PUMP DRIVE PULLEY

Assemble the water pump drive pulley to the keyed fuel pump shaft from the front of the gear housing. Assemble the nut and lock plate to the shaft and tighten securely. Bend the lock plate over on the flat side of the nut to lock it in place.

WATER PUMP AND DRIVE BELTS

1. Turn the water pump so that the low point of its eccentric is toward the drive pulley. Assemble the belts over the pulleys.

2. Using a new ring gasket, assemble the pump to the cylinder block. Hold the pump in place with the clamp ring, capscrews and lock washers finger tight only.

3. Tighten the water pump drive belts by inserting a screwdriver in the hole in the side of the pump body. Rotate the pump body *counter-clockwise* until the belts have proper tension. Belts have proper tension when the outer belt can be pushed down approximately ¾″ with normal thumb pressure.

4. All capscrews in the clamp ring may now be tightened.


Cranking Motor

CRANKING MOTOR

Assemble the cranking motor to the flywheel housing with its mounting spacer and three lock washers and cap screws.

GENERATOR DRIVE UNIT

Use a new gasket. Install the generator drive assembly into the rear of the flange on the cylinder block and secure with cap screws and lock washers.

GENERATOR

1. Place the generator drive chain over the generator drive sprocket.

2. Insert the generator coupling in the drive chain and secure the generator in place.

After the generator is installed on the engine and reconnected, disconnect the Field lead from the "F" terminal on the regulator and then momentarily touch the field lead to the "AMM" terminal on the regulator. Then reconnect the Field lead to the "F" terminal. This correctly polarizes the generator and should be done before starting

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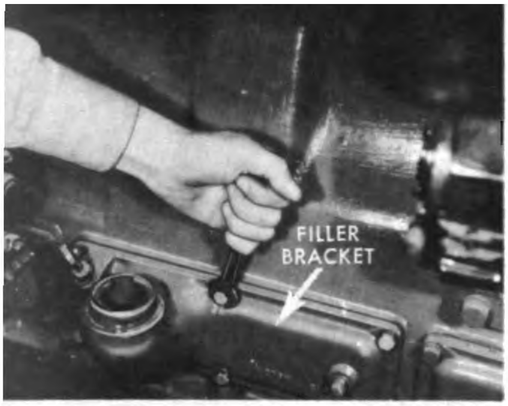

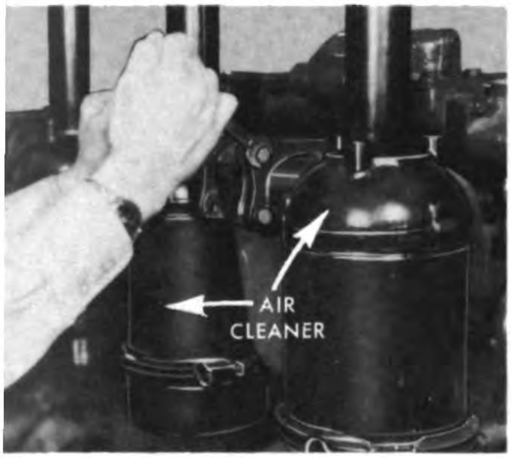

the engine. This should be done after any check, adjustment, repair, or installation of the generator or regulator.

OIL FILLER AND GAUGE BRACKET

1. A bracket for the oil filler and oil level gauge, which also acts as an inspection plate, is provided in the manifold side of the block.

2. Install the bracket to the cylinder block with a new gasket and insert the bayonet oil level gauge in the oil gauge tube.

AIR CLEANERS

1. With new gaskets and adapters assemble the air cleaners to their stud.

2. Secure in place with nuts and lock washers.

LUBRICATION DURING REPAIR AND ASSEMBLY

CRANKSHAFT: 1. As the crankshaft is being laid, lubricate all bearing surfaces on the crankshaft with clean fresh lubricating oil (OE-30).

2. Lubricate all lockplates, bolts and stud nut threads for main bearings with OE-30 oil before tightening the bearing caps in place. It is impossible to get accurate readings on the torque wrench unless all threads are properly oiled.

CRANKSHAFT OIL SEAL: 1. Thoroughly lubricate the asbestos oil seal before assembling to place over the crankshaft flange.

CYLINDER LINERS: 1. After the cylinder block has been thoroughly cleaned to receive the cylinder liners lubricate the block with liquid soap or automobile soap at the points where the rubber pack rings seal the liners in place. Do not use any other lubricant on the rubber pack rings.

PISTON AND CONNECTING RODS: 1. Oil the cylinder liners with OE-30 lubricating oil before inserting the piston assemblies.

2. Oil the piston pins at the points of clearance between the connecting rod and the pistons with OE-30 oil.

3. Oil the connecting rod bearing shells and the connecting rod bolt threads as the connecting rods are being installed to the crankshaft, using OE-30 oil.

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LUBRICATING OIL PUMP: 1. If the lubricating oil pump has been disassembled, oil the gears liberally with OE-30 as it is being reassembled. This insures fast priming of the pump.

CAM ROCKER LEVER ASSEMBLIES: 1. Oil the cam rockers and shafts with lubricating oil.

ROCKER ARM HOUSING: 1. Oil the rocker levers and shafts with lubricating oil as they are being assembled to the engine.

FUEL PUMP: 1. Before replacing the distributor cover to the disc fill all fuel passages with a light grade (OE-10) lubricating oil.

2. Lubricate the metering plunger in the barrel with a light grade (OE-10) lubricating oil.

3. Before replacing the governor housing to the governor unit of the fuel pump lubricate the ball bearing shafts and all working parts of the governor liberally with OE-30 lubricating oil.

4. Before starting the fuel pump after an overhaul of the gear pump it is well to remove the pressure chamber and fill the Number 1 fuel pockets with clean fuel oil of the proper viscosity. Both the Number 1 and Number 2 gears should be oiled in their pockets during assembly to the fuel pump.

CRANKING MOTOR AND GENERATOR: 1. Put a few drops of light lubricating oil at the oil holes of the cranking motor and battery charging generator.

WATER PUMP: 1. Remove both oil plugs in the water pump and fill with (WP) water pump grease, or (WB-2) general purpose grease through one plug hole until the lubricant starts out at the other open plug hole.

AIR CLEANERS: 1. Fill the oil sump of the air cleaners with lubricating oil of the same grade as is used in the engine, dependent upon weather conditions.

2. Dip the wire mesh screen of the air cleaners in a light grade of lubricating oil.

AIR BREATHER: 1. Lubricate and treat the air breather the same as the air cleaners.

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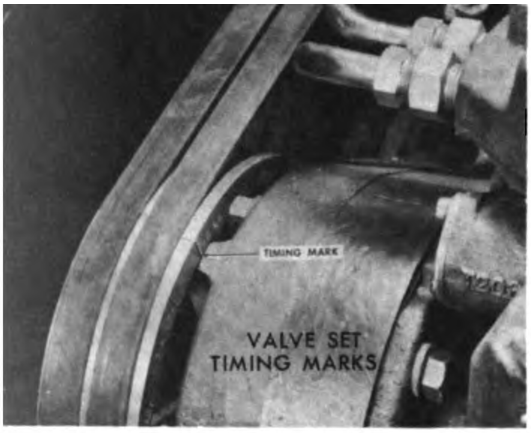

ADJUSTMENTS

The adjustments and servicing instructions that follow are points which should be taken care of by Maintenance and Repair men following assembly and at the intervals specified. Adjustments and points of engine care that can be taken care of by the operators will be found in the Operation Section.

INJECTOR PLUNGER ADJUSTMENT

Never operate the engine when the valves are improperly adjusted.

Check the injector adjustment before initial operation and once every 256 hours of operation thereafter. Also check injector adjustments after an overhaul or at any time when the operator is not sure that the engine is ready to be operated.

1. To set the injector, pull the compression release lever as far back as possible and hold it in this position. This allows the intake valves to remain open. The engine may then be turned over without working against compression.

2. Rotate the engine in its operating direction until Number 1 cylinder comes up on the compression stroke. (On the compression stroke both the intake and exhaust valves will be closed with the compression release in running position.) As the piston approaches top center, the injector rocker lever (the center lever) will start moving downward, pushing the injector plunger down with it.

3. When this injector rocker lever starts its downward movement, continue to turn the engine (approximately ⅛ turn) until the notch marked "1 & 6 VS" on the water pump drive pulley registers with the top center mark on the gear housing. Number 1 cylinder is now in position to adjust the injector.

4. Make sure that both intake and exhaust valves are in closed position before adjusting the injector plunger.

5. With an injector adjusting tool, push the injector plunger firmly in its seat. Then with a screwdriver, turn the adjusting screw down until it just bottoms. Now tighten the lock unit. Do not tighten further or back off the adjusting screw.

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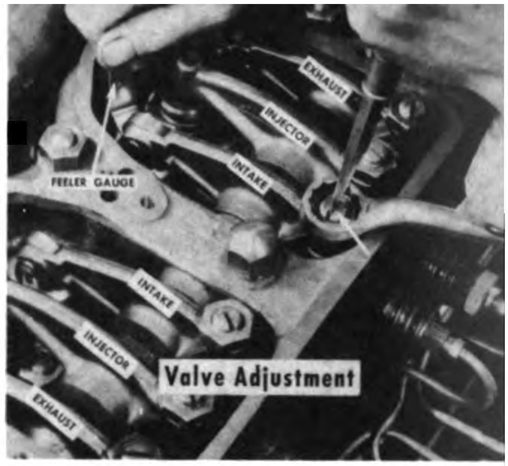

Caution: Be careful not to adjust the injectors too tightly, as this throws an overload on the camshaft and cam rollers, ultimately damaging these parts.

The injectors for only one cylinder can be adjusted at one setting. Two complete revolutions of the crankshaft are necessary to adjust the injectors for all cylinders.

VALVE ADJUSTMENTS

Never operate the engine when the valves are improperly adjusted.

Check the valve adjustment before initial operation and once every 256 hours of operation thereafter. Also check valve adjustments after an overhaul or at any time when the operator is not sure that the engine is ready to be operated.

1. The same engine position used in setting the injector is used for setting the intake and exhaust valves.
2. Make sure the compression release is in running position before setting the intake valves.
3. Always make final valve adjustments when the engine is hot.
4. Set the intake valves at .014" and the exhaust valves at .022".
5. Turn the engine over until the next "VS" notch in the water pump drive pulley indexes with the top center mark on the gear housing. This brings the cylinder next in the firing order to the correct position for injector and valve adjustments.
6. Following this procedure, continue until all injectors and valves have been set.

The valves, for only one cylinder can be adjusted at one setting. Two complete revolutions of the crankshaft are necessary to adjust the valves for all cylinders.

FUEL PUMP TIMING

Check the fuel pump timing before initial operation and before operating the engine following overhaul jobs which might affect the fuel pump timing.

1. Bar the engine over to Number One top center. The engine is on Number One top center when the top center mark on the flywheel lines up with the mark on the flywheel housing through the inspection plate and if both intake and exhaust valves on Number One cylinder are closed. If the top center mark shows on the flywheel Number One exhaust and intake valves are not closed the engine is on Number Six top center and it will be necessary to turn the crankshaft one complete revolution.
2. Check the fuel pump timing marks on the water pump drive pulley and the gear housing. This should show one and six top center.

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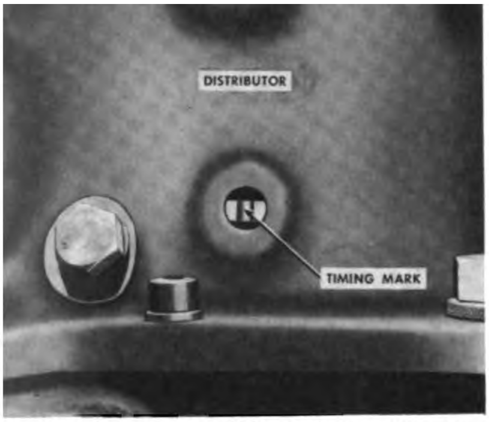

3. Check the distributor collar timing mark through the distributor housing inspection hole.

These checks on fuel pump timing are only necessary, (1) after the fuel pump has been removed from the engine, (2) or if the camshaft timing has been changed, (3) or the fuel pump distributor has been lifted from the fuel pump. The engine cannot get out of time by itself.

DRIVE BELTS

Check tension of water pump belt every 64 hours of operation and correct if needed.

The belts may be tightened by loosening the water pump clamp ring and turning the water pump (which is on an eccentric) counterclockwise to give the belts proper tension. The belts have proper tension when they can be pushed approximately 3/4" with normal thumb pressure.

Belts are often neglected because a poorly adjusted belt does not bring an immediate penalty. A belt which is too tight puts a strain on gears, shaft and belt grooves. Loose belts slip, overheat and wear out more quickly.

PRIMING THE ENGINE

When the engine is started for the first time or after it has been overhauled, the fuel system will be dry and it will be necessary to prime all supply lines with clean fuel. For priming instructions, refer to page 80 of the Operation Section.

ADJUSTMENT OF IDLING GOVERNOR

After the fuel pump is installed on the engine and the engine is running, the low speed or idling governor stop screw should be adjusted.

This adjustment is made by loosening the locknut and turning the idling screw until the engine idles at between 450 and 500 RPM.

If more adjustment is required than the screw permits, readjustment of the linkage to the idling control may be made. Make sure this adjustment is made so that the idling lever holds the screw against the stop on the pump body when in idling position.

CLEANING INJECTORS

The injectors should be checked for clean spray holes every 512 hours of operation. Refer to page 198 of Repair Section for instructions.

TESTING COMPRESSION

Test the compression by barring the engine over every 2048 hours of operation, and if necessary grind the valves.

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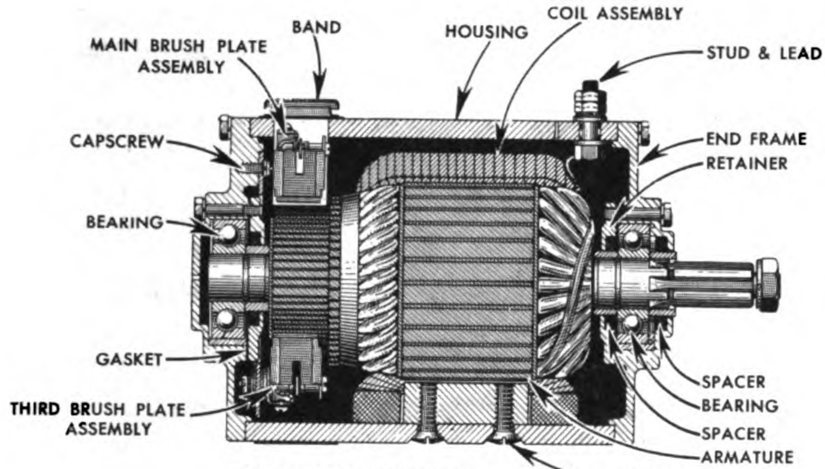
GENERATOR CHECKS AND ADJUSTMENTS



CROSS-SECTION DRAWING OF GENERATOR

GENERATOR BRUSHES: The two main brushes should not be shorter than ¾ inch, third brush ⅝ inch (original length 1 3/32 inch, third brush 1 inch). If worn down to, or almost to, this length, they must be replaced. Brush spring tension must be sufficient to give good clean contact of the brushes on the commutator, and the brushes must be free to slide in their brush holders. The pigtail leads in the brushes must be tight and the lead clips fastened well to the brush holders. The generator has an adjustable third brush and can be adjusted as outlined on page 223.

COMMUTATOR: The commutator must be smooth, round, without excessive roughness, dirt, gum or burned areas. The slots between the segments must be open and not filled with brush or copper dust. The armature leads must be properly soldered to the commutator segments. If the commutator does not meet with the above, the generator must be removed, disassembled, and the commutator serviced.

CONNECTIONS: The connections at the terminals should be checked to make sure they are all tight and in good condition.

Periodic Disassembly: Every 512 hours the generator should be removed from the engine, disassembled, and all parts cleaned and inspected as outlined on page 220 of Repair Section. Generally speaking, disassembly should be carried only so far as is necessary to adequately inspect and clean the parts. For example, it will not be necessary to disassemble the commutator end assembly except as required to replace defective parts. Likewise, the field windings and terminal studs need not be removed from the field frame except for replacement. Indiscriminate disassembly and assembly of such parts may actually damage them, since it tends to weaken leads and connections by stressing and bending them and may damage insulation so that a short or ground will develop.

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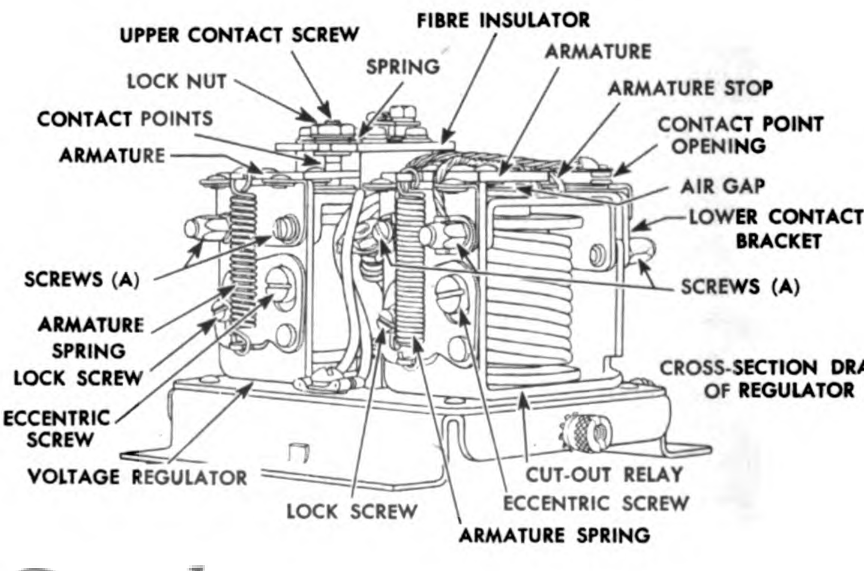
INSTALLATION CAUTION: After the generator is reinstalled on the engine, or after any adjustments or bench tests of either the generator or regulator, the generator must be re-polarized to make sure that it has the correct polarity with respect to the system. This must be done before the engine is started.

To polarize the generator, disconnect the Field lead from the "F" terminal on the regulator and then momentarily touch the field lead to the "AMM" terminal at the regulator. Then reconnect the Field lead to the "F" terminal.

REGULATOR CHECKS AND ADJUSTMENTS

INSPECTION CHECKS: Inspection checks would normally include checking the electrical settings of the cut-out relay and voltage regulator. But without the proper instruments, which include a voltmeter and an ammeter, these checks cannot be made. Tampering with the regulator by unauthorized or unequipped personnel can lead only to damage to the electrical units. Increasing regulator settings beyond their rated values may cause destruction of the generator or regulator, overcharged and damaged batteries, and early failure of other electrical equipment on the vehicle. Reducing regulator settings below the rated values will result in undercharged batteries and inefficient operation of the electrical equipment. The regulator settings are checked and adjusted as outlined in the instructions which follow.

PERIODIC REGULATOR REPLACEMENT: At periodic intervals, the regulator should be removed from the vehicle so that the condition of the contact points, insulators, leads, etc., may be noted and repairs made as necessary. In addition, the mechanical settings (air gaps and point openings) may be readjusted, and the electrical settings (cut-out relay closing voltage and voltage regulator setting) checked and adjusted as necessary.



CROSS-SECTION DRAWING OF REGULATOR

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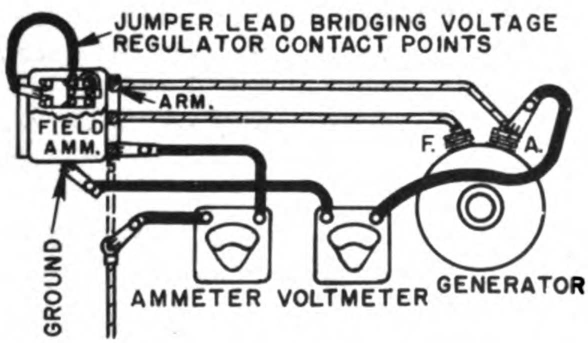
Mechanical Adjustments

a. CUT-OUT RELAY AIR GAP: The cut-out relay air gap should be .057 inch and is measured between the armature and the core with the points *just touching*. It is adjusted by loosening the two contact bracket mounting screws and raising or lowering the bracket as required. Be sure points are lined up and tighten screws after adjustment.

b. CUT-OUT RELAY POINT OPENING: The cut-out relay point opening should be .020 inch and is adjusted by bending the upper armature stop. If the points do not close at the same instant, the contact bracket should be slightly realigned (and air gap reset) and the spring fingers bent (only slightly) until they close simultaneously.

c. VOLTAGE REGULATOR POINT OPENING: The voltage regulator point opening should be .015 inch and is checked with the armature held down against the winding core. It is adjusted by loosening the lock nut and turning the contact screw. Care must be taken to avoid distorting the contact spring. The correct procedure is to place the screw-driver into the screw slot and hold the screw stationary while the lock nut is loosened. The spring should rise slightly above the fibre insulator when the points come together. This provides a wiping action between the points which maintains better contact. After the correct adjustment is made, tighten the lock nut by holding the screw stationary with the screw-driver and tightening lock nut with wrench.



Electrical Adjustments

a. CUT-OUT RELAY CLOSING VOLTAGE: The cut-out relay closing voltage should be 13.5 volts and is checked by connecting the regulator in the normal manner to the generator and a 12-volt battery, with a voltmeter connected from the regulator armature terminal to the regulator base. Slowly increase generator speed and note the voltage at which the cut-out relay points close. Adjust by loosening the locking screw and turning the eccentric. Increasing spring tension increases closing voltage. After each adjustment, slow generator and bring back to speed to check adjustment. Do not set closing voltage above the voltage required to operate the voltage regulator unit. If this occurs, the

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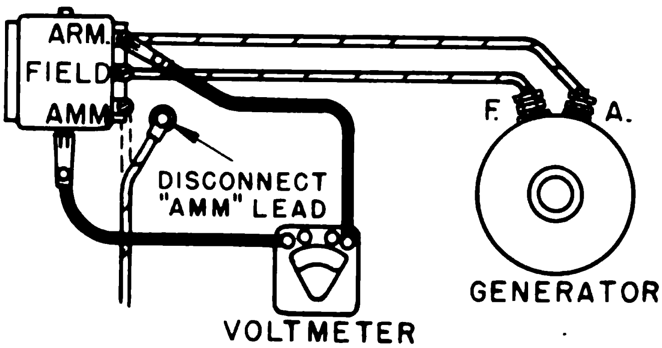
voltage regulator will operate to prevent the voltage reaching the value needed to close the relay contact points. NOTE: The relay must be at operating temperature and in operating position (vertical) when the closing voltage setting is made.



b. VOLTAGE REGULATOR SETTING: The voltage regulator setting should be 15 volts and is checked by connecting the unit to the generator in the normal manner excepting that the regulator "AMM" terminal should be left disconnected. With this lead disconnected the unit will be operating on open circuit. Connect a volt-meter from the regulator 'ARM" terminal or the generator "A" terminal to the regulator base. Operate generator at medium speed (1500 engine r.p.m.) and note voltage at which regulator operates. The regulator must be hot—at operating temperature (145°F.). Either heat regulator in an oven to this temperature (avoid excessive baking or heat) or operate the regulator for about 30 minutes with the cover in place, to obtain this temperature. Adjust by loosening lock screw and turning eccentric. Increasing spring tension increases voltage setting, while reducing tension lowers setting. Tighten lock screw securely after completing adjustments.

CRANKING MOTOR CHECKS AND ADJUSTMENTS

INSPECTION CHECKS: Inspection checks include a periodic investigation of the condition of the battery, battery cables and connections, cranking motor solenoid switch, commutator, brushes, lead connections and mounting.

a. *Battery*—The condition of charge of the battery should be noted as outlined on page 84 of the Operation Section.

b. *Cranking Motor Switch*—The cranking motor solenoid switch should operate without binding, shifting the drive into mesh promptly, and when its circuit is opened, should release the contact disc with a snap, releasing the shift lever quickly. The contact disc should be making good clean contact with the terminals when in operation. (This to be checked at the periodic teardown period).

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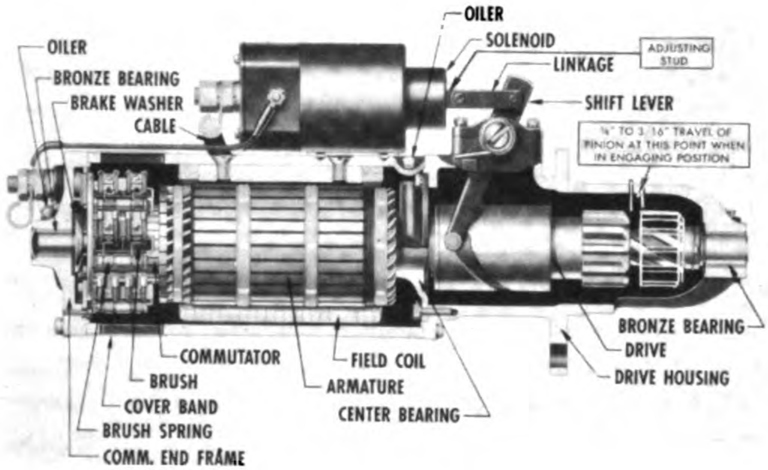

c. *Commutator*—The armature commutator may be observed by removing the cranking motor cover band. It should be clean, not out of round or excessively worn, without high mica or burned bars. Armature leads must be properly connected to the commutator riser bars, and the banding wire should be in place. Failure to meet these specifications requires that the armature be removed and the commutator serviced as outlined on page 231.

d. *Brushes*—The brushes must be making good contact with the commutator and should not be worn any shorter than 5/16 inch (from an original length of ½ inch). If worn down to, or almost to, this length, replace.

e. *Lead Connections*—Lead connections must be tight and in good condition.

f. *Mounting*—Mounting bolts must be tight.

g. *Drive Assembly*—The drive assembly cannot be observed with the cranking motor mounted on the engine, but its action can be noted by observing the operation of the cranking motor.

PERIODIC DISASSEMBLY: At periodic intervals of 512 hours of operation, the cranking motor should be removed from the engine, disassembled and all parts cleaned and inspected as outlined on page 230 of Repair Section. This guards against failure of the equipment at some critical instant, and must be considered an important part of the preventive maintenance routine.

Cranking Motor Checks

DYER DRIVE ADJUSTMENT—When the shift lever has moved back against the cranking motor switch and completed its travel so that the pinion is in the engaging position, it should be possible to move the pinion back ⅛" to 3/16" against the pinion spring. This travel can be adjusted by removing the pin and cotter pin and turning the stud in or out of the plunger as required. Adjustment must be accurate, since

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improper adjustment might put sufficient thrust against the pinion guide lugs to break them off.

NO LOAD TEST—Connect the cranking motor in series with a battery of the specified voltage and an ammeter capable of reading several hundred amperes. If the r.p.m. indicator is available, read the armature r.p.m. as well as the current draw with the unit running free speed or no load. The armature should develop a speed of 6000 r.p.m. at 85 amperes at 22 volts.

TORQUE TEST—Torque testing equipment is required for conducting a stall torque test of the cranking motor. The torque developed, current draw, and voltage are checked together. The cranking motor should develop 25 foot lbs. lock torque at 500 amperes at three volts.

INTERPRETATION OF NO LOAD AND TORQUE TEST.

(a) *Rated torque, current draw, and no load speed* indicates normal condition of the cranking motor.

(b) Low free speed and high current draw with low developed torque may result from:

(1.) Tight, dirty, worn bearings, loose field poles which allow armature to drag.

(2.) Grounded armature or field. Check by raising brushes from armature commutator and testing with test lamp and points from cranking motor terminal to frame and from commutator to frame. If the lamp lights, a ground exists.

(3.) Shorted armature. Check armature on growler.

(c) Failure to operate with high current draw:

(1.) Direct ground in switch, at terminal or brushes.

(2.) Frozen shaft bearings which prevent armature from turning.

(d) Failure to operate with no current draw:

(1.) Open field circuit. Trace with test lamp and points.

(2.) Open armature coils.

(3.) Broken or weakened brush springs, worn brushes, high commutator mica, or other conditions which would prevent good contact between brushes and commutator.

(e) Low no-load speed with low torque and low current draw indicates:

(1.) Open field. Trace circuit with test lamp and points.

(2.) High internal resistance due to worn brushes, dirty commutator, weak or worn springs, and other causes of poor contact between commutators and brushes.

(3.) Defective leads, connections.

(f) High free speed with low developed torque and high current draw indicates shorted fields. It is difficult to detect shorted fields with ordinary testing instruments, since the field resistance is originally low. If shorted fields are suspected, install new fields and check for improvement in performance.

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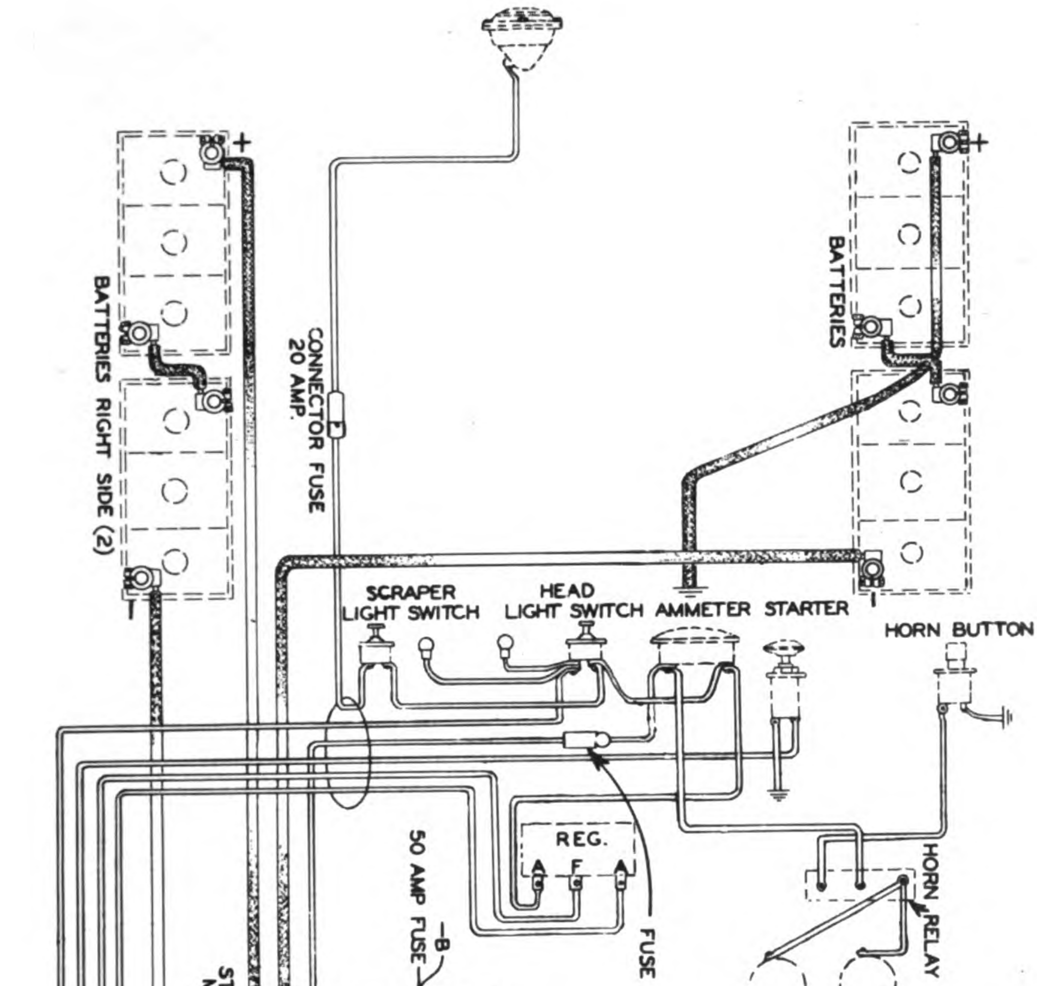

WIRING DIAGRAM

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REPAIR SECTION

Part Three

The POWER CONTROL UNIT

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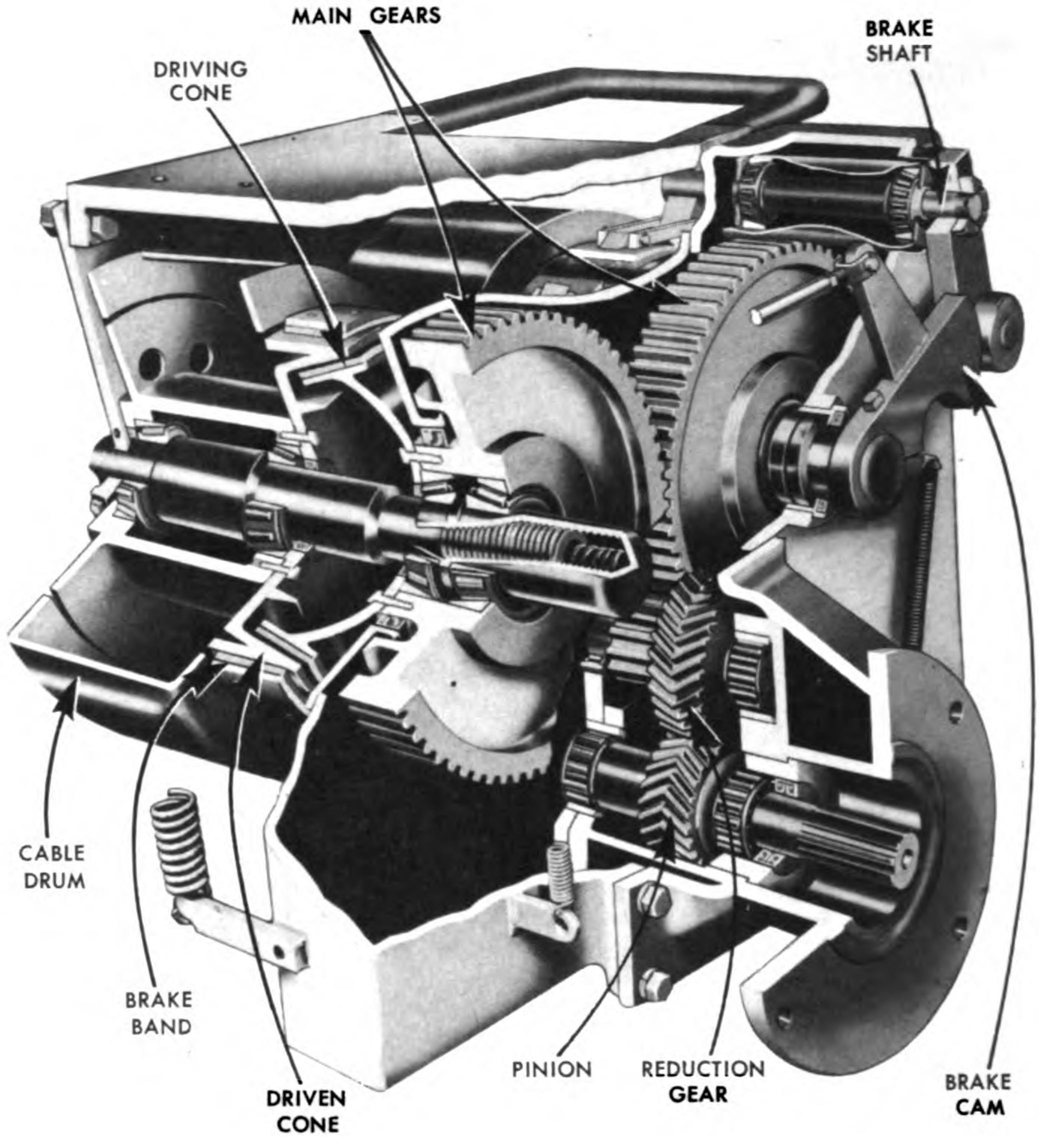

CROSS-SECTION VIEW OF POWER CONTROL UNIT

DISASSEMBLING POWER CONTROL UNIT

When disassembling a Power Control Unit to replace a worn part, install new clutch or brake facings, remove bearing adjusting shims, etc., the length of time that is consumed is quite often an important matter, especially if the disassembly results in other equipment being shut down during that period. Therefore, the instructions which follow explain the quickest and easiest method of correctly removing and disassembling each assembly or group of related parts.

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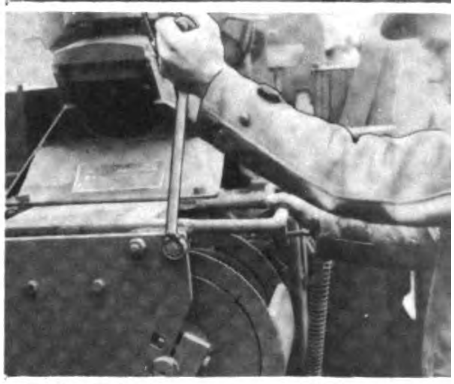
REMOVING CABLE DRUM ASSEMBLIES

The cable drum assemblies can be removed without removing the Power Control Unit from the Tournapull. To remove either the left or right cable drum assembly first remove cable from cable drum. Then proceed as follows:

1. Loosen clamp blocks which clamp rear end of drum shafts to Power Control Unit rear plate by loosening clamp bolts.



2. Then remove capscrews which secure rear plate to Power Control Unit.

3. Remove rear plate and cable guards as one unit by sliding them to the rear, off the ends of the drum shaft, as illustrated. Also remove brake band from drum that is to be removed. (Refer to instructions for removal of brake band on page 272 of the Repair Section).

4. Remove either the right or left cable drum assembly by turning drum shaft out of clutch throw nut, using a wrench as illustrated. Turn the left drum shaft clockwise and the right drum shaft counter-clockwise. In this operation it is necessary to support the cable drum as illustrated in order to prevent damaging the oil seal in the hub of the driving cone as the drum shaft passes through the seal.

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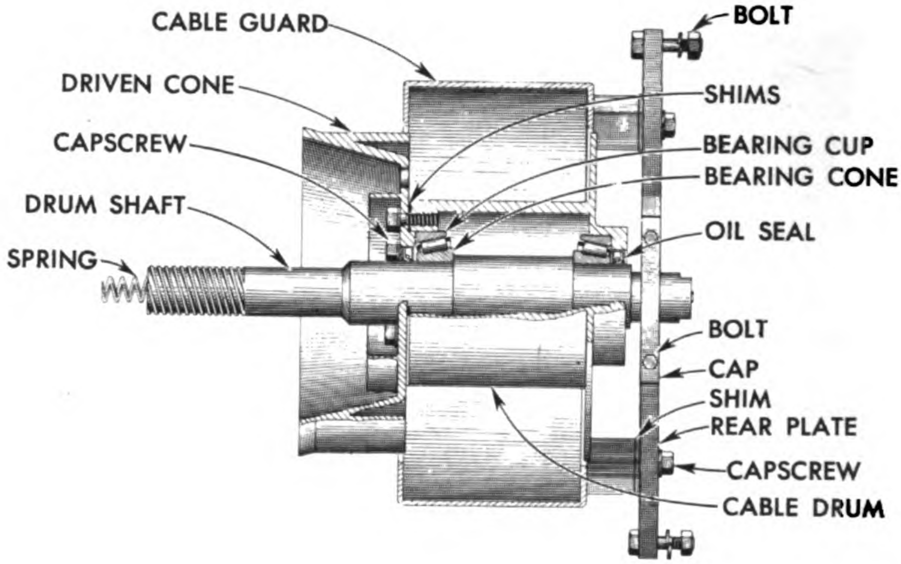
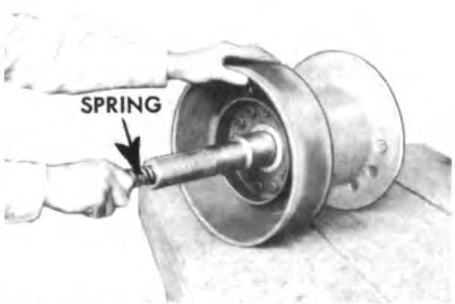
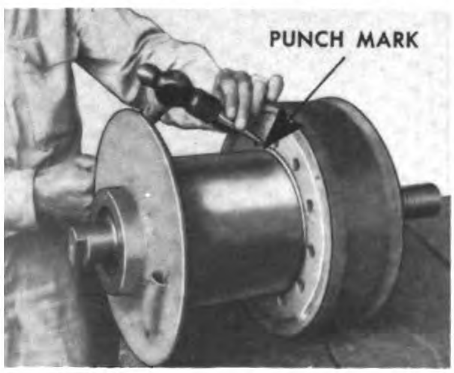


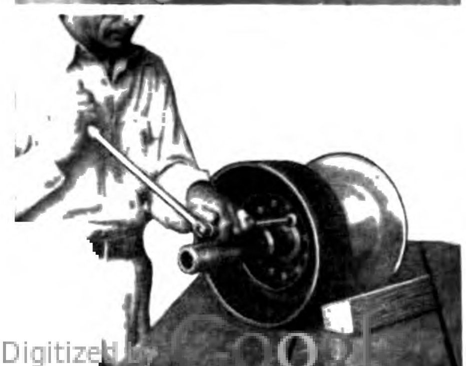
DISASSEMBLING CABLE DRUM ASSEMBLIES



1. If spring at end of drum shaft is to be removed, pull it out of end of shaft.



2. With hammer and punch, mark cable drum and driven cone at the points shown. This is done in order to insure proper alignment when reassembled.



3. Remove capscrews which secure driven cone to cable drum. Then slide driven cone off over end of drum shaft, being careful not to damage hub oil seal.

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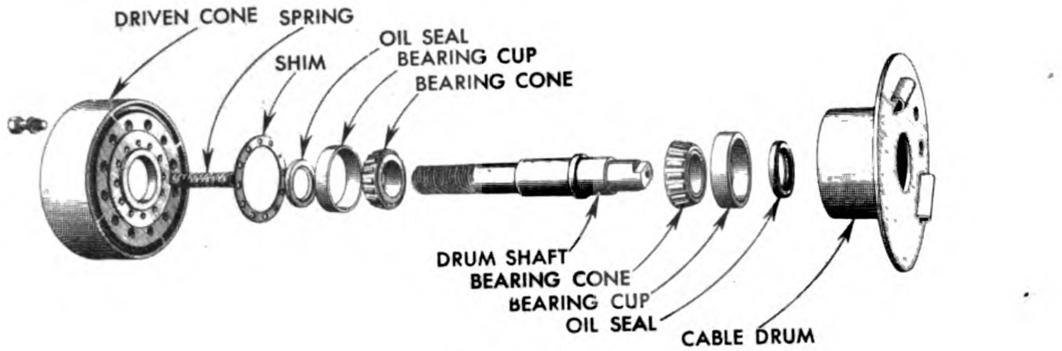
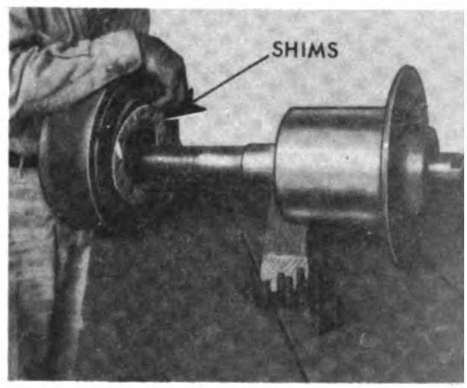
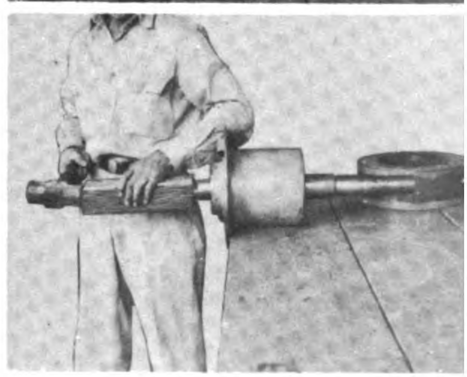


4. Remove bearing adjusting shims from between cable drum and driven cone. To avoid loss of shims wire them together.



5. Remove drum shaft from cable drum by driving against short end of shaft, using a wood block and sledge. The bearing cup at opposite end of cable drum will be removed during this operation.



6. If bearing cones are to be replaced, drive or pull them off drum shaft. Also, the cable drum oil seal and the remaining bearing cup can be removed from the cable drum.

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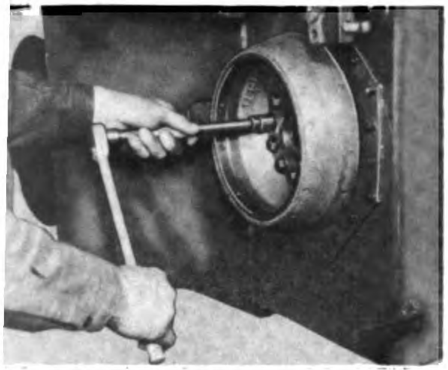

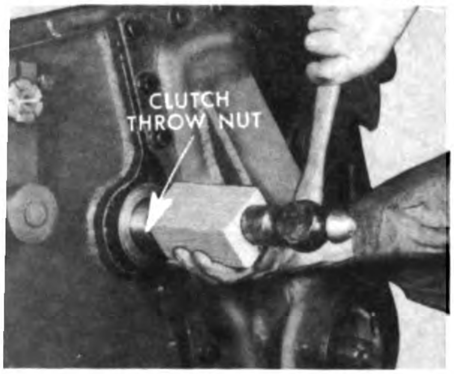

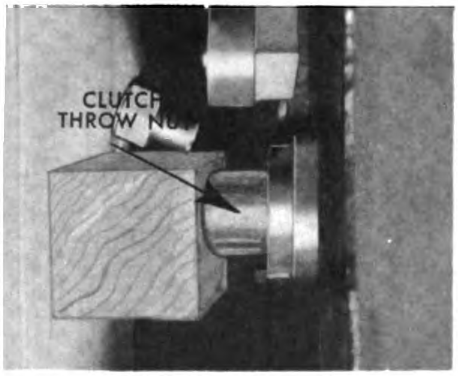

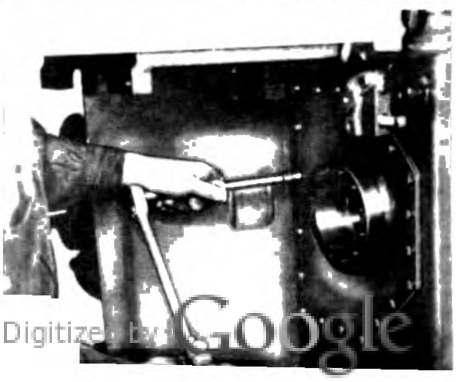

REMOVING MAIN GEAR AND DRIVING CONE ASSEMBLIES

All parts of the main gear and driving cone assemblies except the main gears can be removed from the Power Control Unit without removing the Power Control Unit from the Tournapull. (To remove the main gears, the Power Control Unit must first be removed from the Tournapull and the adaptor neck removed from the Power Control Unit.) To remove and disassemble the left and right main gear and driving cone assemblies, follow the instructions below:

1. Remove cable drum assembly as outlined in preceding instructions. Then remove driving cone by removing capscrews which secure it to hub of main gear. Remove bearing adjusting shims from back side of driving cone. (To avoid loss of shims, wire them together.) If driving cone oil seal is to be replaced, remove it from hub of driving cone.

2. To remove clutch throw nut and main gear bearings, loosen clamp bolt from brake cam, and remove brake cam from clutch throw nut. Then place a wood block against front end of throw nut and drive it out of gear hub, using a sledge, (if Power Control Unit has been removed from Tournapull.)

3. If Power Control Unit has not been removed from Tournapull, clutch throw nut can be removed by moving main gear as far to the rear in gear case as possible and then inserting wood block between front end of clutch throw nut and rear of Tournapull case as illustrated. Then drive against gear hub from rear, using wood block and sledge thereby driving bearing cup out of the rear side of gear hub. Avoid marring gear hub.

4. Lift clutch throw nut and main gear bearings out of gear hub as one unit. If bearings are to be replaced, either drive or pull them off the throw nut.

5. The cover plate can be removed to reach the main gears by first removing the capscrews which secure the cover plate to the case.

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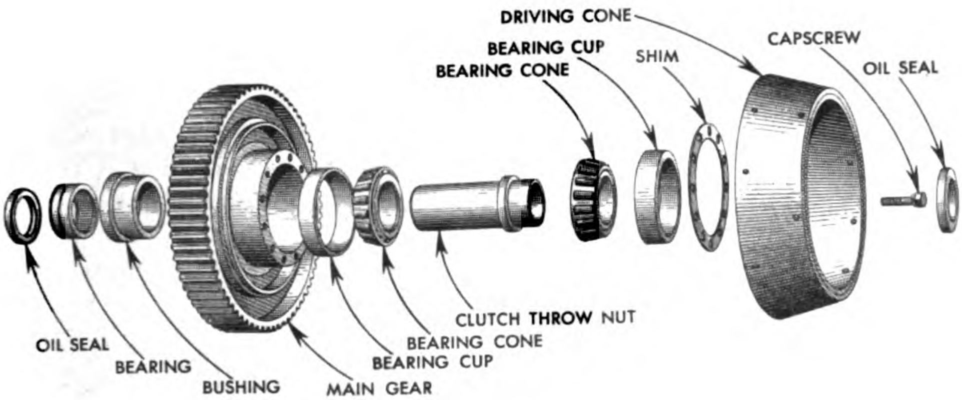
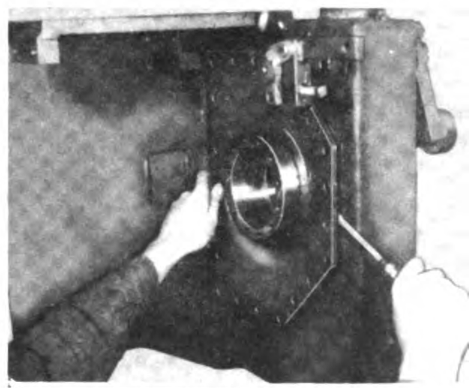
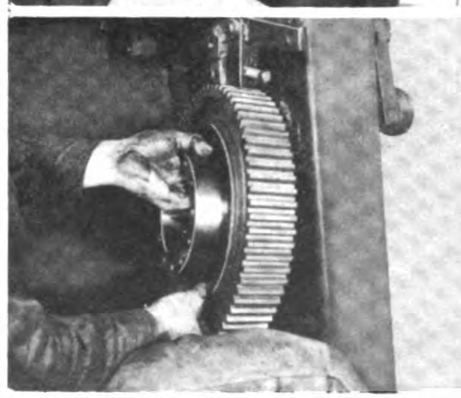


6. Strike cover plate a blow near center with a hammer, thereby breaking cover plate loose from gear case. Then pry cover plate away from gear case as illustrated, using a screw driver or similar tool. Care should be used to pry cover plate off evenly in order to avoid damaging oil seal and dowel pins. Remove oil seal from cover plate if it is to be replaced.



7. To remove the main gears, the Power Control Unit should first be removed from the Tournapull and the adaptor neck removed from the Power Control Unit as outlined in the instructions on page 274. (Both the right and left throw-nuts must be removed before either gear can be removed.)



8. The clutch throw nut bearing, oil seal, and bushing can be driven out of the case if they are to be replaced.

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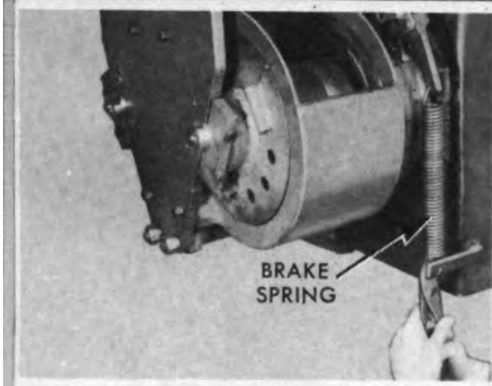
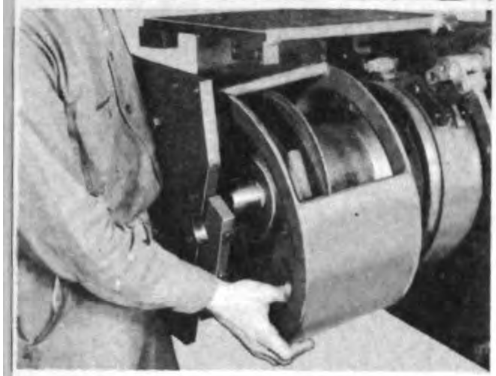
REMOVING BRAKE ASSEMBLIES

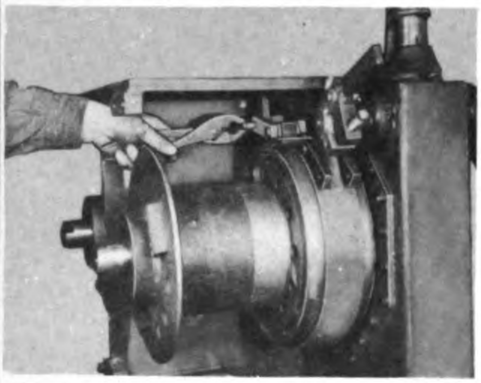
All parts of the brake assemblies can be removed without removing the Power Control Unit from the Tournapull.



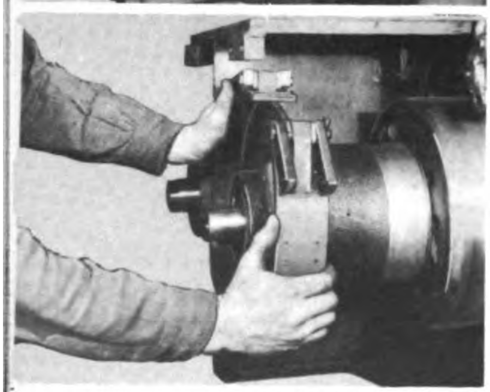
1. Before removing any part of either the left or right brake assembly it is usually advisable to first remove the brake spring.



2. To remove a brake band first remove the rear plate and cable guards by removing the capscrews that secure the rear plate to the Power Control Unit. Then slide the rear plate and cable guard to the rear, off the ends of the drum shafts.



3. Then remove link pins which connect brake links with brake shaft and gear case, leaving brake links connected to brake band.



4. Slide brake band off over cable drum.

5. To remove a brake roller arm or brake shaft it is not necessary that the brake band and cable guard first be removed. The first step in removing the roller arm is to release the clamp bolt at the upper end of the roller arm.

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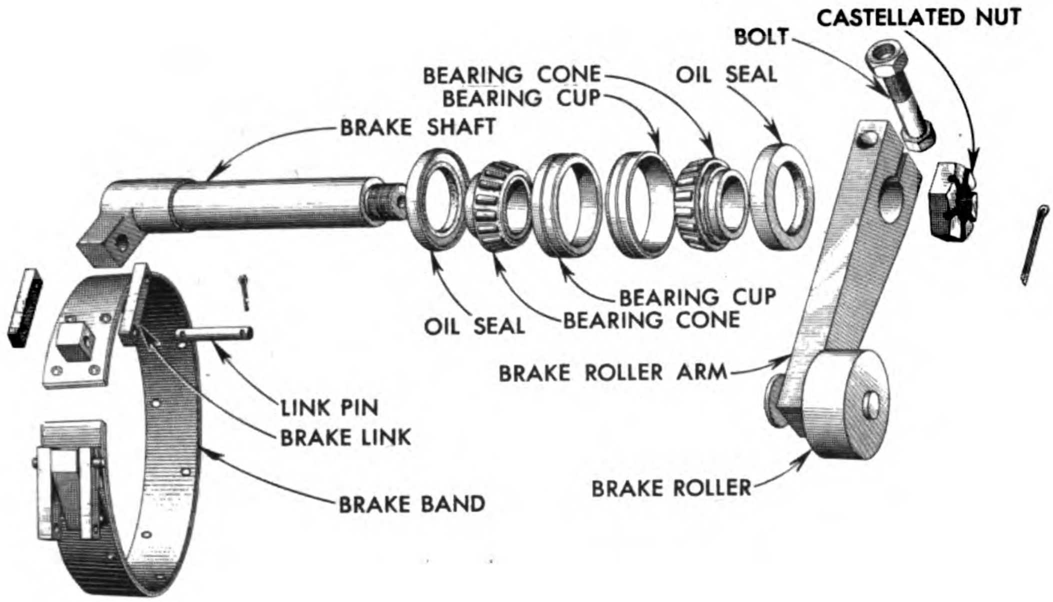
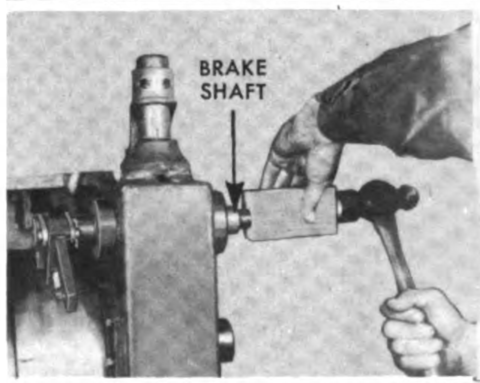
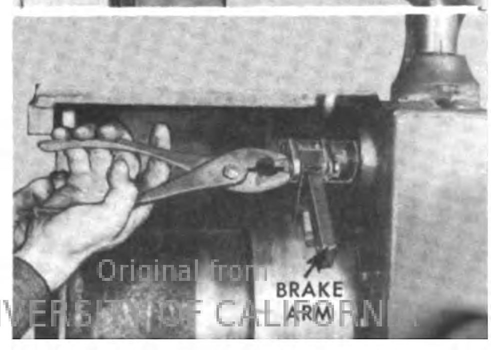


6. Remove the cotter pin and then turn castellated nut off the end of the brake shaft. The roller arm can now be slipped off the front end of the brake shaft.



7. If the brake shaft is to be removed, drive it out of the gear case, using a wooden block and hammer or pry bar. The rear bearing cone and oil seal can then be removed from shaft and the front bearing cone and oil seal from housing. If bearing cups are to be removed, pull them out of housing.



8. The spring arm can be removed from the brake shaft by removing link pin.

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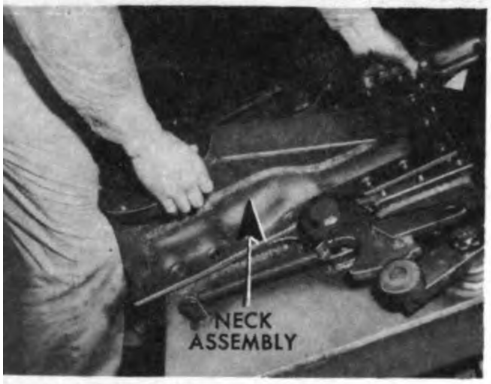

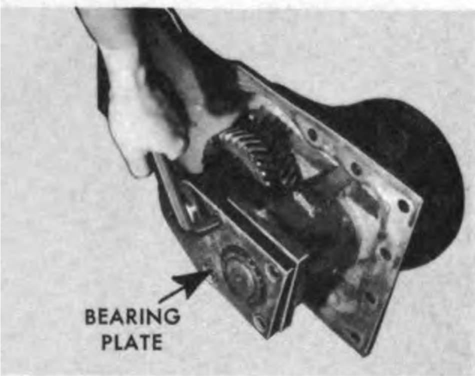

REMOVING ADAPTOR NECK FROM POWER CONTROL UNIT GEAR CASE

To remove the adaptor neck from the Power Control Unit gear case, first remove the Power Control Unit from the Tournapull. (Refer to instructions for removing Power Control Unit from Tournapull.) Then proceed as follows:

1. Remove capscrews which secure the neck to the gear case. (If the cable drum assemblies have not been removed from the Power Control Unit, loosen the clamp bolts at the rear of the drum shafts, insert a bar between the cable drums and rear plate, and pry the drum assemblies forward as far as possible, to permit the neck assembly to clear the main gears.)

2. Lower the neck enough to allow the bearing plate at the rear end of the pinion and reduction gear to pass under the main gears, and then remove the neck from the gear case.

DISASSEMBLING POWER CONTROL UNIT ADAPTOR NECK

1. Remove the four capscrews which secure the bearing plate to the neck and remove the plate.

2. Slide pinion and reduction gear to the rear far enough to allow the reduction gear to be removed.

3. Drive against rear end of pinion with wood block and hammer or sledge, forcing pinion, bushing, bearing and oil seal out through the hole in the face plate. Then drive or pull bearing, oil seal and bushing off pinion and remove bearings and bearing races from neck.

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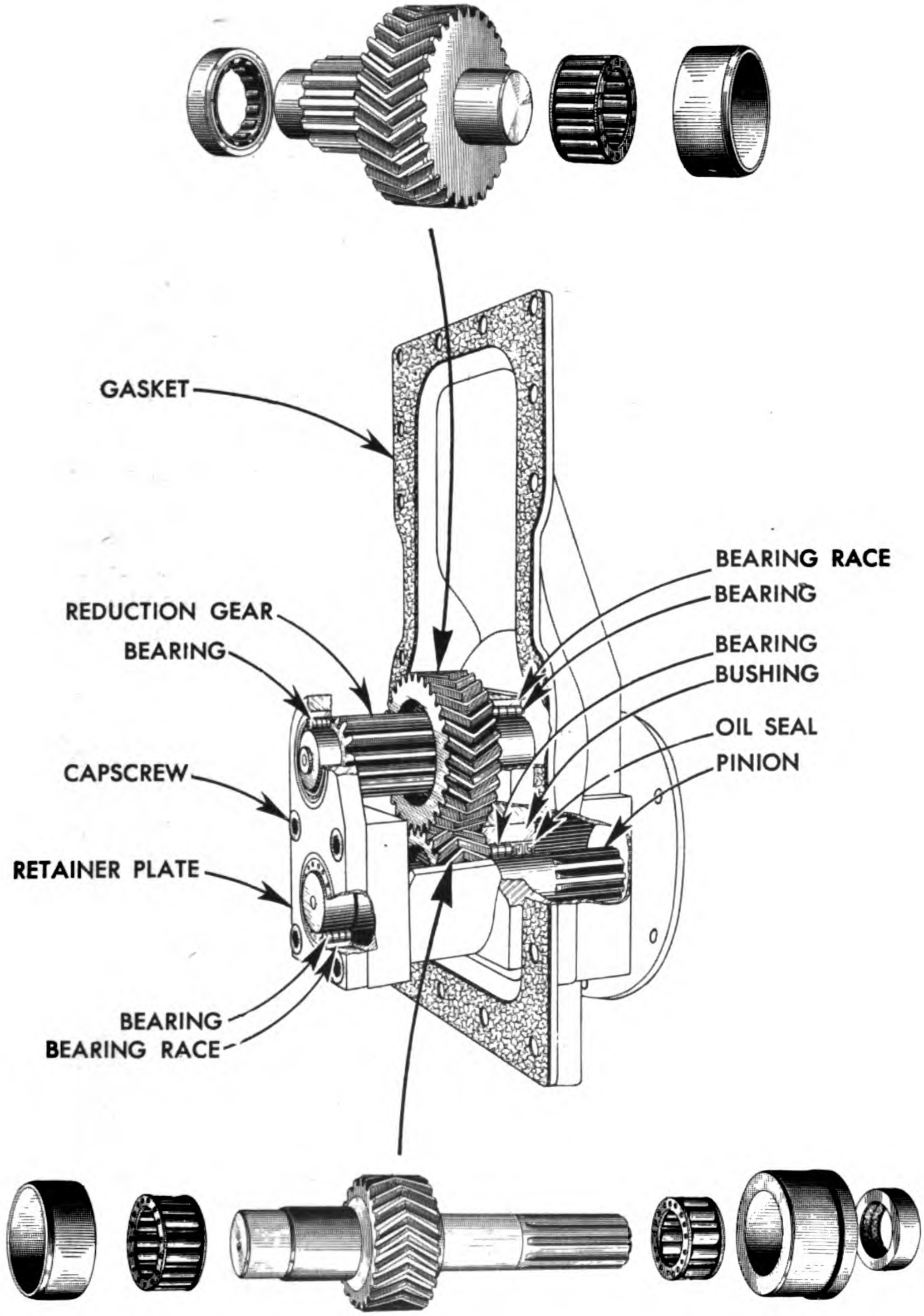

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INSPECTION OF PARTS FOR REPLACEMENT OR REPAIR

Before re-assembling the Power Control Unit the following inspection and care of parts should be made.

1. Carefully examine oil seals before re-installing. Replace any oil seals which do not appear to be in good condition.

2. Make new oil seals pliable by soaking in light weight oil and by running a round object, such as the shank of a screw driver or hammer handle, around the inner circumference of the seal, thus working the leather.

3. Replace all working parts that are worn excessively.

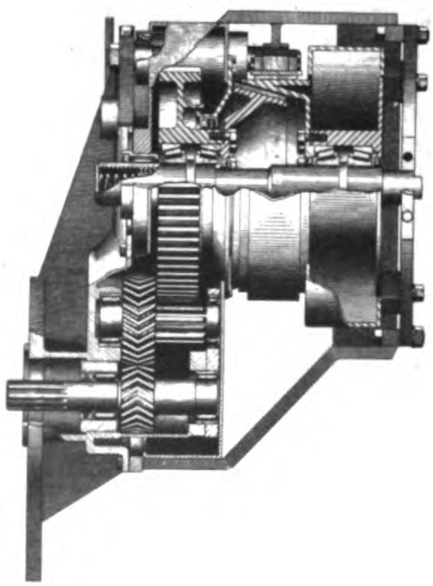
4. Examine bearings before re-installing. Use none that may have become Brinelled, pitted, or excessively worn.

5. Replace bearing cups when replacing bearing cones, and vice-versa.

6. Examine clutch and brake facings before re-installing driving cones or brake bands. Wash oil soaked woven facings with a suitable solvent. Roughen with a rasp, woven facings that have become glazed. Make sure facings are tight on driving cone or brake band before re-installing. If driving cone has been newly relined with metallic facing, the facing should be machined to 15° taper to take off any high spots.

7. Replace brake springs if they have become stretched and lost their tension.

8. Keep all parts clean and free from foreign particles during assembly.



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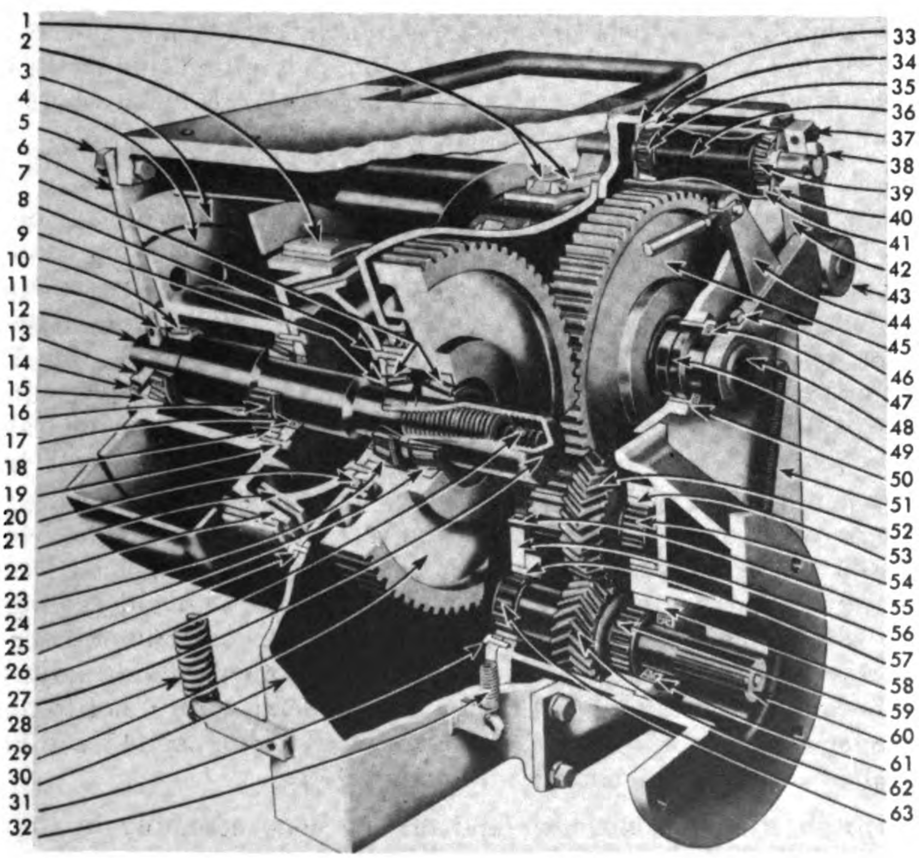
ASSEMBLING POWER CONTROL UNIT

The procedure for assembling the Power Control Unit is the reverse of that for disassembling the Unit. (Refer to disassembling instructions.)

The parts can be assembled in the following order:

BRAKE ASSEMBLIES

Install bearing cone (35) and felt seal (33) onto rear end of left brake shaft (36), if removed. Also press bearing cups (41 and 34) into front and rear ends of housing. Then insert brake shaft (36) through housing from the rear and install remaining bearing cone (39) and felt seal (40) over front end of shaft, up against the bearing cup. (*Note*: During assembly, the brake shaft bearings should be handpacked with lubricant, as outlined in Lubrication Instructions in the Operation Section.) Install clamp bolt and lockwasher (37) at upper end of brake roller arm (42) and install roller arm on end of brake shaft (36). Install castellated nut (38) onto threads on end of shaft and tighten nut to point where all end play of shaft is eliminated, but without drag on the brake shaft bearings. Then install cotter pin in end of shaft, thereby locking nut (38), and tighten clamp bolt (37) in upper end of roller arm (42).



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Install the right brake shaft in a like manner.

The right brake band (2) and similar left brake band are installed later during cable drum installation. Also, the right brake spring (28) and similar left brake spring (not shown in the illustration) are usually installed later, when the unit has been completely assembled.

CLUTCH THROW-NUT BUSHINGS, BEARINGS AND OIL SEALS

If left throw-nut bushing (50) has been removed from gear case, press or drive replacement bushing into case. Insert bearing (49) inside bushing. Do not install oil seal (47) in bushing (50) until after main gear and driving cone assembly has been installed and the main gear bearing adjustment made.

Install the right throw-nut bushing, bearing and oil seal in a like manner.

MAIN GEAR AND DRIVING CONE ASSEMBLIES

Press or drive bearing cones (7) onto clutch throw-nut (27), if removed. Also press bearing cup (24) into hub of main gear (29). Raise main gear into position in gear case. Insert throw-nut (27) into gear hub from rear, with end of throw-nut extending out through throw-nut bushing. Install remaining bearing cup (23) in gear hub from rear, not drawing cup up tight against bearing cone until later. Press oil seal (20) into cover plate (25) with heavy leather cupped toward inner side of plate. Then install gasket and cover plate (25) in position, lining up dowel pin holes with dowel pins, and install capscrews and lockwashers which secure cover plate to gear case (30).

(Be careful not to damage or reverse leather in oil seal (20) when installing cover plate.) Press oil seal (9) into hub of driving cone (21) with leather cupped toward front side of cone. Raise driving cone (21) into position against hub of main gear (29), inserting between the two the number of shims required to correctly adjust the main gear bearings (refer to main gear bearing adjustment instructions in the Repair Section) and install capscrews and lockwashers (8), turning them up tight. (When installing driving cone on gear hub, it is advisable to insert two ½″ stud bolts in opposite capscrew holes in gear hub to serve similar to dowel pins, in order to assure proper alignment of the cone on the gear. The studs should be removed after the cone has been secured to the gear and capscrews installed in their place. Use care when installing the driving cone on the gear hub, to avoid peeling off a burr which might become deposited between the gear hub and cone and thereby cause misalignment) After the main gear bearing adjustment has been made, install oil seal (same as 47), being careful not to damage or reverse leather in oil seal. The brake cam (same as 44) can now be installed on the front end of throw-nut (27).

Install the left main gear and driving cone assembly in the same manner.

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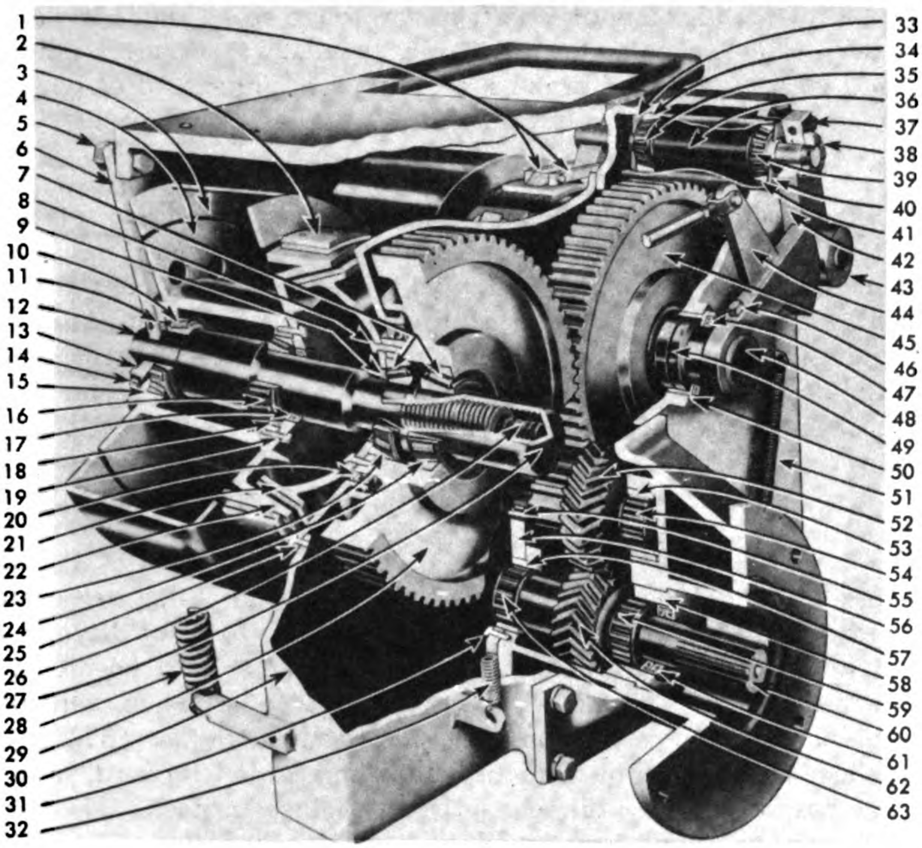

ASSEMBLING CABLE DRUM ASSEMBLIES

Press bearing cones (10 and 16) onto drum shaft (12), if removed. Also press bearing cup (15) into rear end of cable drum (4). Insert drum shaft into cable drum from front end and install remaining bearing cup (18) in cable drum from front end, not installing it tight against bearing cone until later. Place clutch driven cone (22) in position against cable drum (4), inserting between the two the number of shims required to correctly adjust the cable drum bearings (refer to cable drum bearing adjustment instructions), and install capscrews and lockwashers (19), drawing them up tight. After cable drum bearing adjustment has been made, install oil seal (17) in front end of cable drum, and oil seal (11) in rear end of cable drum, with leathers cupped inward, being careful not to damage or reverse leather in oil seals. (NOTE: During assembly, the cable drum bearings should be packed with lubricant, as outlined in Lubrication Instructions in the Operation Section.) Insert spring (26) in end of drum shaft (12).

The left cable drum assembly can be assembled in the same manner.

INSTALLING CABLE DRUM ASSEMBLIES

Raise drum assembly up to rear end of gear case and turn drum shaft (12) into clutch throw-nut (27) using a wrench on rear end of shaft. (Be very careful in this operation not to damage leather in oil

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seal (9) as threads on end of shaft pass through seal.) Slide brake band (2) over cable drum and onto driven cone (22). Connect outer end of band with rear end of brake shaft (36), and inner end of band with lug on gear case by means of brake links and pins (same as 1).

Install left cable drum assembly in a like manner.

If the cable guards (3) have been removed from rear plate (6), reinstall by inserting between the two any shims that were removed and installing the capscrews and lockwashers which secure the cable guard to the rear plate. Install cable guards and rear plate as one unit by sliding over cable drums and fasten rear plate to gear case by inserting capscrews and lockwashers (5) in top and bottom of rear plate. Then install cap (13) on drum shaft (12) by turning capscrews (14) into tapped holes in rear plate.

ASSEMBLING NECK ASSEMBLY

Insert pinion (60) into neck from the front end. Slide bearing (59) over front end of pinion, back against pinion gear. Press or drive bushing (58) into place in neck. Press bearing race (53) into position. Also install bearing (54) on end of reduction gear (52). Then, with pinion moved as far to the rear as possible, place reduction gear (52) in mesh with the pinion and slide reduction gear and pinion forward, into their correct positions. Press oil seal (61) into place in neck. Then install bearing race (57) and bearing (63) in position in lower end of bearing plate (56), and also install bearing (55) in position in upper end of bearing plate. Then place bearing plate (56) in position against neck and install capscrews (31), turning capscrews up tight. The neck can now be installed in position on the Power Control Unit gear case.

INSTALLING NECK ASSEMBLY

When attaching the Model T Power Control Unit neck assembly to the gear case, provision must be made to prevent the rear pinion bearing from slipping off the end of the pinion. The following method may be used in holding this bearing in place while the assemblies are put together.

A wooden wedge is driven into the neck from the front, between the pinion and the bore. This wedge places a load on the bearing and holds it in place. After the neck is assembled, the bearing is held in place by the case, and the wedge can be removed.

Move the Power Control Unit main gears toward the front of the gear case to install the neck assembly. Raise the neck to bring the reduction gear into mesh with the main gear after the neck has been positioned against the case. Then install the capscrews and lockwashers which secure the neck in position against the case.

Adjust the Power Control Unit clutches and brakes after the unit has been installed on the Tournapull.

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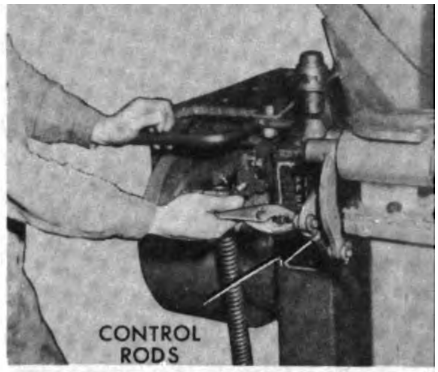
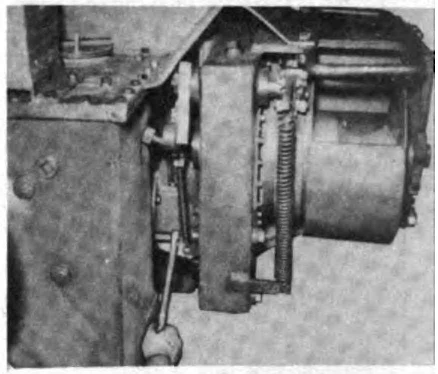
REMOVING POWER CONTROL UNIT

To remove the Power Control Unit from the Tournapull, follow the procedure below.

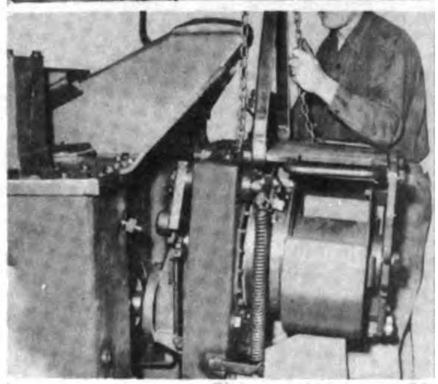
1. Lower the oil level in the Tournapull main case below the Power Control Unit face plate opening. Disconnect the Power Control Unit control rods and secure a hoist chain to the Power Control Unit.



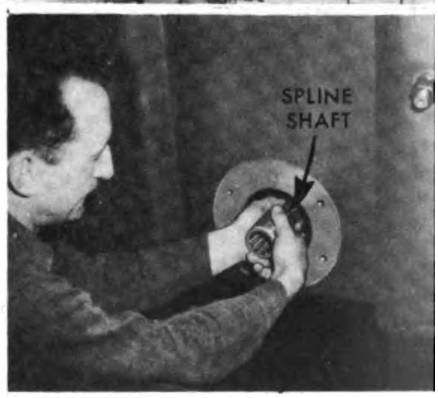
2. Remove the bolts which secure the Power Control Unit to the deck plate. Also remove the capscrews which secure the Power Control Unit face plate to the rear of the Tournapull case.



3. The Power Control Unit can now be removed from the Tournapull by moving it a short distance to the rear, far enough for the spline shaft to clear the Power Control Unit pinion, and then lifting it away from the rear of the Tournapull.



4. The Power Control Unit spline shaft can now be removed by pulling it off the rear of the transmission countershaft.



INSTALLING POWER CONTROL UNIT

To install a Power Control Unit on the Tournapull, simply reverse the above instructions for its removal.

In installing the Power Control Unit it may be necessary to place the transmission in gear and then rotate the countershaft and spline shaft by touching the starter button in order to cause alignment of the splines on the pinion and spline shaft.

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ADJUSTMENTS

CABLE DRUM BEARING ADJUSTMENT

Occasional adjusting of the Power Control Unit cable drum bearings is necessary because of bearing wear.

Check the cable drum bearing adjustment every 256 hours of operation.

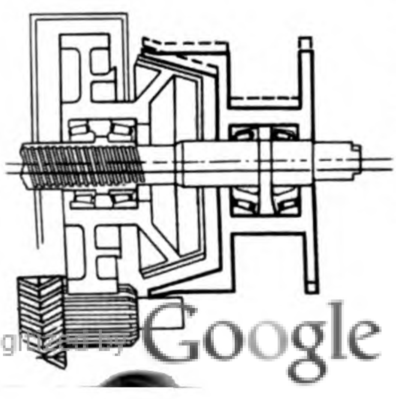
HOW TO CHECK ADJUSTMENT

To check the adjustment insert a pry bar between the rear plate and cable drum, and firmly engage and disengage the clutch while prying against cable drum with the bar. If the drum bearings are loose the cable drum will move back and forth on the drum shaft, and the end of the bar will also move. The "feel of this movement will be very noticeable to the one holding the end of the bar.

If movement is noticeable, the bearings are loose and an adjustment should be made. For a more accurate check, clamp a dial indicator against cable drum, and repeat above operation, noticing end movement as recorded on indicator.

IF BEARINGS ARE LOOSE

If the Unit should be operated with the bearings in either cable drum in a loose adjustment, the cable drum and clutch driven cone would assume an off-center position on the drum shaft and would be in misalignment with the clutch driving cone, as shown in the drawing, thus causing spongy, erratic clutch action. With loose bearings, the driven cone might move to the front or rear with the driving cone as the control lever is moved, thereby preventing proper releasing of the clutch, and causing the throw of the control lever to be increased, possibly resulting in the throw of the control lever being too great for efficient operation. It might also cause the driven cone to drag on the driving cone when the control lever is in neutral position, resulting in over-heating of the clutch, which in turn might cause oil seal leakage due to hardening of the leather in the seals. Also, loose cable drum bearings might result in cable breakage, due to a delay in quick clutch disengagement.



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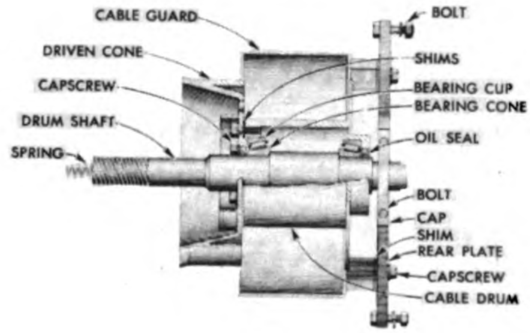
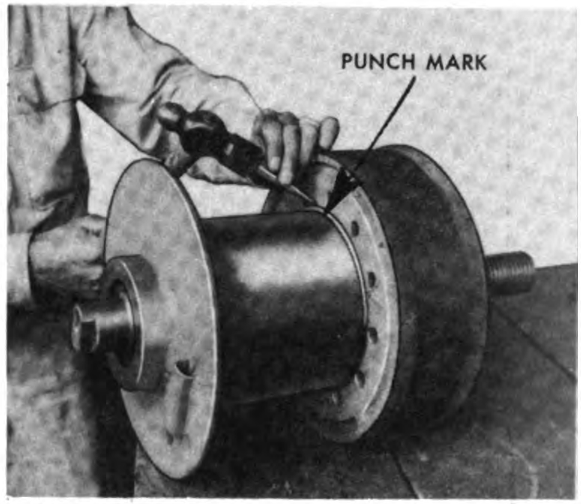


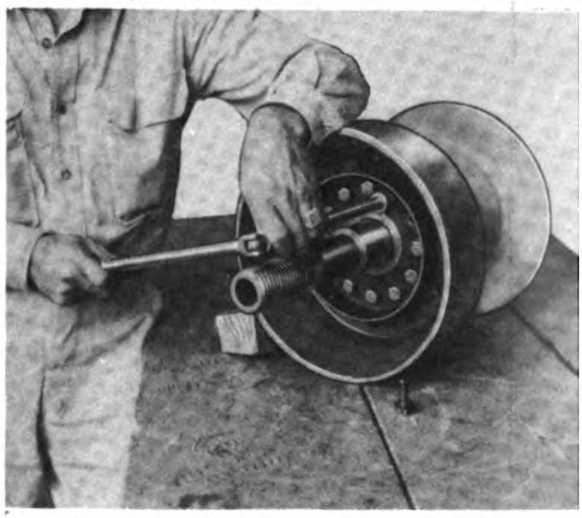
HOW TO MAKE ADJUSTMENT

To make cable drum bearing adjustment first remove cable drum assembly from Unit. (Refer to disassembly instructions on Page 267 of the Repair Section). Then proceed as follows:

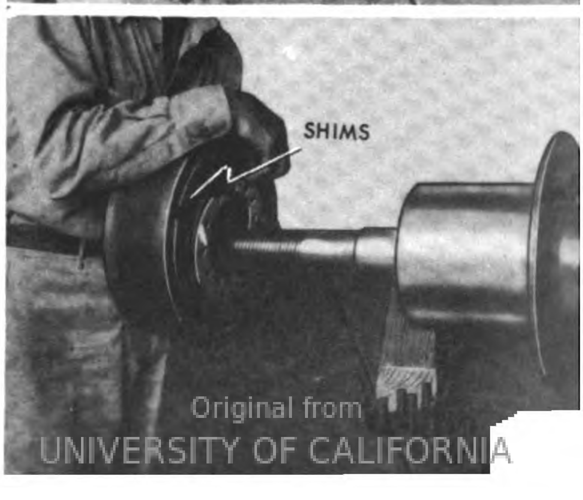
1. With hammer and center punch mark cable drum and driven cone at points illustrated in order to assure proper alignment when reassembled.



2. Remove capscrews which secure driven cone to cable drum. Then slide driven cone off drum shaft, being careful not to damage oil seal.



3. Remove bearing adjusting shim (or shims) from between driven cone and cable drum to take up adjustment. (Shims are of two thicknesses, .004" and .007", in order to make possible a fine variation in adjustment.) Remove shims one at a time in making adjustment.



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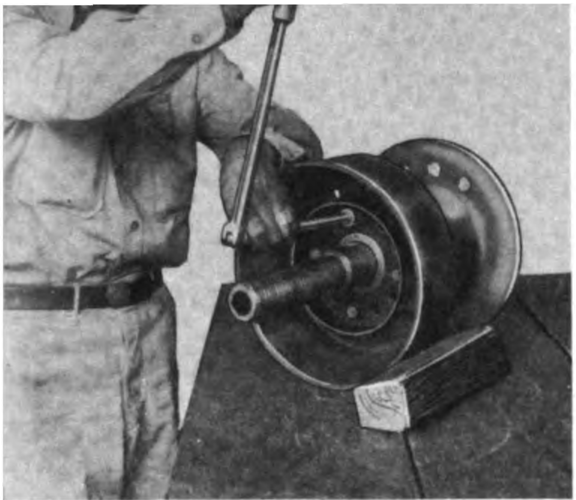

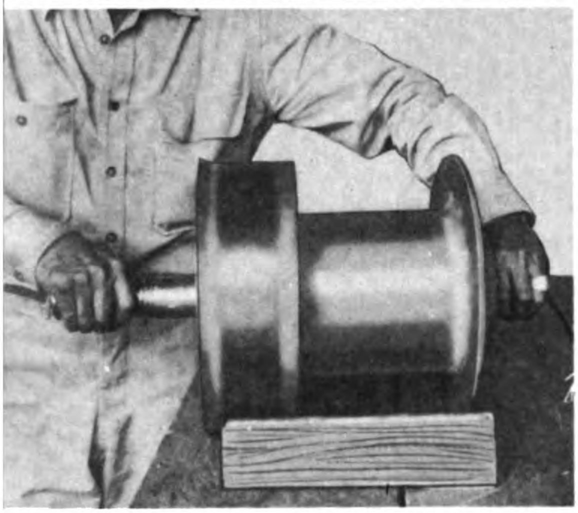

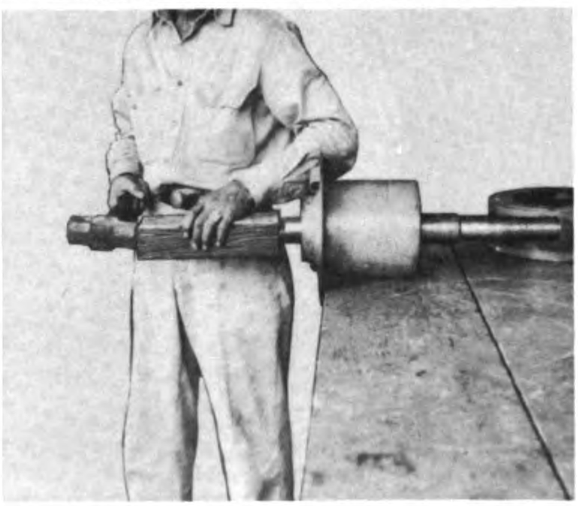

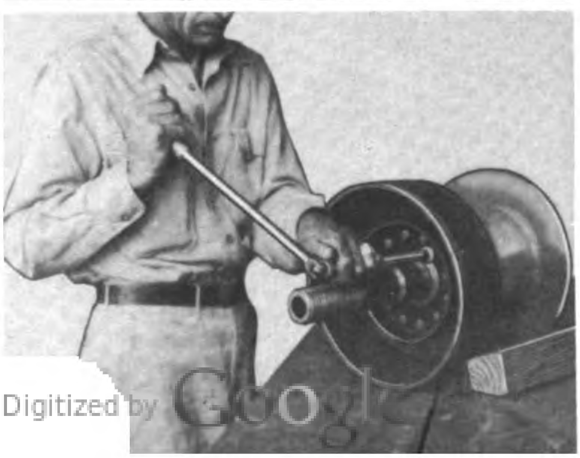

4. Reinstall driven cone on cable drum, lining up center punch marks on cone and drum. (This operation is done only to determine bearing tightness. Therefore, it is only necessary to install capscrews in every third capscrew hole. Do not use lockwashers in this operation due to damage to washers.) Turn capscrews up tight. If new oil seals are to be installed leave them out until after the following test has been made.

5. Test adjustment by turning drum shaft in cable drum, using both hands. If adjustment is correct there will be a definite drag on the drum shaft during this operation. Unless there is a noticeable drag on the drum shaft the bearings are still loose and another shim must be removed. Repeat the above operation until the correct adjustment is reached.

6. In event the bearings are drawn up so tight in the above operation that the drum shaft cannot be turned by hand, it will be necessary to again remove the driven cone and then drive against the short end of the drum shaft, using a wooden block and sledge, thereby freeing the bearings. Then add one .004" shim and repeat operations 4 and 5.

7. When correct adjustment is reached, install capscrews and lockwashers in driven cone, drawing them up tight. If oil seals have been omitted or if release spring has been removed from end of drum shaft, install them in place. Then reinstall drum assembly in Unit.

Note: The cable drum bearings should be hand-packed with lubricant whenever the drum assembly is disassembled. This should therefore be done when making the above adjustment. (Refer to Power Control Unit Lubrication instructions in Operation Section.

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MAIN GEAR BEARING ADJUSTMENT

Occasional adjusting of the main gear bearings is necessary because of bearing wear.

Check the main gear bearings for looseness every 256 hours of operation.

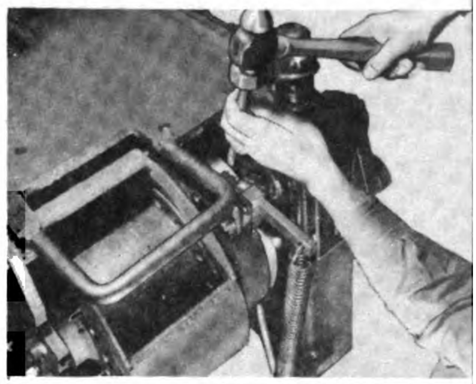
HOW TO CHECK ADJUSTMENT

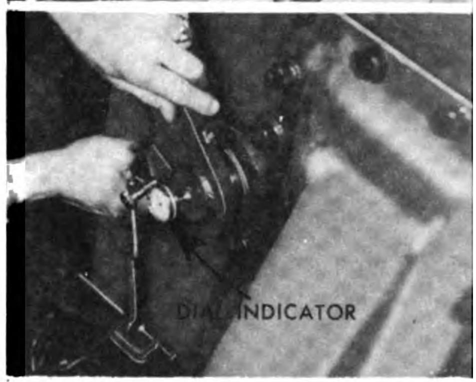
1. Fully engage clutch, using considerable force on control lever. With clutch engaged, wedge driving cone tightly into driven cone by driving two chisels or wedges between driving cone and cover plate on opposite sides of cone. Also disconnect neutral position spring.

2. If dial indicator is available, clamp indicator to unit with the contact point bearing against end of clutch throw nut at center. Move control lever or brake cam slowly out of fully engaged position, back toward neutral, using little force. In other words, take up only the free travel of the control lever. (Check to make sure driving cone is not moving in and out by placing finger between driving cone and cover plate with which to feel any movement.) While moving lever or brake cam back and forth, check reading on indicator. If bearings are loose, throw nut will move in and out and indicator will show within approximately .002″ amount bearings are loose. (As much as .002″ of movement may not be due to loose bearings.)

3. If indicator is not available, fully engage clutch and drive wedges behind cone as in Step 1. Scribe a mark part way around clutch throw nut with a sharp tool such as a knife. (Mark should be right up against throw nut oil seal. Then move control lever or brake cam as in Step 2, while closely watching mark on throw nut. If bearings are loose, throw nut will move in and out and this movement will be visible to the eye when watching mark. The amount of movement determines extent to which bearings are loose.

If dial indicator shows an end movement of as much as .005″ (Step 2), or if there is visible end movement of mark (Step 3), an adjustment should be made.





IF BEARINGS ARE LOOSE

If the Power Control Unit should be operated with the gear bearings in a loose adjustment, the driving cones may become misaligned with driven cones, thus causing spongy, erratic, clutch action. Also, the driving cones may "hang-up" in the driven cones when disengaging the clutches, resulting in cable breakage. In addition, the clutch cones may drag when in neutral position, resulting in over-heating of the unit. This in turn may cause oil seal failure.

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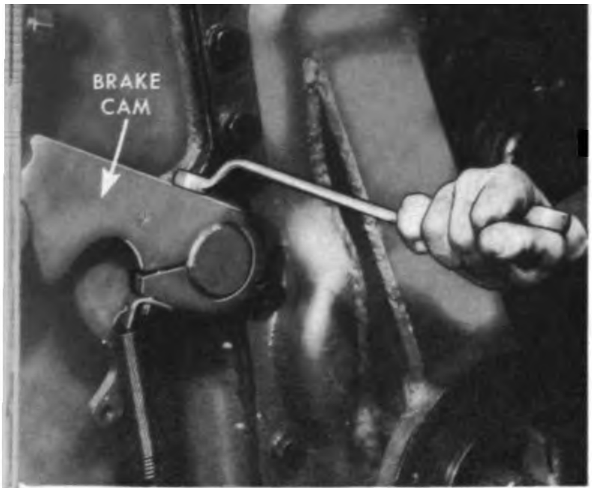
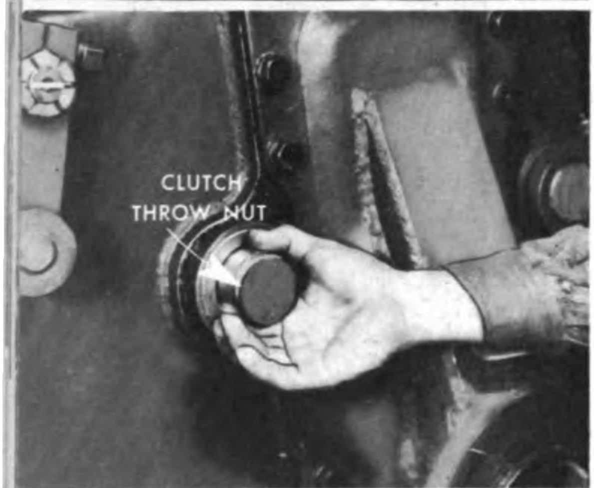
HOW TO MAKE MAIN GEAR BEARING ADJUSTMENT

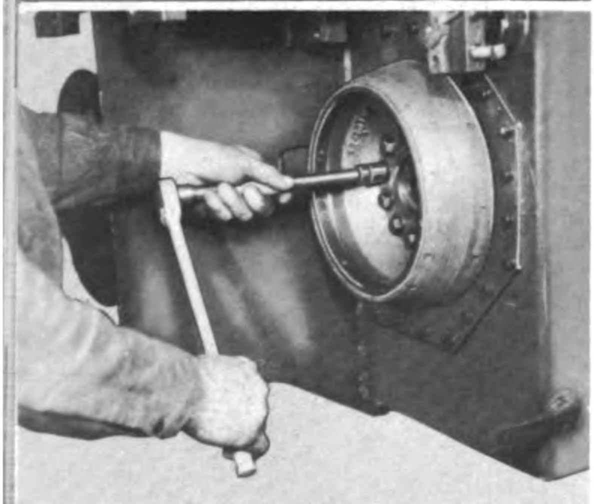


To make main gear bearing adjustment first remove cable drum assembly from unit. (Refer to disassembly instructions on page 268 of Repair Section). Also remove neutral position spring from lower end of brake cam. Then proceed as follows:

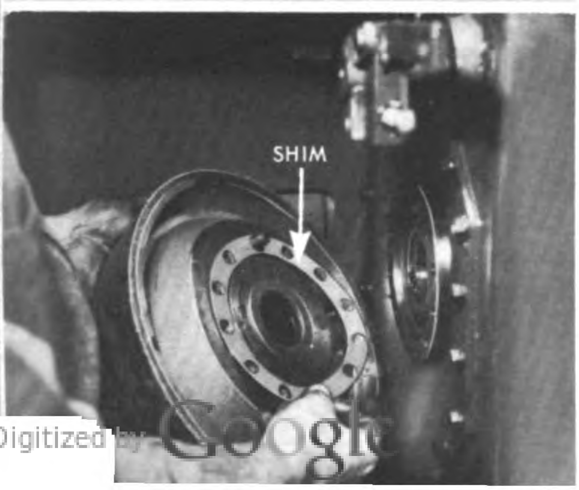
1. Remove brake cam from clutch throw nut.



2. Turn clutch throw nut by hand in order to feel amount of drag on throw nut caused by oil seals. (If bearings are loose, the only drag on throw nut will be from oil seals and this will be very little.)



3. Remove capscrews which secure driving cone to hub of main gear. Then remove driving cone.



4. Remove bearing adjusting shim (or shims) from between driving cone and gear hub in order to take up adjustment. (Shims are of two thicknesses, .004″ and .007″, in order to make possible a fine variation in adjustment.) Remove shims one at a time in making adjustment.

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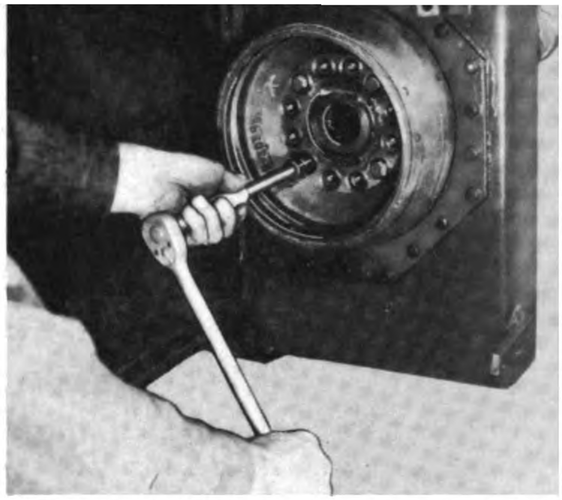
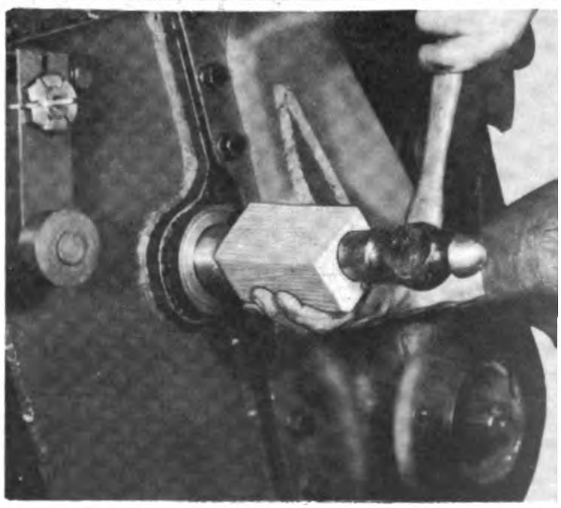
5. Re-install driving cone on gear hub. (This operation is done only to determine bearing tightness. Therefore, it is only necessary to install capscrews in every third capscrew hole. Do not use lockwashers in this operation due to damage to washers.) Turn capscrews up tight.

6. Check bearing tightness by feeling the drag on the throw nut as in Step 2. The bearings are correctly adjusted when all end play of the throw nut in the gear hub has been eliminated, without the bearings causing a heavy drag on the throw nut. (The drag may be slightly more than that caused by oil seals alone, as felt in Step 2, but should not be great enough to prevent the throw nut from being turned with one hand.) In event the bearings are drawn up so tight in the above operation that there is a heavy drag on the throw nut, it will again be necessary to remove the driving cone and then free the bearing as follows:

7. If unit is removed from Tournapull, free the bearings by driving against front end of throw-nut, using wood block and sledge. If unit is installed on Tournapull, move throw-nut to the rear in the gear case as far as possible, and then insert a wood block between front end of throw-nut and rear of Tournapull. Then drive against gear hub from the rear to free the bearing, using a wood block and sledge to avoid marring face of gear hub. Readjust bearings by adding one .004" shim and repeating operations 5 and 6.

8. When correct adjustment is reached, install capscrews and lockwashers in driving cone, drawing them up tight. Examine oil seal in hub of driving cone and replace if necessary. Then re-install drum assembly, cable guards, and rear plate.





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BRAKE ADJUSTMENT

The Power Control Unit brake adjustments are of a type which can be taken care of by operators. For instructions refer to Operation Section.

CLUTCH ADJUSTMENT

The Power Control Unit clutch adjustments are of a type which can be taken care of by operators. For instructions refer to Operation Section.

BRAKE SHAFT BEARING ADJUSTMENT

The Power Control Unit brake shaft bearing adjustments can be taken care of by the operators. For instructions refer to Operation Section.

LUBRICATION

Refer to the Operation Section for complete lubrication instructions.

CLUTCH AND BRAKE FACINGS

TYPES OF FACINGS

LeTourneau Power Control Units may be equipped with either woven or metallic clutch and brake facings. Both types of facings used are of the highest grade, and both have a comparatively high co-efficient of friction. The metallic lining is especially resistant to wear, and ordinarily lasts somewhat longer than the woven lining.

CARE OF FACINGS

The clutch and brake facings usually require very little attention after having been properly installed. There are, however, a few things that can be done to the facings under certain conditions which help the operation of the Power Control Unit. There are also other practices which are sometimes resorted to which do not help the operation and which should be avoided, as discussed below.

(a) WOVEN FACINGS:

Woven facings must be kept free of oil if proper operation is to be expected. If oil or grease should leak onto the facings, the cause of this

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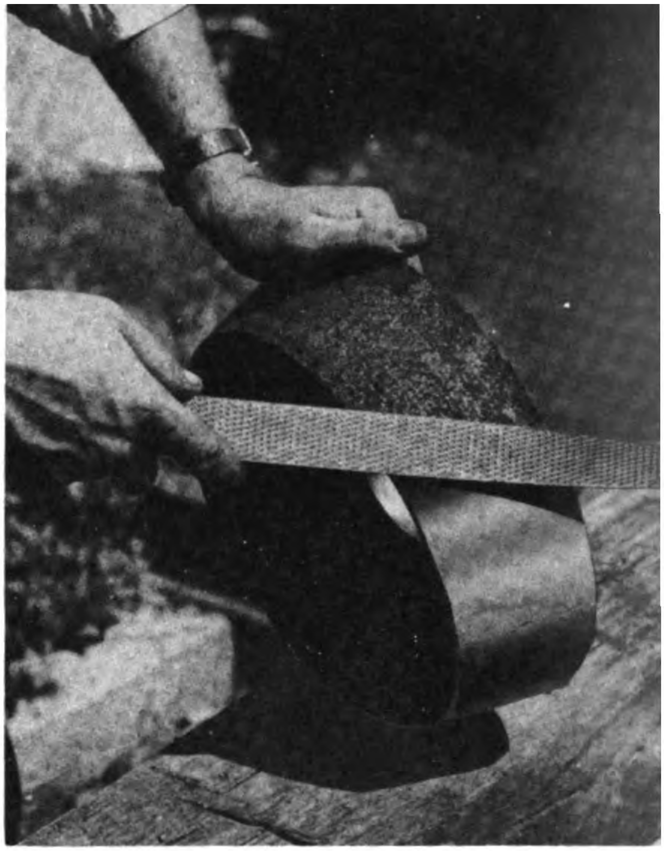

oil leakage should be determined, and the necessary corrections should be made. Unless the clutch and the brake facings are too badly oil soaked, the oil can usually be removed from the facing by washing the facing in a suitable solvent.

Facings sometimes become glazed after they have become worn, and in a case of this kind, the surface of the facings may be roughened with a rasp to improve operation, and to prevent having to replace the lining before it has received its maximum amount of wear.

If the clutch or brake facings overheat during operation do not pour water on them to cool them off. Instead, check the Unit and the operation to determine the cause of the overheating, and allow the lining to cool slowly by its contact with the air. Pouring cold water on a hot clutch will often cause the clutch cones to warp.

The most common causes of overheating of either the clutches or brakes are improper adjustment and slow engaging and disengaging of the clutch and brake by the operator.

(b) METALLIC FACINGS:

To obtain the maximum usefulness from metallic clutch and brake facings, a small amount of light weight oil, such as fuel oil, may be poured on them each day. This helps to keep the facings free from dust and other foreign particles, and makes for longer facing life.

(NOTE: It is recommended that if the clutch facings are metallic, the brake facings should also be metallic, and vice-versa. This is due to the fact that oil may be applied to one type facing but must not be applied to the other, and it is practically impossible to apply oil to either the clutch or brake facing without the oil also leaking onto the other.)

If either the clutch or brake should overheat during operation, do not pour cold water onto the facings to cool them off. Cold water applied to a hot clutch sometimes causes the clutch cones to warp. If overheating does occur, determine the cause, and make the necessary corrections. The most common causes of overheating of either the clutches or brakes are improper adjustment and slow engaging and disengaging of the clutch by the operator.

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RE-LINING CLUTCH DRIVING CONES

(a) WOVEN CLUTCH FACINGS:

To install a new facing on a driving cone, remove the cone from the Power Control Unit. (Refer to disassembly instructions.) Remove the worn facings and rivets from the cone. Proceed with the installation by heating the new facing either in hot water or in an oven, causing it to expand. Then place the facing on a bench with the smaller diameter on the bottom, or in an up-turned driven cone. Lower the unlined driving cone into the heated facing, making certain that the cone and facing are in perfect alignment with each other. Also, in doing this, line up the seam in the lining with the proper rivet holes in the cone, as illustrated.

Place the cone and facing under a press and force the cone tight into the facing. (If a press is not available, other means of exerting heavy pressure on the cone may be used.) Make certain that the cone is not obstructed from being pressed extremely tight in the facing because of coming in contact with the bench during this operation. (Other methods of installing the facings are also sometimes used with fairly satisfactory results, such as hammering the facing tight onto the cone, etc.) Check to determine whether the facing is tight on the cone by striking around the surface of the facing with a hammer. If the facing is tight, a clear "ring" will be heard. Any points where the facing is not tight will show up by giving off a dull noise with no "ring". Drill or punch rivet holes into the facing, making them line up with the rivet holes in the cone. Counterbore each rivet hole to a depth not less than half the thickness of the facing, and not more than 2/3 the thickness of the facing, using a 3/8" counterbore. Then insert the rivets and rivet the facing to the cone.

Unless the facing is installed exceptionally tight on the cone, spongy clutch action may result. If the facing should be installed eccentric and out of alignment with the cone, clutch drag will occur and the clutch will overheat.

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(b) METALLIC CLUTCH FACINGS:

Metallic clutch facings come in segments, shaped to fit the outer circumference of the driving cone, and with the rivet holes already drilled in them. To install the segments on the cone, merely line the holes in the segments up with the holes in the outer circumference of the cone, and rivet the facing to the cone. The rivets should be drawn down very tight in order to prevent the segments from breaking loose when the cone is placed in operation. Only steel rivets should be used.

If possible, the newly lined cones should be placed in a lathe and any high spots or irregularities in the thickness of the different segments machined off. (The facings should be machined to a 15° taper.)

If the clutch surface of the driven cone has worn rough or grooved, it may be advisable to either replace the cone or to machine a very thin cut off the surface of the cone. This machining should also be done on a 15° taper.

RE-LINING BRAKE BANDS

(a) WOVEN LINING:

To re-line a brake band with woven lining, first remove the brake band from the Power Control Unit. (Refer to disassembly instructions.)

Extend the brake lining around the inner circumference of the brake band, and rivet one end of the lining to the band. Push the lining snug against the band with the hand, around the entire circumference of the band. Then move the lining back about 1/4" at the unriveted end, and install the rivets at this end of the band. A small hump will be formed by the lining at the center of the band with this procedure, which should be forced down, causing the lining to be pressed very tight against the brake band. Then install the remaining rivets.

To install the rivets, drill or punch the rivet holes in the lining, and counterbore these holes to a depth of not less than 1/2 and not more than 2/3 the thickness of the lining to provide for the heads of the rivets. Use a 3/8" counterbore. Then install the rivets, clinching them down very tight.

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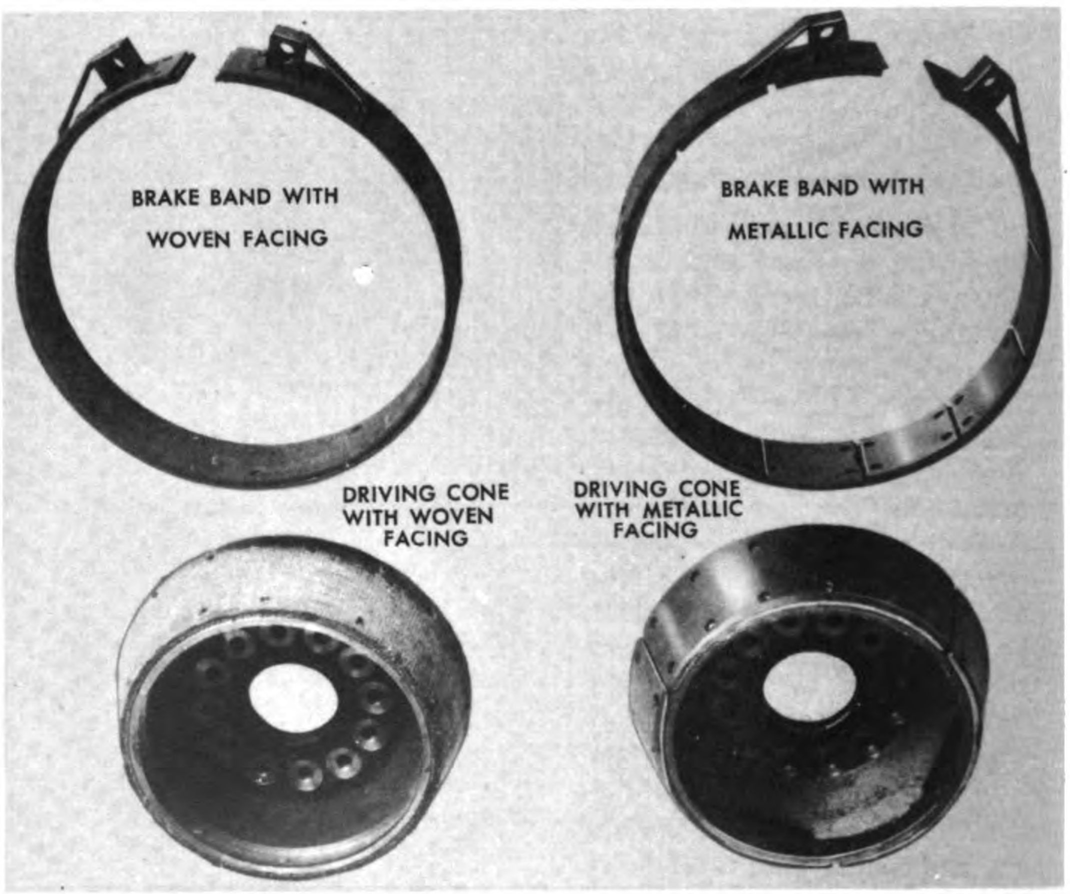
(b) METALLIC LINING:

To reline a brake band with metallic lining, first remove the brake band from the Power Control Unit. (Refer to Disassembly Instructions.) Remove the worn segments and rivets from the brake band.

To install the new segments, place them in position on the inner circumference of the brake band, line the rivet holes in each segment up with the corresponding rivet holes in the brake band, and rivet the segments to the band, using steel rivets. Draw the rivets up very tight in order to prevent the segments from breaking loose when the brake band is placed in operation.



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REPAIR SECTION

Part Four

The SCRAPER

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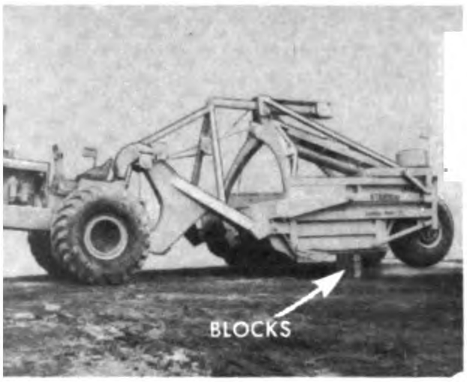
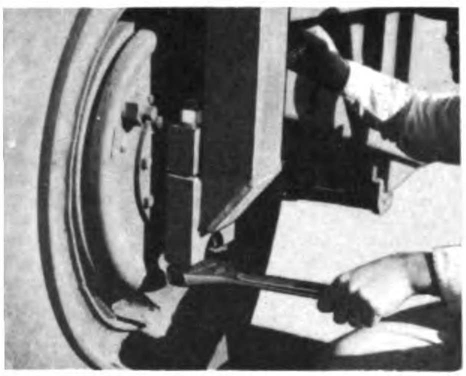
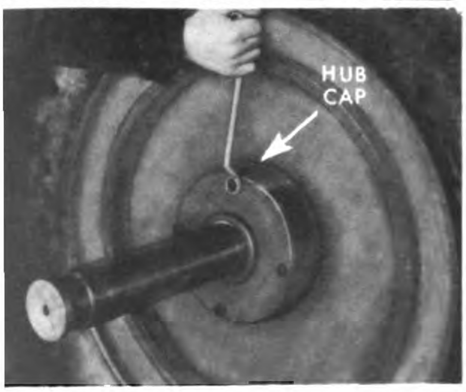
DISASSEMBLING SCRAPER

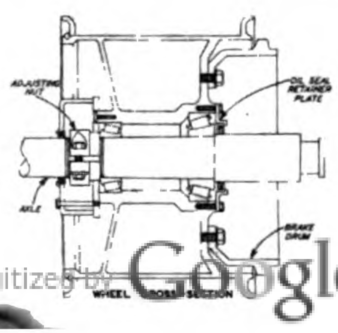
The instructions on the pages which follow give complete information needed for disassembling the Carryall Scraper. Instructions for disconnecting the Scraper from the Tournapull will be found in the Tournapull Repair Section.

REMOVING AND DISASSEMBLING REAR WHEELS









To remove the rear wheels from the Scraper, first raise the wheels off the ground. To do this, raise the blade and place blocks under the bowl just back of the balance point. Then lower the Scraper bowl. This will tip the front of the Scraper forward, raising the rear wheels.

Remove the wheel and axle assembly by removing the clamp blocks from the ends of the axles. Also remove the bolts connecting the brake anchor plate with the Scraper body, and disconnect the hydraulic brake tubing. Then hoist the Scraper bowl enough to lower the Scraper wheels to the ground and then enough more to permit the wheels to be rolled away from the Scraper.

To remove a wheel from an axle, first remove the hub cap from the inner side of the wheel and then loosen the adjusting nut clamp bolt and back off the adjusting nut. The brake backing-plate assembly can be slipped off over the outer end of the axle.

Proceed by removing the capcrews which secure the oil seal retainer plate to the outer end of the wheel hub. Then drive against the axle from the inner end, forcing the inner bearing cone off the axle. Remove the axle from the wheel hub. The remaining bearing cone can be removed from the axle and the bearing cups removed from the wheel hub if desired. If the brake drum is to be removed from the wheel, place corresponding marks on the drum and wheel to assure installation in the same position when re-installing.

NOTE: The procedure for removing and installing the rear tires is the same as that for removing or installing the front tires, as outlined in the Tournapull Repair Section.

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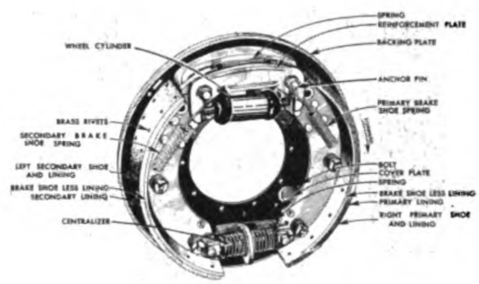
DISASSEMBLING AND SERVICING WHEEL BRAKES

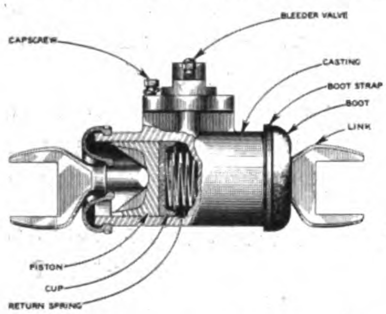
To disassemble a brake backing plate assembly, first remove the backing plate assembly from the axle as previously outlined, and then simply remove the bolts and pins connecting the various parts to the backing plate.



CAUTION: Prevent brake fluid from coming in contact with brake linings either by dripping or from soiled hands. Do not attempt to reline brakes—use only genuine Bendix replacement shoes.

SERVICING WHEEL CYLINDERS

The wheel cylinders have two opposed pistons. Each piston transfers hydraulic pressure into equal mechanical force, expanding the brake shoe to which it is connected into contact with the brake drum.



WHEEL CYLINDER

The cylinder has two boots to protect the internals from foreign matter, two pistons which are connected to the brake shoes, two cups which seal the cylinder, one spring, one inlet fitting which is the means of connecting the cylinder to the system, and one bleeder screw used in expelling air from the system.

After dismantling a wheel cylinder, inspect the following:

(a) If mineral oil is present in the system, the rubber cups will be enlarged and very soft. They cannot be used and it is necessary to discard.

(b) Cylinder walls must be smooth and not pitted nor scratched.

(c) Pistons must be free from burrs.

(d) Occasionally grease retainers become worn allowing grease from the wheel bearings to leak through into the brake drum. When grease comes into contact with the rubber boots they become soft and enlarged, preventing them from protecting the cylinder from foreign matter. If this occurs, replace boots and grease retainer.

Cylinder and parts must be washed in clean alcohol and dipped in hydraulic brake fluid (HB) before assembling. Do not wash cylinder or parts in gasoline, kerosene, or oil.

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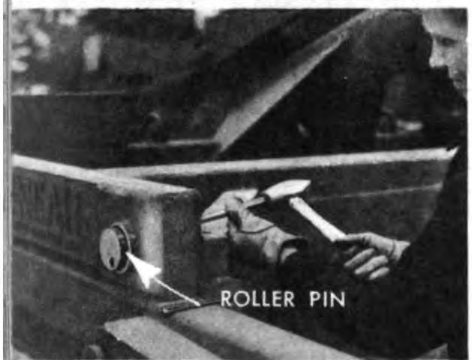
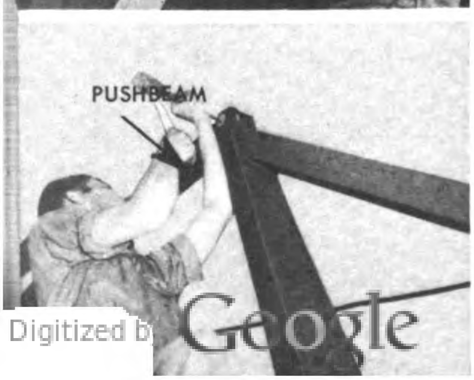
DISASSEMBLING SCRAPER





REMOVING SHEAVE WHEELS, BEARINGS, PINS, ETC.

To remove the sheave wheels, bearings, pins, etc., first remove cotter pin from end of the sheave pin, pull sheave pin out the side of the sheave housing and then remove sheave wheel from sheave housing. Then remove dust seals from hub of sheave wheel and slide sheave bearing out of hub.

REMOVING TAILGATE ROLLERS, BEARINGS, PINS, ETC.

To remove the tailgate rollers, bearings, pins, etc., first remove cotter pin or lock pin from end of roller pin. Pull roller pin out the side of the roller housing and remove roller, raising tailgate arm if necessary and then remove dust seals and bearing from roller.

Before removing the large rollers at the rear of the tailgate, it is first necessary to pull the tailgate ahead to the point where the rollers line up with the round holes in the sides of the Scraper bowl provided for the purpose of removing these rollers.

REMOVING FAIRLEAD SHEAVE HOUSINGS AND BEARINGS

To remove either of the fairlead sheave housings, first release the clamp bolt and remove the adjusting nut from the bracket in which the sheave housing pivots. Then remove the housing from the bracket and remove the bearing cones and cups.

REMOVING REAR HITCH

To remove the rear hitch, simply remove the bolts which secure the hitch to the rear of the main body structure.

REMOVING PUSHBEAM

To remove the pushbeam, first lower the Scraper onto blocks. Remove hoist cable from pushbeam and then remove pushbeam hinge pin by first removing cotter and then driving pin out of pushbeam. The pushbeam is now free to be removed from the Scraper by sliding it to the rear through the upper sheave housing at the top of the arched "A" frame.

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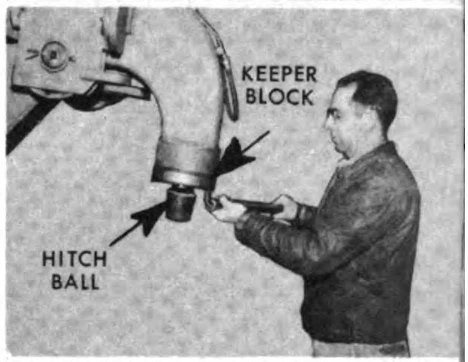
DISASSEMBLING SCRAPER

REMOVING YOKE

To remove the yoke, first disconnect the Tournapull from the Scraper as per instructions in Tournapull Repair Section. Also raise apron enough to clear head of yoke hinge pin and block apron in this position. Connect a hoist chain around top of yoke and raise yoke only enough to remove weight from yoke hinge pins. Remove cotter pins and castellated nuts from end of hinge pins and then remove pins. Then remove yoke from main body structure with a hoist.

REMOVING HITCH BALL FROM YOKE

To remove the hitch ball from the yoke, first disconnect the Tournapull from the Scraper as per instructions in Tournapull Repair Section. Then remove the capscrews which secure the hitch ball keeper block to the yoke, thereby freeing the hitch ball from the yoke. Avoid loss of shims.

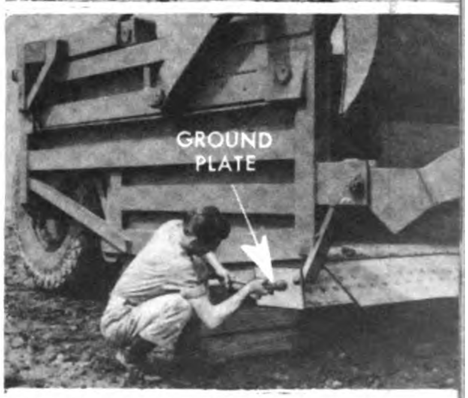


REMOVING BLADES

Raise Scraper bowl and place blocks under bowl to keep it from dropping. Also raise apron and place blocks between apron arms and side sheets to keep it from dropping. Then, using a blade wrench, remove the bolts that secure the blades to the blade base. (See "Changing Blades" in Operation Section for further details.)

REMOVING GROUND PLATES

To remove the ground plates, first block the apron arms and bowl in the raised position as when removing blades. Then remove the bolts which secure the ground plates to the Scraper side sheets. (See "Changing Ground Plates" in Operation Section for further details.)



REMOVING APRON

To remove the apron, first remove the apron cable, and wrap a hoist chain around the front of each apron arm. Then remove the apron hinge pins by first removing the lock screws from the head of each pin and then driving out the hinge pins. The apron is now free to be hoisted out of the Scraper.

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REMOVING TAILGATE RETURN SPRINGS FROM SPRINGPIPE

When removing the tailgate return springs from inside the springpipe, it is first necessary to compress the springs by placing a 4" x 4" x 72" block against the spring pull plate and the "A" frame at the top of the yoke, as was done in replacing the springpipe cable (see page 112 of the Operation Section). Remove from the spiral sheave the cable wedge that secures the springpipe cable to the spiral sheave. Then, with the Scraper bowl lowered, the 72" block in place, and the dead end cable wedge removed from the spiral sheave wheel, gradually raise the scraper bowl, thereby permitting all of the spring tension to be released. The springs can then be removed from the upper end of the springpipe.

REMOVING TAILGATE

Tailgates in Carryall Scrapers are very seldom removed. However, this can be done, as is outlined below.

To remove the tailgate, first disconnect the spiral sheave-to-tailgate cable at the cable wedge on the rear of the tailgate. In doing this, it is necessary to relieve the cable of tension by pulling tailgate forward a short distance and then inserting a bar through the pipe plug holes in the sides of the springpipe. Then release the Power Control Unit brake for the dump cable, moving the control lever into lock-out position. Due to the bar being inserted through the upper end of the springpipe, the springs cannot return the tailgate to the rear, so it is necessary to pry it a short distance to the rear, using a bar. The spiral sheave-to-tailgate cable can then be disconnected from the back side of the tailgate by removing the cable wedge.

Pull the tailgate forward to the position where the large rollers at the rear of the tailgate are in line with the corresponding holes in the sides of the Scraper. Then remove these large tailgate rollers and pins. Pull the tailgate to the front of the bowl and then remove the cable wedges which secure the cable to both sides of the tailgate. Tie hoist chains to both sides of the tailgate, straddling the springpipe. Then hoist the tailgate up under the springpipe as high as possible, and while hoisted, move the left side of the tailgate to the rear and the right side forward. Block up tailgate in this position and untie hoist chain from right side of tailgate. Now pass hoist chain under springpipe and again hook chain to right side of tailgate, leaving some slack in chain so that when tailgate is hoisted, the left side is hoisted first. Now hoist tailgate out of body, continuing to turn tailgate sideways while hoisting.

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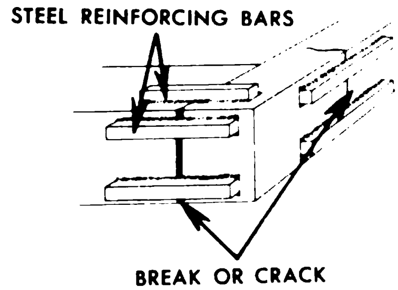
INSPECTION OF PARTS FOR REPLACEMENT OR REPAIR

Other than inspection and replacement of worn sheaves, rollers, bearings, oil seals, pins and other parts, practically the only type of repairs ever required on LeTourneau Carryall Scrapers are welding repairs.

If any welded member of a Carryall Scraper should crack or start to break through severe abuse, the Scraper should be stopped immediately and the crack welded up and reinforced before the damage becomes serious.

Only alloy steel should be used in reinforcing LeTourneau Scrapers and coated arc electrodes used in welding.

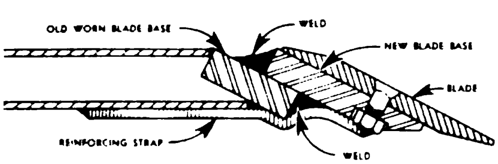
To correctly repair a break in a weld or a crack appearing on a boxbeam, first "V" out the old weld or crack and re-weld, filling the V'd out section with weld metal, flush with the surface of the boxbeam. Then reinforce the point of failure by placing steel bars across the break or crack as illustrated, welding them along both sides but leaving both ends unwelded.

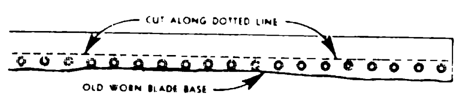


If, after a long period of operation, the blade base should become worn back through the bolt holes as a result of neglect to change the blades, a new blade base can be installed without difficulty if the procedure below is followed:

First, cut the worn blade base from one end to the other along the top edges of the bolt holes, as illustrated.

After having trimmed the old blade base, the new blade base may be laid on top of the old one, with the top edge flush with the scraper bottom. Clamp it in position with "C" clamps. Then weld it to the old blade base along both the top and the bottom edges as illustrated.





Install new blade base reinforcing ribs between the old ones, letting them extend down onto the new blade base. It will be necessary to heat and bend the new reinforcing ribs to make them fit around the old blade base and up against the new one.

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RE-ASSEMBLING

The instructions for re-assembling a Carryall Scraper are the reverse of those for disassembling.

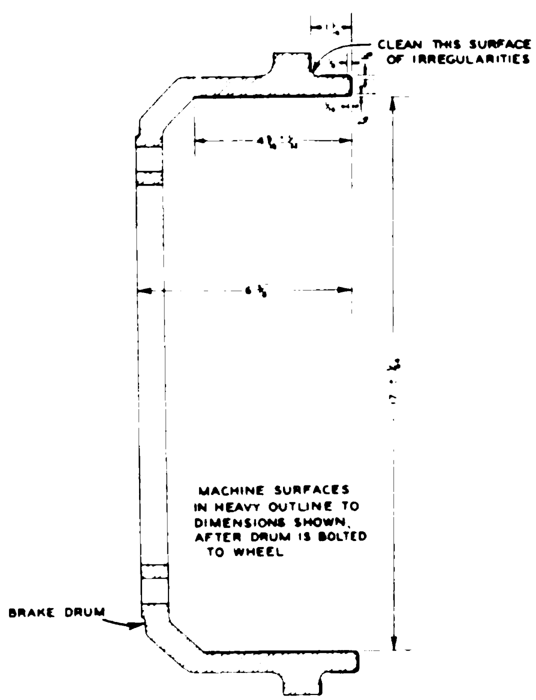
When re-assembling, keep all bearings and working parts free of dirt, grit, or other foreign matter. Do not replace bearing cups without also replacing bearing cones, and vice-versa.

Soak in oil any oil seals in which the leather has become dry and hard, before installing. Also, rub oil seal leathers with some smooth round object such as a hammer handle.

The wheel hub oil seals should be installed with leather cupped inward toward the grease chamber.

When installing the hitch ball in its socket in the yoke, use only enough shims between the keeper block and the yoke to eliminate up and down movement of the hitch ball in its socket. The hitch ball should be free to turn when the capscrews are drawn up tight.

For instructions for installing blades or ground plates, see "Changing Blades" or "Changing Ground Plates" in the Operation Section.



If installing replacement brake drums on the rear wheels, it is necessary that they be machined to run true with the wheel. First install wheel on axle and adjust wheel bearings. Then install brake drum in position on wheel. (Make sure there are no foreign particles between brake drum and wheel. Place wheel assembly in a lathe and machine drum to dimensions shown on accompanying drawing.

Lubricate all points of lubrication before placing the Scraper in operation. (Refer to lubrication instructions in Operation Section.)

During assembly, make all adjustments as outlined in the following adjustment instructions.

ADJUSTMENTS

There are three points of adjustment on the Scraper requiring attention at periodic intervals. These points of adjustment are the hydraulic brakes, wheel bearings, and fairlead sheave housing bearings. The hydraulic brake instructions are in the Operation Section, and the other adjustments follow.

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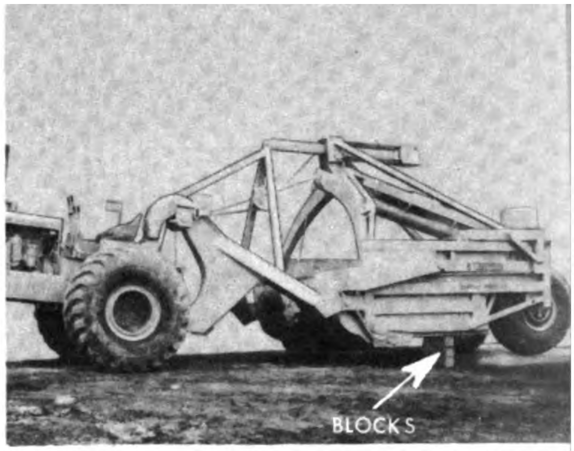
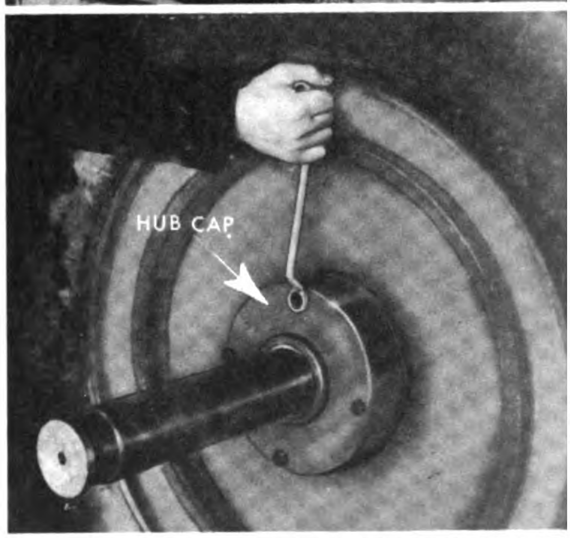
WHEEL BEARING ADJUSTMENT

Check the Scraper wheel bearings for looseness every 64 hours of operation.

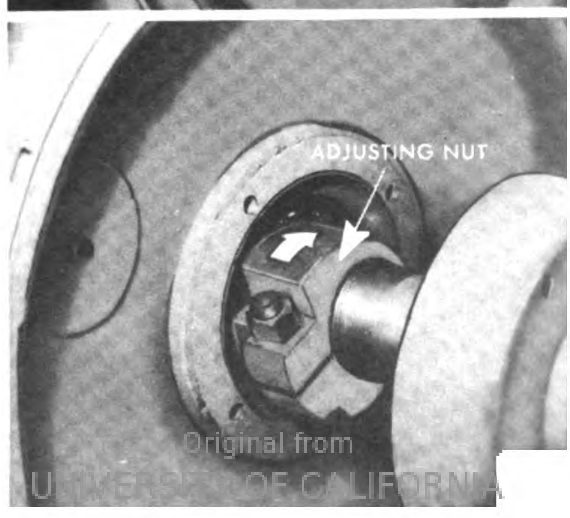


To check the wheel bearings, first raise the rear wheels off the ground. To raise the wheels, raise the bowl and place blocks under the bowl just back of the balance point. Then lower the Scraper bowl. This will tip the front of the Scraper forward, raising the rear wheel.

Insert a pry bar between the wheel and body structure (hydraulic brakes disengaged). Pry back and forth with the bar, noticing any movement of the wheel on the axle. If there is noticeable movement, the bearings are loose and an adjustment should be made.



To make the adjustment, first remove the capscrews which secure the hub cap to the inner side of the wheel and then slide the hub cap back on the axle, away from the wheel.



Start the wheel rotating slowly. While rotating, turn adjusting nut in a clockwise direction until wheel binds heavily. Then relieve binding by backing off adjusting nut ⅛ turn. Lock adjustment by tightening adjusting nut clamp bolt. Check adjustment by rotating wheel, making sure it is free rolling without noticeable end play. If adjustment is correct, re-install hub cap, being careful not to reverse grease seal when sliding it back over the axle.

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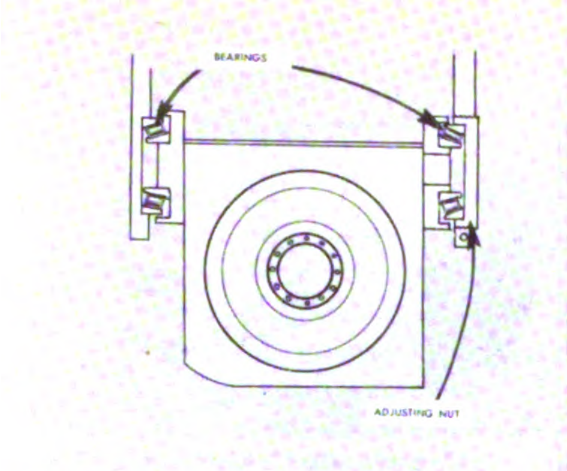
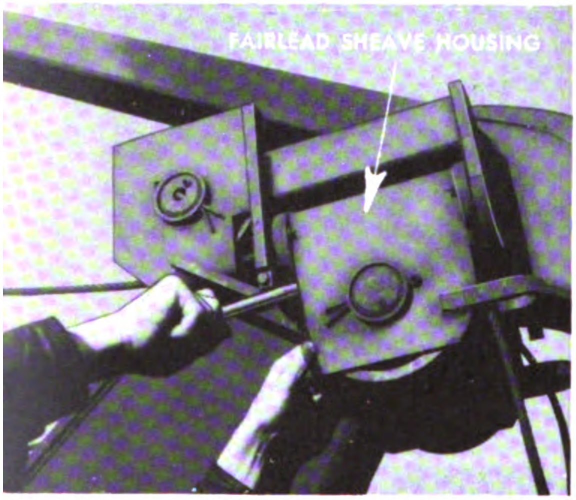
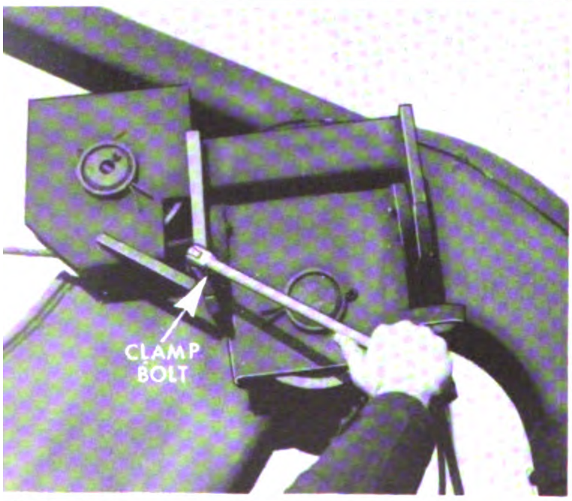
FAIRLEAD SHEAVE HOUSING BEARING ADJUSTMENT



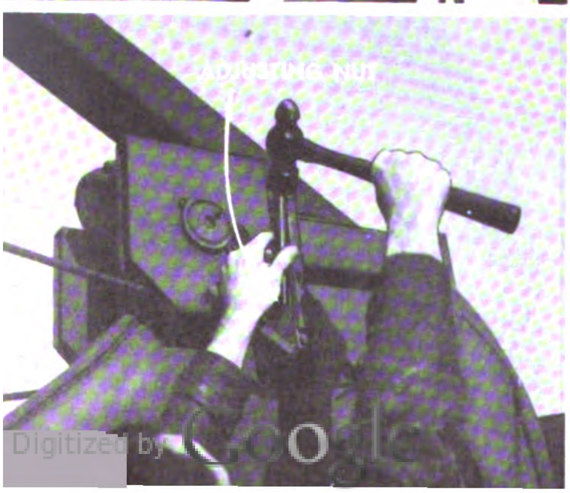
Check the fairlead sheave housing bearings for looseness every 128 hours of operation.



To check the adjustment, insert a pry bar between the end of the sheave housing and the bracket in which it is held. Then, by prying back and forth with the bar, detect any end movement of the housing in the bracket. If end movement is noticeable, an adjustment should be made.



To make the adjustment, first loosen the clamp bolt from the sheave bracket.



Turn the adjusting nut at the end of the housing in a clockwise direction until all end movement of the sheave housing in the bracket is eliminated and until a slight drag is felt when turning the sheave housing to either side by hand. Lock the adjustment by tightening the clamp bolt.

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REPAIR SECTION

Part Five

TABLE OF CLEARANCES AND TOLERANCES OF BEARINGS AND ADJUSTABLE PARTS

and

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TABLE OF CLEARANCES AND TOLERANCES

ENGINE

Intake and Exhaust Valve Clearances:

Cold engine . . . . Intake .015″
Exhaust .025″

Warm engine (just shut off) . . . Intake .012″ - .014″ with injector set
Exhaust .022″ - 0.24″ with injector set
(If injector is free, subtract .002″ from these clearances)

Water Pump Shaft . . . . Ball bearing mounted

All Timing Gears are Keyed to Shafts or
Ball Bearing Mounted Except Idler Gear

Idler gear clearance . . . . .002″ - .0035″

Lube Oil Pump Clearances:

Between shaft and bushing . . . . .005″ - .0017″

Between shaft and pump housing . . . . .001″ - .0025″

Between lubricating pump idler gear
and idler gear shaft . . . . .005″ - .002″

Side clearance between lubricating pump housing
and lubricating pump gears . . . . .001″ - .003″

Clearance between lubricating pump housing and
outside diameter of gear . . . . .001″ - .003″

Camshaft and Bushing Oil Clearance . . . . .0015″ - .004″

Piston Rings:

Top to Bottom	Groove Clearance	Gap Opening
Top	.004″ - .005″	.010″ - .020″
2	.003″ - .0045″	.010″ - .025″
3	.002″ - .0035″	.010″ - .025″
4	.0015″ - .003″	.010″ - .018″
5	.002″ - .0035″	.010″ - .018″

Clearance between Cylinder Head and Piston . . . . .0558″ - .077″

Clearance between Connecting Rod Bushing
and Piston Pin . . . . .002″ - .0027″

Piston Pin and Piston . . . . Select fit

Clearance between Connecting Rod and Crankshaft .006″ - .010″ (side)

Clearance between Connecting Rod and Crankshaft
Oil Clearance . . . . .003″ - .005″

Crankshaft Thrust Bearing Clearance . . . . .0035″ - .0085″

Main Bearing Oil Clearance . . . . .003″ - .006″

Shell Thickness . . . . .1225″ - .123″

Clearance . . . . .003″ - .006″

Clearance (feeler test after tightening nuts) . . . . .0045″ - .005″

Clearance between Cam Rocker Arm Shaft and Bushing .0005″ - .0025″

Clearance between Rocker Arm Shaft and Rocker Arm
Bushing . . . . .001″ - .0025″

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TOURNAPULL

Point of Adjustment	Correct Adjustment	Allowable Tolerance
Axle Bearings	.002" tight	.008" loose to .004" tight
Final Drive Pinion Bearings	.002" tight	.008" loose to .004" tight
Spiral Bevel Gear Carrier Bearings	.000"	.008" loose to .004" tight
Transmission Mainshaft Bearings	.000"	.002" loose to .002" tight
Other Transmission Bearings	non-adjustable	....
Flywheel Clutch Pilot Bearing and Release Bearing	non-adjustable	....
Steering Clutch Throw Out Bearing	non-adjustable	....
Drawbar	Free working without end play	

POWER CONTROL UNIT

Point of Adjustment	Correct Adjustment	Allowable Tolerance
Main Gear Bearings	.002" tight	.000" to .003" tight
Cable Drum Bearings	.005" tight	.003" tight to .006" tight
Brake Shaft Bearings	.000"	.002" loose to .001" tight
Pinion Bearings	non-adjustable	
Clutch Throw Nut Bearings	non-adjustable	

SCRAPER

Point of Adjustment	Correct Adjustment	Allowable Tolerance
Wheel Bearings	.000"	.008" loose to .008" tight
Fairlead Sheave Housing Pivot Bearings	.001" tight	.000" to .002" tight
Sheave Bearings	non-adjustable	....
Tailgate Roller Bearings	non-adjustable	....

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FLYWHEEL CLUTCH SLIPPAGE

CAUSE	REMEDY
Flywheel clutch may be incorrectly adjusted, with clutch pedal possibly striking floor boards before clutch becomes fully engaged.	Correctly adjust clutch as outlined in flywheel clutch adjustment instructions.
Flywheel clutch facing excessively worn.	Install a new lined driven disc.
Flywheel clutch facing oily or greasy, possibly as a result of over-greasing clutch release bearing.	As soon as convenient remove and replace lined disc. Also correct cause foı facing becoming oily or greasy.
Clutch disc warped.	Install a new lined driven disc.
Clutch pressure spring weak, possibly due to overheating or a long period of usage.	Replace pressure spring.

FLYWHEEL CLUTCH DRAGGING

CAUSE	REMEDY
Flywheel clutch incorrectly adjusted.	Correctly adjust flywheel clutch.
Flywheel clutch may be gummed with oil or grease.	Disassemble and clean clutch and install new lined driven disc. Also correct cause of clutch facing becoming gummed with oil or grease.
Clutch lined driven disc may be warped.	Install a new lined driven disc.
Flywheel clutch release bearing dry or damaged.	Lubricate or replace bearing, as needed.
Flywheel clutch pilot bearing dry or damaged.	Lubricate or replace bearing, as needed.

STEERING CLUTCH SLIPPAGE

CAUSE	REMEDY
Steering clutches not in the correct adjustment.	Correctly adjust steering clutches.
Final drive pinion bearings in a loose adjustment, causing driven cone to be mis-aligned with driving cones.	Correctly adjust final drive pinion bearings.
Worn out steering clutch facings.	Install new facing and machine or grind surface of new facing true with cone.
Clutch fingers, links, or pins worn unevenly.	Install complete new set of fingers, links, and pins.
Splines on steering clutch driving cones binding.	Remove cones and correct cause for binding, such as removing burrs, etc.

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IMPROPER STEERING

CAUSE	REMEDY
Steering clutches incorrectly adjusted.	Correctly adjust clutches.
Steering brakes incorrectly adjusted.	Correctly adjust steering brakes.
Steering brake facing worn.	Install new brake facing.
Drive tires have unequal diameters, due to unequal air pressures or because of using a new tire on one side and a worn tire on the other, thus causing Tournapull to tend to pull to one side.	Use only matched tires on drive wheels, and inflate to equal pressures.

DIFFICULT GEAR SHIFTING

CAUSE	REMEDY
Power Control Unit clutches dragging.	Correct cause of clutch dragging. Most probable causes are clutch incorrectly adjusted, main gear bearings loose, or cable drum bearings loose.
Flywheel clutch dragging.	Correctly adjust flywheel clutch.
Transmission oil heavier than that which is recommended.	Drain and flush transmission and fill to level plug with recommended weight and type of lubricant. (See Lubrication Instructions.)
Transmission center control pivot pin (located at upper end of gear shift lever housing) worn or loose.	Tighten or replace pivot pin.
Shifting yoke slots worn.	Replace shifting yokes.
Gear shift lever worn.	Replace gear shift lever.

TRANSMISSION GEAR INTERFERENCE

CAUSE	REMEDY
Shifting yokes may be sprung.	Replace shifting yokes.
Transmission shafts have excessive end play.	If end play is in mainshaft, adjust mainshaft bearings. If end play is in countershaft, correct end play by tightening bearing lock-nut, replacing bearings, etc., depending upon what is causing the end play.
Small interlock pin or balls in shifting bar housing worn, broken, or omitted when transmission was last assembled.	Assemble new interlock pin or balls in shifting bar housing.

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TRANSMISSION WON'T STAY IN GEAR

CAUSE	REMEDY
Small steel balls and springs omitted from above shifting bars in shifting bar housing when last assembled.	Install balls and springs in position in shifting bar housing.
Operator not moving gear shift lever fully into gear.	Move gear shift lever all the way forward or to the rear when shifting gears.

HYDRAULIC BRAKE SLIPPAGE

CAUSE	REMEDY
Brake shoe to drum clearances adjusted too loose.	Adjust hydraulic brakes, correctly setting brake shoe to drum clearances.
Oil or grease getting on brake shoes or drums.	Clean the oil or grease from the brake shoes or drums, replace wheel oil seals if leaking, and be careful when lubricating to avoid getting grease on shoes or drums.
Air in hydraulic lines.	Bleed hydraulic lines as outlined in bleeding instructions in Operation Section.
Insufficient amount of hydraulic fluid in hydraulic lines, possibly due to leakage at some point in the lines.	Repair any points of leakage, and refill brake master cylinder at least ⅔ full of hydraulic brake fluid.
Excessive hydraulic brake pedal lash, resulting in pedal striking dash panel before brakes fully engage.	Make needed adjustment at brake master cylinder. (See hydraulic brake adjustment instructions.
Brake shoes excessively worn.	Replace brake shoes.

HYDRAULIC BRAKES DRAGGING AND OVERHEATING

CAUSE	REMEDY
Brake shoe to drum clearances adjusted too close.	Adjust hydraulic brakes, correctly setting brake shoe to drum clearances.
Brake master cylinder compression rod or "push rod" incorrectly adjusted, preventing piston in master cylinder from returning all the way when the brakes are disengaged, resulting in primary cup closing small compensating port in master cylinder.	Make needed adjustment at brake master cylinder. (See hydraulic brake adjustment instructions.)
Scraper wheel bearings in a loose adjustment.	Correctly adjust wheel bearings.
Brake drum not installed concentric on wheel. (Brake drums are machined after being installed on wheel and, if removed, should be re-installed in the same position.)	Install brake drum concentric on wheel.

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POOR TRACTION OR FLOTATION

CAUSE	REMEDY
Tires not correctly inflated to fit job conditions.	Correctly adjust tire pressures, using tire inflation chart in Operation Section as guide.
Drive tires installed with lugs pointing in wrong direction, preventing space between lugs from cleaning itself of mud as tire rotates.	Remove tire and install so that when traveling forward, tire will rotate in the direction indicated by arrow on sidewall of tire.

FAILURE OF ENGINE TO START

CAUSE	REMEDY
Fuel level too low.	Check the fuel in the tank.
Low fuel pressure.	Check the fuel pressure. Fuel line may be broken or leaking at fittings.
Fuel line shut off.	Check the emergency control valve on the fuel pump to see if it is closed.
Fuel pump screen stopped up.	Inspect the fuel pump screen and clean according to instructions, page 78 of Operation Section.
Air in fuel lines.	Bleed the fuel lines of air.
Weak batteries.	Charge or replace batteries.
Fuel lines frozen.	Check fuel lines for ice or sludge stoppage. Thaw and drain fuel lines.
Out of fuel.	When the engine runs out of fuel, and the fuel supply has been replenished, proceed as follows: Disconnect the fuel line on the pressure side of the priming pump. Work the priming pump to remove all air from the lines to this point. Connect the fuel line and build up 80 pounds pressure on the fuel gauge with the priming pump. Crank the engine with the starter and continue to work the priming pump until the pressure pump starts to build up pressure. To determine when the pressure pump is working, stop the priming pump and watch the fuel pressure gauge to see that it does not drop off in pressure immediately. When the engine starts after the fuel lines have been emptied, it will knock and miss considerably for a short period of time until all the air in the lines has been expelled and solid fuel is going into the injectors. If the engine does not start after turning it over for a short period of time, do not continue to crank. Refer to FAILURE TO START, as further cranking would be an excessive and useless drain on the battery.

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ENGINE FALLING OFF IN POWER

CAUSE	REMEDY
Dirty fuel pump screen.	Clean the fuel pump screen.
Spray holes in the injector stopped up.	Clean the injector cup spray holes.
Incorrect valve or injector adjustment.	Adjust valves and injectors.
Leaking intake or exhaust valves.	Grind the valves.
Air filter stopped up.	Clean the air filters.
Insufficient lubrication.	Correct cause for low lubricating oil pressure. Check for dilution of oil and oil viscosity. Keep oil level to high mark on gauge. Use only a good grade of oil. Change lubricating oil every 64 hours. Keep oil passages open.
Overheated engine.	Do not overload. Keep plenty of cooling water in the radiator. Keep the fan belts adjusted. Check the water pump. Clean out the radiator.
Fuel lines obstructed.	Clean fuel lines. Use only an acceptable grade of fuel.
Back pressure.	Avoid sharp bends in the exhaust pipe. Use exhaust pipe and muffler of sufficient size.
Stuck pistons, rings, or excess cylinder wear.	Install new rings. Install oversize liners and pistons.
Fuel pump distributor disc scored.	Install new disc and cover.
Improper grade of fuel.	Refer to Fuel Oil Specifications.
Injector cup gasket leaking.	Install new cup gasket.

ENGINE STOPS

CAUSE	REMEDY
Engine locked.	Roll the engine over by hand to see if it is free.
Fuel level too low.	Check the fuel level in the tank.
Fuel line stopped.	Check fuel lines for sludge, ice or other obstructions that may be cutting off the flow of fuel.
Engine out of lubricating oil.	Check the oil level in the crankcase.

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ENGINE MISSING

CAUSE	REMEDY
Leaky check valve in the injector or fuel inlet connection.	Install new check valves.
Dirty injector cup spray holes.	Clean injectors.
Spray tip off the injector cup.	Install new injector cup.
Injector plunger sticking.	Clean injector.
Valves sticking.	Check valve springs and guides.
Valve clearance too close.	Reset the valves.
Valves leaking.	Grind valves.
Air in fuel lines.	Prime the engine.
Water in fuel.	Check the filter and fuel supply tank.

ENGINE SMOKING

CAUSE	REMEDY
Dirty injector cup spray holes.	Clean injector cup spray holes.
Valves leaking or clearances too close.	Check and reset valves.
Valve clearances too wide.	Check valve setting.
Injector adjustment set improperly.	Adjust injectors.
Fuel lines may not be attached to their proper connections.	Refer to firing order chart on page 15 of Operation Section.
Engine overloaded possibly due to fuel setting having been altered.	If more fuel is injected than the amount of air in the cylinder will support in combustion, the engine is being overloaded and the surplus fuel will not burn.
Engine running too cool. Operating temperature should be 160° F.	Check thermostats.
Suction lines on the fuel pump admitting air.	Check fuel line connections.
Scored distributor disc.	Install new distributor disc and cover.
Injector plunger sticking.	Refer to "Sticking Injector Plunger" causes.
Check valves may be leaking in fuel inlet connection or in the injector.	Install new check-valves.
Injector cup spray tip cracked.	Install new injector cup.
Air cleaner stopped up.	Clean air cleaner.

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ENGINE OVERHEATING

CAUSE	REMEDY
Insufficient amount of cooling water.	Refill radiator.
Stoppage of cooling system.	Clean radiator.
Insufficient amount or poor quality of lubricating oil.	Change or add oil.
Loose water pump belts.	Tighten belts.
Valve clearance improper.	Check valve clearances.
Overloading. Fuel pump seal has been broken.	If seal is broken, reset as per instructions. (Page 107 of Repair Section.)
Sludge or lime formation in the water jacket.	Disassemble and clean.

DROP IN FUEL PRESSURE

CAUSE	REMEDY
Improper quality of fuel oil.	Refer to Fuel Oil Specifications.
Air leak in the suction line.	Tighten connections or replace.
Fuel filter stopped up.	Clean and drain regularly.
Congealed fuel in the fuel lines.	Refer to Fuel Oil Specifications.
Water in fuel freezing in cold weather.	Thaw lines. Drain water from fuel supply tank.
Excessive wear in the fuel gear pump.	Replace fuel gear pump.

LOW ENGINE LUBRICATING OIL PRESSURE

CAUSE	REMEDY
Lubricating oil diluted.	Correct cause of dilution and refill with good oil.
Insufficient lubricating oil.	Add oil to high level mark on gauge.
Loose suction line or defective gasket.	Tighten or replace gasket.
Gauge line stopped up.	Remove and clean out.
Excessive wear in the lubricating pump.	Rebuild lubricating pump.
Loose bearings.	Replace bearings.
Insufficient amount or improper quality of lubricating oil.	Add oil of proper quality.
Excessive oil leaks around the valve rollers and rocker levers.	Check bushings and ball and socket seats.
Dent in the oil pan closing off the suction line.	Straighten.

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EXCESSIVE USE OF ENGINE LUBRICATING OIL

CAUSE	REMEDY
Oil leaks.	Check the engine for external leaks.
Improper quality of lubricating oil.	Change oil. (See lubrication instructions in Operation Section.)
Stuck piston rings.	Clean ring grooves and install new rings.
Oil drain holes in the piston stopped up.	Use drill to open holes.
Excessive wear on the cylinder walls.	Install new cylinder liners.
Scored piston or sleeve.	Install new piston or liner, or both.
Injector shield left off, thus allowing the oil to enter the injector drain.	Replace shields.
Overload.	Lessen load.
Injector rocker lever socket worn or cracked.	Install new rocker lever socket.
Injector plunger link worn.	Install new injector link or new injector.

ENGINE HAS WEAK CYLINDER

CAUSE	REMEDY
Check-valve leaking in fuel inlet connection or injector.	Reseat or replace.
Leaking or sticking valves.	Clean and grind valves.
Sticking injector plunger.	See "Sticking Injector Plunger" corrections.
Injector spray holes stopped up.	Clean injector spray holes.
Fuel inlet connection gasket leaking at the injector body.	Replace the gasket.
Low compression, caused by stuck rings.	Install new rings.
Improper injector plunger adjustment.	Adjust injector. To locate a weak cylinder: Loosen the fuel supply line at the fuel inlet connections. This will cause the cylinder to miss. Set the throttle to turn the engine about 500 to 600 r. p. m. Loosen each line separately and listen to the exhaust to see if any change occurs. Before proceeding to the next cylinder, tighten the fuel line again. Check all cylinders in this manner.
Injector cup gasket leaking.	Tighten or replace gasket.
Scored distributor disc.	New distributor disc and cover.

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ENGINE KNOCKING

CAUSE	REMEDY
Overload.	Lessen the load.
Dirty injector cup spray holes.	Clean injector cups.
Air in fuel lines.	Tighten connections and prime engine.
Injector push rod bent because of improper injector adjustment, causing it to strike the cylinder block.	Install new push rod.
Loose bearings.	Install new bearing inserts.
Loose piston pins.	Install new shims or bushings.
Piston slap, due to worn pistons and cylinder walls.	Install new cylinder liners or pistons.
Loose flywheel.	Tighten and check run-out.
Injector cup spray tip cracked.	New injector cup.
Priming valve open.	Close priming valve.

DILUTION AND SLUDGE FORMATION IN ENGINE

CAUSE	REMEDY
Idling for long periods.	Shut off the engine when it is not working.
The use of dirty or worn out lubricating oil.	Change oil every sixty-four hours.
An inferior grade of lubricating oil.	Use better grade of oil. (See lubrication instructions.)
Failure to flush the engine properly.	Flush engine as outlined in Lubrication Instructions.
Use of an inferior grade of fuel oil.	Refer to Fuel Oil Specifications.
Injector cup spray holes stopped up.	Clean injector cup spray holes.
Use of the wrong size drill for cleaning the injector cup spray holes.	Use only drills furnished by Cummins Engine Company.
Leaking injector cup gaskets.	Tighten or replace.
Improper adjustment of the injector.	Adjust the injector.
Leaking gaskets at the injector fuel inlet and drain connections.	Tighten or replace.
Stuck piston rings.	Install new piston rings.
Dirty oil filters.	Change filter bags as recommended.
Operating at overload.	Do not exceed rated engine capacity.
Fuel pump setting too high.	Have fuel pump reset.
Engine water temperature too low. Operating temperature should be 160° F.	Check thermostats.

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DILUTION OF ENGINE LUBRICATING OIL

CAUSE	REMEDY
Stuck piston rings.	Install new rings.
Overload. Fuel pump seal has been broken and more fuel is injected than will burn in the available air.	If seal is broken, reset as per instructions. (Page 107 of Repair Section.)
Injector cup gasket leaking. Cup leak can be detected by build-up of fuel around the body, while it is in the cylinder head and the engine is running.	Tighten or replace gasket.
Fuel inlet or drain connections leaking.	Tighten fuel inlet and drain connections.
Injector drain lines and manifold not draining properly to fuel pump.	Remove and clean with compressed air.
Worn injector plungers permitting excess by-pass of fuel.	Install new injectors.
Vacuum in crankcase caused by air-tight or dirty breather cap.	Clean crankcase breather.
Injector cup spray tip cracked.	Install new injector cup.

STICKING INJECTOR PLUNGER

CAUSE	REMEDY
Dirty or gummy fuel.	Clean filters. Use proper grade of fuel oil.
Fuel oil not having a viscosity recommended under Fuel Oil Specifications, or one that possesses no lubricating qualities.	Should it be necessary to use such a fuel oil until the proper grade is obtained, add one quart of lubricating oil to every five gallons of fuel oil.
Uneven tension on the injector hold-down nuts causing distortion in the injector body.	Loosen the nuts and retighten evenly, as previously instructed. If this is causing the trouble, the plunger will return to its correct position immediately. If the above methods do not correct the trouble, replace the injector.

LOW GENERATOR OUTPUT

CAUSE	REMEDY
Poor contacts between brushes and commutator.	Clean commutator with 00 sandpaper.
Excessive resistance in charging circuit.	Clean and tighten all connections in charging circuit.
Voltage regulator set too low.	Readjust voltage regulator.
Battery fully charged.	Normal condition.
Third brush setting incorrect.	Reset third brush.

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NO GENERATOR OUTPUT

CAUSE	REMEDY
Sticking brushes.	Clean brush holders and brush arms. Replace brushes and brush springs.
Gummed or burned commutator.	Clean commutator. Turn down and undercut mica if needed.
Short circuits, ground, or open circuits.	Isolate cause of trouble as explained on page 104 of Operation Section.
Burned or oxidized voltage regulator points.	Clean points with fine cut file. Never use emery or sandpaper.
Cutout relay will not close.	Replace shunt winding on cutout relay.

EXCESSIVE GENERATOR OUTPUT

CAUSE	REMEDY
Voltage regulator setting too high.	Readjust voltage regulator.
Excessively advanced third brush setting.	Retard third brush setting.

BATTERIES BECOMING DISCHARGED

CAUSE	REMEDY
No generator output.	Correct cause for no generator output. (See "No Generator Output" listed above.)
Low generator output.	Correct cause for low generator output. (See "Low Generator Output" listed on previous page.)
Poor connections in charging circuit.	Clean and tighten all connections.
Voltage regulator set too low.	Increase voltage regulator setting.
Cutout relay will not close.	Replace shunt winding on cutout relay.
If right hand batteries become discharged and left hand batteries remain in a charged condition, fuse may be burned out in series-parallel switch.	Replace fuse.
If right hand batteries become partially run down and left hand batteries remain in a charged condition, there may be excessive resistance in series-parallel switch charging circuit, possibly due to dirty or oxidized contact points in switch.	Check and correct cause of excessive resistance in charging circuit.

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TROUBLE SHOOTER'S GUIDE

NOISY GENERATOR

CAUSE	REMEDY
Loose mounting.	Tighten mounting.
Worn or dirty bearings.	Replace bearings.
Improperly seated brushes.	Seat brushes and replace brush holders.

VOLTAGE REGULATOR TROUBLES

CAUSE	REMEDY
Loose wiring and connections may cause a low charging rate even when the battery needs charging.	Tighten connections.
A low charging rate may be due to insufficient generator capacity.	Short around the regulator to see if a higher charging rate is obtained. If no increase in generator output is noticed, generator is probably at fault.
If battery charging rate remains high with a well charging battery, voltage regulator needs adjustment.	Decrease voltage regulator setting.

FAILURE OF CRANKING MOTOR TO OPERATE PROPERLY

CAUSE	REMEDY
Defective connections in the circuit between the cranking motor and battery.	Clean and tighten connections and replace defective cables.
Weak battery.	Charge, or install new battery of proper strength.
Insufficient cranking speeds to turn engine over in cold weather.	Use lighter oil, heat the oil, or pull back the compression release lever while spinning the motor until the engine acquires its highest possible momentum, then release the compression lever to allow the engine to fire.
Open circuit between the solenoid switch and battery as evidenced by no dimming of the lights by refusal of cranking motor to operate.	Operate the shift and lever by hand or determine if the cranking motor can operate. Correct solenoid switch circuits. Make sure that proper connections are being made between the brushes and commutator.
Defective cranking motor windings.	Check with test lamp and points.

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TROUBLE SHOOTER'S GUIDE

POWER CONTROL UNIT CLUTCH SLIPPAGE

CAUSE	REMEDY
Brake cam installed too far to the rear on clutch throw-nut and therefore riding against throw-nut bushing as control level is moved, preventing driving cone from fully engaging driven cone.	Space brake cam farther to the front on clutch throw-nut. (Refer to Step 8 of Power Control Unit clutch adjustment).
Main gear incorrectly spaced inside Power Control Unit gear case, thereby riding against back side of gear case when control lever is moved to engage clutch, preventing driving cone from fully engaging driven cone.	Make Power Control Unit clutch adjustment, correctly spacing main gear inside gear case.
Power Control Unit clutch facing oily or greasy (woven facing only).	Remove driving cone and either replace facing or wash facing with naptha or gasoline. Also prevent further oil or grease from reaching clutch surfaces as follows: Correct oil seal leakage, if present (refer to "Oil Seal Leakage" corrections). Do not lubricate that portion of cable which wraps onto cable drum. Never apply oil to woven facings.
Power Control Unit clutch facing installed eccentric on driving cone (woven facing), or high spots on facing not having been machined off (metallic facing), causing only a part of clutch facing to bear against driven cone when clutch is fully engaged.	If woven facing, either remove facing and install it concentric on cone or machine surface or facing true with cone, using a grinder. If metallic facing, machine off high spots.
Worn out Power Control Unit clutch facing.	Either install new facing on driving cone or install a replacement lined driving cone.
Smooth, glazed Power Control Unit clutch facing.	Remove driving cone and roughen clutch facing with a rasp (woven facing only).

POWER CONTROL UNIT CLUTCH WON'T ENGAGE

CAUSE	REMEDY
Brake cam installed too far to the rear on clutch throw-nut, therefore riding against throw-nut bushing as control lever is moved, preventing driving cone from fully engaging driven cone.	Space brake cam farther to the front on clutch throw-nut. (Refer to Step 8 of Power Control Unit clutch adjustment).
Main gear incorrectly spaced inside Power Control Unit gear case, thereby riding against back side of gear case when control lever is moved to engage the clutch, preventing driving cone from fully engaging driven cone.	Make Power Control Unit clutch adjustment, correctly spacing main gear inside gear case.
Clutch incorrectly adjusted, causing excessive throw of control lever, possibly resulting in control lever striking seat before clutch becomes fully engaged.	Adjust clutch, correctly setting distance of travel of control lever from neutral to the fully engaged position. (Refer to Power Control Unit clutch adjustment instructions.

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TROUBLE SHOOTER'S GUIDE

POWER CONTROL UNIT CLUTCH WON'T RELEASE— CLUTCH DRAGGING

CAUSE	REMEDY
Clutch adjustment incorrect, with travel of control lever from neutral to fully engaged position set at less than the recommended distance, thereby providing insufficient clearance between driving and driven cones when in neutral.	Make Power Control Unit clutch adjustment, correctly setting travel of control lever from neutral to fully engaged position.
Power Control Unit main gear bearings in a loose adjustment, causing driving cone to drag on driven cone when control lever is in neutral position.	Correctly adjust main gear bearings.
Cable drum bearings in a loose adjustment, causing driven cone to drag on driving cone when control lever is in neutral position.	Correctly adjust cable drum bearings.
Power Control Unit clutch facing loose on driving cone, resulting in facing dragging on driven cone when control lever is in neutral.	Remove driving cone and either reinstall facing on driving cone or install new lined cone.
Threads excessively worn on drum shaft or clutch throw-nut, resulting in full travel of control lever being required to take up play in threads instead of moving driving cone away from driven cone.	Replace worn drum shaft or throw-out.

SPONGY POWER CONTROL UNIT CLUTCH

CAUSE	REMEDY
Power Control Unit main gear bearings in a loose adjustment, allowing end play of driving cone on clutch throw-nut, and mis-alignment of driving cone with driven cone.	Correctly adjust main gear bearings.
Cable drum bearings in a loose adjustment, allowing end play of cable drum and driven cone on drum shaft and misalignment of driven cone with driving cone.	Correctly adjust cable drum bearings.
Power Control Unit clutch facing not tight on driving cone, thereby tending to "give" and become "spongy" when engaging and disengaging clutch.	Remove driving cone and re-line or install a replacement lined cone.
Power Control Unit clutch facing installed eccentric on driving cone, causing only a portion of facing to contact driven cone when engaging clutch, resulting in slippage until heavy force is applied on control lever, giving "spongy" action.	Remove driving cone and machine or grind surface of facing true with cone.

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TROUBLE SHOOTER'S GUIDE

POWER CONTROL UNIT CLUTCH WON'T HOLD ADJUSTMENT

CAUSE	REMEDY
Clamp block at rear end of drum shaft insufficiently tightened, allowing drum shaft to turn.	Readjust Power Control Unit clutch and tighten clamp block on drum shaft by turning capscrews down tight, using force.
Brake cam not clamped tight on clutch throw-nut, allowing lever to slip on throw-nut.	Clamp brake cam tight on clutch throw-nut by turning clamp bolt up tight, using force. Then readjust clutch.
Brake roller arm not clamped tight on brake shaft, allowing roller arm to slip on shaft.	Readjust brake and tighten clamp bolt at upper end of roller arm, using force.

POWER CONTROL UNIT BRAKE SLIPPAGE

CAUSE	REMEDY
Brake spring not adjusted tight enough.	Make brake adjustment, tightening set screws on brake spring arm.
Tension of Power Control Unit brake spring decreased, due to old age or long period of operation.	Replace brake spring.
Power Control Unit brake shaft bearings adjusted too tight, preventing free rotation of brake shaft and causing shaft to bind, sometimes holding brake band away from drum.	Correctly adjust brake shaft bearings.
Oily or greasy brake lining (woven lining only.)	Remove Power Control Unit brake band and either replace band or wash lining with naptha or gasoline. Also prevent further oil or grease from reaching brake lining as follows:—If oil seals are leaking, correct leakage (refer to "Oil Seal Leakage" corrections.) Do not lubricate that portion of cable which wraps onto cable drum. Never apply oil to woven lining.
Mud, rocks or other obstacles lodged in brake spring or behind brake roller arms or linkage.	Remove mud, rocks, or other obstructions.
Power Control Unit brake lining worn out.	Replace brake lining.
Brake band improperly formed to fit drum, possibly through accident	Replace or re-shape brake band.

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POWER CONTROL UNIT BRAKE WON'T RELEASE

CAUSE	REMEDY
Brake roller positioned too high against brake cam, preventing cam from moving roller arm outward far enough to cause brake to release when control lever is moved.	Make Power Control Unit brake adjustment, correctly positioning brake roller against brake cam. (Refer to brake adjustment instructions.)
Brake roller arm not clamped tight on brake shaft, allowing roller arm to slip on shaft.	Correctly adjust Power Control Unit brake and tighten clamp bolt at upper end of roller arm, using force.
Main gear incorrectly spaced inside gear case, thereby riding against the reduction gear inside gear case as control lever is moved to release brake, limiting travel of control lever and preventing brake from fully releasing.	Make Power Control Unit clutch adjustment, correctly spacing gear inside gear case.
Brake band frozen to drum.	Move control lever into lock-out position, freeing band from drum.

OVERHEATING OF POWER CONTROL UNIT

CAUSE	REMEDY
Operator not engaging and disengaging Power Control Unit clutches fully and quickly, causing short intervals of clutch slippage and overheating.	Engage and disengage clutches with a quick, full movement of control levers.
Power Control Unit brakes slipping.	Correct the cause for brake slippage. (Refer to "Power Control Unit Brake Slippage" corrections.)
Power Control Unit clutches slipping.	Correct the cause for clutch slippage. (Refer to "Power Control Unit Clutch Slippage" corrections.)
Power Control Unit clutches dragging.	Correct the cause for clutch dragging. (Refer to "Power Control Unit Clutch Dragging" corrections.)

SCRAPER CUTTING LOWER ON ONE SIDE THAN ON OTHER

CAUSE	REMEDY
Unequal air pressures in rear tires.	Check air pressures and inflate to equal pressures.
The use of tires of unequal diameters on rear of Scraper, such as a new tire on one side and worn tire on other, or a larger size tire on one side than on other.	Install tires having equal diameters.

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OIL SEAL LEAKAGE

CAUSE	REMEDY
Lubricants may not be those which are recommended. Oils lighter than recommended may seep out under seals and incorrect type grease may break down and become fluid from heat of operation.	Remove incorrect lubricants and replace with lubricants which are recommended.
Oil seals incorrectly installed during assembly, with leathers cupped outward, away from oil or grease chamber.	Remove oil seals and install with leathers cupped inward, toward oil or grease chamber. Double leather oil seals should be installed with heavy leather facing inward.
Gear case filled with oil above the oil level plug.	Lower oil level to oil level plug.
Oil seals becoming burned and hardened as a result of overheating.	Correct cause for overheating. Also replace leaky oil seals.
Tournapull axle bearings in a loose adjustment, thereby whipping out leather in oil seals.	Correctly adjust axle bearings. Also replace leaky seals.
Breather hole in Power Control Unit oil fill plug not open, causing a pressure to be built up inside the gear case, forcing oil out around the seals.	Remove cork (or dirt) from breather hole in fill plug. Also replace leaky oil seals.
Power Control Unit cable drums filled more than 2/3 full of grease (possibly by inserting grease through rear end of drum shaft with grease gun), causing grease to be forced out around seals as pressure is built up inside drum through heat of operation.	Remove cable drum and pack only 2/3 full of recommended lubricant. Also replace leaky oil seals. Lubricate through holes in drum shaft only in case of emergency.
Power Control Unit main gear bearings in a loose adjustment causing gear and driving cone to wobble, thereby whipping out leather in oil seals.	Correctly adjust main gear bearings. Also replace leaky oil seals.
Power Control Unit cable drum bearings in a loose adjustment, allowing cable drum to raise and lower on drum shaft each time load is raised and lowered, thereby working cable drum oil seals up and down on shaft, permitting grease to escape.	Correctly adjust cable drum bearings. Also replace leaky oil seals.

BEARING FAILURES

CAUSE	REMEDY
Bearings improperly lubricated.	Lubricate at specified intervals and with recommended lubricants.
Bearings incorrectly adjusted. (Adjustable roller bearings only.)	Correctly adjust bearings.
Dirt or other foreign matter in oil or grease.	Correct cause for dirt or foreign matter entering lubricant.

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EXCESSIVE CABLE BREAKAGE

CAUSE	REMEDY
Tailgate forward cable too short causing tailgate arms to strike vertical braces on top of side-sheets before tailgate sliding sheave strikes stop block, possibly resulting in bottom of tailgate kicking up.	Correctly adjust or replace cable. (Refer to cable threading instructions.)
Tailgate forward cable too long, preventing tailgate from coming forward far enough to eject all the load.	Correctly adjust or replace cable. (Refer to cable threading instructions.)
Apron lift cable too short, causing apron to strike arched A-Frame when in raised position.	Correctly adjust or replace apron lift cable. (Refer to cable threading instructions.)
Failure of operator to release Power Control Unit clutch when pushbeam stops or tailgate sliding sheave stops are brought together.	Promptly release Power Control Unit clutch when pushbeam stops or tailgate stops have been pulled together.
Traveling over unlevel ground or turning with either the pushbeam stops or tailgate sliding sheave stops together.	Allow clearance at these points when traveling. (Refer to operating instructions.)

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PARTS CATALOG

SECT. 3

WARNING

SPARE PARTS can be supplied promptly and accurately only if positively identified by correct part number and correct part name.

FURNISH THIS INFORMATION ON ALL REQUISITIONS.

WITHOUT FAIL, on all requisitions, give name of machine, name of manufacturer, model or size, manufacturer's serial number of each machine and subassemblies attached to machine, and components and accessories for which spare parts are required.

List spare parts for only one make or kind of machine on each requisition.

Requisitions must be double spaced to provide room for office notations when necessary.

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PARTS CATALOG

FOR

SCRAPER, ROAD MOTORIZED, CABLE-OPERATED, 12 CU. YD., LETOURNEAU MODEL SUPER C TOURNAPULL, WITH MODEL LP CARRYALL

★

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On this page is shown a sample spare parts requisition on QMC Form No. 400 which conforms to the latest revisions. The marginal notes give instructions for preparing a requisition for spare parts for Engineer equipment.

The revised QMC Form 400 has new column headings. Until new forms are available use the present form and type or write in corrections in column headings as shown below.

Under revised heading "Nomenclature" and "Unit" list the article and the unit (ea for each; lb for pound; etc.). Under heading "Maximum or Authorized Level" list the authorized organizational allowances or depot stock levels given in ENG 7 and ENG 8 of the ASF Engineer Supply Catalog (superseding Part III, Corps of Engineers Supply Catalog). The total number on hand for each item is listed under "On Hand". In column headed "Due In" enter the total quantity previously requisitioned but not delivered. Column headed "Required" is to be changed to read "Quantity Desired" and column headed "Approved" is to read "Remarks." For "Initial" and "Replenishment" requisitions, the sum of "Quantity Desired", "Due In", and "On Hand" should equal "Maximum or Authorized Level."

(Additional details on this subject are covered in ENG 1 of the ASF Engineer Supply Catalog which incorporates information formerly contained in Section AA-1, Part III, Engineer Supply Catalog.)

State PERIOD designation by use of one of the following terms:

(1) "INITIAL"—first requisition of authorized allowances.
(2) "REPLENISHMENT"-subsequent requisitions to maintain authorized allowances.
(3) "SPECIAL"—requisitions for necessary repairs not covered by allowances.

Type "SPARE PARTS" in upper right hand corner of requisition.

Address requisitions to Engineer Field Maintenance Office, P. O. Box 1679, Columbus, Ohio (except for spare parts for searchlights and barrage balloons which are addressed to Schenectady, N. Y. or Ogden, Utah ASF depots).

Give complete shipping instructions. Special instructions for packing, marking, routing, etc., should be given at bottom of requisition.

State proper nomenclature of machine, also make, model, machine serial number and U. S. A. registration number.

Prepare a separate requisition for each different machine.

State basis or authority and date delivery is required, immediately below description of machine.

Double space between items.

Group parts required under group headings as shown in manufacturers' parts catalogs (Technical Manuals).

State OCE stock numbers, manufacturers' parts numbers and nomenclature accurately and completely. Do not use abbreviations.

WAR DEPARTMENT
Q. M. C. Form No. 400
(Revised 10 Aug. 1943)

SPARE PARTS

REQUISITION

To: Engineer Field Maintenance Office
P. O. Box 1679, Columbus, Ohio
No. of Sheets 1 Sheet No. 1
Requisition No. E-908-4-44 Date 10 January, 1944 Period Replenishment

SHIP TO Engineer Property Officer, FORT LEWIS, WASHINGTON

MARKED FOR: Supply Officer, 150th Engr. Regiment, FORT LEWIS, WASHINGTON

Requisitioned By (show Signature, Rank, Organization, Destination. If different from "ship to" include address):

Robert E. Roe
Robert E. Roe,
Major, C. E.
Engineer Property Officer

For the Commanding Officer:

John E. Doe
John E. Doe
Col., C. E.
Executive Officer

STOCK NO.	NOMENCLATURE AND UNIT		AUTH. or MAX. LEVEL	ON HAND	DUE IN	QUANTITY DESIRED	REMARKS
PARTS	FOR SCRAPER, ROAD, MOTORIZED, CABLE OPERATED, 12 CU. YD. LE TOURNEAU MODEL SUPER C TOURNAPULL WITH MODEL LP CARRYALL						
	BASIS: to replenish second echelon set						
	DELIVERY: by 5 February 1944						
CUMMINS ENGINE CO. PARTS	ENGINE SECTION						
S-[illegible]574	PRECLEANER	EA	4	3	0	1	
H-8770-2	PISTON	EA	6	3	0	3	
S-1811	PUMP	EA	1	0	0	1	
R. G. LE TOURNEAU INC. PARTS	TOURNAPULL & SCRAPER SECTION						
R-6010	PINION	EA	2	0	0	2	
R-[illegible]197	BULLGEAR	EA	4	2	0	2	
R-5091	GASKET	EA	2	0	0	2	
D-404[illegible]	IDLER	EA	2	1	0	1	
H-80[illegible]7	SPRING	EA	4	2	0	2	

*Nonexpendable items such as tools must be accounted for, when requisitioned, by a statement that they have been placed on REPORT OF SURVEY or STATEMENT OF CHARGES.

Emergency requisitions sent by telephone, teletype, cablegram, telegraph or radio must be confirmed immediately with requisition marked: "Confirming (state identifying data)."

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PREPARATION OF REQUISITIONS

A Sample requisition in the correct form for submission by the Engineer Property Officer is shown on the opposite page.

THIS SHALL BE FOLLOWED IN MAKING OUT REQUISITIONS.

In order to eliminate duplication of work, Property Officers may authorize organizations to prepare requisitions in final form, leaving requisition number space blank for completion by Property Officer.

THE FOLLOWING RULES WILL BE OBSERVED CAREFULLY IN PREPARING REQUISITIONS FOR SPARE PARTS:

a. Prepare a separate requisition for each different machine.

b. Type "SPARE PARTS" in upper right hand corner of requisition form.

c. State PERIOD designation by use of one of the following terms:

   (1) "INITIAL"—first requisition of authorized allowances.

   (2) "REPLENISHMENT"—subsequent requisitions to maintain authorized allowances.

   (3) "SPECIAL"—requisitions for necessary repairs not covered by allowances.

d. Give complete shipping instructions.

e. State proper nomenclature of machine, and make, model, serial number and registration number.

f. State basis or authority, and date delivery is required, immediately below description of machine.

g. Group parts required under group headings as shown in manufacturers' parts catalogs.

h. State manufacturers' parts numbers and nomenclature descriptions accurately and completely. Do not use abb.eviations.

i. Double space between items.

j. Emergency requisitions sent by telephone, telegraph, or radio must always be confirmed immediately with requisition marked: *"Confirming* (state identifying data)".

k. Nonexpendable items must be accounted for.

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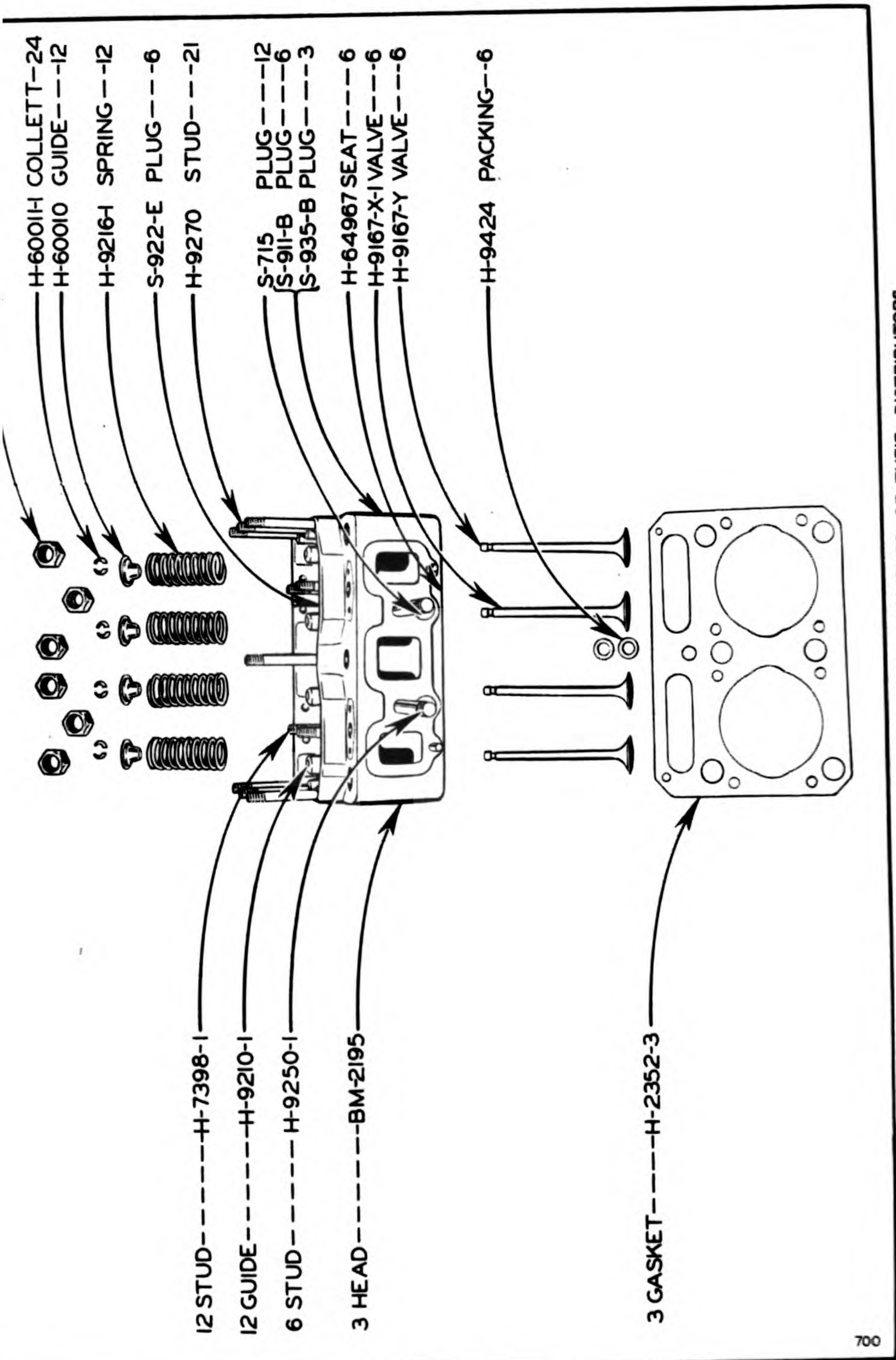

CUMMINS ENGINE CO. PARTS. ORDER FROM CUMMINS ENGINE CO. OR THEIR DISTRIBUTORS.

CYLINDER HEAD

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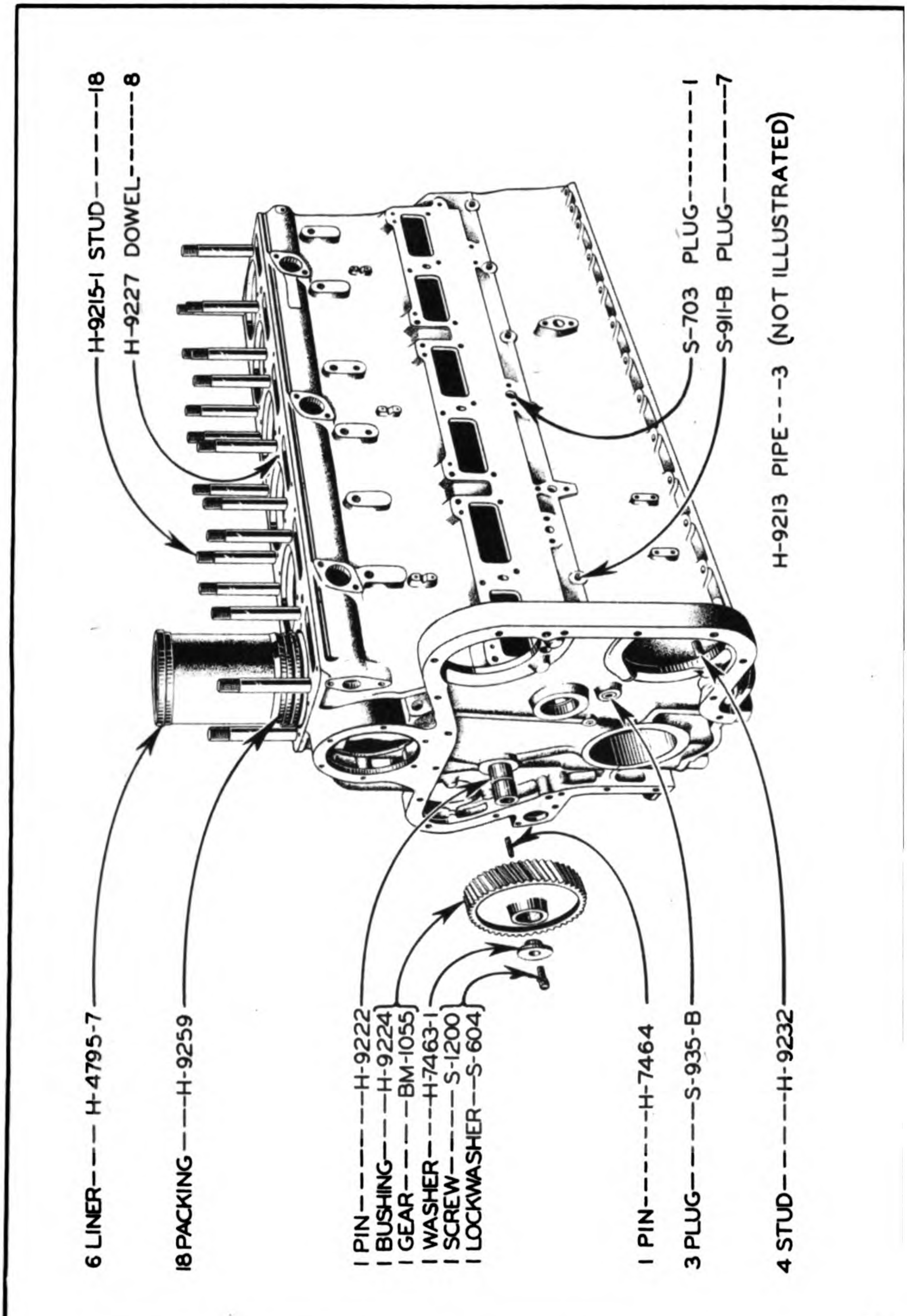

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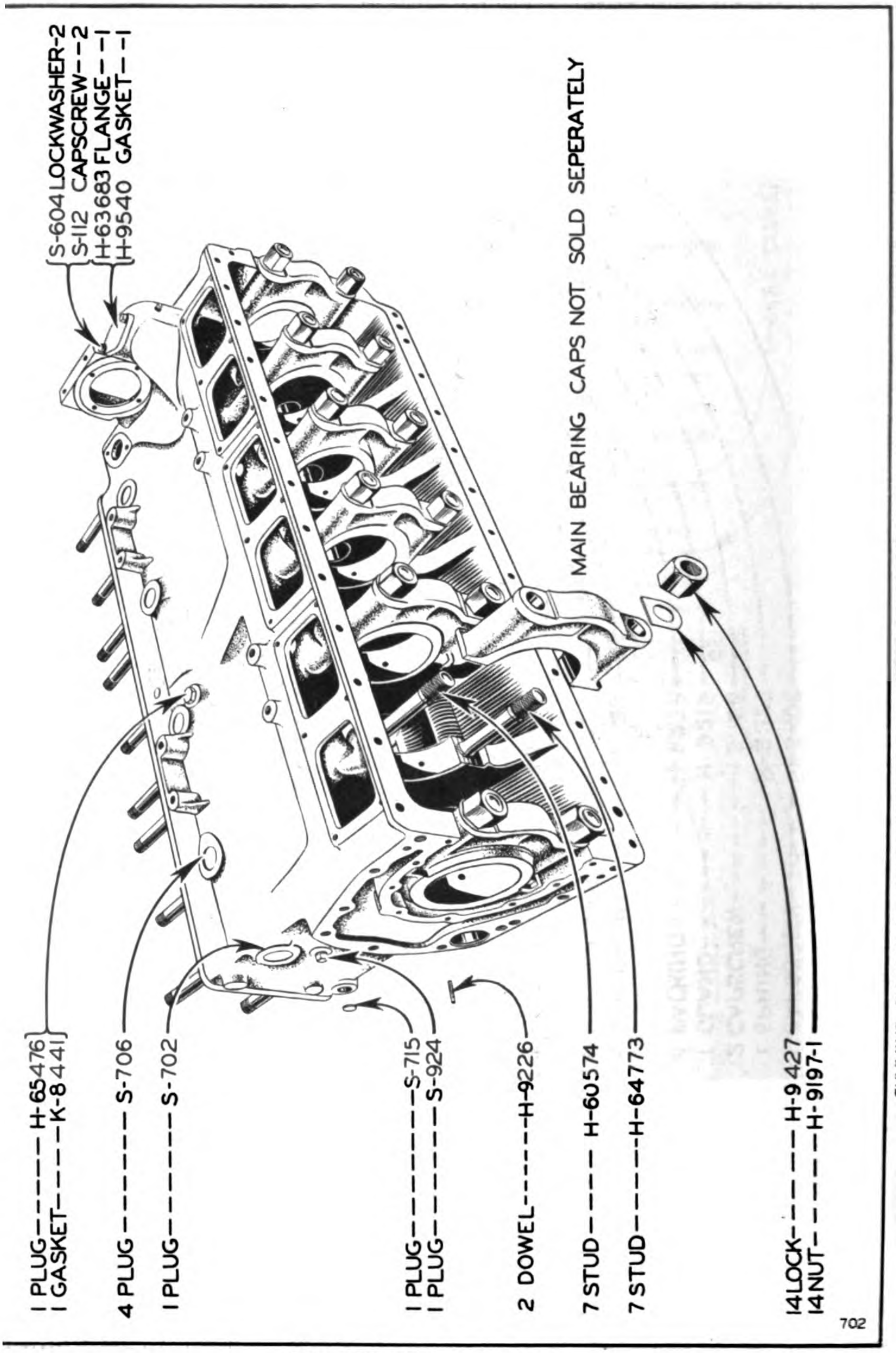

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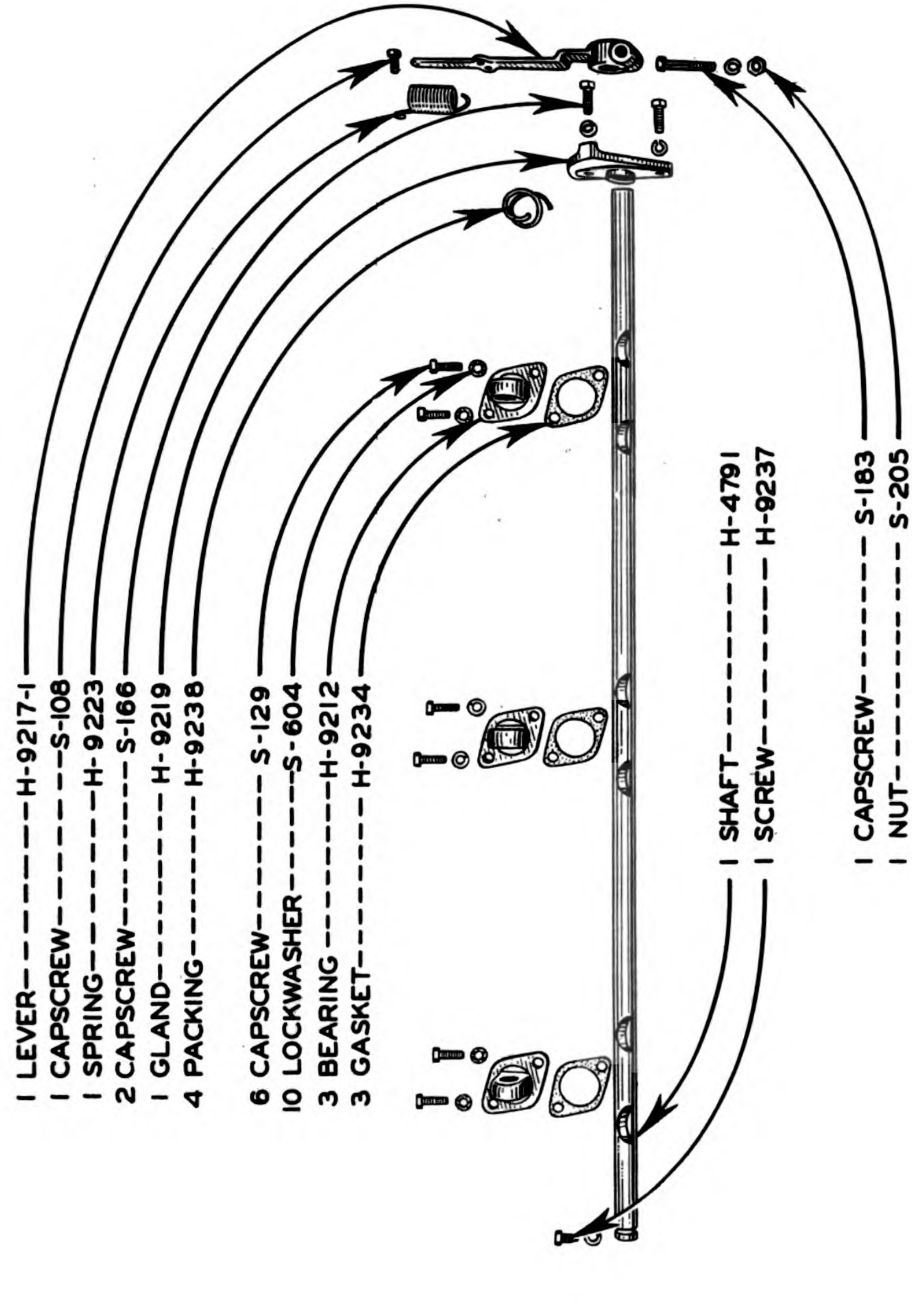

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COMPRESSION RELEASE

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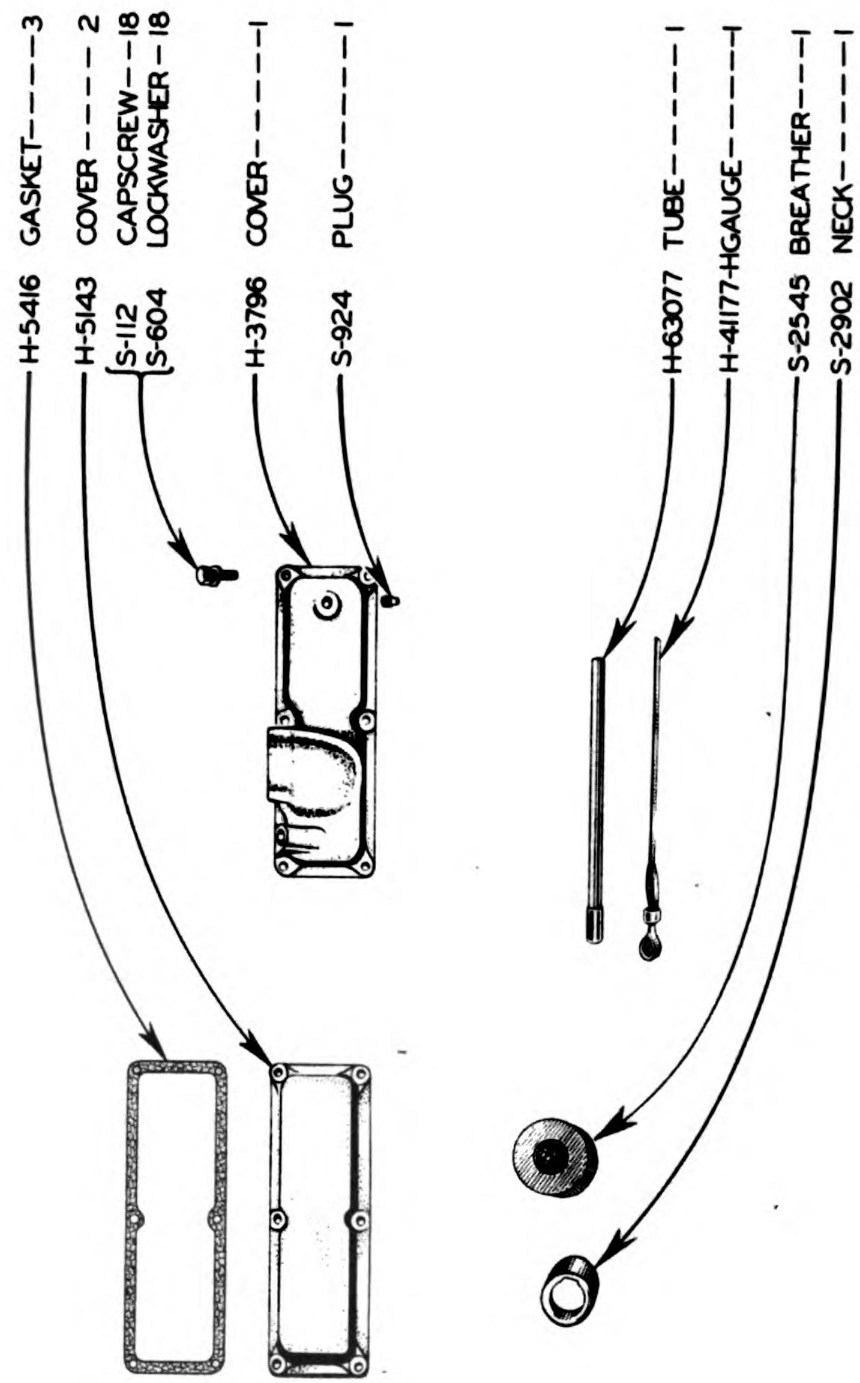

CUMMINS ENGINE CO. PARTS. ORDER FROM CUMMINS ENGINE CO. OR THEIR DISTRIBUTORS.

HAND HOLE COVER

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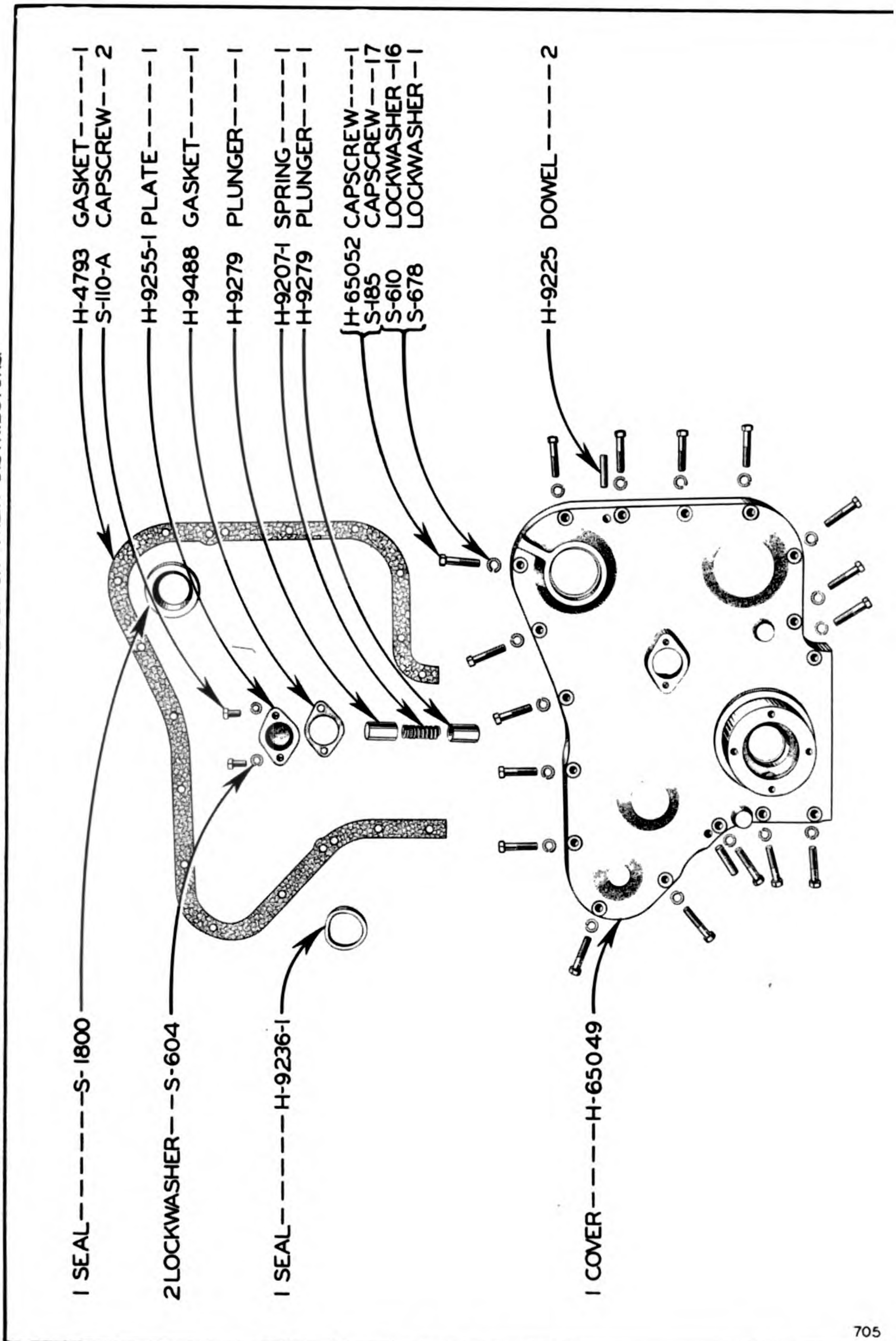

GEAR CASE COVER

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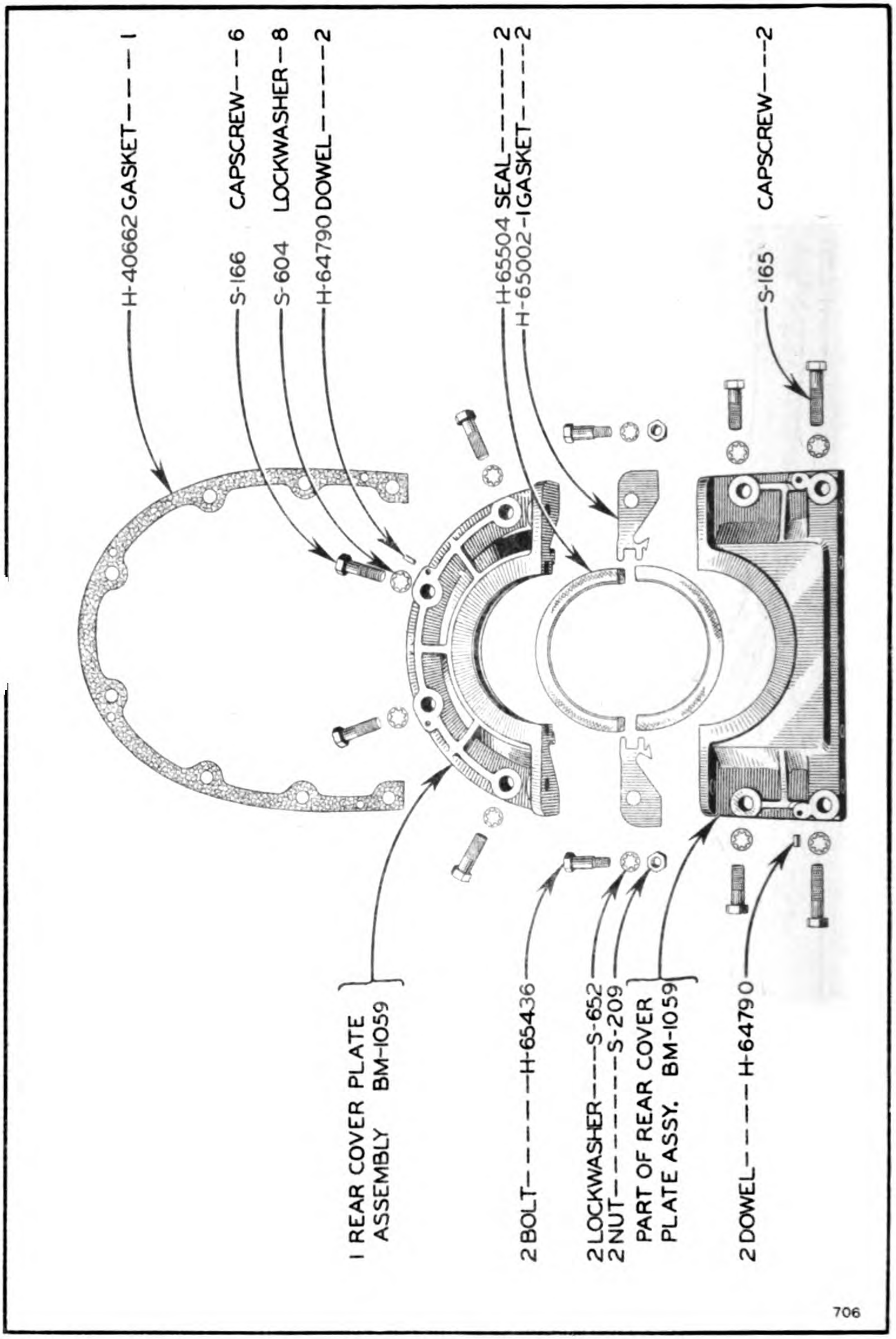

REAR COVER

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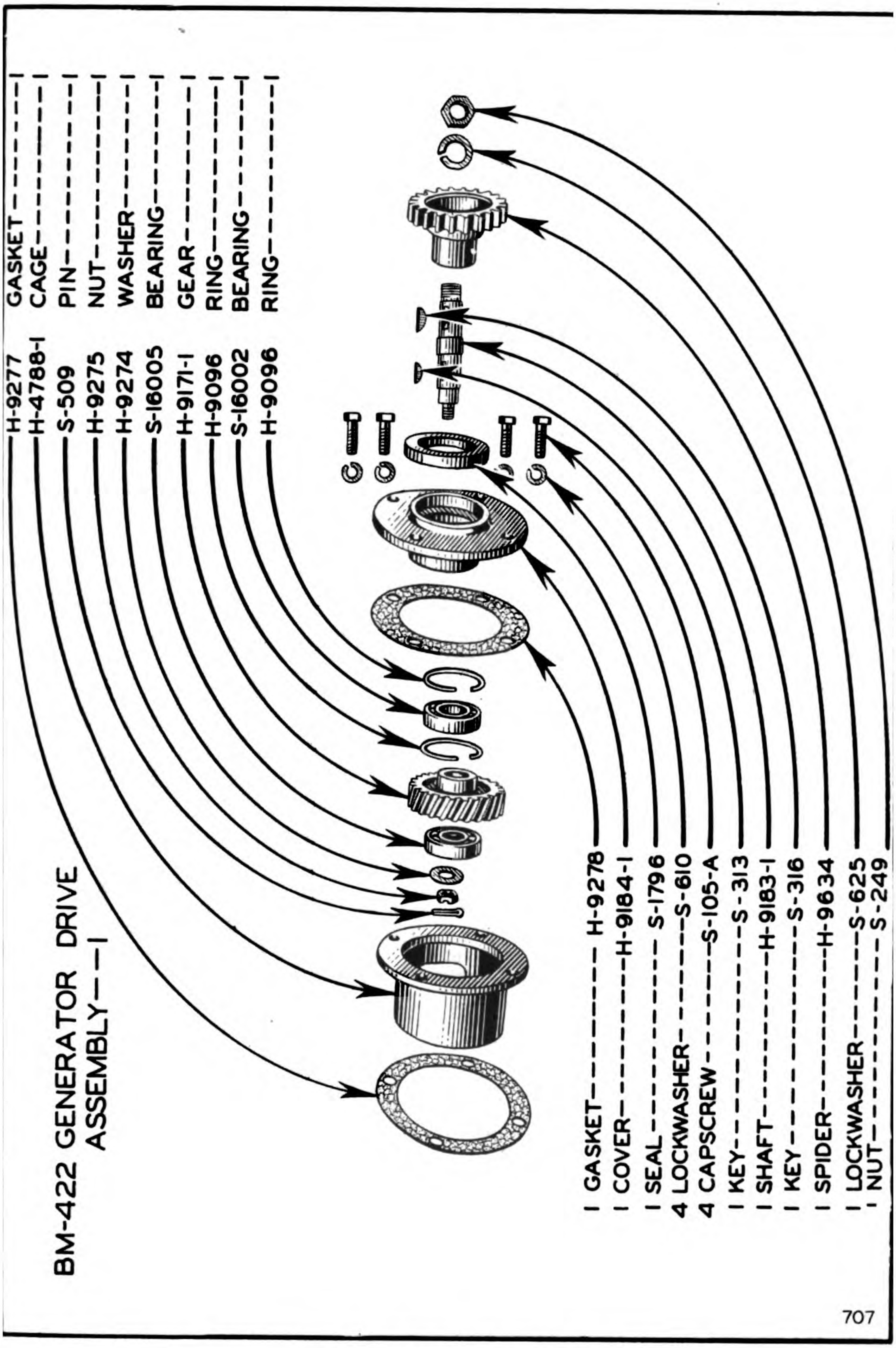

GENERATOR DRIVE

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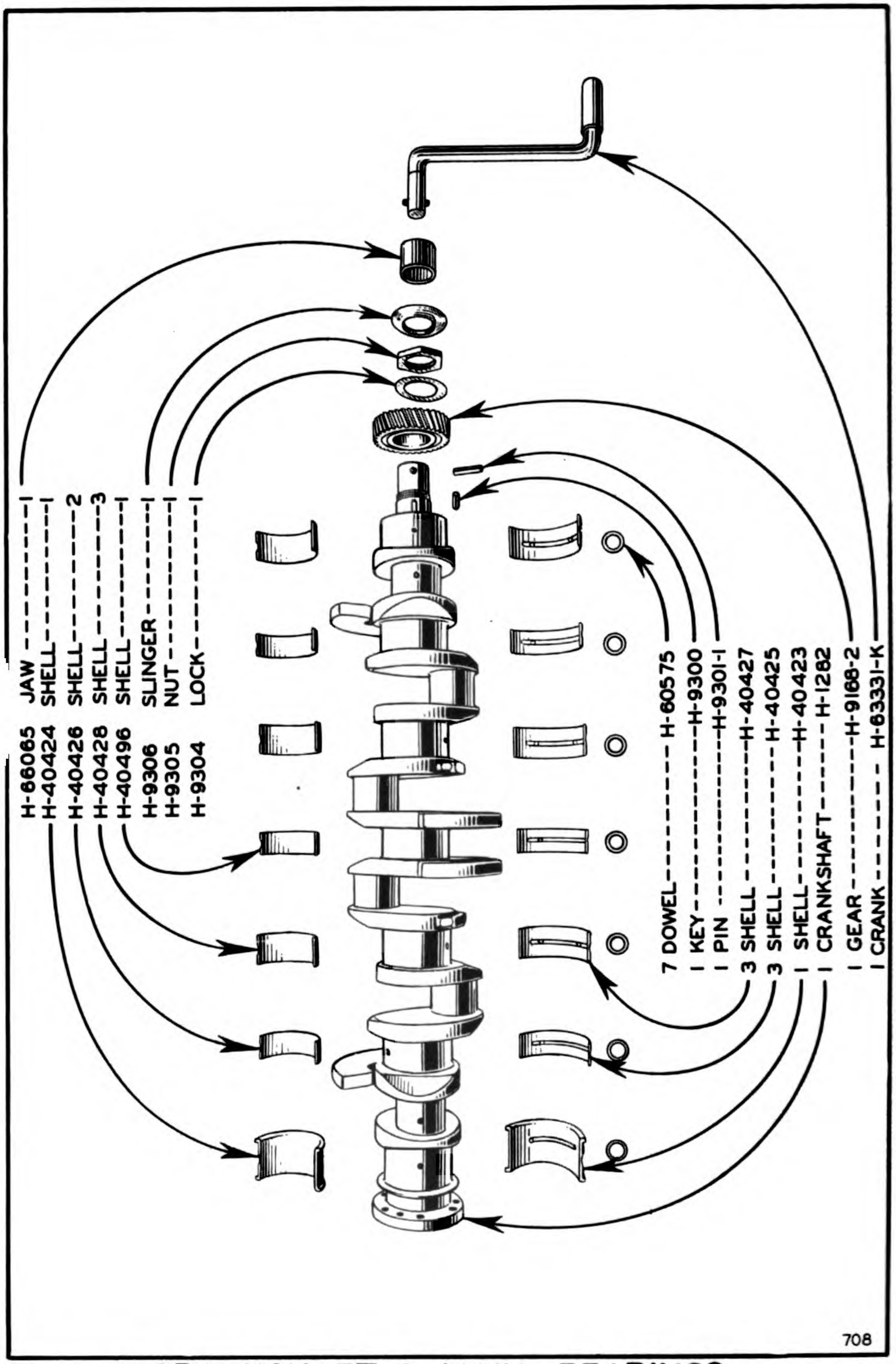

CRANKSHAFT & MAIN BEARINGS

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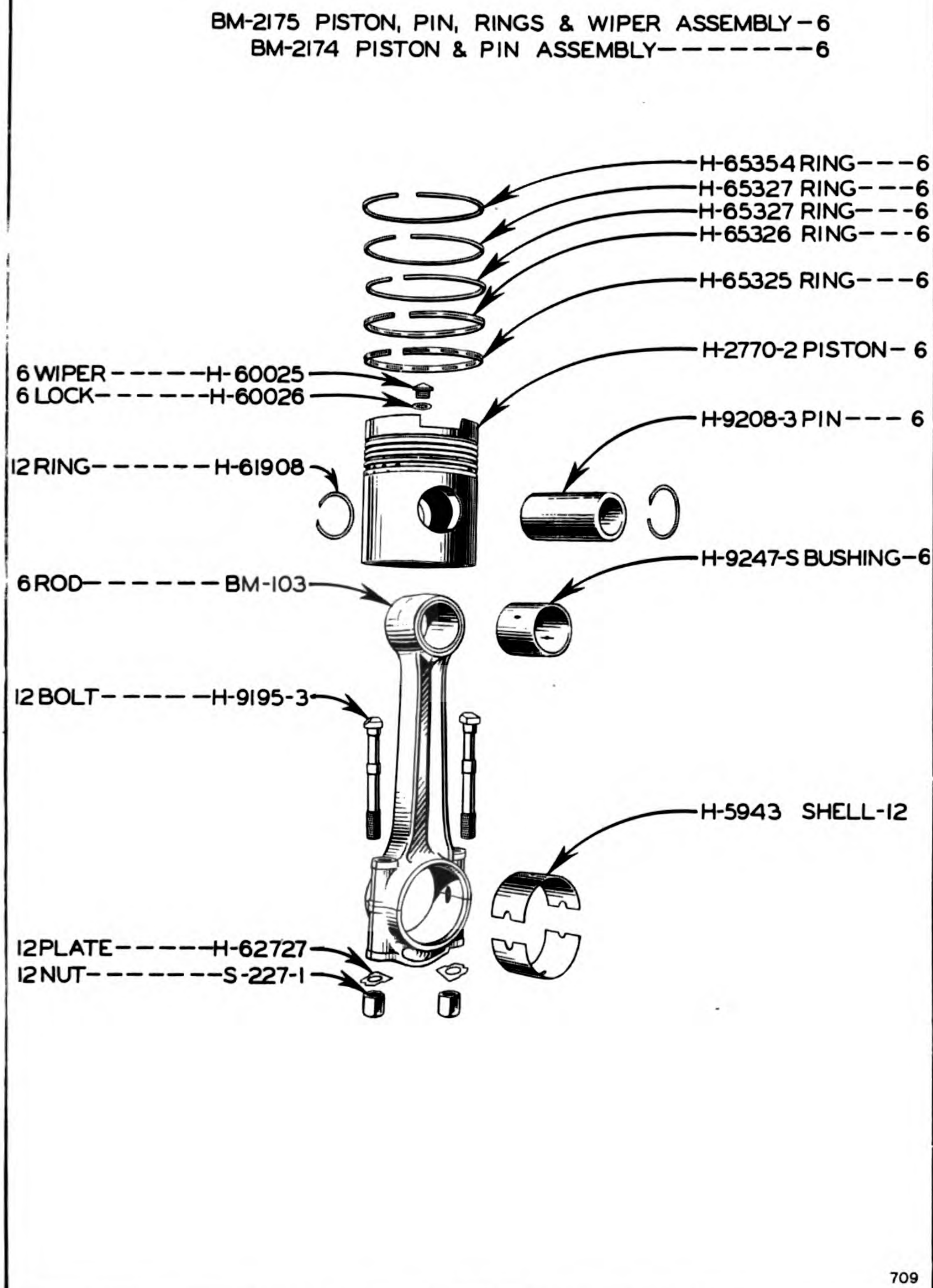

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PISTON & CONNECTING RODS

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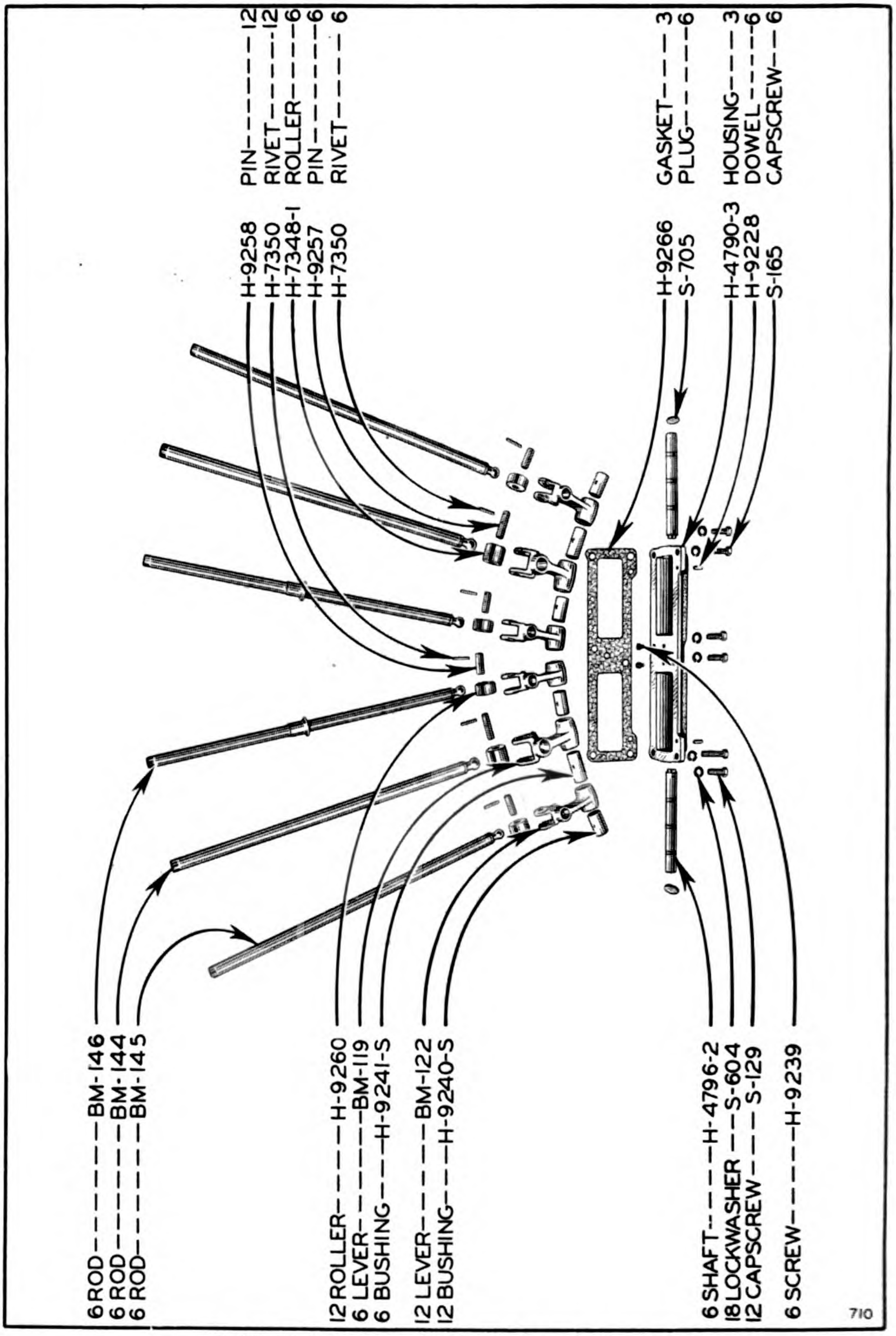

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CAM FOLLOWER & PUSH RODS

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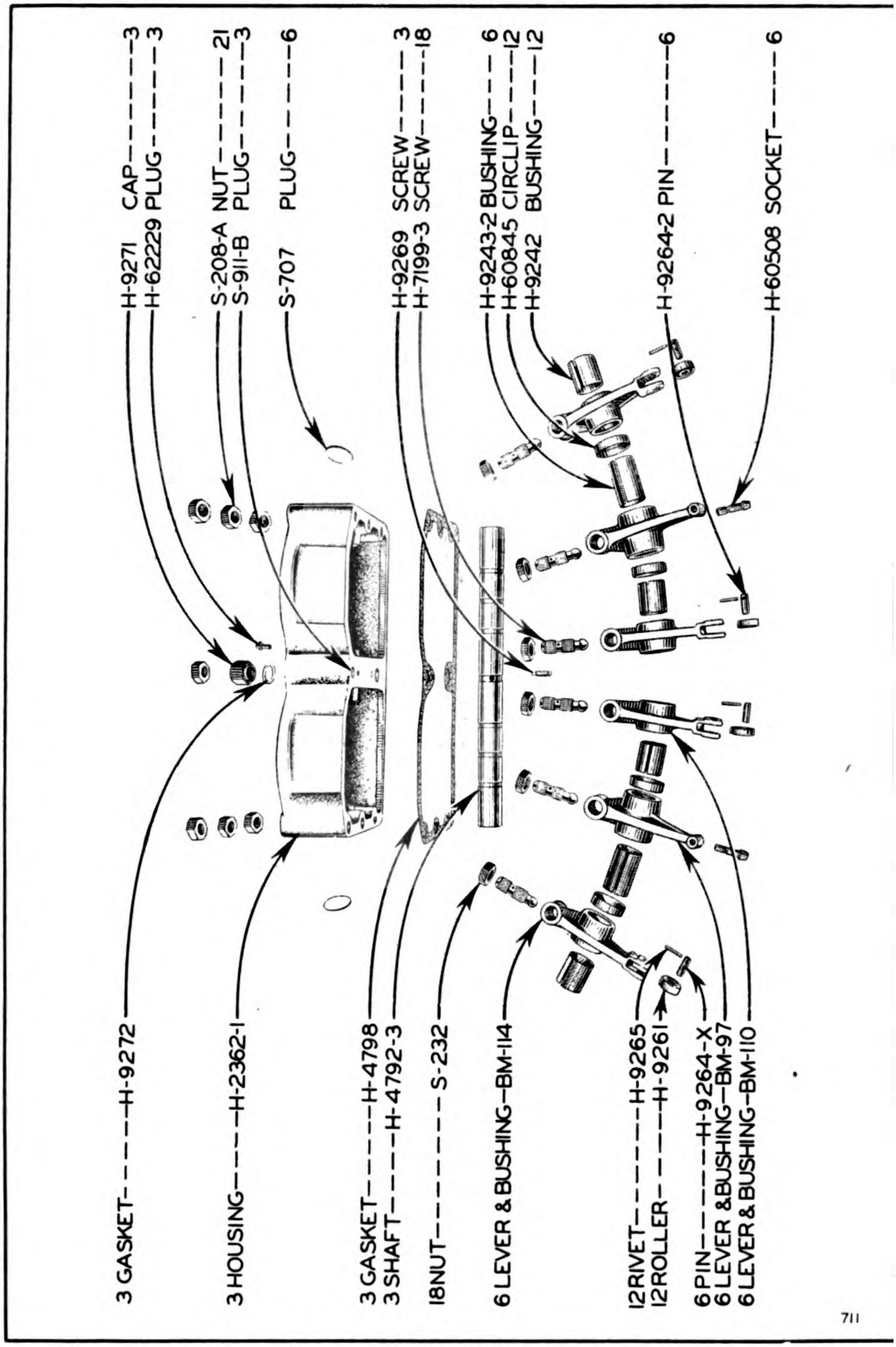

ROCKER LEVER HOUSING

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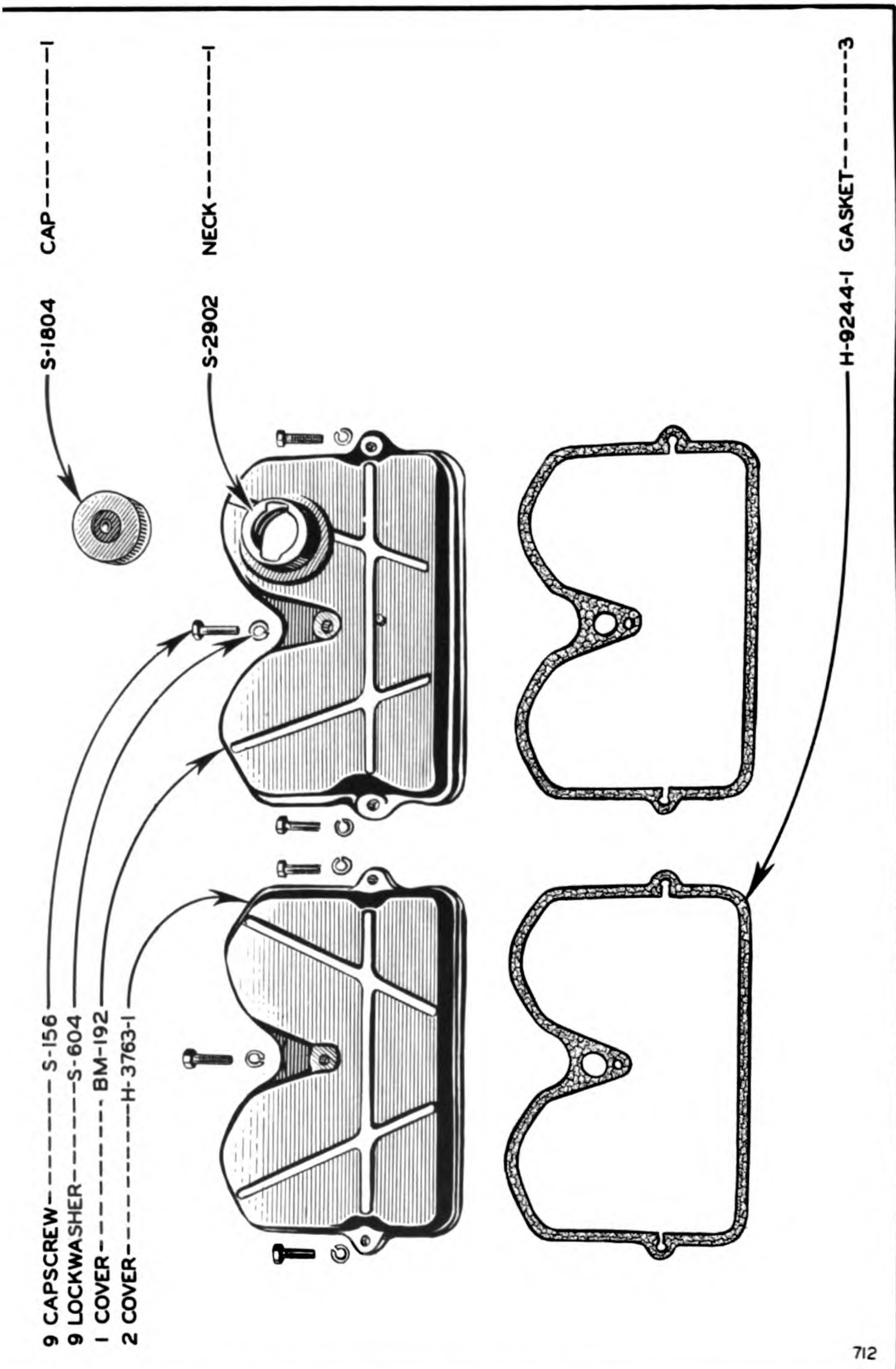

ROCKER HOUSING COVERS

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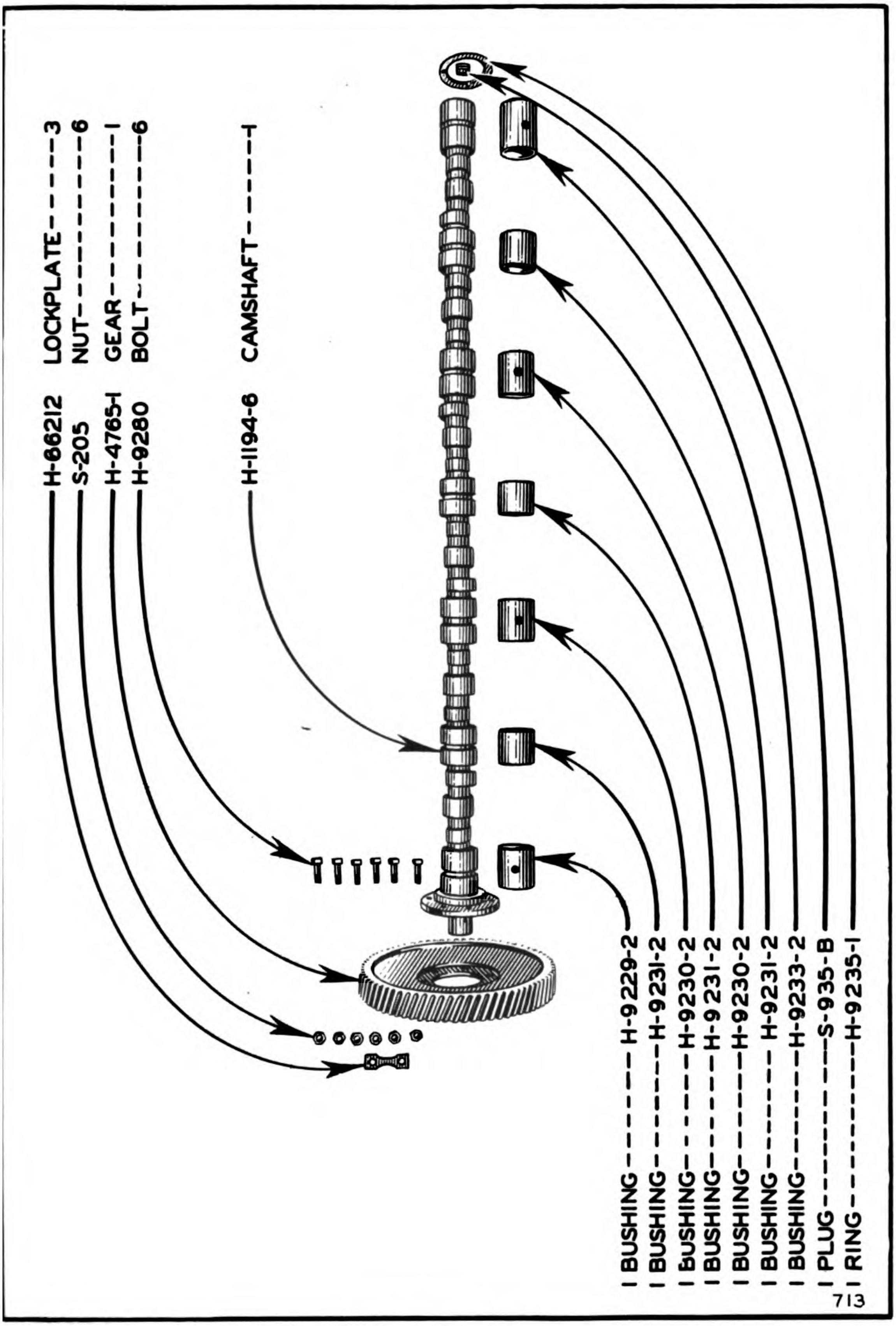

CAMSHAFT

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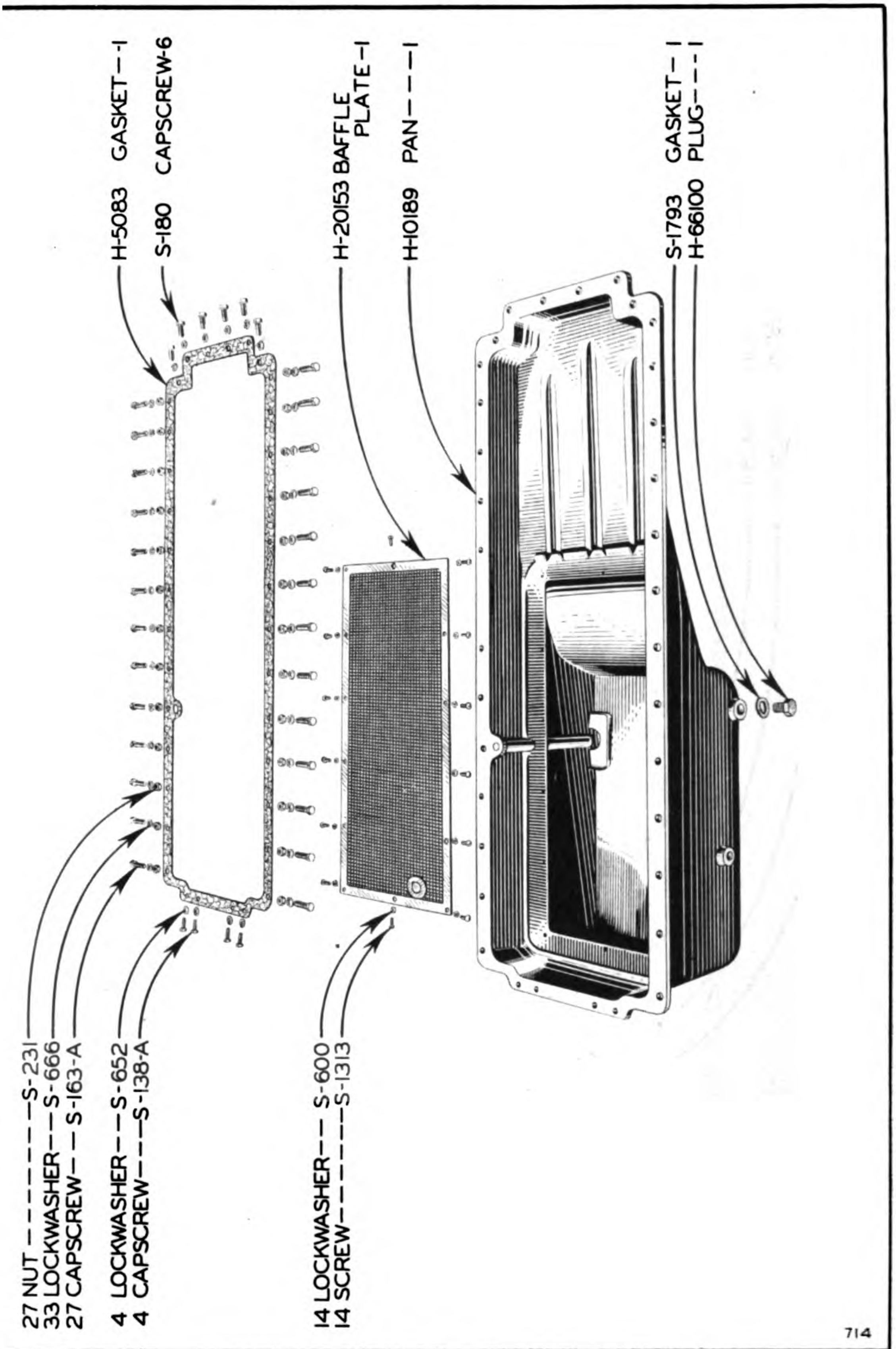

OIL PAN

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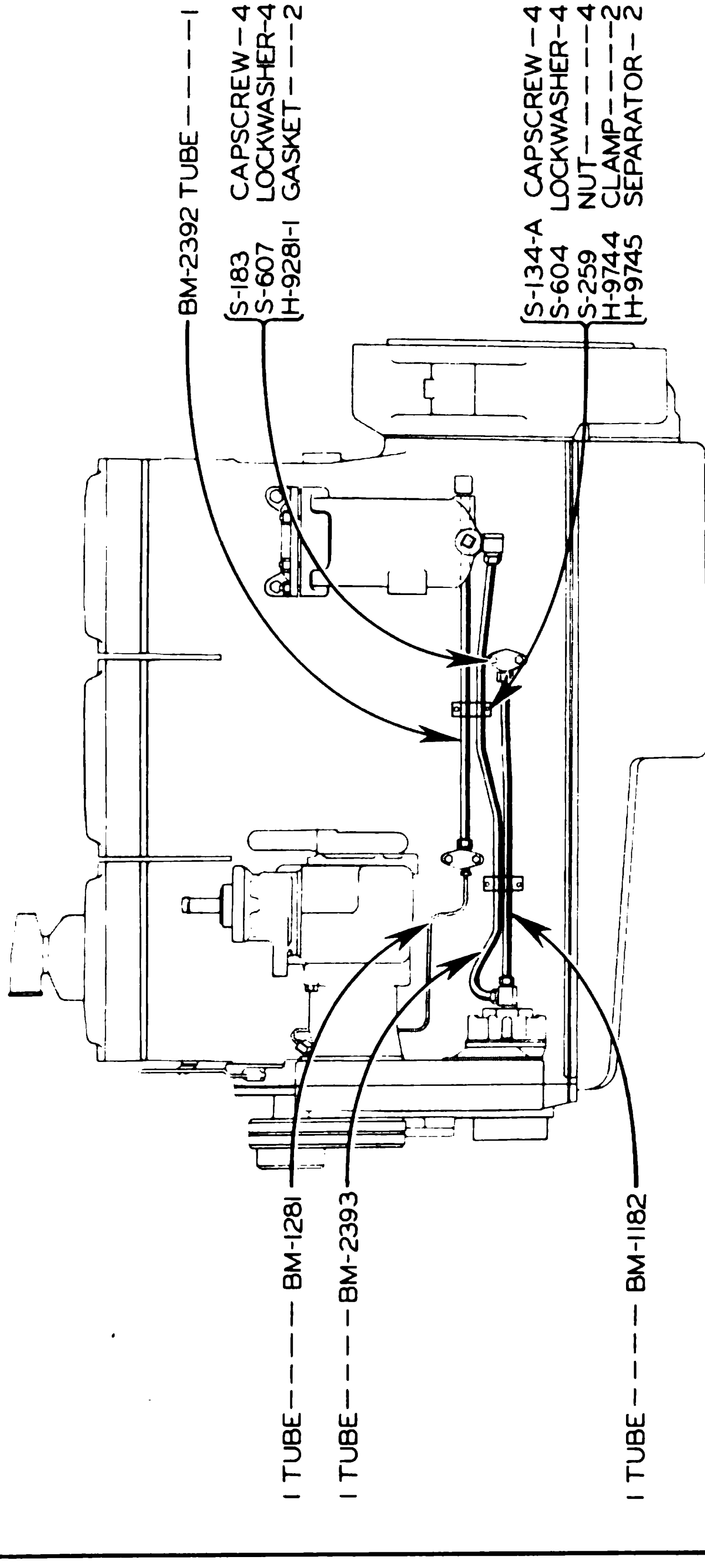
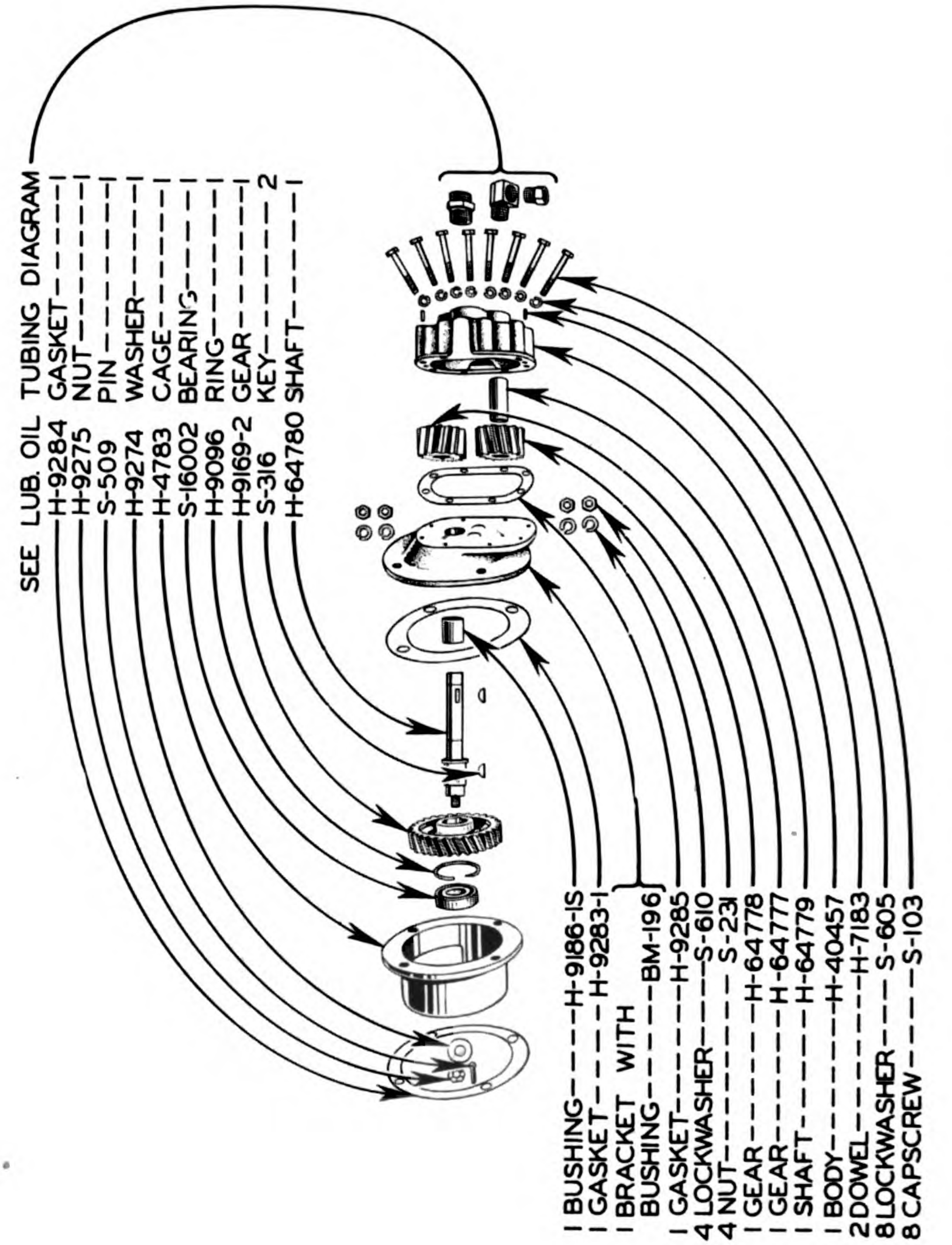
CUMMINS ENGINE CO. PARTS. ORDER FROM CUMMINS ENGINE CO. OR THEIR DISTRIBUTORS.



LUBRICATING OIL TUBING



CUMMINS ENGINE CO. PARTS. ORDER FROM CUMMINS ENGINE CO. OR THEIR DISTRIBUTORS.

716

LUBRICATING PUMP

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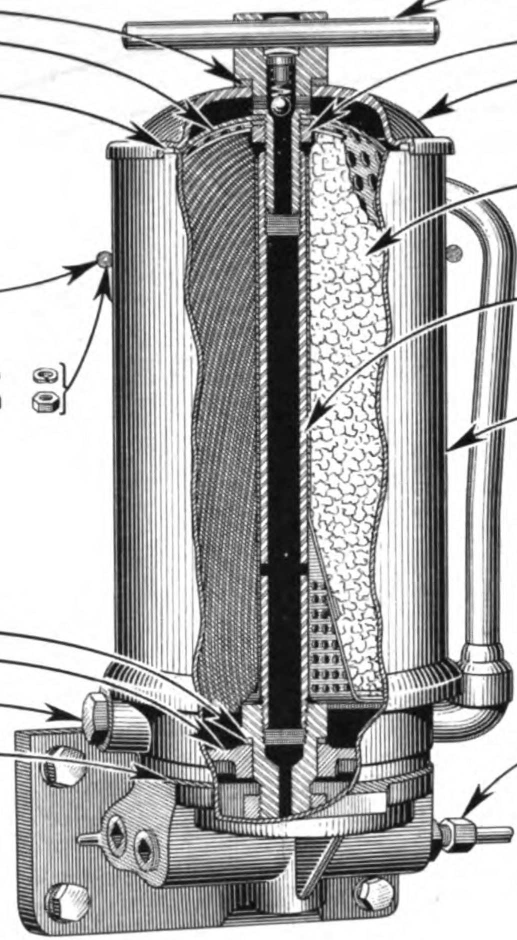
CUMMINS ENGINE CO. PARTS. ORDER FROM CUMMINS ENGINE CO. OR THEIR DISTRIBUTORS.



1 GASKET— — — —S-2470-B
1 CAP— — — — — —H-10368-4
1 GASKET— — — —S-2470-C
1 U BOLT— — — — — —H-63171
2 LOCKWASHER— — —S-605
2 NUT— — — — — — — — —S-209
1 GASKET— — — —H-10368-17
1 BASE— — — — —H-10376-24
1 PLUG— — — — — —10368-22
1 GASKET— — — —S-2470-D
1 GASKET— — —H-10368-18

H-10368-27 RELIEF VALVE AND STUD— — —1
S-232 NUT— — — — — — —1
H-10368-3 COVER— — — — —1
S-2470-A CARTRIDGE— — 1
H-10376-28 STUD & TUBE-1
H-10376-30 BODY— — — — — —1

S-967 BUSHING— — — —1
S-110-A CAPSCREW— — —2
S-1008-A CONNECTION— —1
S-1010-A ELBOW— — — — — —1
S-1006-A CONNECTION— —2
H-64307 FLANGE— — — — —2
H-9281 GASKET— — — —2
S-604 LOCKWASHER— —2
BM-2390 TUBE-DRAIN— —1
BM-2420 TUBE-INLET— —1

THESE PARTS NOT ILLUSTRATED

717

DE LUXE OIL FILTER

ALWAYS GIVE MACHINE NUMBER WHEN ORDERING PARTS

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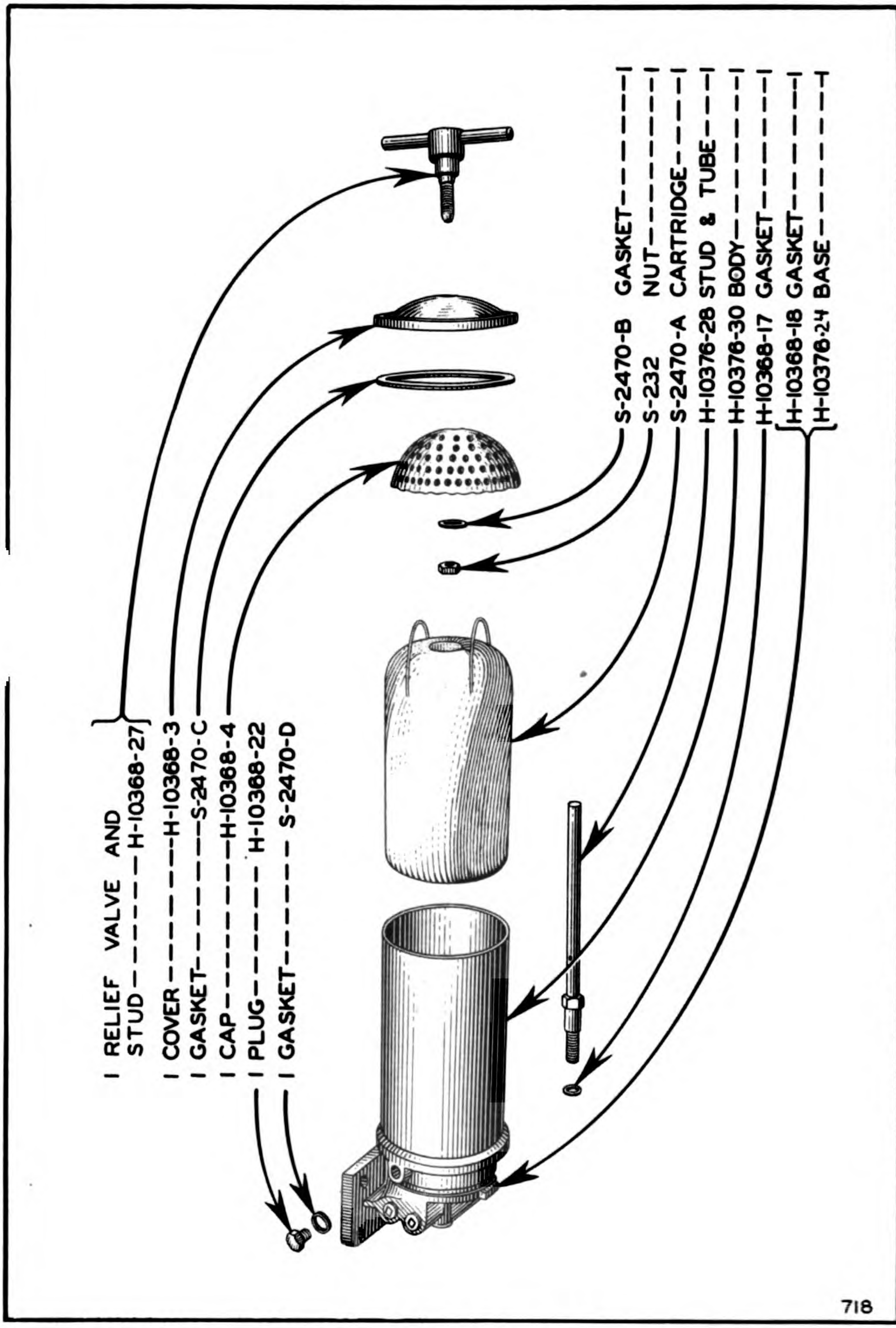

CUMMINS ENGINE CO. PARTS. ORDER FROM CUMMINS ENGINE CO. OR THEIR DISTRIBUTOR.

DE LUXE OIL FILTER

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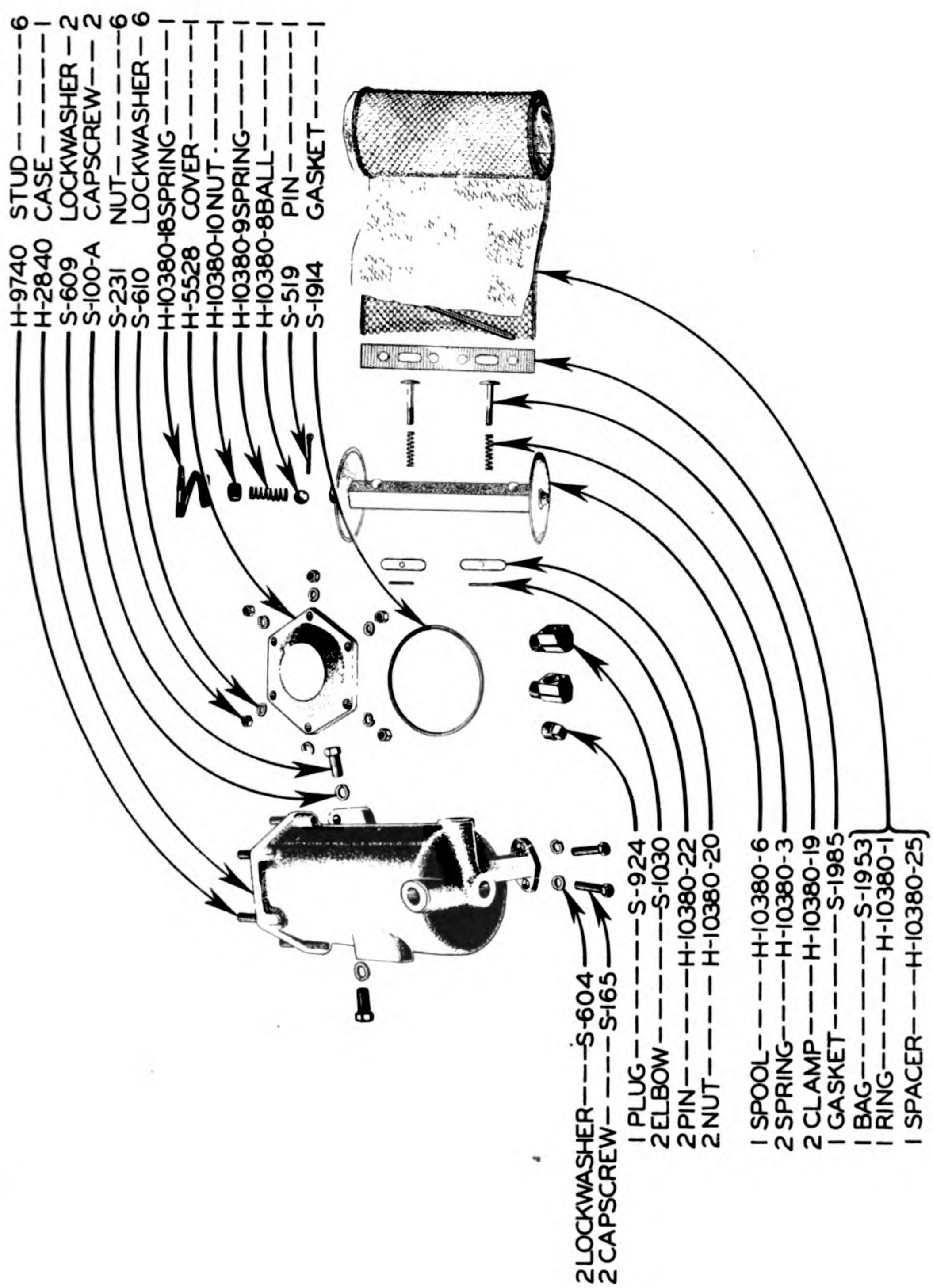

719

LUBRICATION OIL FILTER

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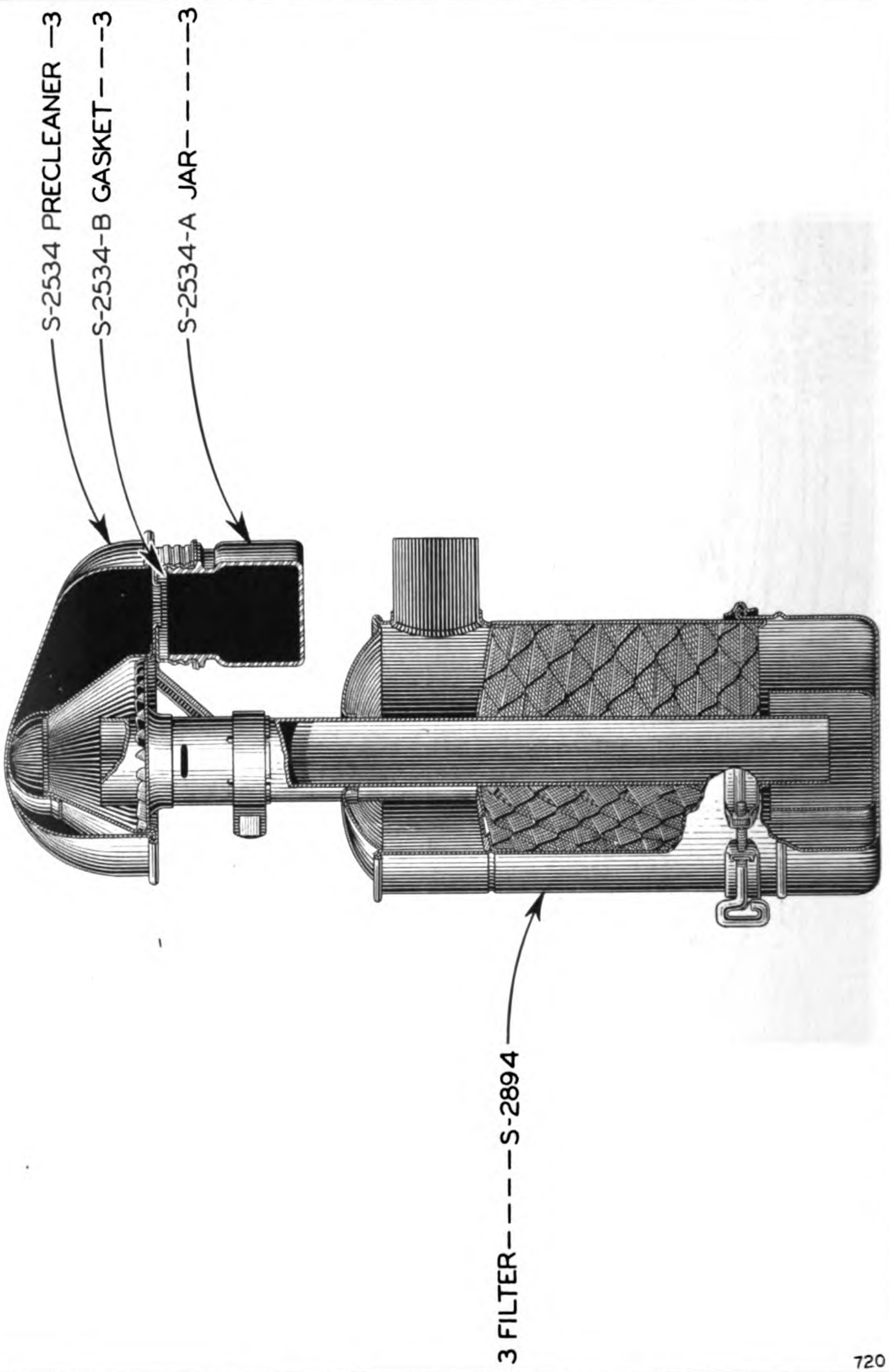

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DONALDSON AIR CLEANER

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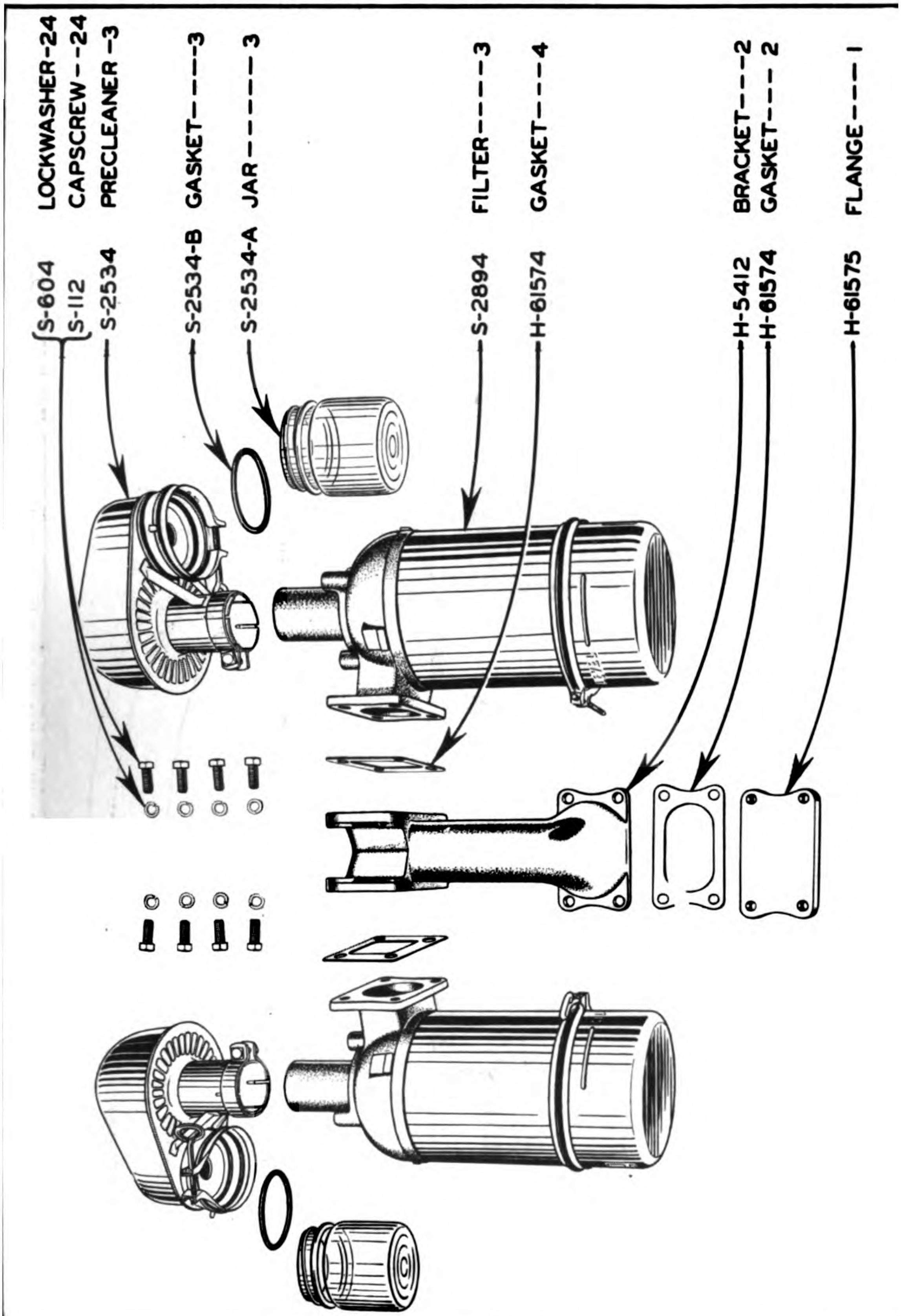

DONALDSON AIR CLEANER

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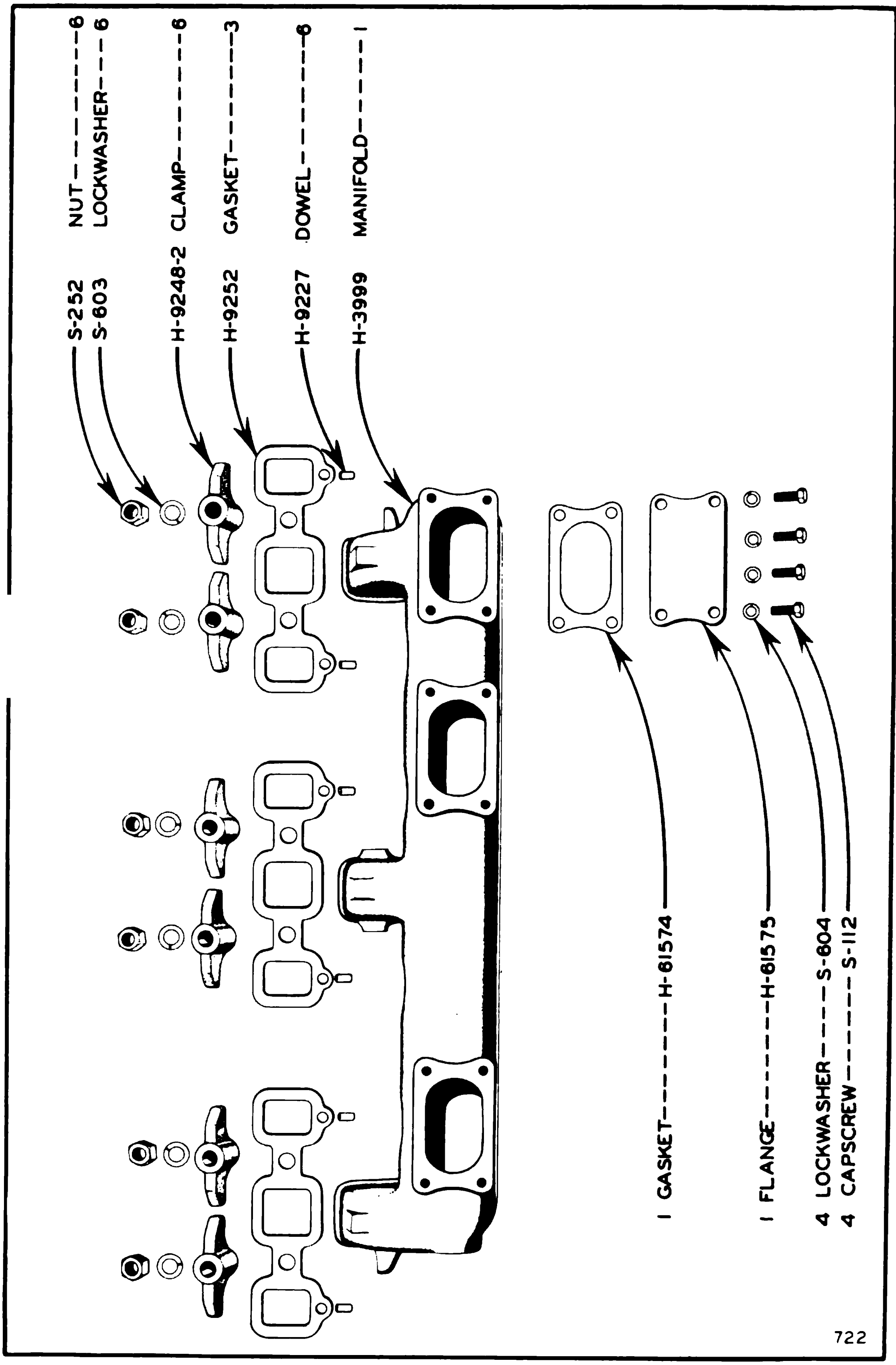

AIR INTAKE MANIFOLD

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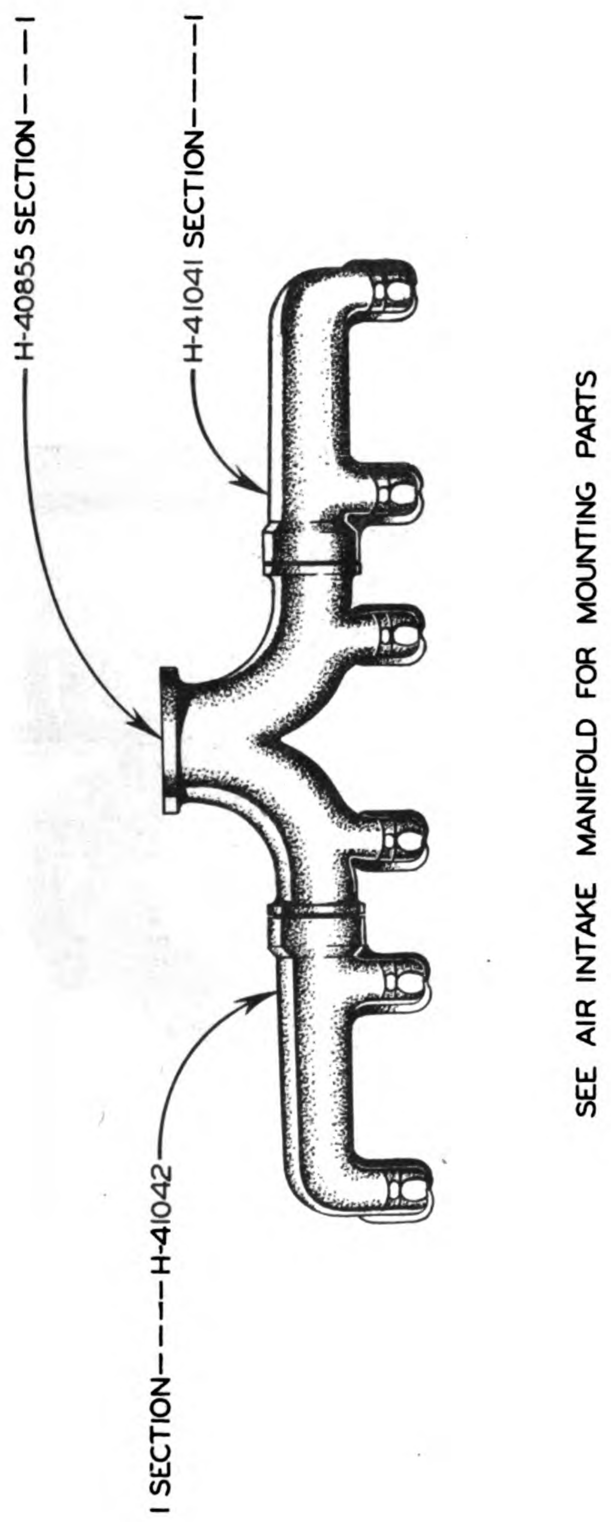

EXHAUST MANIFOLD

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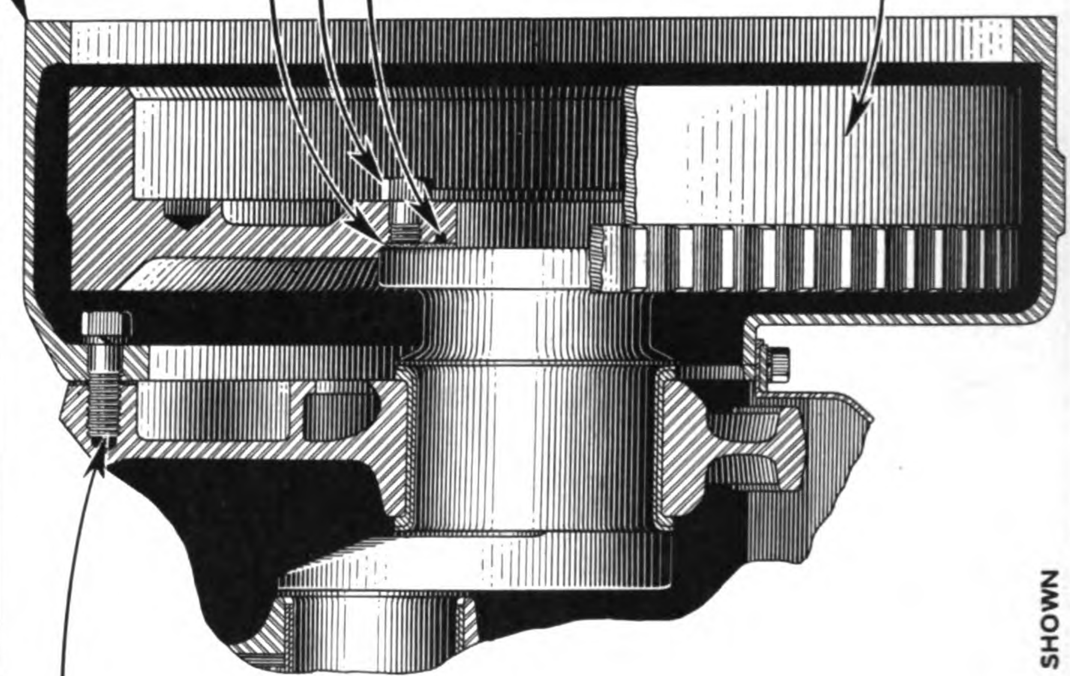

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FLYWHEEL & FLYWHEEL HOUSING

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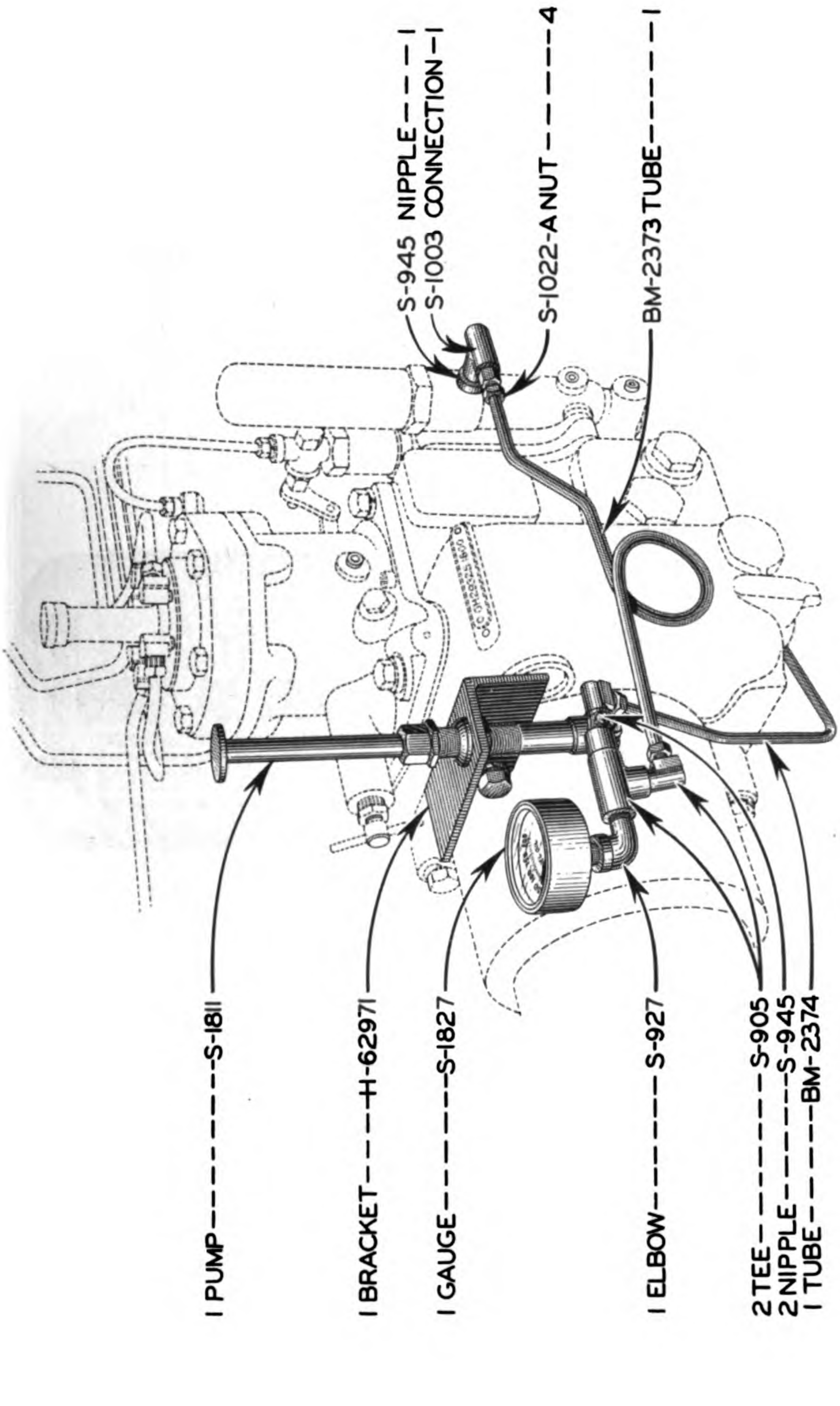

PRIMING PUMP & BRACKET

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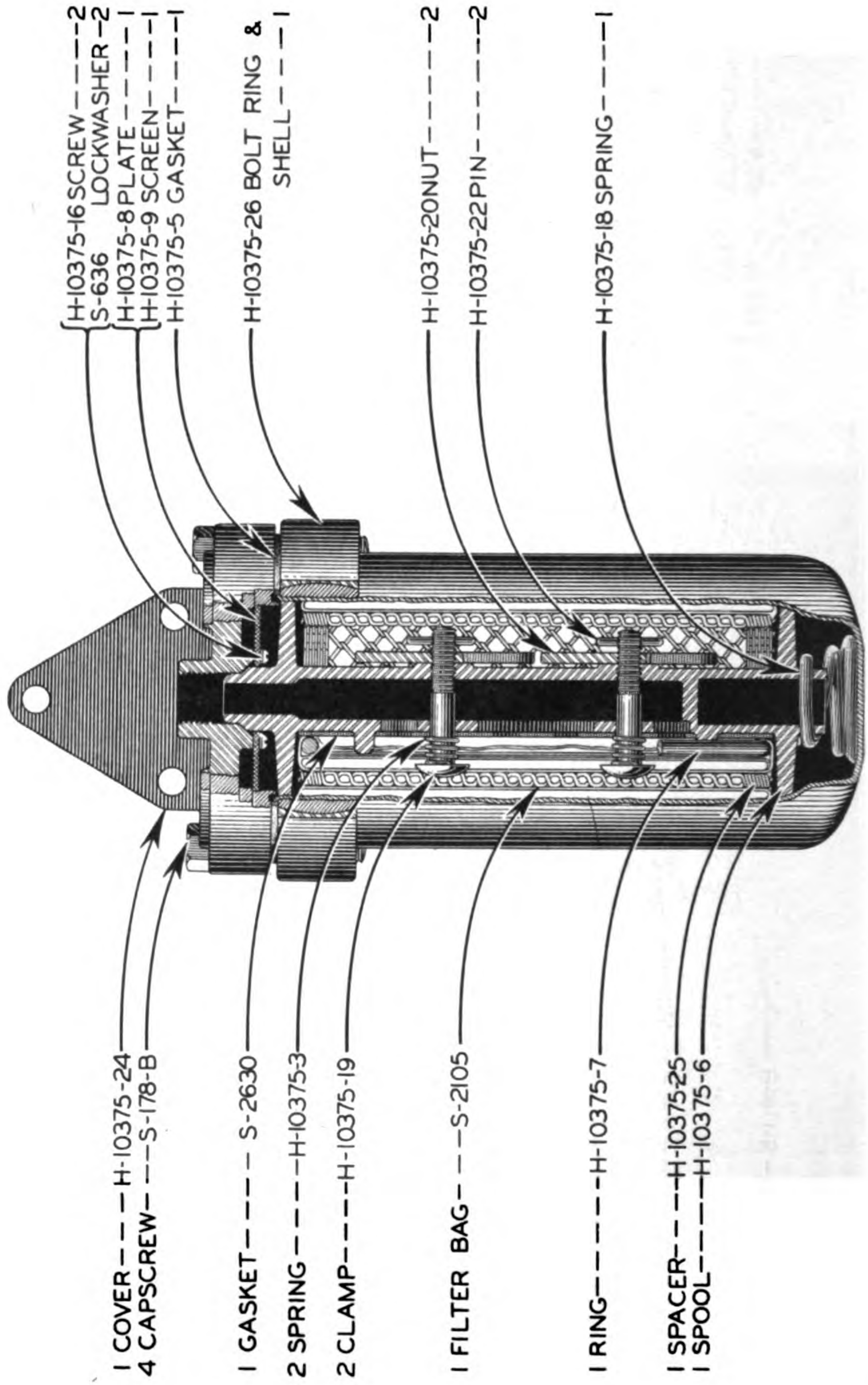

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NUGENT FUEL FILTER

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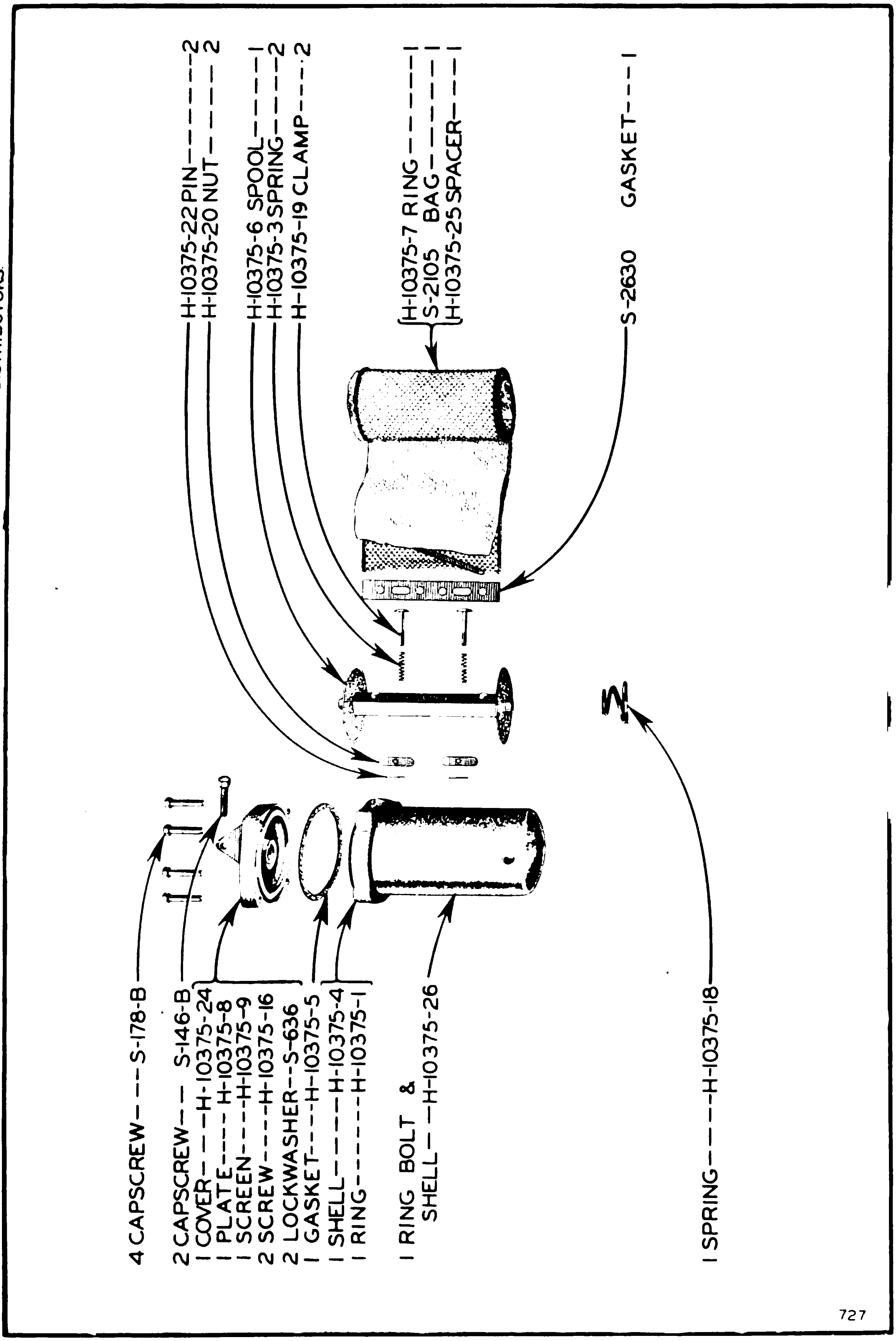
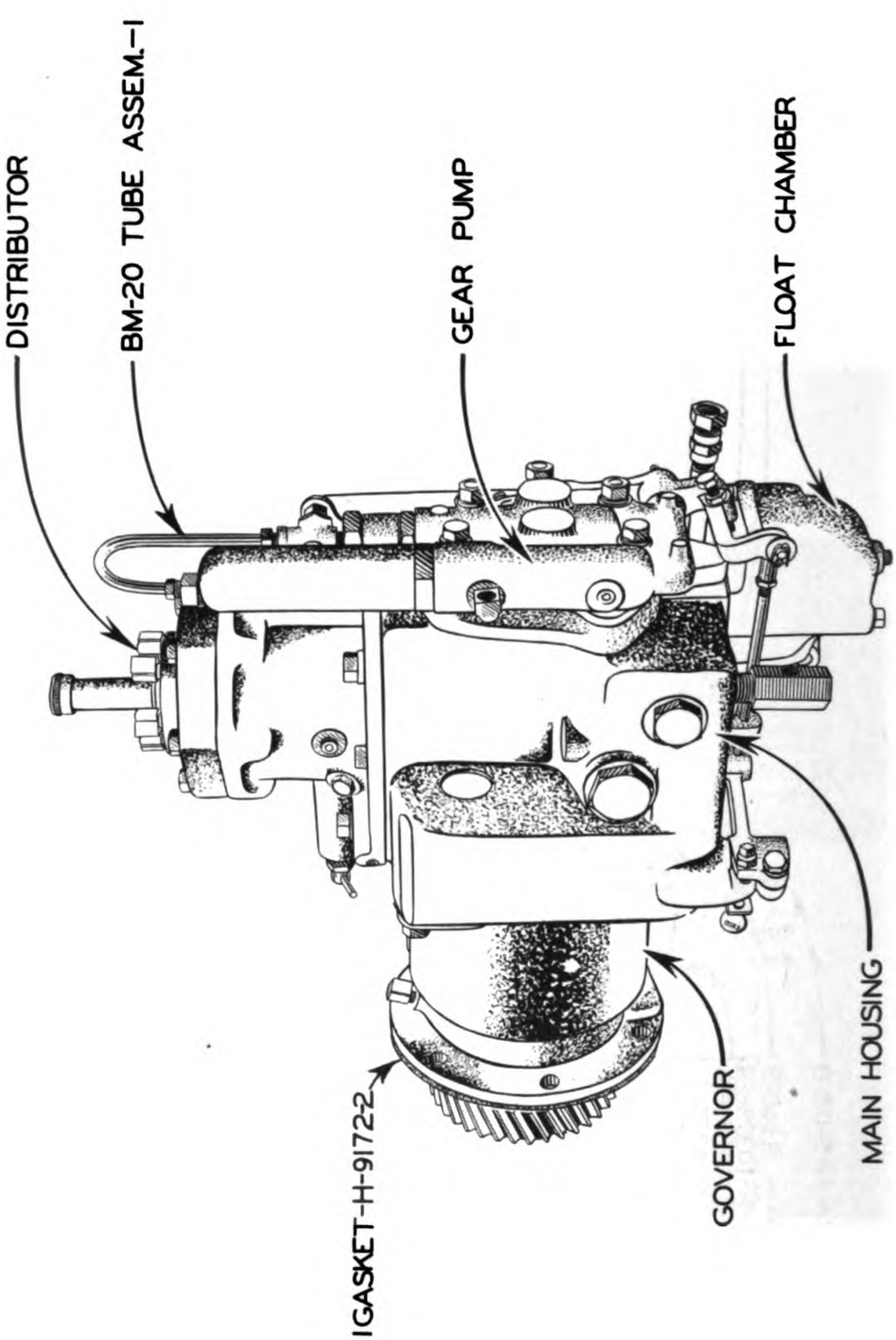


NUGENT FUEL FILTER



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FUEL PUMP ASSEMBLY DRAWING

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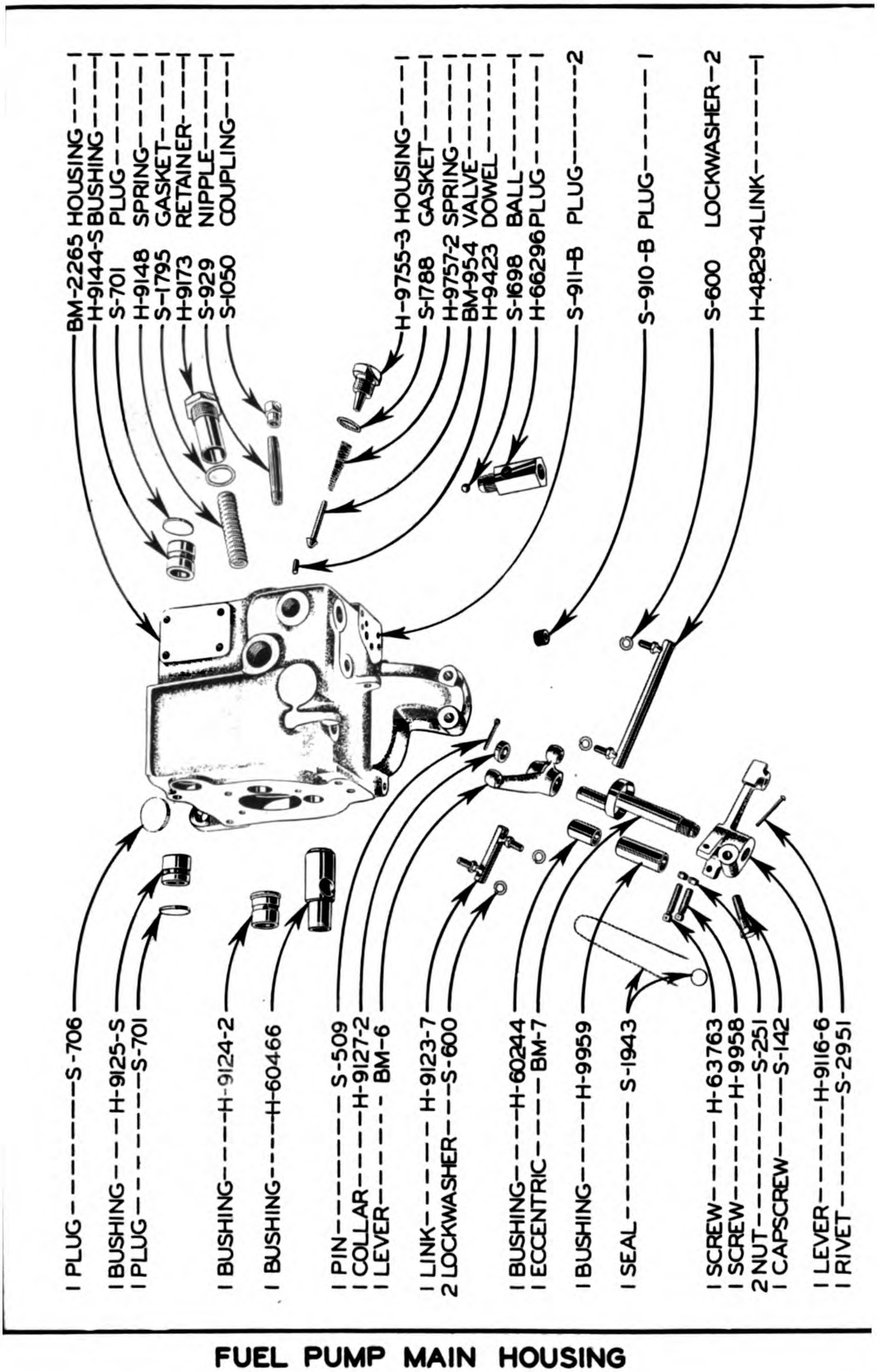

FUEL PUMP MAIN HOUSING

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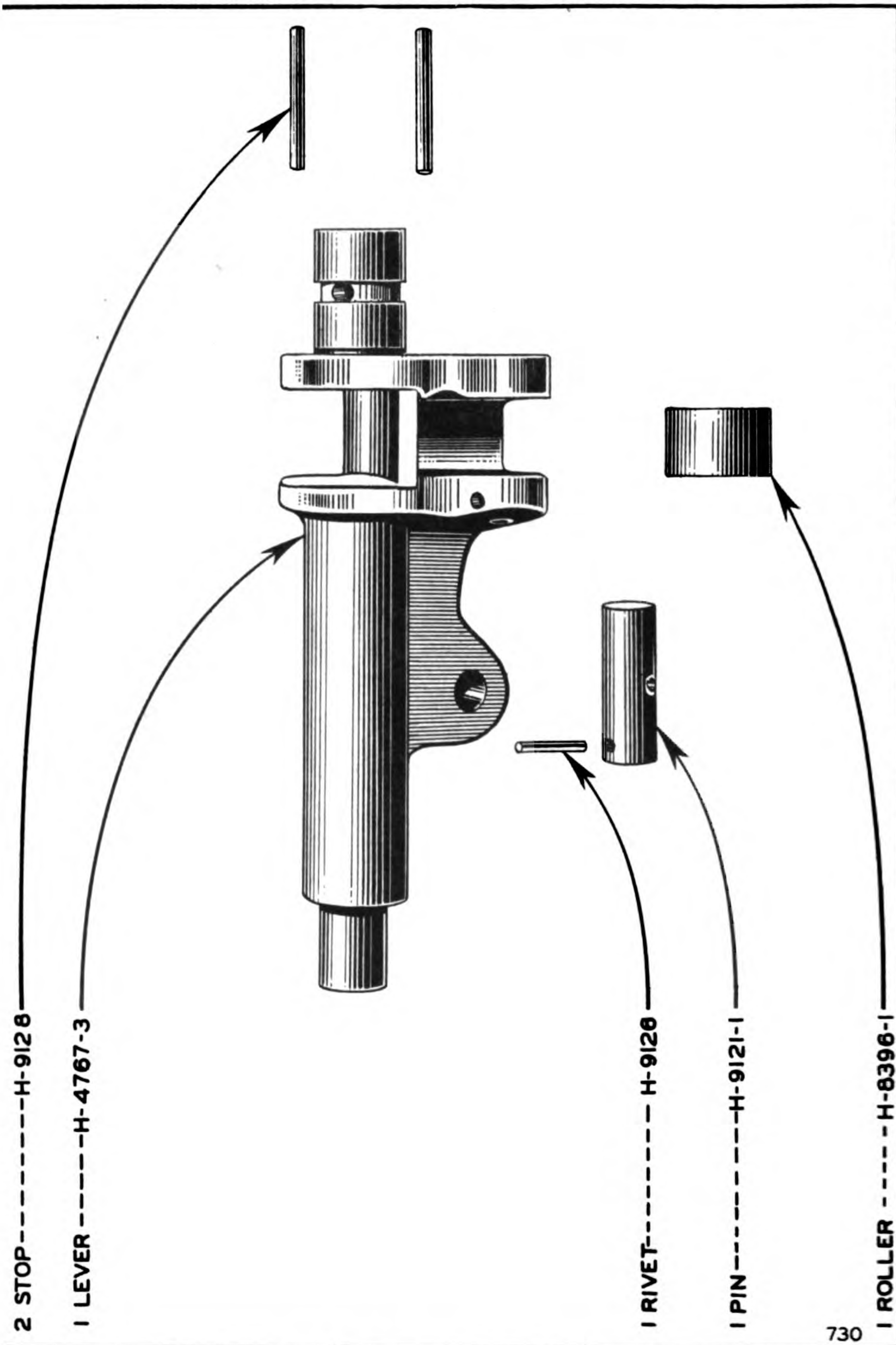

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CAM ROCKER LEVER

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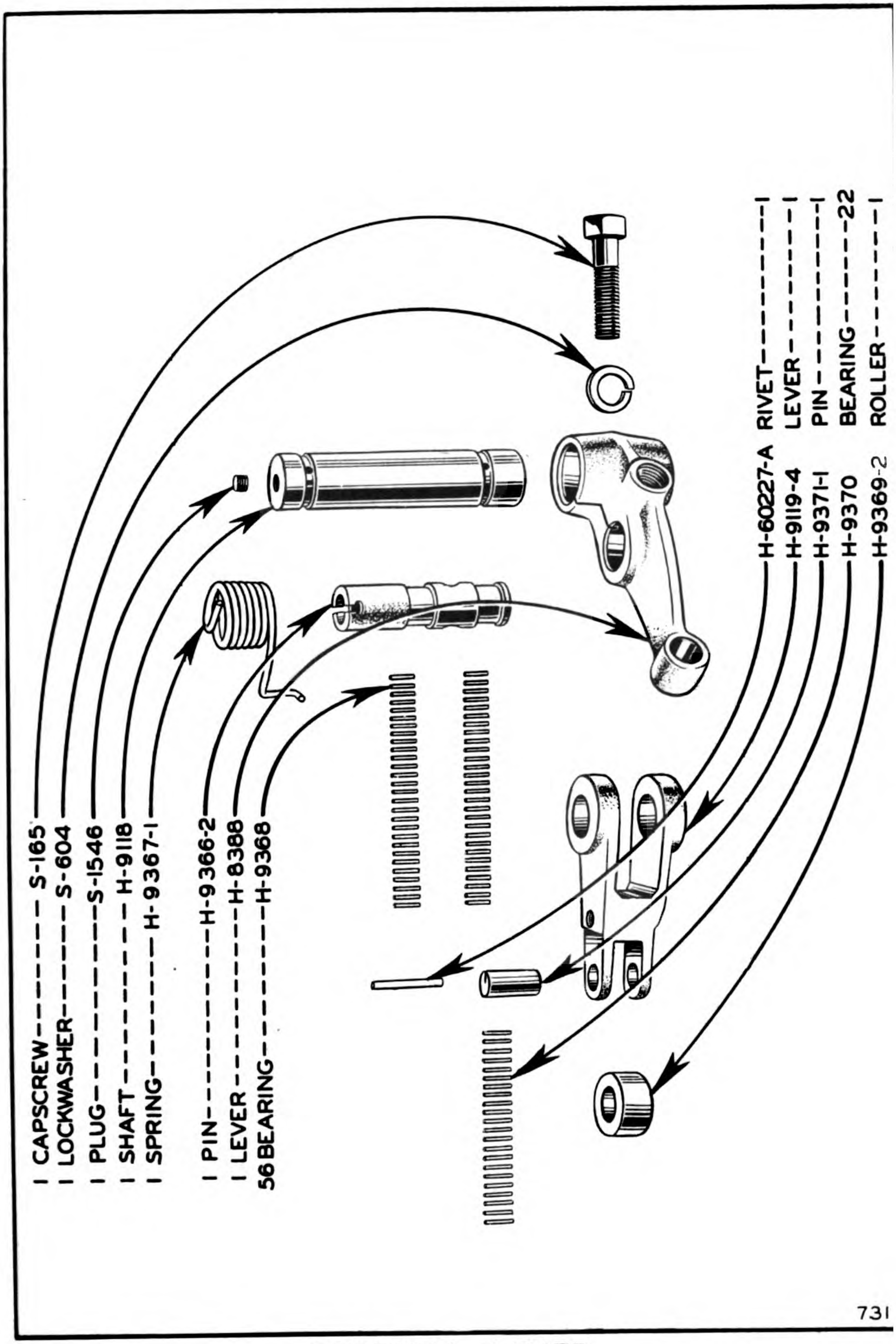

VERTICAL LEVER

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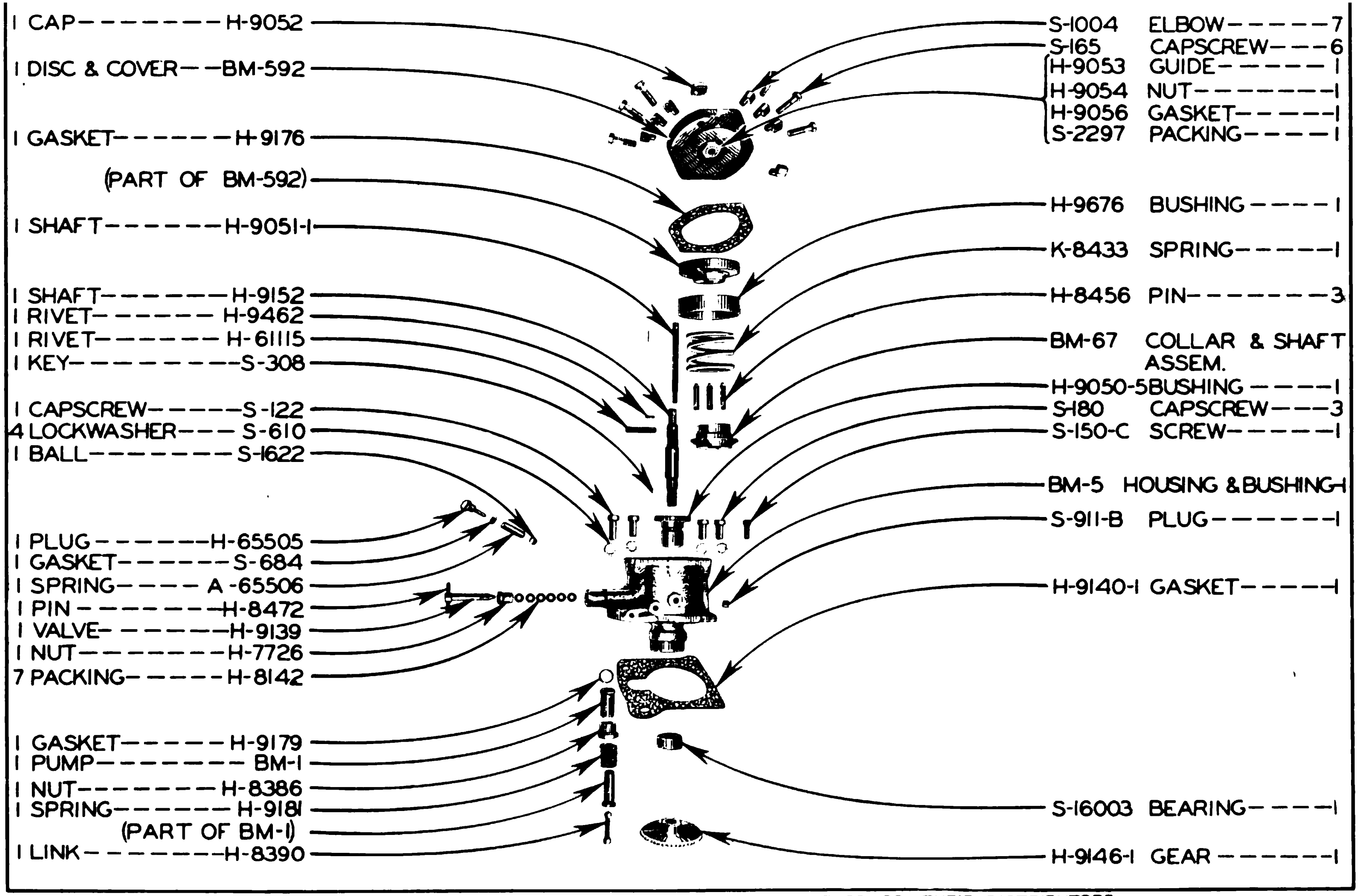

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DISTRIBUTOR

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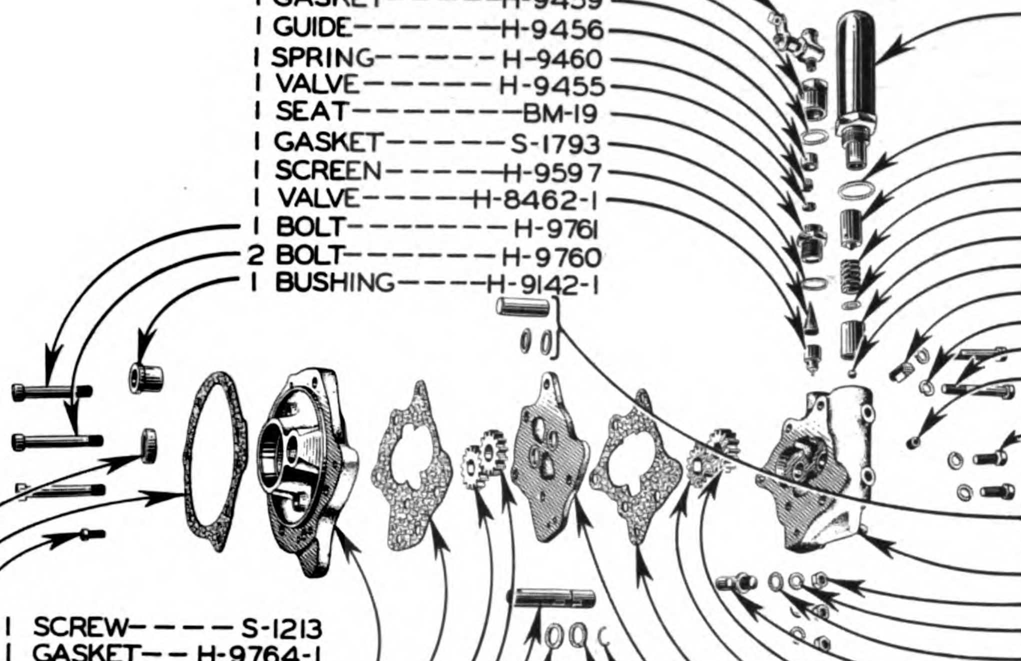
CUMMINS ENGINE CO. PARTS. ORDER FROM CUMMINS ENGINE CO. OR THEIR DISTRIBUTORS.

BM-12 GEAR PUMP ASSEM.--1

1 COCK--------S-1873
1 HOUSING---H-9458-1
1 GASKET-----H-9459
1 GUIDE------H-9456
1 SPRING-----H-9460
1 VALVE------H-9455
1 SEAT--------BM-19
1 GASKET------S-1793
1 SCREEN-----H-9597
1 VALVE-----H-8462-1
1 BOLT--------H-9761
2 BOLT-------H-9760
1 BUSHING----H-9142-1

H-64889 CHAMBER---1
S-1822 GASKET-----1
H-9135-3 VALVE-------1
H-9495-1 SPRING-----1
H-9910 WASHER
H-9134-1 SLEEVE------1
S-1698 BALL--------1
S-1004-1 ELBOW------1
S-604 LOCKWASHER—4
S-141 CAPSCREW-- 2
S-911-B PLUG-------1
S-112 CAPSCREW---1
H-9759 SHAFT-------1
H-60099 SEAL--------1
H-60098 WASHER-----1
H-2427-3 BODY-------1
S-205 NUT---------3
S-604 LOCKWASHER— 3
H-6753 GASKET-----1
H-9765 SHAFT------1
H-9508 GEAR-------1
H-9507 GEAR-------1
H-9766-2 GASKET-----1
H-4893-2 SPACER-----1
S-1848 RING--------1
H-60099 SEAL-------1
S-314 KEY--------1



1 SCREEN---- S-1213
1 GASKET-- H-9764-1
1 SEAL------S-1918
1 BODY-----H-2425-5
1 GASKET---H-9767-1
1 GEAR------H-9132-1
1 GEAR------ H-9509
1 SHAFT-----H-9758-1
1 WASHER---H-60098
1 KEY-------H-9919

GEAR PUMP

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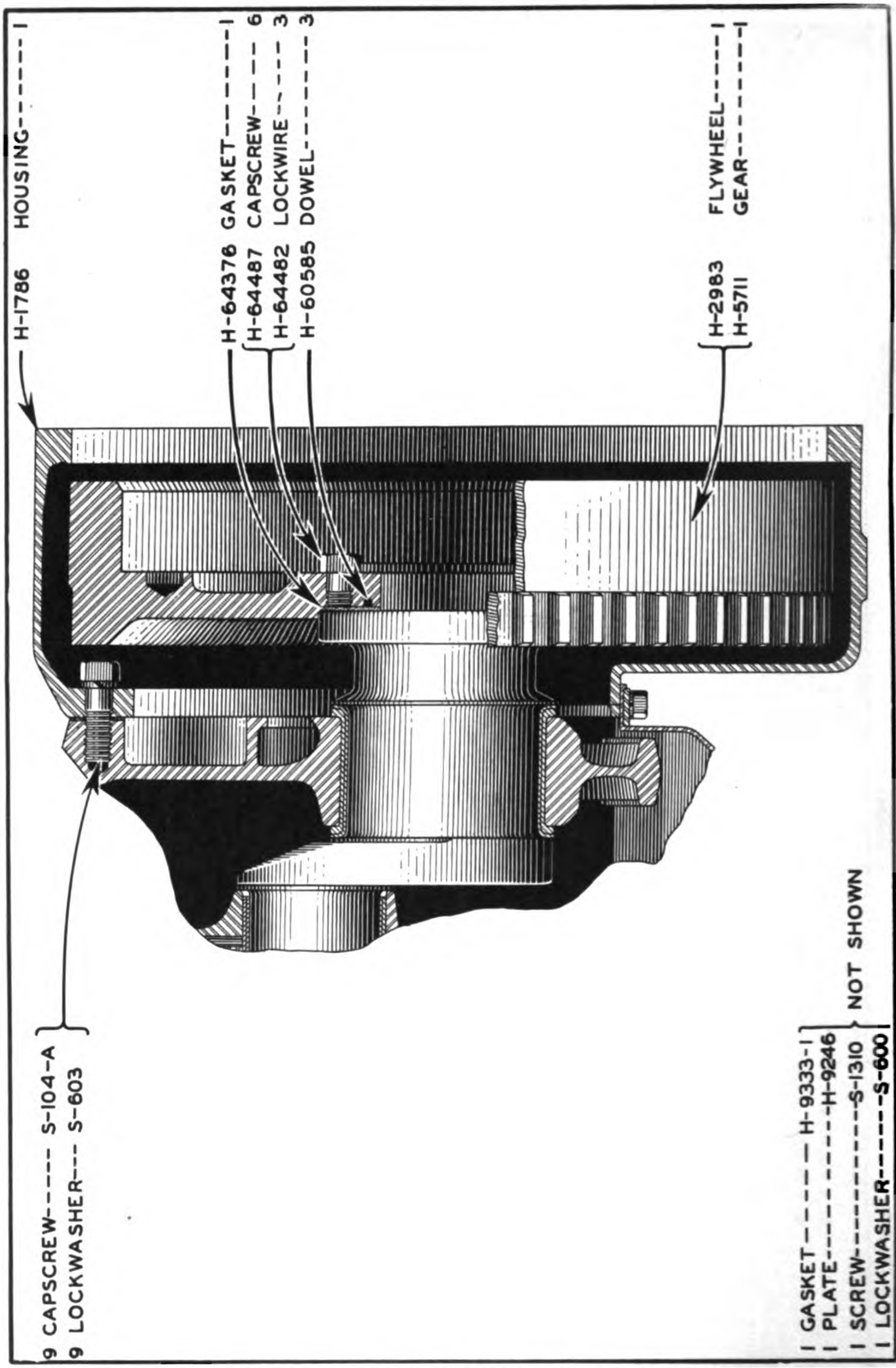
352 HBID 600 CUMMINS ENGINE FOR SUPER C



FLYWHEEL & FLYWHEEL HOUSING

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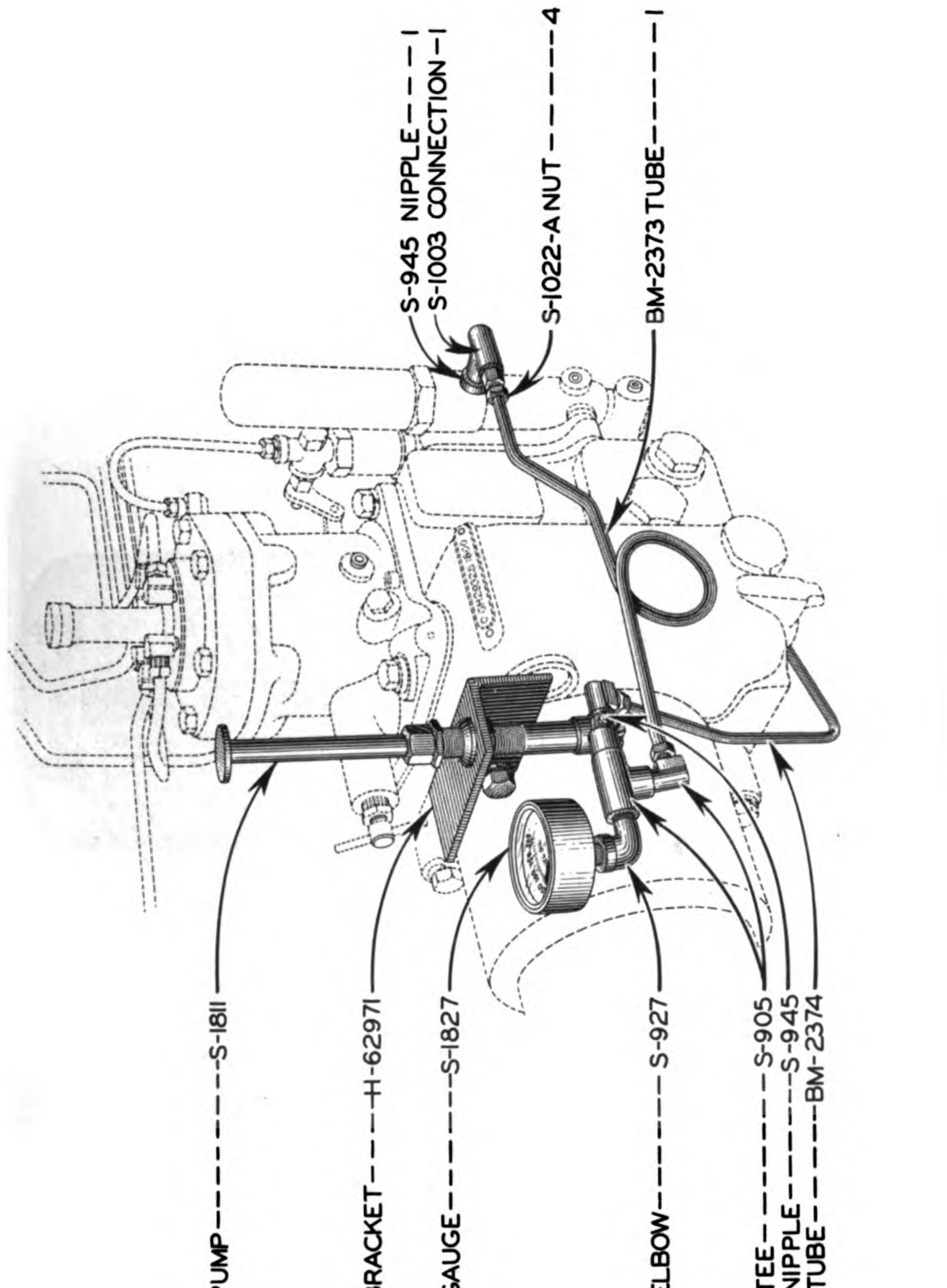

PRIMING PUMP & BRACKET

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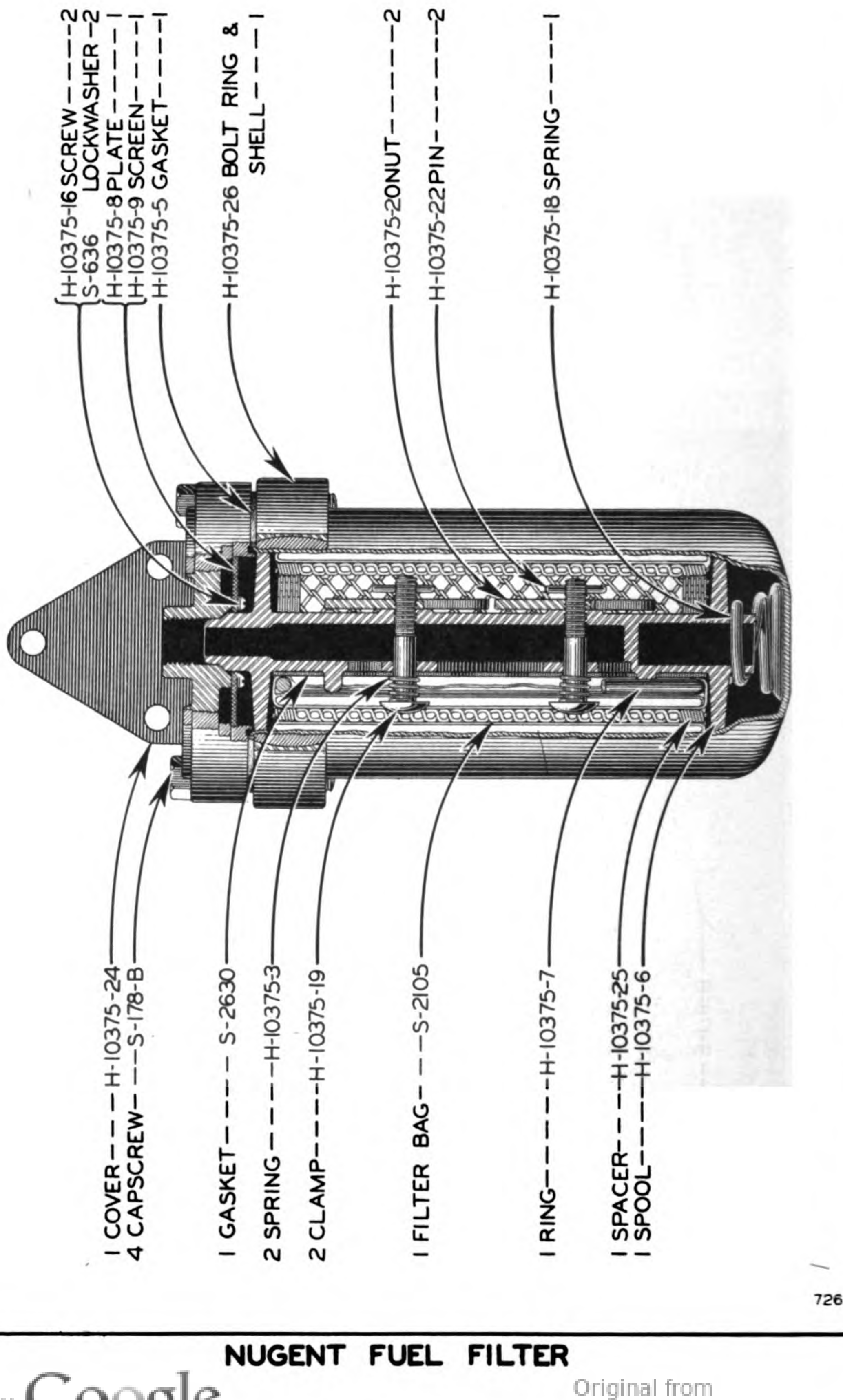

CUMMINS ENGINE CO PARTS ORDER FROM CUMMINS ENGINE CO. OR THEIR DISTRIBUTORS.

NUGENT FUEL FILTER

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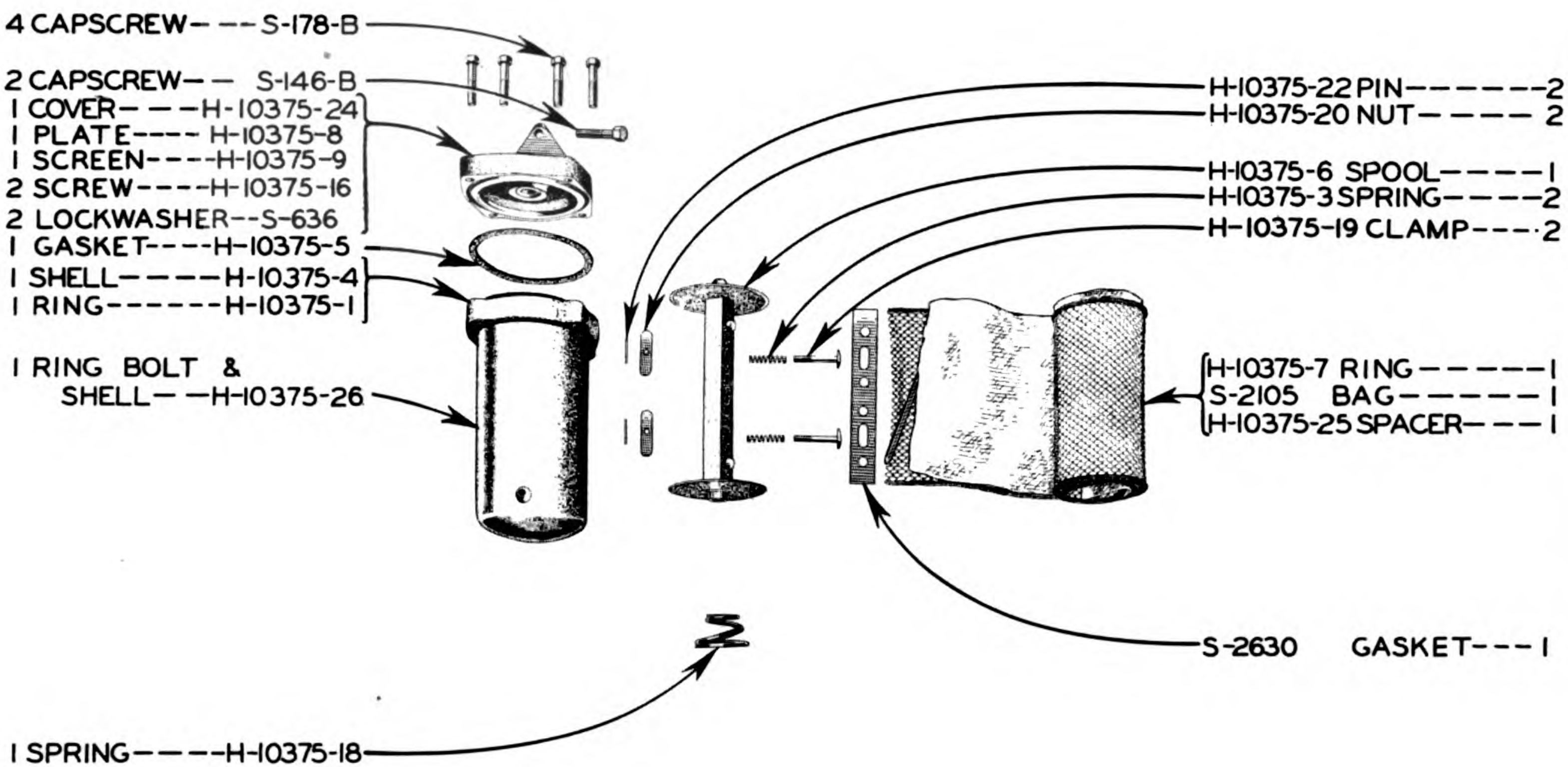
CUMMINS ENGINE CO. PARTS. ORDER FROM CUMMINS ENGINE CO. OR THEIR DISTRIBUTORS.



727

NUGENT FUEL FILTER

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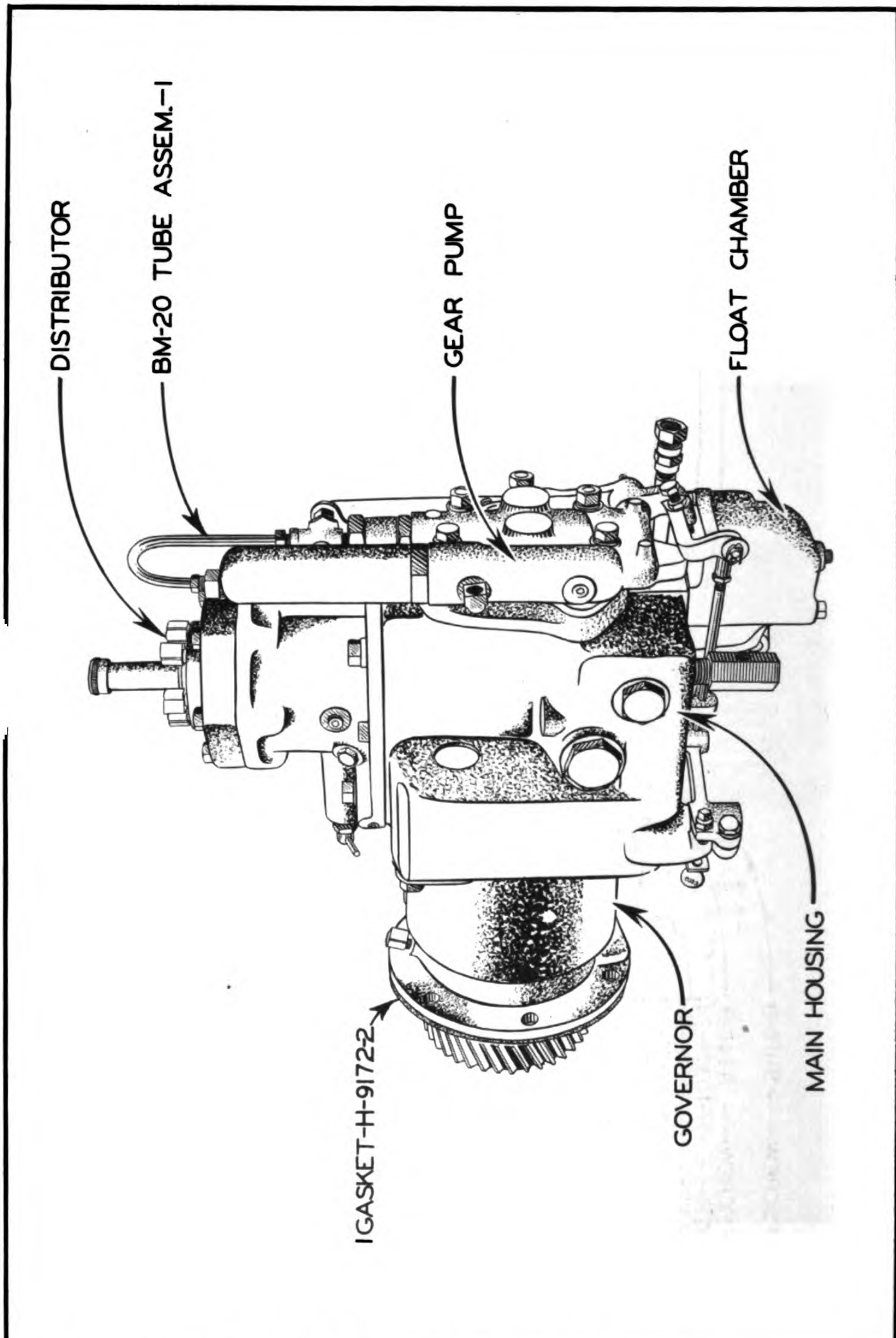

CUMMINS ENGINE CO. PARTS. ORDER FROM CUMMINS ENGINE CO. OR THEIR DISTRIBUTORS.

FUEL PUMP ASSEMBLY DRAWING

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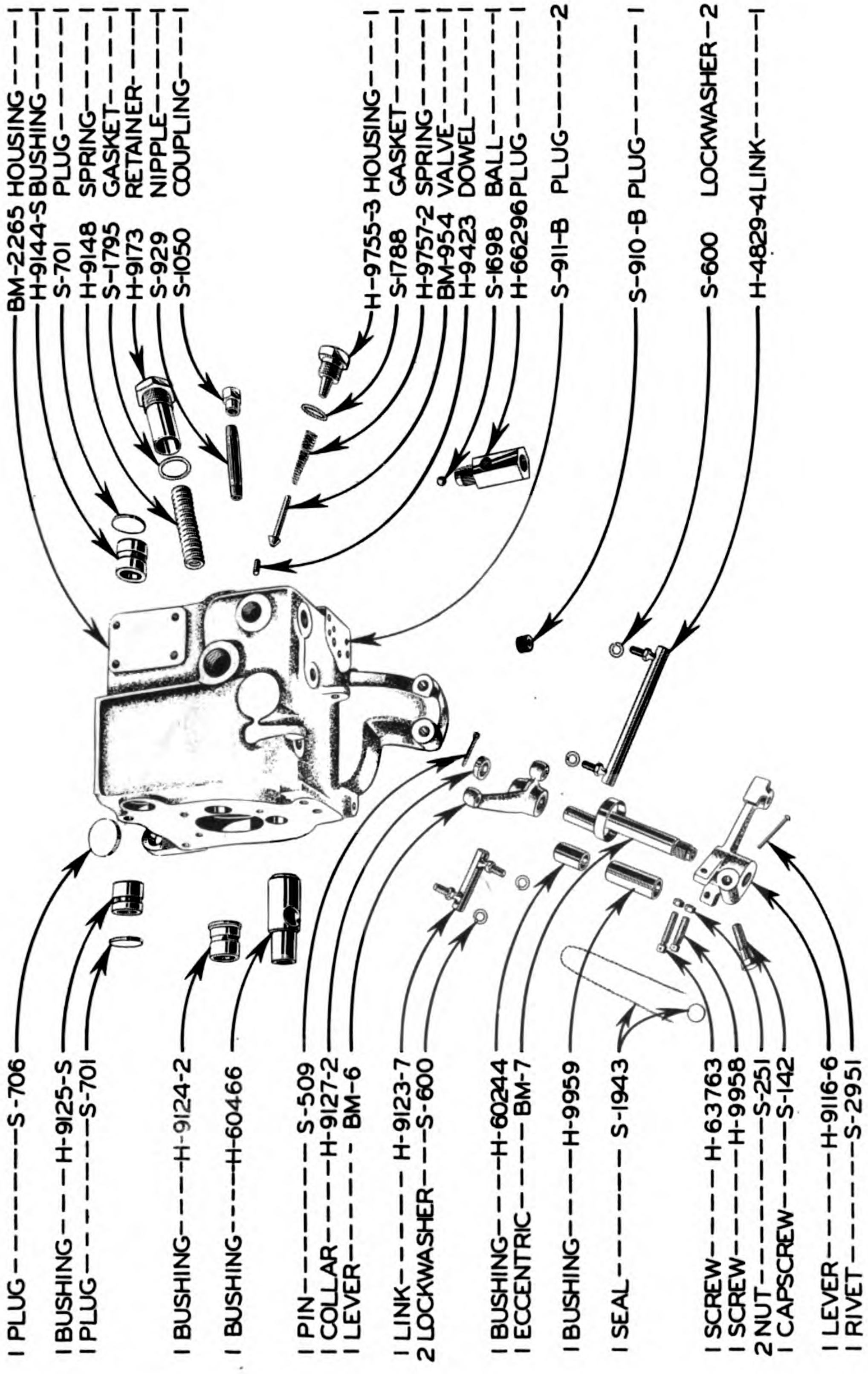

FUEL PUMP MAIN HOUSING

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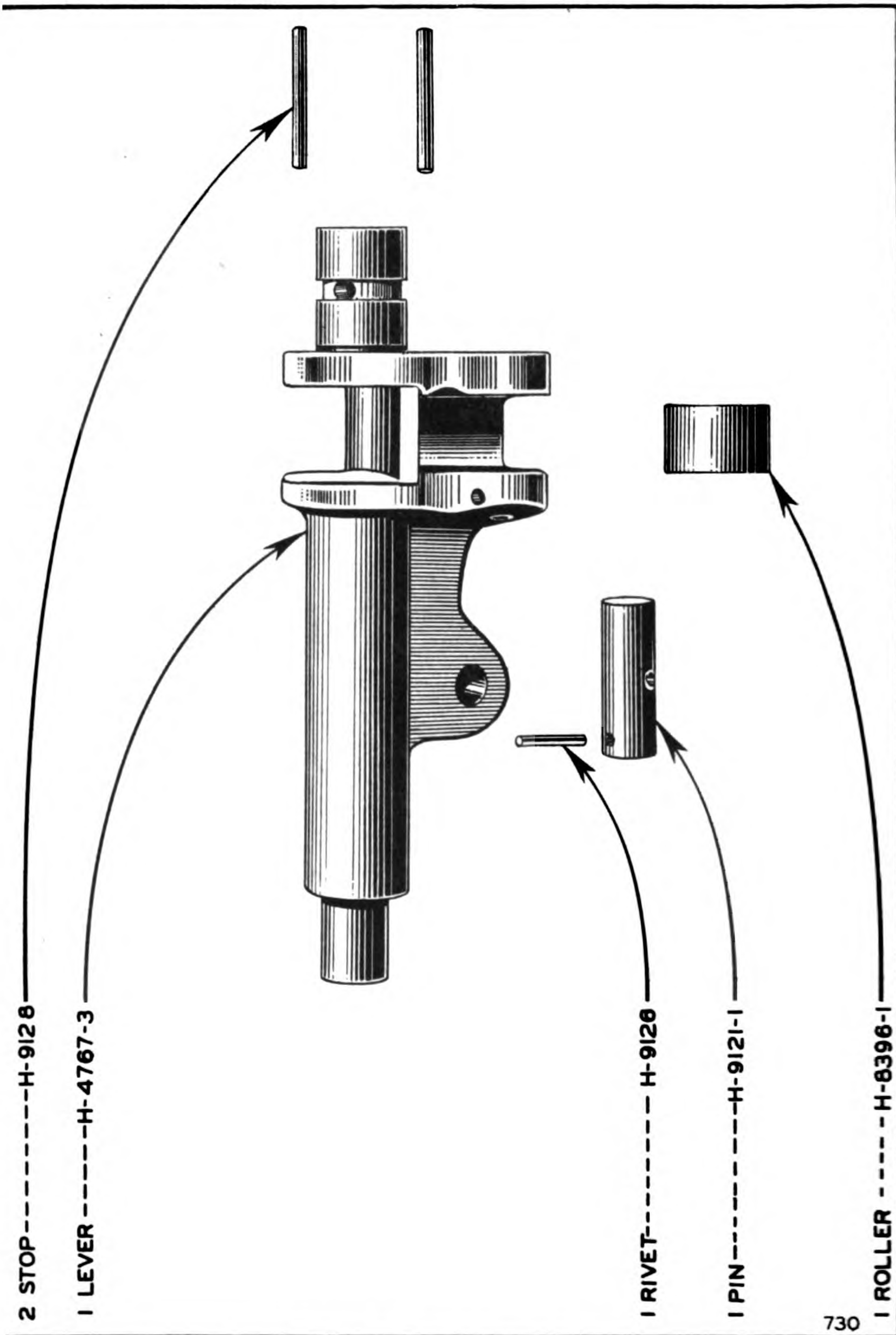

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CAM ROCKER LEVER

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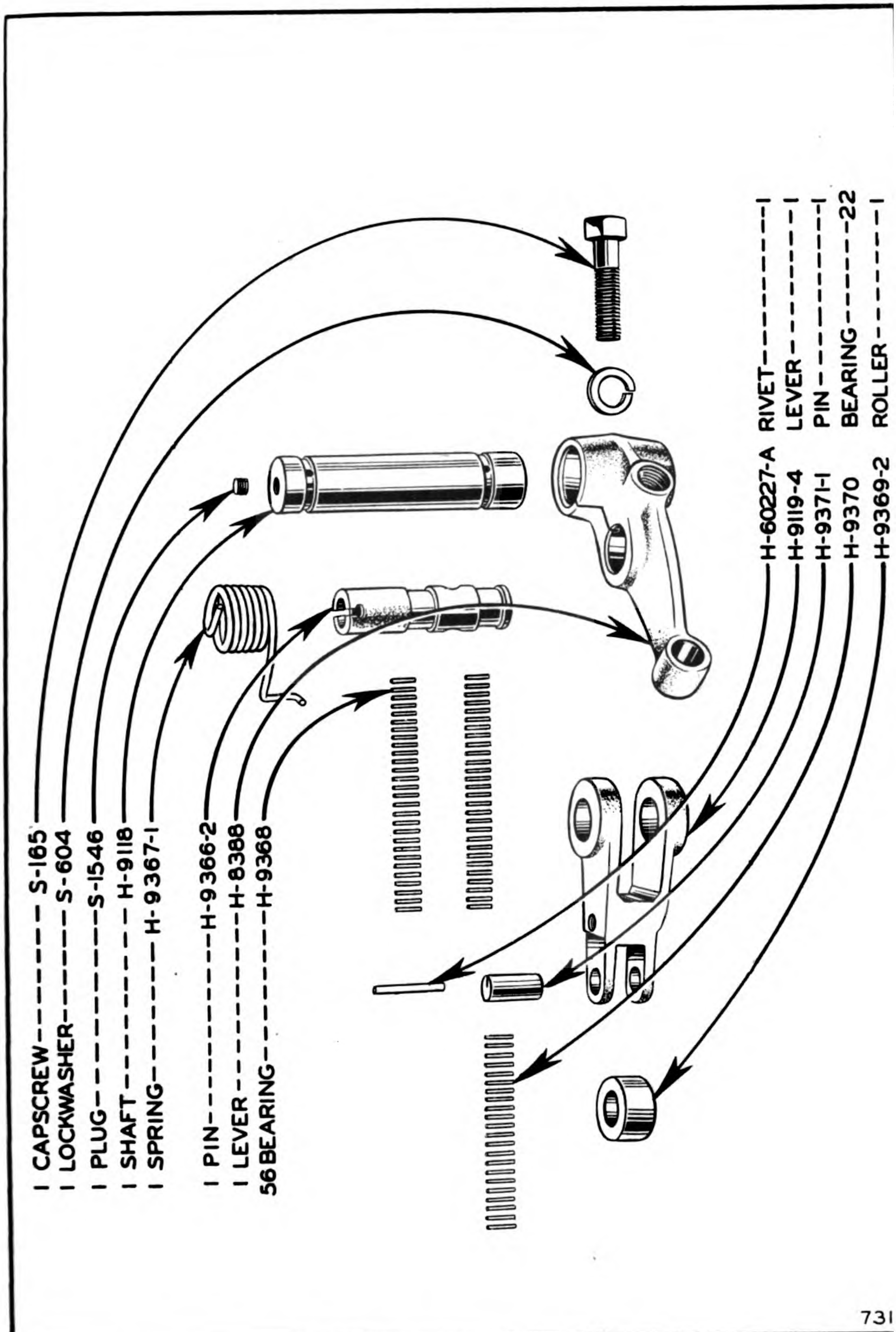

VERTICAL LEVER

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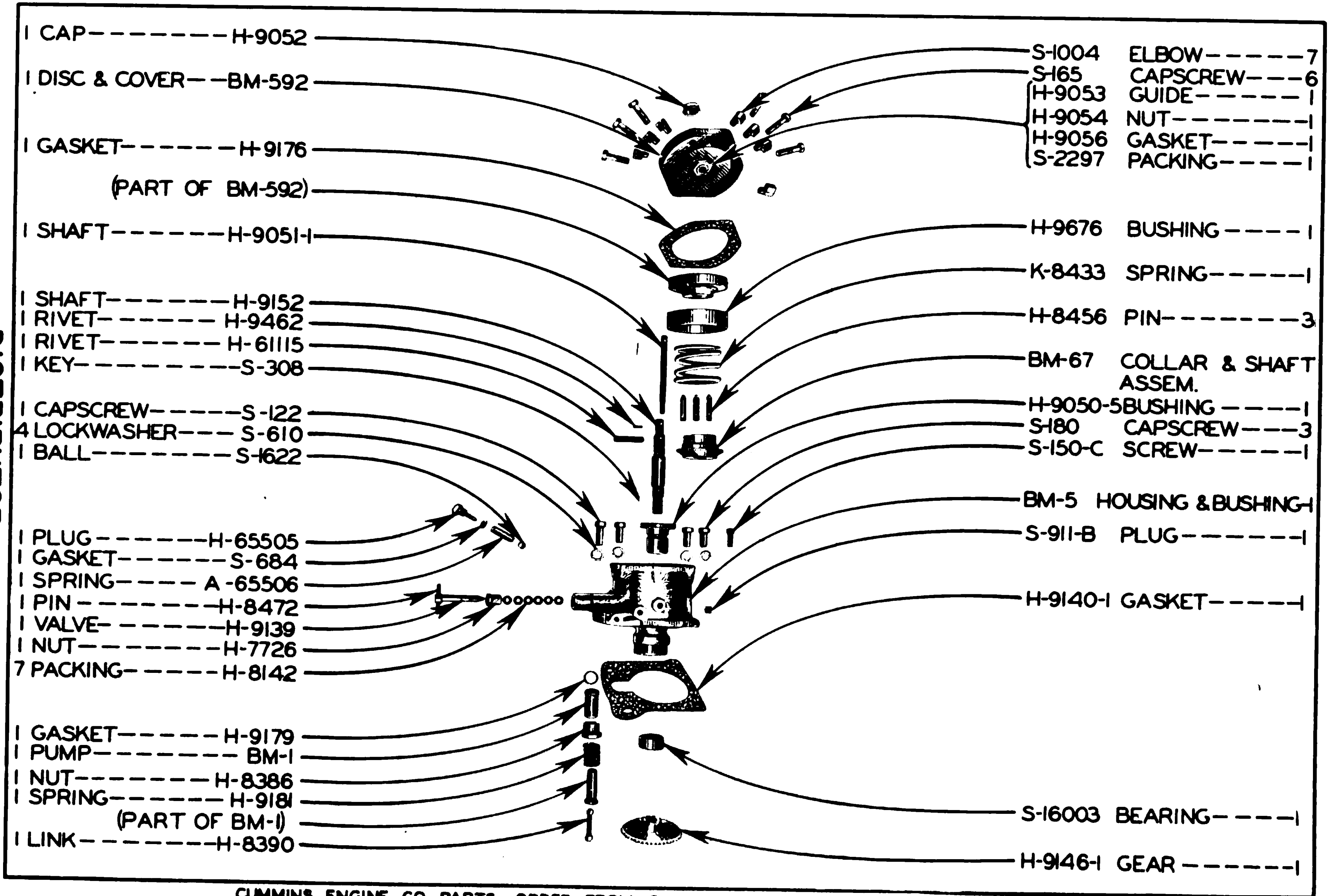

CUMMINS ENGINE CO. PARTS. ORDER FROM CUMMINS ENGINE CO. OR THEIR DISTRIBUTORS.

DISTRIBUTOR

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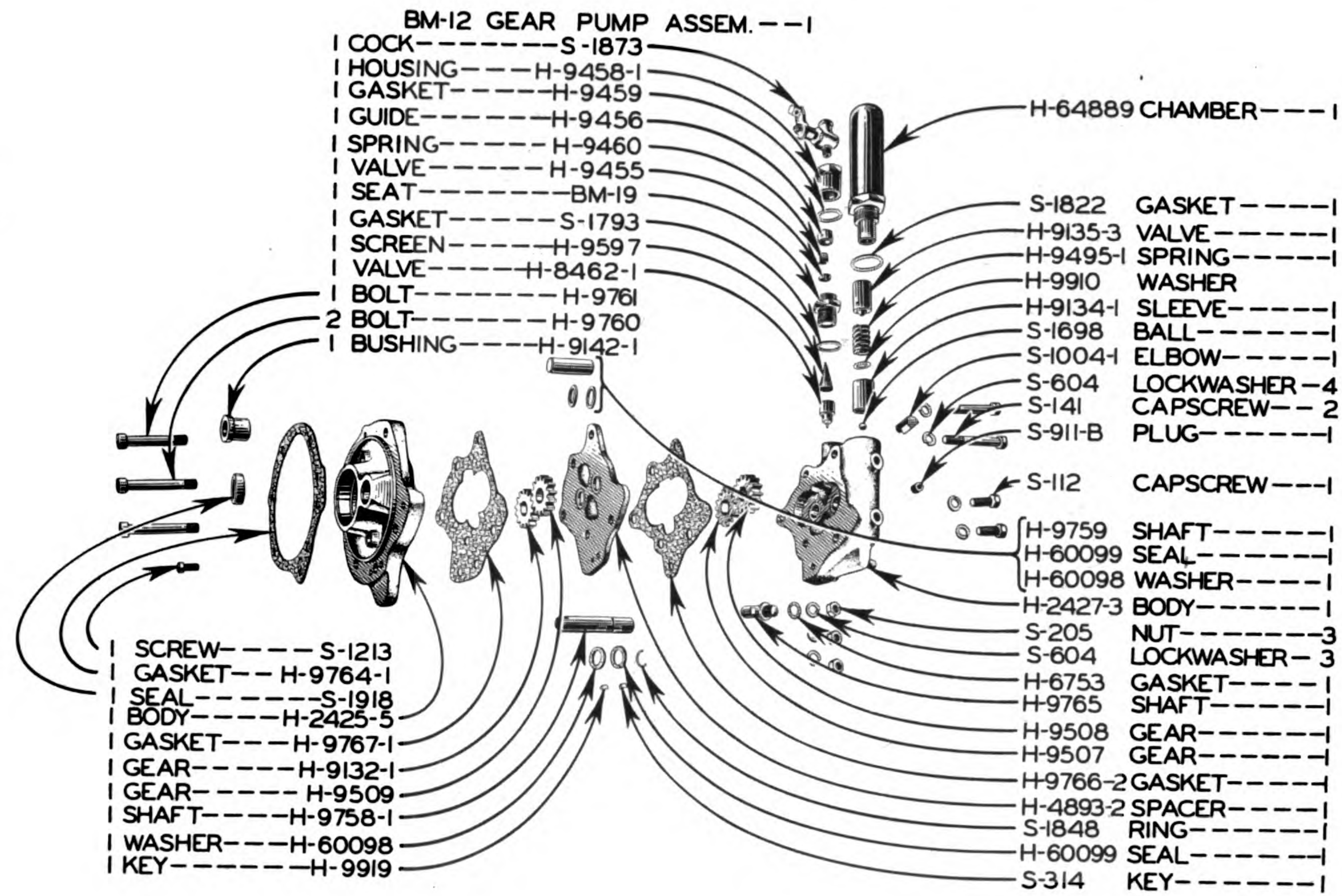

GEAR PUMP

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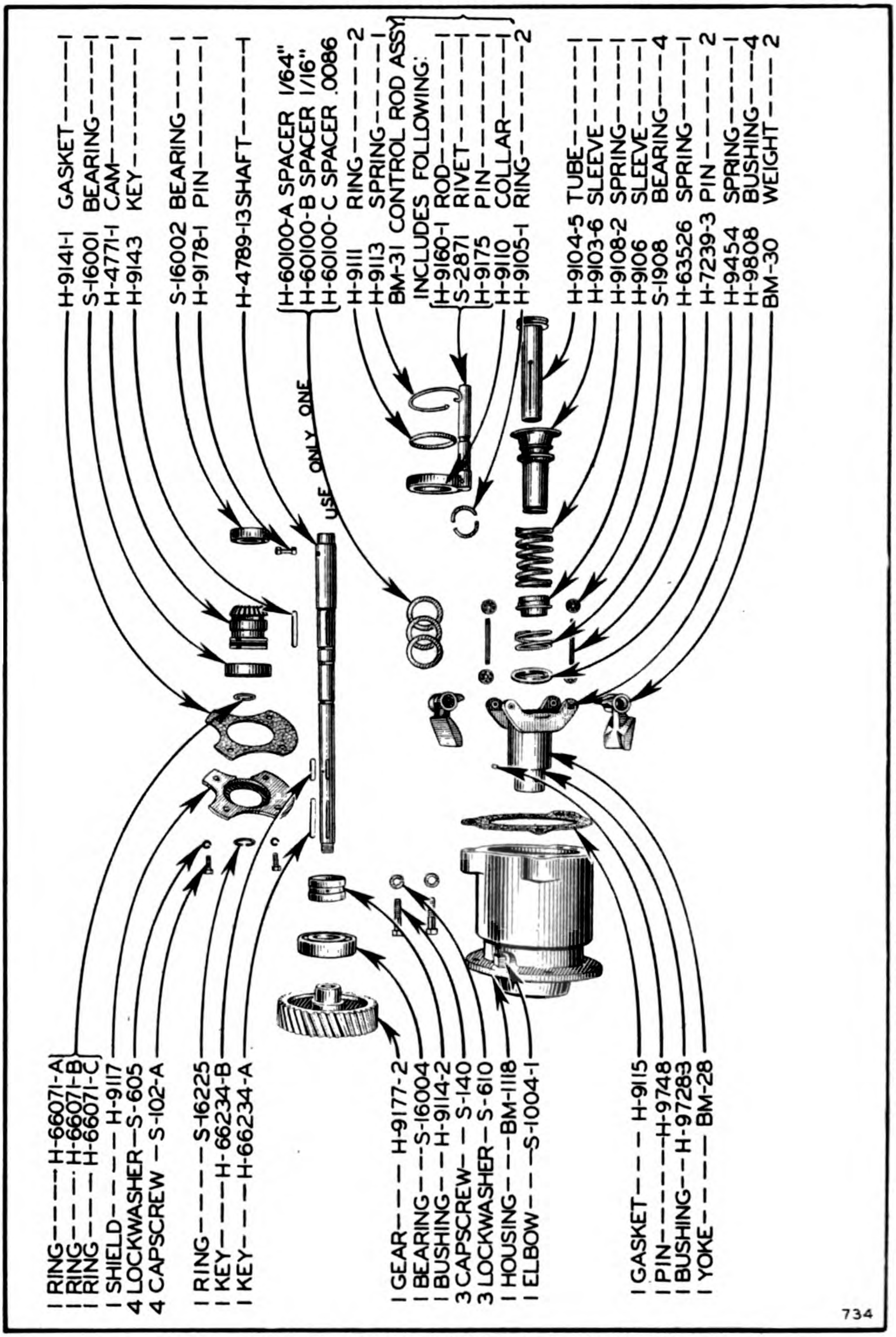

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FUEL PUMP MAIN SHAFT & GOVERNOR

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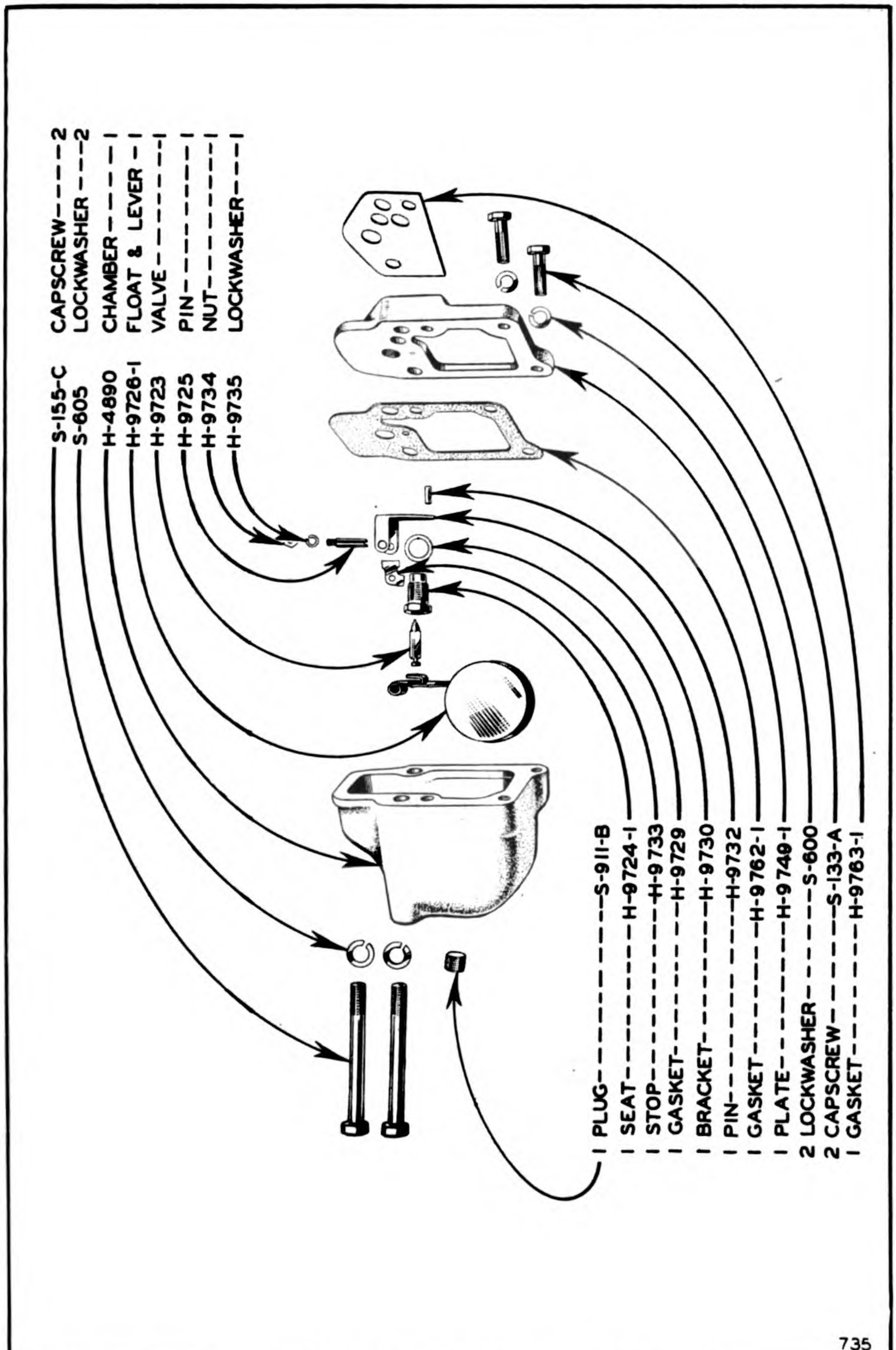

FLOAT CHAMBER

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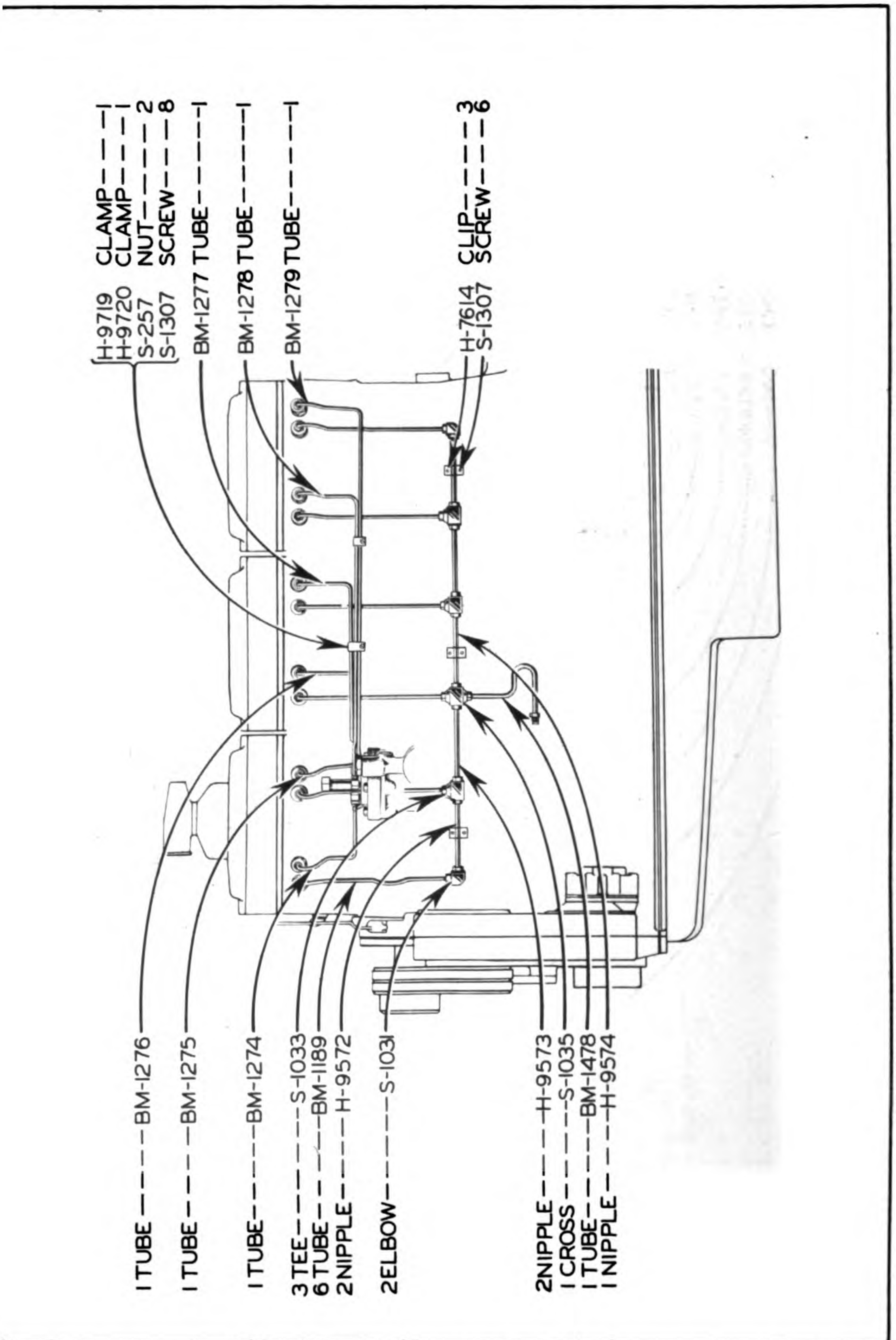

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FUEL TUBING

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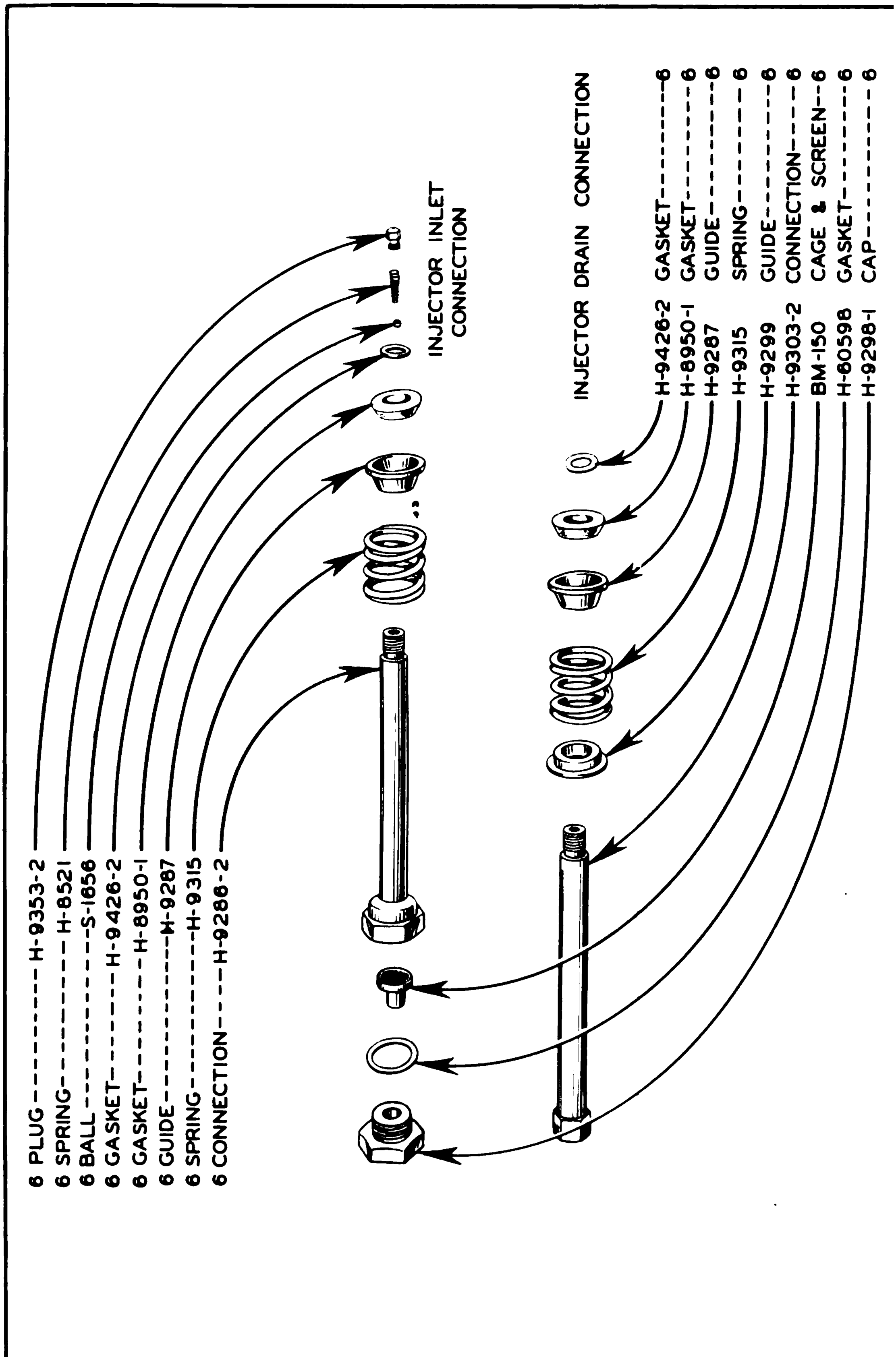

INJECTOR INLET & OUTLET CONNECTION

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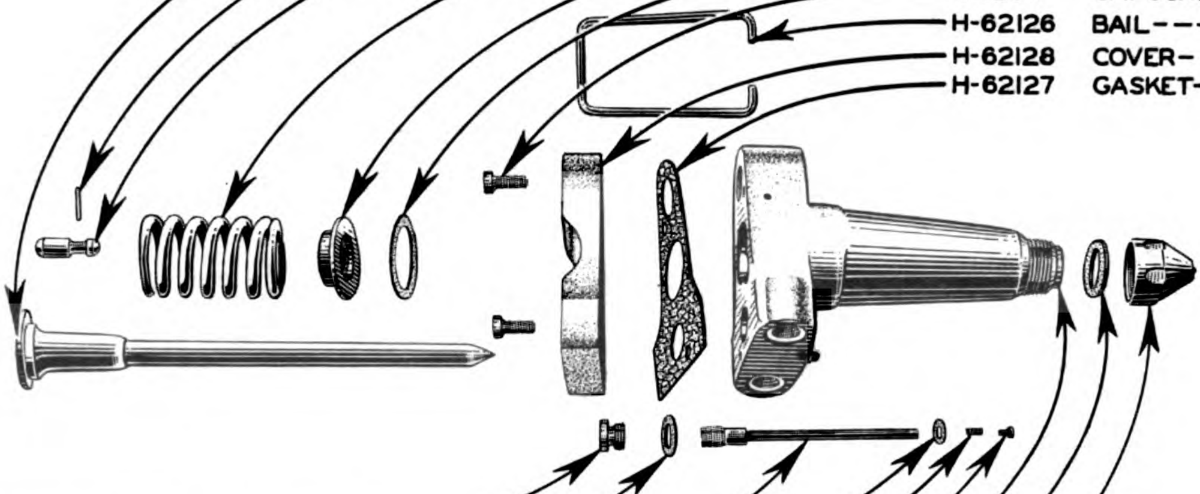
BM-142 INJECTOR ASSEMBLY—6

INCLUDED WITH——BM-2469
H-9355 PIN——6
H-7194-2 LINK——6
H-62123 SPRING——6
S-2345-1 SEAL——6
H-62129 GASKET——6
S-1207 CAPSCREW——12
H-62126 BAIL——6
H-62128 COVER——6
H-62127 GASKET——6



6 PLUG——H-9433
6 GASKET——H-9432
6 VALVE——BM-136
6 GASKET——H-9434
6 SPRING——H-624[illegible]
6 STOP——H-62406
6 BODY & PLUNGER——BM-2469
6 GASKET——H-62409
6 CUP ASSEMBLY——BM-1640
12 INJECTOR STUD NUT——S-200 (NOT SHOWN)

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INJECTOR

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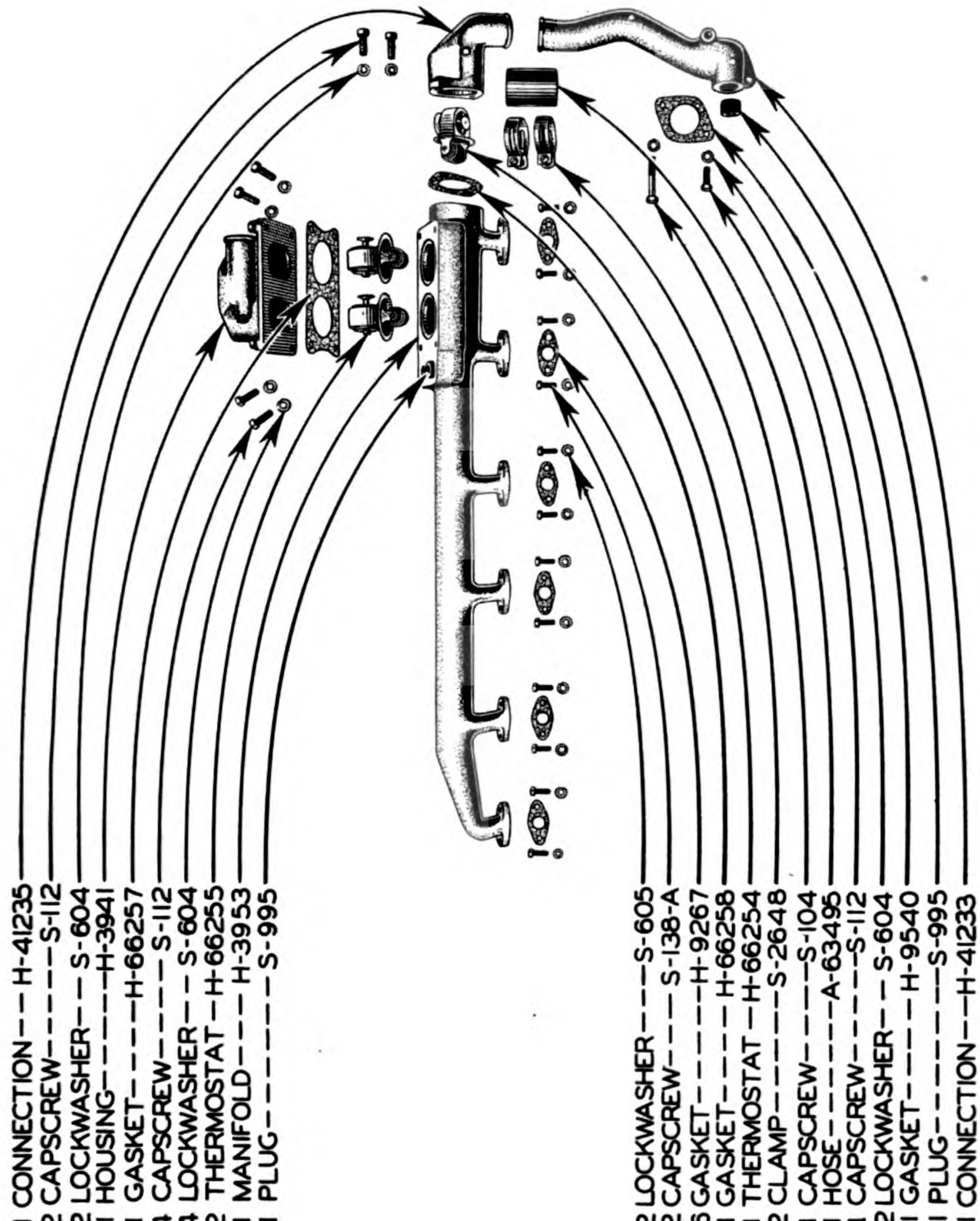

WATER MANIFOLD

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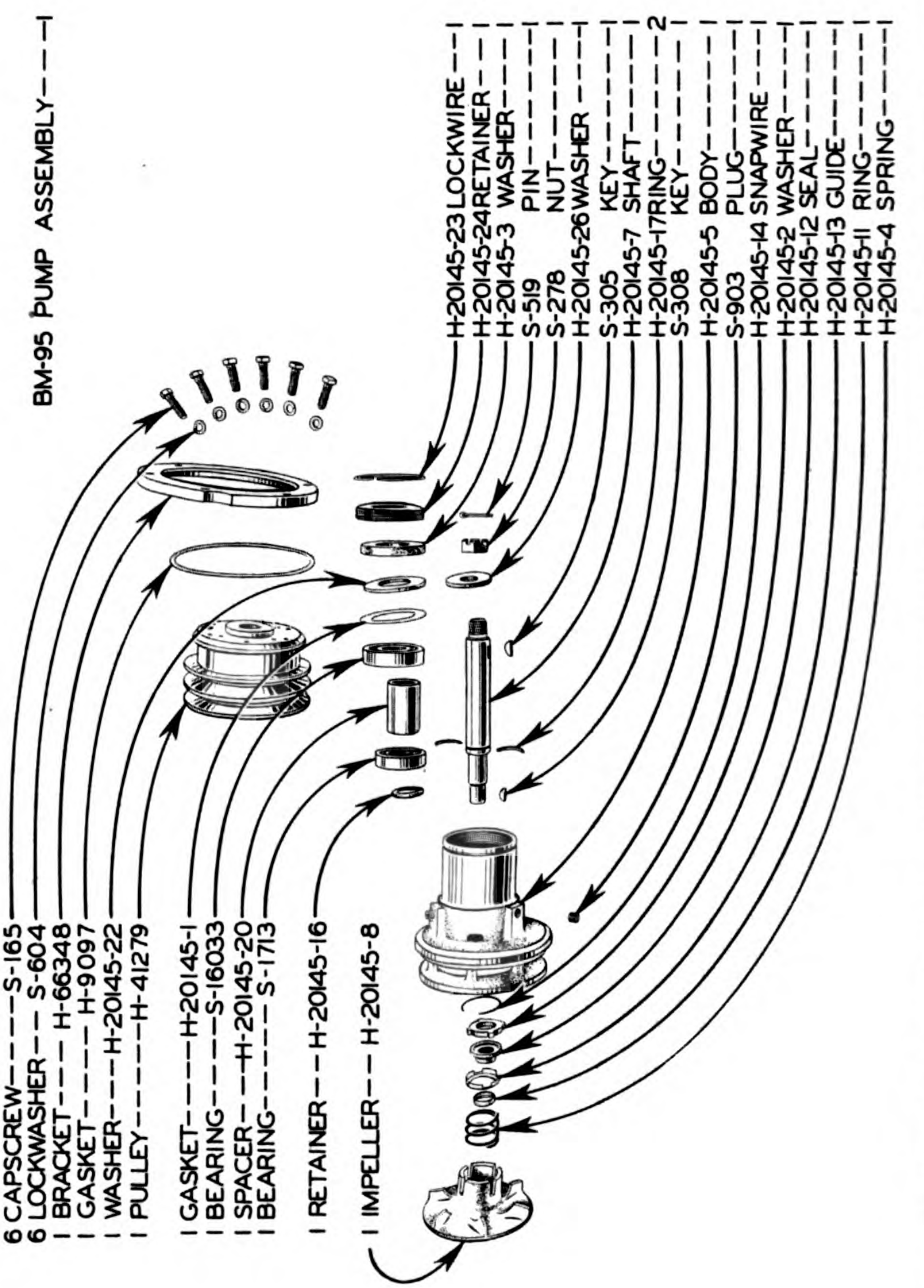

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WATER PUMP

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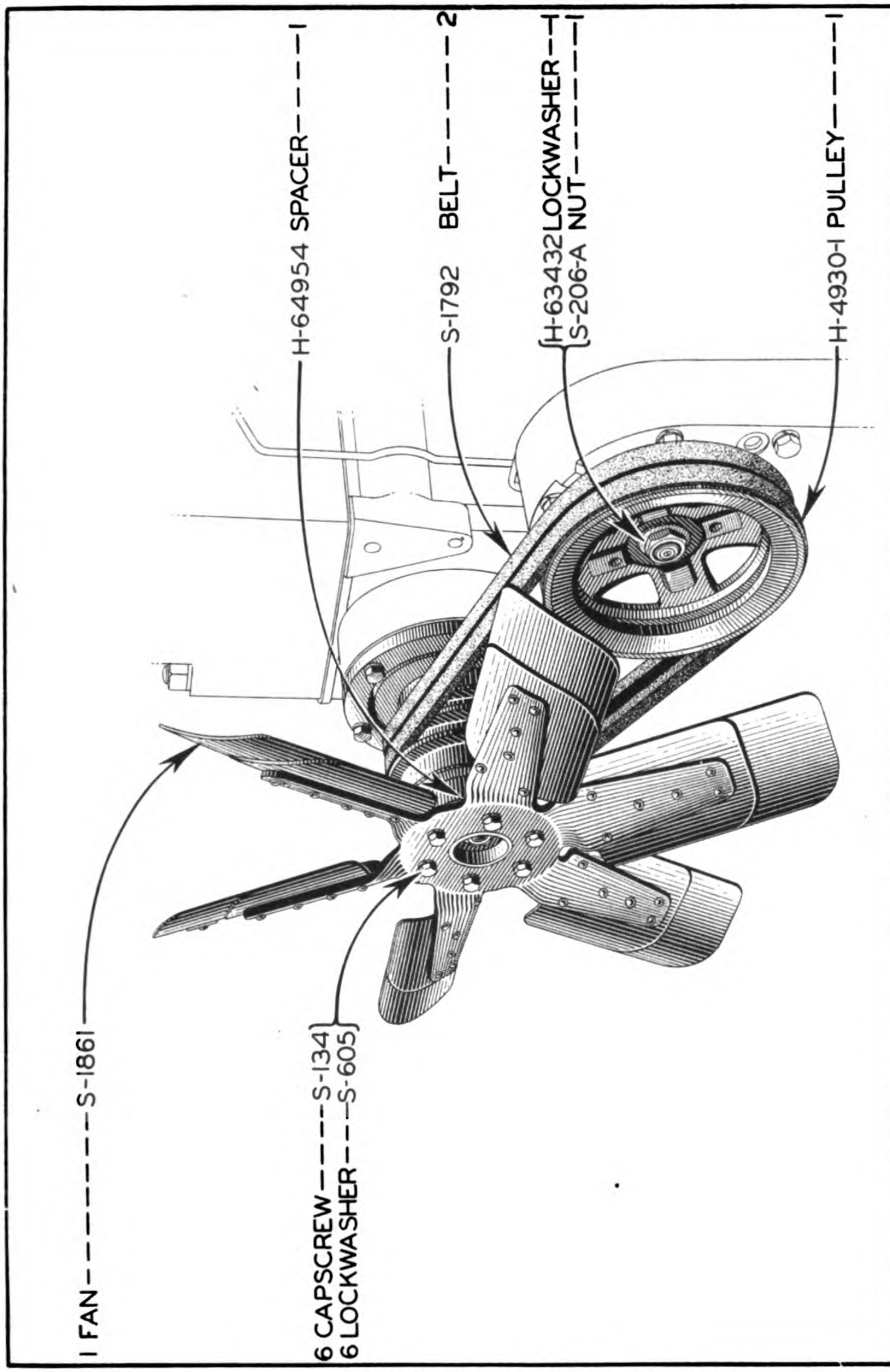
HBID 600 CUMMINS ENGINE FOR SUPER C 369



CUMMINS ENGINE CO. PARTS. ORDER FROM CUMMINS ENGINE CO. OR THEIR DISTRIBUTOR.

DRIVE PULLEY, BELTS & FAN

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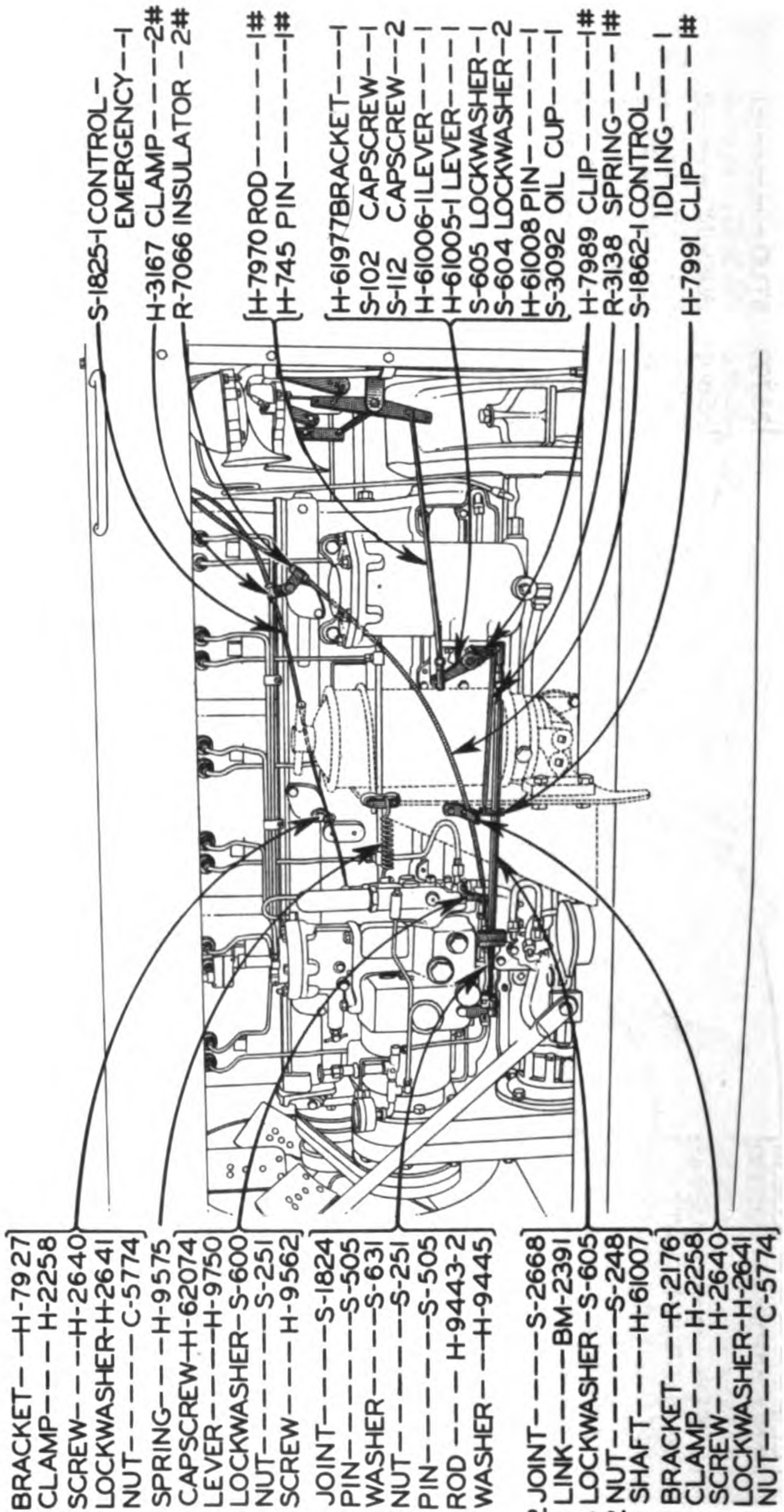

LE TOURNEAU PART NUMBERS. ALL OTHER PARTS ARE CUMMINS ENGINE CO. PARTS. ORDER FROM CUMMINS ENGINE CO.

THROTTLE GROUP

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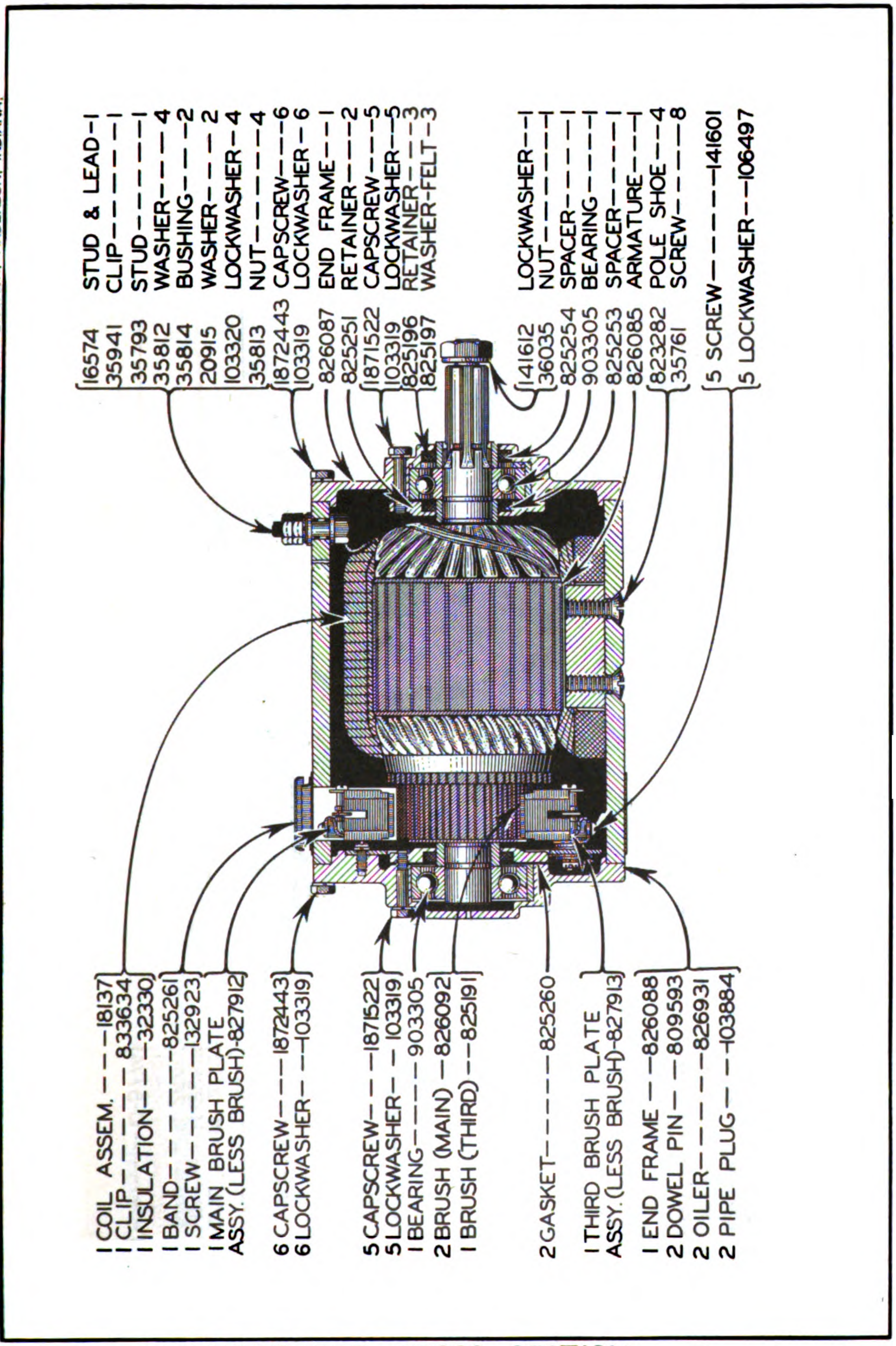

GENERATOR—CROSS SECTION

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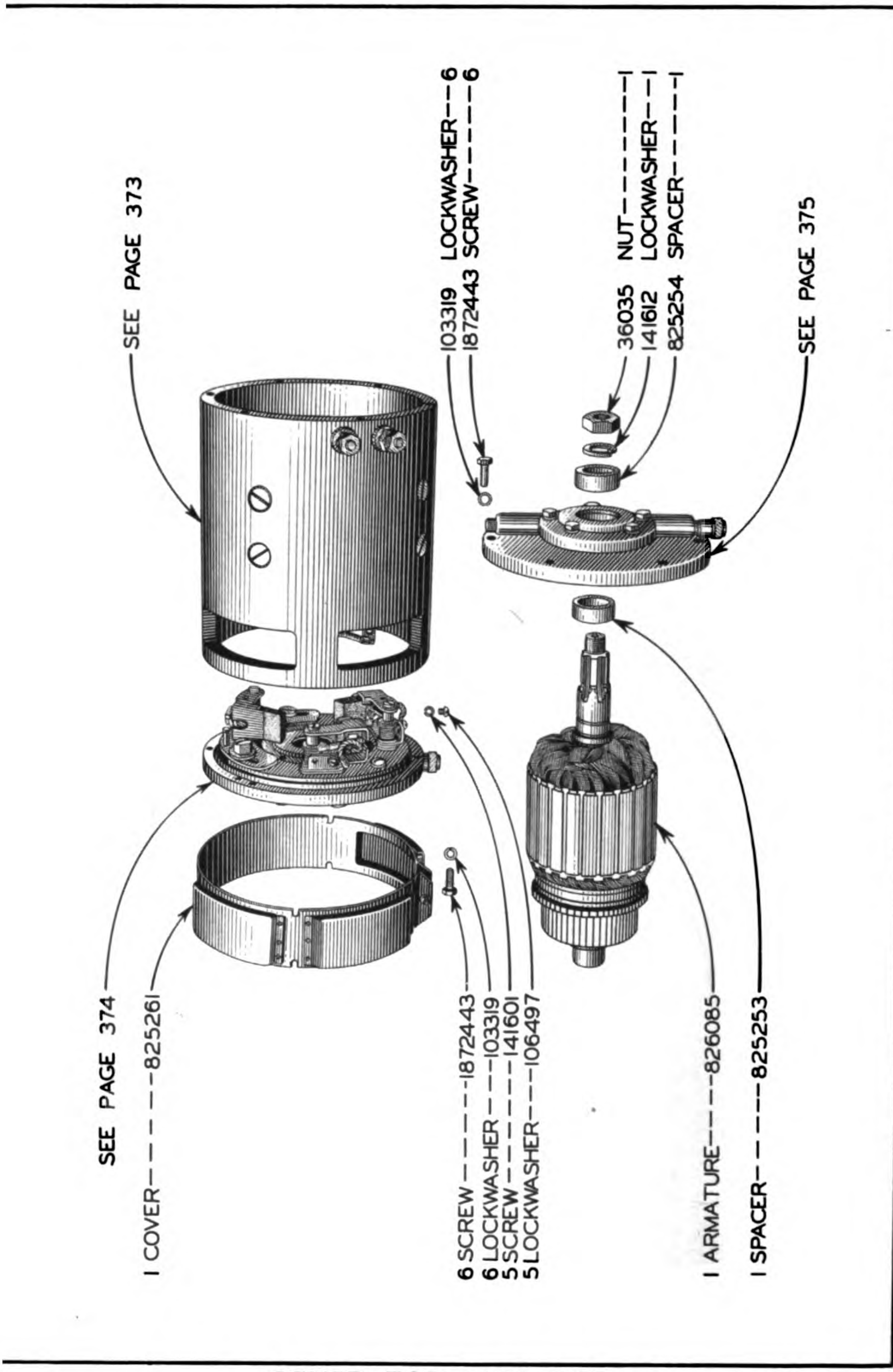

DELCO-REMY DIVISION PART NUMBERS ORDER FROM DELCO-REMY DIVISION OF GENERAL MOTORS CORPORATION, ANDERSON, INDIANA

GENERATOR—EXPLODED.

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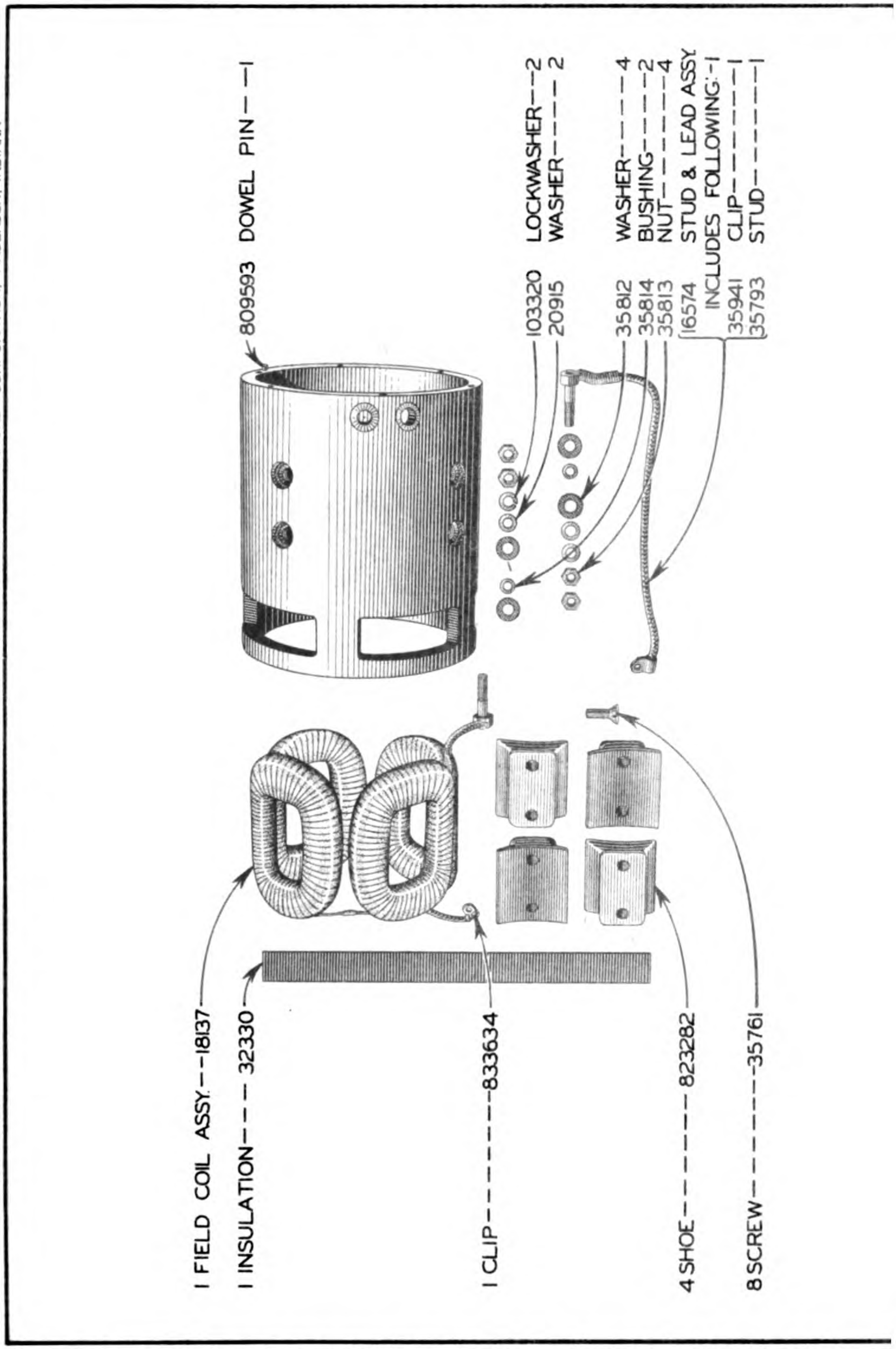

GENERATOR FRAME & FIELD ASSEM. EXPLODED

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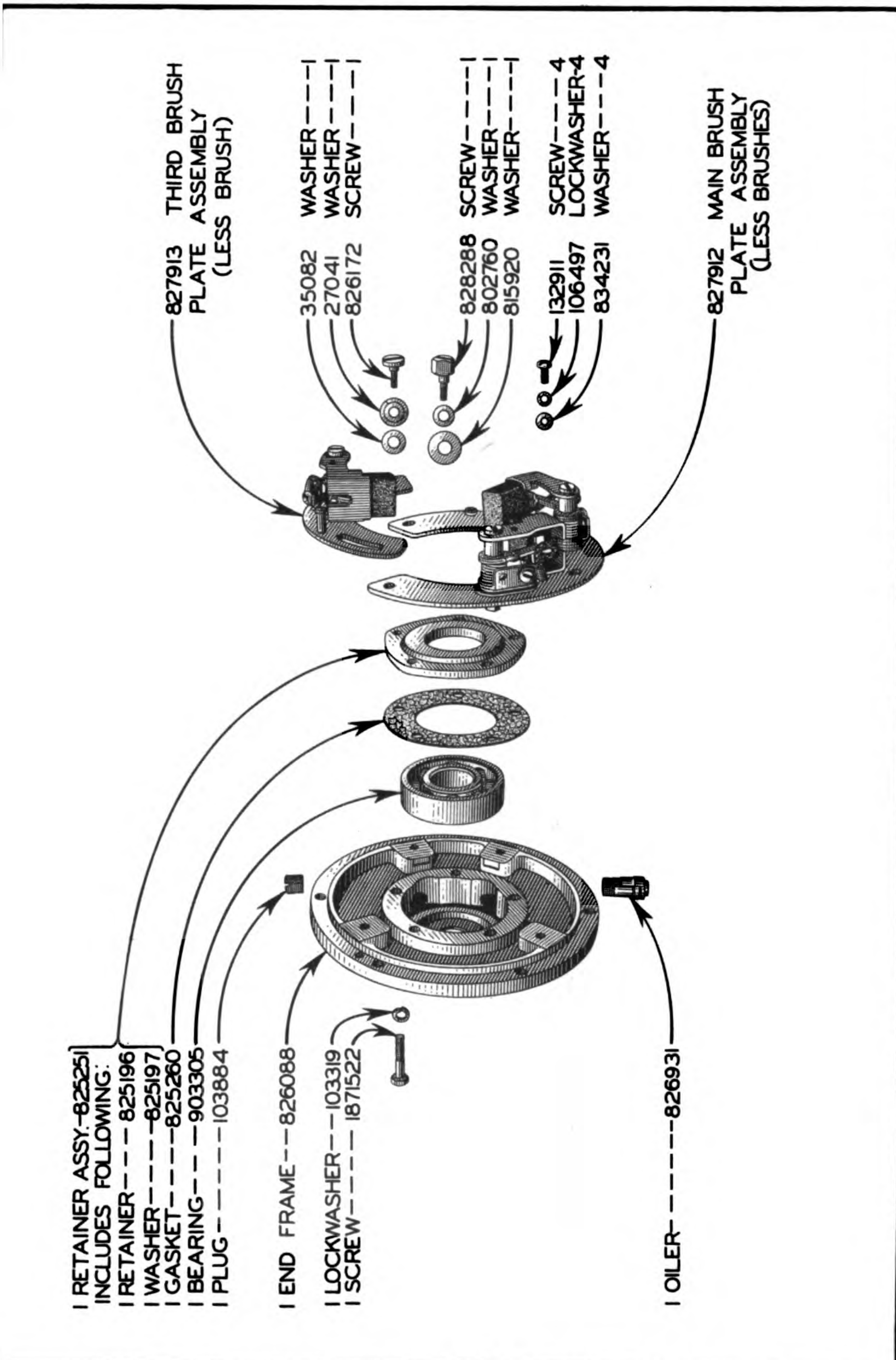

GENERATOR COMMUTATOR END - EXPLODED

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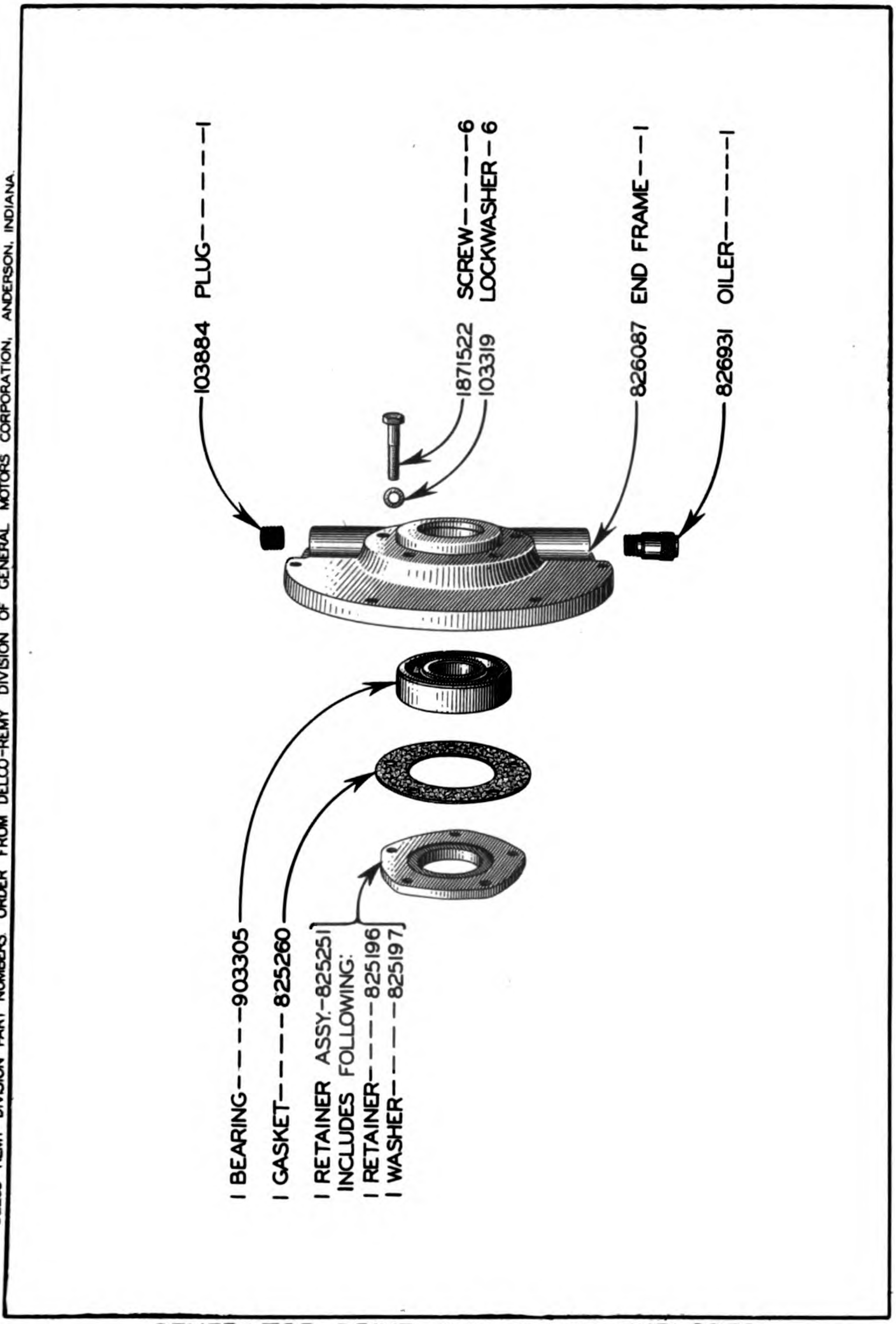

GENERATOR DRIVE END FRAME-EXPLODED

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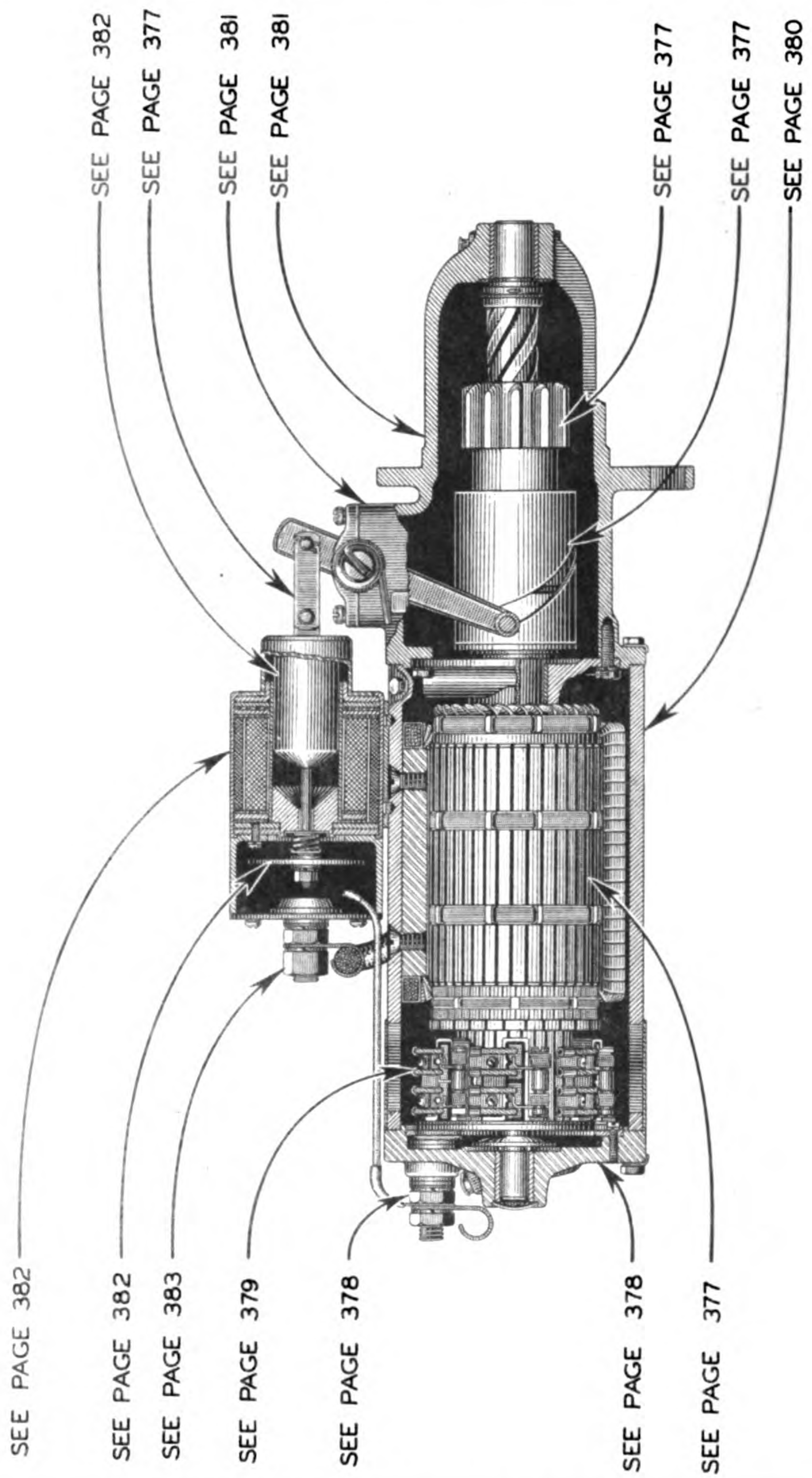

DELCO-REMY DIVISION PART NUMBERS ORDER FROM DELCO-REMY DIVISION OF GENERAL MOTORS CORPORATION, ANDERSON, INDIANA

CRANKING MOTOR—CROSS SECTION

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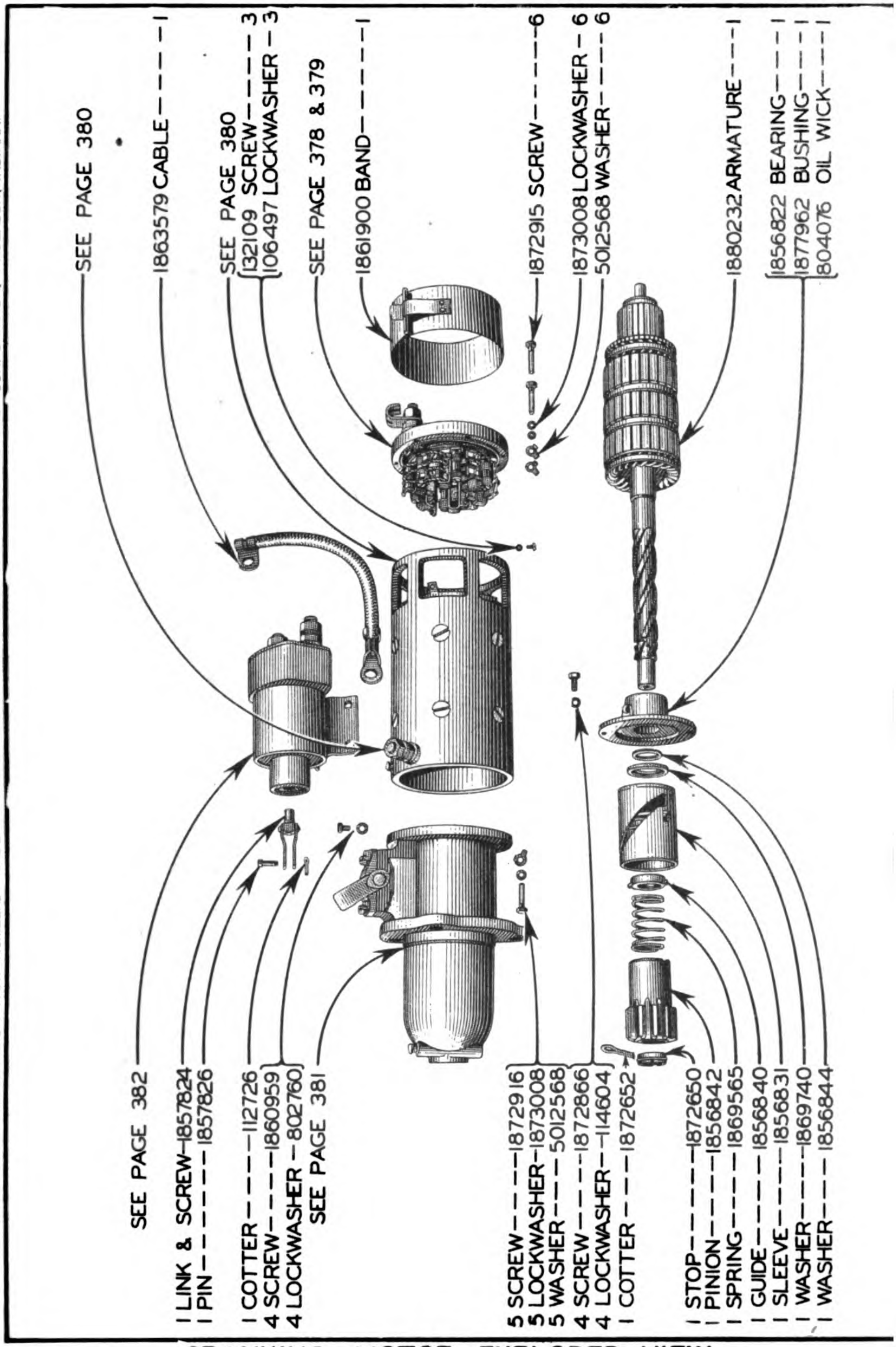
DELCO-REMY DIVISION PART NUMBERS ORDER FROM DELCO-REMY DIVISION OF GENERAL MOTORS CORPORATION, ANDERSON, INDIANA.



CRANKING MOTOR—EXPLODED VIEW

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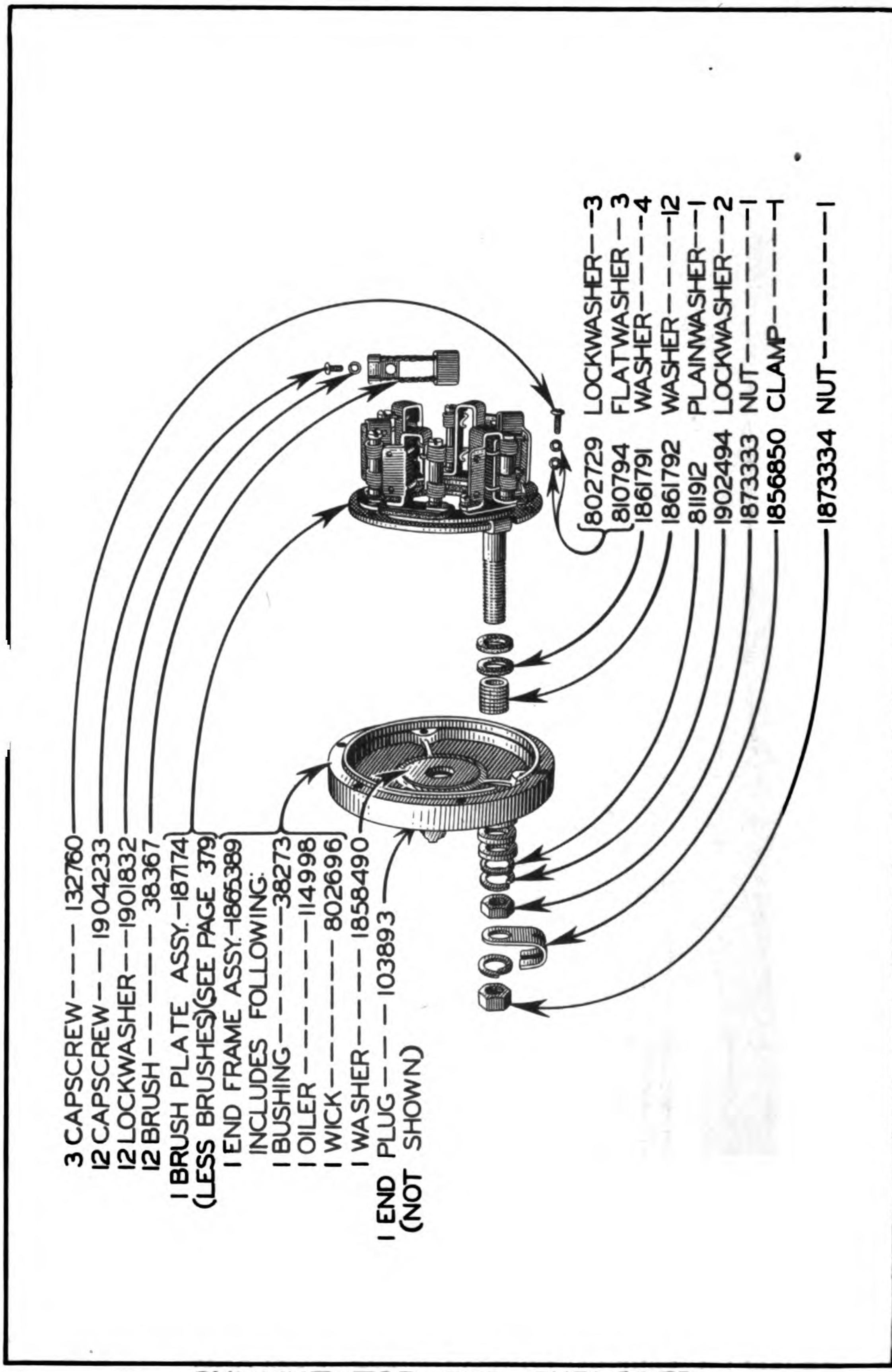

CUMMUTATOR END-EXPLODED

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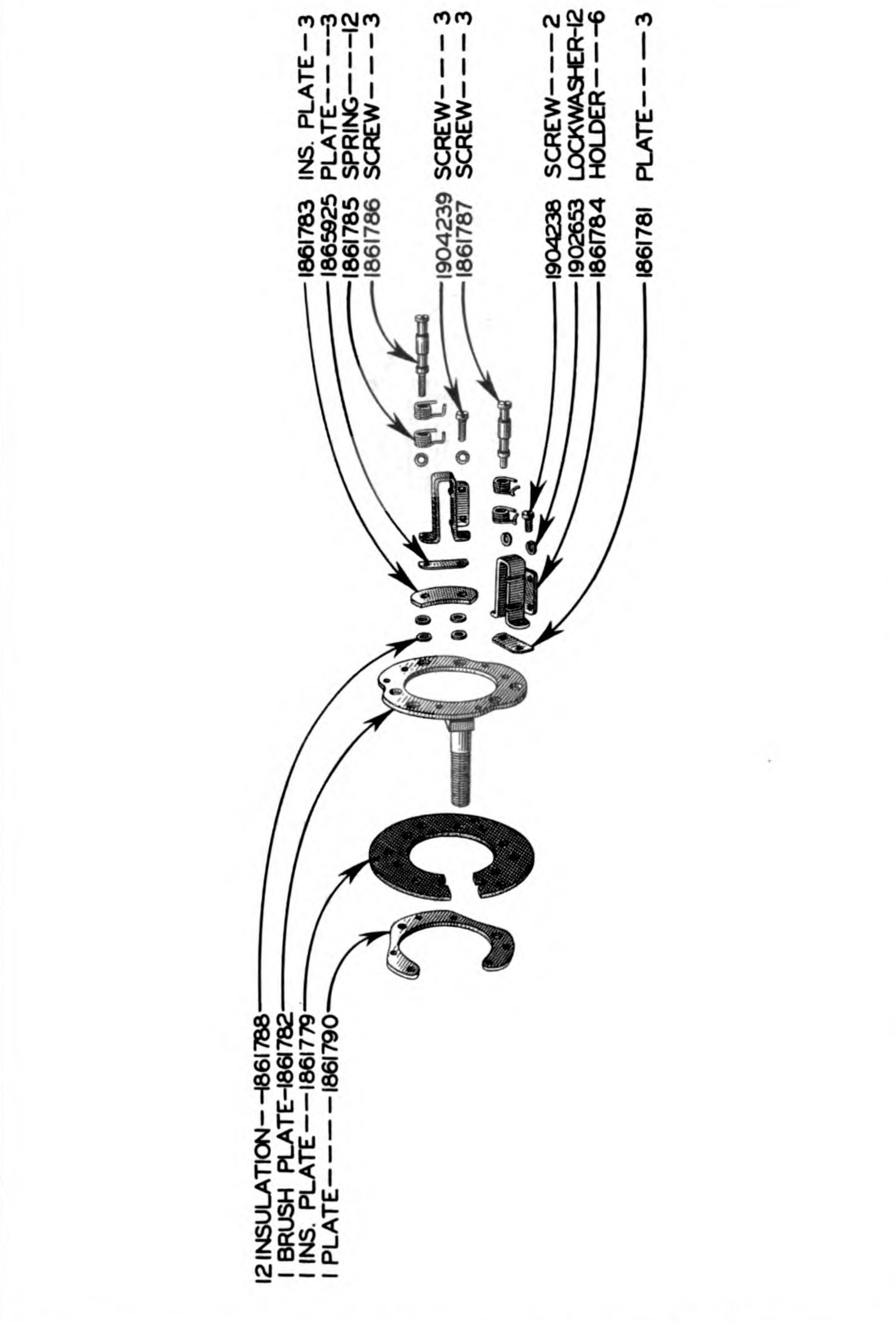

CRANKING MOTOR BRUSH PLATE-EXPLODED

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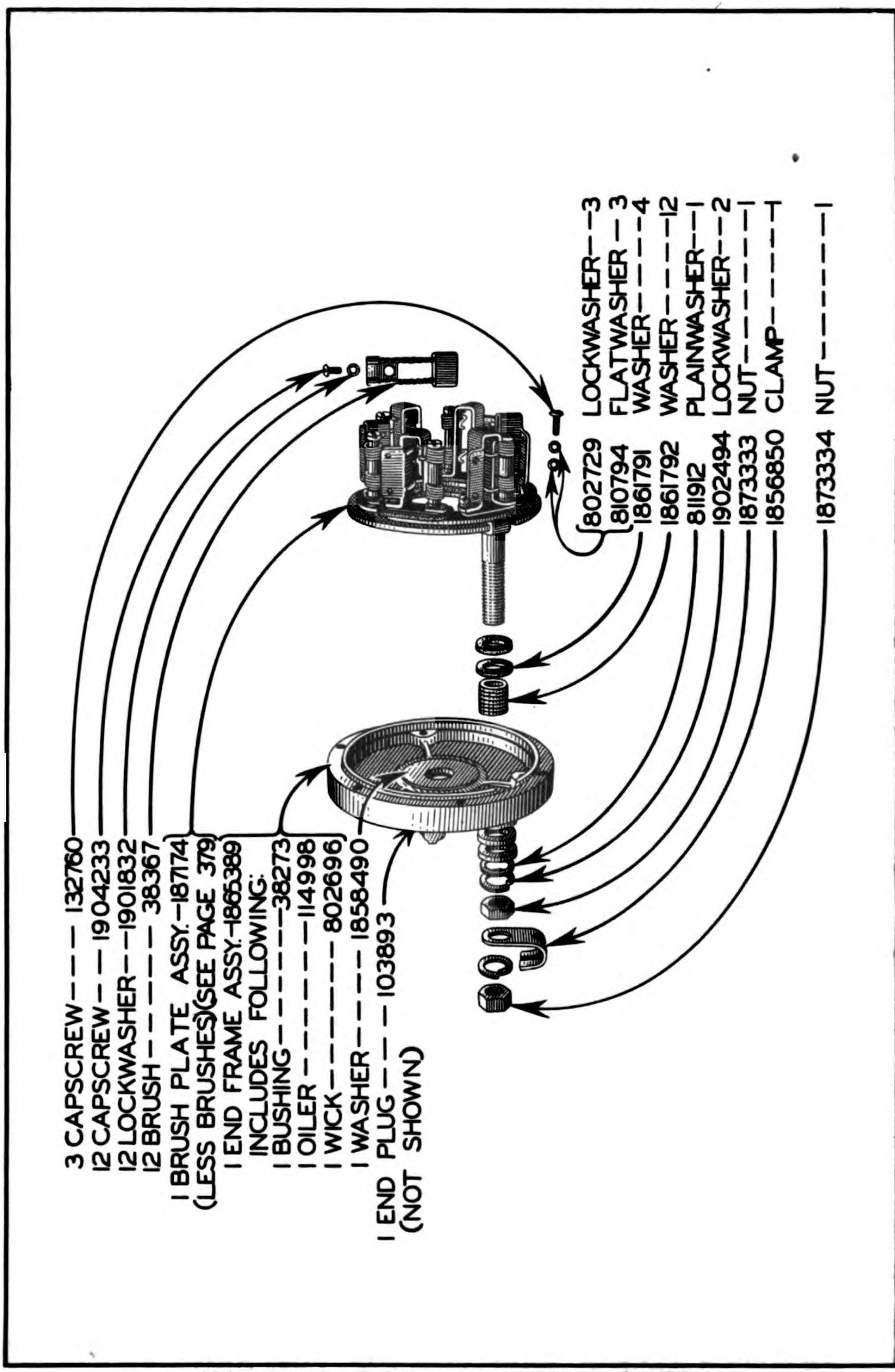
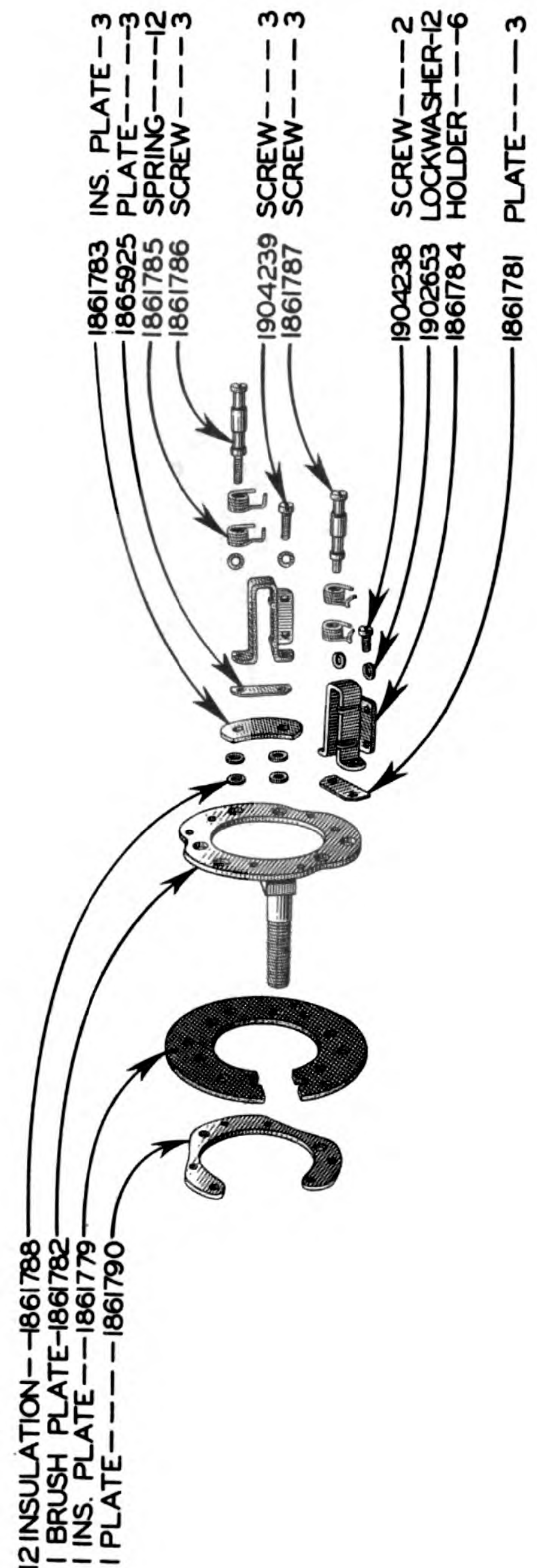


DELCO-REMY DIVISION PART NUMBERS. ORDER FROM DELCO-REMY DIVISION OF GENERAL MOTORS CORPORATION, ANDERSON, INDIANA.

CUMMUTATOR END-EXPLODED

Digitized by Google Original from UNIVERSITY OF CALIFORNIA



CRANKING MOTOR BRUSH PLATE-EXPLODED

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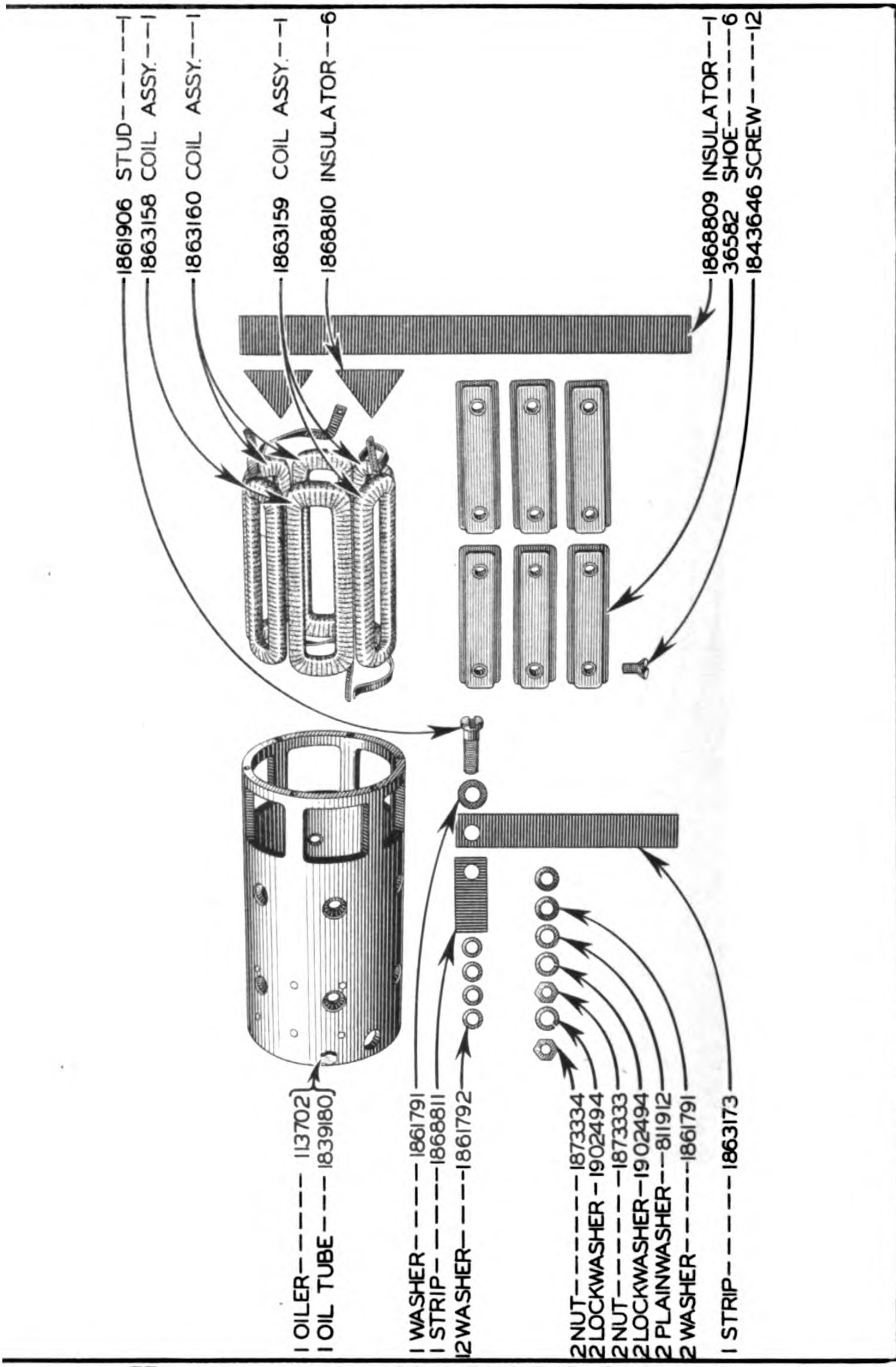

FRAME & FIELD ASSEMBLY-EXPLODED

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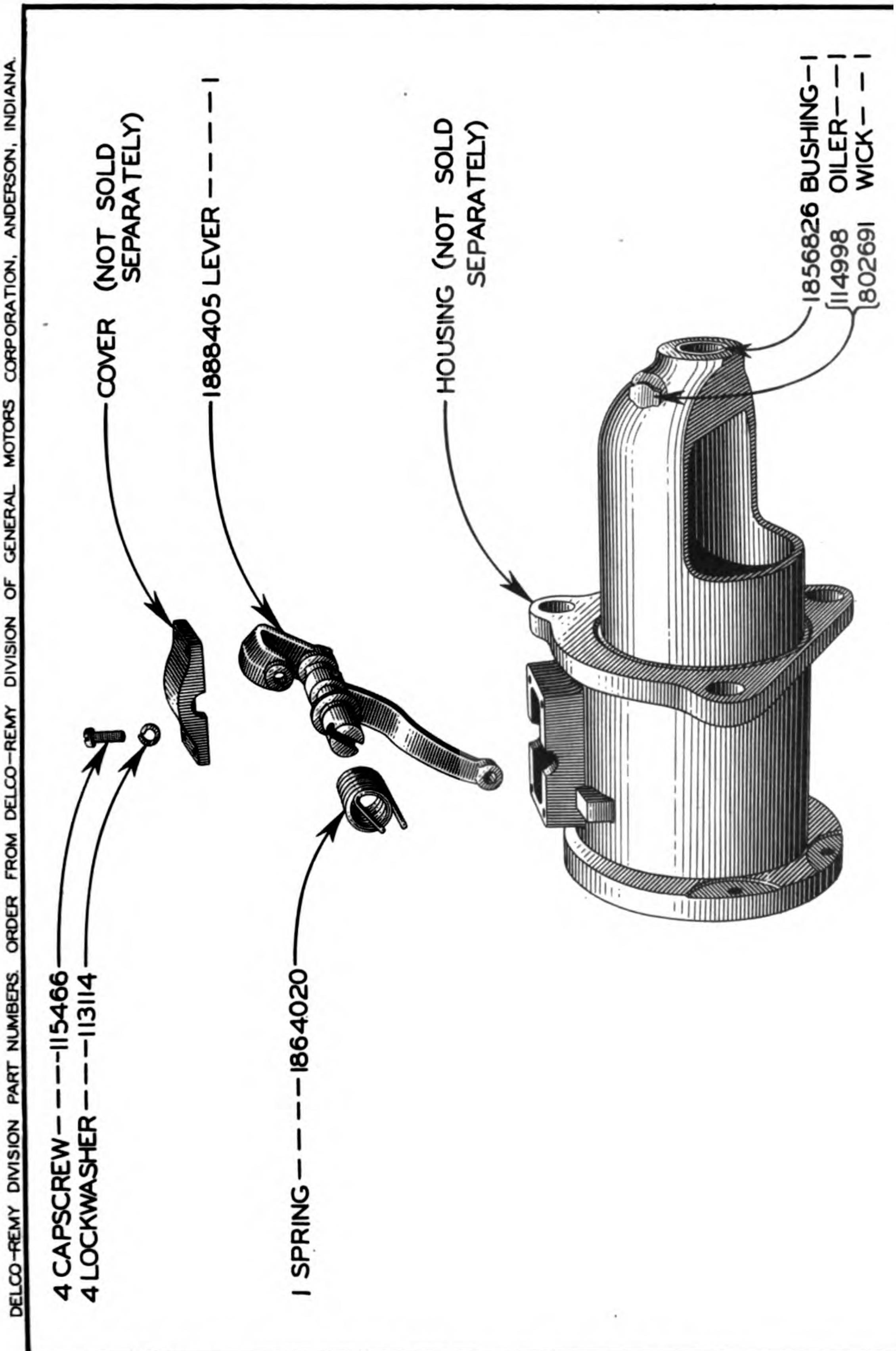

DYER DRIVE HOUSING—EXPLODED

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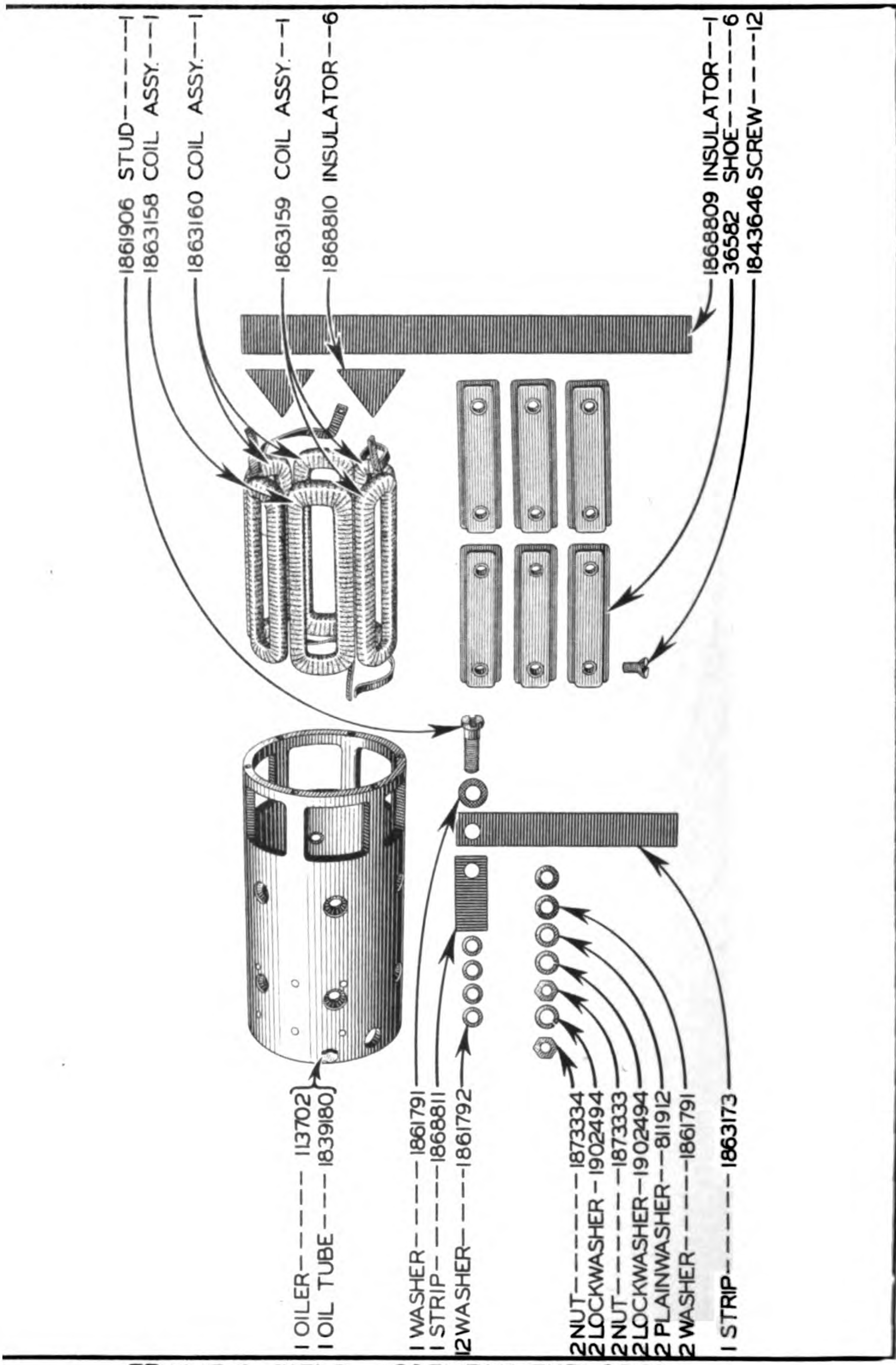

FRAME & FIELD ASSEMBLY-EXPLODED

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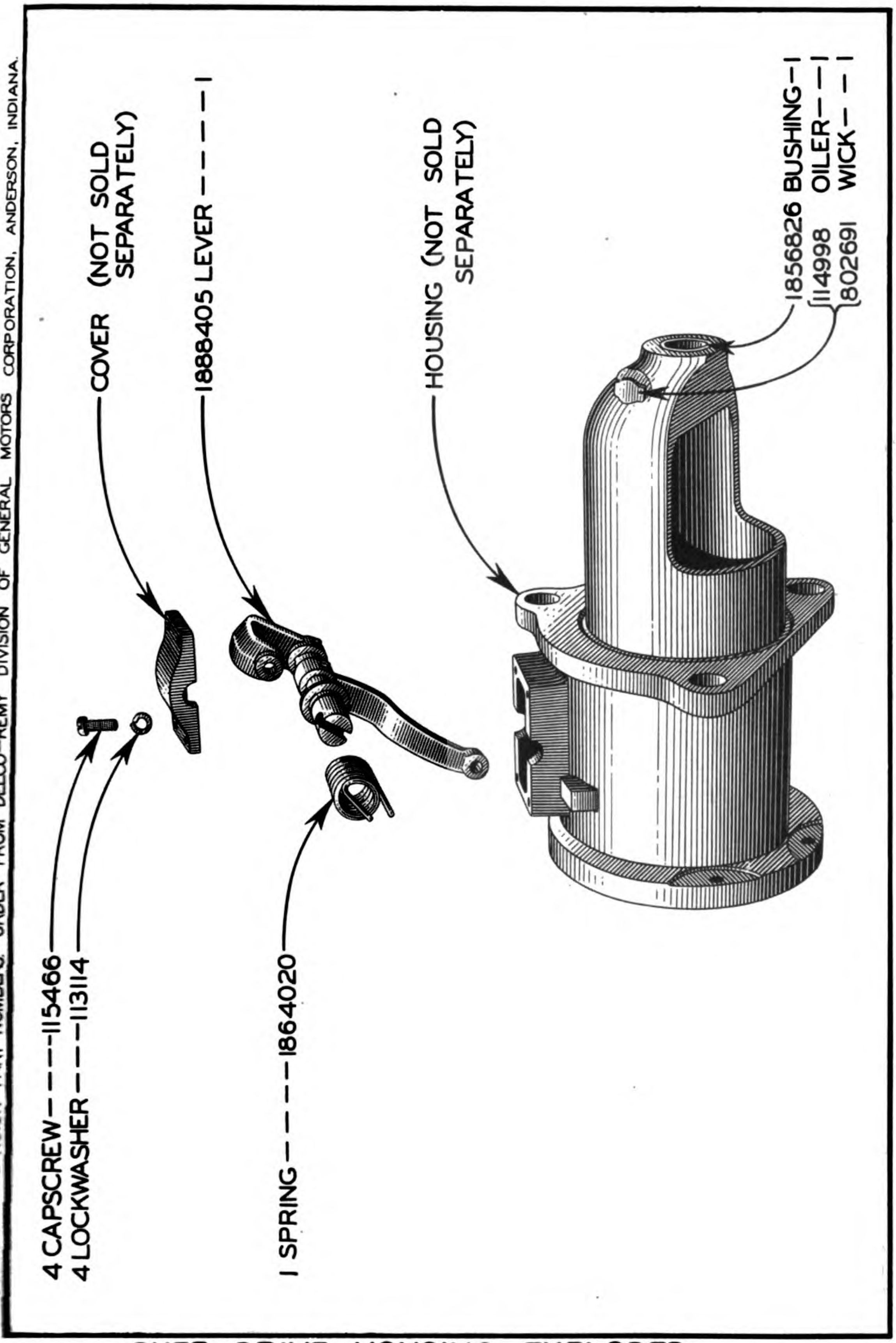

DYER DRIVE HOUSING-EXPLODED

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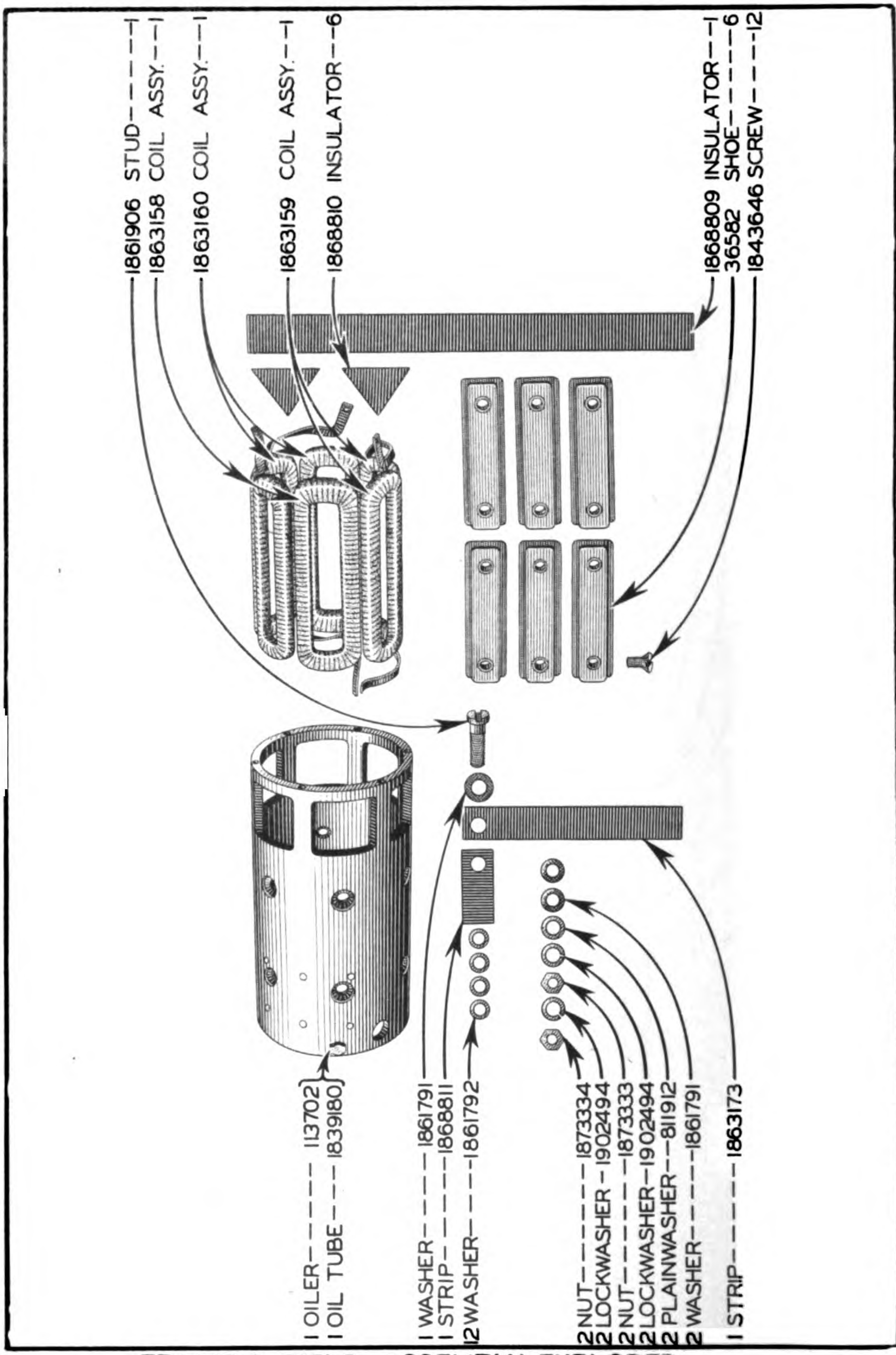

FRAME & FIELD ASSEMBLY-EXPLODED

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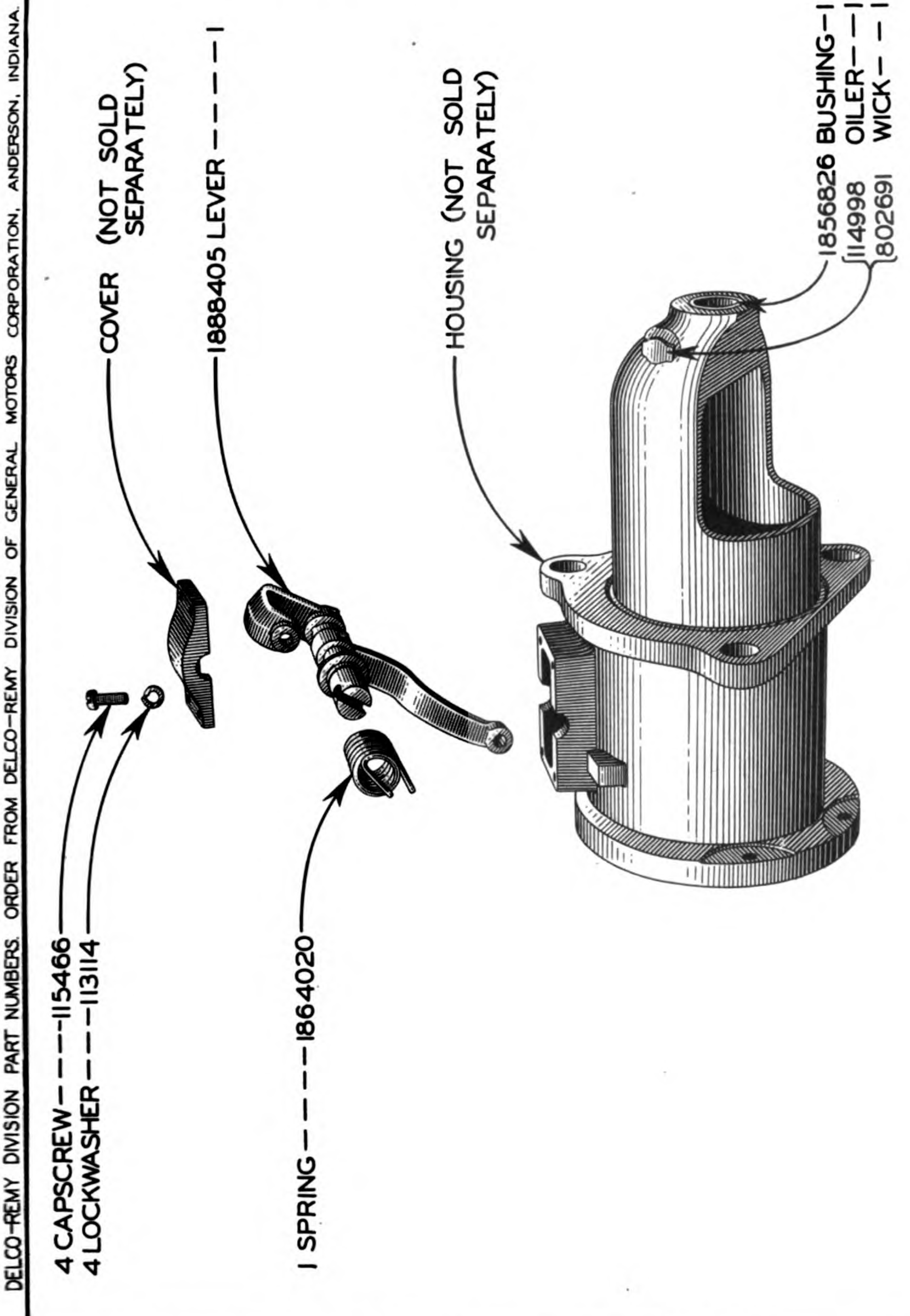

DYER DRIVE HOUSING-EXPLODED

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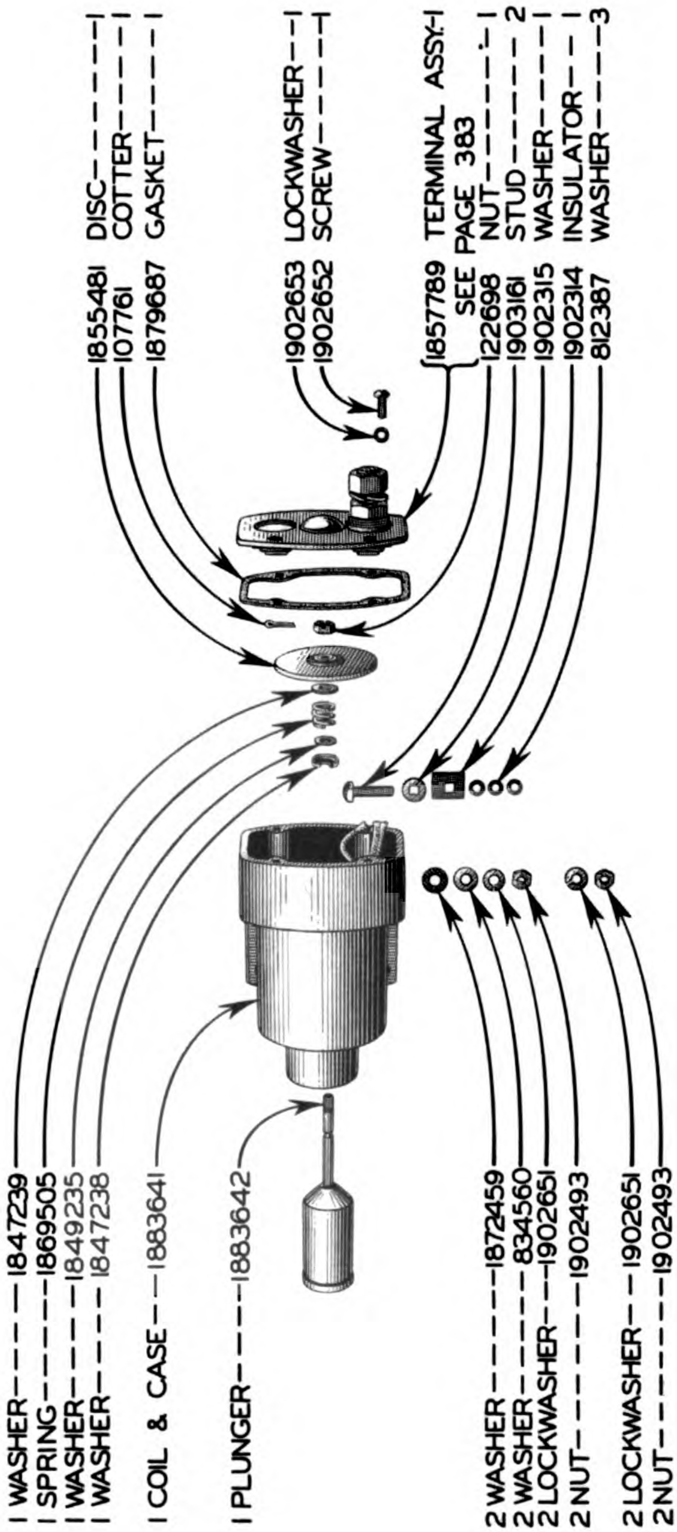

DELCO-REMY DIVISION PART NUMBERS. ORDER FROM DELCO-REMY DIVISION OF GENERAL MOTORS CORPORATION, ANDERSON, INDIANA

SOLENOID SWITCH—EXPLODED

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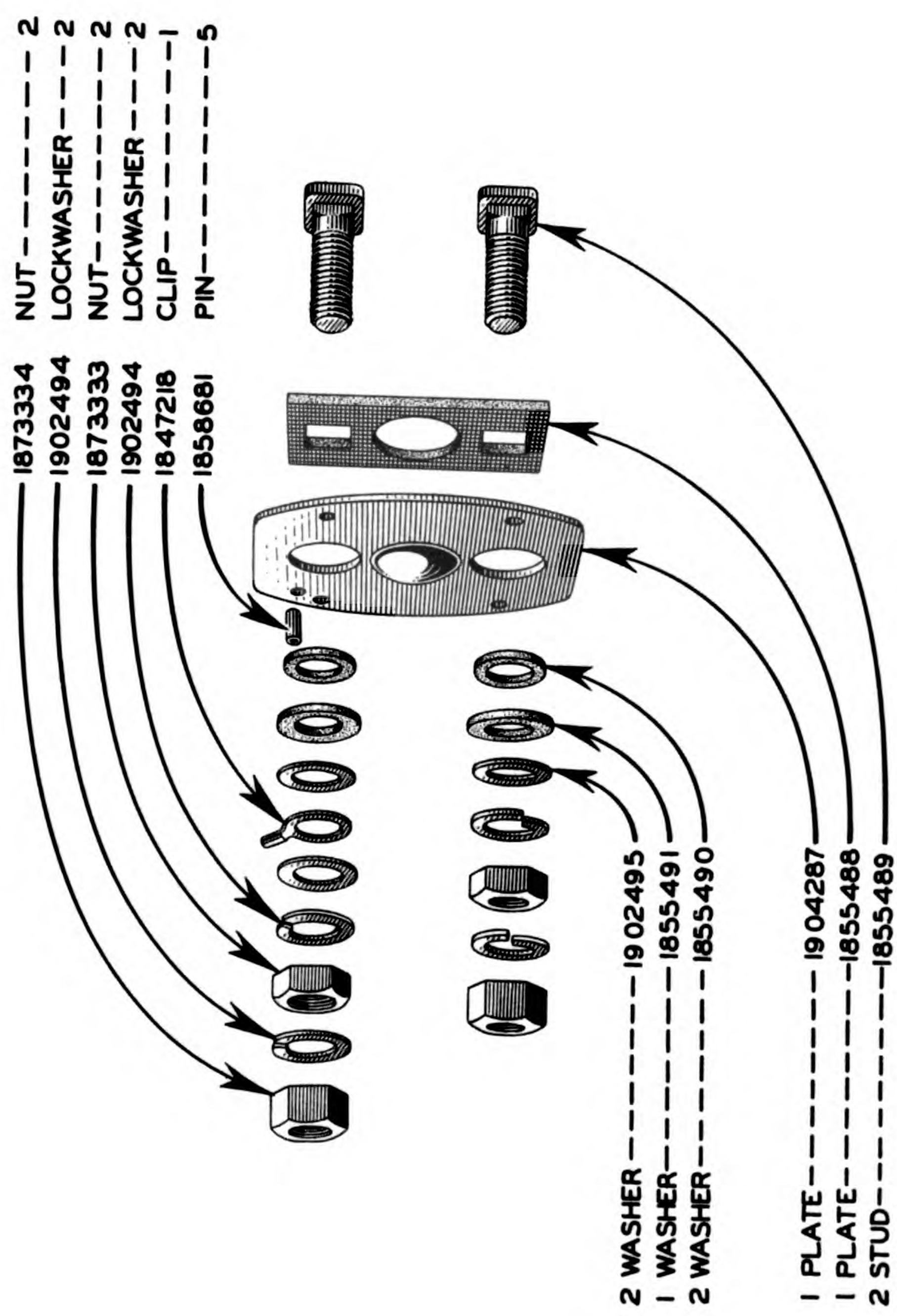

SOLENOID TERMINAL—EXPLODED

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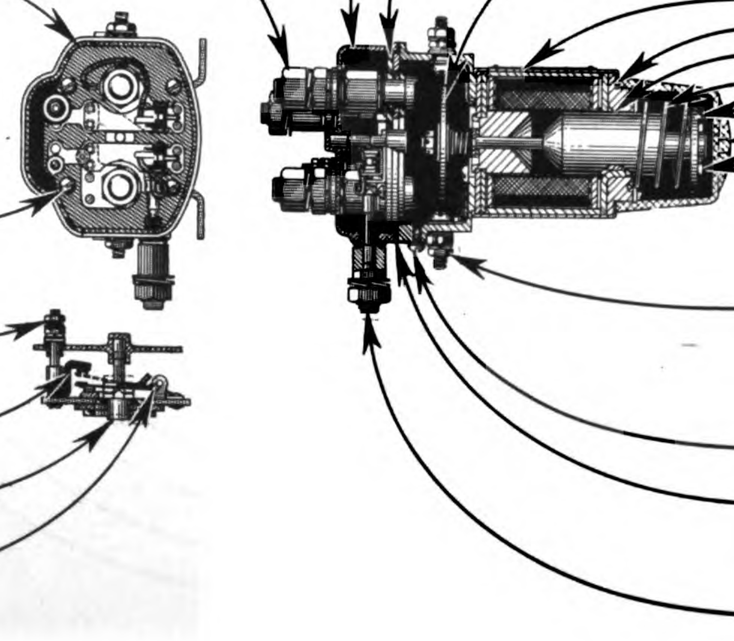
1	INS. PLATE	1855488
2	WASHER	1902495
2	NUT	1869036
4	LOCKWASHER	1902494
2	WASHER	1855491
2	NUT	1855492
2	NUT	1873334
3	CLIP	1862172
2	CLIP	1856850
1	CONTACT ASSY	1869007
4	SCREW	132123
4	LOCKWASHER	1902653
4	WASHER	807218
1	BUSHING	1845396
2	WASHER	834231
2	NUT	115295
2	LOCKWASHER	802731
1	CLIP	1867662
1	CONTACT AND SUPPORT	1864890
1	PLUNGER	1869033
1	BLADE	1869025
1	BLADE	1869022
1	PIN	1869028
1	SPRING	1869029



1869037	COVER	1
1869035	INSULATOR	1
1855481	DISC	1
1872510	SPRING	1
1847239	WASHER	1
1869849	SPACER	1
1866833	WASHER	1
1849235	WASHER	1
1869851	NUT	1
107761	PIN	1
1873516	COIL & CASE	1
1871092	GASKET	1
1866838	PLUNGER	1
1866841	SPRING	1
1857386	RETAINER	1
1873200	COVER	1
108630	PIN	1
1902315	WASHER	2
1903161	STUD	2
1902314	INSULATOR	2
812387	BUSHING	6
1872459	INS. WASHER	2
814162	WASHER	2
802760	LOCKWASHER	4
116004	NUT	4
1869042	GROUND STRAP	1
115431	SCREW	1
1902653	LOCKWASHER	1
1869034	GASKET	1
1872384	TERMINAL ASSY.	
187944	FUSE	2
812622	WASHER	2
110730	LOCKWASHER	2
124934	NUT	2
1902494	LOCKWASHER	2
1902495	WASHER	2

DELCO-REMY DIVISION PART NUMBERS. ORDER FROM DELCO-REMY DIVISION OF GENERAL MOTORS CORPORATION, ANDERSON, INDIANA

SERIES PARALLEL-CROSS SECTION

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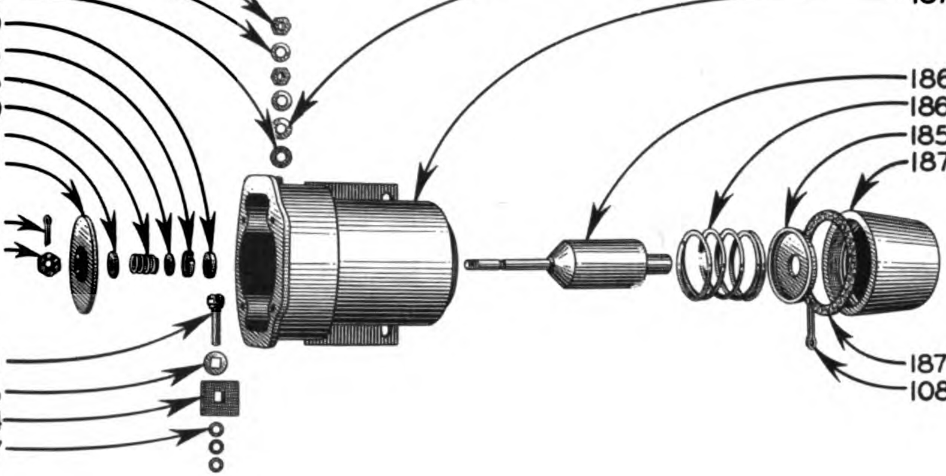
DIVISION PART NUMBERS. ORDER FROM DELCO-REMY DIVISION OF GENERAL MOTORS CORPORATION, ANDERSON, INDIANA



SERIES PARALLEL—EXPLODED

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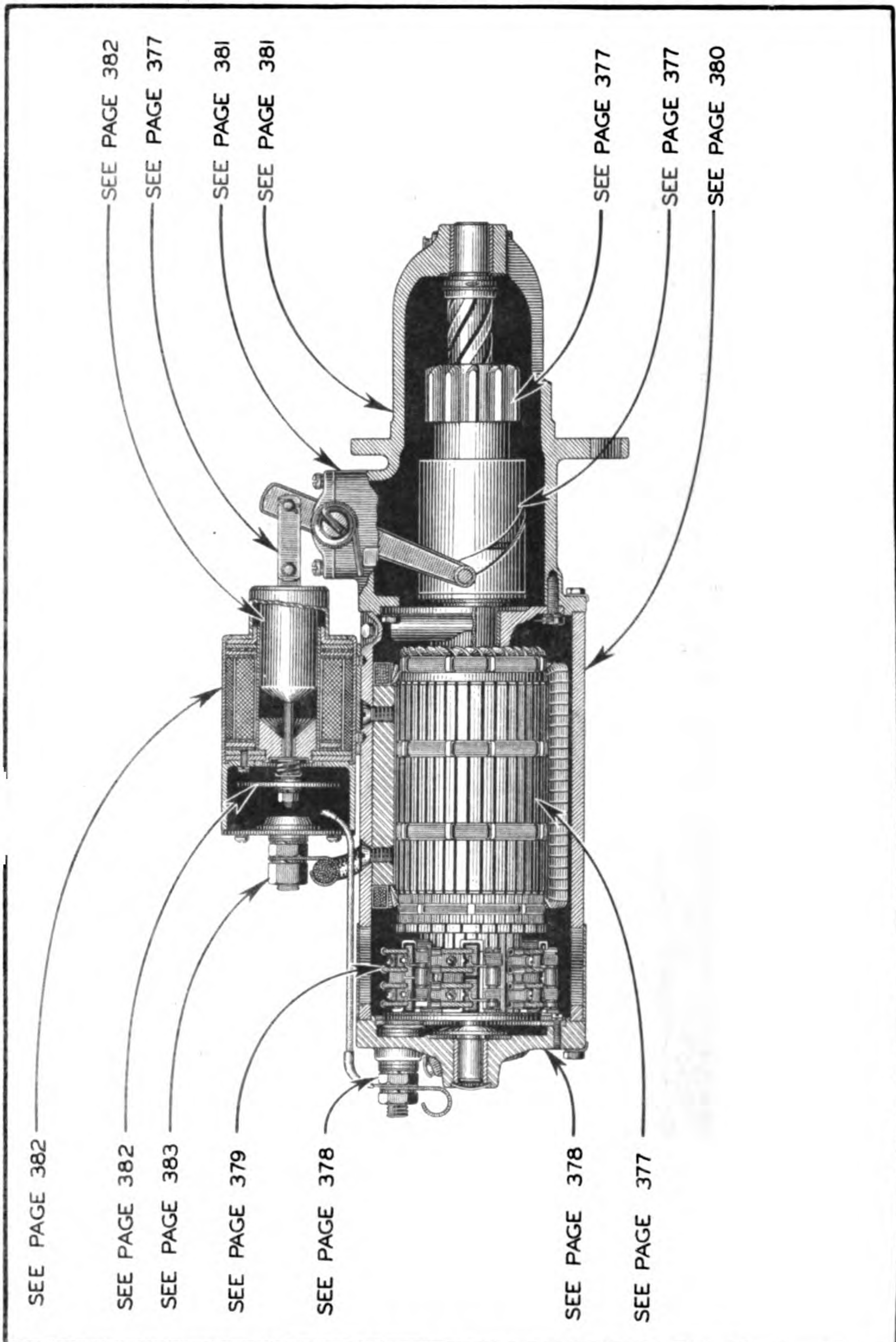

CRANKING MOTOR—CROSS SECTION

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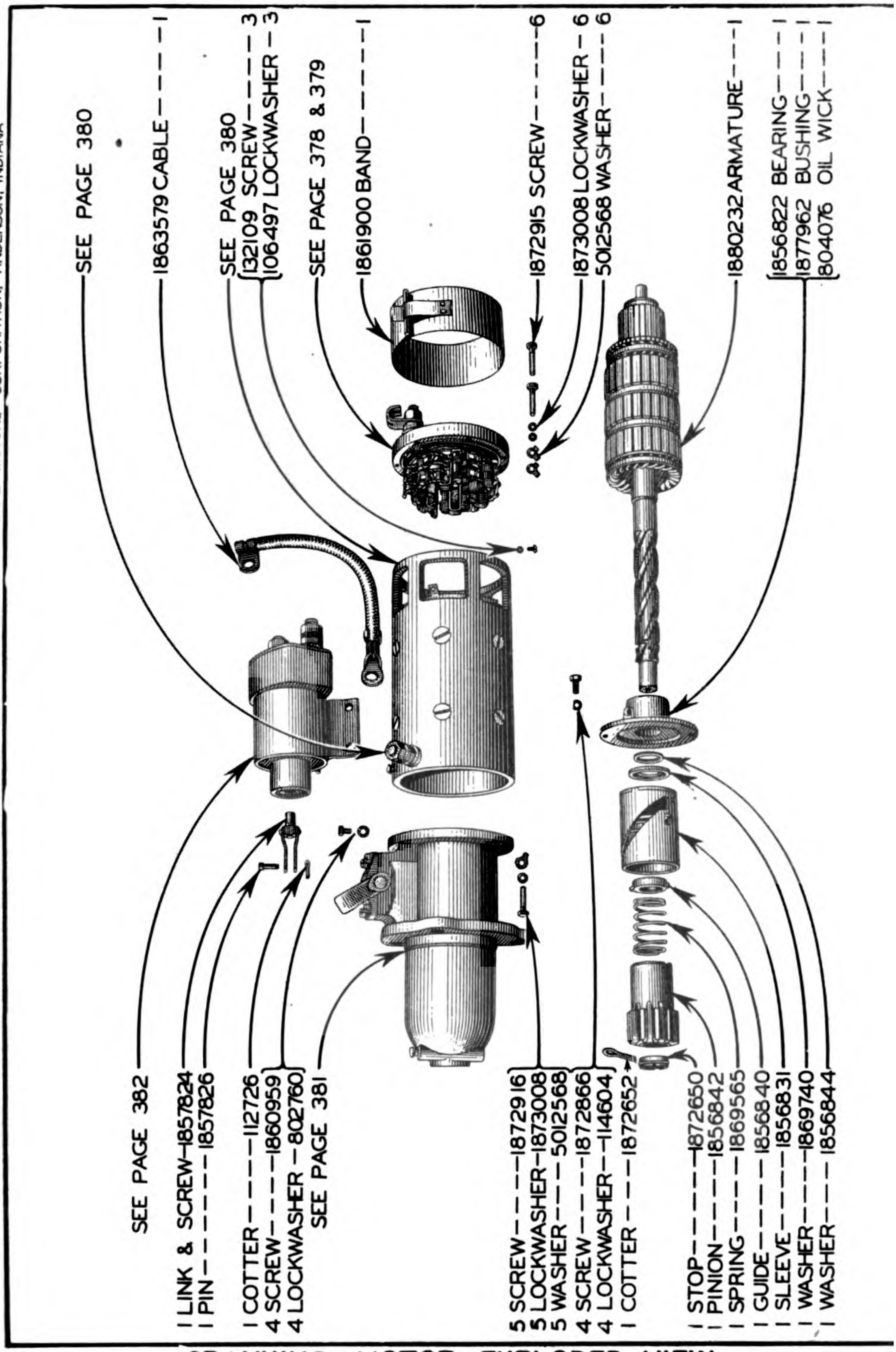

CRANKING MOTOR—EXPLODED VIEW

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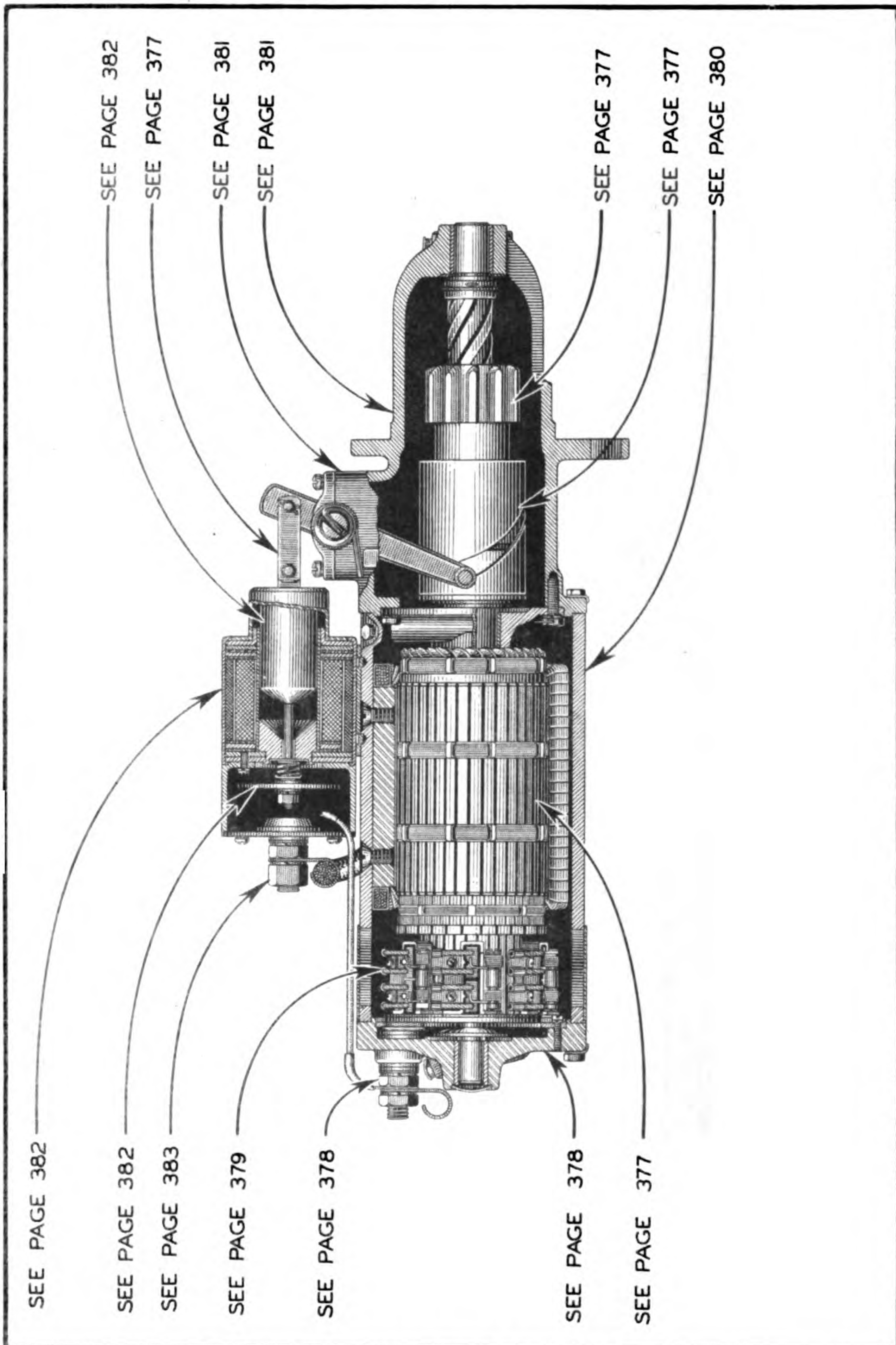

CRANKING MOTOR—CROSS SECTION

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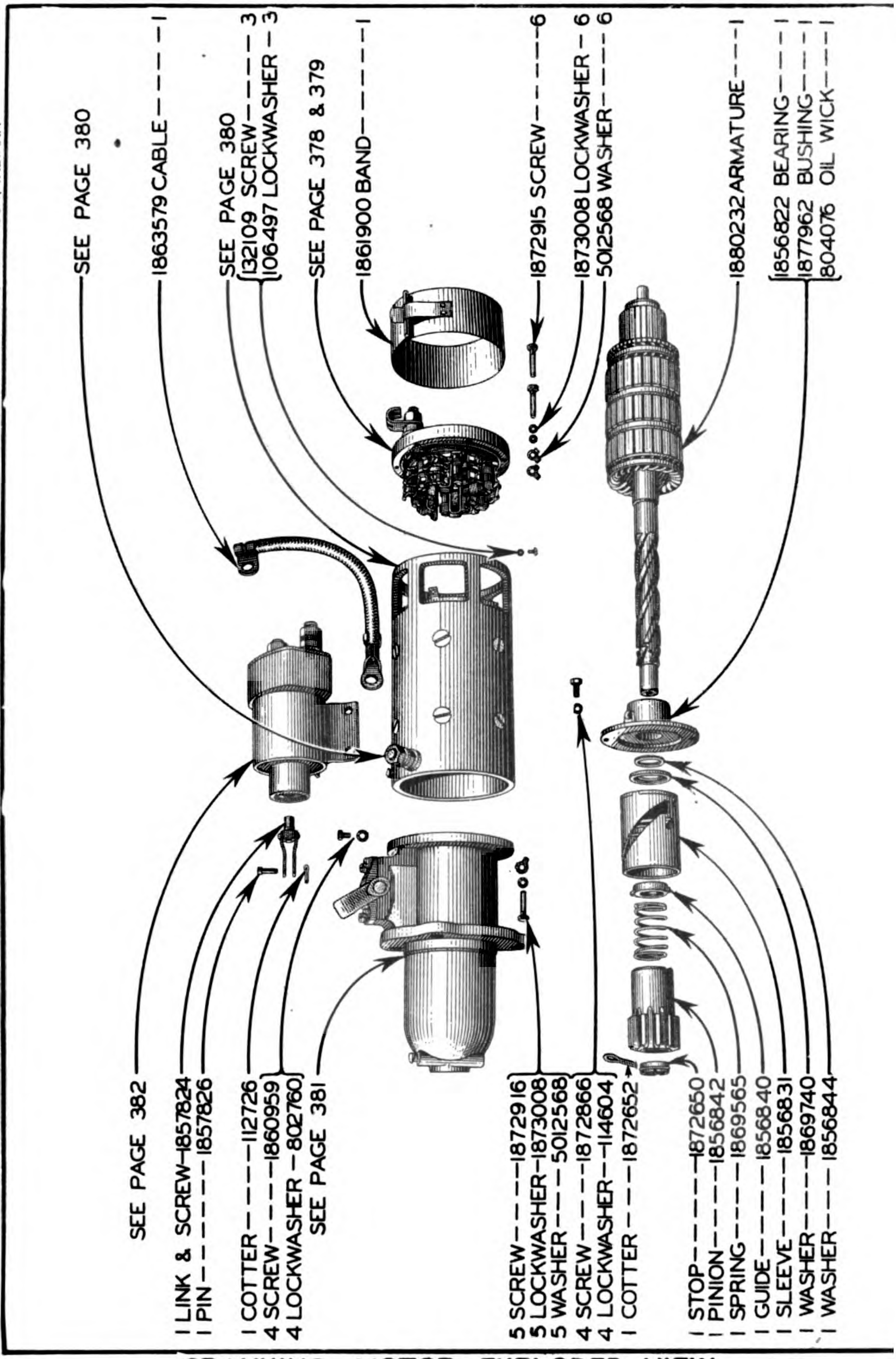
DELCO-REMY DIVISION PART NUMBERS. ORDER FROM DELCO-REMY DIVISION OF GENERAL MOTORS CORPORATION, ANDERSON, INDIANA



CRANKING MOTOR—EXPLODED VIEW

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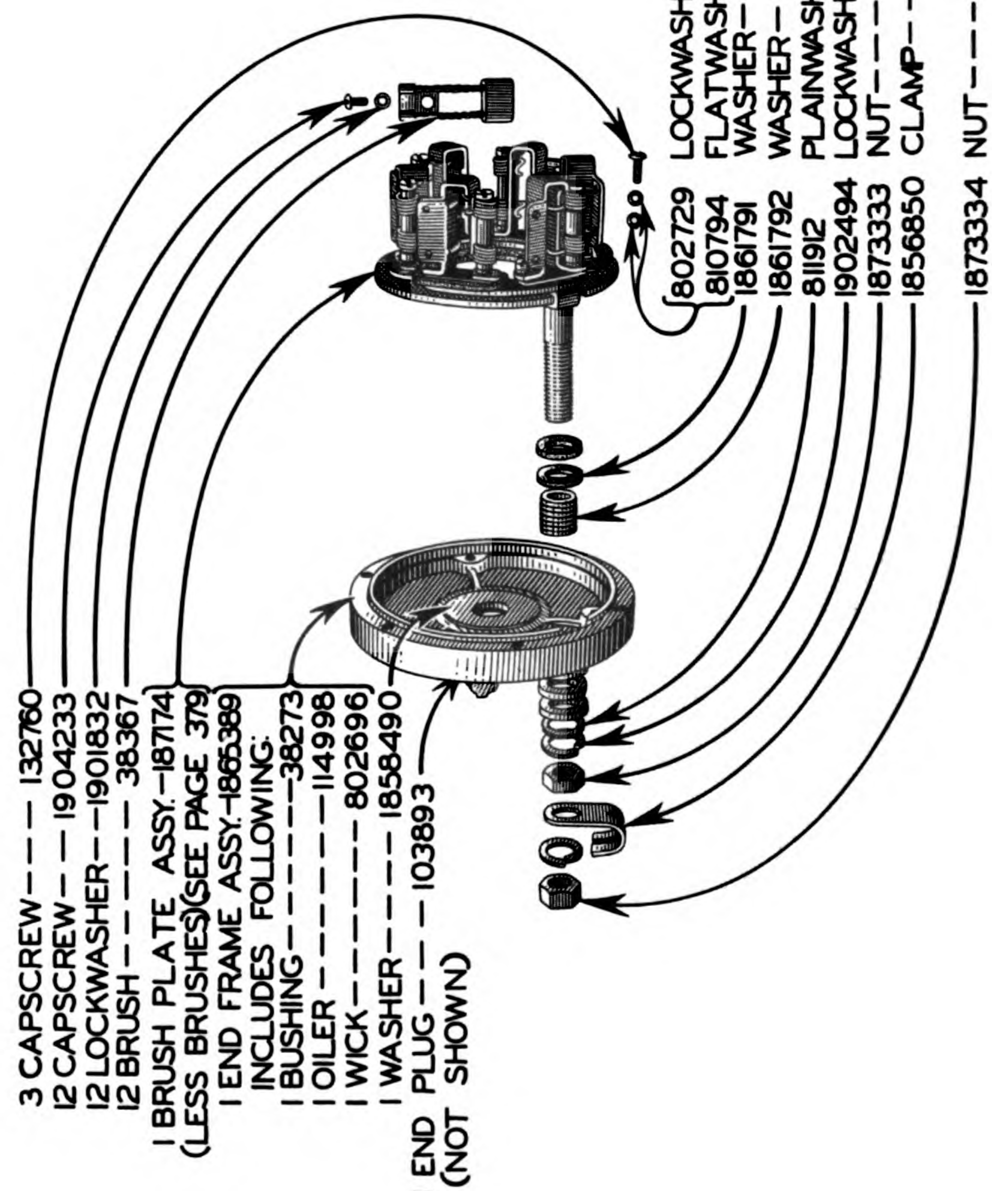

DELCO-REMY DIVISION PART NUMBERS. ORDER FROM DELCO-REMY DIVISION OF GENERAL MOTORS CORPORATION, ANDERSON, INDIANA.

CUMMUTATOR END-EXPLODED

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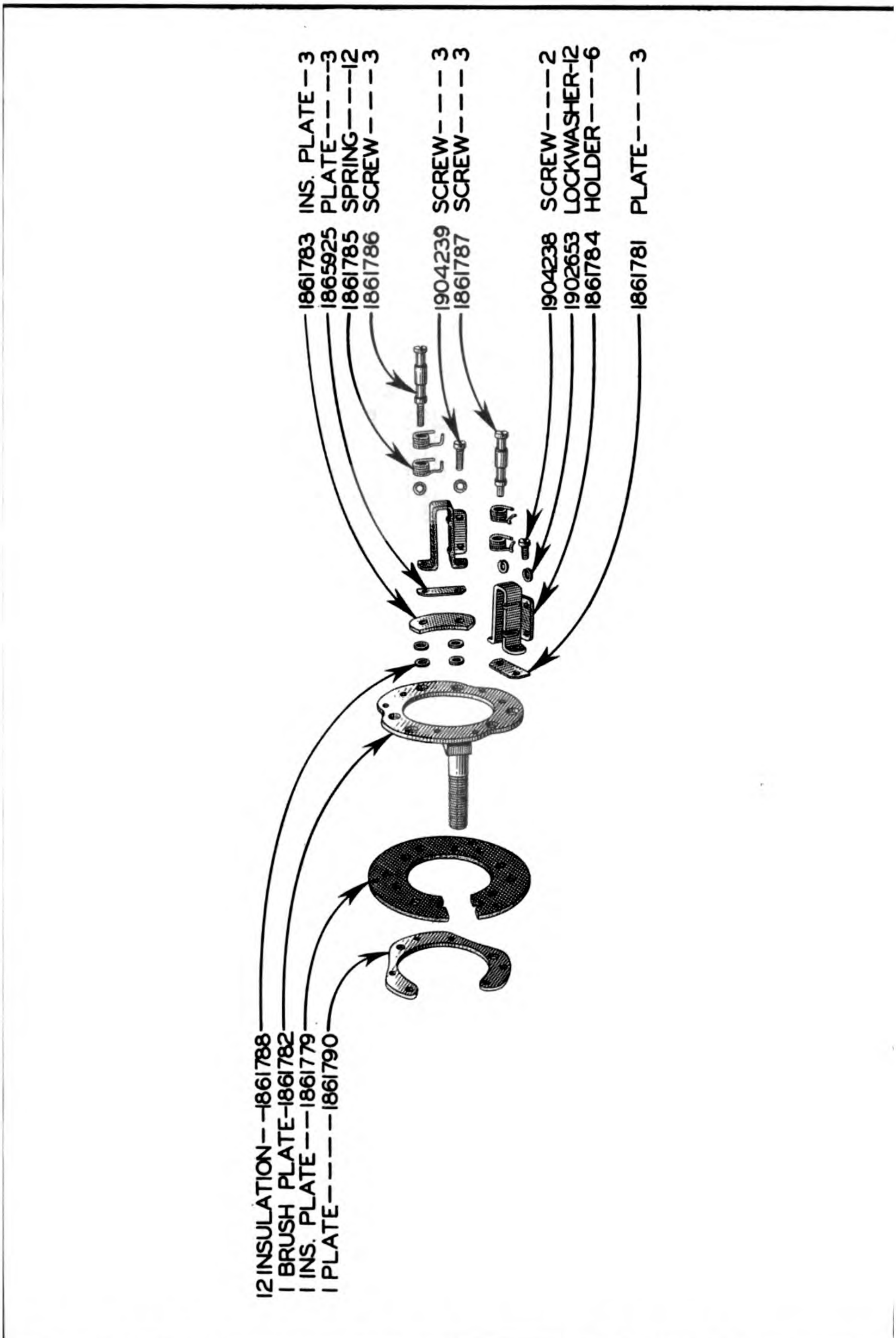

CRANKING MOTOR BRUSH PLATE-EXPLODED

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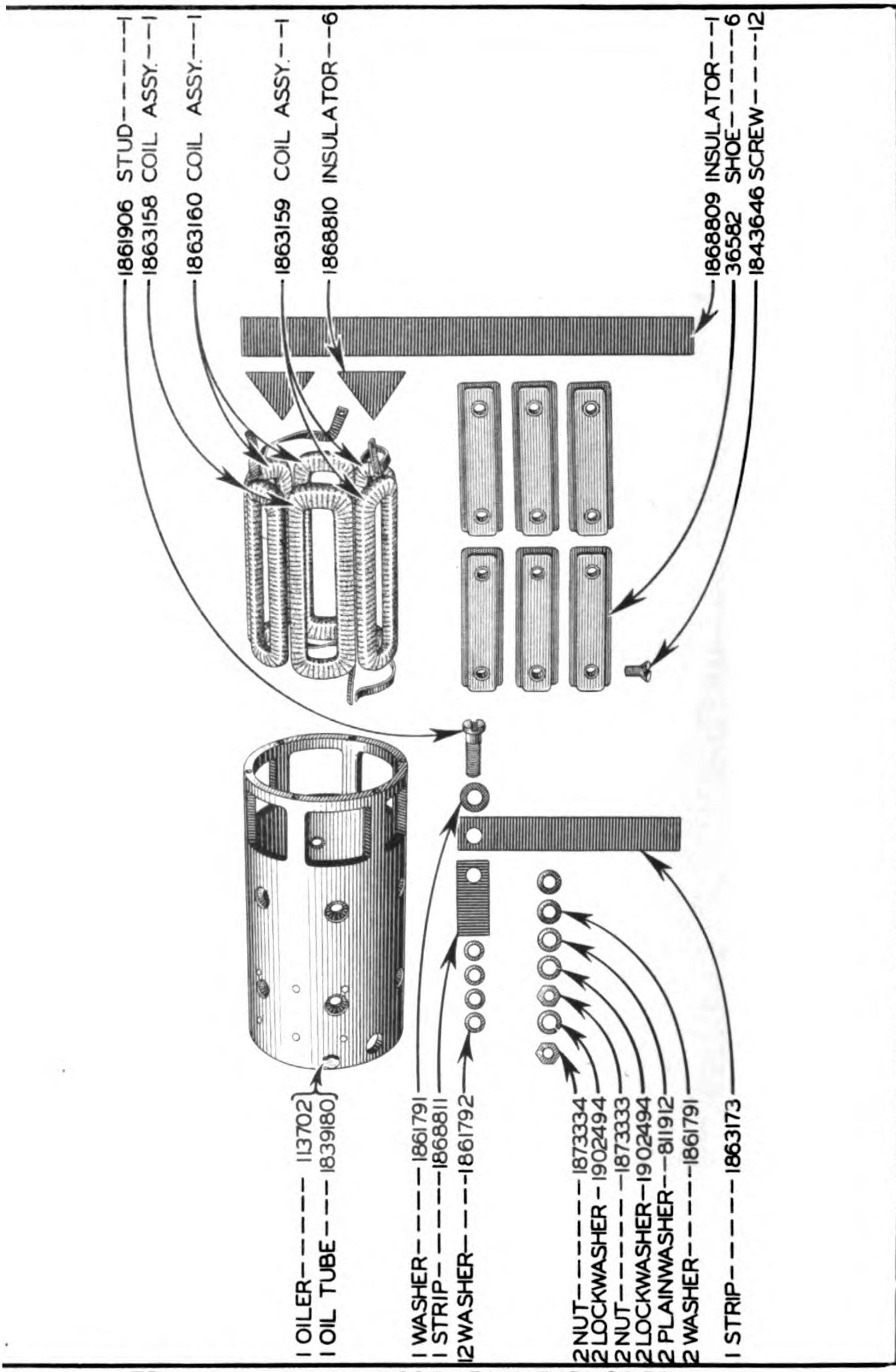

FRAME & FIELD ASSEMBLY-EXPLODED

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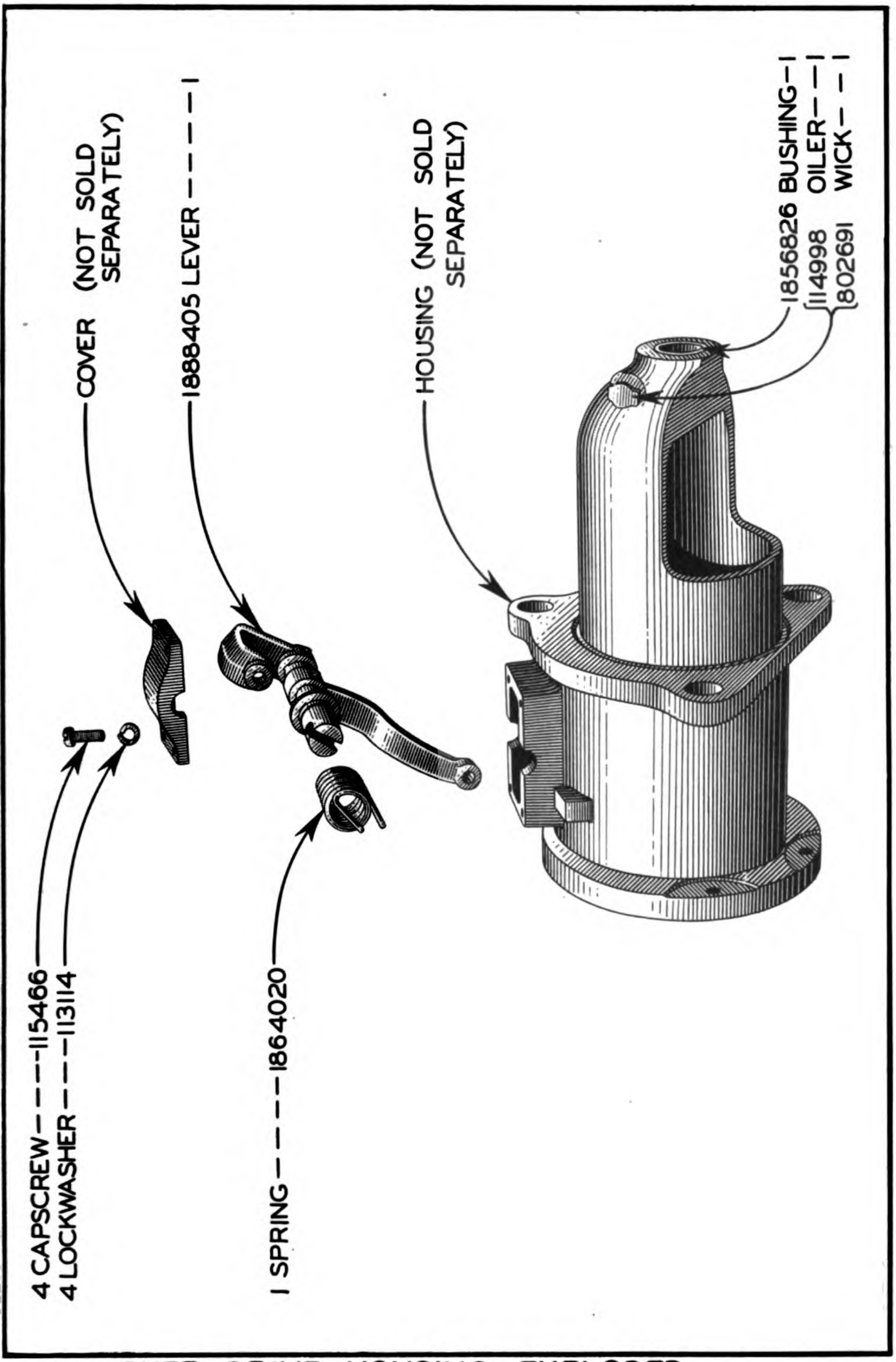

DYER DRIVE HOUSING-EXPLODED

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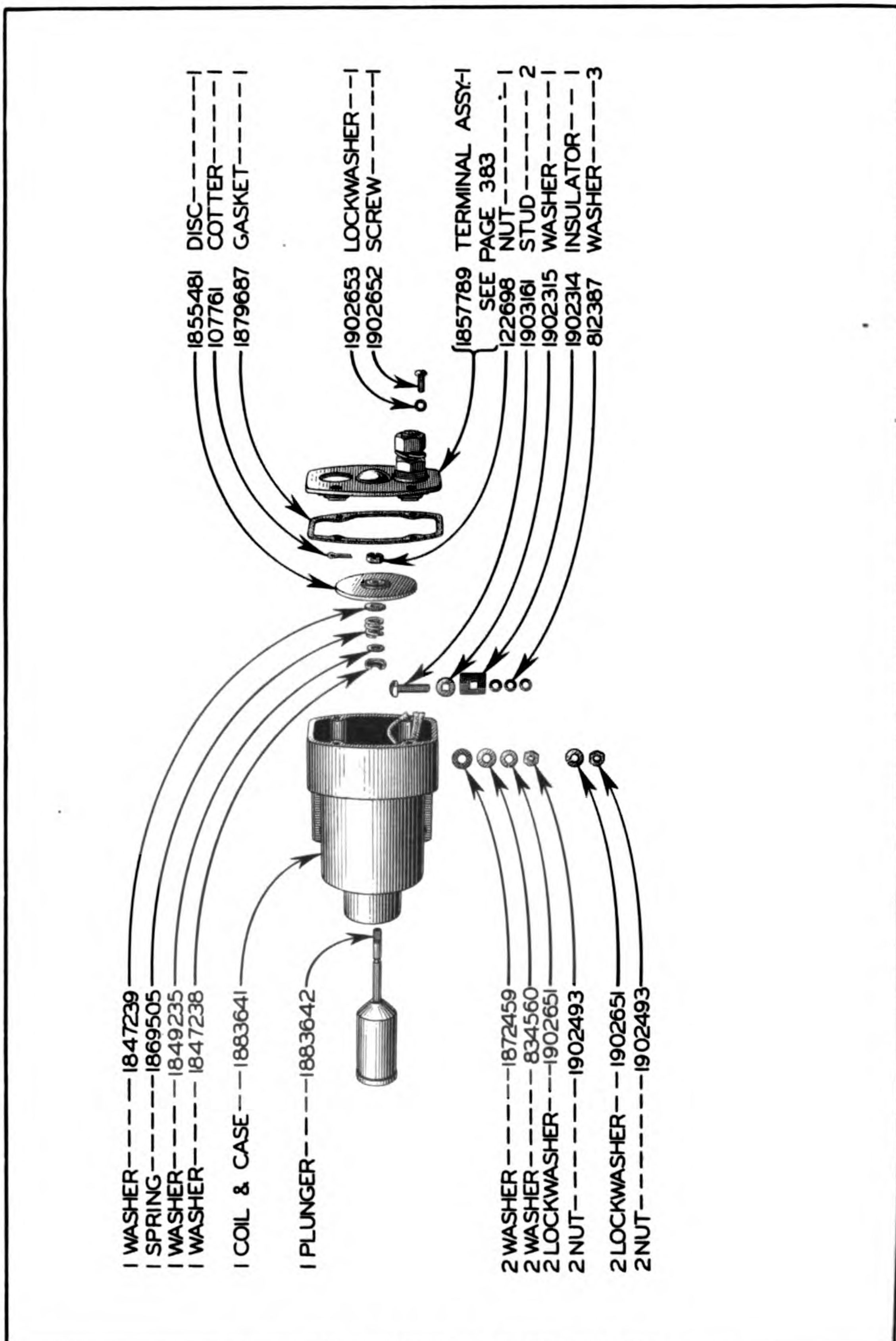

DELCO-REMY DIVISION PART NUMBERS, ORDER FROM DELCO-REMY DIVISION OF GENERAL MOTORS CORPORATION, ANDERSON, INDIANA

SOLENOID SWITCH—EXPLODED

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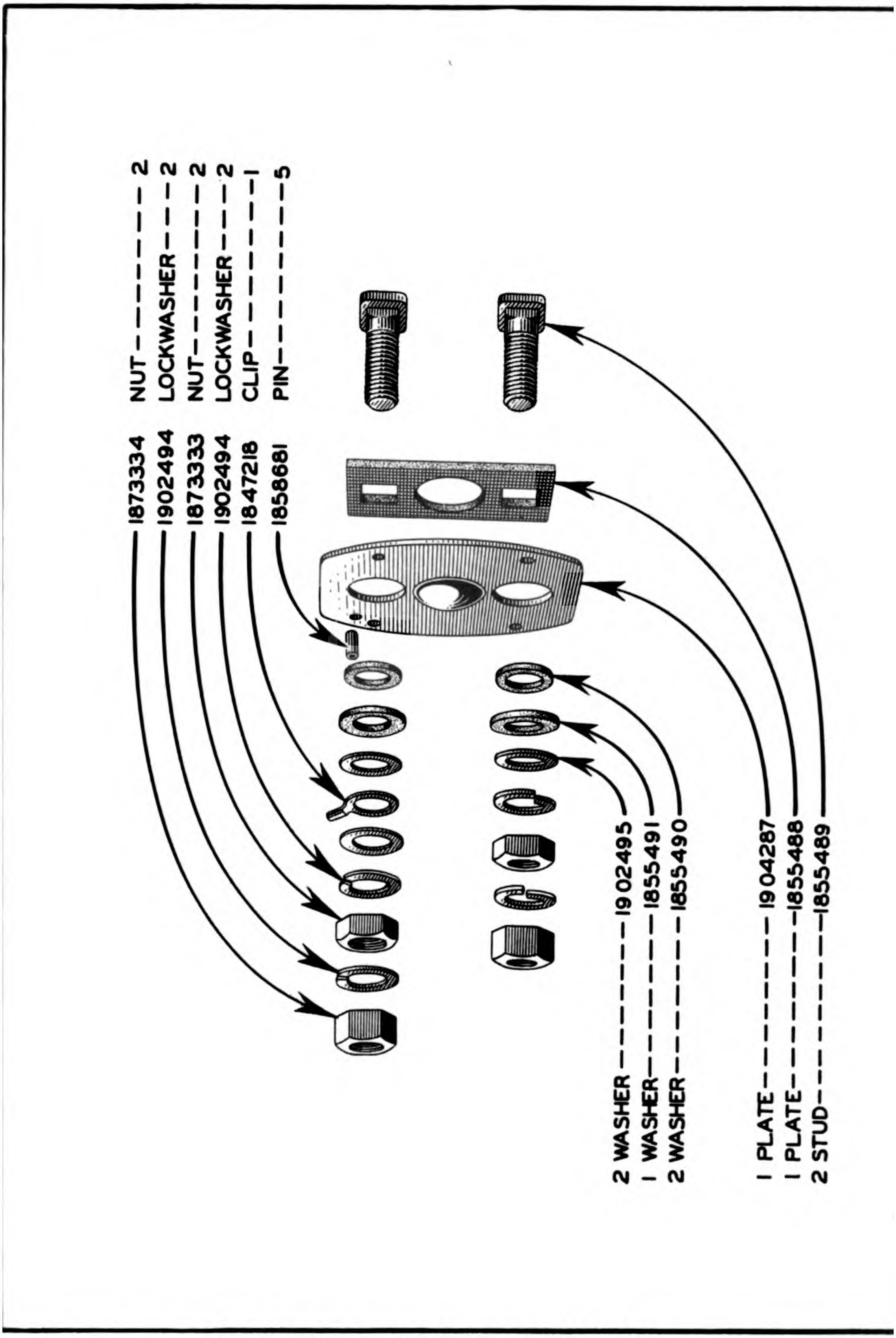

SOLENOID TERMINAL—EXPLODED

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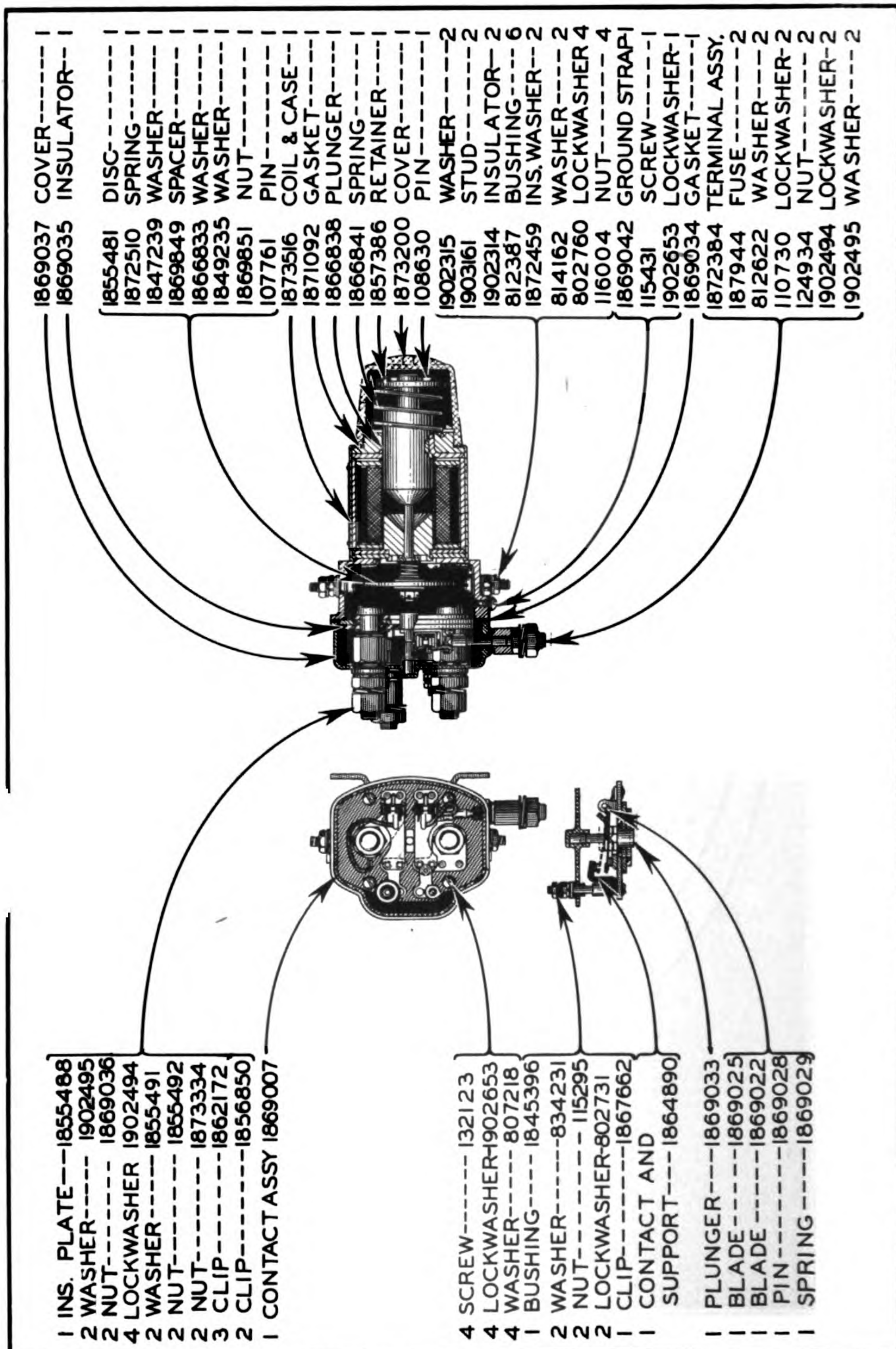

SERIES PARALLEL-CROSS SECTION

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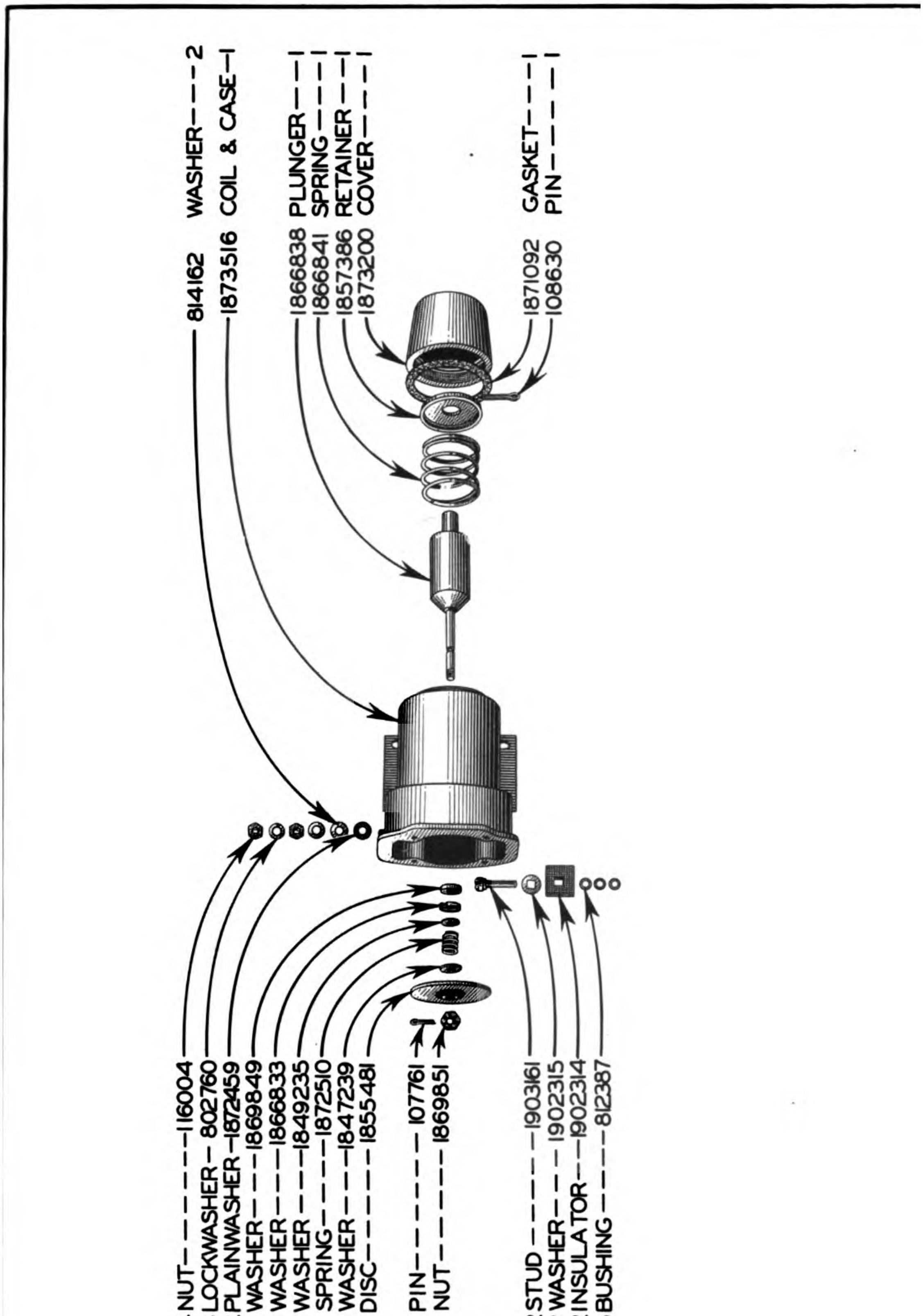

SERIES PARALLEL-EXPLODED

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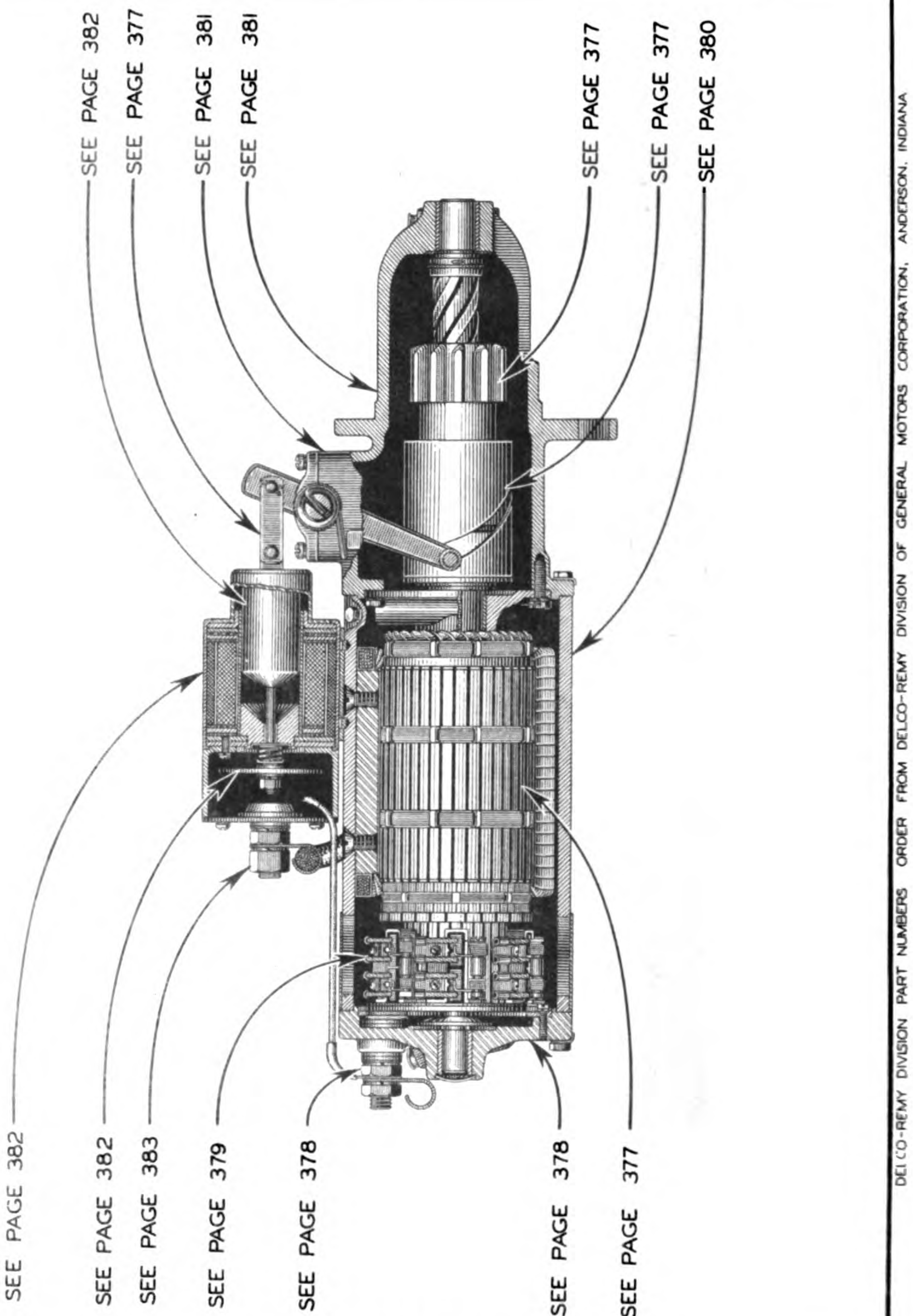

CRANKING MOTOR—CROSS SECTION

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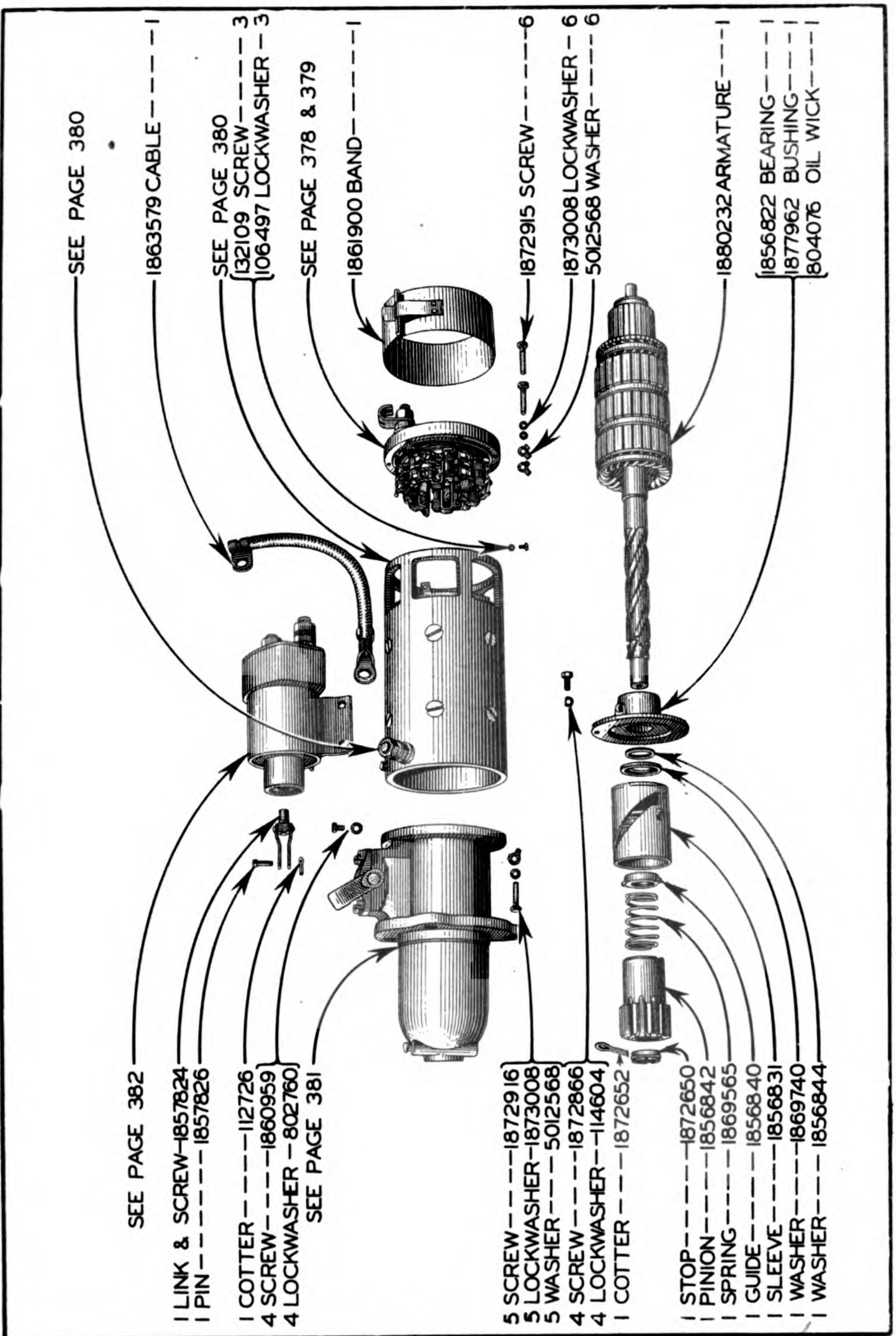
DELCO-REMY DIVISION PART NUMBERS. ORDER FROM DELCO-REMY DIVISION OF GENERAL MOTORS CORPORATION, ANDERSON, INDIANA



CRANKING MOTOR—EXPLODED VIEW

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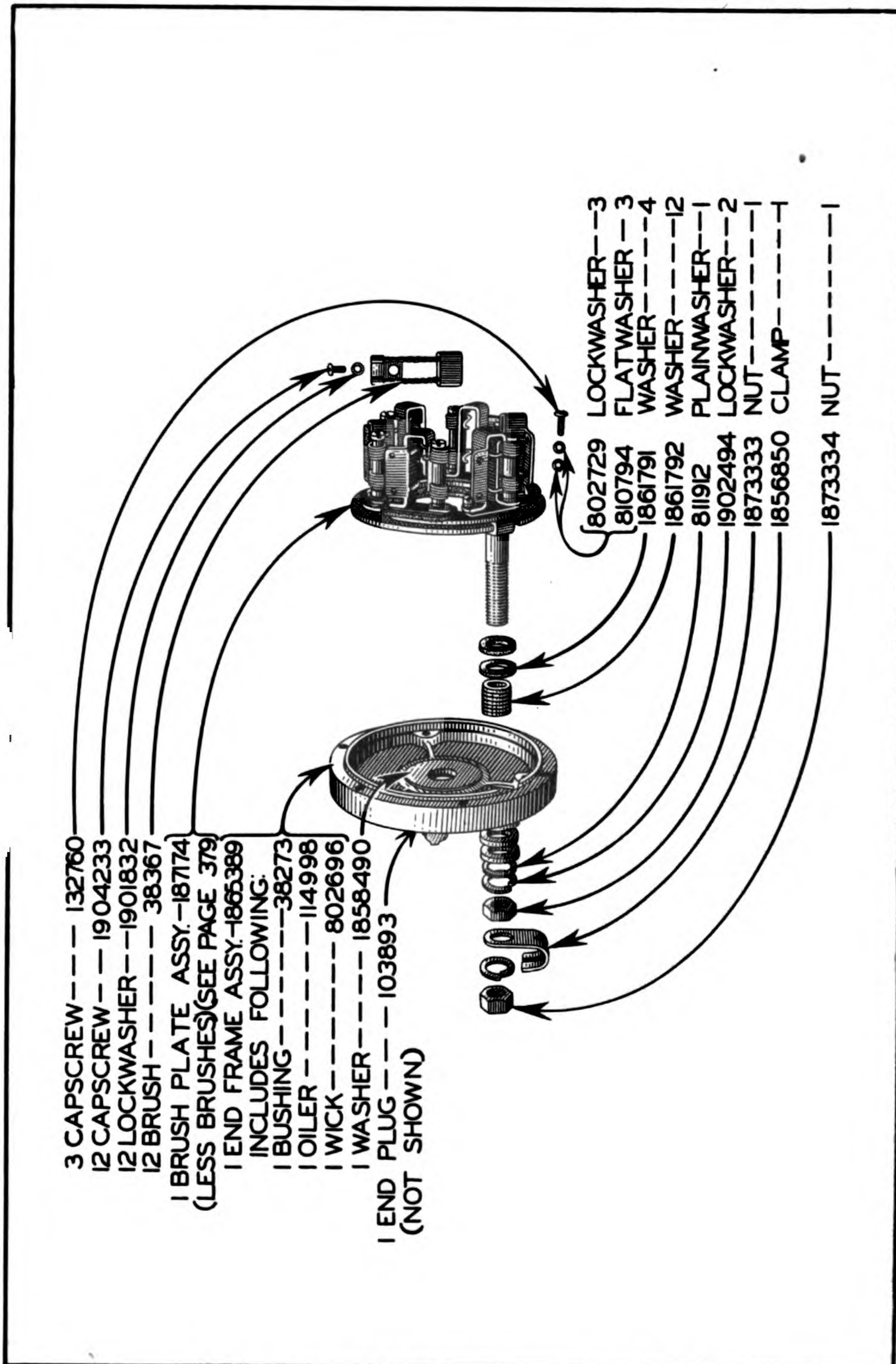

DELCO-REMY DIVISION PART NUMBERS. ORDER FROM DELCO-REMY DIVISION OF GENERAL MOTORS CORPORATION, ANDERSON, INDIANA.

CUMMUTATOR END-EXPLODED

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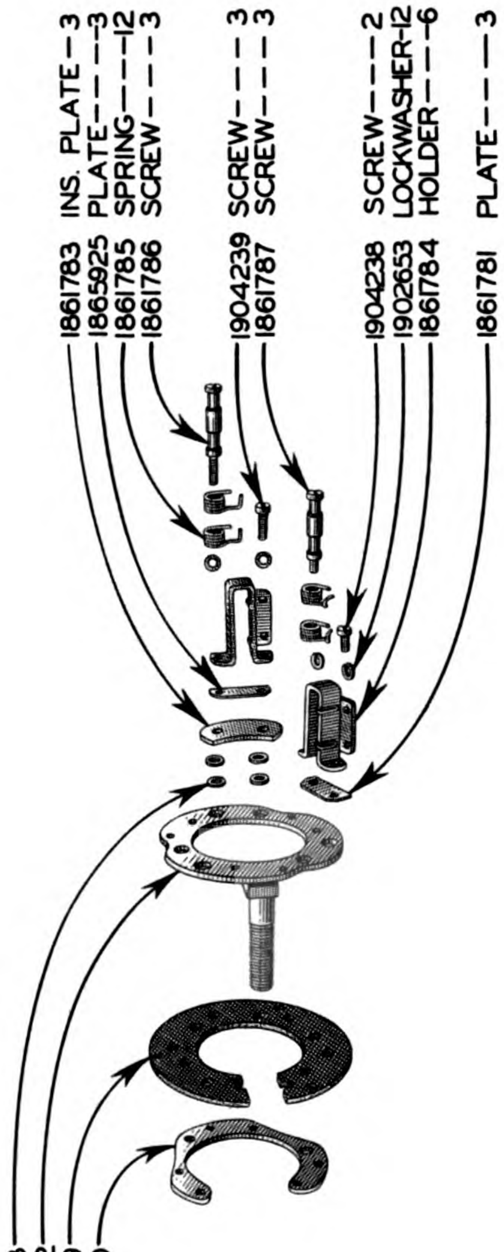
Original from UNIVERSITY OF CALIFORNIA



CRANKING MOTOR BRUSH PLATE-EXPLODED

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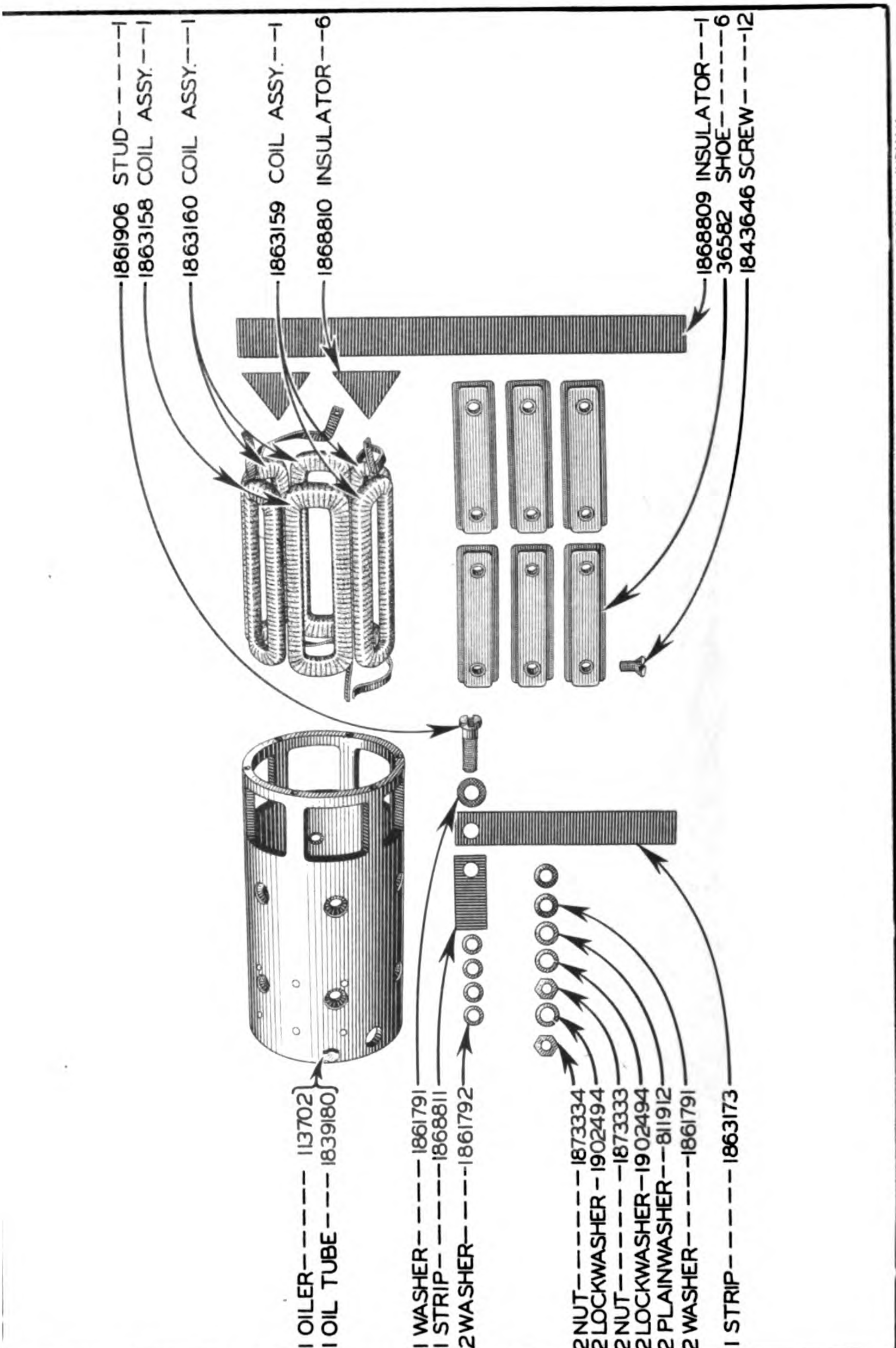

FRAME & FIELD ASSEMBLY-EXPLODED

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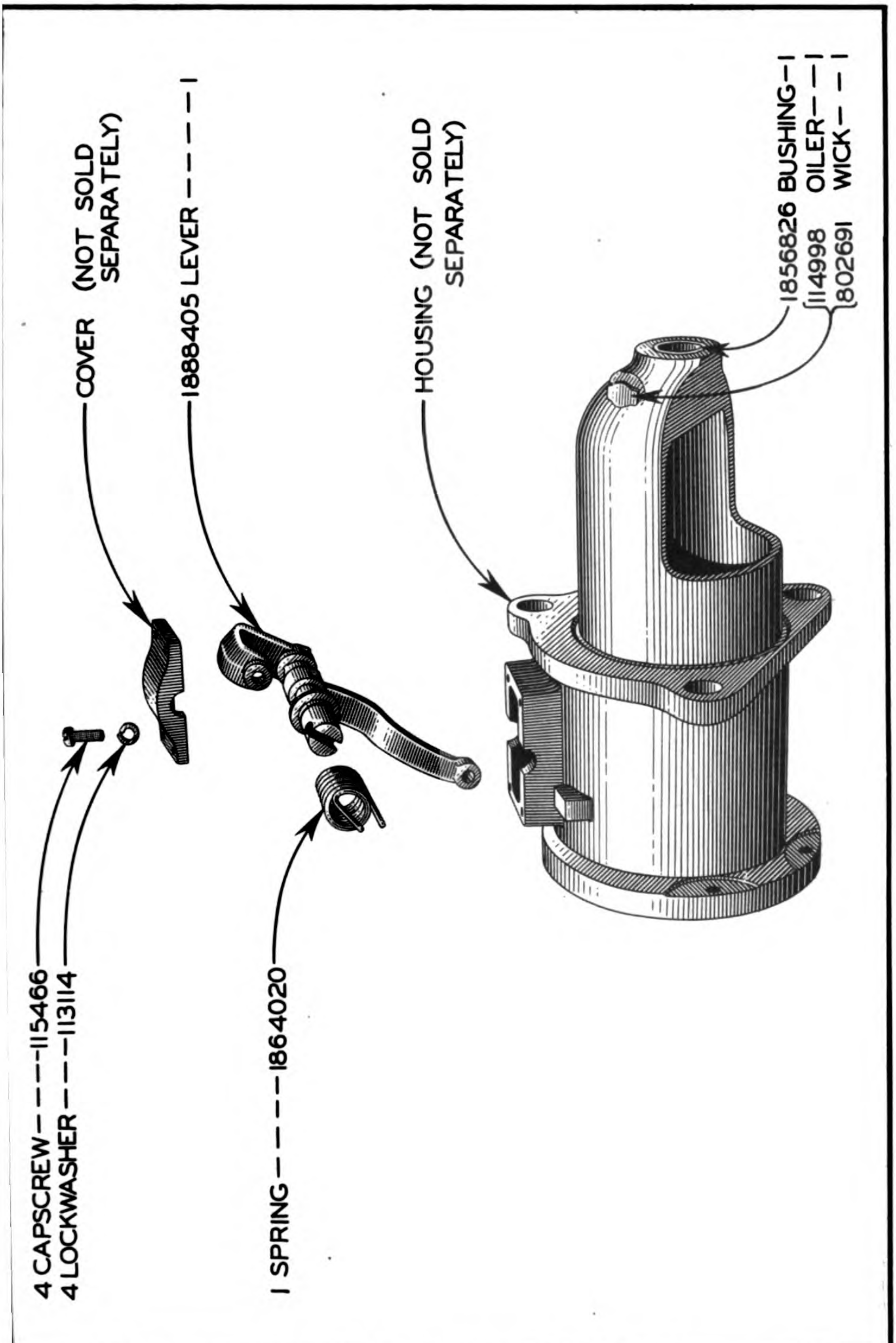

DYER DRIVE HOUSING—EXPLODED

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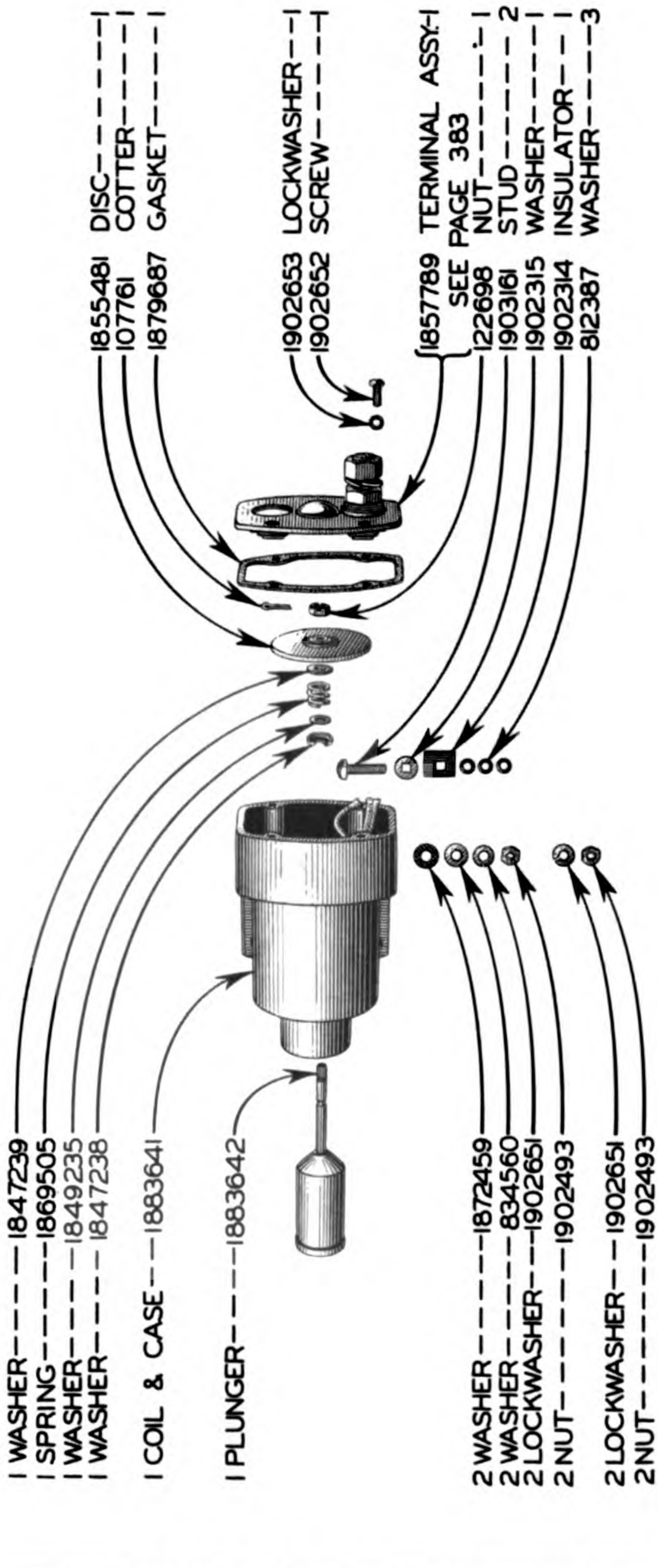

DELCO-REMY DIVISION PART NUMBERS ORDER FROM DELCO-REMY DIVISION OF GENERAL MOTORS CORPORATION, ANDERSON, INDIANA

SOLENOID SWITCH—EXPLODED

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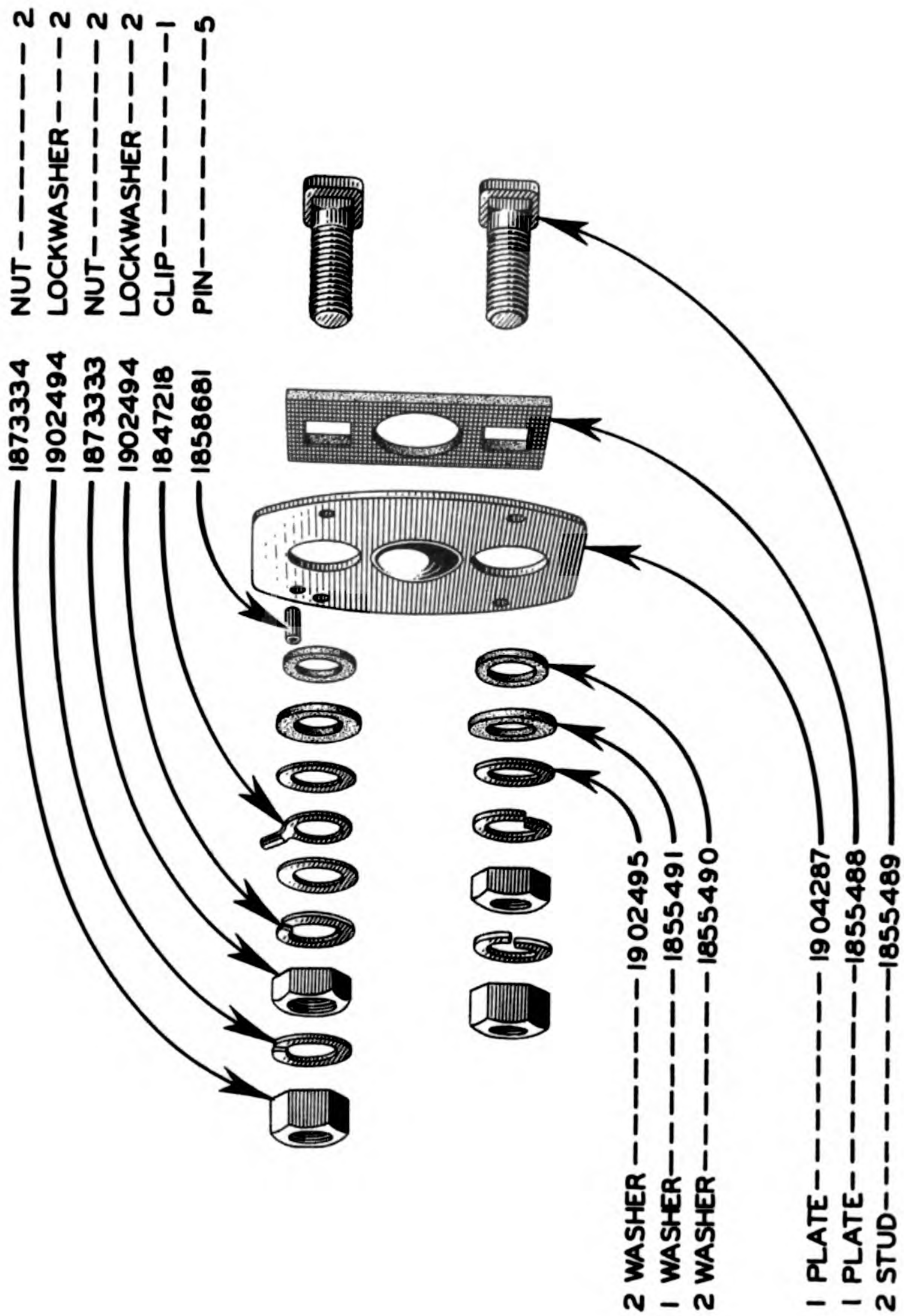

SOLENOID TERMINAL—EXPLODED

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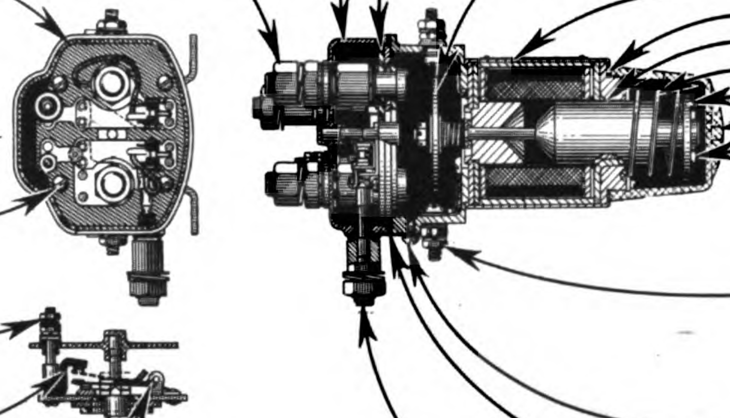
1	INS. PLATE	1855488
2	WASHER	1902495
2	NUT	1869036
4	LOCKWASHER	1902494
2	WASHER	1855491
2	NUT	1855492
2	NUT	1873334
3	CLIP	1862172
2	CLIP	1856850
1	CONTACT ASSY	1869007
4	SCREW	132123
4	LOCKWASHER	1902653
4	WASHER	807218
1	BUSHING	1845396
2	WASHER	834231
2	NUT	115295
2	LOCKWASHER	802731
1	CLIP	1867662
1	CONTACT AND SUPPORT	1864890
1	PLUNGER	1869033
1	BLADE	1869025
1	BLADE	1869022
1	PIN	1869028
1	SPRING	1869029



1869037	COVER	1
1869035	INSULATOR	1
1855481	DISC	1
1872510	SPRING	1
1847239	WASHER	1
1869849	SPACER	1
1866833	WASHER	1
1849235	WASHER	1
1869851	NUT	1
107761	PIN	1
1873516	COIL & CASE	1
1871092	GASKET	1
1866838	PLUNGER	1
1866841	SPRING	1
1857386	RETAINER	1
1873200	COVER	1
108630	PIN	1
1902315	WASHER	2
1903161	STUD	2
1902314	INSULATOR	2
812387	BUSHING	6
1872459	INS. WASHER	2
814162	WASHER	2
802760	LOCKWASHER	4
116004	NUT	4
1869042	GROUND STRAP	1
115431	SCREW	1
1902653	LOCKWASHER	1
1869034	GASKET	1
1872384	TERMINAL ASSY.	
187944	FUSE	2
812622	WASHER	2
110730	LOCKWASHER	2
124934	NUT	2
1902494	LOCKWASHER	2
1902495	WASHER	2

DELCO-REMY DIVISION PART NUMBERS. ORDER FROM DELCO-REMY DIVISION OF GENERAL MOTORS CORPORATION, ANDERSON, INDIANA

SERIES PARALLEL-CROSS SECTION

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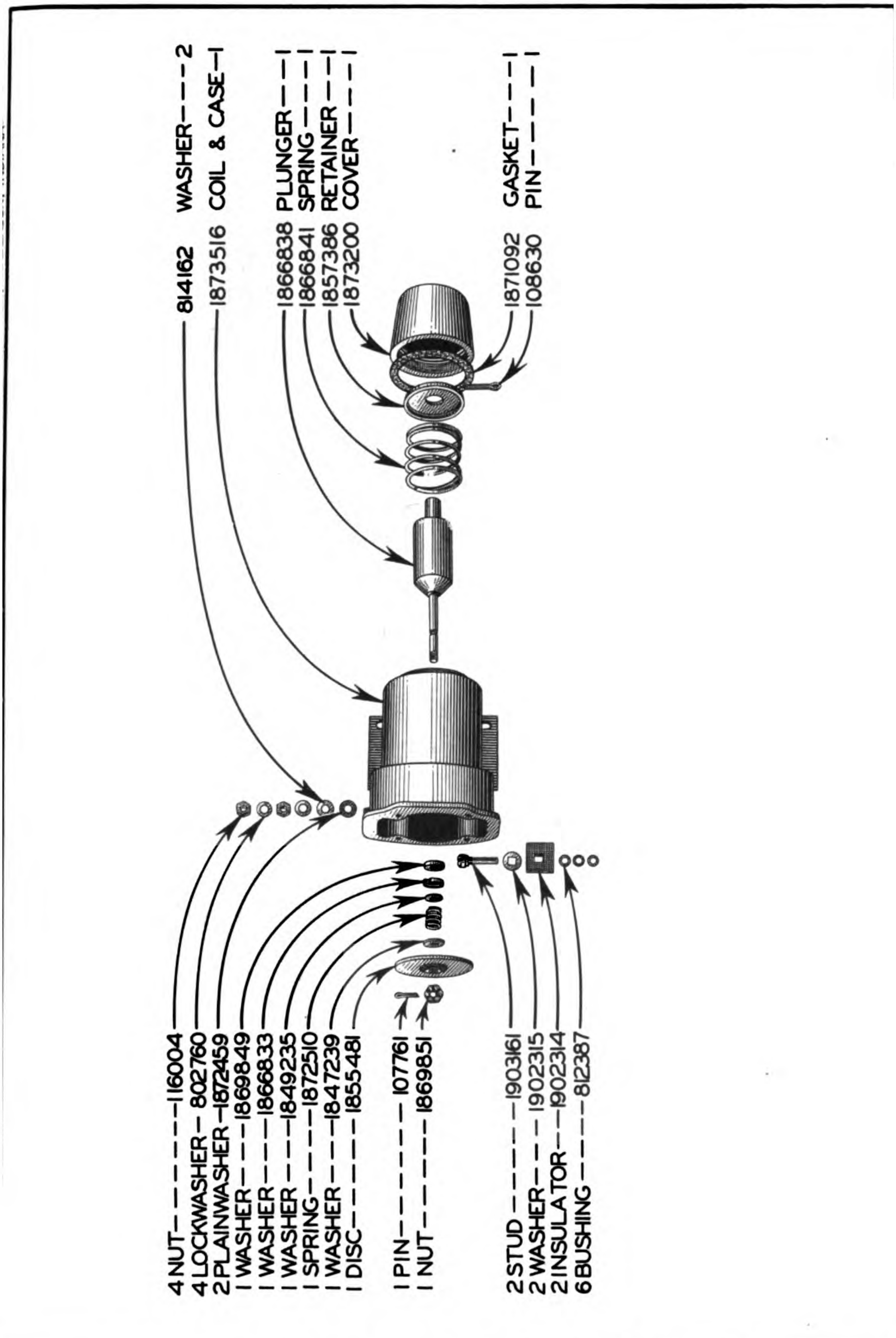

SERIES PARALLEL—EXPLODED

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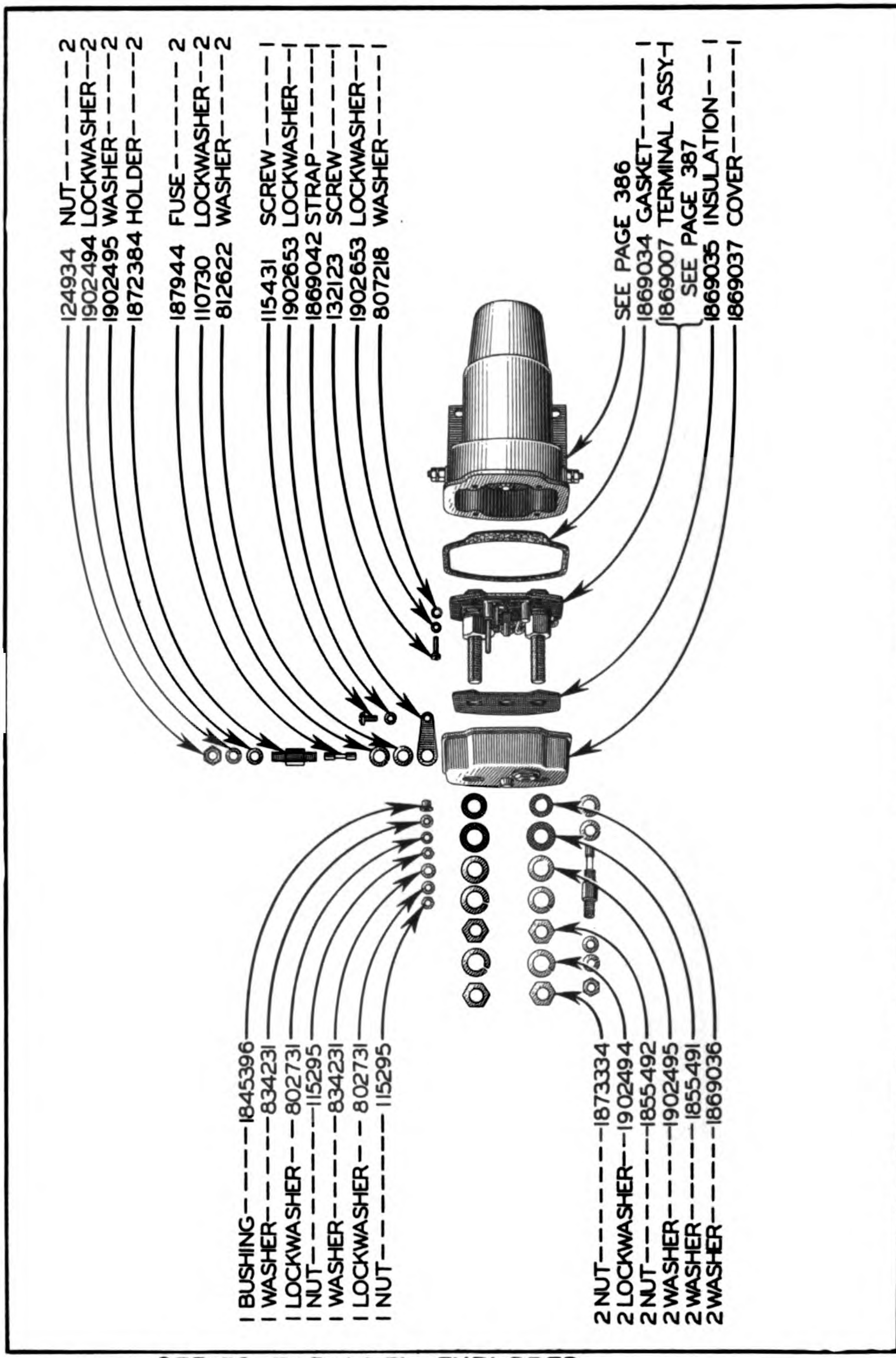

DELCO-REMY DIVISION PART NUMBERS. ORDER FROM DELCO-REMY DIVISION OF GENERAL MOTORS CORPORATION, ANDERSON, INDIANA

SERIES PARALLEL-EXPLODED

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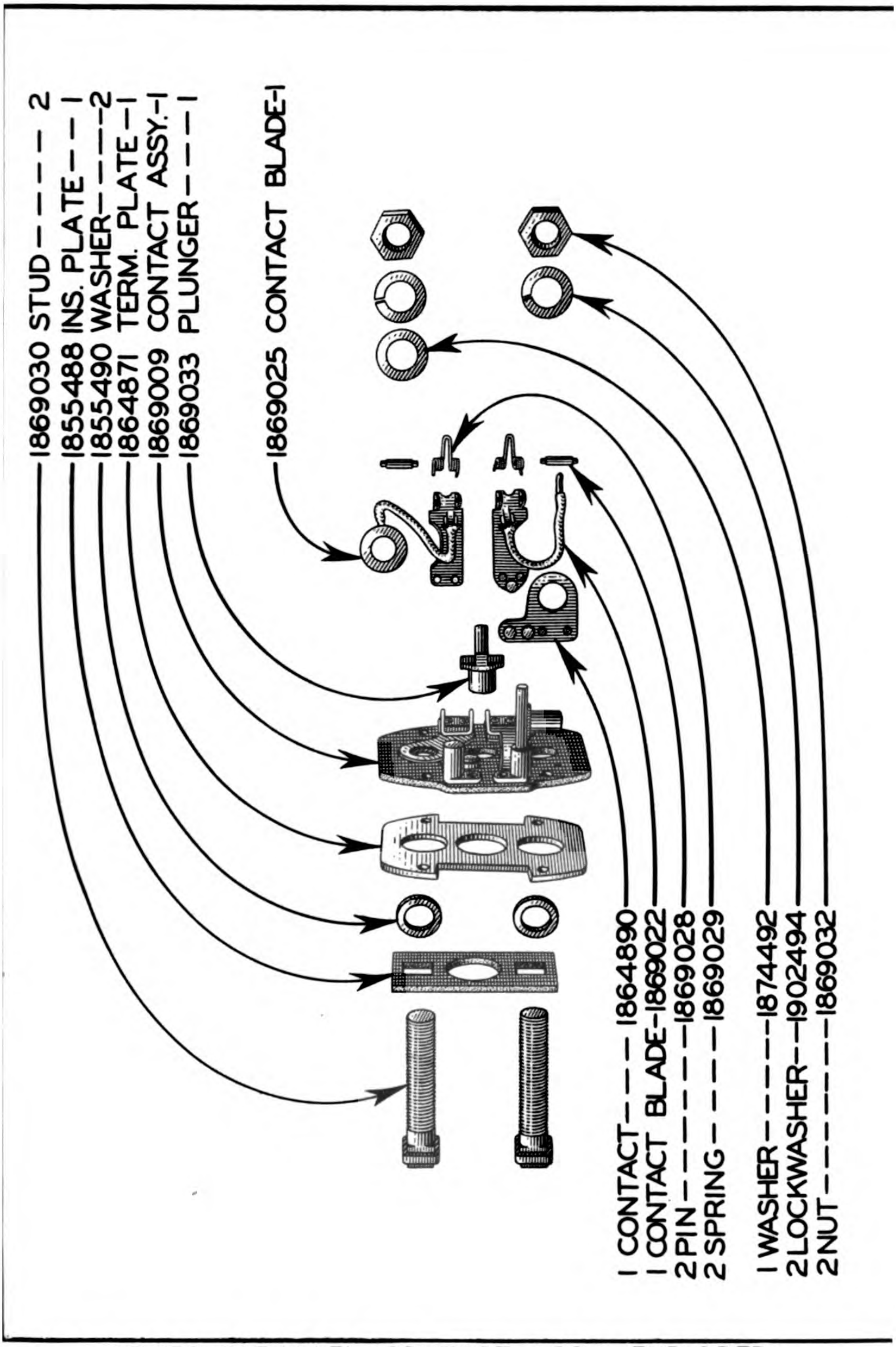

SERIES PARALLEL CONTACT ASSY.—EXPLODED

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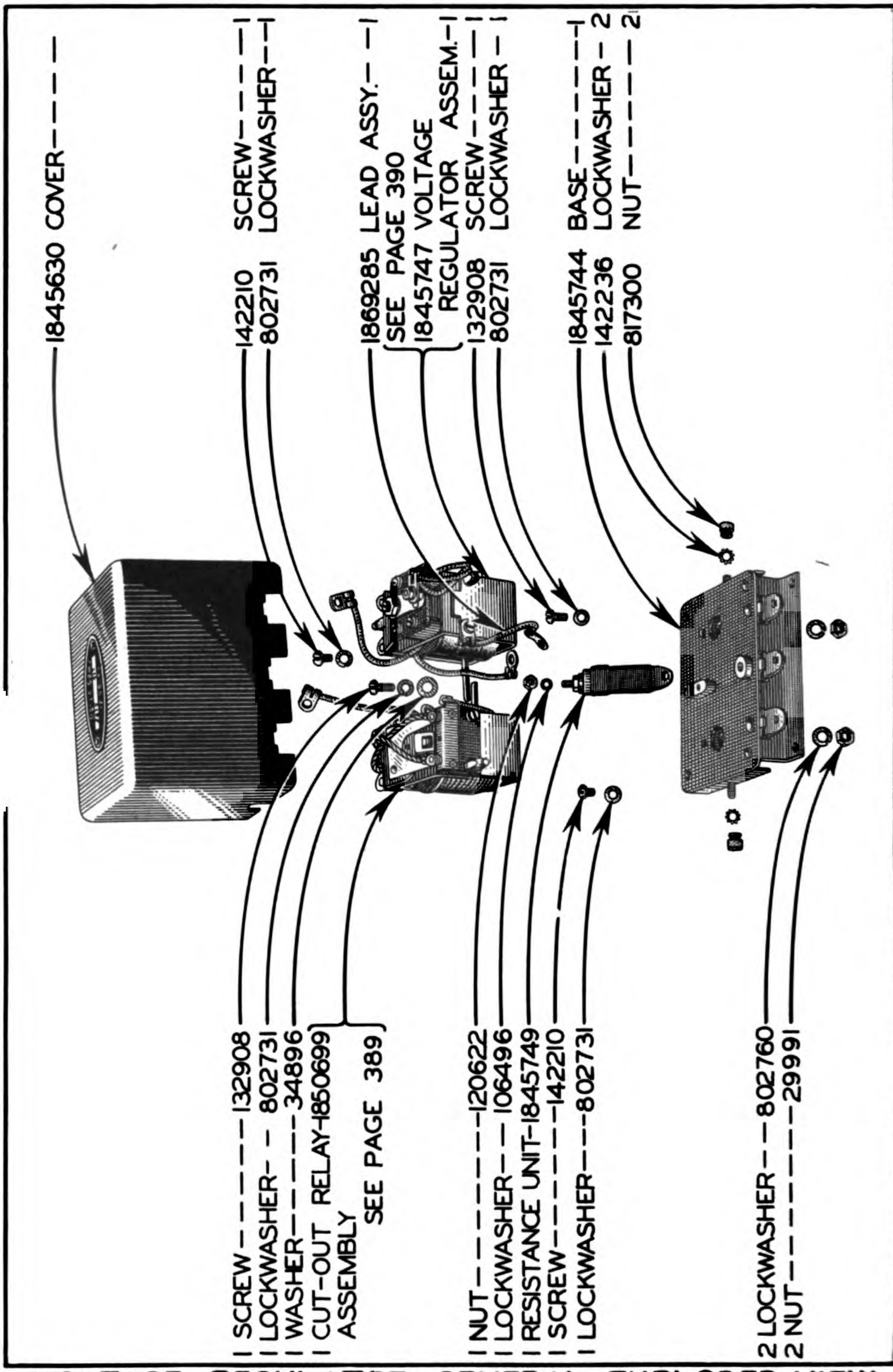

VOLTAGE REGULATOR—GENERAL EXPLODED VIEW

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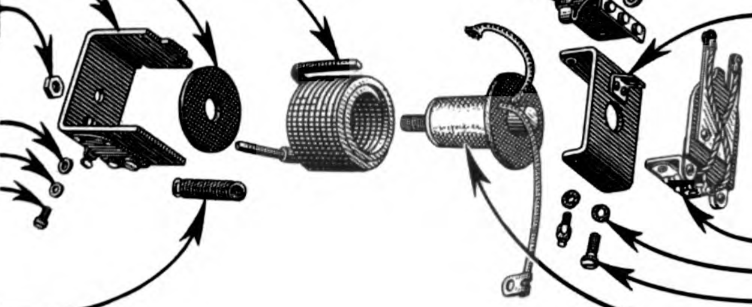
DELCO-REMY DIVISION PART NUMBERS. ORDER FROM DELCO-REMY DIVISION OF GENERAL MOTORS CORPORATION, ANDERSON, INDIANA.



#NOT A SERVICEABLE PART

VOLTAGE REGULATOR-EXPLODED

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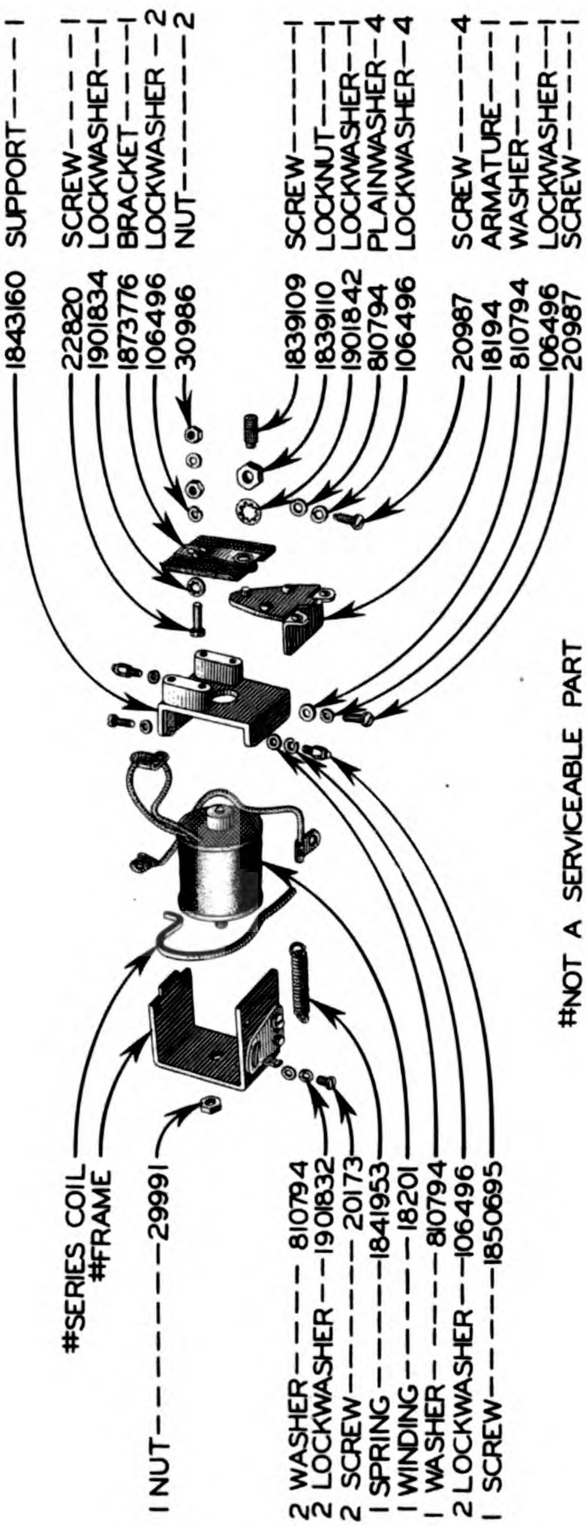

DELCO-REMY DIVISION PART NUMBERS ORDER FROM DELCO-REMY DIVISION OF GENERAL MOTORS CORPORATION, ANDERSON, INDIANA.

CUT-OUT RELAY-EXPLODED

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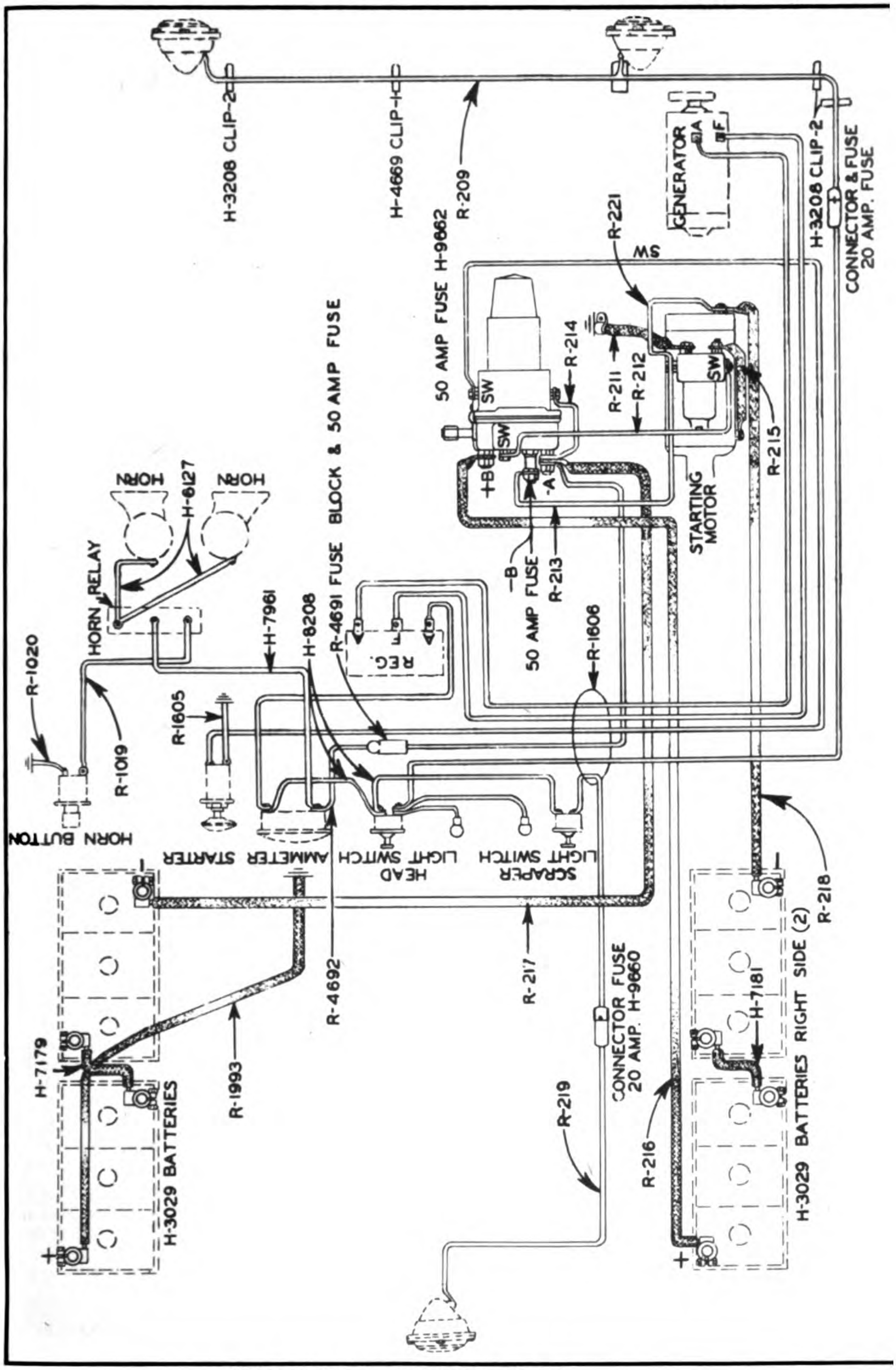

WIRING DIAGRAM

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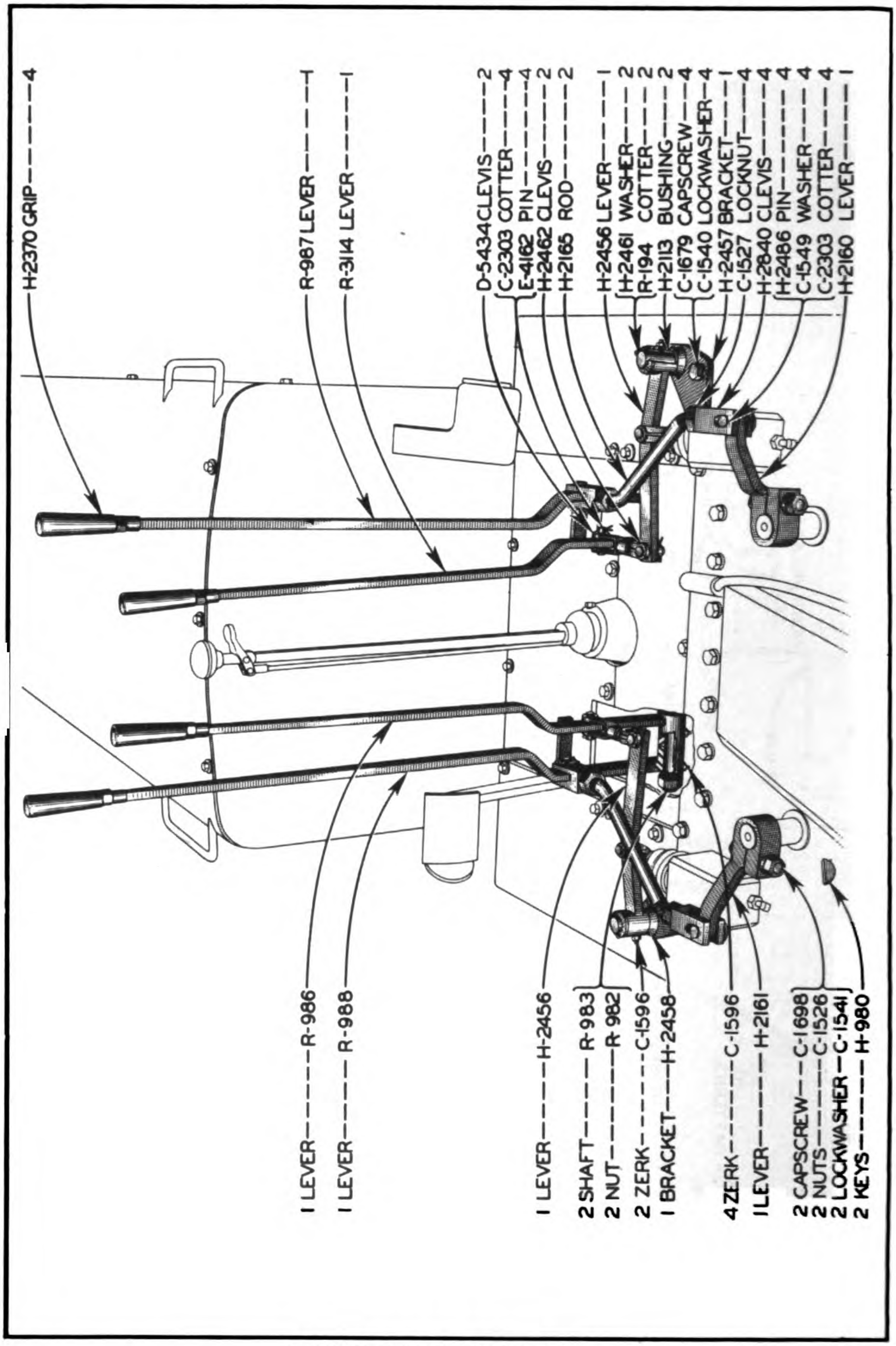

CONTROL GROUP

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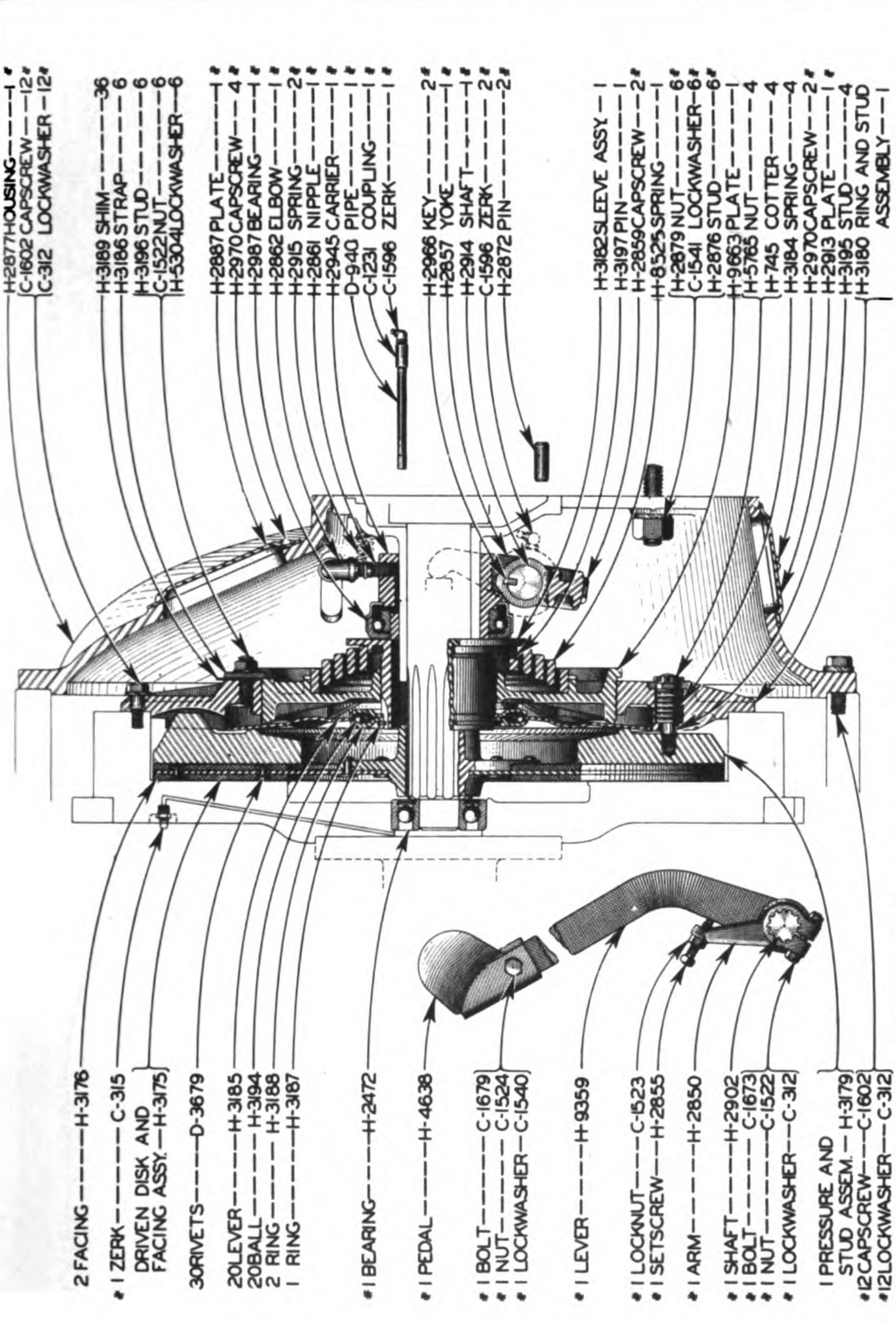

NOT INCLUDED IN GROUP NO. H-8088. ALL PARTS MARKED THUS MUST BE ORDERED SEPARATELY.

FLYWHEEL CLUTCH- CROSS SECTION

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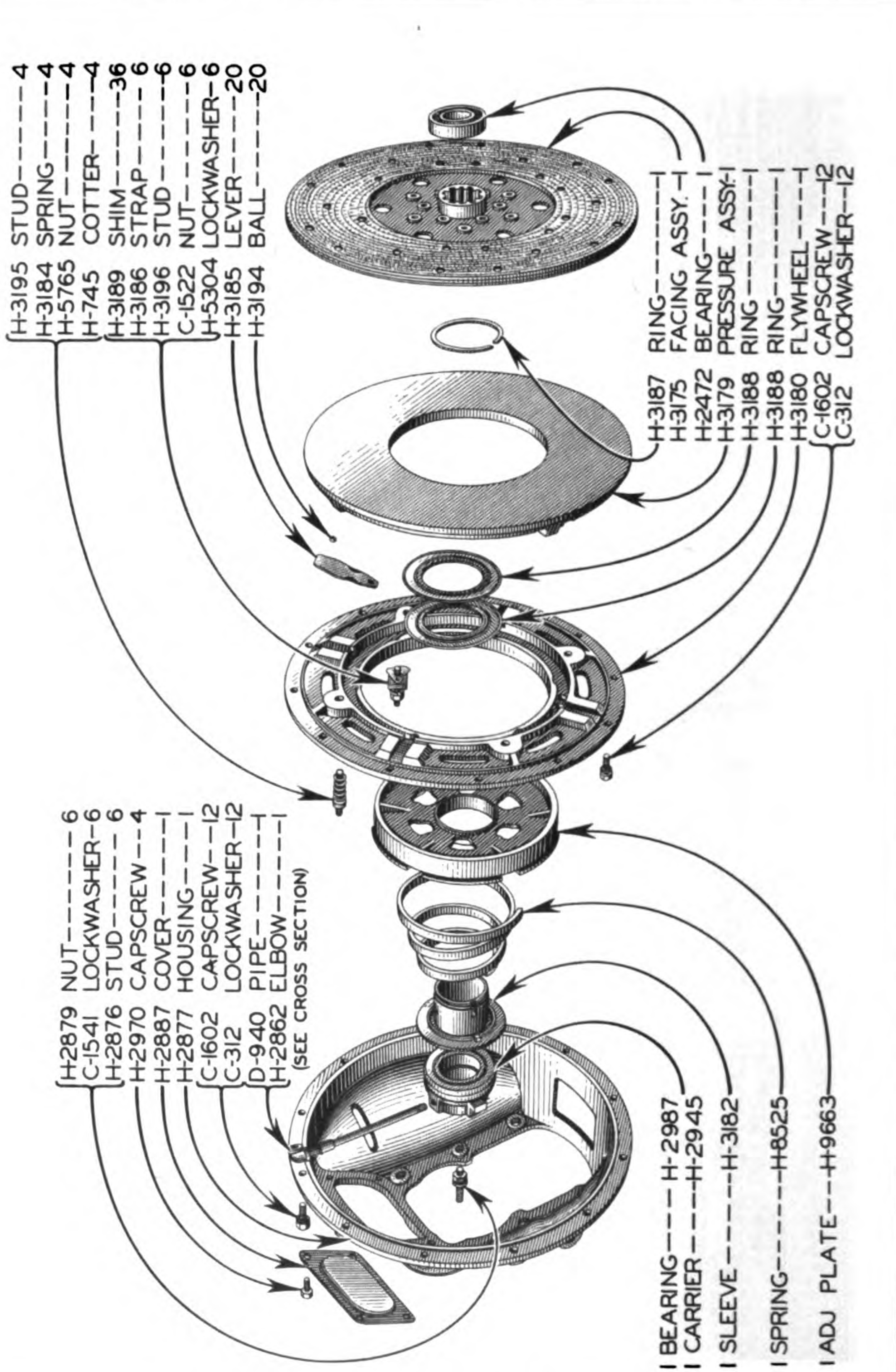

FLYWHEEL CLUTCH—EXPLODED

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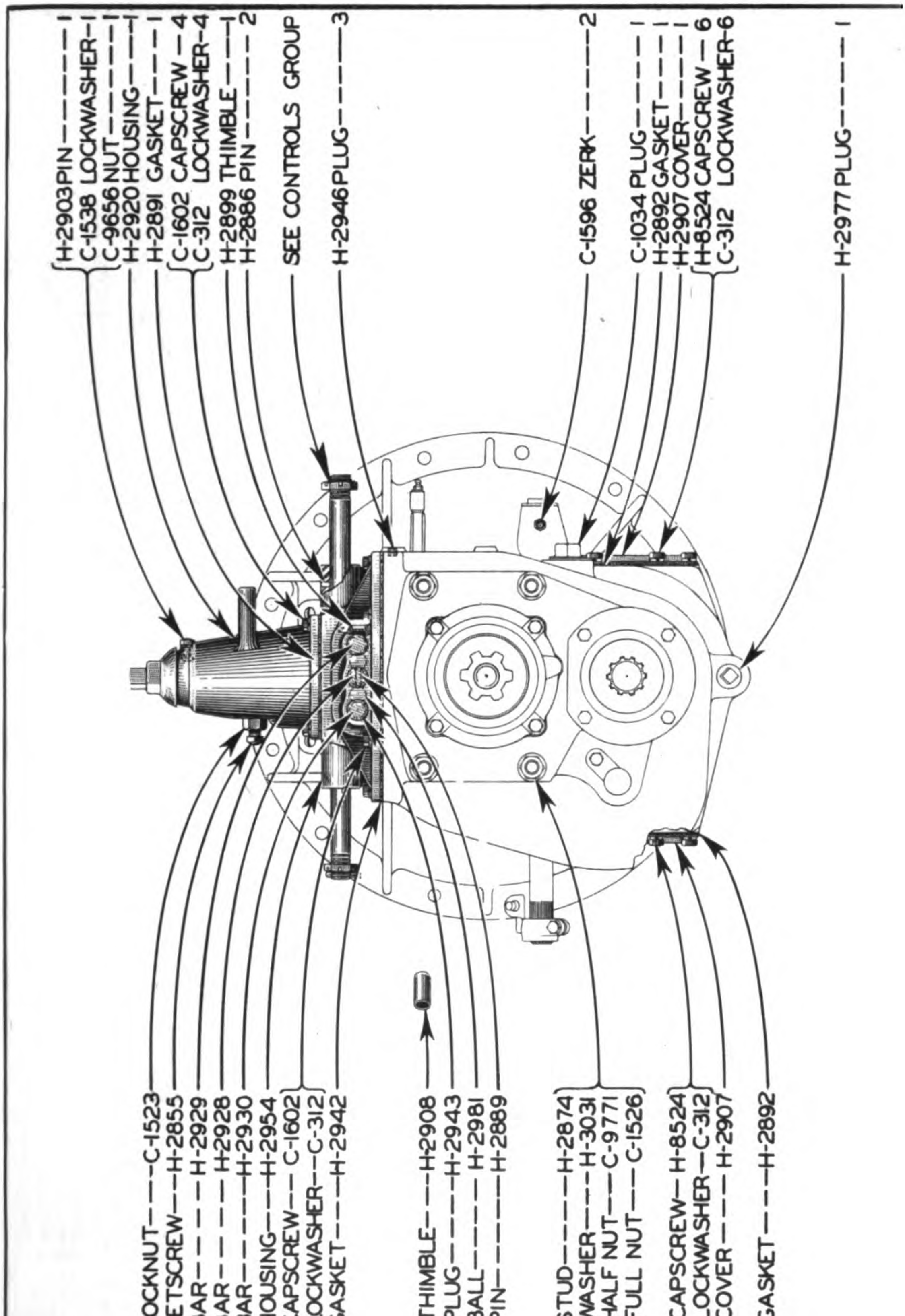

TRANSMISSION—REAR VIEW

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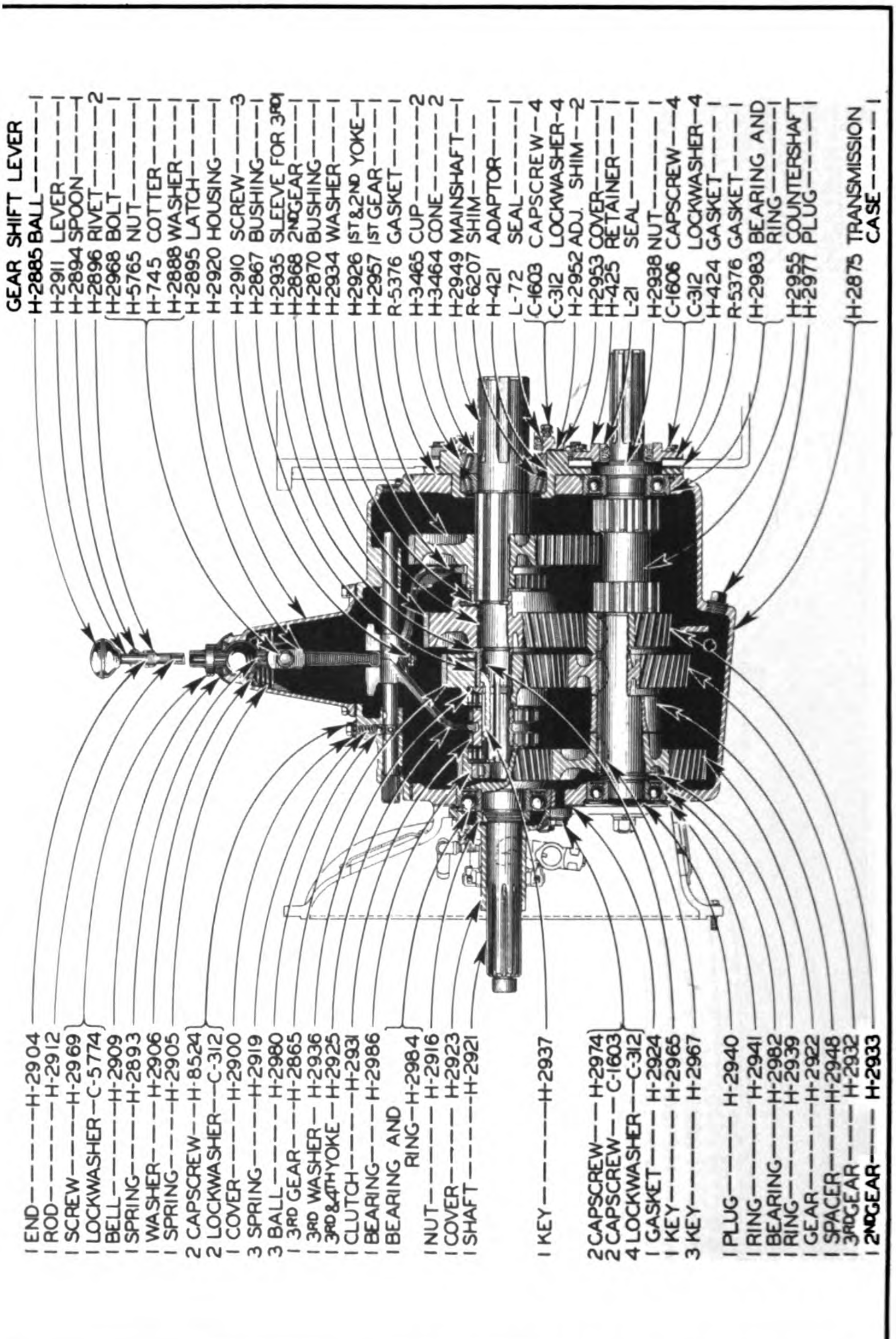

TRANSMISSION-CROSS SECTION

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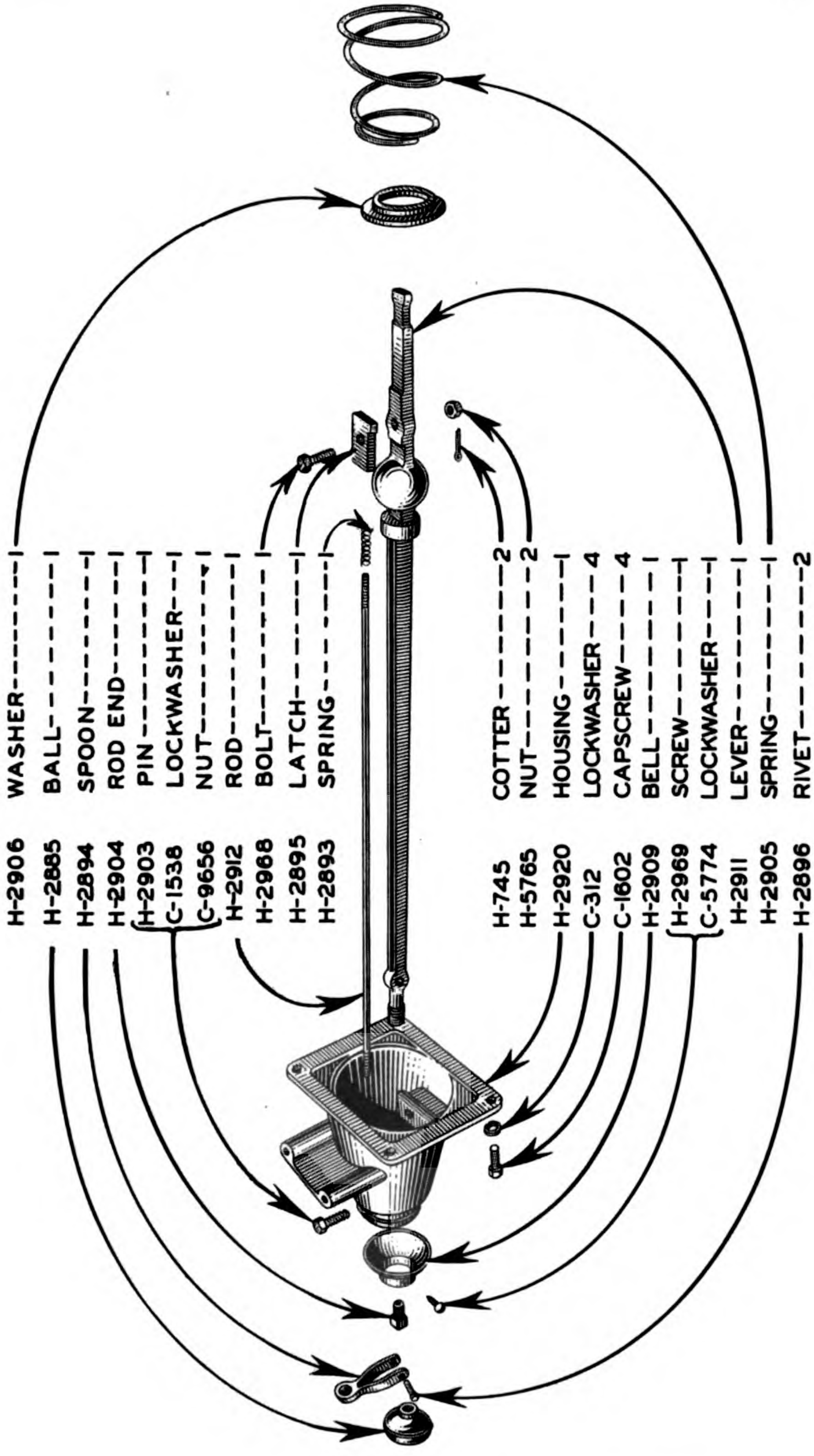

TRANSMISSION SHIFT LEVER-EXPLODED

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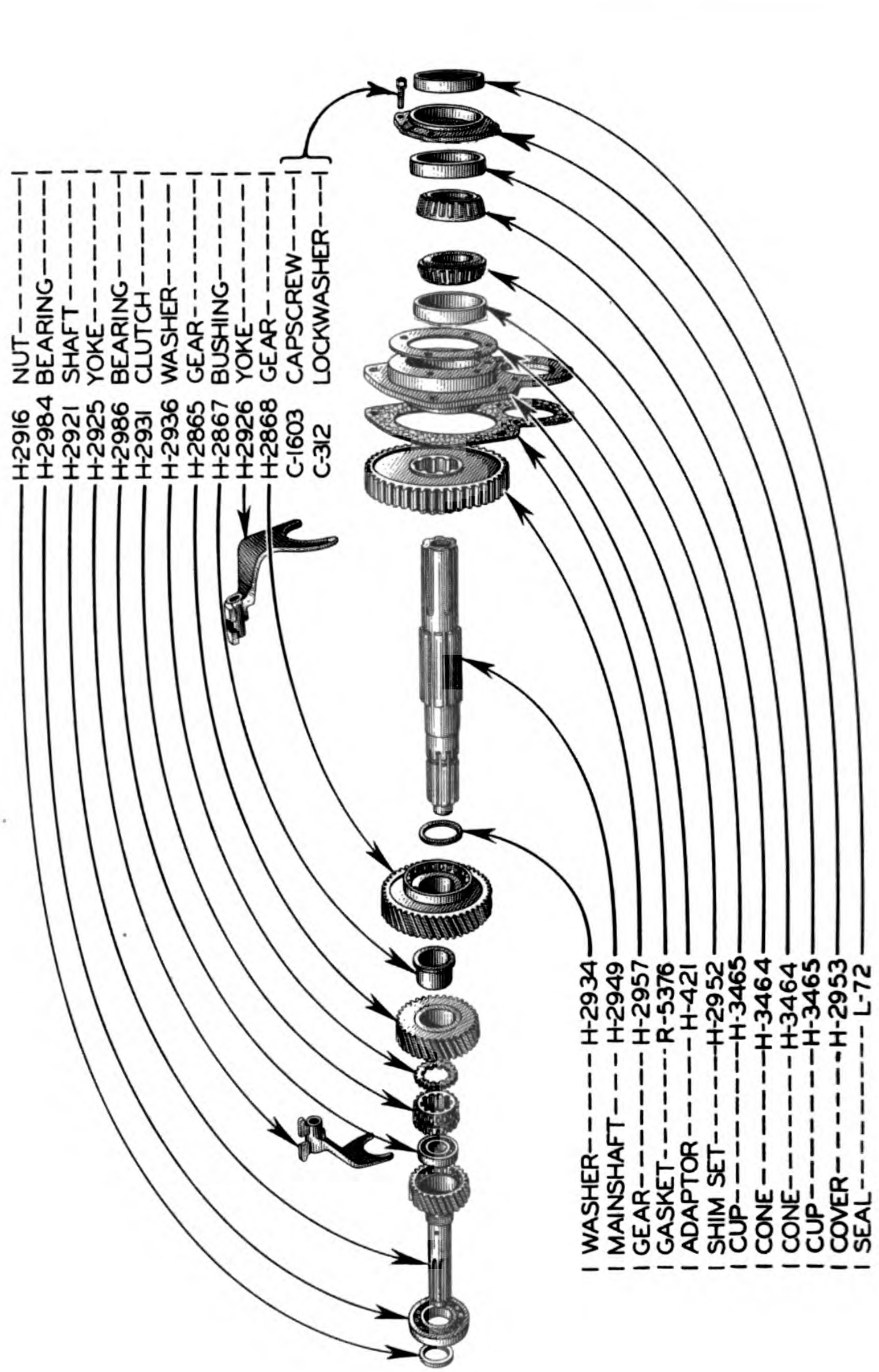

UPPER TRANSMISSION SHAFT—EXPLODED

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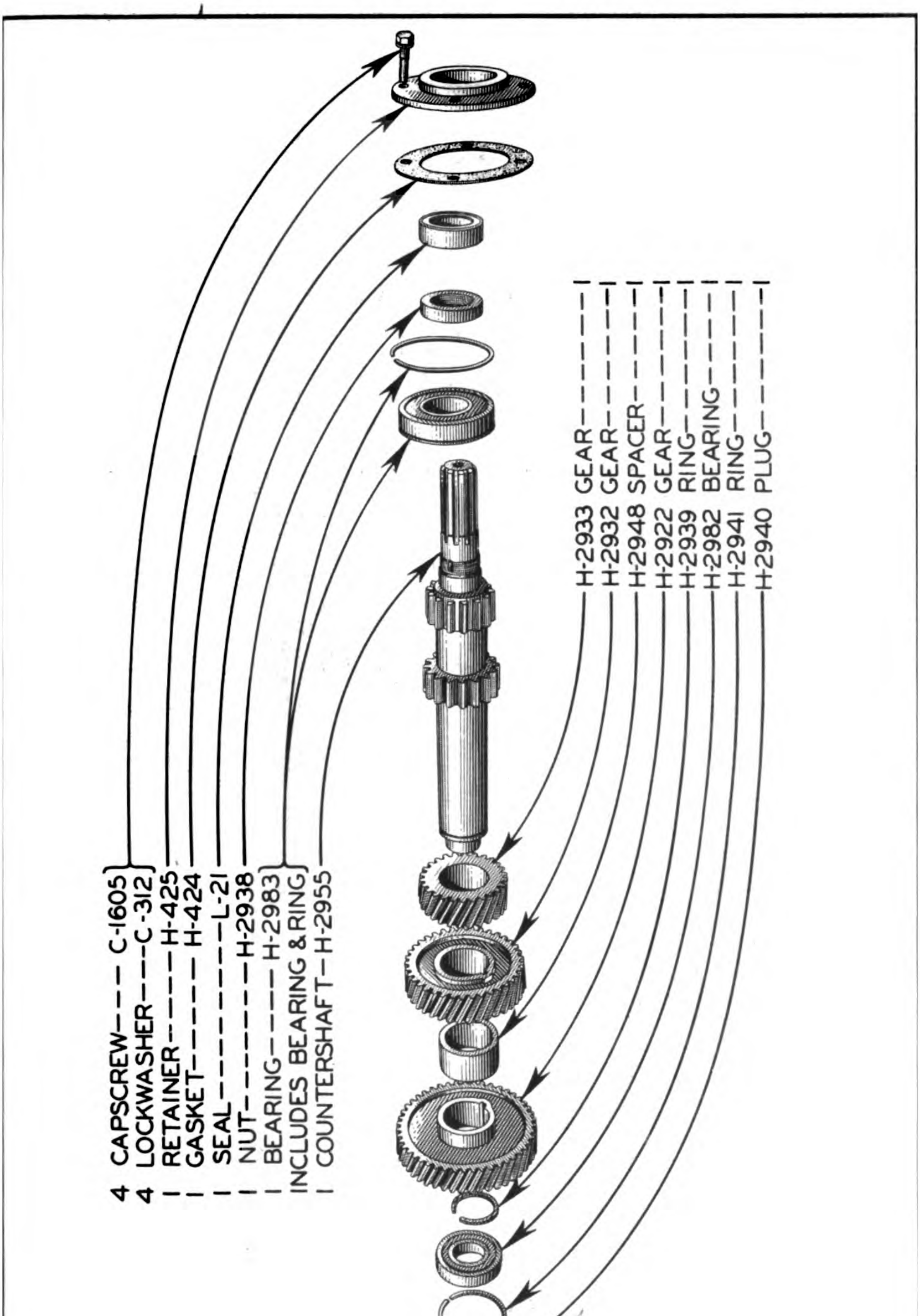

LOWER TRANSMISSION SHAFT-EXPLODED

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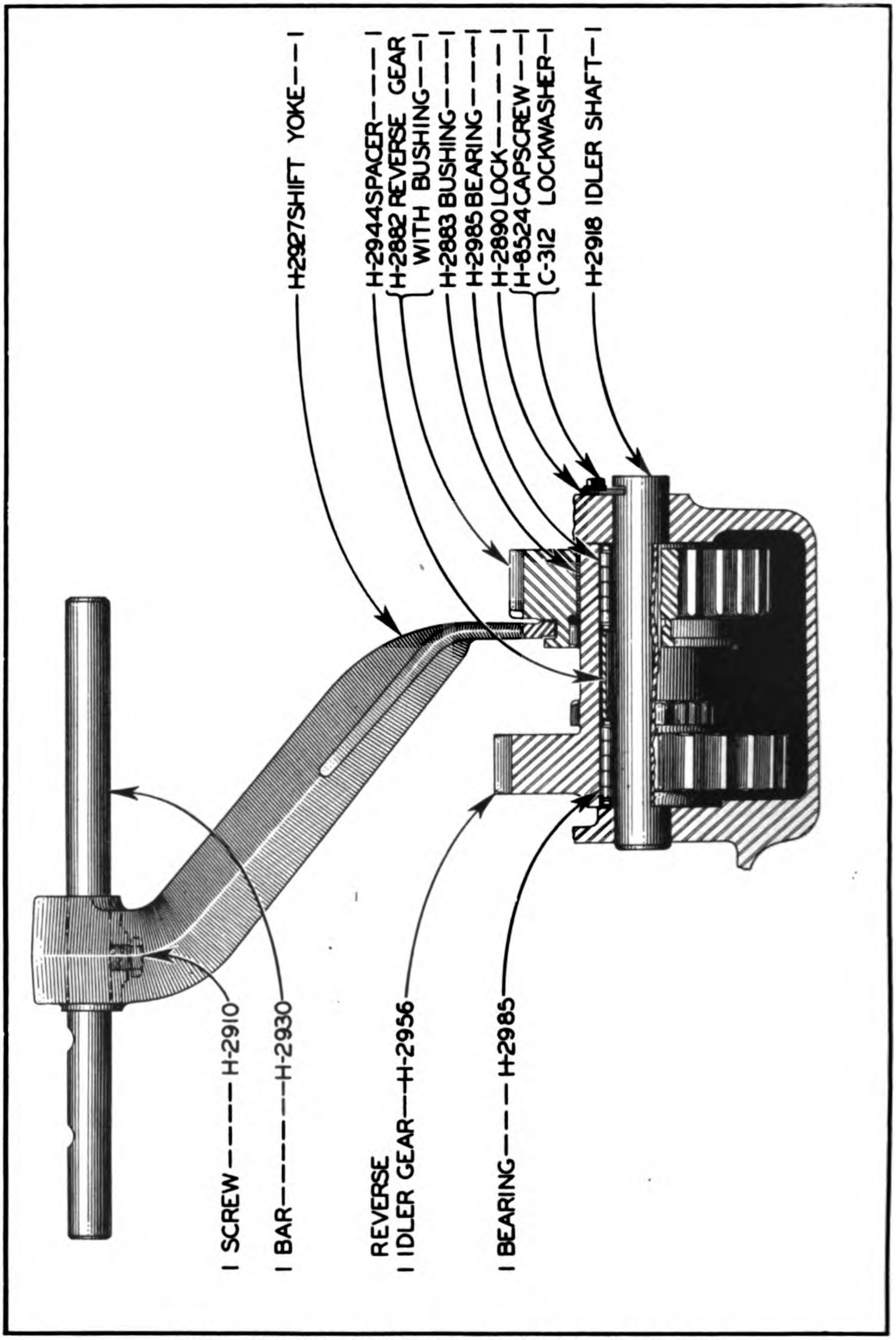

REVERSE IDLER GEAR ASSEM.

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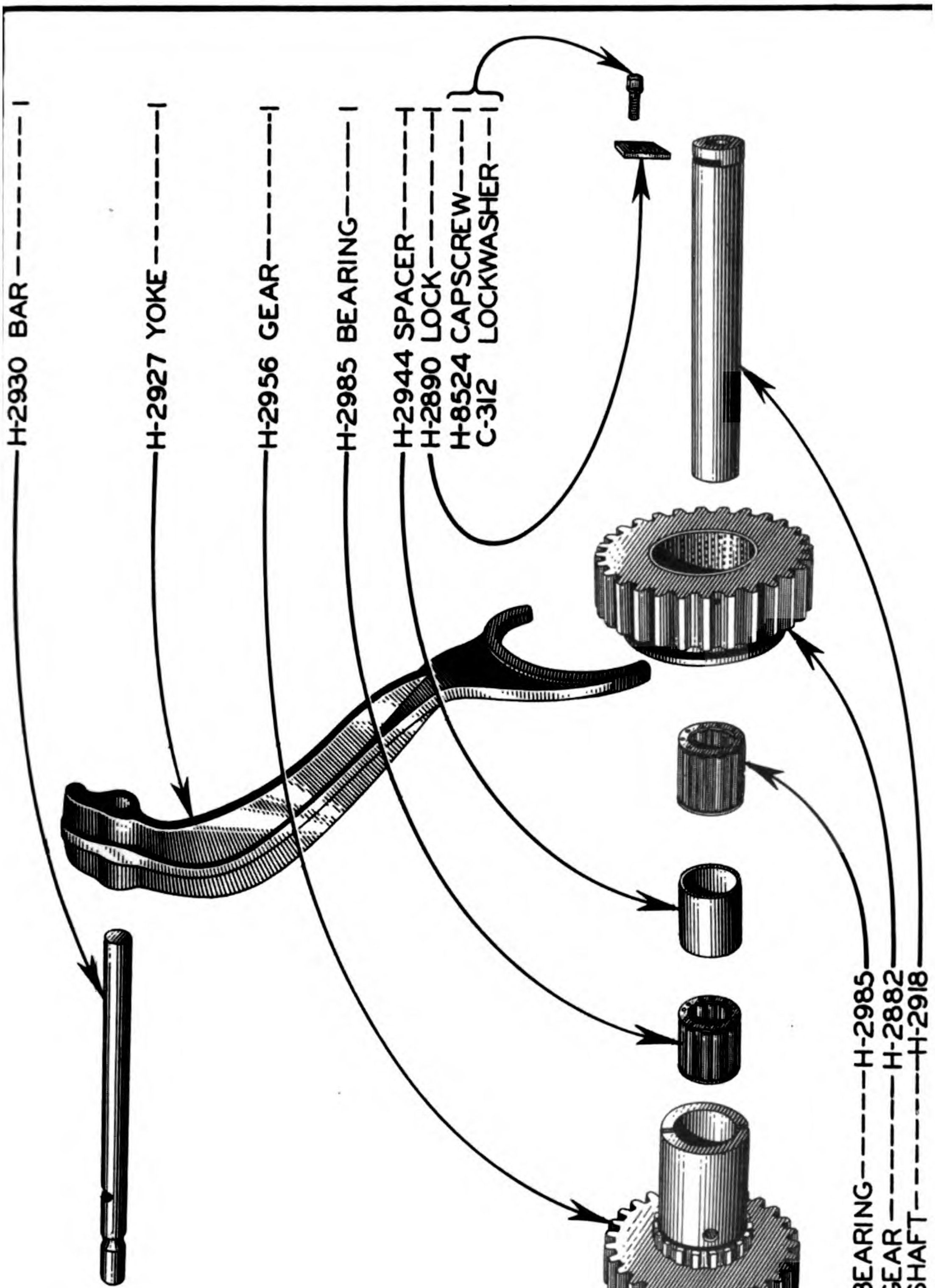

REVERSE IDLER—EXPLODED

ALWAYS GIVE MACHINE NUMBER WHEN ORDERING PARTS.

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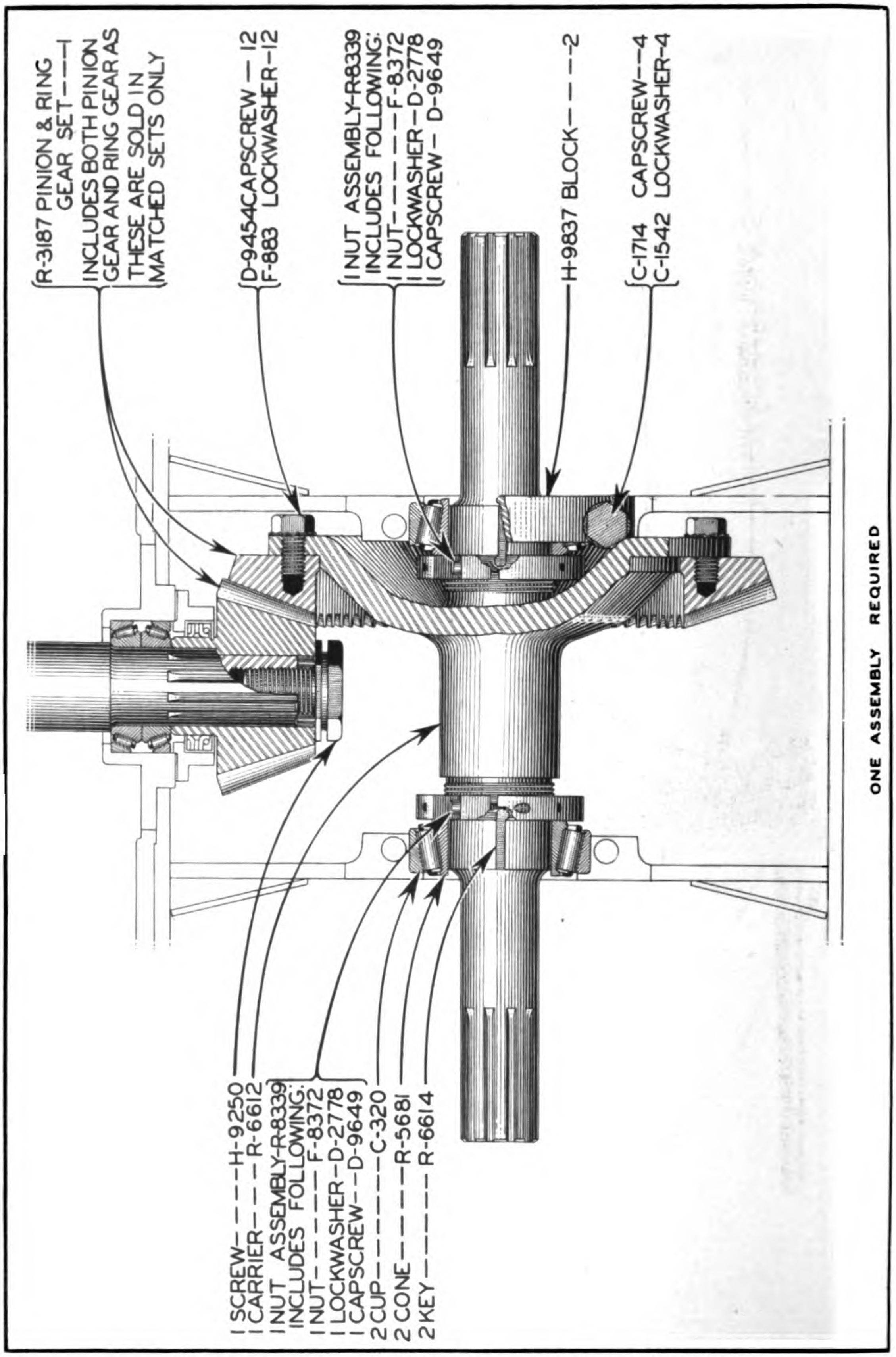

RING GEAR & PINION—CROSS SECTION

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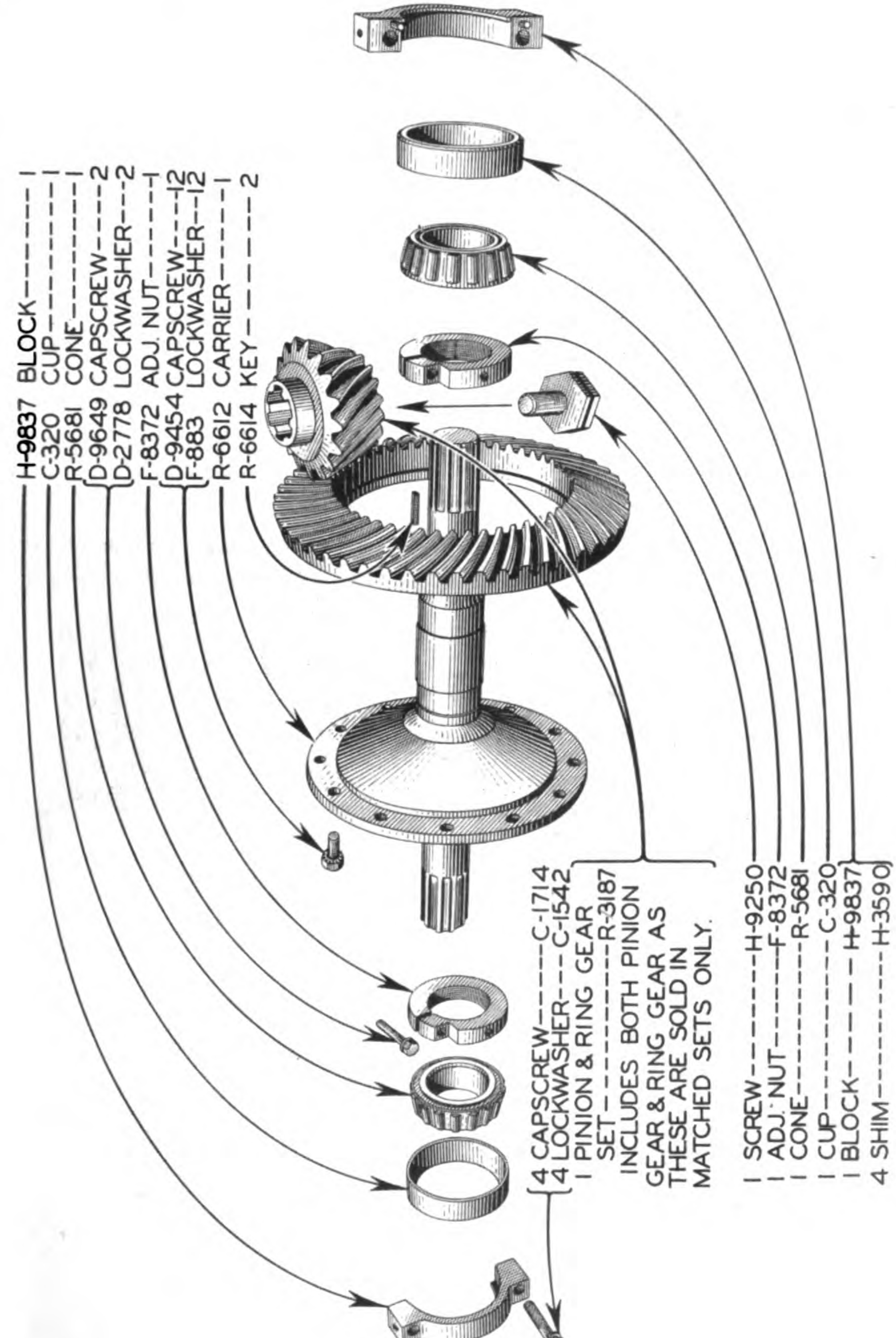

RING GEAR & PINION—EXPLODED

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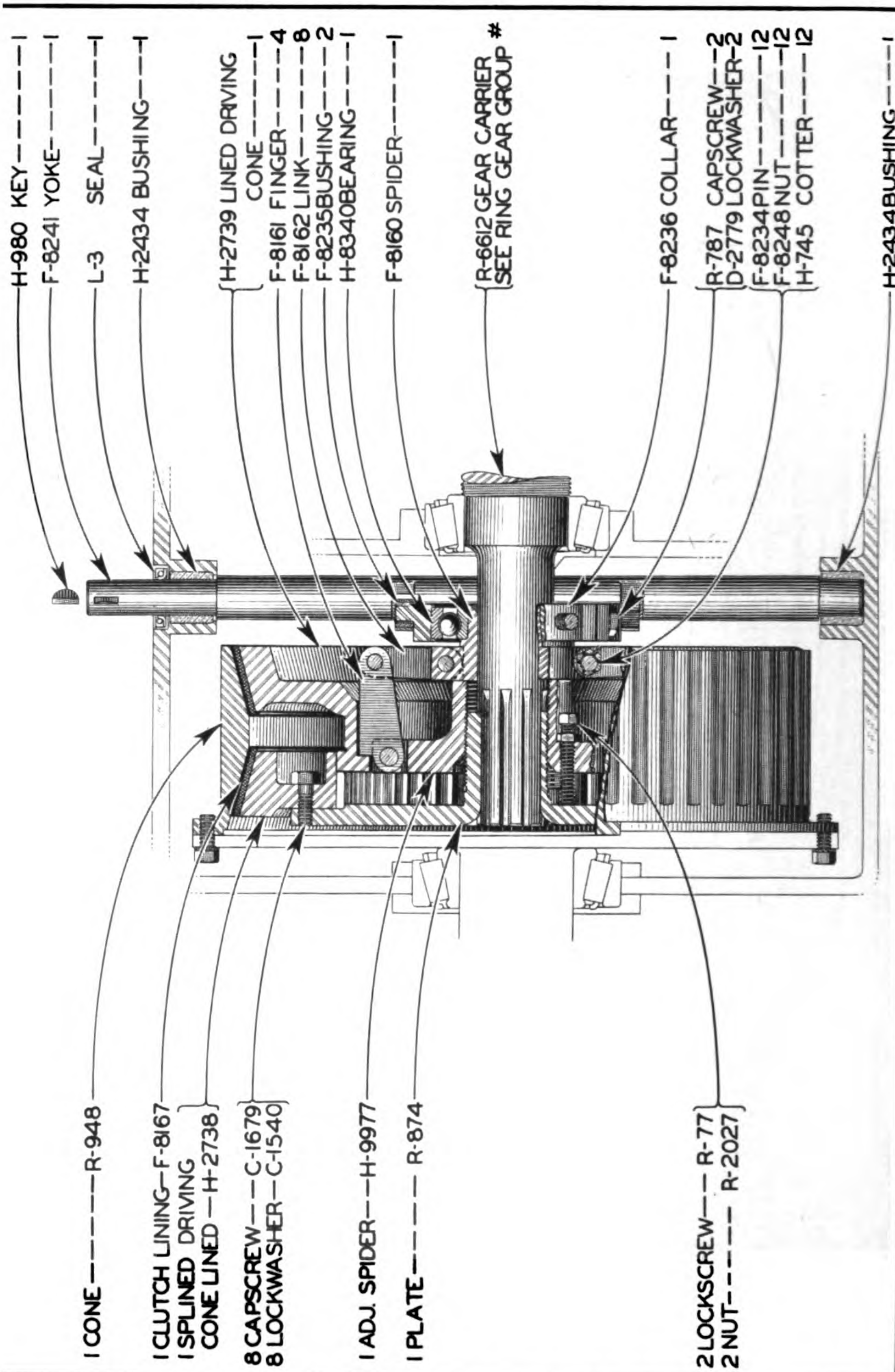

STEERING CLUTCH—CROSS SECTION

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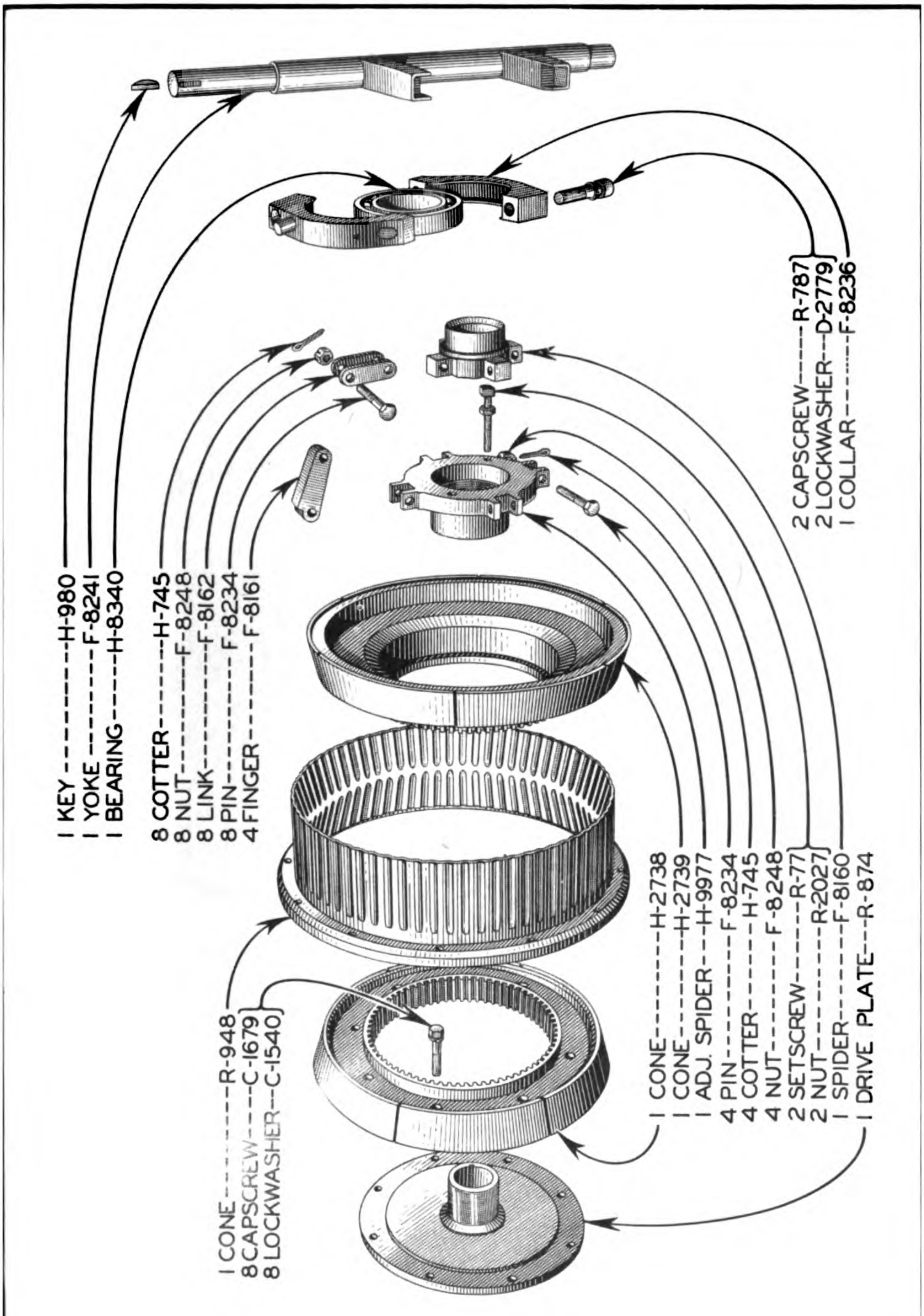

STEERING CLUTCH-EXPLODED

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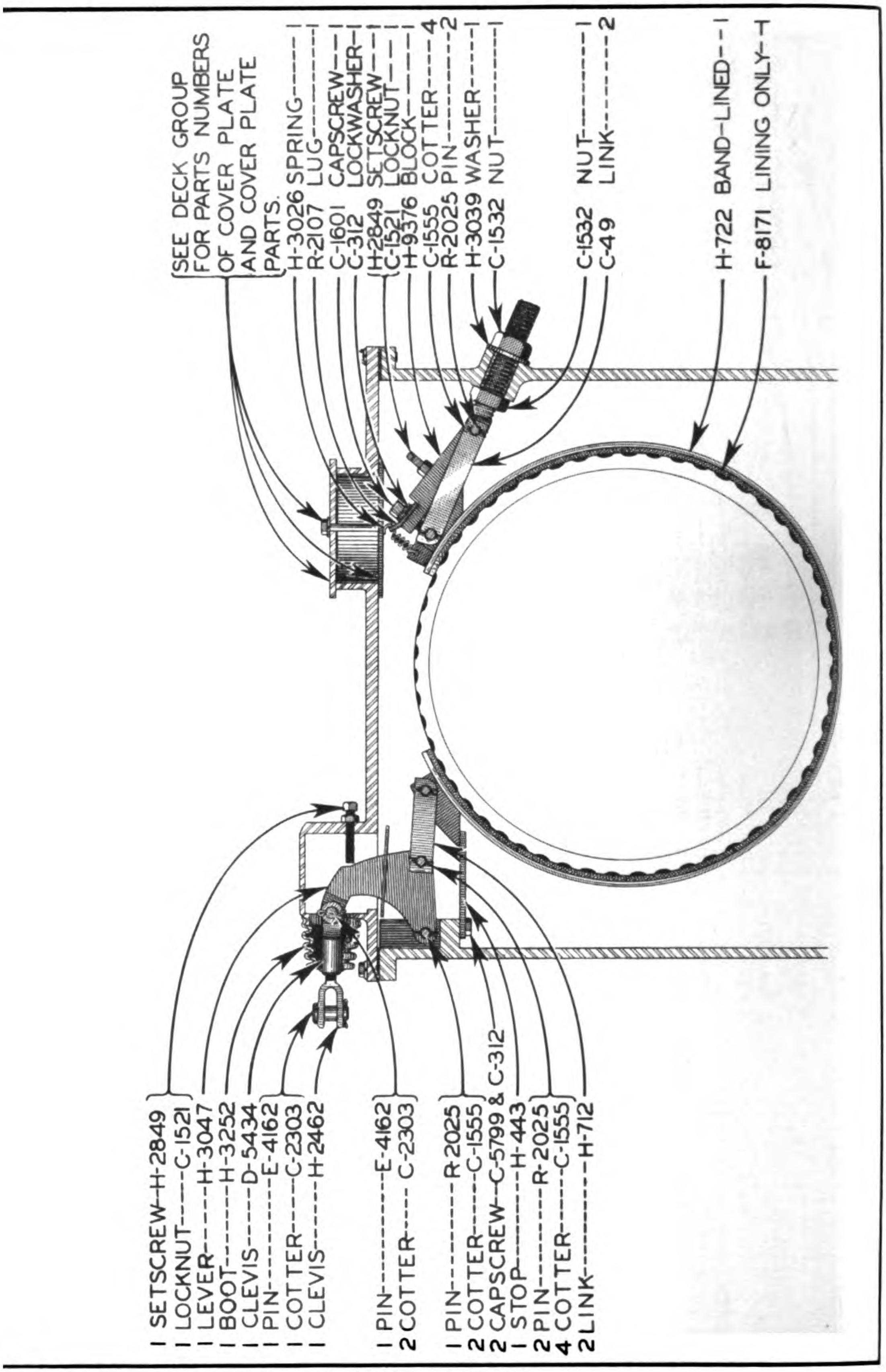

BRAKE GROUP

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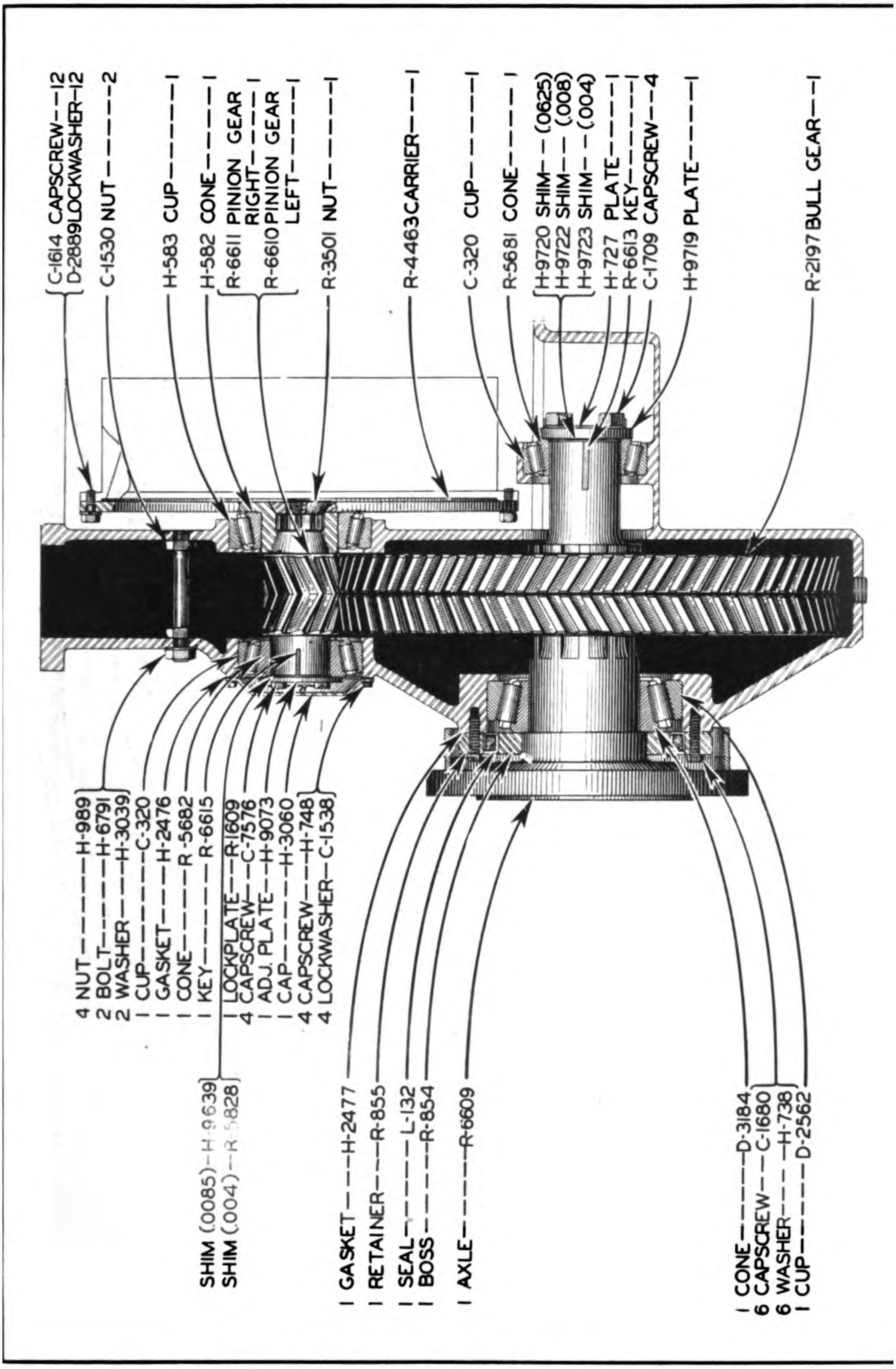

FINAL DRIVE ASSEMBLY

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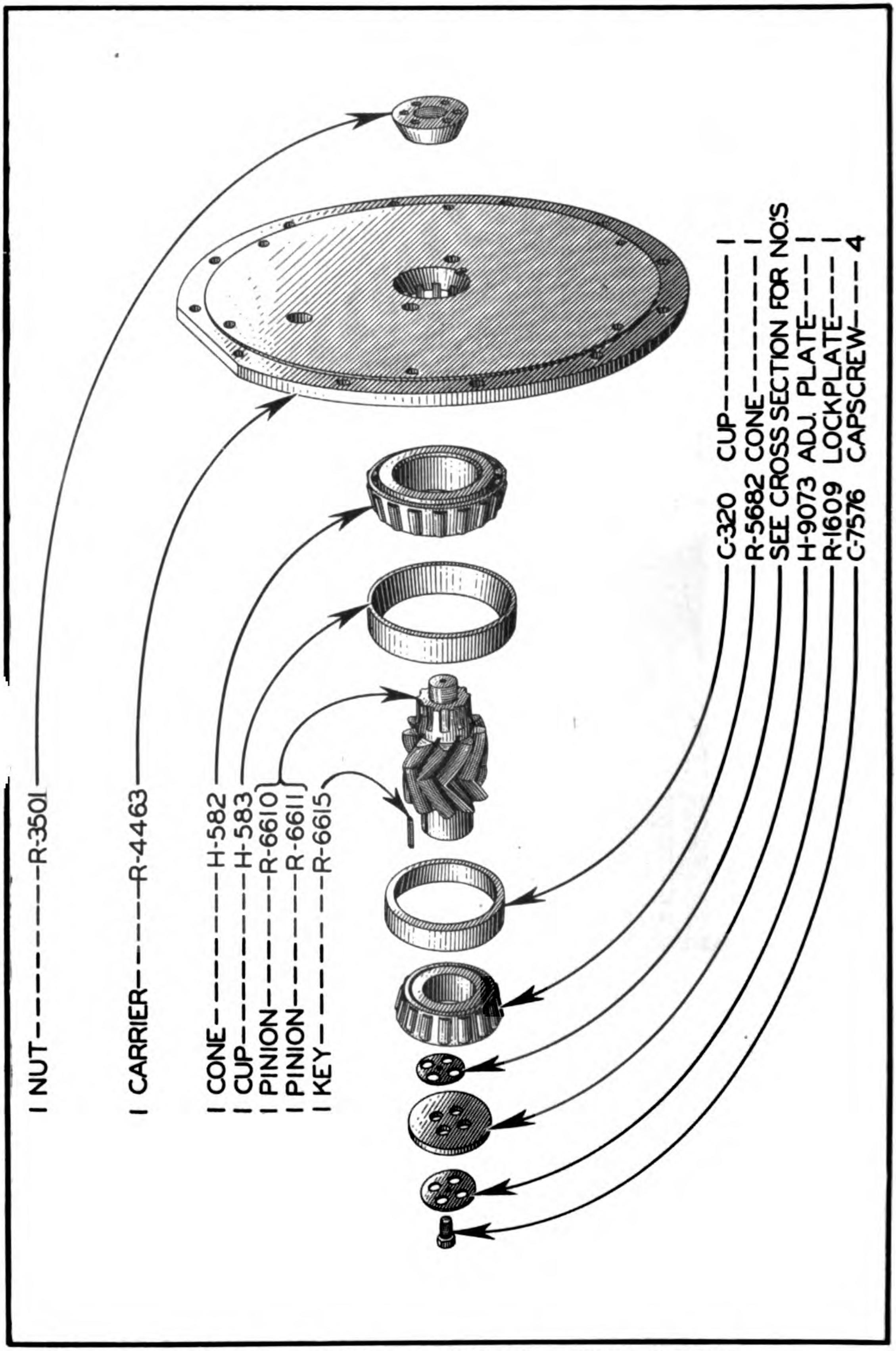

FINAL DRIVE PINION—EXPLODED

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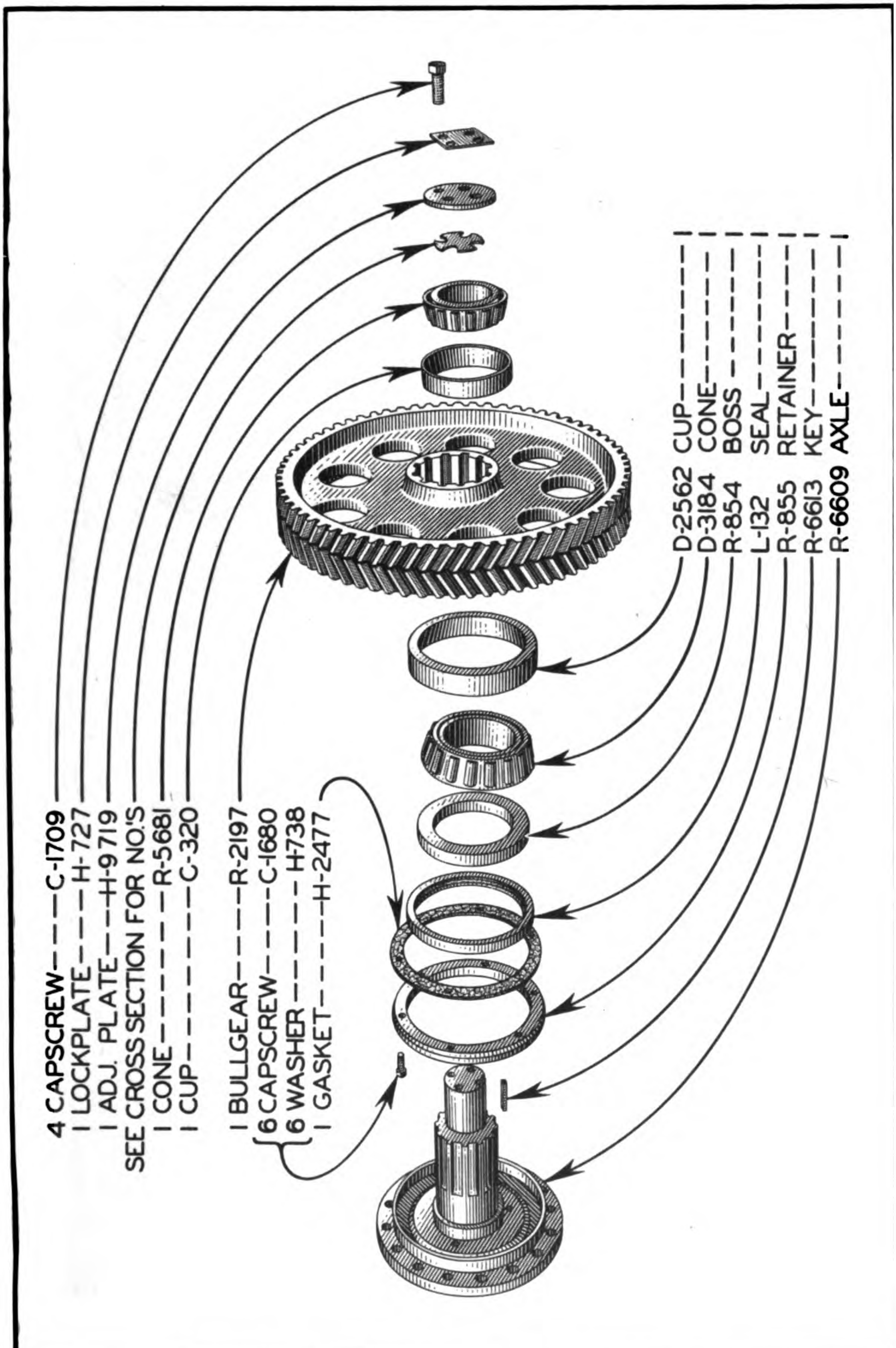

FINAL DRIVE AXLE—EXPLODED

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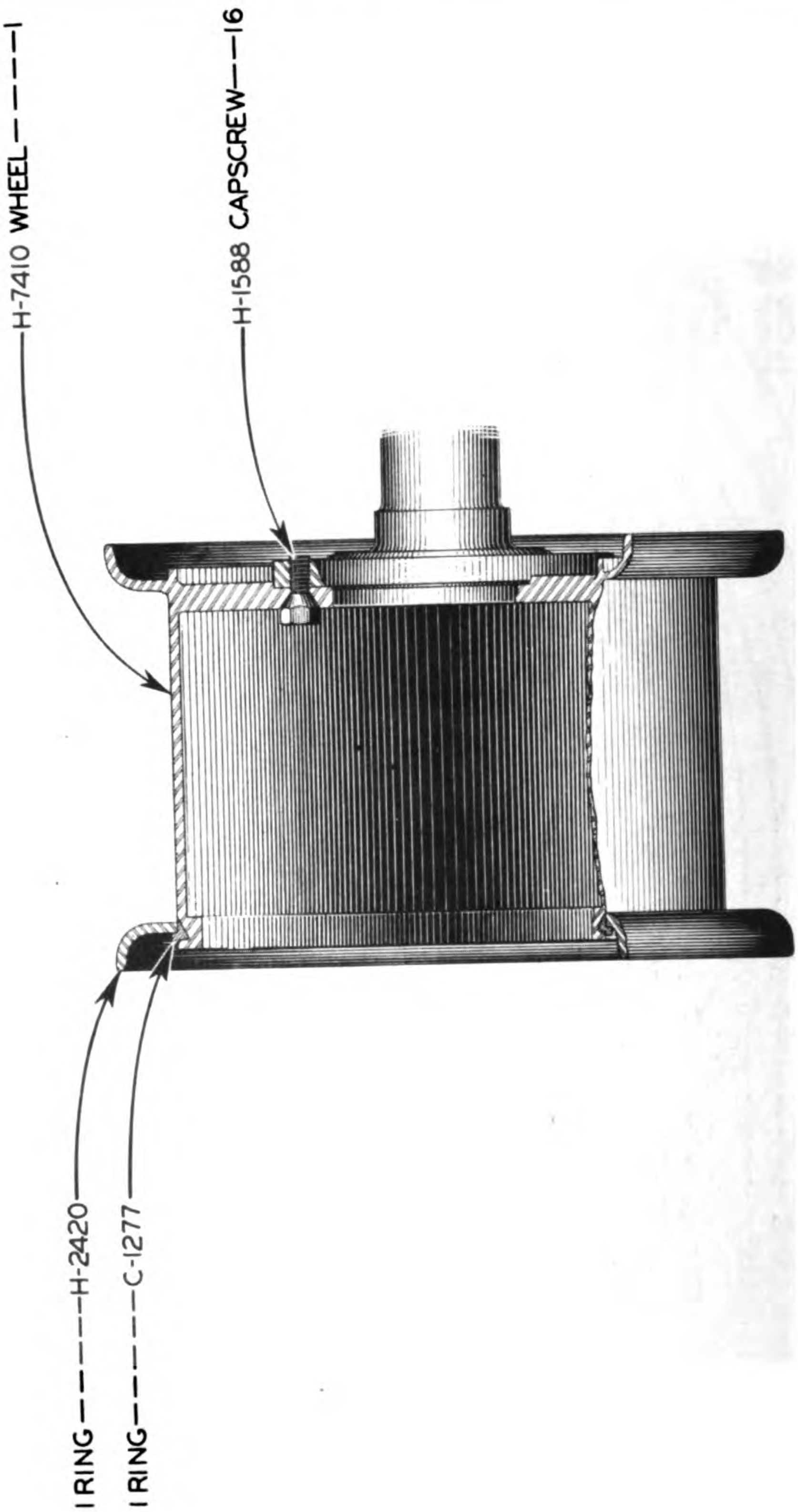

TWO ASSEMBLIES REQUIRED

WHEEL GROUP

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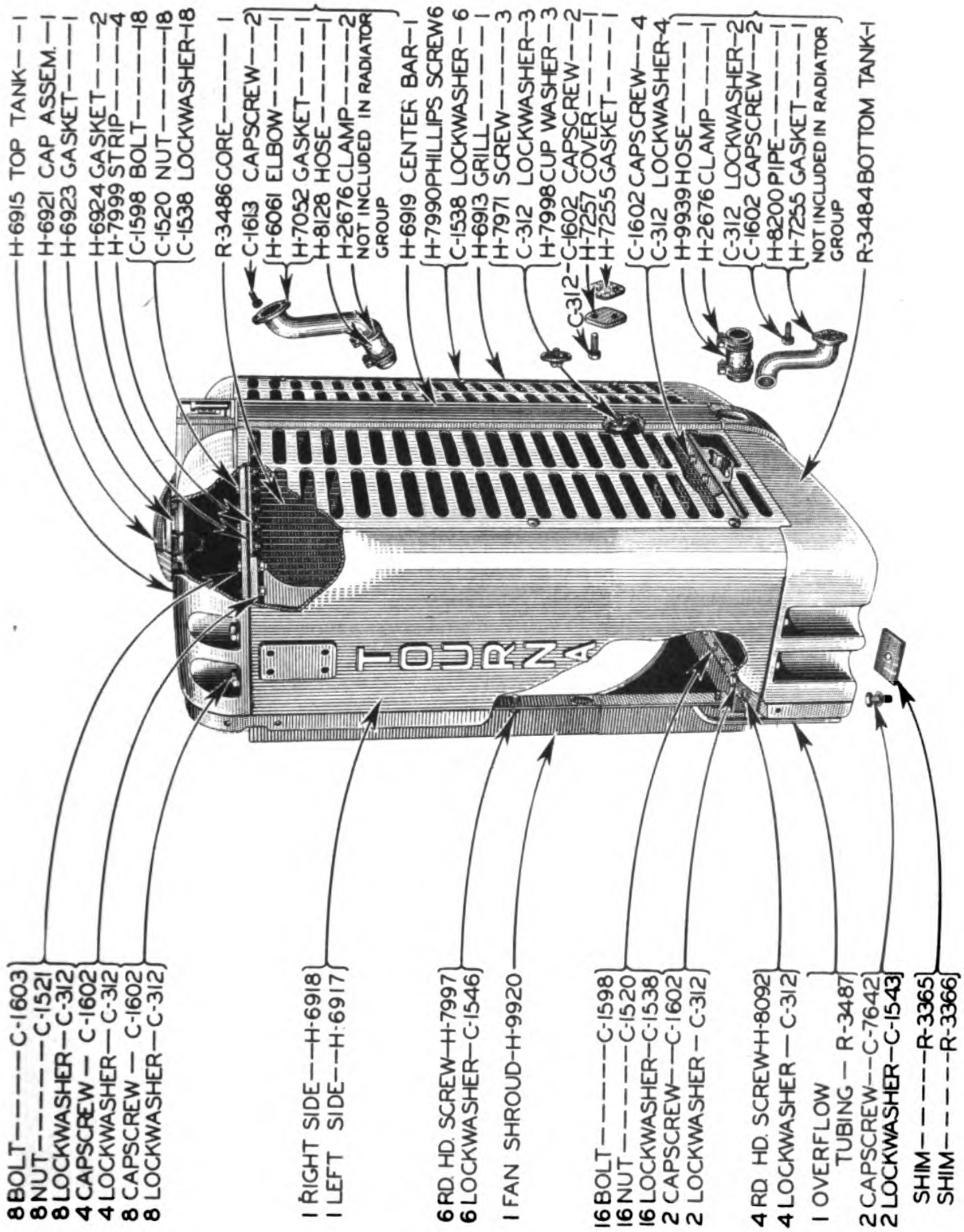

RADIATOR GROUP

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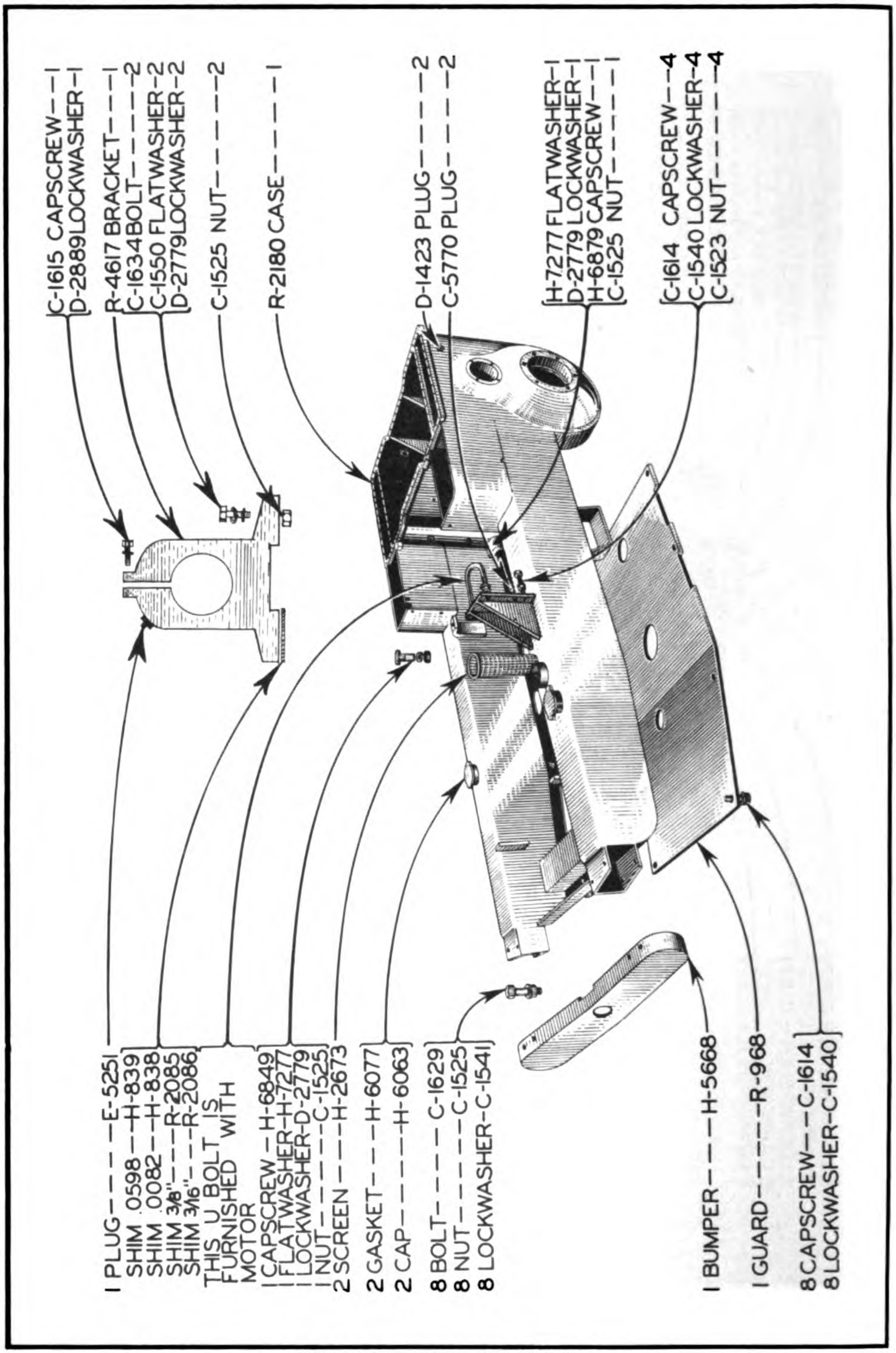

CASE & TANK

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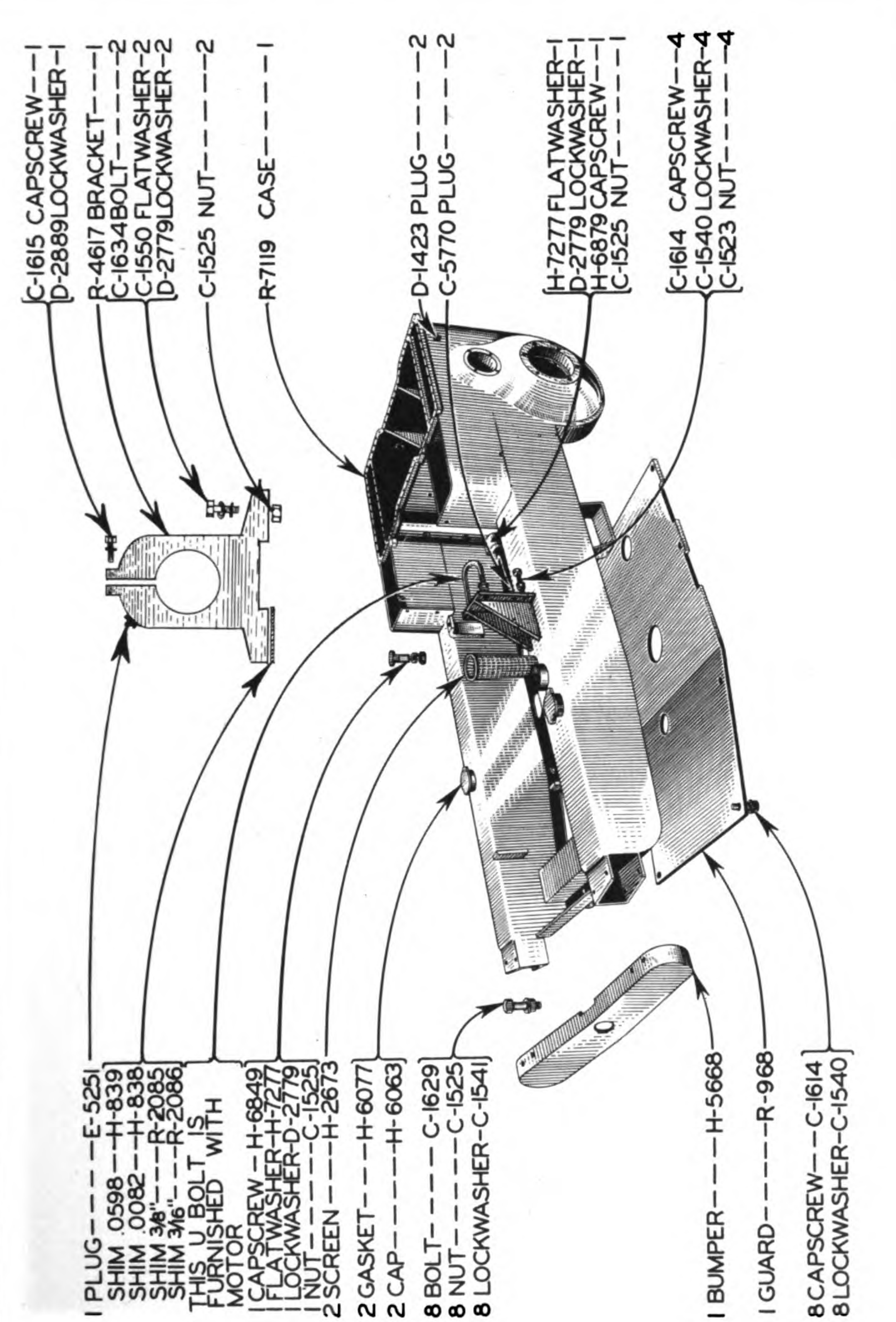

CASE & TANK – SQUARE CASE

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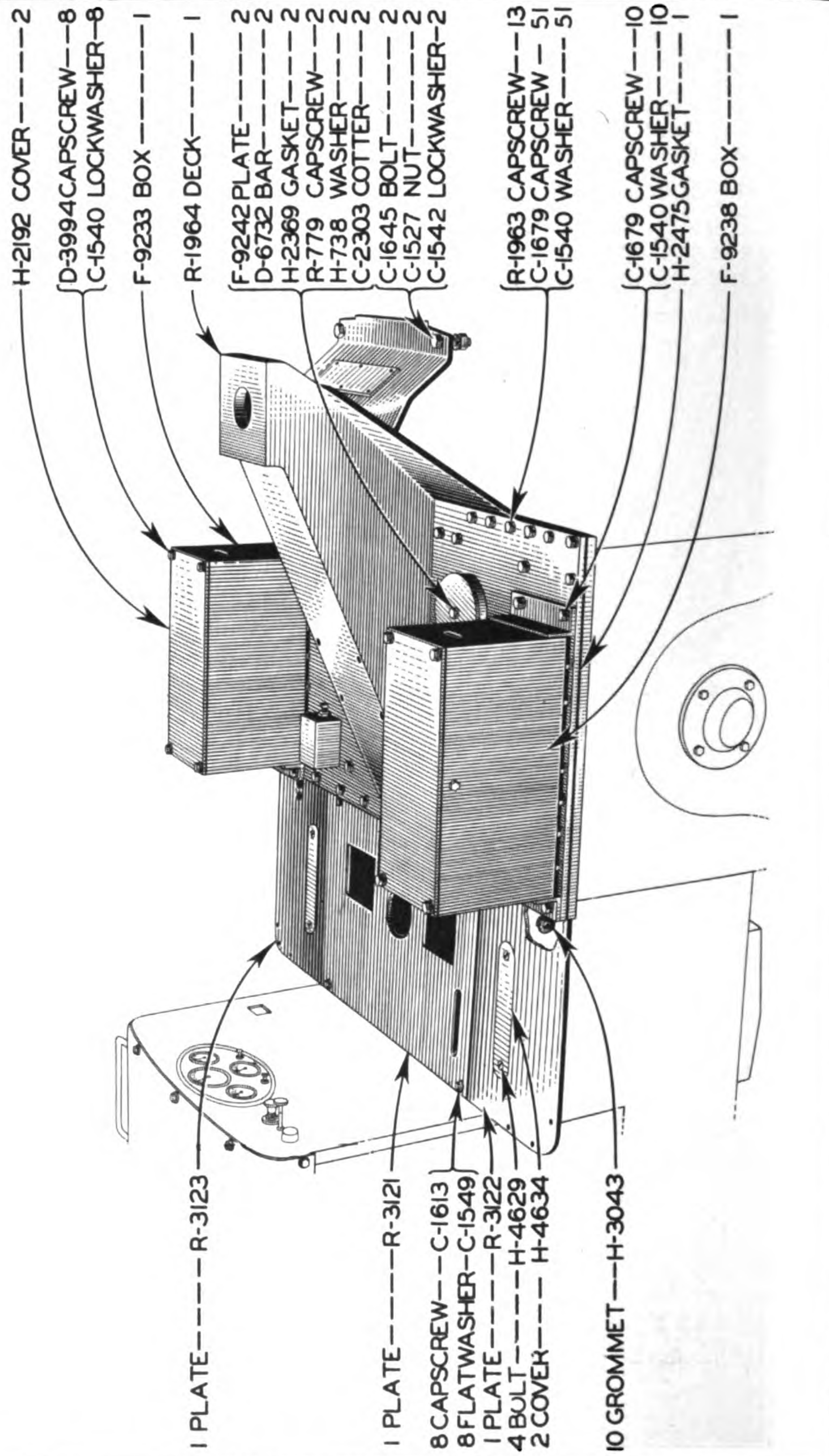

DECK GROUP

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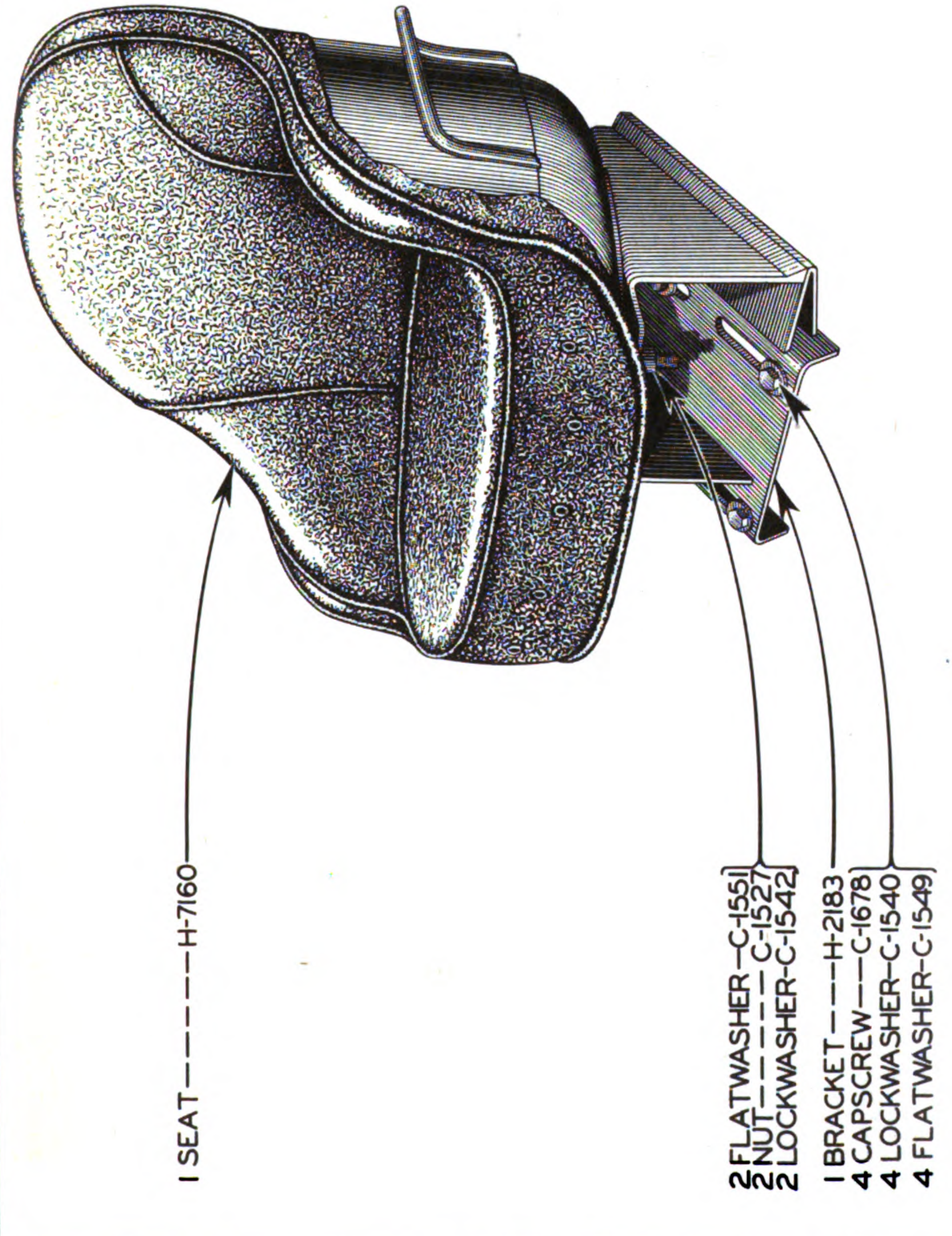

SEAT GROUP

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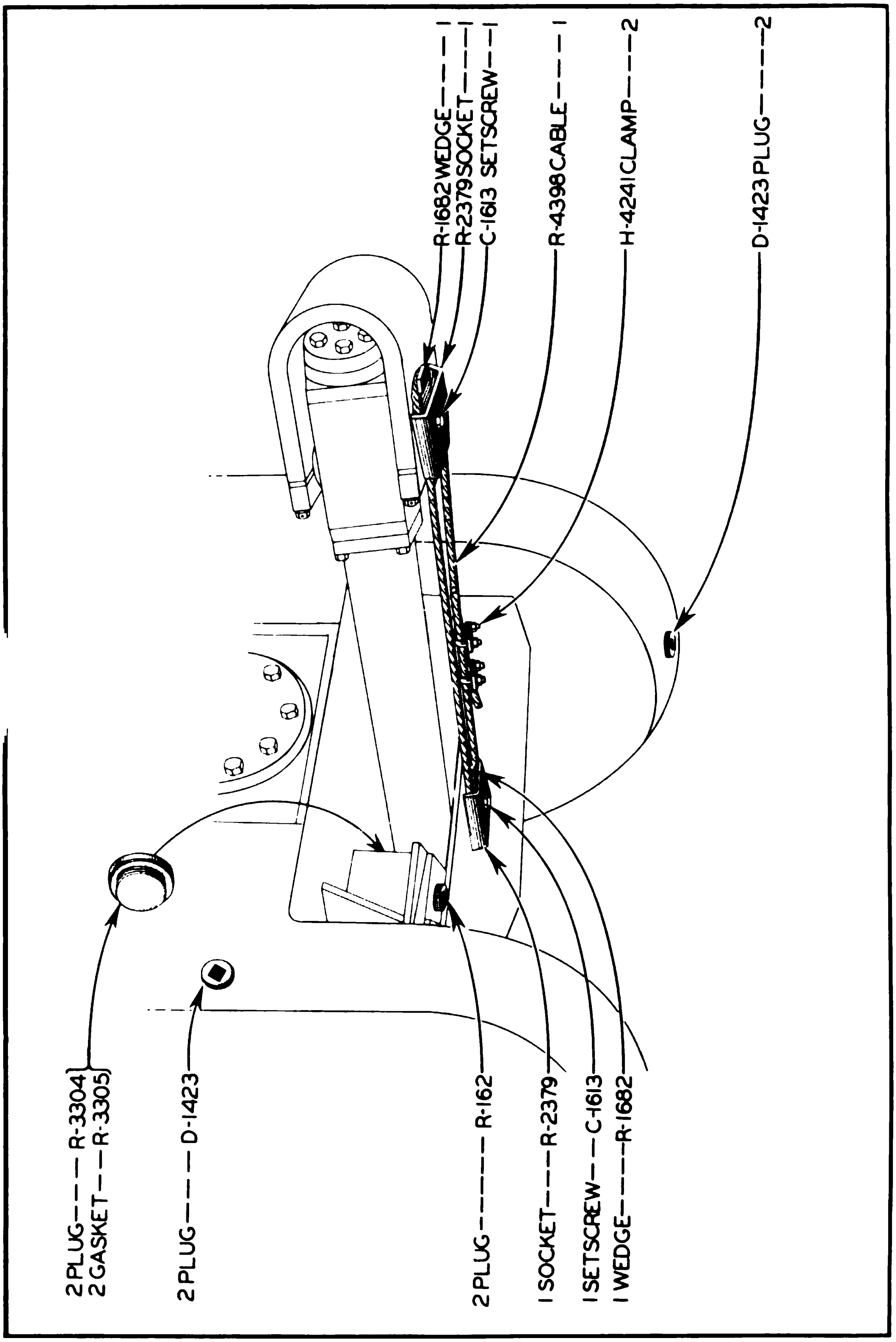

SAFETY CABLE

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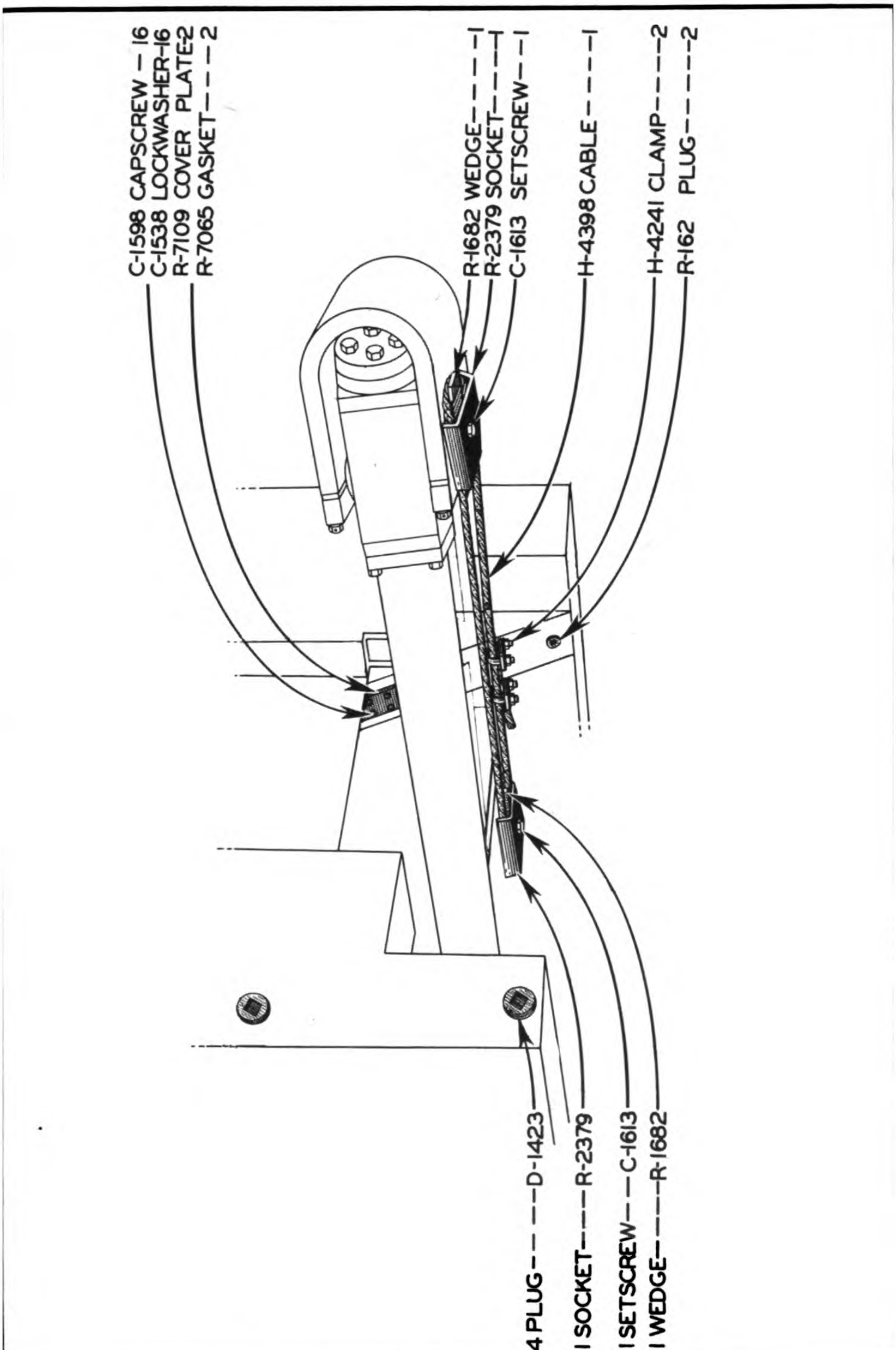

SAFETY CABLE

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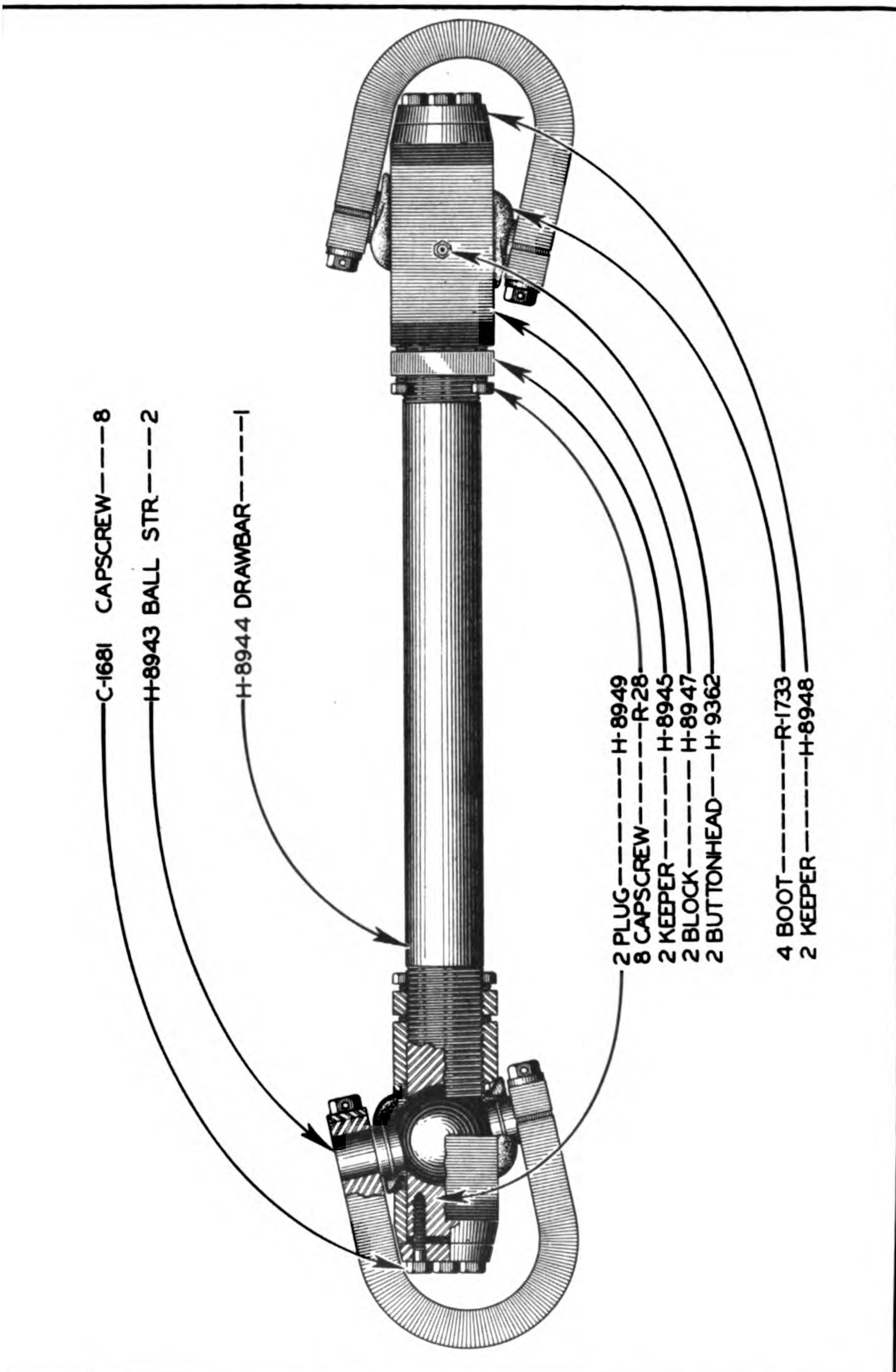

DRAWBAR GROUP

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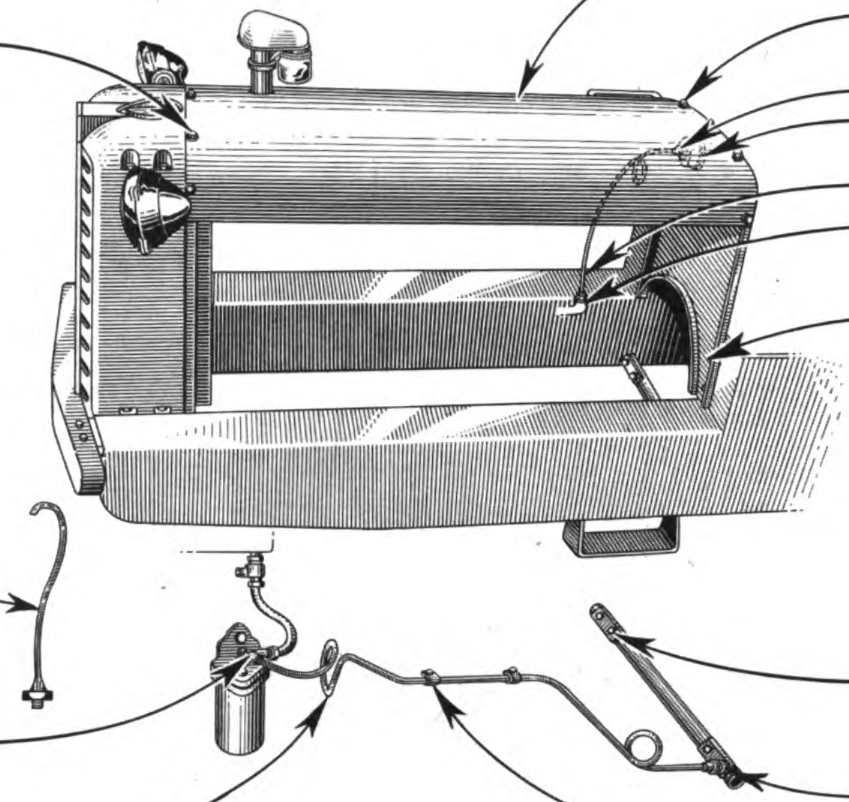

OIL LINE GROUP

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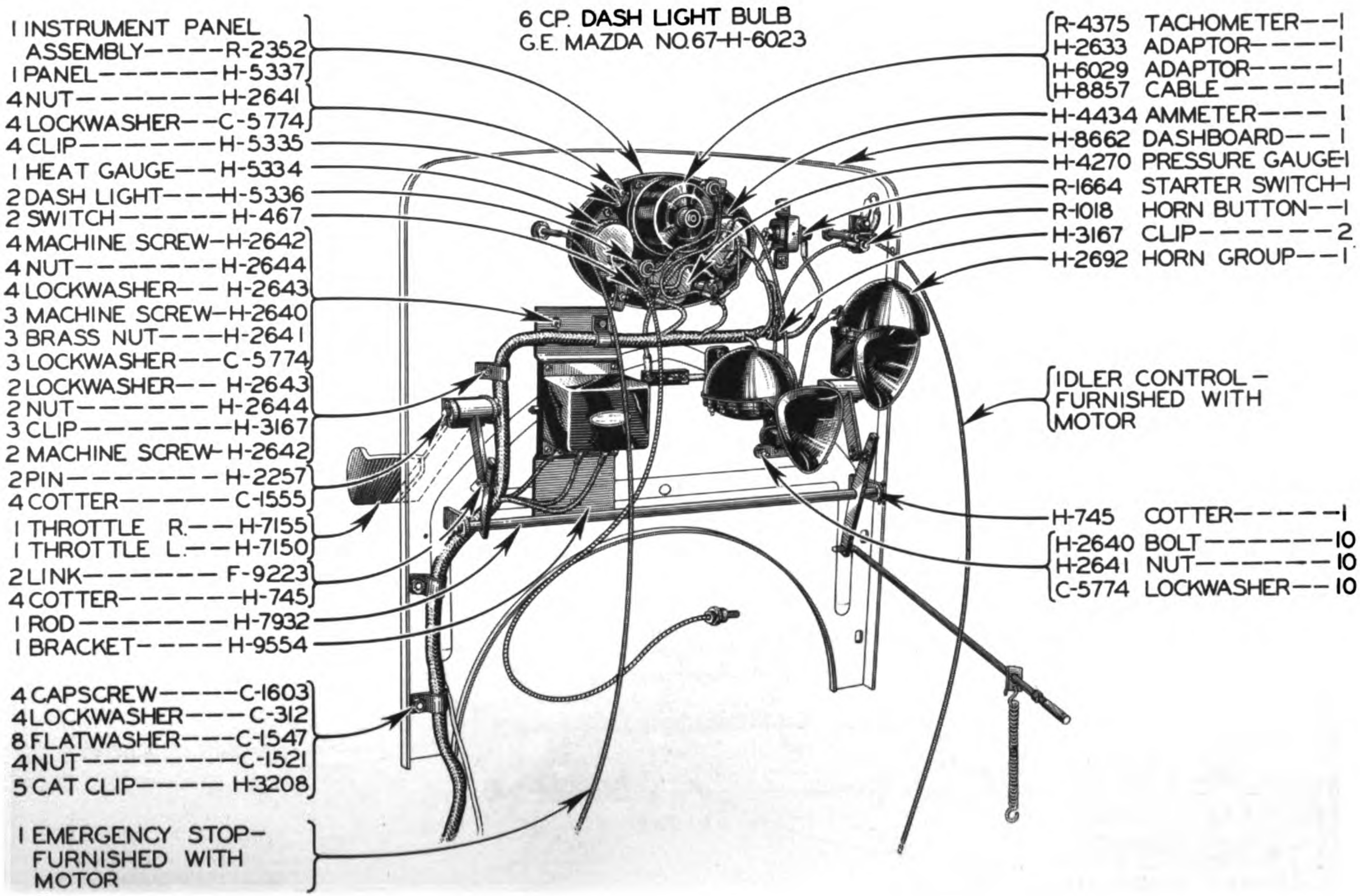

DASH GROUP

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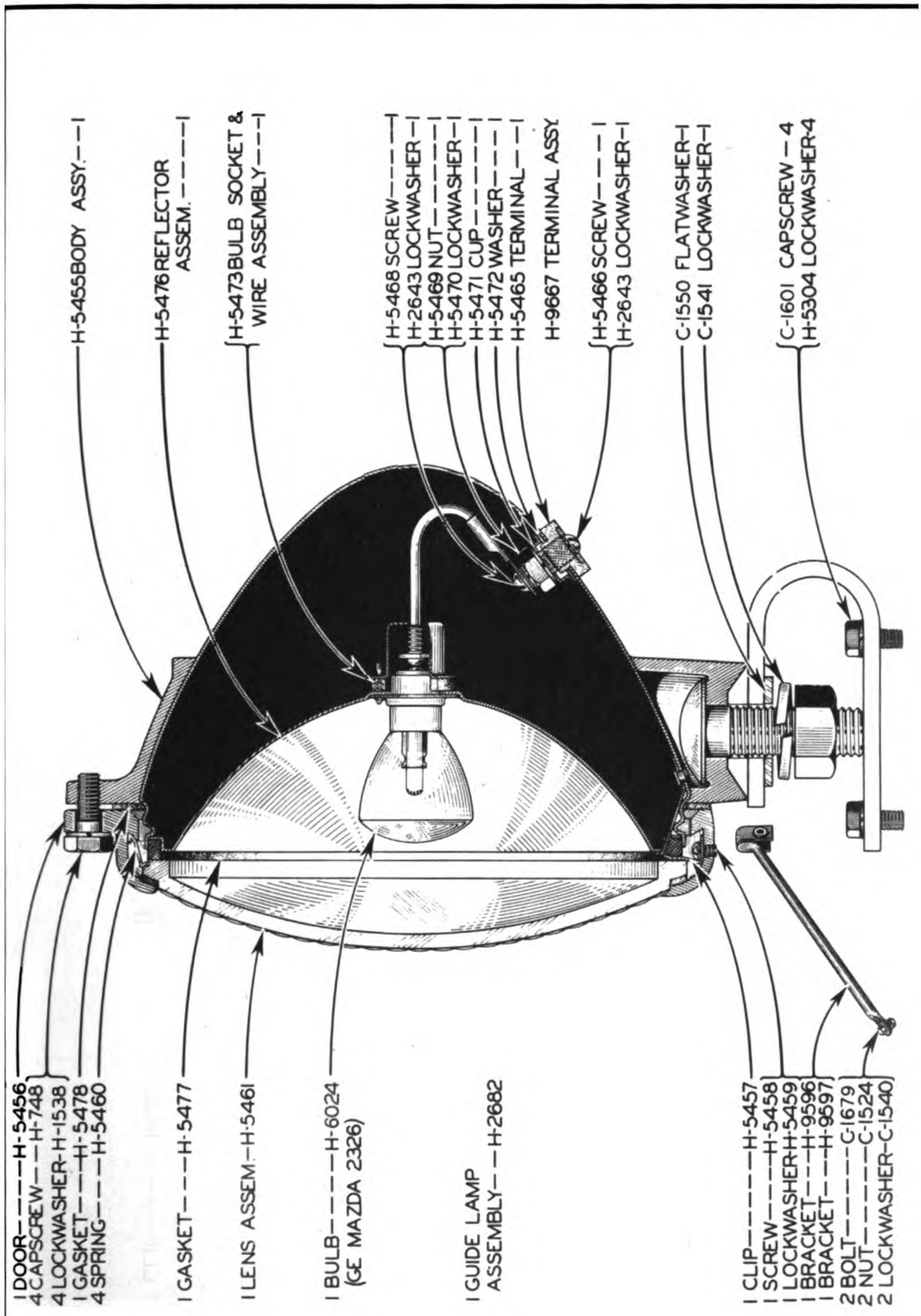

HEAD LAMP GROUP

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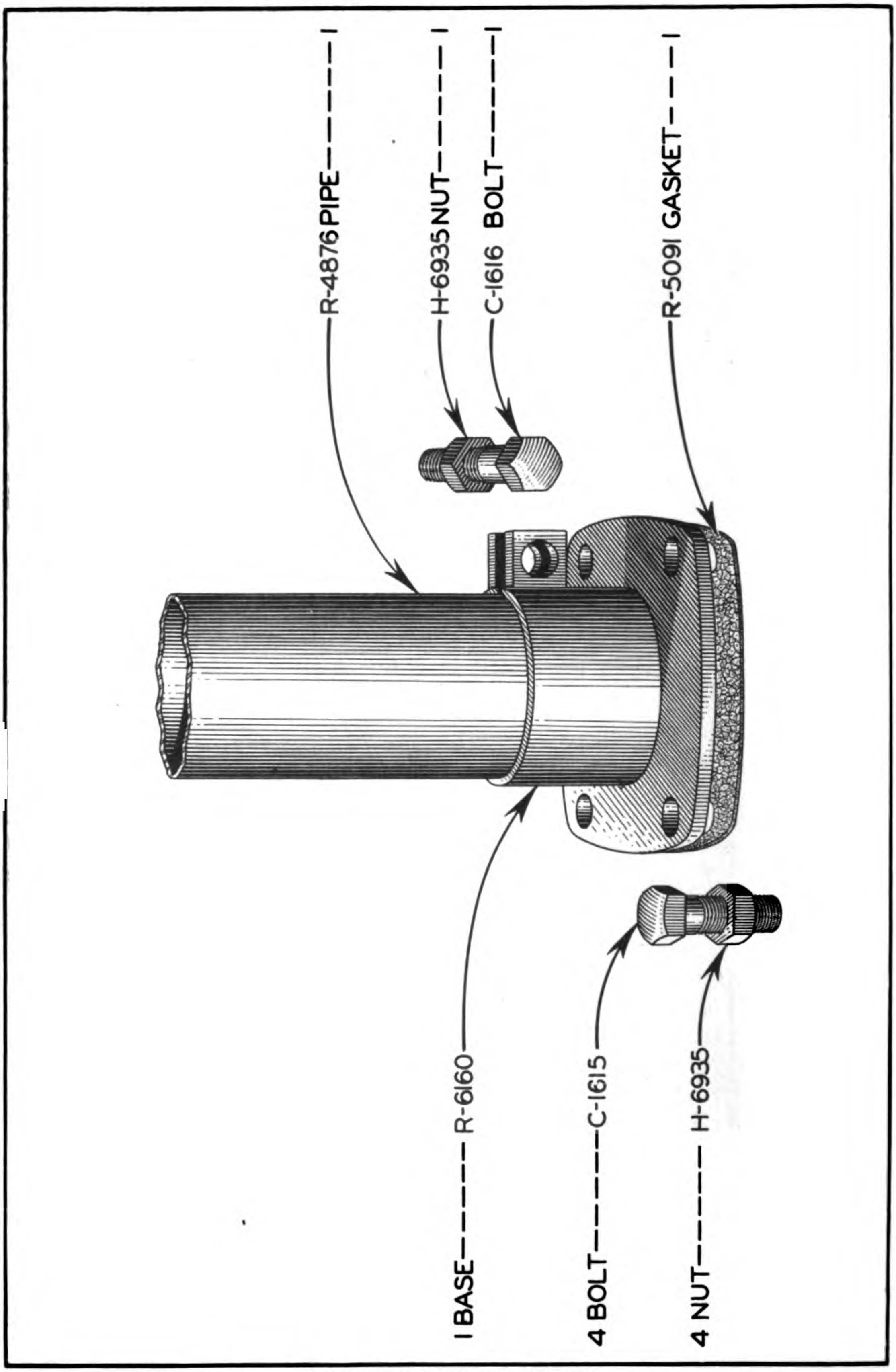

EXHAUST GROUP

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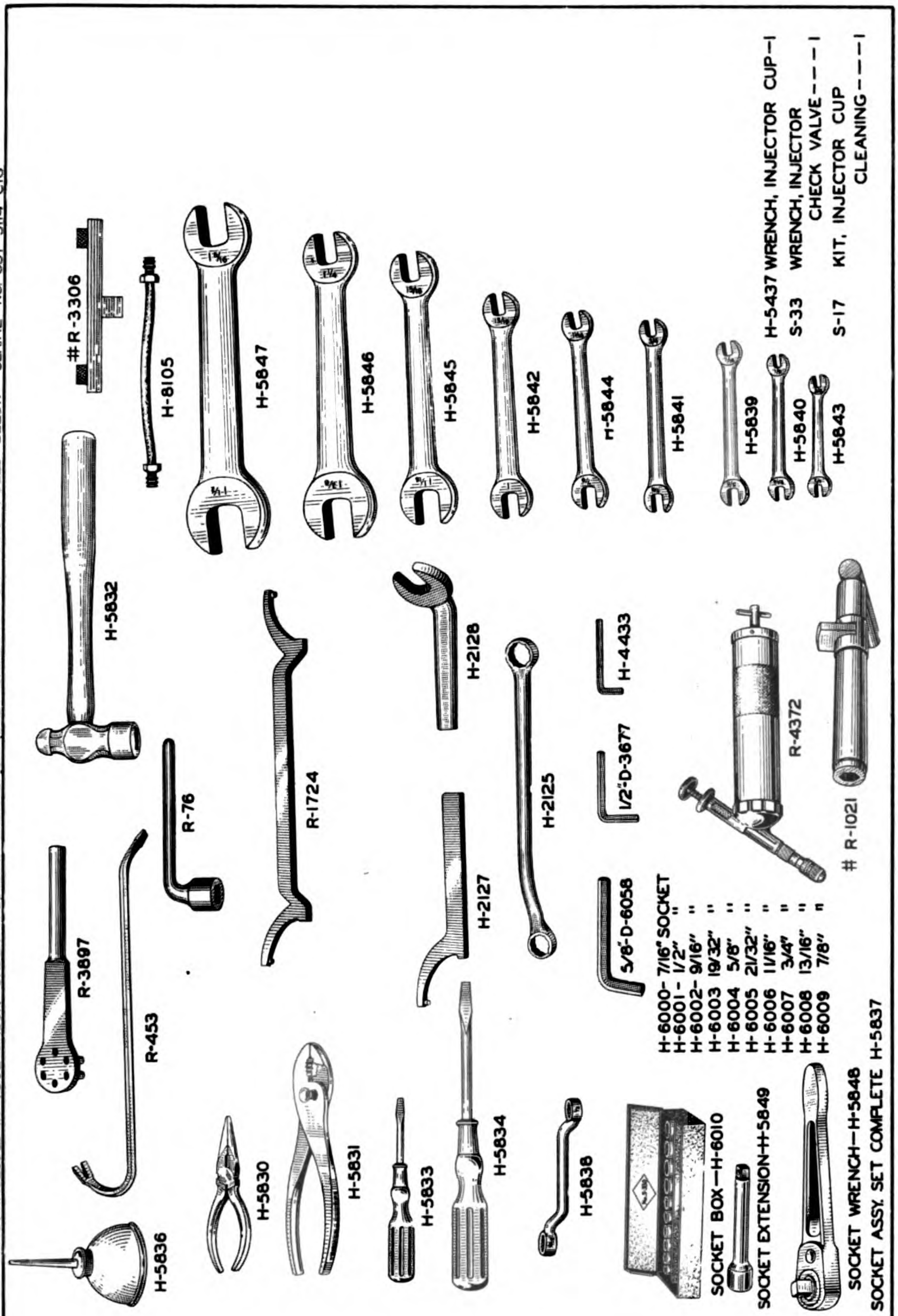

TOOL GROUP

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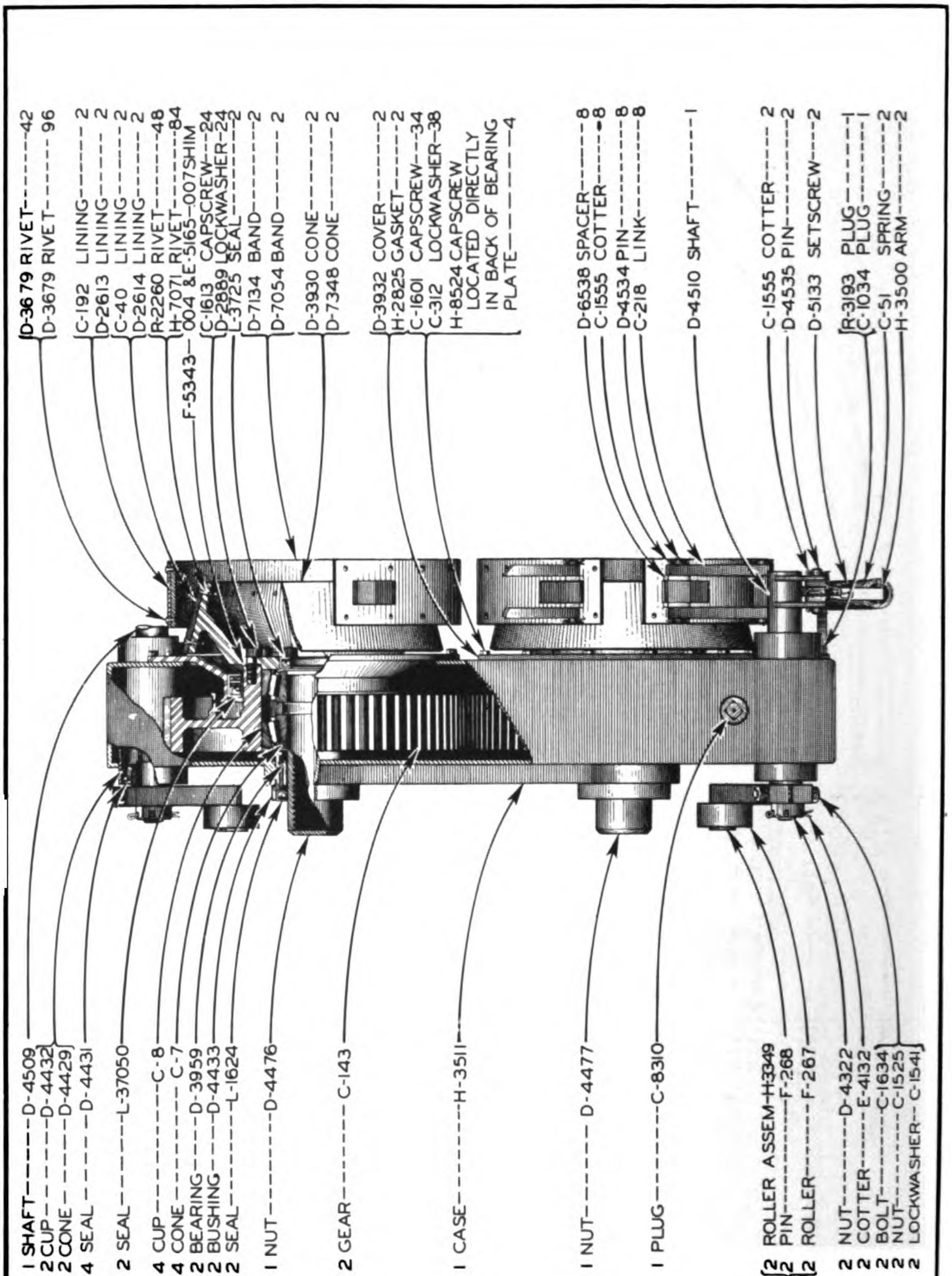

PCU CASE CROSS SECTION

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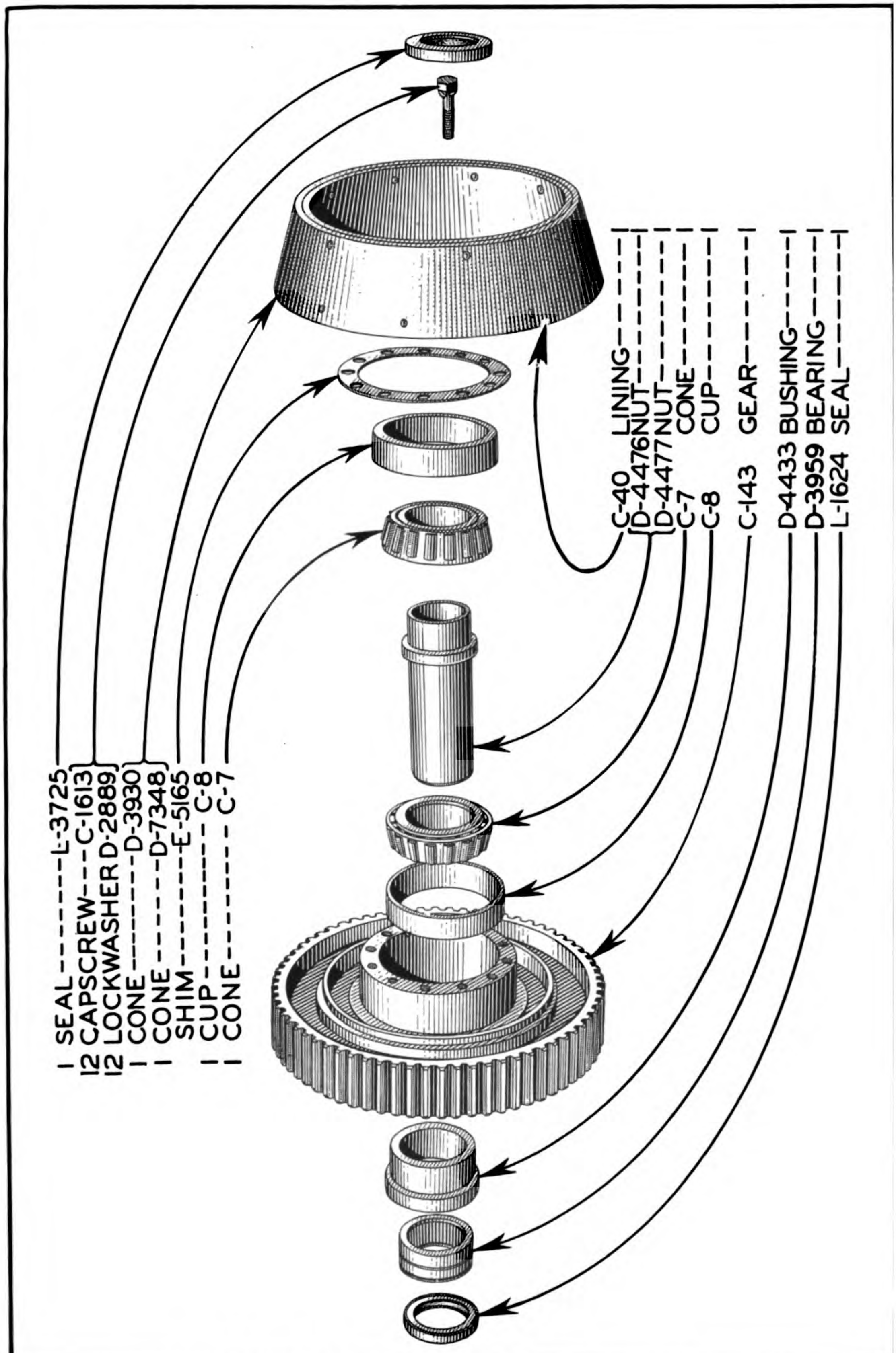

MAIN GEAR & DRIVING CONE

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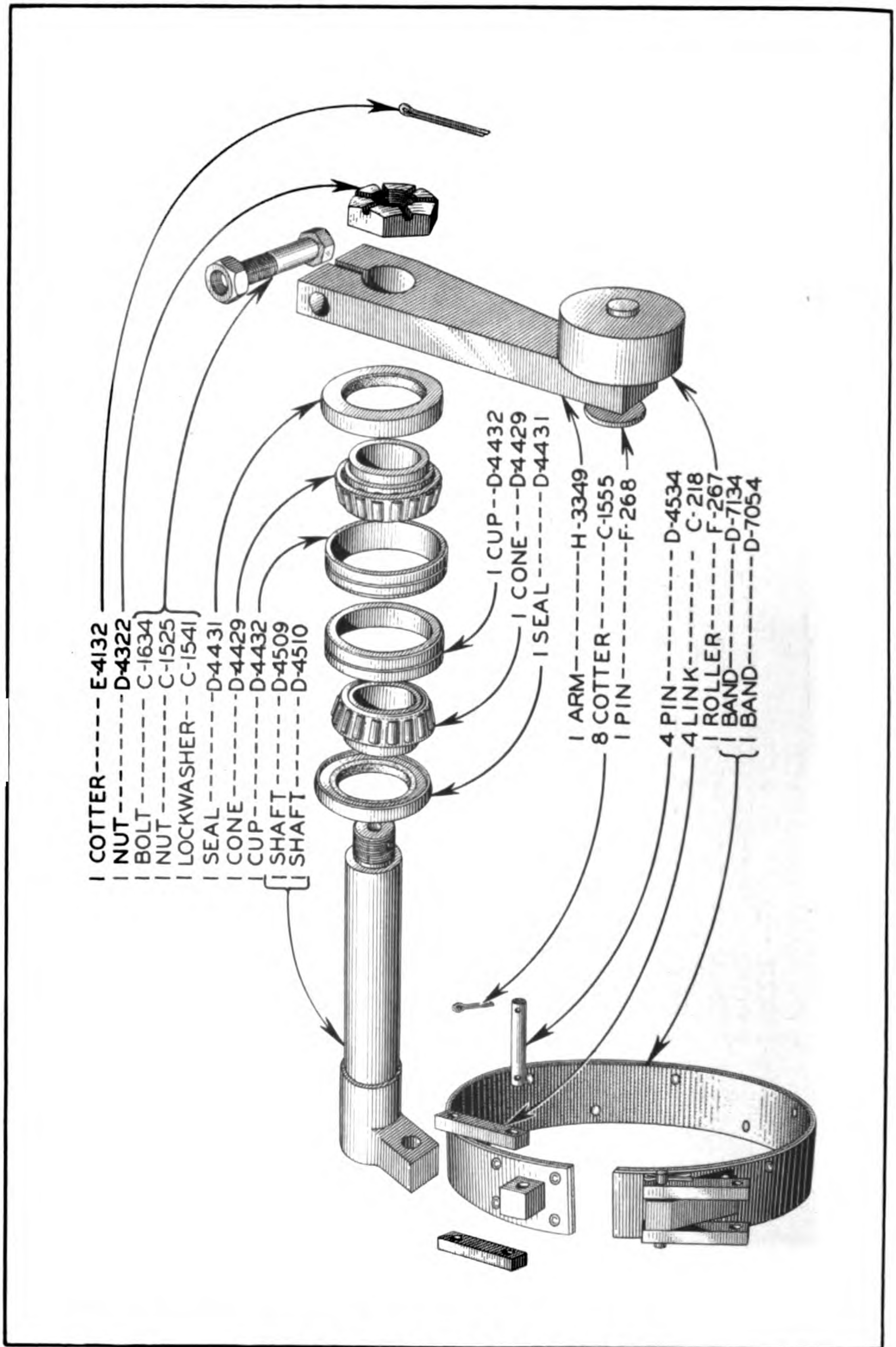

BRAKE GROUP—EXPLODED

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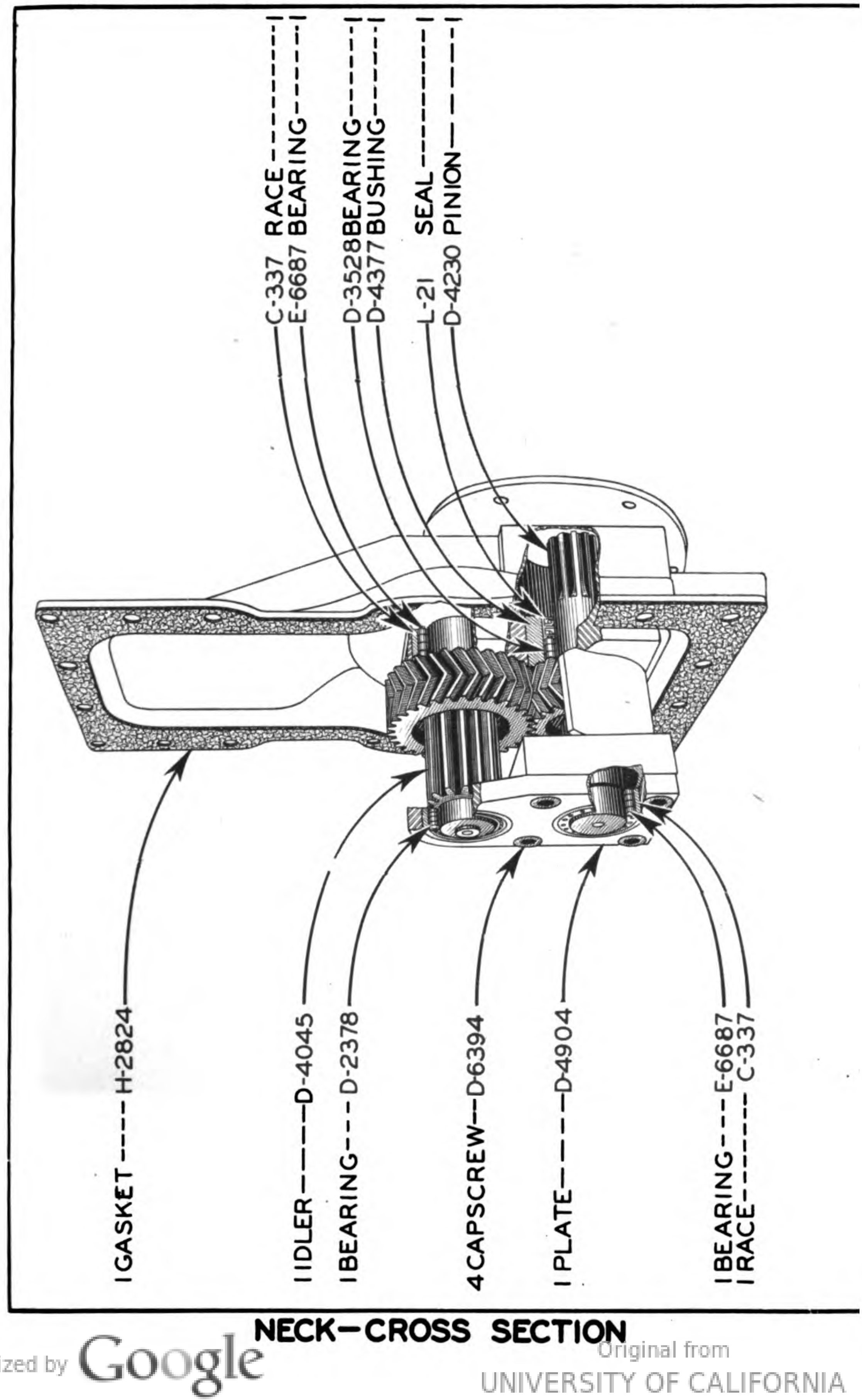

NECK—CROSS SECTION

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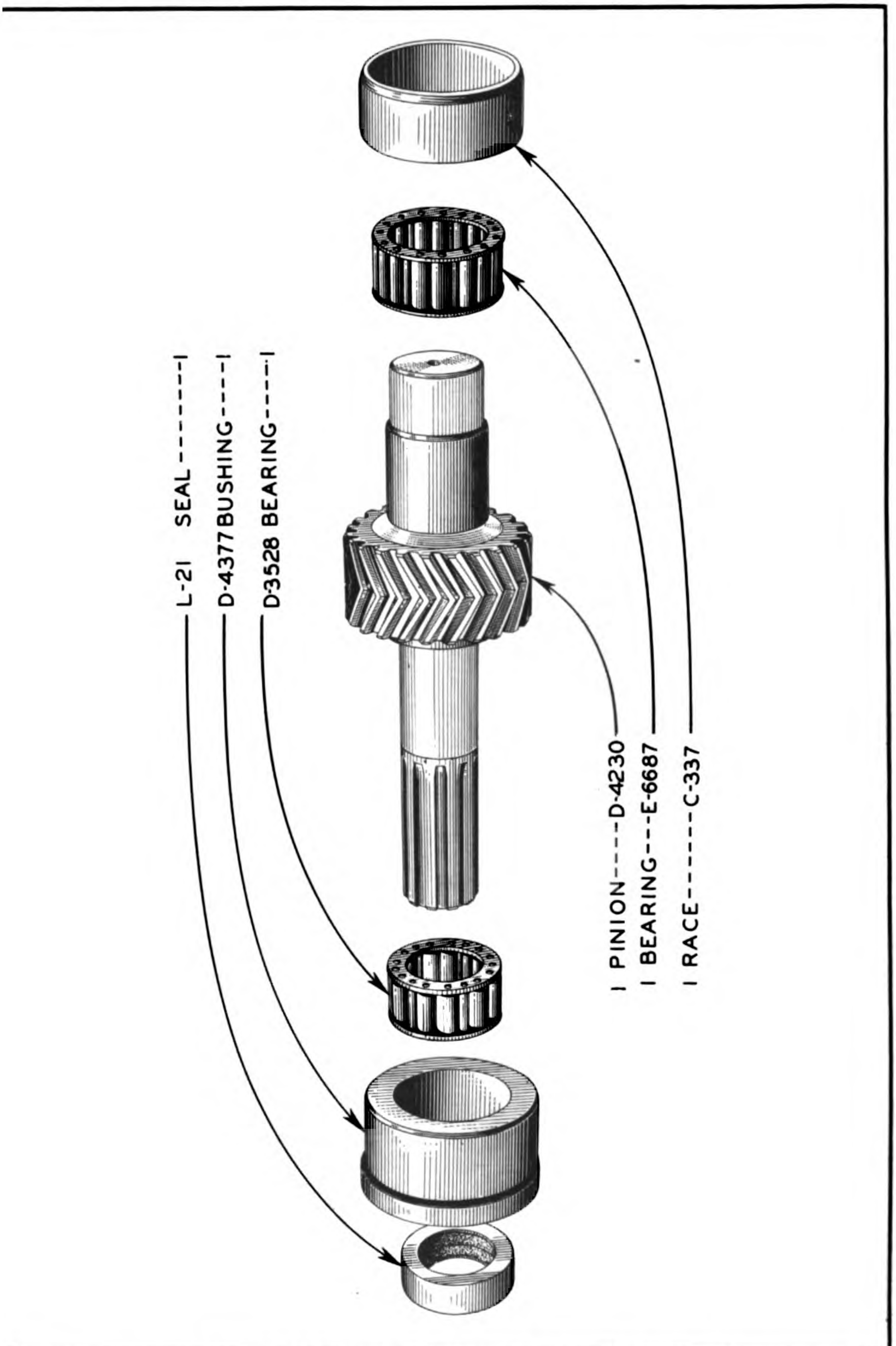

PINION ASSEMBLY—EXPLODED

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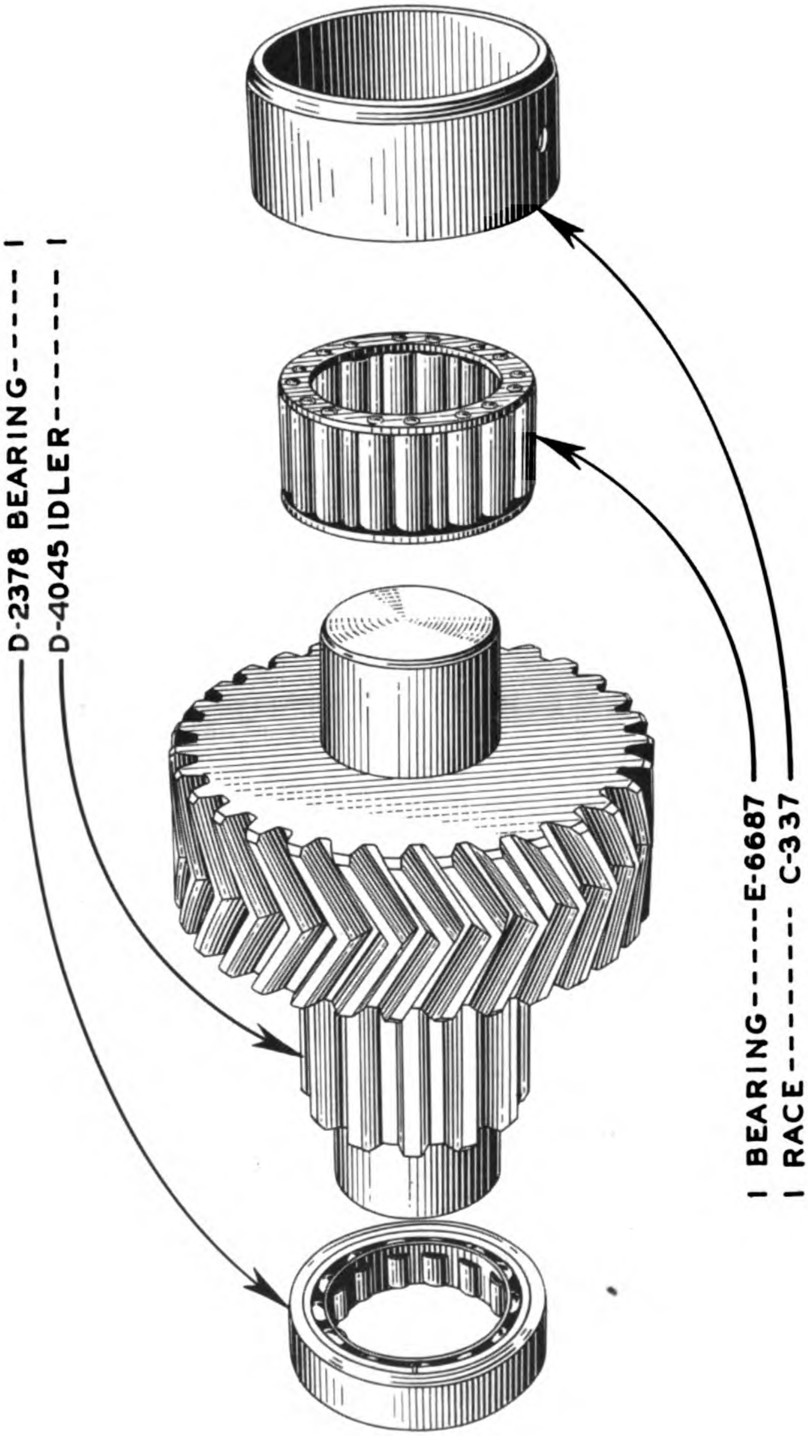

IDLER ASSEMBLY-EXPLODED

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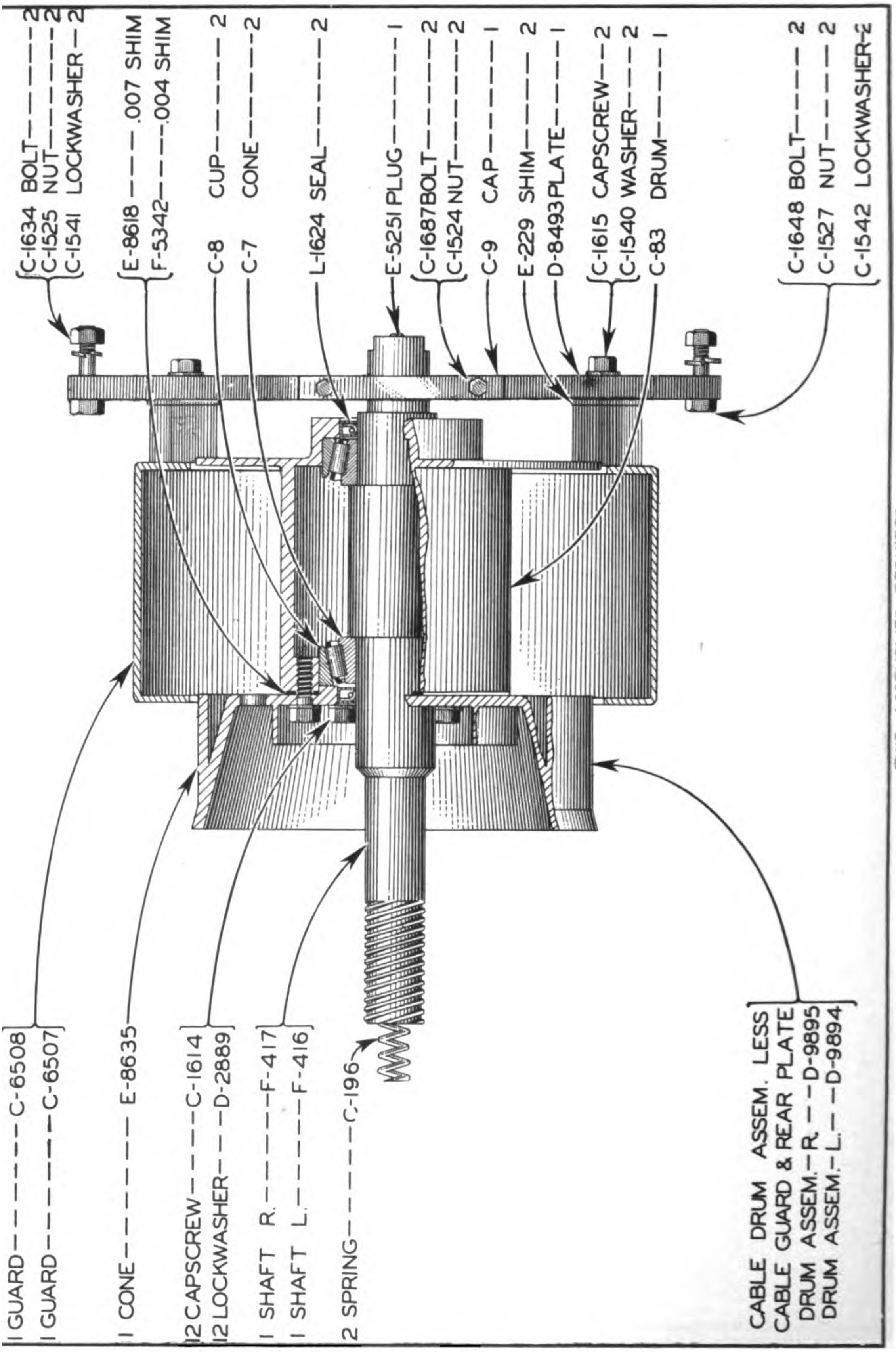

CABLE DRUM—CROSS SECTION

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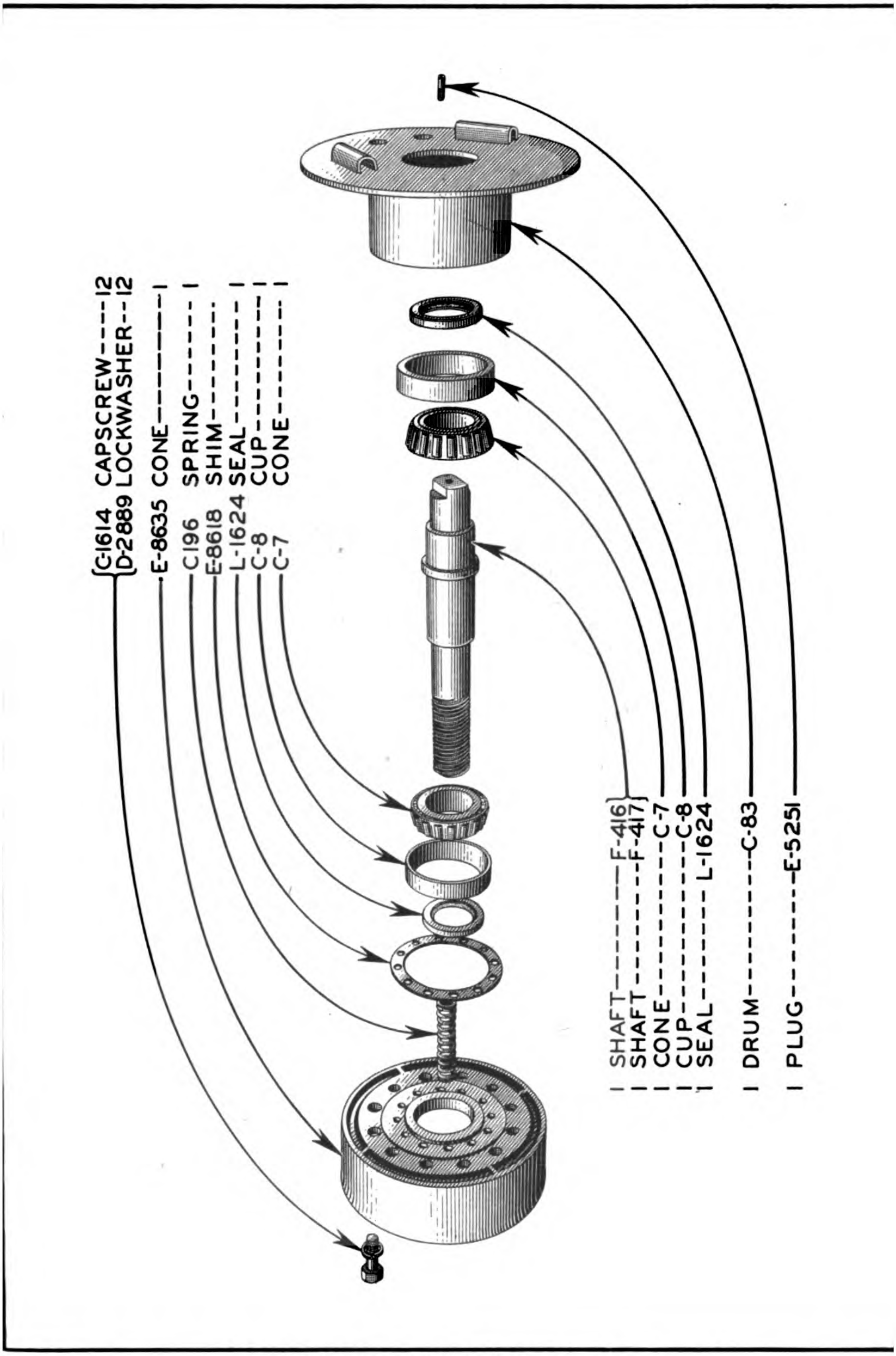

CABLE DRUM—EXPLODED

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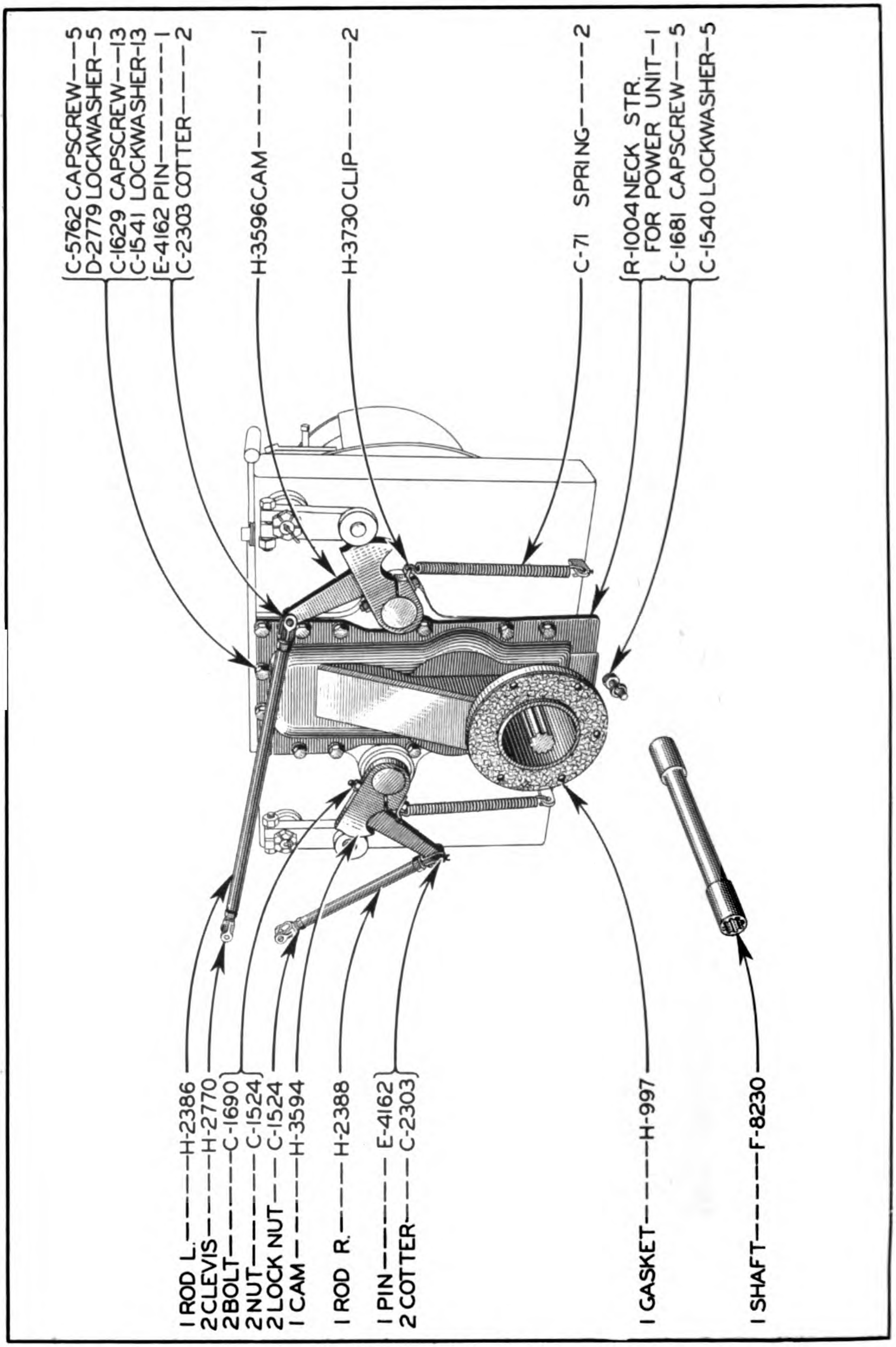

NECK GROUP

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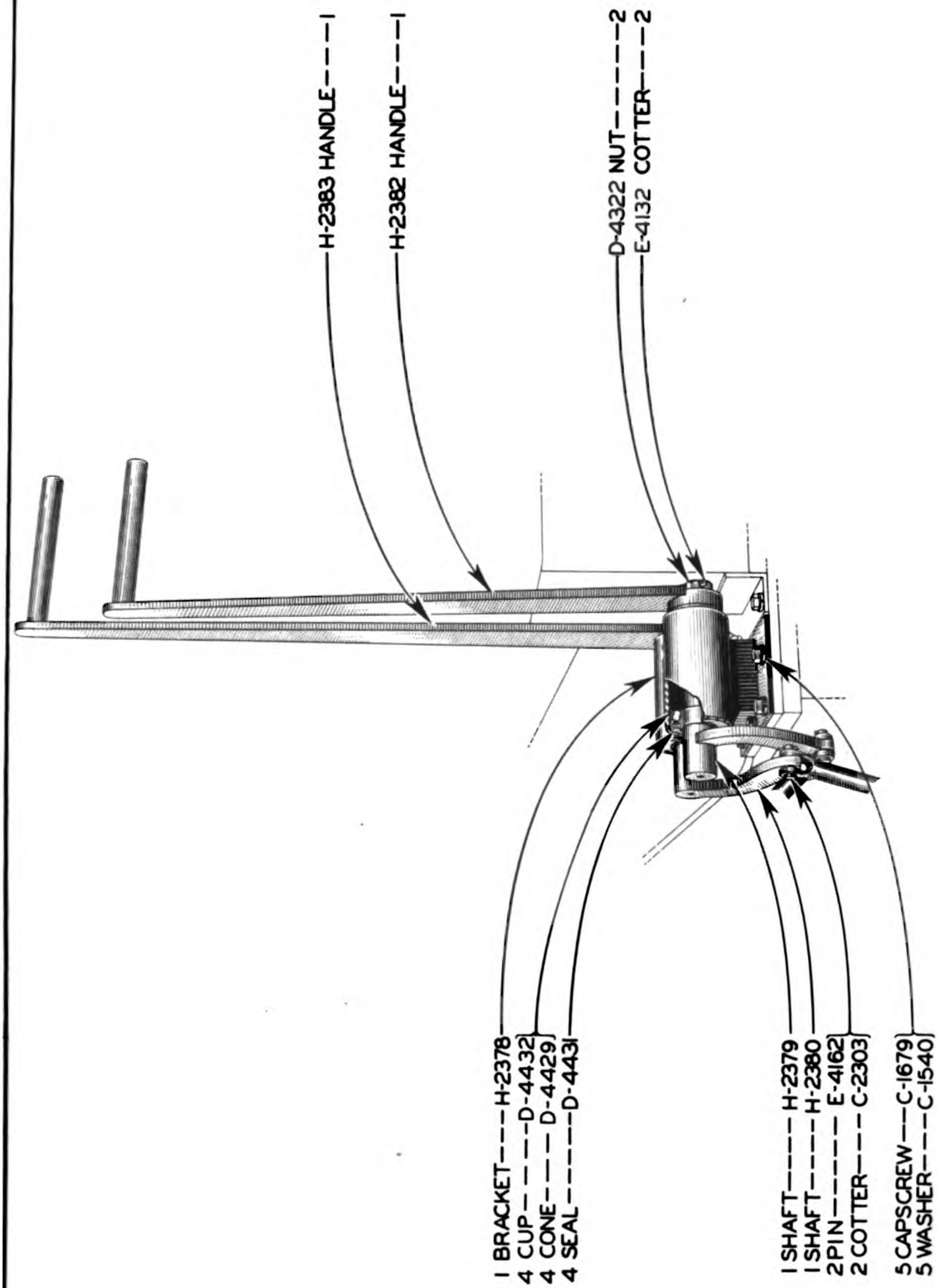

PCU HANDLE ASSEMBLY

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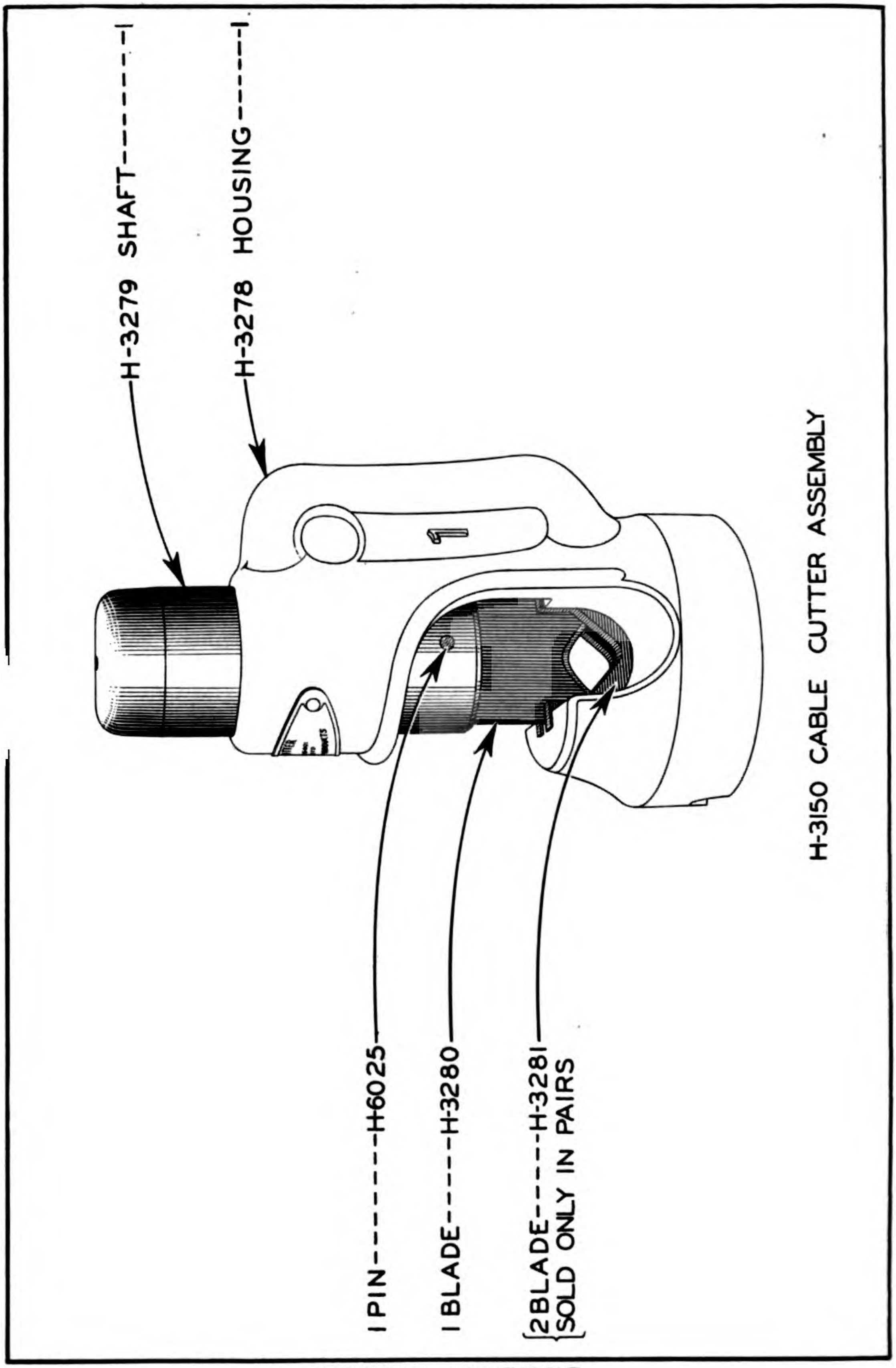

CABLE CUTTER

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HOIST CABLE

R-5084 1/2x6x19=105' Long

DUMP CABLE

H-9541 1/2x6x19=126' Long Required
R-5062 1/2x6x19=500' Spool & Cable

APRON TO SLIDING SHEAVE

R-5085 7/8x6x19=14'6" Long

TAILGATE TO SPIRAL SHEAVE

H-9543 5/8x6x19=13'6" Long

TAILGATE TO SLIDING SHEAVE

H-9544 7/8x6x19=51' Long

SPRINGPIPE CABLE

H-9545 5/8x6x19=17' Long

SEE OPERATIONS SECTION FOR CABLE THEADING INSTRUCTION

CABLE LENGTHS

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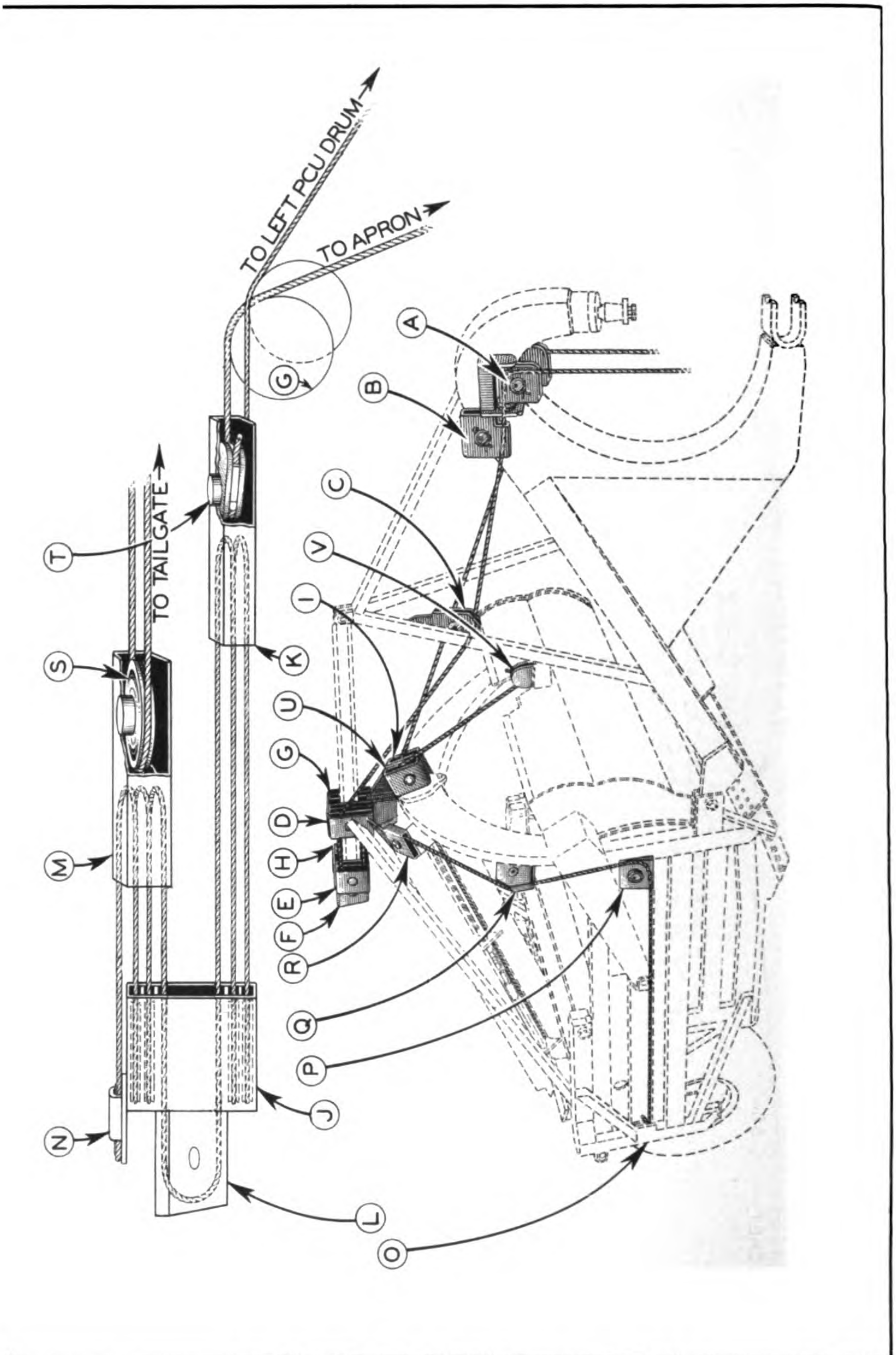

CABLE THREADING DIAGRAM

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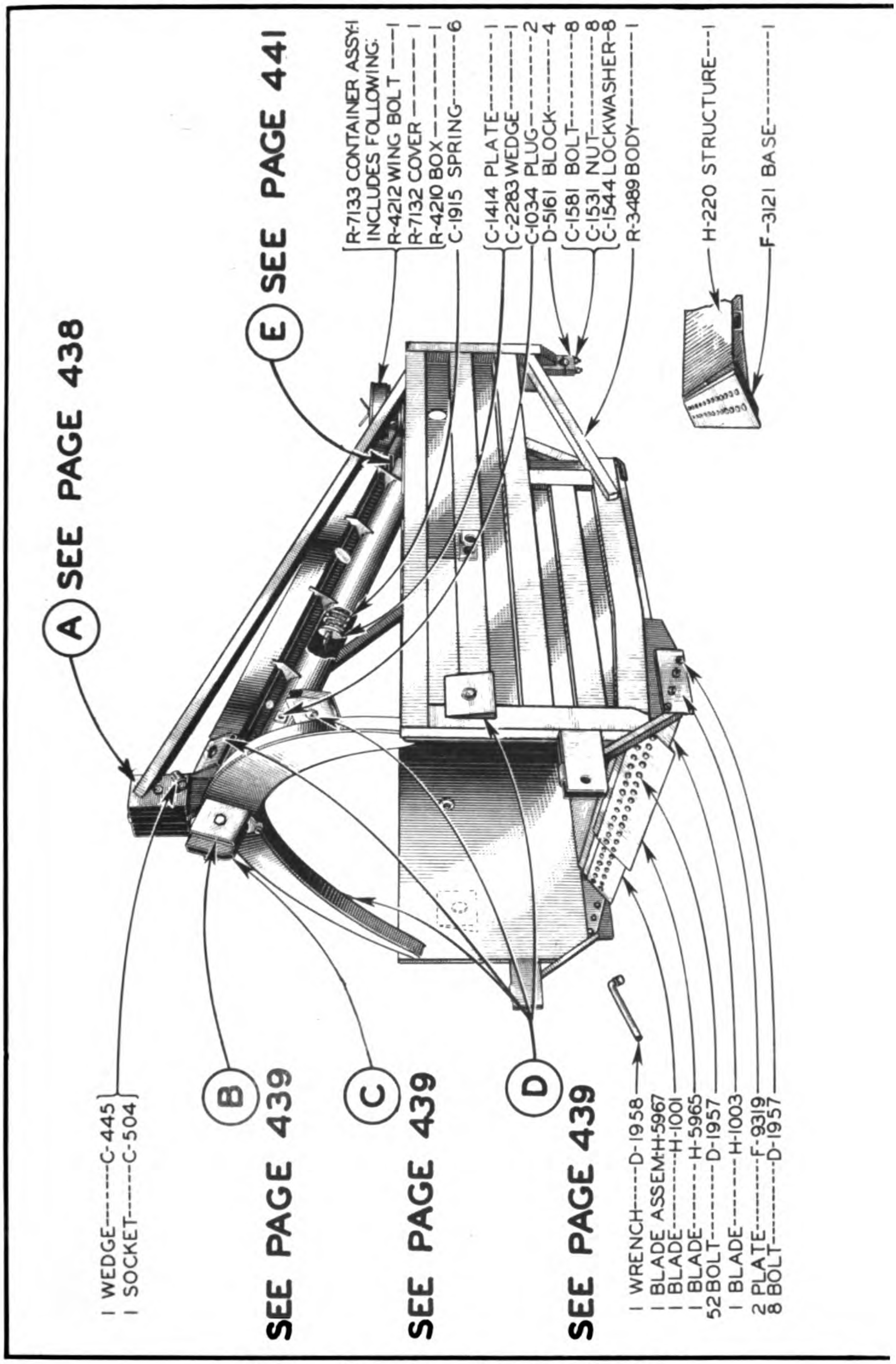
MODEL LP CARRYALL FOR SUPER C 43



MAIN BODY ASSEMBLY

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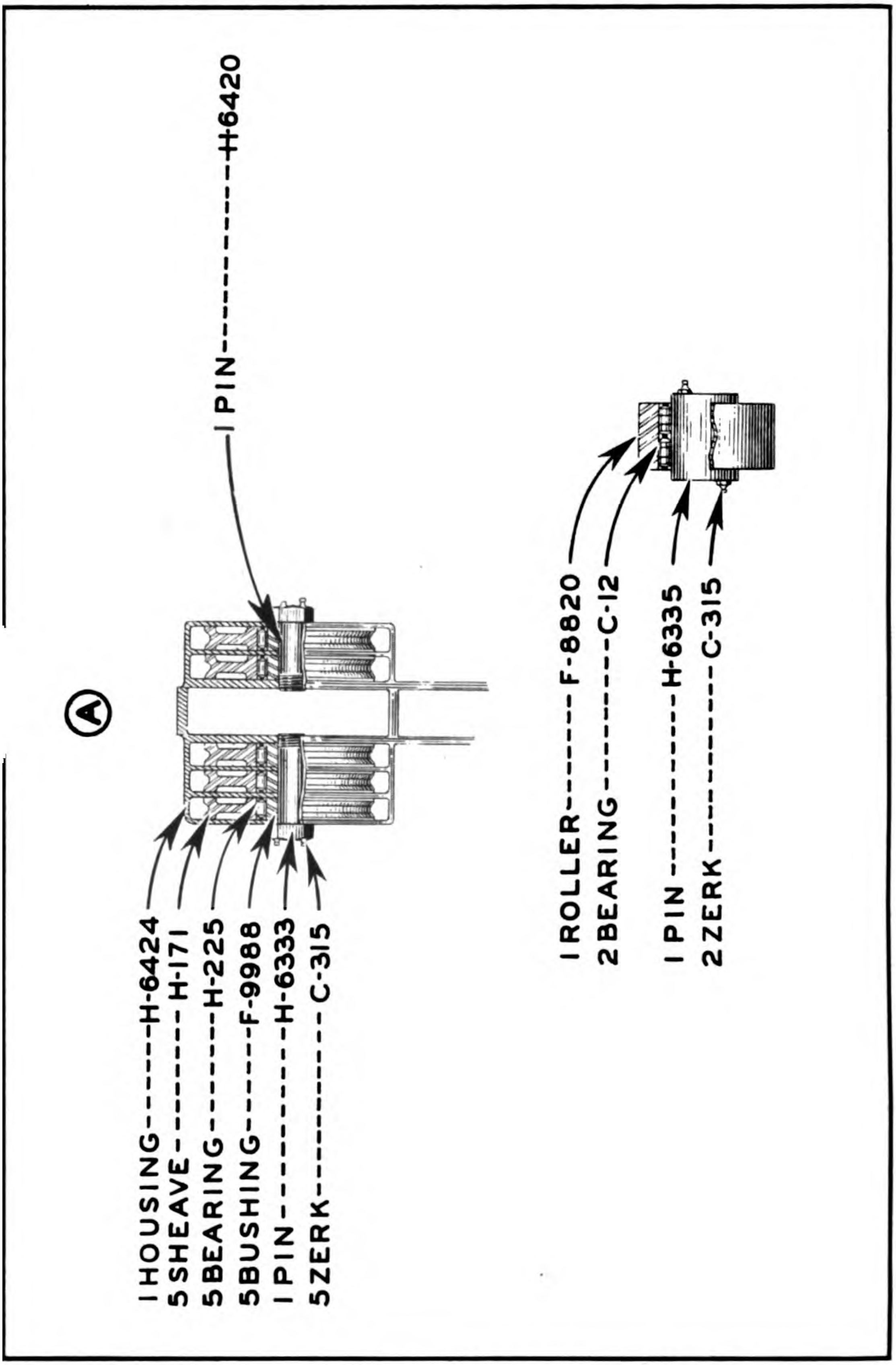

MAIN BODY SUB ASSEMBLIES

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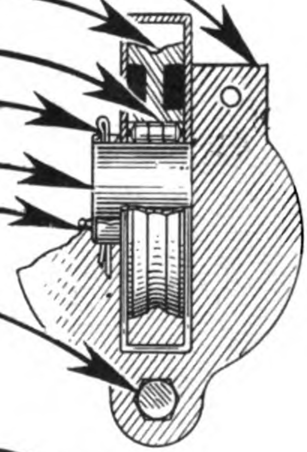
1 SHEAVE---------- H-171
1 BEARING--------- H-225
1 BUSHING--------F-9988
1 PIN-------------F-9991
1 NUT------------ F-9989
1 ZERK----------- C-315

(B)

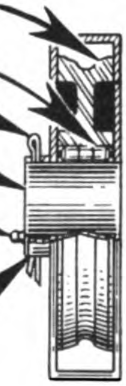
1 HOUSING---------H-271
1 SHEAVE---------F-7269
1 BEARING-------- C-177
1 COTTER----------C-1051
1 PIN------------C-138
1 ZERK-----------C-315
3 CAPSCREW--------H-1111
3 LOCKWASHER--- C-1544



(C)

6 SHEAVE---------F-7269
6 BEARING---------C-177
6 COTTER---------C-1051
4 PIN------------C-138
6 ZERK----------- C-315

2 PIN------------F-5027
FOR SIDE SHEET HOUSING



(D)

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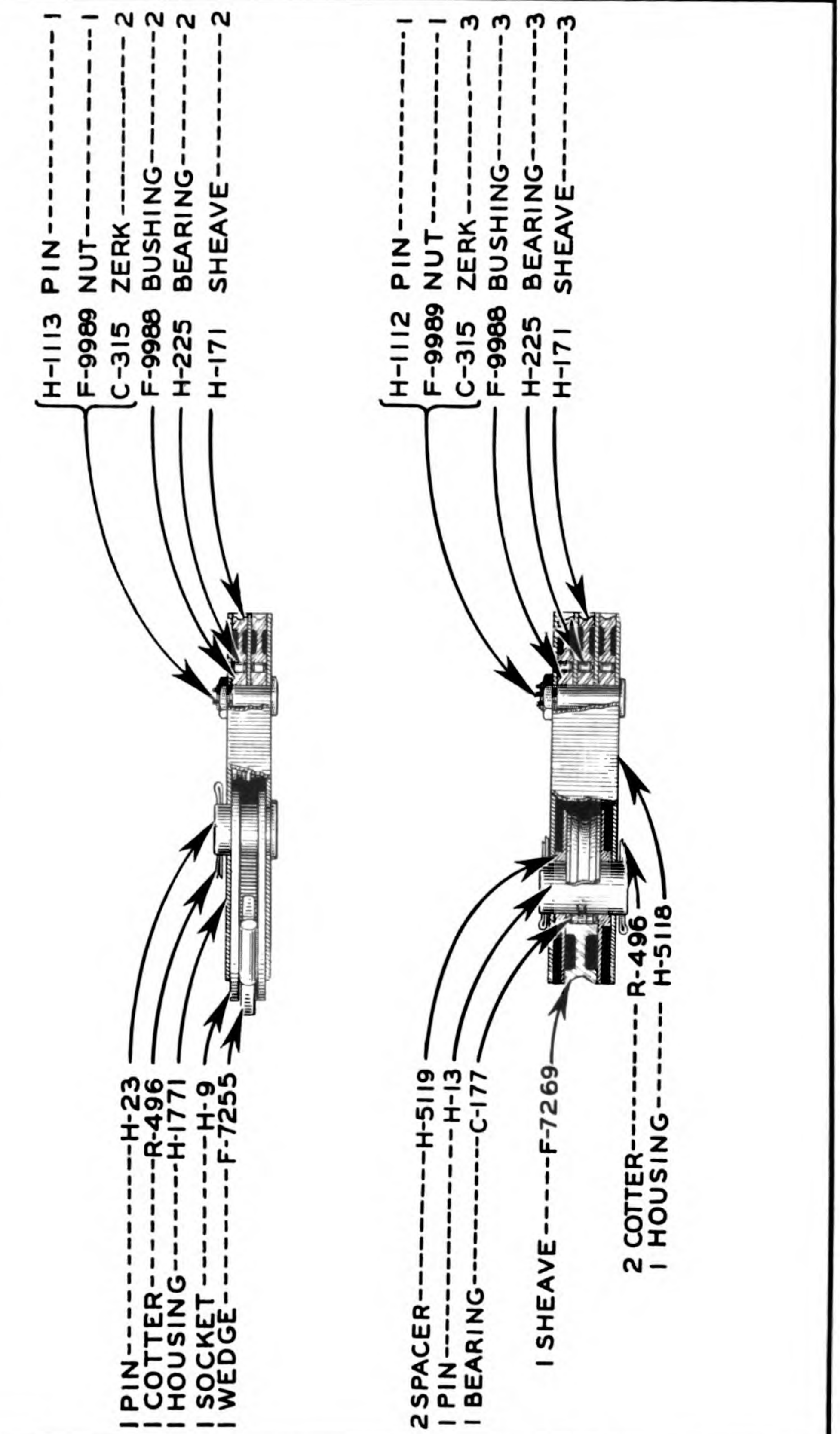
SLIDING SHEAVE ASSEMBLIES



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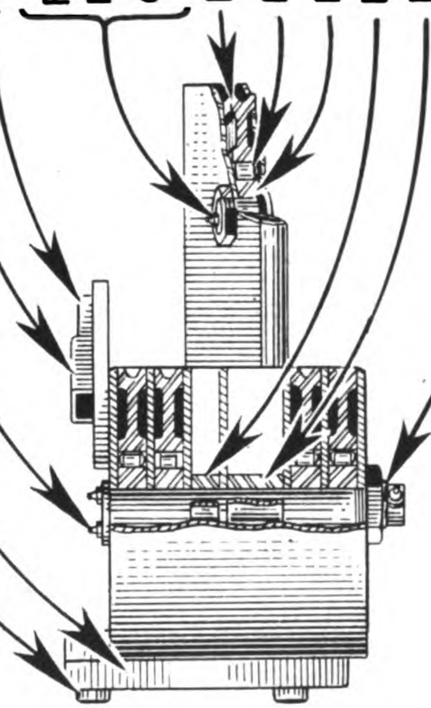
MODEL LP CARRYALL FOR SUPER C 44

E

D-6394	CAPSCREW	2
H-5288	BUMPER	1
C-315	ZERK	2
C-503	SOCKET	1
H-2320	WEDGE	1
F-9991	PIN	1
F-9989	NUT	1
C-315	ZERK	1
H-171	SHEAVE	5
H-225	BEARING	5
F-9988	BUSHING	5
H-272	SPACER	1
H-273	SPACER	1
H-6427	PIN	1
F-9989	NUT	1
C-315	ZERK	2



MAIN BODY SUB ASSEMBLIES

ALWAYS GIVE MACHINE NUMBER WHEN ORDERING PARTS

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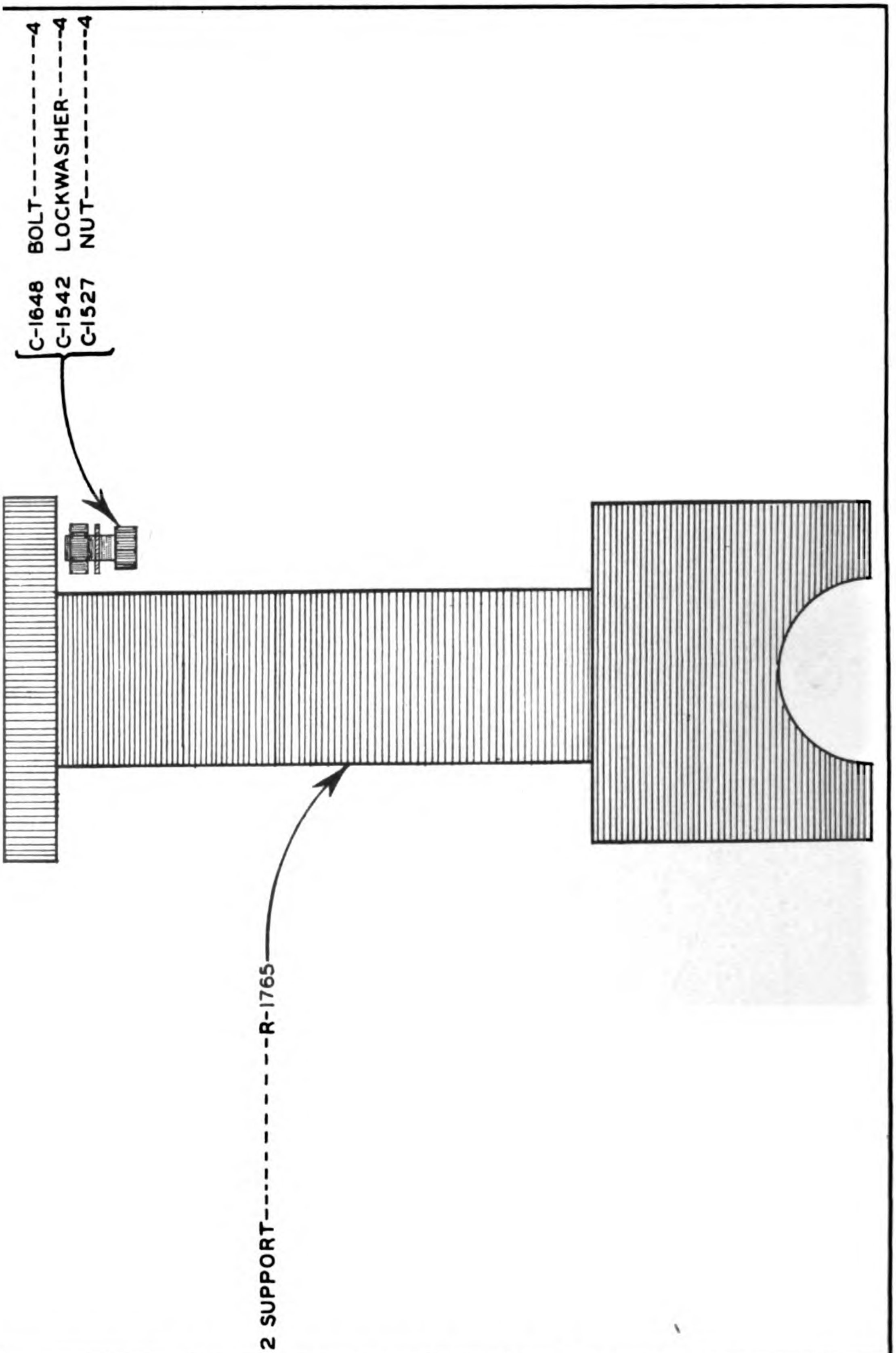

AXLE SUPPORT BEAM

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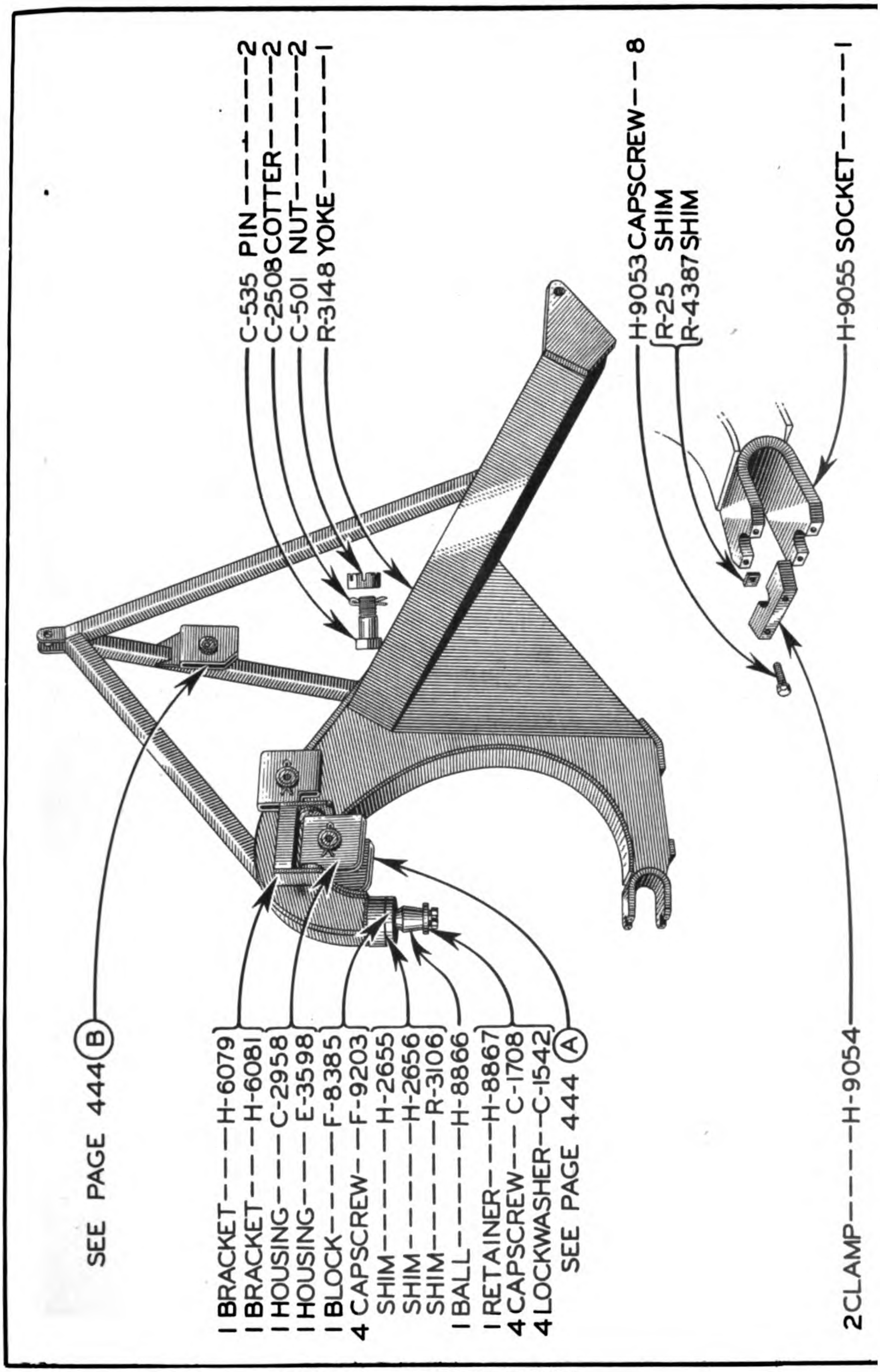

YOKE ASSEMBLY

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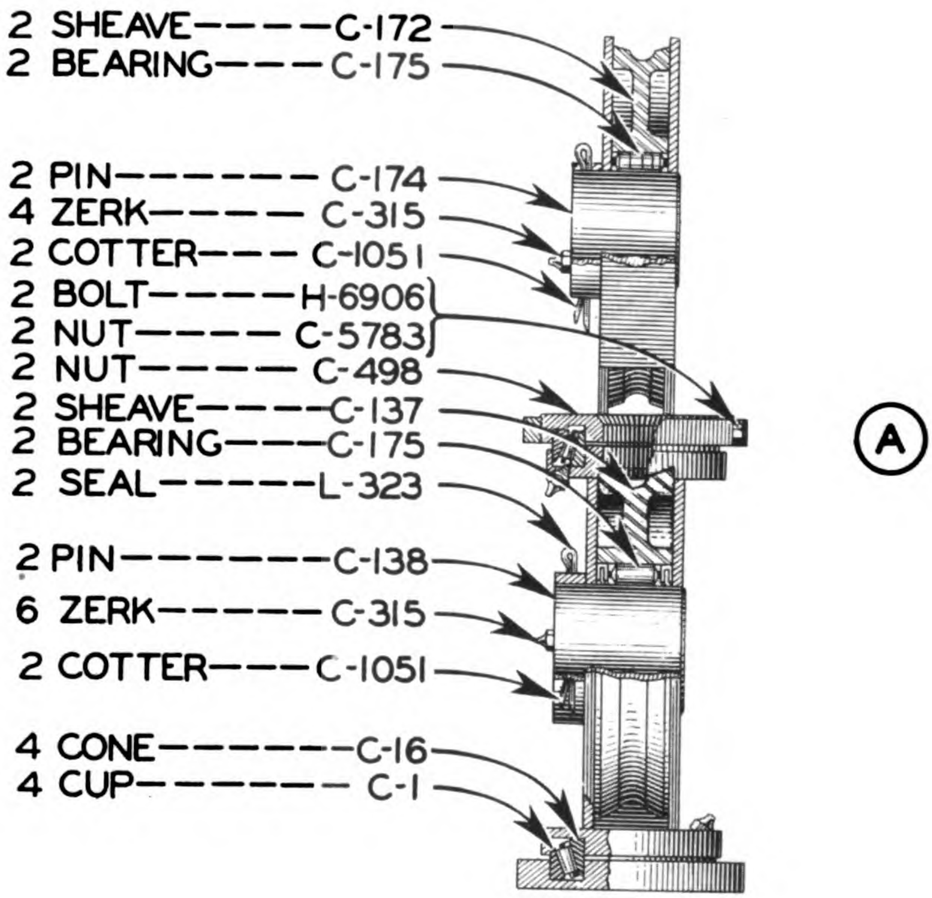

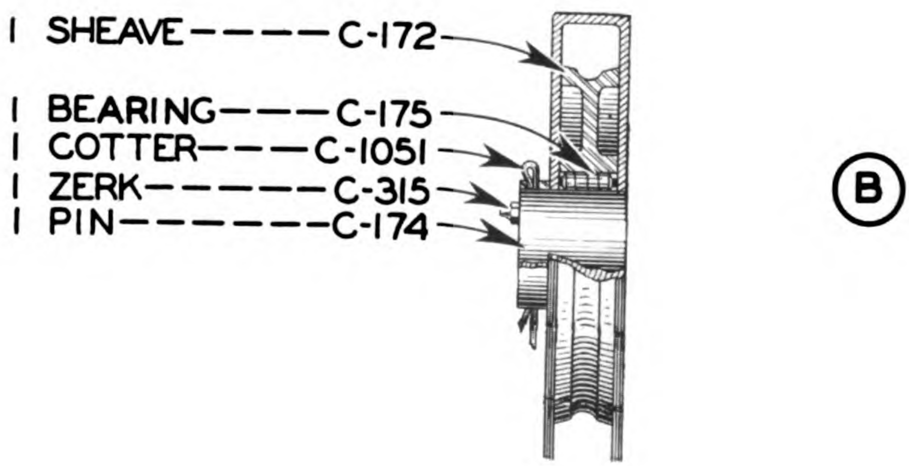

YOKE SUB ASSEMBLY

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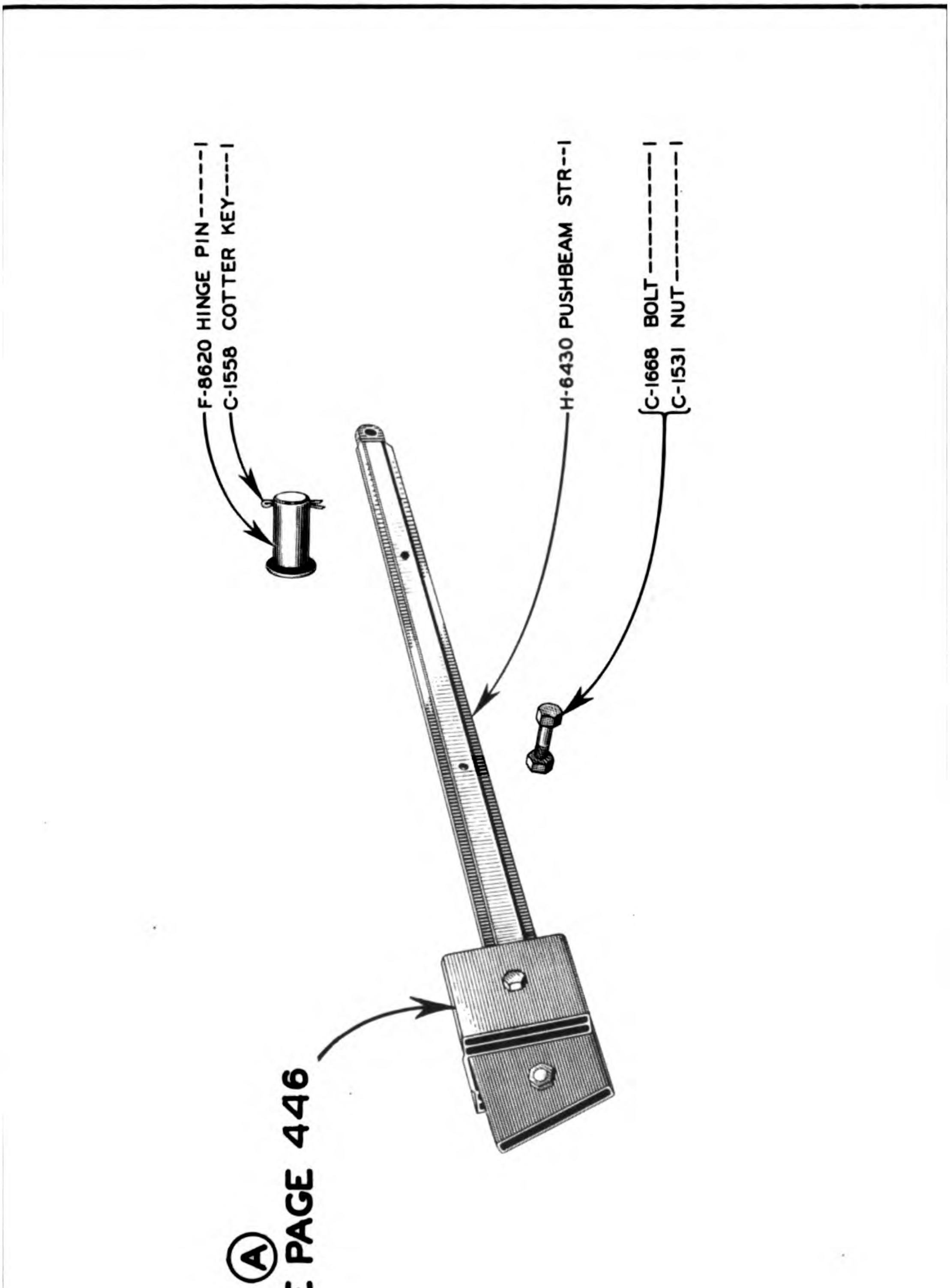

PUSHBEAM GROUP

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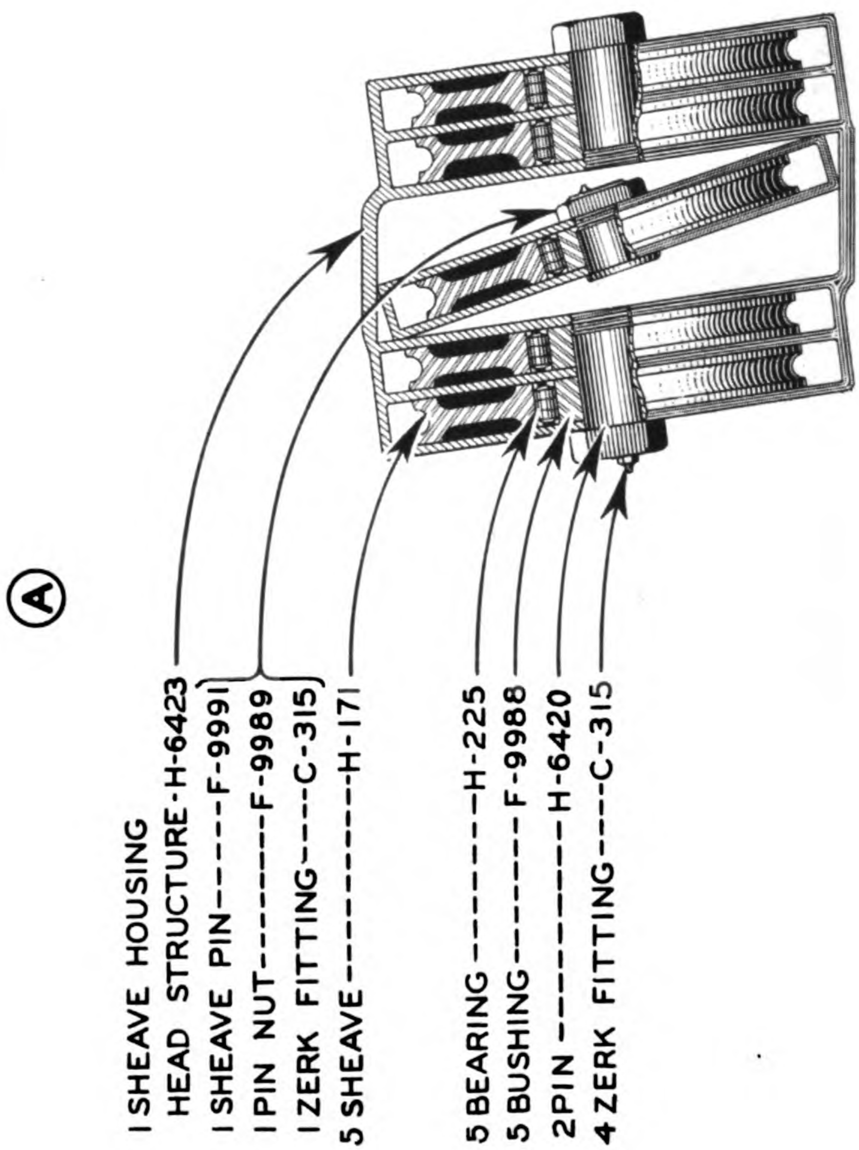

PUSHBEAM SUB ASSEMBLY

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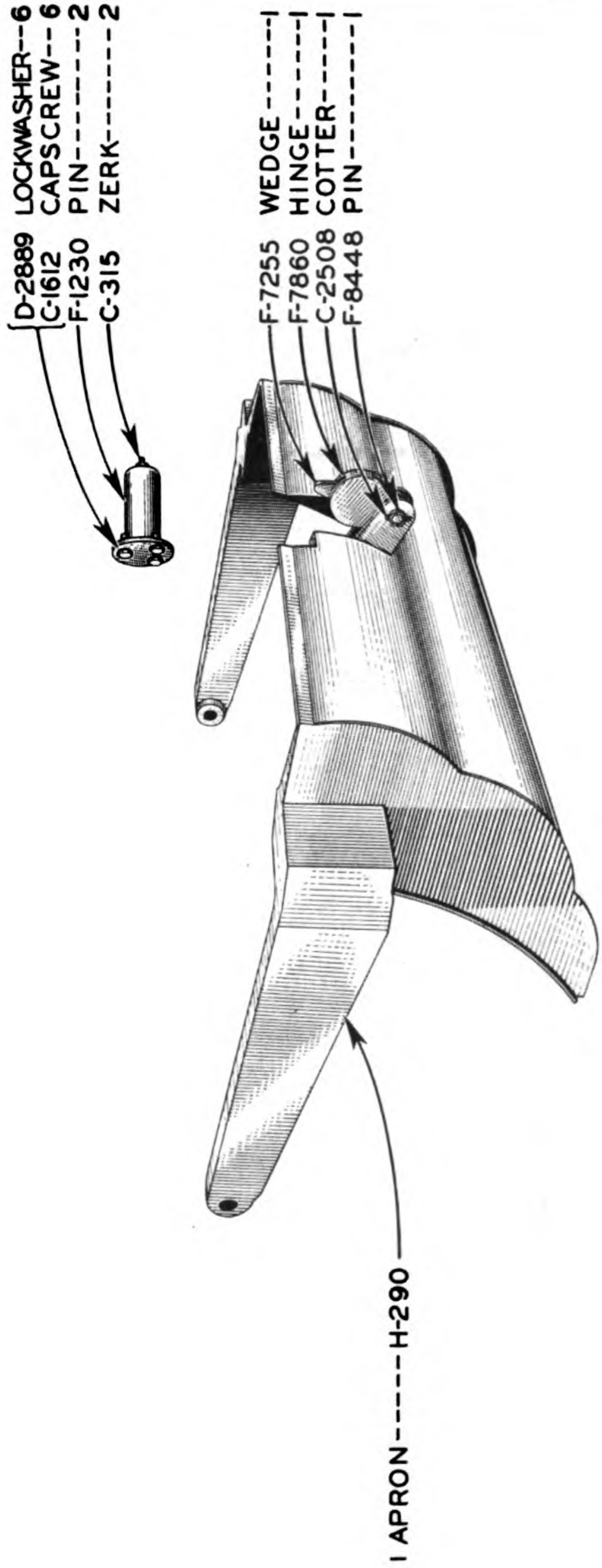
MODEL LP CARRYALL FOR SUPER C 447



APRON GROUP

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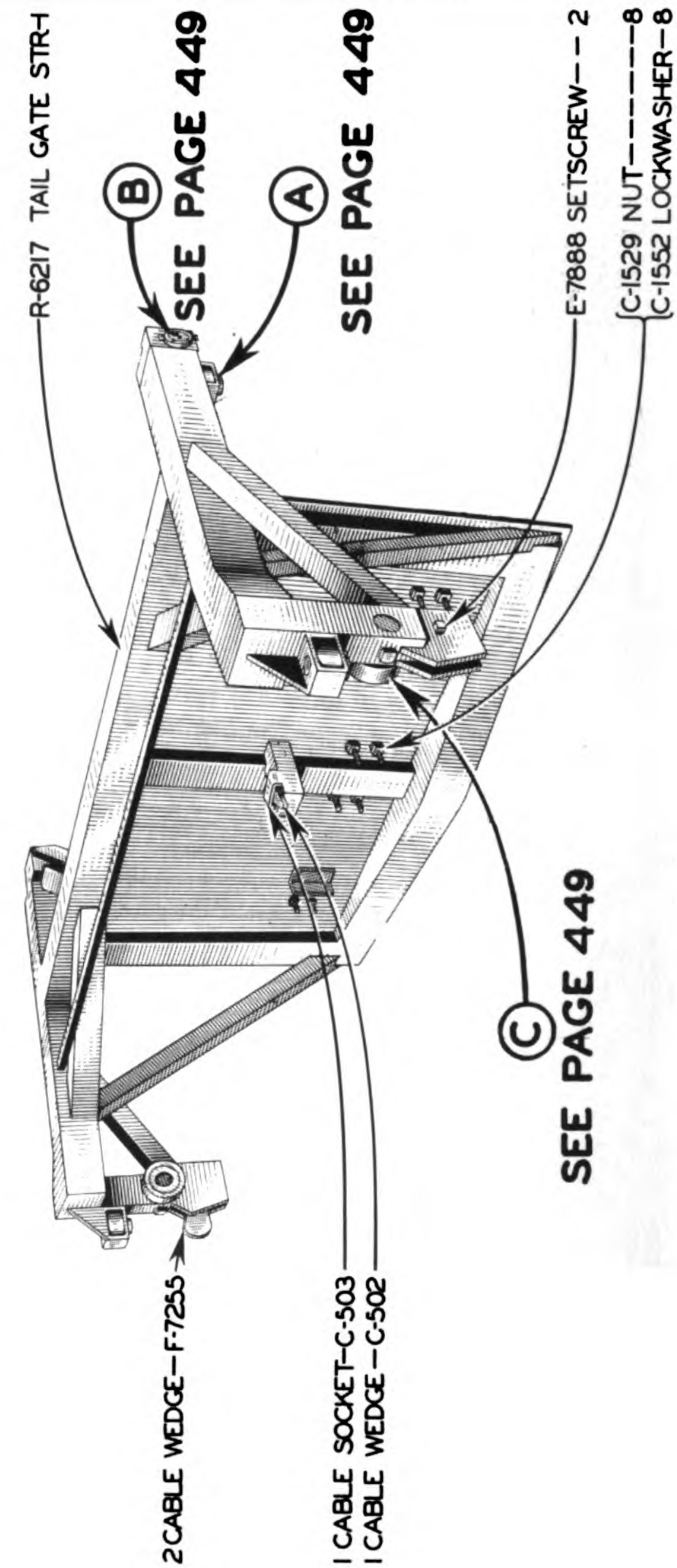

TAILGATE GROUP

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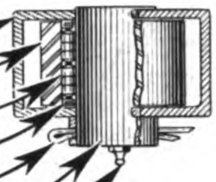
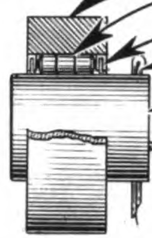
MODEL LP CARRYALL FOR SUPER C 44

(A)

THRUST ROLLER
4 HOUSING------ H-2465
4 ROLLER----------C-133
8 BEARING---------C-12
8 DUST SEAL--------L-135
4 COTTER KEY----- C-1558
4 ROLLER PIN------ C-134
4 ZERK FITTING----C-1596



(B)



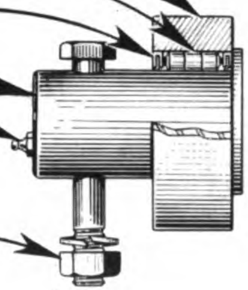
C-131 MAIN ROLLER---2
C-177 BEARING------2
L-323 DUST SEAL------4
C-1051 COTTER KEY----2
F-5027 ROLLER PIN---- 2
C-315 ZERK FITTING---2

(C)

2 REAR ROLLER-----C-131
2 BEARING---------C-177
4 DUST SEAL------ L-323

2 ROLLER PIN----R-1306
2 ZERK FITTING----C-315

2 BOLT-----------C-1577
2 NUT------------C-1531
2 LOCKWASHER----C-1544



TAILGATE SUB ASSEMBLIES

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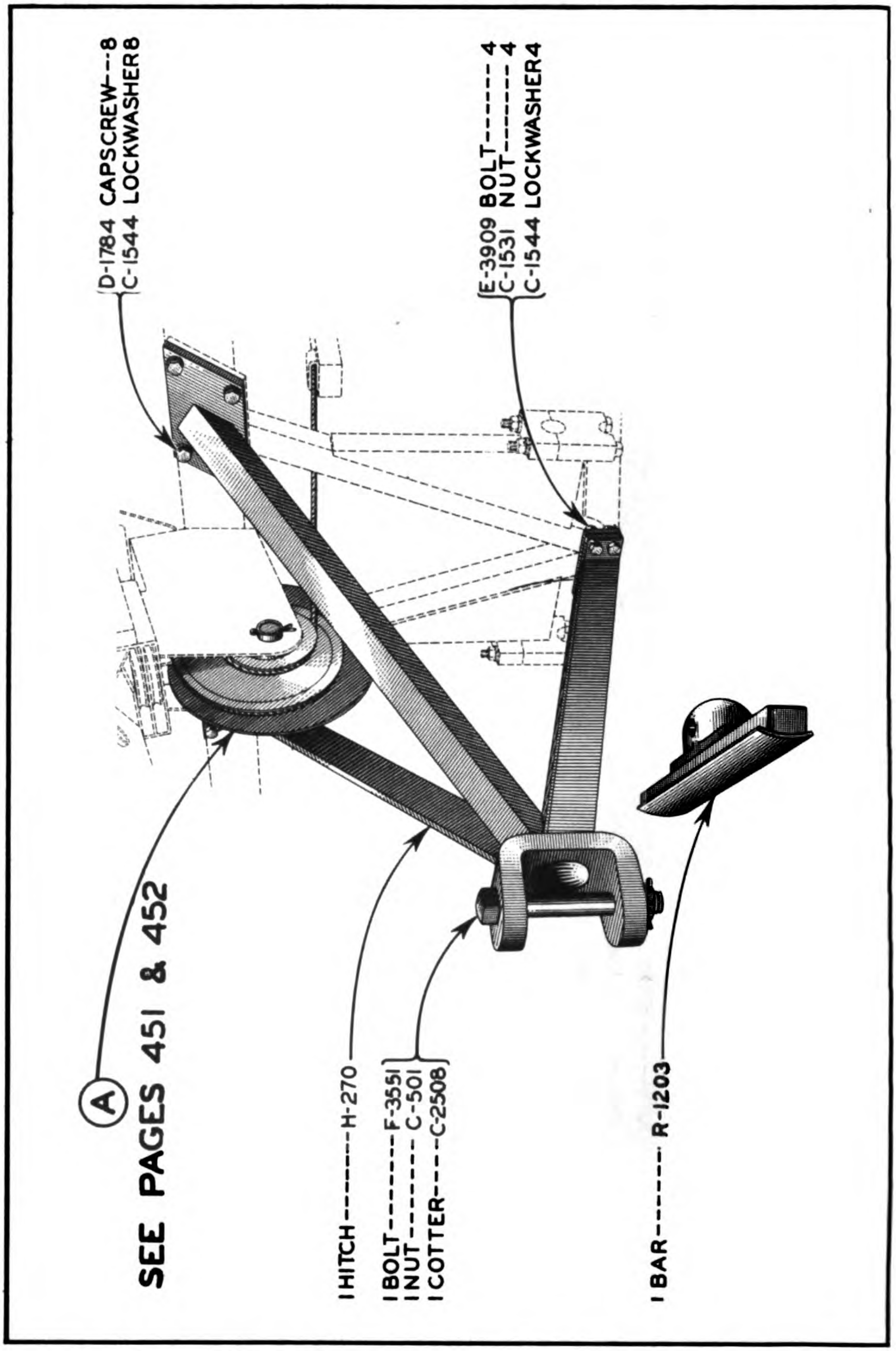
MODEL LP CARRYALL FOR SUPER C



REAR HITCH GROUP

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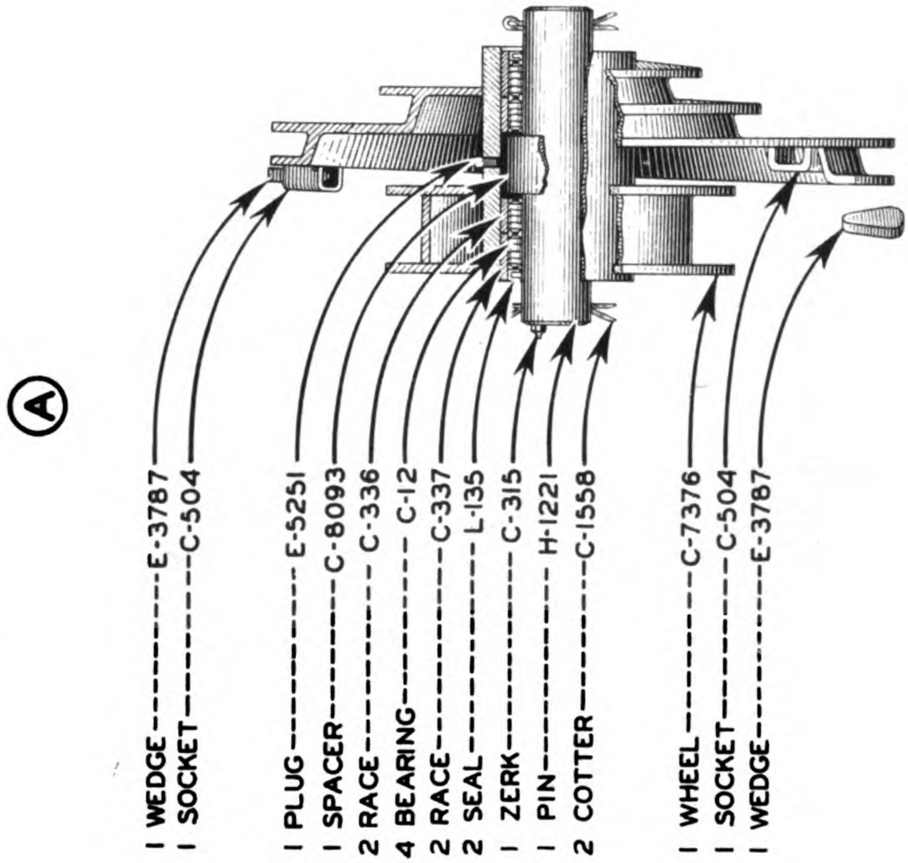

SPIRAL SHEAVE ASSEMBLY

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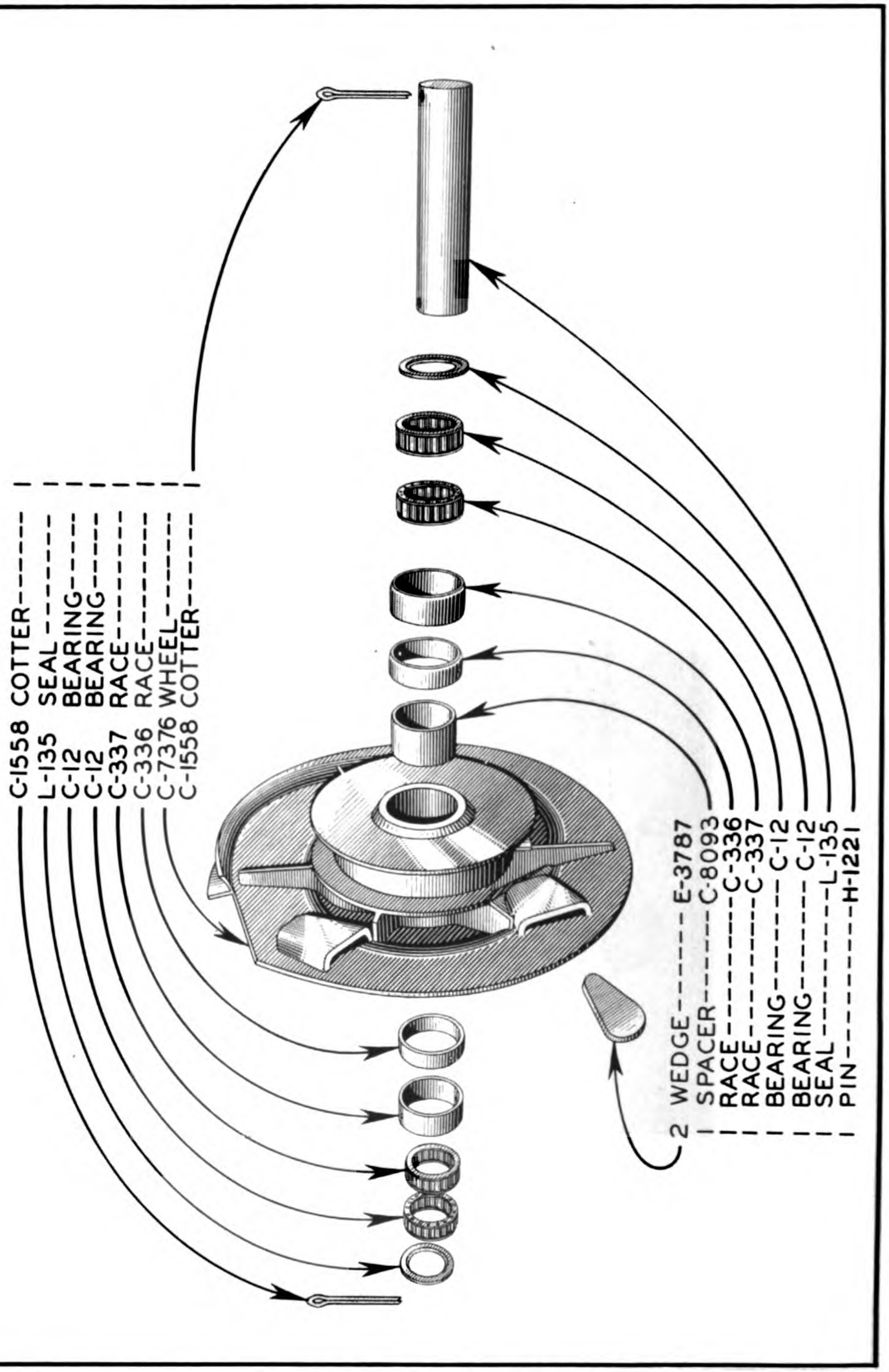
 MODEL LP CARRYALL FOR SUPER C



SPIRAL SHEAVE-EXPLODED

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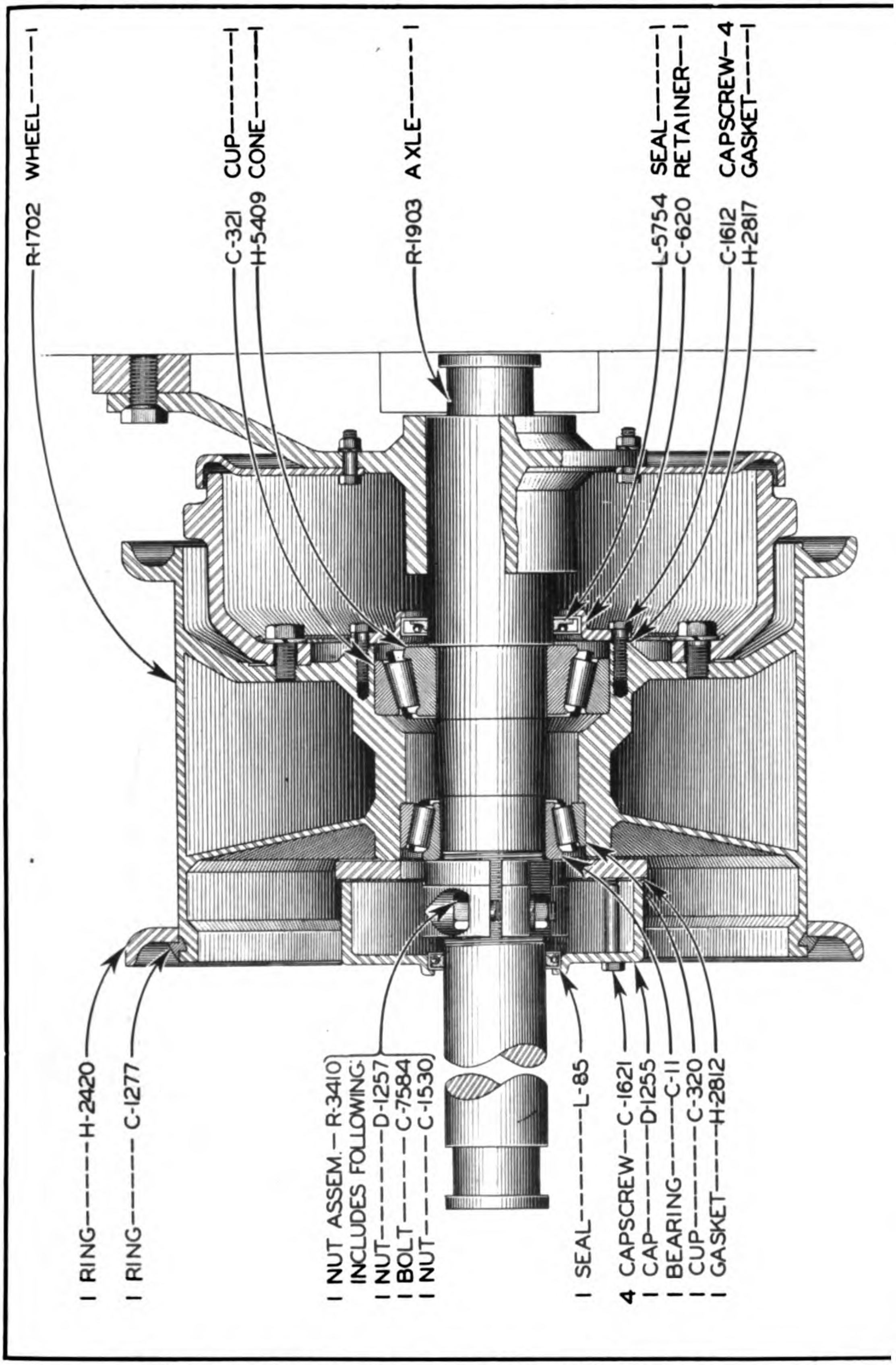
MODEL LP CARRYALL FOR SUPER C 453



18 X 24 SGL. REAR WHEEL

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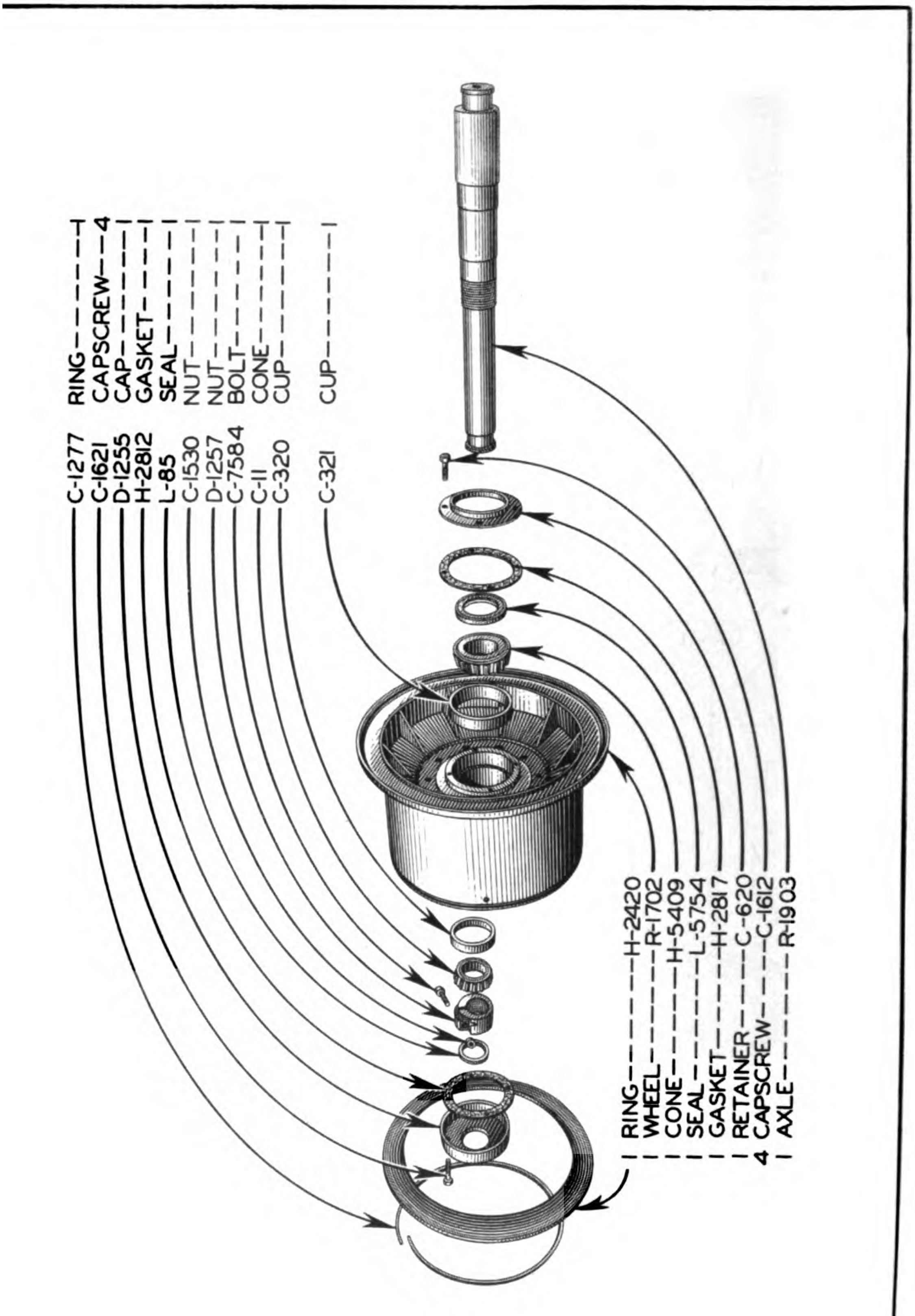

18 X 24 SGL. WHEEL-EXPLODED

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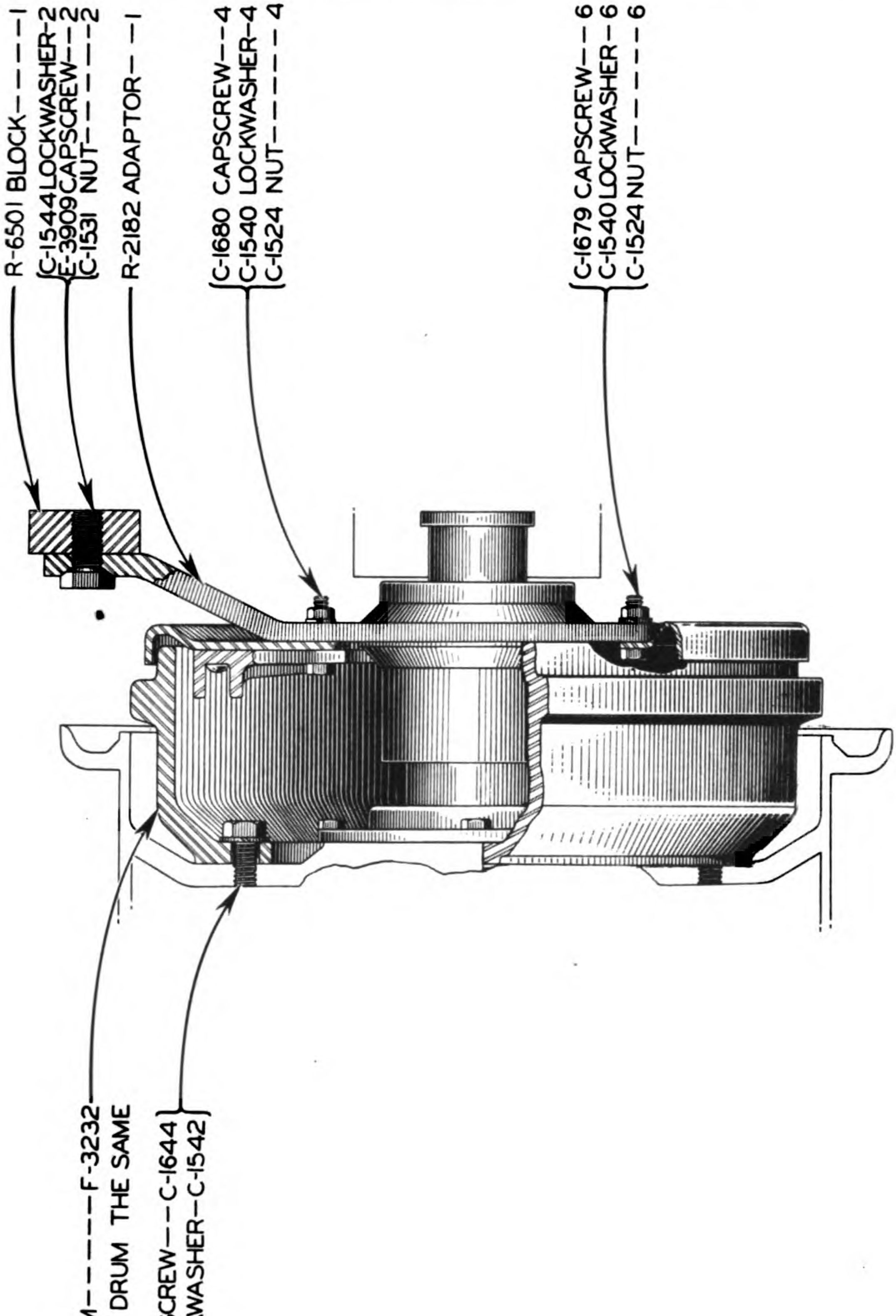
MODEL LP CARRYALL FOR SUPER C



BRAKE DRUM & ANCHOR—SECTIONAL

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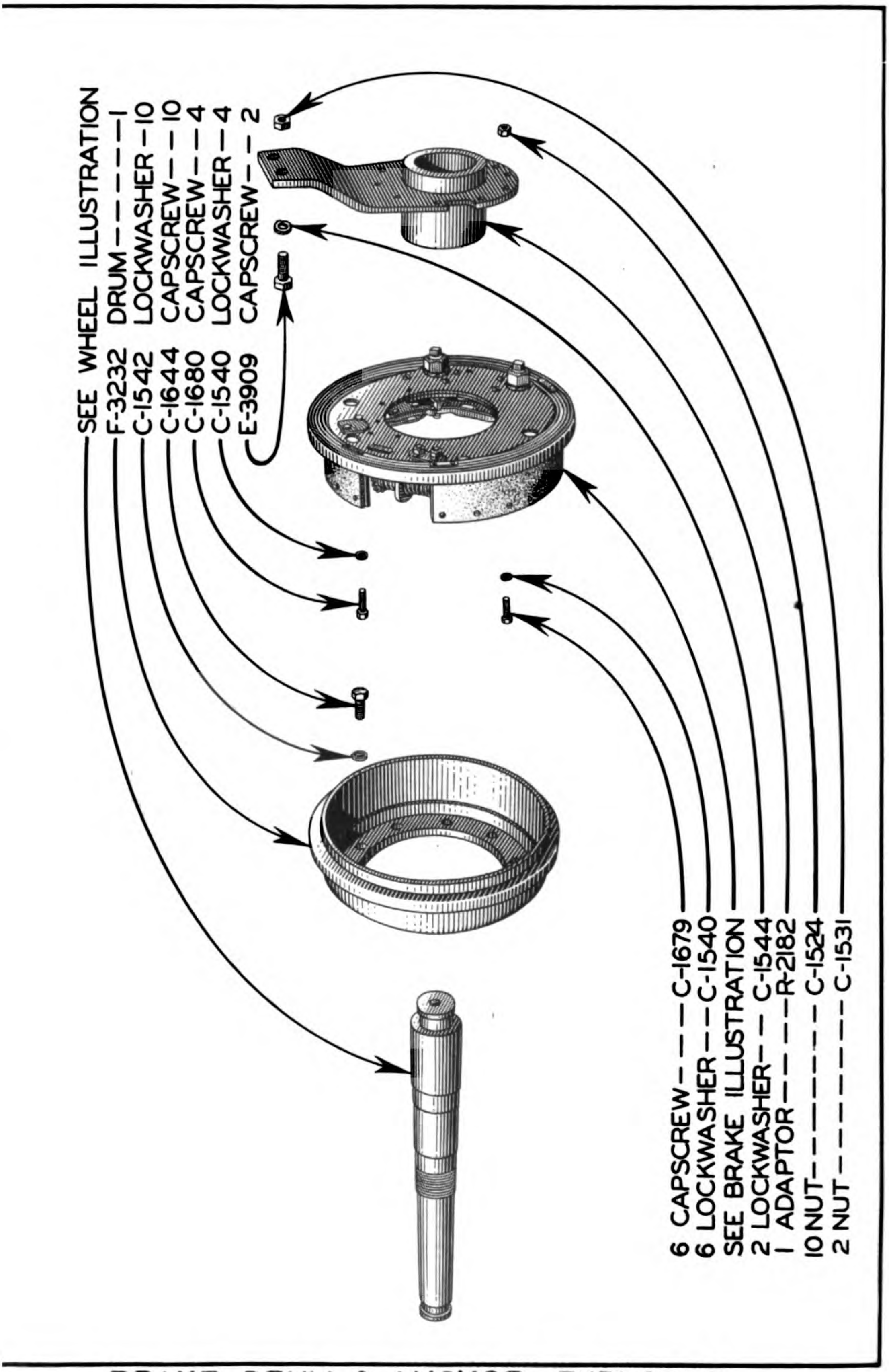

BRAKE DRUM & ANCHOR—EXPLODED

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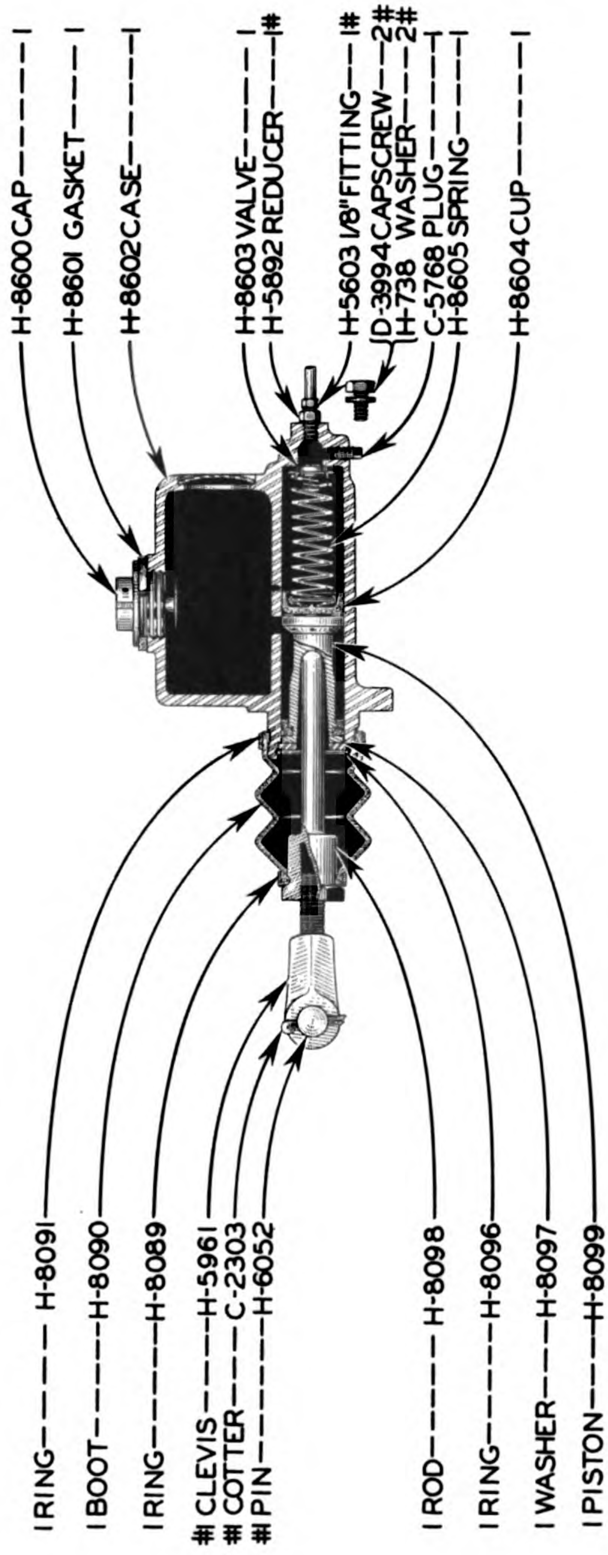

MASTER CYLINDER – SECTIONAL

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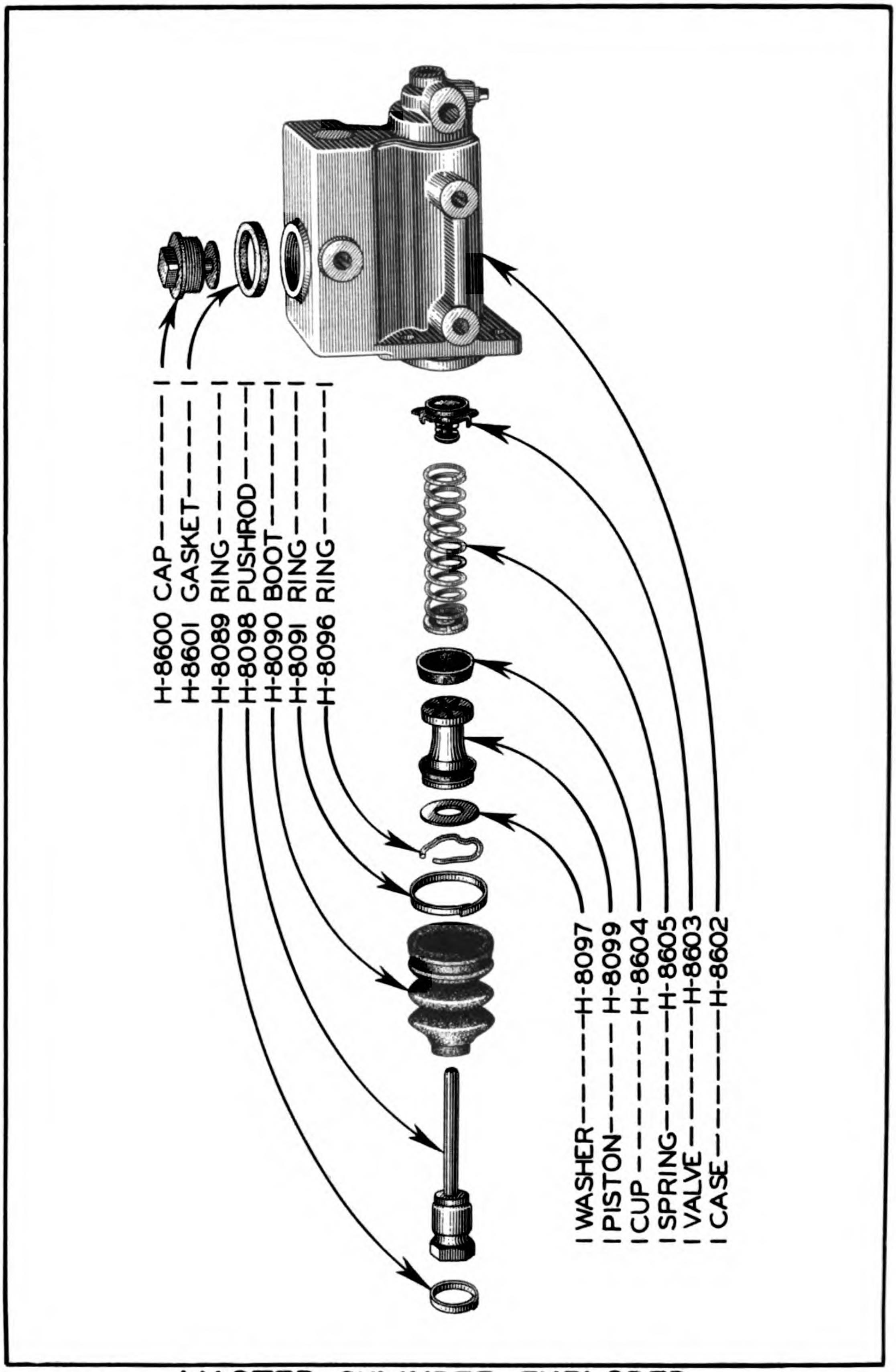

MASTER CYLINDER—EXPLODED

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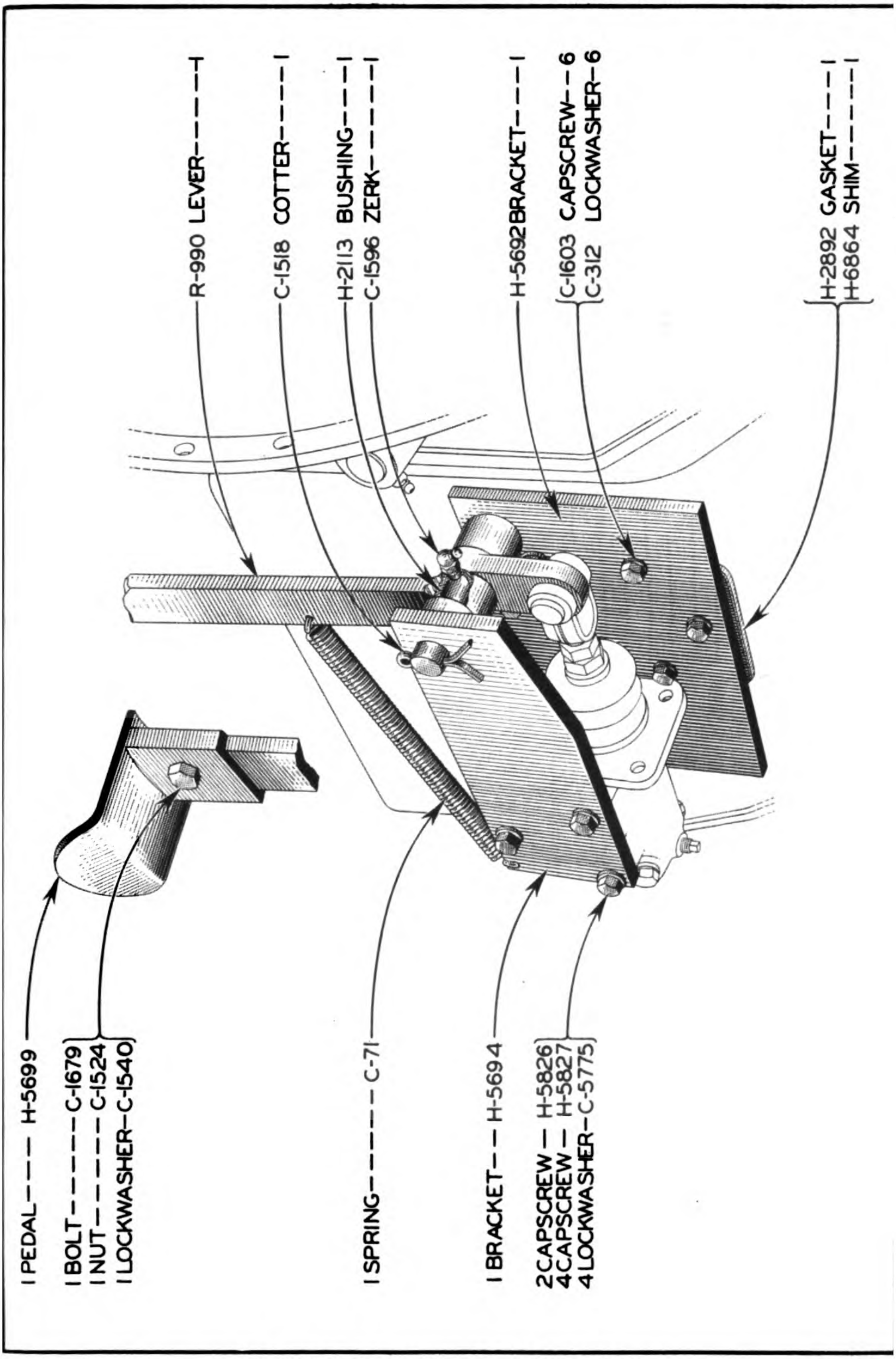

BRAKE PEDAL & BRACKET

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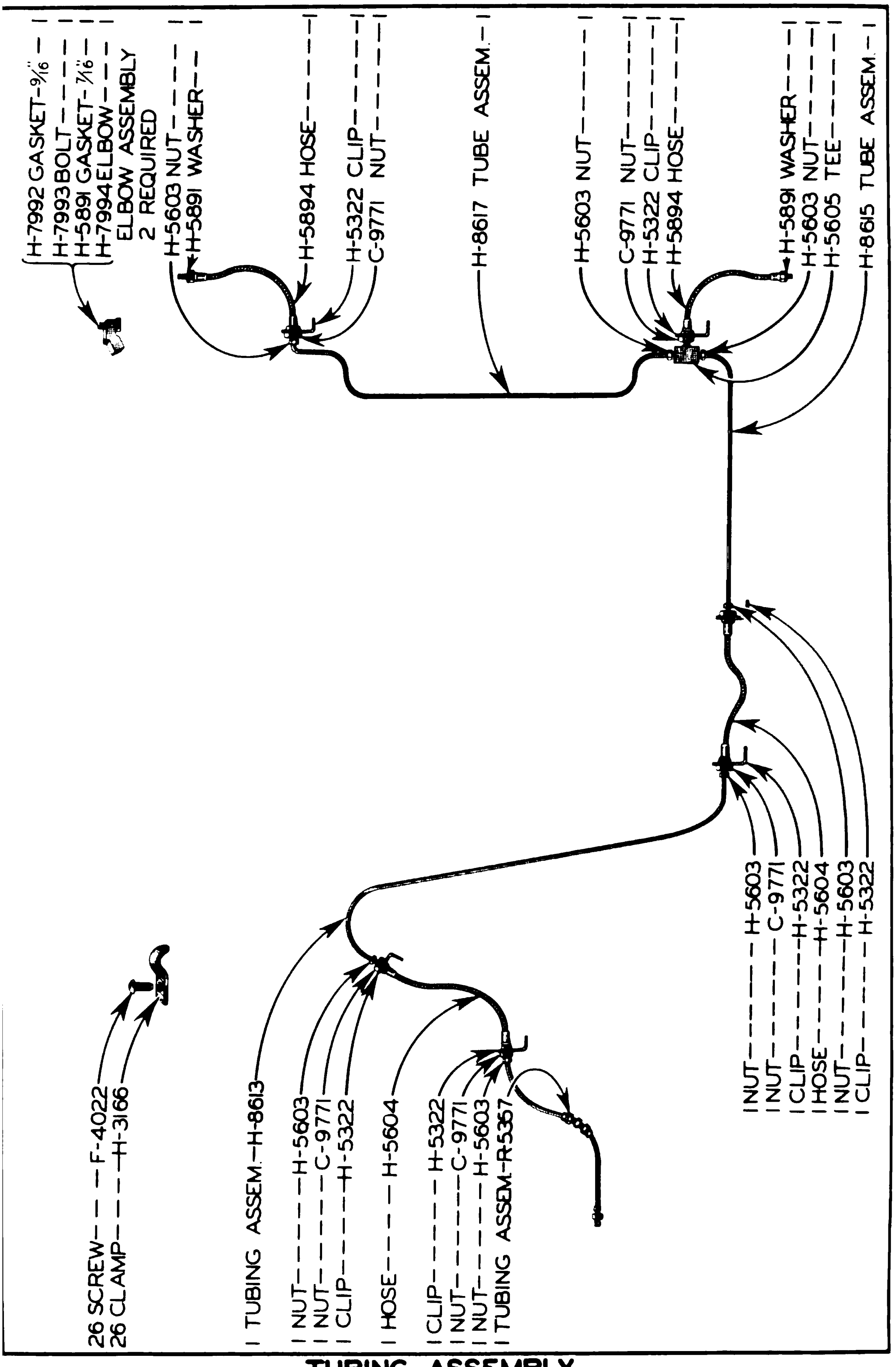

TUBING ASSEMBLY

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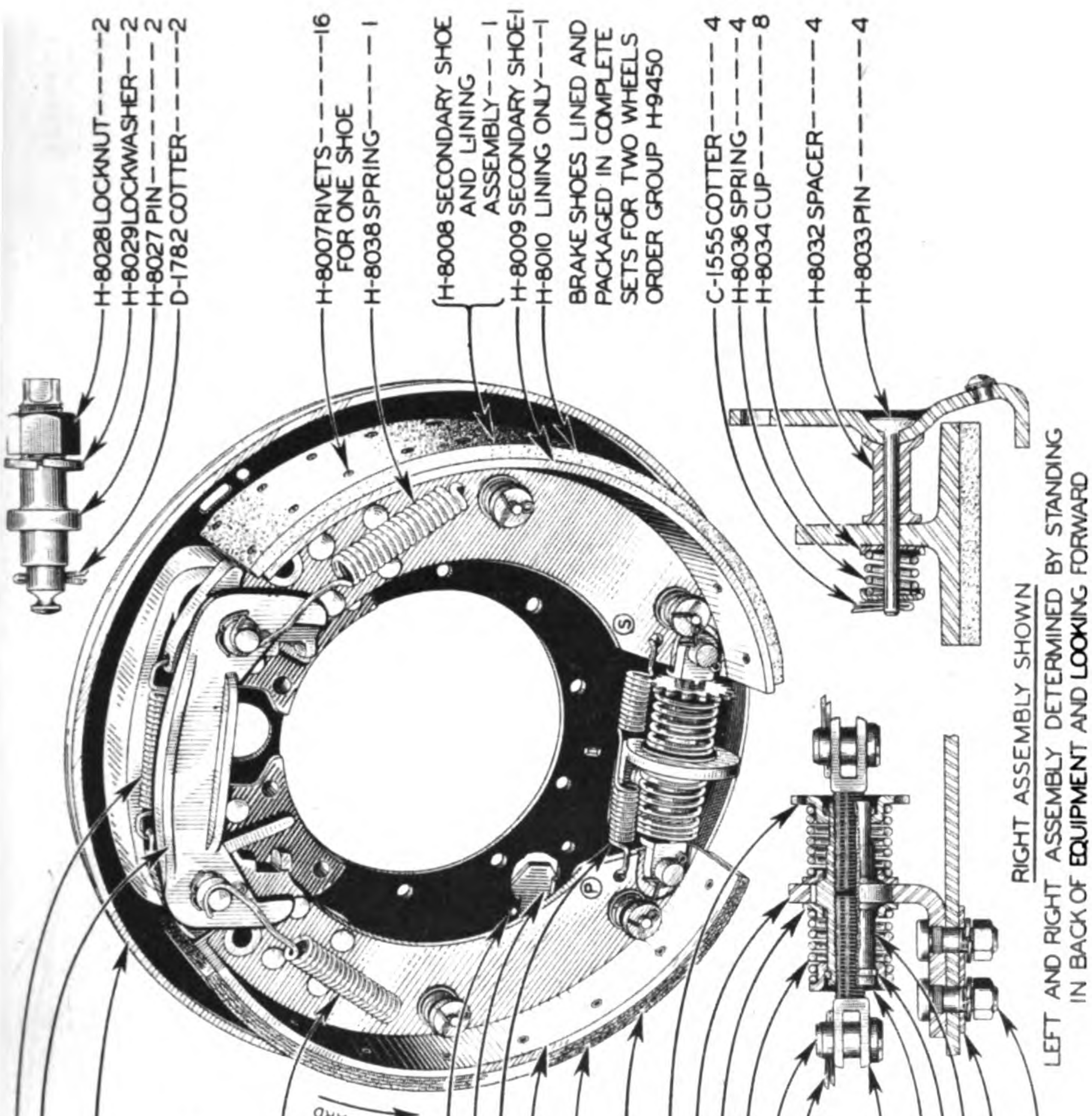

RIGHT BRAKE ASSEMBLY

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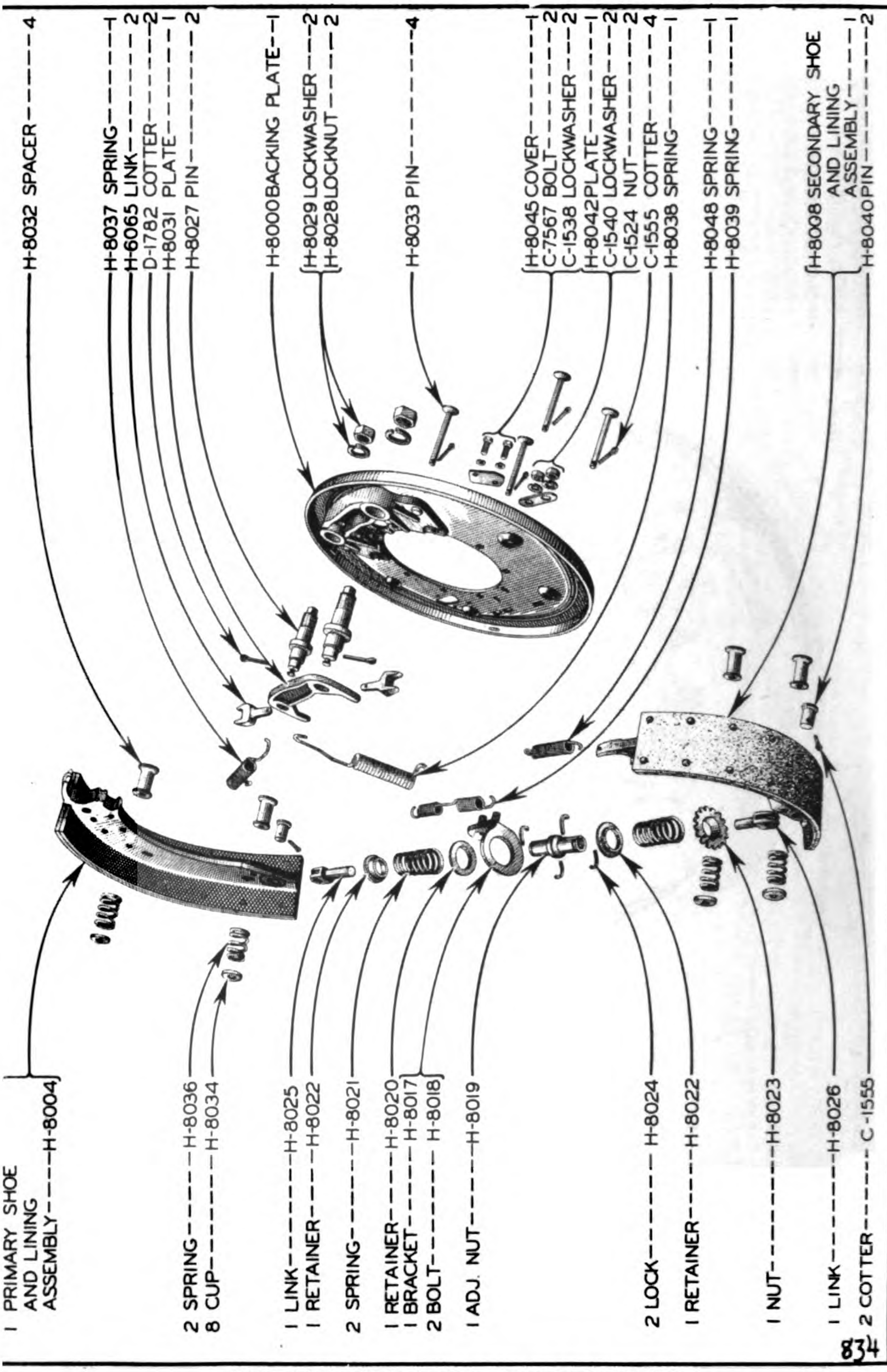

RIGHT BRAKE-EXPLODED

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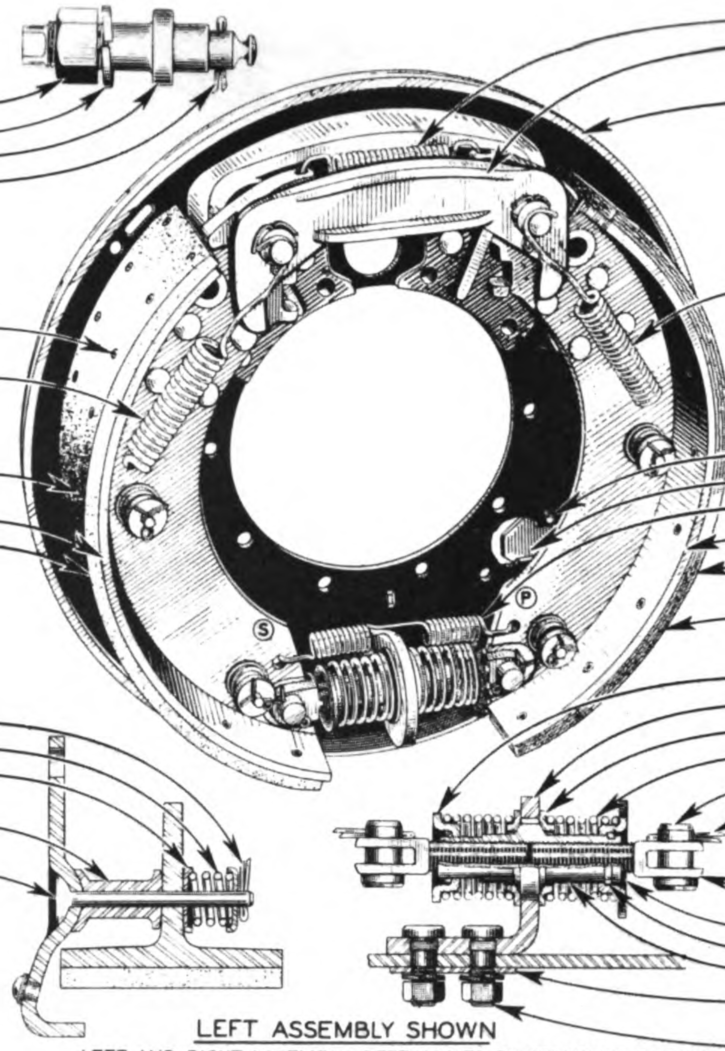

LEFT BRAKE ASSEMBLY

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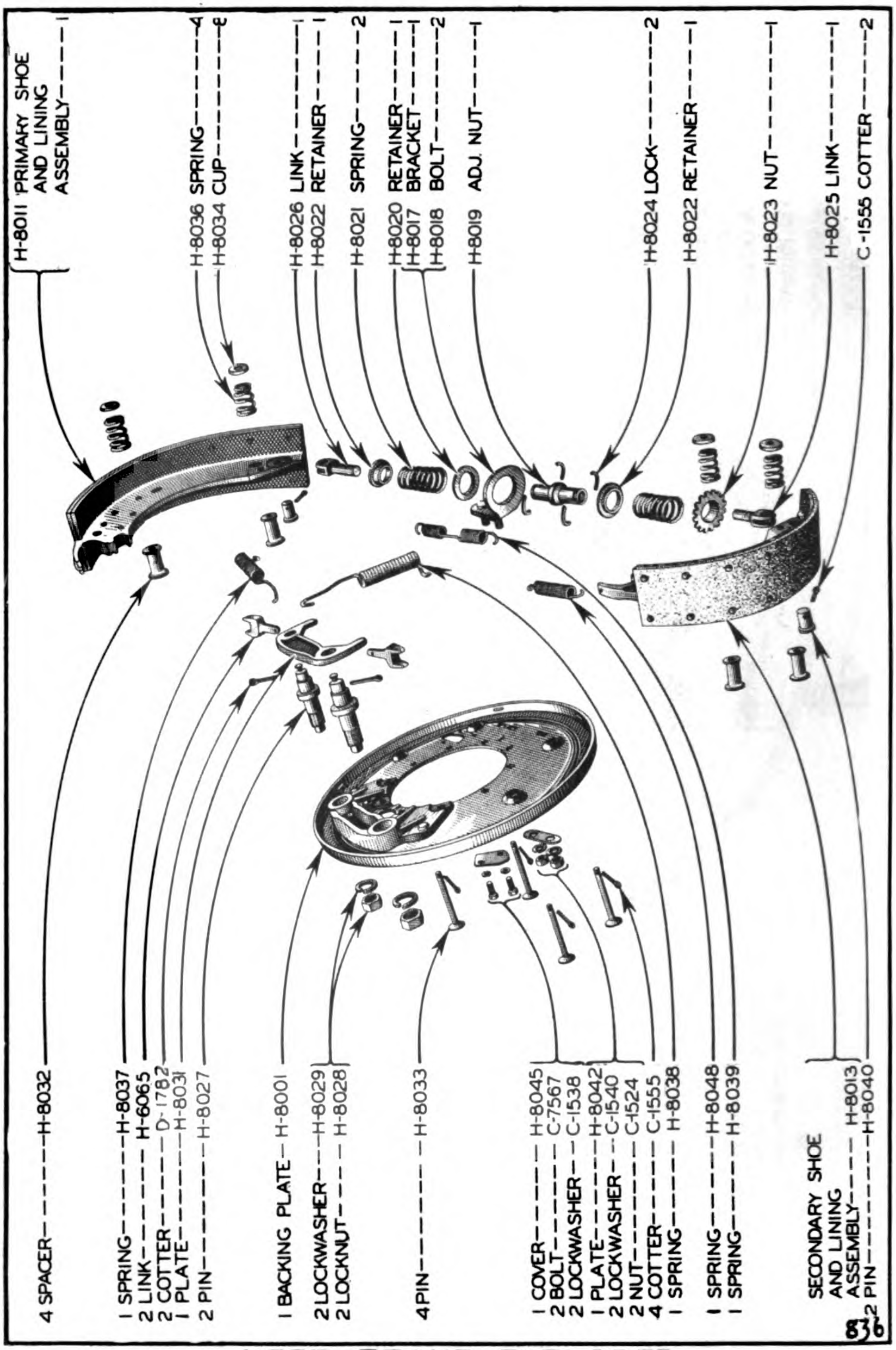

LEFT BRAKE-EXPLODED

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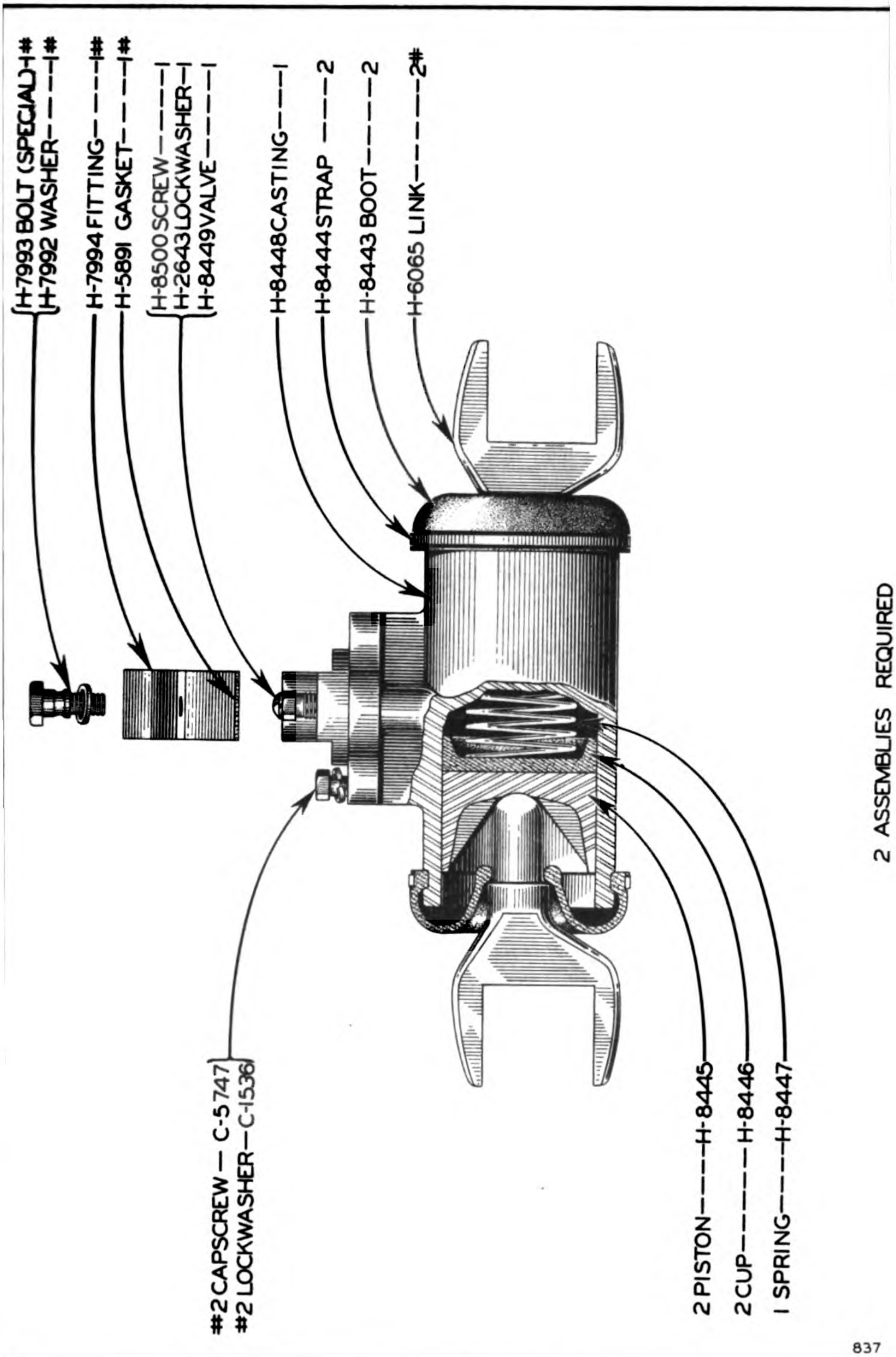

WHEEL CYLINDER-SECTIONAL

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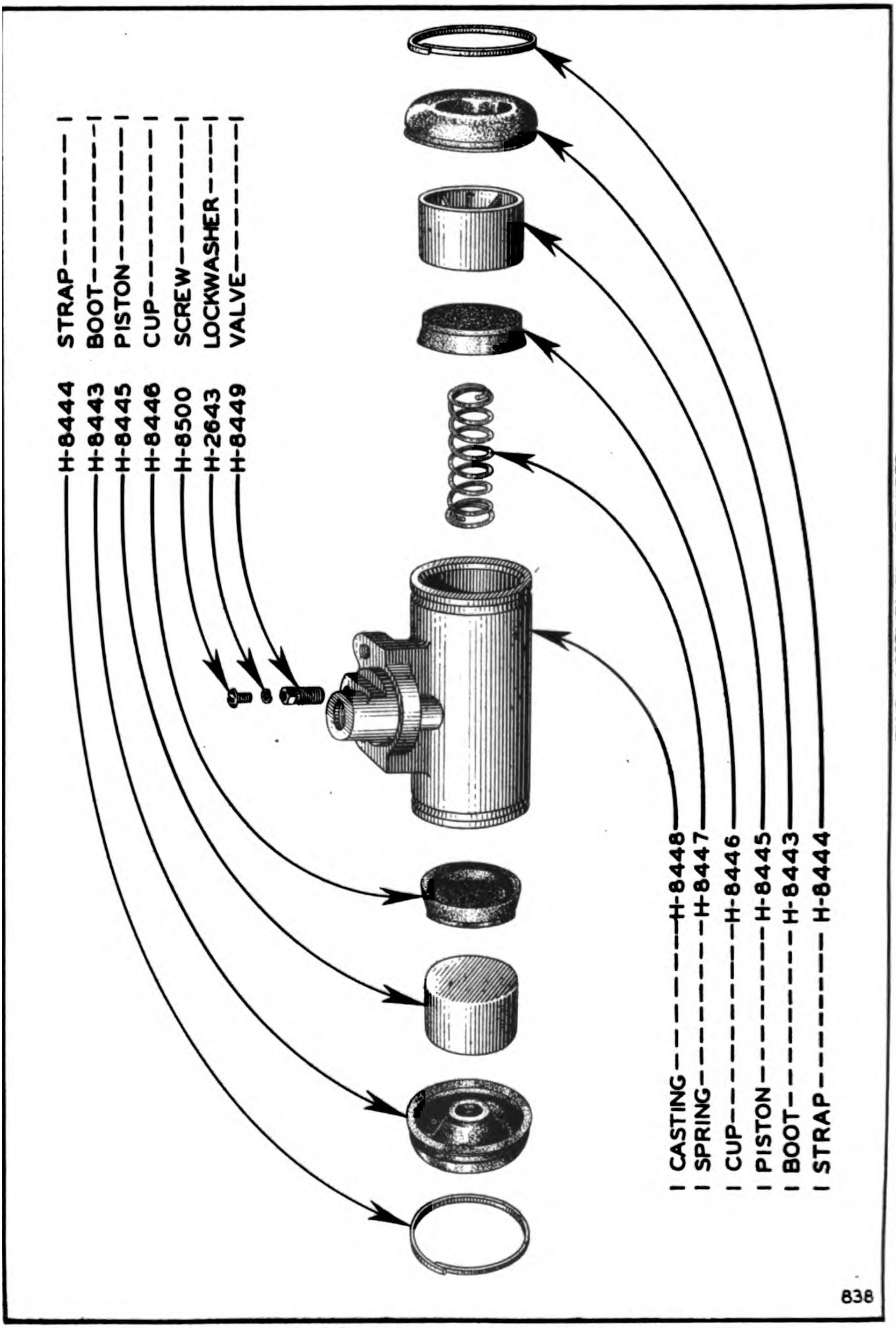

WHEEL CYLINDER—EXPLODED

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LIST OF ASSEMBLIES FOR HBID-600 MOTOR

(PARTS INDENTED ARE INCLUDED IN THE PART UNDER WHICH THEY ARE INDENTED.)

PART NUMBER	DESCRIPTION	QTY.	PRICE EACH
	CYLINDER HEAD		
BM-1078	CYLINDER HEAD, VALVES, & STUDS ASSEMBLY (Includes Following):	3	$ 71.80
H-60011-1	COLLETT, VALVE HALF	24	
H-60010	GUIDE, VALVE SPRING	12	
H-9216-1	SPRING, VALVE	12	
H-9167-Y	VALVE, EXHAUST	6	
H-9167-X-1	VALVE, INTAKE	6	
BM-2195	HEAD, STUDDED (Includes Following):	3	58.45
H-9210-1	GUIDE, VALVE STEM	12	
S-715	PLUG, 1" EXPANSION	12	
S-911-B	PLUG, 1/8" PIPE	6	
S-935-B	PLUG, 3/8" PIPE	3	
S-922-E	PLUG, 3/4" PIPE	6	
H-64967	SEAT, EXHAUST VALVE	6	
H-9250-1	STUD, EXHAUST MANIFOLD	6	
H-7398-1	STUD, INJECTOR	12	
H-9270	STUD, ROCKER ARM HOUSING	21	
	CYLINDER BLOCK		
BM-2401	CYLINDER BLOCK STUDDED (Includes Following):	1	408.50
H-9229-2	BUSHING, CAMSHAFT (FRONT)	1	
H-9230-2	BUSHING, CAMSHAFT 3 & 5	2	
H-9231-2	BUSHING, CAMSHAFT 2-4-6	3	
H-9233-2	BUSHING, CAMSHAFT (REAR)	1	
S-112	CAPSCREW, 3/8"-24 x 1", WATER BLIND FLANGE	2	
H-9228	DOWEL, CAMROCKER HOUSING	6	
H-9227	DOWEL, CYLINDER HEAD	6	
H-9226	DOWEL, FLYWHEEL HOUSING	2	
H-9227	DOWEL, FUEL PUMP	2	
H-9225	DOWEL, GEAR CASE COVER	2	
H-64790	DOWEL, REAR COVER PLATE	4	
H-63683	FLANGE, WATER BLIND (SIDE)	1	
K-8441	GASKET, WATER DRAIN PLUG	1	
H-9540	GASKET, WATER BLIND FLANGE	1	
H-9427	LOCK, MAIN BEARING STUD NUT	14	
S-604	LOCKWASHER, WATER BLIND FLANGE	2	
H-9197-1	NUT, MAIN BEARING STUD	14	
H-9222	PIN, IDLER GEAR	1	
S-715	PLUG, 1" EXPANSION, COMPRESSION RELIEF SHAFT HOLE	1	
S-703	PLUG, 3/4" EXPANSION, LUBRICATING OIL DRAIN	1	
S-702	PLUG, 1 3/4" EXPANSION, WATER HEADER	1	
S-706	PLUG, 1 1/2" EXPANSION, WATER HEADER	4	
S-901	PLUG, 1/4" PIPE, LUBRICATING OIL DRAIN	1	
S-911-B	PLUG, 1/8" PIPE, LUBRICATING OIL HEADER	7	
S-935-B	PLUG, 3/8" PIPE, LUBRICATING OIL HEADER	2	
S-935-B	PLUG, 3/8" PIPE, WATER DRAIN	1	
S-924	PLUG, 1/2" PIPE, WATER DRAIN	1	
H-65476	PLUG, WATER DRAIN	1	
H-9215-1	STUD, CYLINDER HEAD	18	
H-9232	STUD, LUBRICATING PUMP	4	
H-60574	STUD, MAIN BEARING	7	
H-64773	STUD, MAIN BEARING SLOTTED	7	
BM-1055	GEAR, IDLER (Includes Following):	1	23.75
H-9224	BUSHING, IDLER GEAR	1	

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REAR COVER

BM-1059	REAR COVER ASSEMBLY (Includes Following):	1	9.70
H-65436	CAPSCREW, REAR COVER JOINING	2	
H-65002-1	GASKET, REAR COVER JOINING	2	
S-652	LOCKWASHER, 5/16" EVERLOCK, REAR COVER JOINING	2	
S-209	NUTS, 5/16"-24 REAR COVER PLATE JOINING	2	

HAND HOLE COVER

BM-2461	HAND HOLE COVER & FILLER SPOUT COVER ASSEMBLY (Includes Following):	1	7.90
H-3796	COVER	1	
S-2902	NECK, FILLER	1	
H-63077	TUBE, OIL LEVEL GAUGE	1	

GENERATOR DRIVE

BM-422	GENERATOR DRIVE UNIT ASSEMBLY (Includes Following):	1	44.40
S-16005	BEARING, CAGE BALL	1	
S-16002	BEARING, CAGE COVER BALL	1	
H-4788-1	CAGE, GENERATOR DRIVE BEARING	1	
H-9184-1	COVER, GENERATOR DRIVE BEARING CAGE	1	
H-9277	GASKET, GENERATOR DRIVE BEARING CAGE	1	
H-9278	GASKET, GENERATOR DRIVE BEARING CAGE COVER	1	
H-9171-1	GEAR, GENERATOR DRIVE	1	
S-313	KEY, WOODRUFF FOR DRIVE GEAR	1	
S-316	KEY, WOODRUFF FOR SPROCKET	1	
S-625	LOCKWASHER, ¾" POS. LOCK COUPLING SPIDER	1	
S-249	NUT, ¾"-16, COUPLING SPIDER	1	
H-9275	NUT, BEARING RETAINER	1	
S-509	PIN, COTTER	1	
H-9096	RING, BEARING RETAINER SNAP	2	
S-1796	SEAL, OIL	1	
H-9183-1	SHAFT, GENERATOR DRIVE	1	
H-9634	SPIDER, GENERATOR COUPLING	1	
H-9274	WASHER, BEARING RETAINER	1	

CRANKSHAFT & MAIN BEARING

BM-135	CRANKSHAFT ASSEMBLY (Includes Following):	1	378.00
H-1282	CRANKSHAFT	1	
H-9168-2	GEAR PINION (CRANKSHAFT)	1	
H-9300	KEY, CRANKSHAFT PINION	1	
H-9304	LOCK, CRANKSHAFT NUT	1	
H-9305	NUT, CRANKSHAFT	1	
H-9301-1	PIN, HAND CRANKING	1	
H-9306	SLINGER, OIL	1	

PISTON

BM-2175	PISTON ASSEMBLY (Includes Following):	6	15.75
H-65327	RING, COMPRESSION	12	
H-65354	RING, KEYSTONE	6	
H-65326	RING, OIL REGULATOR NARROW	6	
H-65325	RING, OIL REGULATOR WIDE	6	
BM-2174	PISTON & PINS ASSEMBLY (Includes Following):	6	14.40
H-60026	LOCK, INJECTOR CUP WIPER	6	
H-9208-3	PIN, PISTON	6	
H-2770-2	PISTON, BARE	6	
H-61908	RING, PISTON PIN SNAP	12	
H-60025	WIPER, INJECTION CUP	6	

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CONNECTING ROD

BM-103	CONNECTING ROD LESS SHELL ASSEMBLY (Includes Following):	6	15.30
H-9195-3	BOLT, CONNECTING ROD	12	
H-9247-S	BUSHING, PISTON PIN	6	
S-227-1	NUT, CONNECTING ROD BOLT	12	
H-62727	PLATE, CONNECTING ROD LOCK	12	

CAM ROCKER HOUSING AND PUSH RODS

BM-125	CAM ROCKER HOUSING ASSEMBLY (Includes Following):	3	25.55
H-4790-3	HOUSING, CAM ROCKER	3	
S-705	PLUG, 7/8" EXPANSION	6	
H-9239	SCREW, SHAFT LOCK	6	
H-4796-2	SHAFT, CAM ROCKER	6	
BM-121	INJECTOR CAM ROCKER ASSEMBLY	6	4.20
BM-119	LEVER & BUSHING, INJECTOR CAM	6	2.70
H-9241-S	BUSHING, INJECTOR CAM LEVER	6	
H-9257	PIN, INJECTOR CAM ROLLER	6	
H-7350	RIVET, INJECTOR CAM ROLLER PIN	6	
H-7348-1	ROLLER, INJECTOR CAM	6	
BM-124	VALVE CAM ROCKER LEVER ASSEMBLY	12	4.25
BM-122	LEVER & BUSHING, VALVE CAM	12	3.15
H-9240-S	BUSHING, VALVE CAM LEVER	12	
H-9258	PIN, VALVE CAM ROLLER	12	
H-7350	RIVET, CAM ROLLER PIN	12	
H-9260	ROLLER, VALVE CAM	12	
BM-145	ROD, EXHAUST PUSH	6	2.55
BM-144	ROD, INJECTOR PUSH	6	3.00
BM-146	ROD, INTAKE PUSH	6	3.15

ROCKER LEVER HOUSING

BM-106	ROCKER LEVER HOUSING ASSEMBLY (Includes Following):	3	46.35
H-60845	CIRCLIP, ROCKER LEVER	12	
H-2362-1	HOUSING, ROCKER LEVER	3	
S-707	PLUG, 1¼" EXPANSION, ROCKER LEVER HOUSING	6	
S-911-B	PLUG, 1/7" PIPE, ROCKER HOUSING	3	
H-62229	PLUG, ROCKER HOUSING VENT	3	
H-9269	SCREW, ROCKER SHAFT LOCK	3	
H-4792-3	SHAFT, ROCKER LEVER	3	
BM-117	EXHAUST ROCKER LEVER ASSEMBLY	6	5.80
BM-114	LEVER & BUSHING, EXHAUST	6	3.25
H-9242	BUSHING, VALVE ROCKER LEVER	6	
S-232	NUT, 5/8"-18, ROCKER LEVER ADJUSTING SCREW	6	
H-9264-X	PIN, EXHAUST ROCKER LEVER ROLLER	6	
H-9265	RIVET, EXHAUST ROCKER LEVER ROLLER PIN	6	
H-9261	ROLLER, ROCKER LEVER	6	
H-7199-3	SCREW, ROCKER LEVER ADJUSTING	6	
BM-99	INJECTOR ROCKER LEVER ASSEMBLY (Includes Following):	6	4.85
BM-97	LEVER & BUSHING, INJECTOR	6	2.60
H-9243-2	BUSHING, INJECTOR ROCKER LEVER	6	
S-232	NUT, 5/8"-12 ROCKER LEVER ADJUSTING SCREW	6	
H-7199-3	SCREW, ROCKER LEVER ADJUSTING	6	
H-60508	SOCKET, INJECTOR ROCKER LEVER	6	
BM-113	INTAKE ROCKER LEVER ASSEMBLY (Includes Following):	6	5.60
BM-110	LEVER & BUSHING, INTAKE	6	3.10
H-9242	BUSHING, VALVE ROCKER LEVER	6	
S-232	NUT, 5/8"-18, ROCKER LEVER ADJUSTING SCREW	6	
H-9264-2	PIN, INTAKE ROCKER LEVER ROLLER	6	
H-9265	RIVET, ROCKER LEVER ROLLER PIN	6	
H-9261	ROLLER, ROCKER LEVER	6	
H-7199-3	SCREW, ROCKER LEVER ADJUSTING	6	

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ROCKER LEVER HOUSING COVER

BM-192	ROCKER HOUSING COVER ASSEMBLY (Includes Following):	1	3.40
H-62588	ANCHOR, BREATHER	1	
H-3868	COVER, BREATHER HOUSING	1	
S-2902	NECK, CINCH FILLER	1	

CAMSHAFT

BM-89	CAMSHAFT ASSEMBLY (Includes Following):	1	108.00
H-9280	BOLT, CAMSHAFT GEAR	6	
H-1194-6	CAMSHAFT	1	
H-4765-1	GEAR, CAMSHAFT	1	
H-66212	LOCKPLATE, CAMSHAFT BOLT NUT	3	
S-205	NUT, 3/8"-24 CAMSHAFT GEAR BOLT	6	
S-935-B	PLUG, 3/8" PIPE	1	
H-9235-1	RING, CAMSHAFT THRUST	1	

LUBRICATING OIL PIPING

BM-1281	TUBE, ENGINE TO GOVERNOR LUBRICATING (Includes Following):	1	1.10
S-1022-A	NUT, TUBE	2	
BM-2392	TUBE, FILTER TO ENGINE	1	4.85
H-65540-A	FLANGE, LUBRICATING OIL CONNECTION	1	
S-1037	NUT, TUBE	1	
S-1072	NUT, SLEEVE PACKING	1	
S-1091-1	SLEEVE, PACKING	1	
BM-2393	TUBE, LUBRICATING OIL PUMP TO FILTER	1	4.35
S-1037	NUT, TUBE	2	
BM-1182	TUBE, LUBRICATING OIL SUCTION	1	7.85
H-64855	FLANGE, LUBRICATING OIL SUCTION	1	
S-1076	NUT, TUBE PACKING	2	
S-1077	SLEEVE, TUBE PACKING	2	

LUBRICATING PUMP

BM-419	LUBRICATING PUMP ASSEMBLY (Includes Following):	1	60.65
BM-196	BRACKET & BUSHING	1	6.70
H-9186-1S	BUSHING, LUBRICATING PUMP BRACKET	1	
S-16002	BEARING, BALL	1	
H-40457	BODY LUBRICATING PUMP	1	
H-4783	CAGE, LUBRICATING PUMP BEARING	1	
S-103	CAPSCREW, 5/16"-18 x 2 1/4" BODY TO BRACKET	8	
H-7183	DOWEL, LUBRICATING PUMP BRACKET	2	
H-9285	GASKET, BRACKET TO BODY	1	
H-9283-1	GASKET, BRACKET TO CAGE	1	
H-9169-2	GEAR, LUBRICATING PUMP DRIVE	1	
H-64777	GEAR, LUBRICATING PUMP DRIVE	1	
H-64778	GEAR, LUBRICATING PUMP IDLER	1	
S-316	KEY, LUBRICATING PUMP DRIVE GEAR	2	
S-605	LOCKWASHER, 5/16" POS. LOCK	8	
H-9275	NUT, RETAINER	1	
S-509	PIN, COTTER FOR RETAINER NUT	1	
H-9096	RING, BEARING RETAINER SNAP	1	
H-64780	SHAFT, LUBRICATING PUMP DRIVE	1	
H-64779	SHAFT, LUBRICATING PUMP IDLER	1	
H-9274	WASHER, RETAINER	1	

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DELUXE FILTER

BM-2390	TUBE, FILTER DRAIN	1	1.65
	(Includes Following):		
S-1070	SLEEVES, RUBBER	2	
S-1068	NUT, PACKING	2	
BM-2420	TUBE DELUXE FILTER INLET	1	1.50
S-1069	NUT, TUBE PACKING	2	
S-1071	SLEEVES, RUBBER	2	

EXHAUST MANIFOLD

BM-1340	EXHAUST MANIFOLD ASSEMBLY	1	25.25
	(Includes Following):		
H-40855	SECTION, MANIFOLD CENTER	1	
H-41041	SECTION, MANIFOLD FRONT	1	
H-41042	SECTION, MANIFOLD REAR	1	

PRIMING PUMP & BRACKET

BM-2373	TUBE, PRIMING PUMP DISCHARGE	1	.95
BM-2374	TUBE, PRIMING PUMP INTAKE	1	.70
S-1022-A	NUT, TUBE PUMP INTAKE & DISCHARGE TUBE	4	

FUEL OIL FILTER (NUGENT)

BM-2971	TUBE, CUNO TO NUGENT FILTER	1	1.15
S-1068	NUT, TUBE PACKING	2	
S-1070	SLEEVE, TUBE	2	
BM-2970	TUBE, NUGENT FILTER TO FUEL PUMP	2	1.35
S-1068	NUT, TUBE PACKING	4	
S-1070	SLEEVE, TUBE PACKING	4	

FUEL PUMP

BM-1310	FUEL PUMP ASSEMBLY	1	296.55

FUEL PUMP MAIN HOUSING

BM-2265	FUEL PUMP HOUSING ASSEMBLY	1	33.30
	(Includes Following):		
H-9124-2	BUSHING, CAM ROCKER LEVER	1	
H-60466	BUSHING, GOVERNOR CONTROL ROD	1	
H-9959	BUSHING, HAND CONTROL ECCENTRIC	1	
H-9125-S	BUSHING, PLUNGER LEVER SHAFT (SHORT)	1	
H-9144-S	BUSHING, PLUNGER LEVER SHAFT (LONG)	1	
H-9423	DOWEL, GEAR PUMP HOUSING	1	
S-1546	PLUG, OIL LINE	1	
S-910-B	PLUG, 1/4" PIPE FOR DRAIN	1	
S-911-B	PLUG, 1/8" PIPE FOR HOUSING	2	
H-65827	TUBE, FLOAT CHAMBER VENT	1	
BM-954	VALVE BY PASS	1	.40
BM-6	GOVERNOR LEVER & BUSHING ASSEMBLY	1	2.20
H-60244	BUSHING, GOVERNOR LEVER	1	
H-9131-2	LEVER, GOVERNOR	1	
BM-7	ECCENTRIC, HAND CONTROL	1	5.65

CAM ROCKER LEVER

BM-32	CAM ROCKER LEVER ASSEMBLY	1	11.20
	(Includes Following):		
H-4767-3	LEVER, CAM ROCKER	1	
H-9121-1	PIN, CAM ROCKER LEVER ROLLER	1	
H-9126	RIVET, CAM ROCKER, LEVER ROLLER PIN	1	
H-8396-1	ROLLER, CAM ROCKER LEVER	1	
H-9128	STOP, VERTICAL LEVER	2	

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VERTICAL LEVER

BM-41	VERTICAL LEVER ASSEMBLY	1	15.20
	(Includes Following):		
H-9368	BEARING, PLUNGER LEVER PIN	56	
H-9370	BEARING, VERTICAL LEVER ROLLER	22	
S-165	CAPSCREW, 3/8"-24 x 1 1/2", PLUNGER LEVER	1	
H-8388	LEVER, PLUNGER	1	
H-9119-4	LEVER, VERTICAL	1	
S-604	LOCKWASHER, 3/8" POS. LOCK, PLUNGER LEVER CAPSCREW	1	
H-9366-2	PIN, PLUNGER LEVER	1	
H-9371-1	PIN, VERTICAL LEVER ROLLER	1	
S-1546	PLUG, PLUNGER LEVER SHAFT	1	
H-60227-A	RIVET, VERTICAL LEVER ROLLER PIN	1	
H-9369-2	ROLLER, VERTICAL LEVER	1	
H-9118	SHAFT, PLUNGER LEVER	1	

DISTRIBUTOR

BM-42	DISTRIBUTOR ASSEMBLY	1	91.65
	(Includes Following):		
BM-592	DISC & COVER ASSEMBLY	1	43.25
H-9052	CAP, DUST	1	
S-1004	ELBOW, TUBE	7	
H-9056	GASKET, TACHOMETER SHAFT GUIDE	1	
H-9053	GUIDE, TACHOMETER SHAFT	1	
H-9054	NUT, TACHOMETER SHAFT GUIDE	1	
S-2297	PACKING, TACHOMETER SHAFT GUIDE	1	
BM-67	DISTRIBUTOR SHAFT ASSEMBLY	1	8.45
	(Includes Following):		
H-8456	PIN, DISTRIBUTOR DISC DRIVE	3	
H-61115	RIVET, DRIVE COLLAR	1	
H-9462	RIVET, TACHOMETER SHAFT	1	
H-9152	SHAFT, DISTRIBUTOR DRIVE	1	
H-9051-1	SHAFT, TACHOMETER DRIVE	1	
BM-5	HOUSING & BUSHING ASSEMBLY	1	16.10
H-9676	BUSHING, DISTRIBUTOR DISC	1	
H-9050-5	BUSHING, DISTRIBUTOR SHAFT	1	
BM-2	PRIMING VALVE ASSEMBLY	1	1.20
H-8472	PIN, PRIMING VALVE	1	
H-9139	VALVE, PRIMING	1	
S-1622	BALL, CHECK	1	
S-16003	BEARING, DISTRIBUTOR SHAFT BALL	1	
S-165	CAPSCREW 3/8"-24 x 1 1/2", DISTRIBUTOR COVER	6	
S-684	GASKET, DISTRIBUTOR CHECK VALVE	1	
H-9176	GASKET, DISTRIBUTOR HOUSING COVER	1	
H-9179	GASKET, METERING PUMP	1	
H-9146-1	GEAR, DISTRIBUTOR DRIVE	1	
S-308	KEY, WOODRUFF	1	
H-8386	NUT, PLUNGER BARREL CLAMP	1	
H-7726	NUT, PRIMING VALVE PACKING	1	
H-8142	PACKING, PRIMING VALVE	1	
S-911-B	PLUG, 3/8" PIPE, TIMING HOLE	1	
H-65505	PLUG, DISTRIBUTOR CHECK VALVE	1	
BM-1	PUMP, METERING	1	3.00
A-65506	SPRING, DISTRIBUTOR CHECK VALVE	1	
K-8433	SPRING, DISTRIBUTOR DISC	1	
BM-20	TUBE, GEAR PUMP TO DISTRIBUTOR	1	.70
S-1873-A	NUT, TUBE	1	
S-1022-A	NUT, TUBE	1	

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GEAR PUMP

BM-12	GEAR PUMP ASSEMBLY (Includes Following):	1	53.30
BM-19	CHECK VALVE SEAT & SCREEN ASSEMBLY	1	1.70
H-9597	SCREEN, CHECK VALVE SEAT	1	
S-1698	BALL, CHECK	1	
H-2425-5	BODY, #1 GEAR PUMP	1	
H-2427-3	BODY, #2 GEAR PUMP	1	
H-9760	BOLT, GEAR PUMP BODY (LONG)	2	
H-9761	BOLT, GEAR PUMP BODY (SHORT)	1	
H-9142-1	BUSHING, CAM ROCKER LEVER	1	
H-64889	CHAMBER, PRESSURE	1	
S-1873	COCK, SHUT OFF	1	
S-1004	ELBOW, TUBE	1	
S-1793	GASKET, CHECK VALVE HOUSING	1	
H-9459	GASKET, FUEL SUPPLY CHECK VALVE	1	
H-9767-1	GASKET, #1 GEAR PUMP SPACER	1	
H-9766-2	GASKET, #2 GEAR PUMP SPACER	1	
H-6753	GASKET, IDLING LEVER SHAFT	1	
S-1822	GASKET, PRESSURE CHAMBER	1	
H-9132-1	GEAR, #1 DRIVE	1	
H-9507	GEAR, #2 DRIVE	1	
H-9509	GEAR, #1 IDLER	1	
H-9508	GEAR, #2 IDLER	1	
H-9456	GUIDE FUEL SUPPLY CHECK VALVE	1	
H-9458-1	HOUSING FUEL SUPPLY CHECK VALVE	1	
H-9919	KEY, #1 DRIVE GEAR	1	
S-314	KEY, #2 DRIVE GEAR	1	
S-604	LOCKWASHER, 3/8" POSITIVE LOCK	3	
S-205	NUT, 3/8"-24", BODY BOLT	3	
S-911-B	PLUG, 1/8" PIPE, #2 BODY	1	
S-1848	RING, SNAP	1	
S-1213	SCREW, SPACER PLATE	1	
H-60099	SEAL SPACER	2	
S-1918	SEAL, SHAFT	1	
H-9758-1	SHAFT, GEAR PUMP DRIVE	1	
H-9759	SHAFT, GEAR PUMP IDLER	1	
H-9765	SHAFT, IDLING LEVER	1	
H-9134-1	SLEEVE, PRESSURE REGULATOR VALVE	1	
H-4893-2	SPACER, GEAR PUMP	1	
H-9460	SPRING, FUEL SUPPLY CHECK VALVE	1	
H-9495-1	SPRING, PRESSURE REGULATING VALVE	1	
H-8462-1	VALVE, FUEL PUMP CHECK	1	
H-9455	VALVE, FUEL SUPPLY CHECK	1	
H-9135-3	VALVE, PRESSURE REGULATING	1	
H-60098	WASHER FOR OIL SEALS	2	
H-9910	WASHER, PRESSURE REGULATING		

FUEL PUMP MAIN SHAFT

BM-2831	FUEL PUMP MAIN SHAFT ASSEMBLY (Includes Following):	1	29.60
H-4771-1	CAM, FUEL PUMP	1	
H-9143	KEY, FUEL PUMP CAM	1	
H-9178-1	PIN, GEAR PUMP DRIVE	1	
S-911-B	PLUG, 1/8" PIPE, MAIN SHAFT	1	
H-4789-13	SHAFT, FUEL PUMP MAIN	1	

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GOVERNOR

BM-31	GOVERNOR CONTROL ROD ASSEMBLY (Includes Following):	1	6.00
H-9110	COLLAR, GOVERNOR CONTROL SLEEVE	1	
H-9175	PIN, GOVERNOR THRUST WASHER	1	
S-2871	RIVET, CONTROL ROD COLLAR	1	
H-9160-1	ROD, GOVERNOR CONTROL	1	
BM-1118	GOVERNOR HOUSING ASSEMBLY (Includes Following):	1	8.50
H-9114-2	BUSHING, GOVERNOR HOUSING	1	
BM-1173	GOVERNOR WEIGHT & SPRING ASSEMBLY (Includes Following):	1	8.65
H-60100-A	SPACER, 1/64", MAXIM SPEED		
H-60100-B	SPACER, 1/16", MAXIM SPEED		
H-60100-C	SPACER, .0086", MAXIM SPEED		
H-9108-2	SPRING, GOVERNOR MAXIMUM SPEED	1	
H-63526	SPRING, GOVERNOR IDLING SPEED	1	
·BM-30	WEIGHT, GOVERNOR	2	ea. 3.25
BM-28	GOVERNOR YOKE ASSEMBLY	1	13.65
H-9808	BUSHING, GOVERNOR WEIGHT PIN	4	
H-9728-3	BUSHING, GOVERNOR YOKE	1	
H-9748	PIN, GOVERNOR YOKE BUSHING	1	

FLOAT CHAMBER

BM-24	FLOAT CHAMBER ASSEMBLY (Includes Following):	1	6.00
H-9730	BRACKET, FLOAT BEARING	1	
S-133-A	CAPSCREW, 1/4"-28 x 7/8", FLOAT CHAMBER	2	
H-4890	CHAMBER, FLOAT	1	
H-9726-1	FLOAT & LEVER	1	
H-9762-1	GASKET, FLOAT CHAMBER	1	
H-9729	GASKET, VALVE SEAT	1	
S-600	LOCKWASHER, 1/4" POS. LOCK FLOAT CHAMBER	2	
H-9735	LOCKWASHER, FLOAT LEVER BEARING PIN	1	
H-9734	NUT, FLOAT LEVER BEARING PIN	1	
H-9725	PIN, FLOAT LEVER BEARING	1	
H-9732	PIN, FLOAT LEVER LOCATING	1	
H-9749-1	PLATE, FLOAT CHAMBER TOP	1	
S-911-B	PLUG, 1/8" PIPE	1	
H-9724	SEAT, FLOAT VALVE	1	
H-9733	STOP, FLOAT	1	
H-9723	VALVE, FLOAT	1	

FUEL TUBING

BM-1284	INJECTOR DRAIN MANIFOLD ASSEMBLY (Includes Following):	1	2.55
S-1035	CROSS, TUBE	1	
S-1031	ELBOW, TUBE	2	
H-9572	NIPPLE, 1/8" x 6 1/8", INJECTOR DRAIN	2	
H-9573	NIPPLE, 1/8" x 6 7/8", INJECTOR DRAIN	2	
H-9574	NIPPLE, 1/8" x 6 3/8", INJECTOR DRAIN	1	
S-1033	TEE, TUBE	3	
BM-1189	TUBE, INJECTOR DRAIN	6	.50
BM-1478	TUBE, INJECTOR DRAIN MANIFOLD TO PUMP	1	.80
S-1023-A	NUT, TUBE	2	
BM-1274	TUBE, INJECTOR SUPPLY TUBE No. 1	1	.85
BM-1275	TUBE, INJECTOR SUPPLY TUBE No. 2	1	.85
BM-1276	TUBE, INJECTOR SUPPLY TUBE No. 3	1	.85
BM-1277	TUBE, INJECTOR SUPPLY TUBE No. 4	1	.85
BM-1278	TUBE, INJECTOR SUPPLY TUBE No. 5	1	.85
BM-1279	TUBE, INJECTOR SUPPLY TUBE No. 6	1	.85
S-1022-A	NUT, TUBE (FOR ALL INJECTOR TUBING)	24	

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INJECTOR FUEL INLET CONNECTION

BM-499	FUEL INLET CONNECTION ASSEMBLY	6	3.45
	(Includes Following):		
S-1656	BALL, FUEL CONNECTION CHECK	6	
BM-150	CAGE & SCREW	6	.20
H-9298-1	CAP, FUEL CONNECTION	6	
H-9286-2	CONNECTION, FUEL INLET	6	
H-60598	GASKET, FUEL CAP	6	
H-9426-2	GASKET, FUEL CONNECTION (COPPER)	6	
H-8950-1	GASKET, FUEL CONNECTION (LEATHER)	6	
H-9287	GUIDE, FUEL CONNECTION SPRING	6	
H-9353-2	PLUG, INLET CONNECTION	6	
H-9315	SPRING, FUEL CONNECTION	6	
H-8521	SPRING, FUEL CHECK VALVE	6	

INJECTOR FUEL DRAIN CONNECTION

BM-495	INJECTOR FUEL DRAIN ASSEMBLY	6	1.50
	(Includes Following):		
H-9303-2	CONNECTION, INJECTOR FUEL DRAIN	6	
H-9426-2	GASKET, INJECTOR DRAIN CONNECTION (COPPER)	6	
H-8950-1	GASKET, INJECTOR DRAIN CONNECTION (LEATHER)	6	
H-9287	GUIDE, FUEL CONNECTION SPRING	6	
H-9299	GUIDE, FUEL CONNECTION SPRING	6	
H-9315	SPRING, FUEL CONNECTION	6	

INJECTOR

BM-142	TRACTOR INJECTOR ASSEMBLY	6	26.50
	(Includes Following):		
BM-2469	BODY & PLUNGER ASSEMBLY	6	13.65
H-7194-2	LINK, INJECTOR PLUNGER	6	
H-9355	PIN, INJECTOR PLUNGER LINK	6	
BM-136	CHECK VALVE SEAT ASSEMBLY	6	1.50
BM-1640	INJECTOR CUP & GASKET ASSEMBLY	6	3.30
H-62409	GASKET, INJECTOR CUP	6	
H-62126	BAIL, INJECTOR PLUNGER RETAINING	6	
H-62128	COVER, INJECTOR	6	
H-9432	GASKET, CHECK VALVE PLUG	6	
H-9434	GASKET, CHECK VALVE SEAT	6	
H-62127	GASKET, INJECTOR COVER	6	
H-62129	GASKET, INJECTOR PLUNGER OIL SEAL	6	
H-9433	PLUG, INJECTOR CHECK VALVE	6	
S-1207	SCREW COVER	12	
S-2345-1	SEAL, INJECTOR PLUNGER	6	
H-62411	SPRING, INJECTOR CHECK VALVE	6	
H-62123	SPRING, INJECTOR PLUNGER	6	
H-62406	STOP, INJECTOR CHECK VALVE	6	

WATER PUMP

BM-95	PUMP, WATER	1	32.00
	(Includes Following):		
S-1713	BEARING, INNER	1	
S-16033	BEARING, OUTER	1	
H-20145-5	BODY	1	
H-20145-1	GASKET, OIL	1	
H-20145-13	GUIDE, SPRING	1	
H-20145-8	IMPELLER	1	
S-308	KEY, IMPELLER	1	
S-305	KEY, PULLEY	1	
H-20145-23	LOCKWIRE	1	

THROTTLE CONTROL

BM-2391	LINK, THROTTLE CONTROL	1	2.20

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PART NUMBER	DESCRIPTION	PAGE	QTY.	PRICE EACH
A-63495	HOSE, WATER BY-PASS	367	1	$ .09
A-65506	SPRING, DISTRIBUTOR CHECK VALVE	360	1	.04
H-1194-6	CAMSHAFT	341	1	76.40
H-1282	CRANKSHAFT	336	1	356.50
H-1736	HOUSING, FLYWHEEL	352	1	38.24
H-2352-3	GASKET, CYLINDER HEAD	328	3	1.33
H-2362-1	HOUSING, ROCKER LEVER	339	3	8.73
H-2425-5	BODY, #1 GEAR PUMP	361	1	8.05
H-2427-3	BODY, #2 GEAR PUMP	361	1	9.77
H-2770-2	PISTON, BARE	337	6	9.90
H-2840	HOUSING, LUBRICATING OIL FILTER	347	1	22.20
H-2983	FLYWHEEL	352	1	64.19
H-3763-1	COVER, ROCKER HOUSING	340	2	2.40
H-3796	COVER	332	1	6.23
H-3941	HOUSING, THERMOSTAT	367	1	5.20
H-3953	MANIFOLD, WATER	367	1	10.82
H-3999	MANIFOLD, AIR INTAKE	349	1	11.32
H-4765-1	GEAR, CAMSHAFT	341	1	30.43
H-4767-3	LEVER, CAM ROCKER	358	1	9.73
H-4771-1	CAM, FUEL PUMP	362	1	16.67
H-4783	CAGE, LUBRICATING PUMP BEARING	344	1	5.15
H-4788-1	CAGE, GENERATOR DRIVE BEARING	335	1	5.40
H-4789-13	SHAFT, FUEL PUMP MAIN	362	1	12.40
H-4790-3	HOUSING, CAM ROCKER	338	3	5.06
H-4791	SHAFT, COMPRESSION RELEASE	331	1	4.50
H-4792-3	SHAFT, ROCKER LEVER	339	3	4.20
H-4793	GASKET, GEAR CASE COVER	333	1	.36
H-4795-7	LINER, CYLINDER	329	6	14.85
H-4796-2	SHAFT, CAM ROCKER	338	6	1.60
H-4798	GASKET, ROCKER HOUSING TO CYLINDER HEAD	339	3	.07
H-4829-4	LINK, GOVERNOR	357	1	3.66
H-4890	CHAMBER FLOAT	363	1	1.88
H-4893-2	SPACER, GEAR PUMP	361	1	4.03
H-4930-1	PULLEY, WATER PUMP DRIVE	369	1	9.24
H-4944	BRACKET, GENERATOR	...		4.34
H-5083	GASKET, PAN TO BLOCK	342	1	.54
H-5143	COVER	332	2	3.69
H-5412	BRACKET, AIR FILTER	349	2	5.73
H-5416	GASKET, HAND HOLE COVER	332	3	.33
H-5528	COVER, OIL FILTER	347	1	2.40
H-5711	GEAR, FLYWHEEL RING	352	1	6.39
H-5943	CONNECTING ROD—BEARING	337	12	4.47
H-6753	GASKET, IDLING LEVER SHAFT	361	1	.08
H-7183	DOWEL, LUBRICATING PUMP BRACKET	344	2	.08
H-7194-2	LINK PLUNGER	366	6	.31
H-7199-3	SCREW, ROCKER LEVER ADJUSTING	339	18	1.70
H-7239-3	PIN, GOVERNOR WEIGHT	362	2	.38
H-7348-1	ROLLER, INJECTOR CAM	338	6	.97
H-7350	RIVET, INJECTOR CAM ROLLER PIN	338	18	.01
H-7398-1	STUD, INJECTOR	328	6	.17
H-7463-1	WASHER, IDLER GEAR PIN	329	1	.45
H-7464	PIN, WASHER LOCK	329	1	.03
H-7614	CLIP, DRAIN MANIFOLD	364	3	.15
H-7726	NUT, PRIMING VALVE PACKING	360	1	.36
H-8142	PACKING, PRIMING VALVE	360	7	.05
H-8386	NUT, PLUNGER BARREL CLAMP	360	1	.26
H-8388	LEVER, PLUNGER	359	1	3.13
H-8390	LINK, METERING PUMP	360	1	1.13
H-8396-1	ROLLER, CAM ROCKER LEVER	358	1	.82
H-8456	PIN, DISTRIBUTOR DISC DRIVE	360	3	.15
H-8462-1	VALVE, FUEL PUMP CHECK	361	1	1.17
H-8472	PIN, PRIMING VALVE	360	1	.07
H-8521	SPRING, FUEL CHECK VALVE	365	6	.07

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H-8950-1	GASKET, FUEL CONNECTION (LEATHER)	365	12	.12
H-9050-5	BUSHING, DISTRIBUTOR SHAFT	360	1	1.28
H-9051-1	SHAFT, TACHOMETER DRIVE	360	1	1.30
H-9052	CAP, DUST	360	1	.11
H-9053	GUIDE, TACHOMETER SHAFT	360	1	1.55
H-9054	NUT, TACHOMETER SHAFT GUIDE	360	1	.54
H-9056	GASKET, TACHOMETER SHAFT GUIDE	360	1	.08
H-9096	RING, BEARING RETAINER SNAP	335,344	3	.15
H-9097	GASKET, WATER PUMP TO BLOCK	368	1	.20
H-9103-6	SPRING, GOVERNOR I. T.	362	1	9.52
H-9104-5	TUBE, GOVERNOR YOKE	362	1	5.40
H-9105-1	RING, GOVERNOR SPLIT LOCK	362	2	Pr. .20
H-9106	SLEEVE, GOVERNOR SPRING	362	1	2.65
H-9108-2	SPRING, GOVERNOR MAXIMUM SPEED	362	1	1.20
H-9110	COLLAR, GOVERNOR CONTROL SLEEVE	362	1	2.73
H-9111	RING, GOVERNOR THRUST	362	2	.47
H-9113	SPRING, THRUST RING RETAINER	362	1	.35
H-9114-2	BUSHING, GOVERNOR HOUSING	362	1	.50
H-9115	GASKET, GOVERNOR HOUSING	362	1	.05
H-9116-6	LEVER, CONTROL	357	1	2.40
H-9117	SHIELD BALL BEARING	362	1	1.56
H-9118	SHAFT, PLUNGER LEVER	359	1	1.53
H-9119-4	LEVER, VERTICAL	359	1	4.98
H-9121-1	PIN, CAM ROCKER LEVER ROLLER	358	1	.42
H-9123-7	LINK, VERTICAL LEVER	357	1	3.50
H-9124-2	BUSHING, CAM ROCKER LEVER	357	1	.35
H-9125-S	BUSHING, PLUNGER LEVER SHAFT (SHORT)	357	1	.32
H-9126	RIVET, CAM ROCKER LEVER ROLLER PIN	358	1	.07
H-9127-2	COLLAR, HAND CONTROL ECCENTRIC	357	1	.47
H-9128	STOP, VERTICAL LEVER	358	1	.07
H-9132-1	GEAR, #1 DRIVE	361	1	2.10
H-9134-1	SLEEVE, PRESSURE REGULATOR VALVE	361	1	1.40
H-9135-3	VALVE, PRESSURE REGULATING	361	1	1.07
H-9139	VALVE, PRIMING	360	1	1.10
H-9140-1	GASKET, DISTRIBUTOR HOUSING	360	1	.03
H-9141-1	GASKET, BALL BEARING SHIELD	362	1	.04
H-9142-1	BUSHING, CAM ROCKER LEVER	361	1	.51
H-9143	KEY, FUEL PUMP CAM	362	1	.11
H-9144-S	BUSHING, PLUNGER LEVER SHAFT (LONG)	357	1	.35
H-9146-1	GEAR, DISTRIBUTOR DRIVE	360	1	13.32
H-9148	SPRING, CAM ROCKER LEVER	357	1	.40
H-9152	SHAFT, DISTRIBUTOR DRIVE	360	1	3.87
H-9160-1	ROD, GOVERNOR CONTROL	362	1	3.10
H-9167-X-1	VALVE, INTAKE	328	6	1.95
H-9167-Y	VALVE, EXHAUST	328	6	2.10
H-9168-2	GEAR, PINION (CRANKSHAFT)	336	1	18.53
H-9169-2	GEAR, LUBRICATING PUMP DRIVE	344	1	13.79
H-9171-1	GEAR, GENERATOR DRIVE	335	1	11.25
H-9172-2	GASKET, GOVERNOR FLANGE TO BLOCK	356	1	.08
H-9173	RETAINER, CAM ROCKER LEVER SPRING	357	1	.93
H-9175	PIN, GOVERNOR THRUST WASHER	362	1	.13
H-9176	GASKET, DISTRIBUTOR HOUSING COVER	360	1	.05
H-9177-2	GEAR, FUEL PUMP DRIVE	362	1	20.73
H-9178-1	PIN, GEAR PUMP DRIVE	362	1	.41
H-9179	GASKET, METERING PUMP	360	1	.07
H-9181	SPRING, METERING PUMP	360	1	.23
H-9183-1	SHAFT, GENERATOR DRIVE	335	1	4.09
H-9184-1	COVER, GENERATOR DRIVE BEARING CAGE	335	1	4.90
H-9186-1S	BUSHING, LUBRICATING PUMP BRACKET	344	1	.33
H-9195-3	BOLT, CONNECTING ROD	337	12	2.17
H-9197-1	NUT, MAIN BEARING STUD	330	14	.40
H-9207-1	SPRING, LUBRICATING OIL PRESSURE REGULATOR	333	1	.30
H-9208-3	PIN, PISTON	337	6	2.80

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H-9210-1	GUIDE, VALVE STEM	328	12	.47
H-9212	BEARING, COMPRESSION RELEASE SHAFT	331	3	1.13
H-9213	TUBE, LUBRICATING	329	3	1.40
H-9215-1	STUD, CYLINDER HEAD	329	18	48
H-9216-1	SPRING, VALVE	328	12	.50
H-9217-1	LEVER, COMPRESSION RELEASE	331	1	.98
H-9219 C. I.	GLAND, COMPRESSION RELEASE PACKING	331	1	2.23
H-9220-1	CONNECTION, ENGINE WATER (LOWER)			.78
H-9221	GASKET, ENGINE WATER CONNECTION			.03
H-9222	PIN, IDLER GEAR	329	1	2.67
H-9223	SPRING, COMPRESSION RELEASE LEVER	331	1	.37
H-9224	BUSHING, IDLER GEAR	329	1	80
H-9225	DOWEL, GEAR CASE COVER	333	2	.12
H-9226	DOWEL, FLYWHEEL HOUSING	330	2	.16
H-9227	DOWEL	329,350	14	.07
H-9228	DOWEL, CAMROCKER HOUSING	338	6	.03
H-9229-2	BUSHING, CAMSHAFT (FRONT)	341	1	1.15
H-9230-2	BUSHING, CAMSHAFT 3 & 5	341	2	.97
H-9231-2	BUSHING, CAMSHAFT 2-4-6	341	3	1.05
H-9232	STUD, LUBRICATING PUMP	329	4	.10
H-9233-2	BUSHING, CAMSHAFT REAR	341	1	1.12
H-9234	GASKET, COMPRESSION RELEASE BEARING	331	3	01
H-9235-1	RING, CAMSHAFT THRUST	341	1	.63
H-9236-1	SEAL, CRANKSHAFT OIL	333	1	.05
H-9237	SCREW, COMPRESSION RELEASE SHAFT LOCK	331	1	.11
H-9238	PACKING, COMPRESSION RELEASE LEVER	331	4	.07
H-9239	SCREW, SHAFT LOCK	338	6	.08
H-9240-S	BUSHING, VALVE CAM LEVER	338	12	10
H-9241-S	BUSHING, INJECTOR CAM LEVER	338	6	.12
H-9242	BUSHING, VALVE ROCKER LEVER	339	12	12
H-9243-2	BUSHING, INJECTOR ROCKER LEVER	339	6	15
H-9244-1	GASKET, COVER TO ROCKER HOUSING	340	3	10
H-9245 C. I.	SPACER, STARTING MOTOR			2.23
H-9246	PLATE, INDEX HOLE COVER	352	1	.15
H-9247-S	BUSHING, PISTON PIN	337	6	1.25
H-9248-2	CLAMP, MANIFOLD	350	6	.50
H-9250-1	STUD, EXHAUST MANIFOLD	328	6	.20
H-9252	GASKETS, MANIFOLD TO CYLINDER HEAD	350	3	27
H-9255-1	PLATE, CAMSHAFT THRUST	333	1	1.60
H-9257	PIN, INJECTOR CAM ROLLER	338	6	.53
H-9258	PIN, VALVE CAM ROLLER	338	12	.47
H-9259	PACKING, CYLINDER LINER	329	18	.26
H-9260	ROLLER, VALVE CAM	338	12	.97
H-9261	ROLLER, ROCKER LEVER	339	12	1.07
H-9264-2	PIN, INTAKE ROCKER LEVER ROLLER	339	6	.17
H-9264-X	PIN, EXHAUST ROCKER LEVER ROLLER	339	6	.22
H-9265	RIVET, EXHAUST ROCKER LEVER ROLLER PIN	339	12	.03
H-9266	GASKET, CAM ROCKER HOUSING	338	3	.03
H-9267	GASKET, WATER MANIFOLD TO HEAD	367	6	03
H-9269	SCREW, ROCKER SHAFT LOCK	339	3	.08
H-9270	STUD, ROCKER ARM HOUSING	328	21	.12
H-9271	CAP, LUBRICATING PIPE	339	3	.27
H-9272	GASKET, LUBRICATING PIPE CAP	339	3	.04
H-9274	WASHER, BEARING RETAINER	335,344	2	14
H-9275	NUT, BEARING RETAINER	335,344	2	.13
H-9277	GASKET, GENERATOR DRIVE BEARING CAGE	335	1	.05
H-9278	GASKET, GENERATOR DRIVE BEARING CAGE	335	1	.05
H-9279	PLUNGER, LUBRICATING OIL PRESSURE REGULATOR	333	2	.85
H-9280	BOLT, CAMSHAFT GEAR	341	6	.10
H-9281	GASKET, DRAIN TUBE FLANGE	345	2	.02
H-9281-1	GASKET, LUBRICATING FLANGE	343	2	.02
[illegible]283-1	GASKET, BRACKET TO CAGE	344	1	.05
[illegible]284	GASKET, LUBRICATING PUMP	344	1	.08
[illegible]	GASKET, BRACKET TO BODY	344	1	.02

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H-9286-2	CONNECTION, FUEL INLET	365	6	1 53
H-9287	GUIDE, FUEL CONNECTION SPRING	365	12	.15
H-9298-1	CAP, FUEL CONNECTION	365	6	.36
H-9299	GUIDE, FUEL CONNECTION SPRING	365	6	16
H-9300	KEY, CRANKSHAFT PINION	336	1	08
H-9301-1	PIN, HAND CRANKING	336	1	11
H-9303-2	CONNECTION, INJECTOR FUEL DRAIN	365	6	[illegible]
H-9304	LOCK, CRANKSHAFT NUT	336	1	20
H-9305	NUT, CRANKSHAFT	336	1	1 6[illegible]
H-9306	SLINGER, OIL	336	1	4[illegible]
H-9315	SPRING, FUEL CONNECTION	365	12	12
H-9333-1	GASKET, FLYWHEEL HOUSING	352	1	4 78
H-9353-2	PLUG, INLET CONNECTION	365	6	08
H-9355	PIN, INJECTOR PLUNGER LINK	366	6	03
H-9366-2	PIN, PLUNGER LEVER	359	1	1 95
H-9367-1	SPRING, VERTICAL LEVER	359	1	23
H-9368	BEARING, PLUNGER LEVER PIN	359	56	[illegible]
H-9369-2	ROLLER, VERTICAL LEVER	359	[illegible]	[illegible]3
H-9370	BEARING, VERTICAL LEVER ROLLER	359	[illegible]	[illegible]
H-9371-1	PIN, VERTICAL LEVER ROLLER	359	1	5[illegible]
H-9423	DOWEL, GEAR PUMP HOUSING	357	1	.07
H-9424	PACKING, LUBRICATING PIPE	328	6	[illegible]
H-9426-2	GASKET, FUEL CONNECTION (COPPER)	365	12	[illegible]
H-9427	LOCK, MAIN BEARING STUD NUT	330	14	[illegible]
H-9432	GASKET, CHECK VALVE PLUG	366	6	05
H-9433	PLUG, INJECTOR CHECK VALVE	366	6	[illegible]
H-9434	GASKET, CHECK VALVE SEAT	366	5	0[illegible]
H-9443-2	ROD, IDLING LEVER	370	1	[illegible]
H-9445	WASHER, IDLING LEVER	370	1	[illegible]
H-9454	SPRING, GOVERNOR I. T	362	1	3[illegible]
H-9455	VALVE, FUEL SUPPLY CHECK	361	1	5[illegible]
H-9456	GUIDE, FUEL SUPPLY CHECK VALVE	361	1	9[illegible]
H-9458-1	HOUSING, FUEL SUPPLY CHECK VALVE	361	1	1 4[illegible]
H-9459	GASKET, FUEL SUPPLY CHECK VALVE	361	1	0[illegible]
H-9460	SPRING, FUEL SUPPLY CHECK VALVE	361	1	[illegible]
H-9462	RIVET, TACHOMETER SHAFT	360	1	[illegible]
H-9488	GASKET, CAMSHAFT THRUST PLATE	333	1	[illegible]
H-9495-1	SPRING, PRESSURE REGULATING VALVE	361	1	[illegible]
H-9507	GEAR, #2 DRIVE	361	1	2 4[illegible]
H-9508	GEAR, #2 IDLER	361	1	2 [illegible]
H-9509	GEAR, #1 IDLER	361	1	2 4[illegible]
H-9540	GASKET, WATER BLIND FLANGE	330,367	2	02
H-9562	SCREW, IDLING LEVER SPRING SUPPORT	370	1	03
H-9572	NIPPLE, 1/8"x 6 1/8"	364	[illegible]	2[illegible]
H-9573	NIPPLE, 1/8"x 6 7/8"	364	2	2[illegible]
H-9574	NIPPLE, 1/8"x 6 3/8"	364	1	21
H-9575	SPRING, IDLING LEVER	370	1	27
H-9597	SCREEN, CHECK VALVE SEAT	361	1	56
H-9634	SPIDER, GENERATOR COUPLING	335	1	3 86
H-9676	BUSHING, DISTRIBUTOR DISC	360	1	3 89
H-9719	CLAMP, FUEL LINE	364	1	15
H-9720	CLAMP, FUEL LINE	364	1	[illegible]
H-9723	VALVE, FLOAT	363	1	5[illegible]
H-9724-1	SEAT, FLOAT VALVE	363	1	4[illegible]
H-9725	PIN, FLOAT LEVER BEARING	363	1	05
H-9726-1	FLOAT & LEVER	363	1	1 49
H-9728-3	BUSHING, GOVERNOR YOKE	362	1	[illegible]
H-9729	GASKET, VALVE SEAT	363	1	03
H-9730	BRACKET, FLOAT BEARING	363	1	27
H-9732	PIN, FLOAT LEVER LOCATING	363	1	07
H-9733	STOP, FLOAT	363	1	[illegible]
H-9734	NUT, FLOAT LEVER BEARING PIN	[illegible]	[illegible]	[illegible]
H-9735	LOCKWASHER, FLOAT LEVER BEARING PIN	[illegible]	[illegible]	[illegible]
H-9740	STUD, OIL FILTER COVER	[illegible]	[illegible]	[illegible]
H-9744	CLAMP, LUBRICATING TUBE	[illegible]		[illegible]

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H-9745	SEPARATOR, LUBRICATING TUBE	343	2	.15
H-9748	PIN, GOVERNOR YOKE BUSHING	362	1	.10
H-9749-1	PLATE, FLOAT CHAMBER (TOP)	363	1	1.09
H-9750	LEVER, IDLING	370	1	2.68
H-9755-3	HOUSING, BY PASS VALVE	357	1	.90
H-9757-2	SPRING, BY PASS VALVE	357	1	.23
H-9758-1	SHAFT, GEAR PUMP DRIVE	361	1	2.10
H-9759	SHAFT, GEAR PUMP IDLER	361	1	1.15
H-9760	BOLT, GEAR PUMP BODY (LONG)	361	2	.36
H-9761	BOLT, GEAR PUMP BODY (SHORT)	361	1	.32
H-9762-1	GASKET, FLOAT CHAMBER	363	1	.02
H-9763-1	GASKET, FLOAT CHAMBER TOP PLATE	363	1	.04
H-9764-1	GASKET, GEAR PUMP TO HOUSING	361	1	.05
H-9765	SHAFT, IDLING LEVER	361	1	.96
H-9766-2	GASKET, #2 GEAR PUMP SPACER	361	1	.03
H-9767-1	GASKET, #1 GEAR PUMP SPACER	361	1	.03
H-9808	BUSHING, GOVERNOR WEIGHT PIN	362	4	.24
H-9876	COUPLING, GENERATOR	...	..	5.39
H-9910	WASHER, PRESSURE REGULATING	361	1	.04
H-9919	KEY, #1 DRIVE GEAR	361	1	.07
H-9958	SCREW, CONTROL LEVER ADJUSTING	357	1	.37
H-9959	BUSHING, HAND CONTROL ECCENTRIC	357	1	.34
H-10189	PAN, OIL	342	1	69.74
H-10368-3	COVER	345,346	1	2.26
H-10368-4	CAP PERFORATED	345,346	1	2.26
H-10368-17	GASKET, CENTER STUD	345,346	1	.13
H-10368-18	GASKET, BASE	345,346	1	.40
H-10368-22	PLUG, DRAIN	345,346	1	.33
H-10368-26	COVER, ASSEMBLY	...	1	8.79
H-10368-27	RELIEF VALVE ASSEMBLY	345,346	1	3.40
H-10375-3	SPRING, CLAMP	354,355	2	.05
H-10375-5	GASKET, COVER	354,355	1	.15
H-10375-6	SPOOL, BAG	354,355	1	16.85
H-10375-7	RING, BAG	354,355	1	.17
H-10375-8	PLATE, GUARD	354,355	1	.60
H-10375-9	SCREEN, SAFETY	354,355	1	.60
H-10375-16	SCREW, #6-32 x 5/16"	354,355	2	.03
H-10375-18	SPRING, SHOCK	354,355	1	.25
H-10375-19	CLAMP, BAG	354,355	2	.20
H-10375-20	NUT, ELONGATED CLAMP	354,355	2	.10
H-10375-22	PIN, CROSS	354,355	2	.04
H-10375-24	COVER	354,355	1	2.10
H-10375-25	SPACER, WIRE MAT	354,355	1	2.50
H-10375-26	RING, BOLT, & SHELL	354,355	1	4.30
H-10376-24	BASE	345,346	1	2.10
H-10376-28	STUD & TUBE ASSEMBLY	345,346	1	3.40
H-10376-30	BODY ASSEMBLY	345,346	1	19.98
H-10380-1	RING, BOLT	347	1	.20
H-10380-3	SPRING, BAG RING CLAMP	347	2	.05
H-10380-6	SPOOL, BAG	347	1	5.20
H-10380-8	BALL, BY-PASS RELIEF	347	1	.25
H-10380-9	SPRING, BY-PASS RELIEF	347	1	.25
H-10380-10	NUT, BY-PASS ADJUSTING	347	1	.15
H-10380-18	SPRING, SHOCK	347	1	.45
H-10380-19	CLAMP, BAG RING	347	2	.25
H-10380-20	NUT, ELONGATED CLAMP	347	2	.10
H-10380-22	PIN, CROSS	347	2	.04
H-10380-25	SPACER, WIRE MAT	347	1	.60
H-20145-1	GASKET, OIL	368	1	.12
H-20145-2	WASHER, CARBON	368	1	.45
H-20145-3	WASHER, CORK	368	1	.18
H-20145-4	SPRING	368	1	.14
H-20145-5	BODY	368	1	7.20
H-20145-7	SHAFT	368	1	6.15

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H-20145-8	IMPELLER	368	1	6.30
H-20145-11	RING, SEAL CLAMP	368	1	.09
H-20145-12	SEAL, FLEXIBLE	368	1	.27
H-20145-13	GUIDE, SPRING	368	1	.06
H-20145-14	SNAP WIRE	368	1	.06
H-20145-16	RETAINER, SPLIT RING	368	1	.72
H-20145-17	RING, SPLIT	368	2	.45
H-20145-20	SPACER, BEARING	368	1	.60
H-20145-22	WASHER, CORK RETAINER	368	1	.24
H-20145-23	LOCKWIRE	368	1	.09
H-20145-24	RETAINER, CORK	368	1	.72
H-20145-26	WASHER, CLAMP	368	1	.30
H-20153	PLATE, OIL PAN DECK	342	1	15.48
H-40423	BEARING, MAIN BEARING LOWER REAR	336	1	15.25
H-40424	BEARING, MAIN UPPER REAR	336	1	15.25
H-40425	BEARING, MAIN LOWER 2-4-6	336	3	6.37
H-40426	BEARING, MAIN UPPER 2-6	336	2	6.37
H-40427	BEARING, MAIN LOWER 1-3-5	336	3	8.28
H-40428	BEARING, MAIN UPPER 1-3-5	336	3	8.28
H-40457	BODY, LUBRICATING PUMP	344	1	4.83
H-40496	BEARING, MAIN UPPER #4	336	1	6.37
H-40662	GASKET, REAR COVER PLATE TO BLOCK	334	1	.10
H-40855	SECTION, MANIFOLD CENTER	351	1	10.49
H-41041	SECTION, MANIFOLD FRONT	351	1	7.49
H-41042	SECTION, MANIFOLD REAR	351	2	6.83
H-41177-H	GAUGE, OIL LEVER	332	1	.97
H-41233	CONNECTION, BY-PASS (LOWER)	367	1	3.66
H-41235	CONNECTION, BY-PASS (UPPER)	367	1	2.33
H-41279	PULLEY, WATER PUMP	368	1	6.60
H-60010	GUIDE, VALVE SPRING	328	12	.61
H-60011-1	COLLETT, VALVE HALF	328	24	Pr. .18
H-60025	WIPER, INJECTOR CUP	337	6	4.15
H-60026	LOCK, INJECTOR CUP WIPER	337	6	.01
H-60098	WASHER, FOR OIL SEALS	361	2	.04
H-60099	SEAL, SPACER	361	2	.01
H-60100-A	SPACER, 1/64", MAXIM SPEED	362	1	.07
H-60100-B	SPACER, 1/16", MAXIM SPEED	362	1	.07
H-60100-C	SPACER, .0086", MAXIM SPEED	362	1	.07
H-60227-A	RIVET, VERTICAL LEVER ROLLER PIN	359	1	.07
H-60244	BUSHING, GOVERNOR LEVER	357	1	.20
H-60466	BUSHING, GOVERNOR CONTROL ROD	357	1	2.66
H-60508	SOCKET, INJECTOR ROCKER LEVER	339	6	.50
H-60574	STUD, MAIN BEARING	330	7	1.32
H-60575	DOWEL, MAIN BEARING RING	336	7	.24
H-60585	DOWEL, FLYWHEEL TO CRANKSHAFT	352	3	.17
H-60598	GASKET, FUEL CAP	365	6	.03
H-60845	CIRCLIP, ROCKER LEVER	339	12	.10
H-61005-1	LEVER, THROTTLE (FIXED)	370	1	2.17
H-61006-1	LEVER, THROTTLE (ADJUSTABLE)	370	1	1.83
H-61007	SHAFT, THROTTLE LEVER	370	1	.16
H-61008	PIN, THROTTLE LEVER	370	1	.16
H-61115	RIVET, DRIVE COLLAR	360	1	.15
H-61574	GASKETS	349,350	7	.07
H-61575	FLANGE, BLIND	349,350	2	1.24
H-61908	RING, PISTON PIN SNAP	337	12	.08
H-61977	BRACKET, THROTTLE CONTROL	370	1	2.52
H-62074	CAPSCREW, IDLING LEVER	370	1	.06
H-62123	SPRING, INJECTOR PLUNGER	366	6	1.12
H-62126	BAIL, INJECTOR PLUNGER RETAINING	366	6	.91
H-62127	GASKET, INJECTOR COVER	366	6	.15
H-62128	COVER, INJECTOR	366	6	2.92
H-62129	GASKET, INJECTOR PLUNGER OIL SEAL	366	6	.10
H-62229	PLUG, ROCKER HOUSING VENT	339	3	.20
H-62406	STOP, INJECTOR CHECK VALVE	366	6	.36
H-62409	GASKET INJECTOR CUP	366	6	.04

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H-[illegible]	SPRING, INJECTOR CHECK VALVE	366	6	[illegible]
H-[illegible]727	PLATE CONNECTING ROD LOCK	337	12	[illegible]
H-[illegible]	BRACKET, PRIMING PUMP	[illegible]33	1	1.06
H-[illegible]077	TUBE, OIL LEVER GAUGE	332	1	1.59
H-[illegible]	BOLT, DELUXE FILTER U	345	1	1.22
H-[illegible]135	BRACKET, FUEL FILTER			2.81
H-[illegible]	SPACER, FUEL FILTER BRACKET			.30
H-63188	SPACER FUEL FILTER BRACKET			.23
H-63331-K	CRANK, HAND	336	1	2.56
H-63432	LOCKWASHER, WATER PUMP DRIVE PULLEY	369	1	.04
H-63526	SPRING, GOVERNOR IDLING SPEED	362	1	.90
H 63683	FLANGE, WATER BLIND (SIDE)	330	1	.82
H-63763	SCREW, CONTROL LEVER ADJUSTING	357	1	.13
H-64307	FLANGE, DRAIN TUBE	345	2	2.00
H-64376	GASKET, FLYWHEEL TO CRANKSHAFT	352	1	.03
H 64482	LOCKWIRE	352	3	.03
H 64487	CAPSCREW	352	6	.17
H 64773	STUD, MAIN BEARING SLOTTED	330	7	1.30
H-64777	GEAR, LUBRICATING PUMP DRIVE	344	1	5.83
H-64778	GEAR, LUBRICATING PUMP IDLER	344	1	5.50
H-64779	SHAFT, LUBRICATING PUMP IDLER	344	1	.67
H-64780	SHAFT, LUBRICATING PUMP DRIVE	344	1	3.10
H-64790	DOWEL, REAR COVER PLATE	334	4	.07
H 64889	CHAMBER, PRESSURE	361	1	3.47
H 64954	SPACER FAN	369	1	8.82
H-64967	SEAT, EXHAUST VALVE	328	6	4.36
H-65002-1	GASKET, REAR COVER JOINING	334	2	.01
H-65049	COVER, GEAR CASE	333	1	18.25
H-65052	SCREW	333	1	1.07
H-65325	RING, OIL REGULATOR WIDE	337	6	.43
H-65326	RING, OIL REGULATOR NARROW	337	6	.40
H-65327	RING, COMPRESSION	337	12	.37
H-65354	RING, KEYSTONE	337	6	.30
H-65436	CAPSCREW, REAR COVER JOINING	334	2	.13
H 65476	PLUG, WATER DRAIN	330	1	.93
H 65504	SEAL CRANKSHAFT OIL	334	2	.20
H-65505	PLUG, DISTRIBUTOR CHECK VALVE	360	1	.27
H-65827	TUBE, FLOAT CHAMBER VENT			.10
H-66065	JAW, HAND CRANK	336	1	3.70
H-66071-A	RING, BALL BEARING SPACER .059	362	1	.07
H-66071-B	RING, BALL BEARING SPACER .062	362	1	.07
H-66071-C	RING, BALL BEARING SPACER .065	362	1	.07
H-66100	PLUG, OIL PAN DRAIN	342	1	.60
H-66212	LOCKPLATE, CAMSHAFT BOLT NUT	341	3	.07
H-66231	COVER, HAND CRANK JAW			1.67
H 66232	GASKET, HAND CRANK JAW			.03
H-66234-A	KEY, FUEL PUMP DRIVE GEAR	362	1	.17
H-66234-B	KEY, GOVERNOR YOKE	362	1	.13
H-66254	THERMOSTAT, BY PASS LINE	367	1	1.94
H-66255	THERMOSTAT, MAIN LINE	367	2	2.44
H-66257	GASKET, THERMOSTAT HOUSING	367	1	.03
H-66258	GASKET, BY PASS CONNECTION	367	1	.03
H-66296	PLUG, FUEL INLET	357	1	1.10
H-66348	BRACKET, WATER PUMP & HEAT EXCHANGE MOUNTING	368	1	3.16
K-8433	SPRING, DISTRIBUTOR DISC	360	1	1.68
K-8441	GASKET, WATER DRAIN PLUG	330	1	.07
S-100-A	CAPSCREW, 9/16"-18 x 1¼"	347	2	.01
S-101-A	CAPSCREW, 7/16"-20 x 1"			.03
S-102	CAPSCREW, 5/16"-18 x 1"	370	1	.02
S-102-A	CAPSCREW, 5/16"-24 x ¾"	362	4	.03
S-103	CAPSCREW, 5/16"-18 x 2¼"	344	8	.02
S-103-A	CAPSCREW, ⅝"-11 x 2"			.13
S-104	CAPSCREW, ⅜"-16 x 2¼"	367	1	.05

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S-104-A	CAPSCREW, 5/8"-18 x 1½"	352	9	.07
S-105-A	CAPSCREW, 7/16"-20 x 1¼"	335	4	05
S-108	CAPSCREW, 5/16"-24 x 5/8"	331	1	03
S-109-A	CAPSCREW, 9/16"-18 x 1½"			[illegible]
S-110-A	CAPSCREW, 3/8"-24 x ¾"	333,345	4	.03
S-112	CAPSCREW, 3/8"-24 x 1"	330,332, 349 350,361, 367,370	58	.03
S-122	CAPSCREW, 7/16"-14 x 1¼"	360	1	.07
S-129	CAPSCREW, 3/8"-24 x 1"	331,338	18	.03
S-133-A	CAPSCREW, ¼"-28 x 7/8"	363	2	.02
S-134	CAPSCREW, 5/16"-18 x 2"	369	6	.03
S-134-A	CAPSCREW, #10-24 x ¾"	343	4	02
S-138-A	CAPSCREW, 5/16"-24 x 7/8"	342,367	16	03
S-140	CAPSCREW, 7/16"-14 x 1¾"	361	3	.05
S-141	CAPSCREW, 3/8"-16 x 2¾"	361	2	06
S-142	CAPSCREW, 5/16"-24 x 1¼"	357	1	.02
S-146-B	CAPSCREW, 3/8"-24 x 3"	355	2	.03
S-150-C	SCREW, ¼"-28 x 1"	360	1	.12
S-155-C	CAPSCREW, 5/16"-24 x 4"	363	2	.09
S-156	CAPSCREW, 3/8"-16 x 1¼"	340	9	.03
S-163-A	CAPSCREW, 7/16"-20 x 1½"	342	27	.02
S-165	CAPSCREW, 3/8"-24 x 1½"	334,338,347, 359,360,368	23	.03
S-166	CAPSCREW, 3/8"-24 x 1⅛"	331,334	8	.03
S-178-B	CAPSCREW, 7/16"-14 NC x 2¼"	354,355	8	.05
S-180	CAPSCREW, 7/16"-14 x 1"	342,360	9	.04
S-183	CAPSCREW, 3/8"-24 x 2"	331,343	5	.07
S-185	CAPSCREW, 7/16"-20 x 2"	333	17	.07
S-200	NUT, ½"-13	366	12	.03
S-205	NUT, 3/8"-24	331,341,361	10	03
S-206-A	NUT, ¾"-16	369	1	.27
S-208-A	NUT, ½"-13	339	21	.02
S-209	NUT, 5/16"-24	334,345	4	.01
S-218	NUT, 7/8"-24, CYLINDER HEAD STUD	328	18	.13
S-223	NUT, 3/8"-16, FILTER TO BRACKET			02
S-227-1	NUT, CONNECTING ROD BOLT	337	12	18
S-231	NUT, 7/16"-20	342,344,347	37	.03
S-232	NUT, 5/8"	339,345,346	20	.05
S-248	NUT, 5/16"-24	370	2	.01
S-249	NUT, ¾"-16, COUPLING SPIDER	335	1	.05
S-251	NUT, ¼"-28	357,370	5	.01
S-252	NUT, 5/8"-18 BRASS	350	6	23
S-257	NUT, 3/16"-24	364	2	01
S-259	NUT, #10-24	343	4	01
S-278	NUT, ¾"-16 SLOTTED	368	1	38
S-305	KEY, PULLEY	368	1	.02
S-308	KEY, WOODRUFF	360,368	2	.01
S-313	KEY, WOODRUFF FOR DRIVE GEAR	335	1	02
S-314	KEY, #2 DRIVE GEAR	361	1	.03
S-316	KEY	335,344	2	.01
S-505	PIN, COTTER	370	2	01
S-509	PIN, COTTER	335,344,357	3	.01
S-519	PIN, COTTER	347,368	2	.01
S-600	LOCKWASHER, ¼"	342,352, 357,363,370	22	.01
S-603	LOCKWASHER, 5/8"	350,352	15	01
S-604	LOCKWASHER, 3/8"	329,330, 331,332,333, 334,340,343, 345,347,349, 350,359,361, 367,368,370	128	01

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S-605	LOCKWASHER, 5/16"	344,345, 362,363,367, 369,370	40	.01
S-607	LOCKWASHER, #10 POS. LOCK	343	4	.01
S-609	LOCKWASHER, 9/16"	347	2	.01
S-610	LOCKWASHER, 7/16"	333,335,344, 347,360,362	37	.01
S-625	LOCKWASHER, ¾"	335	1	.12
S-631	WASHER, ¼"	370	1	.01
S-636	LOCKWASHER, 9/64"	354,355	4	.01
S-652	LOCKWASHER, 5/16" EVERLOCK	334,342	6	.01
S-666	LOCKWASHER, 7/16"	342	33	.03
S-678	LOCKWASHER, 7/16"	333	1	.03
S-684	GASKET, DISTRIBUTOR CHECK VALVE PLUG	360	1	.05
S-701	PLUG, 1⅛", EXPANSION	357	2	.07
S-702	PLUG, 1¾", EXPANSION	330	1	.18
S-703	PLUG, ¾", EXPANSION	329	1	.07
S-705	PLUG, ⅞", EXPANSION	338	6	.10
S-706	PLUG, 1½", EXPANSION	330,357	5	.13
S-707	PLUG, 1¼", EXPANSION	339	6	.10
S-715	PLUG, 1" EXPANSION	328,330	13	.07
S-901	PLUG, ¼" PIPE LUBRICATING OIL DRAIN	...	..	.07
S-903	PLUG, ⅛" PIPE, OIL	368	1	.05
S-905	TEE, ⅛" PIPE	353	2	.17
S-910-B	PLUG, ¼"	357	1	.12
S-911-B	PLUG, ⅛" PIPE	328,329, 339,357,360, 361,363	21	.06
S-922-E	PLUG, ¾" PIPE	328	6	.12
S-924	PLUG, ½" PIPE	330,332,347	3	.05
S-927	ELBOW, ⅛" STREET	353	1	.10
S-929	NIPPLE	357	1	.10
S-935-B	PLUG, ⅜" PIPE	328,329,341	7	.18
S-945	NIPPLE, ⅛" PIPE CLOSE	353	3	.06
S-967	BUSHING, ½"x¼", PIPE	345	1	.09
S-995	PLUG, ¾" PIPE	367	2	.12
S-1003	CONNECTION, TUBE	353	1	.14
S-1004	ELBOW, TUBE	360,362	8	.16
S-1004-1	ELBOW, LUBRICATING OIL TUBE	361	1	.16
S-1006-A	CONNECTION	345	2	.33
S-1007-A	ELBOWS, FILTER INLET & OUTLET TUBE	...	..	.51
S-1008-A	CONNECTION, FILTER TUBE	345	1	.39
S-1010-A	ELBOW, FILTER TUBE	345	1	.30
S-1022-A	NUT, TUBE	353	4	.03
S-1023-A	NUT, TUBE	...	..	.03
S-1030	ELBOW, TUBE	347	2	.80
S-1031	ELBOW, TUBE	364	2	.15
S-1033	TEE, TUBE	364	3	.27
S-1035	CROSS, TUBE	364	1	.33
S-1037	NUT, TUBE	...	..	.24
S-1050	COUPLING, PIPE, INJECTOR DRAIN	357	1	.30
S-1068	NUT, PACKING	...	..	.15
S-1069	NUT, TUBE PACKING	...	..	.15
S-1070	SLEEVES, RUBBER	...	..	.06
S-1071	SLEEVES, RUBBER	...	..	.06
S-1072	NUT, SLEEVE PACKING	...	..	.30
S-1074	CONNECTION, STRAIGHT TUBE	...	..	.77
S-1076	NUT, TUBE PACKING	...	..	.30
S-1077	SLEEVE, TUBE PACKING	...	..	.30
S-1200	SCREW, WASHER	329	1	.03
S-1207	SCREW, COVER	366	12	.03
S-1213	SCREW, SPACER PLATE	361	1	.05
S-1307	SCREW, FUEL LINE CLIP	364	14	.03
S-1310	SCREW, INDEX HOLE COVER	352	1	.03

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S-1313	SCREW, OIL PAN DECK PLATE	342	14	.01
S-1327	SCREW, FUEL FILTER BRACKET		..	.03
S-1546	PLUG	359	1	.09
S-1622	BALL, CHECK	360	1	.03
S-1656	BALL, FUEL CONNECTION CHECK	365	6	.02
S-1698	BALL, FUEL CHECK	357,361	2	.03
S-1713	BEARING, INNER	368	1	3.10
S-1788	GASKET, BY PASS VALVE	357	1	.03
S-1792	BELTS, WATER PUMP DRIVE	369	2	1.26
S-1793	GASKET, DRAIN PLUG	342,361	2	.05
S-1795	GASKET, CAM ROCKER LEVER SPRING RETAINER	357	1	.03
S-1796	SEAL, OIL	335	1	.75
S-1800	SEAL, FAN PULLEY OIL	333	1	.95
S-1804	CAP	340	1	1.00
S-1811	PUMP, HAND PRIMING	353	1	7.17
S-1822	GASKET, PRESSURE CHAMBER	361	1	.05
S-1824	JOINT, SOLID SWIVEL	370	1	.20
S-1825-1	CONTROL, EMERGENCY STOP PULL	370	1	1.67
S-1827	GAUGE, FUEL PRESSURE	353	1	2.50
S-1848	RING, SNAP	361	1	.03
S-1861	FAN, 22" SUCTION TYPE	369	1	12.48
S-1862-1	CONTROL, IDLING PULL	370	1	3.83
S-1873	COCK, SHUT OFF	361	1	3.20
S-1873-A	NUT, TUBE	...	..	.15
S-1877-1	CHAIN, COUPLING	...	..	1.47
S-1908	BEARING, GOVERNOR WEIGHT BALL	362	4	1.50
S-1914	GASKET, FILTER COVER	347	1	.20
S-1915-1	ELEMENT, OIL FILTER	...	..	26.87
S-1918	SEAL, SHAFT	361	1	.45
S-1943	SEAL, LEAD	357	1	.03
S-1953	BAG, FILTER	347	1	.65
S-1985	GASKET, BAG	347	1	.14
S-2104	FILTER, FUEL OIL	...	..	24.27
S-2105	BAG, FILTER	354,355	2	1.60
S-2297	PACKING, TACHOMETER SHAFT GUIDE	360	1	.01
S-2345-1	SEAL, INJECTOR PLUNGER OIL	366	6	.95
S-2470	FILTER, DELUXE LUBRICATING OIL	...	..	30.00
S-2470-A	CARTRIDGE	345,346	2	2.40
S-2470-B	GASKET, COVER STUD	345,346	2	.21
S-2470-C	GASKET, COVER	345,346	2	.43
S-2470-D	GASKET, DRAIN PLUG	345,346	2	.12
S-2534	PRECLEANERS, DONALDSON H-102-A	348,349	6	5.25
S-2534-A	JARS, DUST	348,349	6	.30
S-2534-B	GASKET, RUBBER	348,349	6	.09
S-2545	CAP, BREATHER	332	1	3.45
S-2630	GASKET, BAG	354,355	2	.06
S-2648	CLAMP, HOSE	367	2	.08
S-2668	JOINT	370	2	.33
S-2871	RIVET, CONTROL ROD COLLAR	362	1	.01
S-2894	FILTERS, DONALDSON AIR A678	348,349	6	18.12
S-2902	NECK, FILLER	332,340	2	.09
S-2951	RIVET, CONTROL LEVER	357	1	.06
S-3092	CUP, OIL	370	1	.09
S-16001	BEARING, CAM BALL	362	1	3.77
S-16002	BEARING, CAGE COVER BALL	335,344,362	3	2.90
S-16003	BEARING, DISTRIBUTOR SHAFT BALL	360	1	3.10
S-16004	BEARING, GOVERNOR HOUSING BALL	362	1	3.17
S-16005	BEARING, CAGE BALL (N.D. 1304)	335	1	3.10
S-16033	BEARING, OUTER (N.D. 1305)	368	1	3.33
S-16225	RING, SNAP	362	1	.03
BM-1	PUMP, METERING	360	1	3.00
BM-2	PRIMING VALVE ASSEMBLY	...	..	1.20
BM-5	HOUSING & BUSHING ASSEMBLY	360	1	16.10
BM-6	GOVERNOR LEVER & BUSHING ASSEMBLY	357	1	2.20

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BM-7	ECCENTRIC, HAND CONTROL	357	1	5.65
BM-12	GEAR PUMP ASSEMBLY	361	1	53.30
BM-19	CHECK VALVE SEAT & SCREEN ASSEMBLY	361	1	1.70
BM-20	TUBE, GEAR PUMP TO DISTRIBUTOR	356	1	.70
BM-24	FLOAT CHAMBER ASSEMBLY			6.00
BM-28	GOVERNOR YOKE ASSEMBLY	362	1	13.65
BM-30	WEIGHT, GOVERNOR	362	2	ea. 3.25
BM-31	GOVERNOR CONTROL ROD ASSEMBLY	362	1	6.00
BM-32	CAM ROCKER LEVER ASSEMBLY			11.20
BM-41	VERTICAL LEVER ASSEMBLY			15.20
BM-42	DISTRIBUTOR ASSEMBLY			91.65
BM-67	DISTRIBUTOR SHAFT ASSEMBLY	360	1	8.45
BM-89	CAMSHAFT ASSEMBLY			108.00
BM-95	PUMP, WATER	368	1	32.00
BM-97	LEVER AND BUSHING, INJECTOR	339	6	2.60
BM-99	INJECTOR ROCKER LEVER ASSEMBLY			4.85
BM-103	CONNECTING ROD LESS SHELL ASSEMBLY	337	6	15.30
BM-106	ROCKER LEVER HOUSING ASSEMBLY			46.35
BM-110	LEVER AND BUSHING, INTAKE	339	6	3.10
BM-113	INTAKE ROCKER LEVER ASSEMBLY			5.60
BM-114	LEVER AND BUSHING, EXHAUST	339	6	3.25
BM-117	EXHAUST ROCKER LEVER ASSEMBLY			5.80
BM-119	LEVER & BUSHING, INJECTOR CAM	338	6	2.70
BM-121	CAM ROCKER INJECTOR ASSEMBLY			4.20
BM-122	LEVER & BUSHING, VALVE CAM	338	12	3.15
BM-124	VALVE CAM ROCKER LEVER ASSEMBLY			4.25
BM-125	CAM ROCKER HOUSING ASSEMBLY			25.55
BM-135	CRANKSHAFT ASSEMBLY			378.00
BM-136	CHECK VALVE SEAT ASSEMBLY	366	6	1.50
BM-142	TRACTOR INJECTOR ASSEMBLY	366	6	26.50
BM-144	ROD, INJECTOR PUSH	338	6	3.00
BM-145	ROD, EXHAUST PUSH	338	6	2.55
BM-146	ROD, INTAKE PUSH	338	6	3.15
BM-150	CAGE & SCREEN	365	6	.20
BM-192	ROCKER HOUSING COVER ASSEMBLY	340	1	3.40
BM-196	BRACKET AND BUSHING	344	1	6.70
BM-419	LUBRICATING PUMP ASSEMBLY			60.65
BM-422	GENERATOR DRIVE UNIT ASSEMBLY	335	1	44.40
BM-495	INJECTOR FUEL DRAIN ASSEMBLY			1.50
BM-499	FUEL INLET CONNECTION ASSEMBLY			3.45
BM-592	DISC & COVER ASSEMBLY	360	1	43.25
BM-954	VALVE, BY PASS	357	1	.40
BM-1055	GEAR, IDLER	329	1	23.75
BM-1059	REAR COVER ASSEMBLY	334	1	9.70
BM-1078	CYLINDER HEAD, VALVES, & STUDS ASSEMBLY			71.80
BM-1118	GOVERNOR HOUSING ASSEMBLY	361	1	8.50
BM-1173	GOVERNOR WEIGHT & SPRING ASSEMBLY			8.65
BM-1182	TUBE, LUBRICATING OIL SUCTION	343	1	7.85
BM-1189	INJECTOR DRAIN TUBE	364	6	.50
BM-1274	TUBE, INJECTOR SUPPLY NO. 1	364	1	.85
BM-1275	TUBE, INJECTOR SUPPLY NO. 2	364	1	.85
BM-1276	TUBE, INJECTOR SUPPLY NO. 3	364	1	.85
BM-1277	TUBE, INJECTOR SUPPLY NO. 4	364	1	.85
BM-1278	TUBE, INJECTOR SUPPLY NO. 5	364	1	.85
BM-1279	TUBE, INJECTOR SUPPLY NO. 6	364	1	.85
BM-1281	TUBE, ENGINE TO GOVERNOR LUBRICATING ASSEMBLY	343	1	1.10
BM-1284	INJECTOR DRAIN MANIFOLD ASSEMBLY			2.55
BM-1310	FUEL PUMP ASSEMBLY			296.55
BM-1340	EXHAUST MANIFOLD ASSEMBLY			25.25
BM-1478	TUBE, INJECTOR DRAIN MANIFOLD TO PUMP	364	1	.80
BM-1640	INJECTOR CUP & GASKET ASSEMBLY	366	6	3.30
BM-2174	PISTON & PINS ASSEMBLY	337	6	14.40
BM-2175	PISTON ASSEMBLY	337	6	15.75

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BM-2195	HEAD, STUDDED	328	3	58.45
BM-2265	FUEL PUMP HOUSING ASSEMBLY	357	1	33.[illegible]
BM-2373	TUBE, PRIMING PUMP DISCHARGE	353	1	.95
BM-2374	TUBE, PRIMING PUMP INTAKE	[illegible]	1	[illegible]
BM-2390	TUBE, FILTER DRAIN	345	1	1.[illegible]
BM-2391	LINK, THROTTLE CONTROL	370	1	2.20
BM-2392	TUBE, FILTER TO ENGINE	343	1	4.85
BM-2393	TUBE, LUBRICATING OIL PUMP TO FILTER	343	1	4.35
BM-2401	CYLINDER BLOCK STUDDED			408.50
BM-2420	TUBE, DELUXE FILTER INLET	345	1	1.50
BM-2461	HAND HOLE COVER & FILLER SPOUT ASSEMBLY			7.90
BM-2469	BODY & PLUNGER ASSEMBLY	366	6	13.65
BM-2831	FUEL PUMP MAIN SHAFT ASSEMBLY			29.60
BM-2970	TUBE, NUGENT FILTER TO FUEL PUMP			1.35
BM-2971	TUBE, CUNO TO NUGENT FILTER			1.15

HBID-600 CUMMINS ENGINE PARTS NOT SHOWN

PART NUMBER	DESCRIPTION	PRICE EACH
H-4944	BRACKET, GENERATOR	$ 4.34
H-9220-1	CONNECTION, ENGINE WATER (LOWER)	.78
H-9221	GASKET, ENGINE WATER CONNECTION	.03
H-9245 C. I.	SPACER, STARTING MOTOR	2.23
H-9876	COUPLING, GENERATOR	5.39
H-63185	BRACKET, FUEL FILTER	2.81
H-63186	SPACER, FUEL FILTER BRACKET	.30
H-63188	SPACER, FUEL FILTER BRACKET	.23
H-65825	TUBE, FLOAT CHAMBER VENT	.10
H-66231	COVER, HAND CRANK JAW	1.67
H-66232	GASKET, HAND CRANK JAW	.03
S-103-A	CAPSCREW, 5/8"-11 x 2"	.13
S-109-A	CAPSCREW, 9/16"-18 x 1 1/2"	.10
S-223	NUT, 3/8"-16 FILTER TO BRACKET	.02
S-901	PLUG, 1/4" PIPE, LUBRICATION OIL DRAIN	.07
S-1068	NUT, PACKING	.15
S-1069	NUT, TUBE PACKING	.15
S-1070	SLEEVES, RUBBER	.06
S-1071	SLEEVES, RUBBER	.06
S-1074	CONNECTION, STRAIGHT TUBE	.77
S-1327	SCREW, FUEL FILTER BRACKET	.03
S-1873-A	NUT, TUBE	.15
S-1877-1	CHAIN COUPLING	1.47

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PART No.	DESCRIPTION	PAGE	QTY.	WEIGHT Lb.	Oz.	PRICE EACH
16574	STUD & LEAD ASSEMBLY	371,373	2		.093	$ .50
18137	FIELD COIL ASSEMBLY (4 COILS)	371,373	1	5	.875	12.00
18194	ARMATURE	390	1		.046	.70
18198	BRACKET, STOP	389	1		.093	.45
18201	WINDING	390	1		.500	6.00
18203	WINDING	389	1		.578	3.75
18204	WINDING, SHUNT	389	1		.1875	3.00
20173	SCREW	389	4			.01
20915	WASHER, PLAIN (37/64 x 1/32 x 5/16")	371,373	2		.01—	.05
20987	SCREW (#8-36—3/8")	389,390	9		.01—	.01
22820	SCREW	389,390	3		.01—	.05
27041	WASHER, PLAIN	374	1		.01—	.05
29991	NUT, MOUNTING	388,389,390	3		.01—	.05
30986	NUT, SCREW	390	2		.01—	.05
32330	STRIP, INSULATION	371,373	1		.01	.05
34896	SCREW	388	1		.01—	.01
35082	WASHER, SPRING	374	1		.01—	.05
35761	SCREW (3/8-24 x 29/32")	371,373	8		.063	.02
35777	SPRING, BRUSH		3		.012	.10
35793	STUD	371,373	2		.063	.20
35812	WASHER, INSULATION	371,373	4		.01—	.10
35813	NUT	371,373	4		.012	.10
35814	BUSHING, INSULATION	371,373	2		.01—	.10
35941	CLIP TO MAIN BRUSH	371,373	1		.01—	.05
36035	NUT, SHAFT (D.E.)	371,372	1		.062	.25
36582	SHOE, POLE	380	6	1	.031	.75
37330	SUPPORT, WINDING	389	1			
37339	SPRING, ARMATURE	389	1		.0156	.15
38273	BUSHING (C.E.)	378	1		.063	.60
38367	BRUSH	378	12		.025	.40
103319	LOCKWASHER	371,372,374, 375	23		.01—	.01
103320	LOCKWASHER (19/32 x 1/16 x 5/16")	371,373	2		.01—	.01
103884	PLUG	371,374,375	2			.10
103893	PLUG, END (C.E.)	378	1		.019	.05
106496	LOCKWASHER, SCREW	388,389,390	13		.01—	.01
106497	LOCKWASHER (5/16 x 3/64 x 3/16")	371,372,374, 377	9		.01—	.01
107761	PIN, COTTER	382,384,386	2		.01—	.01
108630	PIN, COTTER	384,385,386	2		.01—	.02
110730	LOCKWASHER (21/32 x 1/16 x 25/64")	384,385	6		.01—	.01
112726	PIN, COTTER	377	1		.01—	.01
113114	LOCKWASHER, SCREW (15/32 x 3/64 x 17/64")	381	4		.01—	.01
113702	CUP, OIL	380	1			.05
114604	LOCKWASHER (1/2 x 3/64 x 17/64")	377	4		.01—	.01
114998	CUP, OIL	378,381	2			.05
115295	NUT	384,385	2			.02
115431	SCREW	384,385	1			.01
115466	SCREW (1/4-20 x 5/8")	381	4		.013	.03
115607	SCREW (#8-32 x 5/16")		12		.01—	.01
116004	NUT (1/4-20 x 3/16")	384,386	4		.01—	.05
120622	NUT	388	1		.01—	.02
122698	SCREW	382	1			.05
124934	NUT	384,385	2		.016	.10
132109	SCREW, SHORT GROUNDED BRUSH	377	3		.01—	.01
132123	SCREW (#10-32 x 5/8")	384,385	7		.01—	.02
132760	SCREW (#8-32 x 1/2")	378	3		.01	.02
132908	SCREW	388	2		.01	.01
132911	SCREW (#10-32 x 5/8")	374	5		.01—	.01
132923	SCREW (#10-32 x 1")	371	1		.01—	.03

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141601	SCREW (#10-32 x 3/10")	371,382	5		.01—	.01
141612	LOCKWASHER	371,372	1		.014	.02
142210	SCREW	388	4		.01	.01
142236	LOCKWASHER	388	2		...	.05
187944	FUSE	384,385	2		.01—	.10
802691	OIL WICK (D.E.)	381	1		.01—	.05
802696	OIL WICK (C.E.)	378	1		.01—	.10
802729	LOCKWASHER (23/64 x 3/64 x 11/64")	378	3		.01	.01
802731	LOCKWASHER	384,385,388	14		.01—	.01
802760	LOCKWASHER	374,377,384, 386,388	9		.01—	.01
804076	OIL WICK IN CENTER BEARING	377	1		.01—	.05
804218	WASHER, PLAIN	384,385	4		.01—	.05
809593	PIN, DOWEL (C.E. & D.E.)	371,373	2		.01—	.05
810794	WASHER, SCREW PLAIN	378,389,390	12		.01—	.01
811912	WASHER, PLAIN (7/8 x 1/32 x 33/64")	378,380	2		.01—	.05
812387	BUSHING (IN SW. HOUSING)	382,384,386	6		.01—	.05
812622	WASHER, PLAIN (11/16 x 1/32 x 3/8")	384,385	2		.01—	.05
814162	WASHER, PLAIN	384,386	2		.01—	.01
815920	WASHER, PLAIN	374	1		.01—	.05
817300	NUT, COVER	388	2		.	.05
823282	SHOE, POLE	371,373	2	1	.0	1.50
825183	HOLDER, BRUSH (THIRD)		1		.062	.35
825184	STUD, BRUSH HOLDER		3		.023	.10
825185	BUSHING (STEEL IN BRUSH HOLDER)		3		.01—	.10
825186	BRACKET		3		.015	.20
825187	WASHER (2 HOLES)		6		.01	.05
825189	WASHER (2 HOLES)		4		.021	.05
825190	BUSHING (IN BRUSH PLATE)		8		.01—	.10
825191	BRUSH (THIRD)	371	1		.012	.70
825196	CUP, RETAINER (C.E. & D.E.)	371,374,375	3		.01—	.15
825197	WASHER, FELT (C.E. & D.E.)	371,374,375	3		.01—	.05
825251	PLATE, RETAINER (C.E. & D.E.)	371,374,375	2		.375	1.50
825253	COLLAR, SPACE (INSIDE, D.E.)	371,372	1		.01—	.20
825254	COLLAR, SPACE (OUTSIDE, D.E.)	371,372	1		.01—	.30
825260	GASKET (C.E. & D.E.)	371,374,375	2		.01—	.10
825261	BAND, COVER	371,372	1		.500	2.50
826085	ARMATURE	371,372	1	13	.125	35.00
826087	FRAME, DRIVE END	371,375	1	3	.375	6.50
826088	FRAME, COMMUTATOR END	371,373	1	3	.250	7.50
826090	PLATE, MAIN BRUSH		1		.343	.50
826091	HOLDER, BRUSH—MAIN		2		.031	.35
826092	BRUSH, MAIN	371	2		.031	.75
826094	PLATE, THIRD BRUSH		1		.156	.25
826172	SCREW, TENSION	374	1		.01—	.05
826931	OILER (C.E. & D.E.)	371,374,375	2		.042	.50
827912	PLATE ASSY., MAIN BRUSH (See List of Assemblies)	371,374	1		.562	6.50
827913	PLATE ASSEMBLY, THIRD BRUSH	371,374	1		.250	2.50
828288	SCREW, CLAMP	374	1		.01—	.10
833634	CLIP TO THIRD BRUSH	371,373	1		.01—	.05
834231	WASHER	374,384,385	4		.01—	.05
834560	WASHER	382	2		...	.05
903305	BEARING, BALL (C.E. & D.E.)	371,374,375	2		.031	4.10
1839042	ARMATURE	389	1		.125	1.25
1839044	BRACKET & POINTS	389	1		.031	.75
1839108	BRACKET ASSEMBLY	390	1		.046	.85
1839109	SCREW, SILVER	390	1		.01—	.35
1839110	NUT, SCREW LOCK	390	1		.01—	.05
1839180	TUBE, OIL—IN FIELD FRAME	380	1		.01—	.25
1841953	SPRING	390	1		.015	.10
1843160	SUPPORT, BRACKET	390	1		.145	.55
1843646	SCREW	380	12		.	.02
1845396	BUSHING (ON SW. TERM.)	384,385	1		.01—	.10

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1845630	COVER	388	1		625	1 00
1845744	BASE ASSEMBLY	388	1		625	2 00
1845747	VOLTAGE REGULATOR ASSEMBLY	388	1		125	10 50
1845749	RESISTANCE UNIT	388	1		031	50
1847218	CLIP, TERMINAL	383	1			05
1847238	WASHER	382	1			05
1847239	WASHER, SPRING RETAINER (CUPPED)	382,384,386	1		01—	05
1848183	STRIP, INSULATING		2		01—	05
1849235	WASHER (33/64 x 1/64 x ¼")	382,384,386	2		01—	05
1850695	SCREW & COVER BUMPER	389,390	4		01—	10
1850699	CUT-OUT RELAY ASSEMBLY	388	1	1	110	9 00
1855481	DISC ON PUSH ROD	382,384,386	2		.156	1 25
1855488	PLATE INSIDE	383,384,389	1		.016	20
1855489	SCREW, TERMINAL	383	2		.02	2 50
1855490	WASHER, BUSHING	383,389	2		01—	.05
1855491	WASHER (OUTSIDE OF COVER)	383,384,385	2		.01—	05
1855492	NUT	384,385	2		½	05
1856822	PLATE, CENTER BEARING	377	1	1	.266	4 00
1856826	BUSHING	381	1		094	50
1856831	SLEEVE, SHIFT	377	1	1	031	3 00
1856840	GUIDE PINION	377	1		100	2 35
1856842	PINION, MOTOR DRIVE	377	1	1	.188	6 50
1856844	WASHER, SPACE	377	1		01—	10
1856850	CLIP	376,384,385	4		.052	20
1857386	CUP, RETAINER	384,386	1		01—	.15
1857739	TERMINAL & PLATE ASSEMBLY	382	1		12	6 00
1857824	SCREW LINK & ADJUSTING	377	1		.109	.50
1857826	PIN	377	1		.094	.15
1858490	WASHER (C E)	378	1		017	25
1858681	BUSHING	383	5			01
1860959	SCREW, MOUNTING (¼-20 x ⅜")	377	4		.01—	.02
1861779	PLATE, INSULATION	379	1		.031	65
1861781	PLATE (GROUND BRUSH)	379	3		.013	10
1861782	PLATE, BRUSH & STUD	379	1		.344	2 00
1861783	PLATE INSULATION—2 HOLE	379	3		.01	10
1861784	HOLDER BRUSH	379	6		063	25
1861785	SPRING	379	12		.01—	05
1861786	SCREW LONG—INS BRUSH	379	3		.025	15
1861787	SCREW, LONG—GROUNDED BRUSH	379	3		.029	.15
1861788	INSULATION, SCREW	379	12		.01—	05
1861790	PLATE, SUPPORT—BRASS	378	1		.141	1.25
1861791	WASHER (⅞" O D)	378,380	6		.01—	.05
1861792	WASHER (11/16" O D)	378,380	12		.01—	.05
1861900	BAND, COVER	377	1		.094	.40
1861906	STUD	380	1		109	.30
1862172	CLIP-ON FUSE, BATTERY A & NEG. TERM	384,385	3		.01—	.02
1863158	FIELD COIL ASSEMBLY (2 COILS)	380	1		938	1.80
1863159	COIL FIELD	380	1	1		1 80
1863160	FIELD COIL ASSEMBLY	380	1		875	1.80
1863173	STRIP	380	1		.01—	10
1863579	CABLE SOLENOID CONNECTOR	377	1		406	85
1864020	SPRING	381	1		051	.30
1864871	PLATE, TERMINAL—STEEL	387	1		195	15
1864890	CONTACT & SUPPORT	384,387	1		.031	.60
1865389	FRAME, END	378	1	2	.344	4.00
1865925	PLATE, SPACE—INSULATED BRUSH	379	3		.021	.20
1866833	WASHER, SLOTTED & CUPPED	384,386	1		.01—	.10
1866838	PLUNGER & PUSH ROD ASSEMBLY	384,386	1		.750	2 00
1866841	SPRING PLUNGER RETURN	384,386	1		.01—	10
1867662	CLIP—ON SW TERM	384,385	1		.01—	.01
1868809	STRIP, 13" INSULATION	380	1		01	05
1868810	INSULATOR—TRIANGLE	380	6		025	.05

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ELECTRICAL EQUIPMENT FOR SUPER C 491

1868811	STRIP, INSULATION—3" UNDER STUD	380	1		.01—	.05
1869007	TERMINAL PLATE & CONTACT ASSEMBLY	384	1	1	1	10.00
1869008	CONTACT PLATE ASSEMBLY W/BLADES	384,387	1		.25	4.50
1869009	CONTACT PLATE ASSEMBLY—LESS BLADES W/STATIONARY POINTS	387	1		.203	2.00
1869022	CONTACT BLADE—L.H. WITH 3 POINTS	384,387	1		.016	.80
1869025	CONTACT BLADE—R.H. WITH 2 POINTS	384,387	1		.016	.80
1869028	PIN HINGE	384,387	2		.01—	.05
1869029	SPRING, TENSION	384,387	2		.01—	.05
1869030	STUD & CONTACT	387	2		.188	2.75
1869032	NUT, STUD—½ x 13 x 11/16"	387	2		.063	.20
1869033	PLUNGER—BLACK INS. MATERIAL	384,387	1		.01—	.10
1869034	GASKET—SOFT RUBBER	384,385	1		021	.10
1869035	INSULATOR—UNDER COVER	384,385	1		.021	.15
1869036	WASHER	384,385	2		.01—	.05
1869037	COVER, SWITCH	384,385	1		.594	1.35
1869042	STRAP, GROUND	384,385	1		.016	.05
1869285	LEAD ASSEMBLY	388	1			.10
1869457	HOUSING, MOTOR DRIVE	381	1	9	.438	18.00
1869505	SPRING	382	1			.05
1869565	SPRING, MESHING	377	1		.063	.15
1869595	CLIP—ON SW. HSG. TERM. STUD	384	2		.015	.02
1869740	WASHER, SPACE	377	1		044	.02
1869849	WASHER	384,386	1		.01—	.05
1869851	NUT—¼-28 x 3/16"	384,386	1		01—	.10
1871092	GASKET	384,386	1		.01—	.05
1871522	SCREW (C.E. & D.E.)	371,374,375	10		01—	.03
1871714	BRUSH PLATE ASSEMBLY—LESS BRUSHES	378	1	1	.219	10.00
1872384	FUSE TERMINAL ASSEMBLY	384,385	2		.031	.95
1872443	SCREW—¼-28 x ¾"	371,372	12		016	.03
1872459	WASHER—OUTSIDE SW. HOUSING	382,384,386	2		01—	.01
1872510	SPRING, DISC—ON PUSH ROD	384,386	1		01	.05
1872650	STOP, PINION	377	1		050	.75
1872652	KEY, COTTER	377	1		.01—	.05
1872866	SCREW—¼-20 x ⅝"	377	4		.014	.10
1872915	SCREW (C.E.)—¼-28 x 1⅜"	377	6		025	.10
1872916	SCREW—¼-28 x 1-1/6"	377	5		031	.10
1873008	LOCKWASHER, SCREW (C.E.)	377	11		.01—	.05
1873200	COVER, SPRING	384,386	1		.328	2.00
1873333	NUT—½-13 x 7/16"	378,380,383, 385	4		.025	.05
1873334	NUT—½-13 x 7/16"	378,380,383, 384,385	4		.036	.05
1873516	COIL & CASE ASSEMBLY	384,386	1	5	.50	10.00
1873776	BRACKET, CONTACT—LESS POINT	390	1		.015	.55
1874492	WASHER—⅞ x 1/32 x 33/64"	387	2		.01—	.05
1877962	BUSHING, CENTER BEARING	377	1		094	.80
1878260	ARM, BRUSH		3		024	.30
1878261	SLEEVE, SPACE		3		01—	.10
1879687	GASKET	372	1			.15
1880232	ARMATURE	377	1	15	.75	32 50
1883641	CASE & COIL ASSEMBLY	382	1			10.00
1883642	PLUNGER ASSEMBLY	382	1		11	.95
1888405	LEVER ASSEMBLY	381	1			6 00
1901832	LOCKWASHER	378,389	14			.01
1901834	LOCKWASHER, SCREW	390	1		.01—	.01
1901842	LOCKWASHER	390	1			.01
1902314	INSULATOR	382,384,386	4			.03
1902315	WASHER	382,384,386	4			.02

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1902493	NUT	382				.05
1902494	LOCKWASHER	378,380,383, 384,385,387	4		.01—	.03
1902495	WASHER, NUT PLAIN	383,384,385	2		.01—	.05
1902651	LOCKWASHER	382	4			.01
1902652	SCREW	382	4			.01
1902653	LOCKWASHER, SCREW	379,382,384, 385	5		.01—	.01
1903161	SCREW, TERMINAL	382,384,386	4			.10
1904233	SCREW	378	12			.01
1904238	SCREW	379	6			.01
1904239	SCREW	379	6			.02
1904287	PLATE, TERMINAL	383	1			.25
5012568	WASHER, SCREW (C.E.) 25/64 x 1/32 x 17/64"	377	11		.01—	.05
5024654	NUT—#10-32 x 5/32"		3		.01—	.03

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ELECTRICAL EQUIPMENT FOR SUPER C 49

PART No.	DESCRIPTION	QTY.	PRICE EACH
1850699	VOLTAGE REGULATOR ASSEMBLY	1	
	(Includes following shown on Page 389):		
1850695	SCREW & COVER BUMPER	2	$ .10
106496	LOCKWASHER	4	.01
810794	PLAIN WASHER	3	.05
22820	SCREW	1	.05
1839044	BRACKET (AND POINTS)	1	.75
18203	WINDING	1	3.75
1839042	ARMATURE	1	1.25
18198	STOP BRACKET	1	.45
20987	SCREW	1	.01
18204	SHUNT WINDING	1	3.00
37330	SUPPORT FOR SERIES WINDING	1	
37339	ARMATURE SPRING	1	.15
1901832	LOCKWASHER	1	.01
20173	SCREW	1	.01
29991	MOUNTING NUT	1	.05
	FRAME (NOT A SERVICE PART)		
	SERIES WINDING (NOT A SERVICE PART)		
1845747	CUT-OUT RELAY ASSEMBLY		
	(Includes following shown on Page 390):		
1850695	SCREW & COVER BUMPER	2	.10
106496	LOCKWASHER	9	.01
20987	SCREW	5	.05
18201	WINDING	1	6.00
29991	MOUNTING NUT	1	.05
22820	SCREW	1	.05
1901834	LOCKWASHER	1	.01
30986	NUT	2	.05
1839109	SCREW (SILVER)	1	.35
1839110	LOCKNUT	1	.05
1901842	LOCKWASHER	1	.01
1873776	CONTACT BRACKET (LESS POINT)	1	.55
810794	PLAIN WASHER	8	.01
18194	ARMATURE	1	.70
1843160	BRACKET SUPPORT	1	.55
1841953	SPRING	1	.10
	SERIES COIL (NOT A SERVICE PART)	1	
	FRAME (NOT A SERVICE PART)	1	
187174	BRUSH PLATE ASSEMBLY		
	(Includes following shown on Page 379):		
1861790	SUPPORT PLATE (BRASS)	1	1.25
1861779	INSULATION PLATE	1	.65
1861782	BRUSH PLATE & STUD	1	2.00
1861788	SCREW INSULATION	12	.05
1861783	INSULATION PLATE (2 HOLE)	3	.10
1865925	SPACE PLATE (INSULATED BRUSH)	3	.20
1861784	BRUSH HOLDER	6	.25
1861786	SCREW, LONG—INS. BRUSH	3	.15
1861785	SPRING	12	.05
1904239	SCREW	3	.02
1902653	LOCKWASHER	12	.01
1861787	SCREW, LONG—GROUNDED BRUSH	3	.15
1861781	PLATE (GROUND BRUSH)	3	.10
1904238	SCREW	2	.01

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1869457	DRIVE HOUSING ASSEMBLY (Includes following shown on Page 381):		
115466	SCREW—1/4-20 x 5/8"	4	.03
113114	LOCKWASHER	4	.01
114998	OIL CUP	1	.05
1856826	BUSHING	1	.50
802691	OIL WICK	1	.05
	COVER (NOT A SERVICE PART)	1	
1857789	TERMINAL ASSEMBLY FOR SOLENOID (Includes following shown on Page 383):		
1855489	TERMINAL SCREW	2	2.50
1855488	PLATE (INSIDE)	1	.20
1904287	TERMINAL PLATE	1	.25
1858681	BUSHING	5	.01
1855490	BUSHING WASHER	2	.05
1885491	WASHER	1	.05
1873333	NUT	2	.05
1873334	NUT	2	.05
1902494	LOCKWASHER	4	.03
1847218	TERMINAL CLIP	1	.05
1902495	PLAIN WASHER	2	.05
1869007	TERMINAL ASSEMBLY FOR SERIES PARALLEL (Includes following shown on Page 387):		
1869030	STUD & CONTACT	2	2.75
1855488	PLATE (INSIDE)	1	.20
1855490	BUSHING WASHER	2	.05
1864871	TERMINAL PLATE (STEEL)	1	.15
1869009	CONTACT PLATE ASSEMBLY (LESS BLADES)	1	2.00
1869033	PLUNGER	1	.10
1864890	CONTACT & SUPPORT	1	.60
1869022	CONTACT BLADE (L.H. WITH 3 POINTS)	1	.80
1869025	CONTACT BLADE (R.H. WITH 2 POINTS)	1	.80
1869029	TENSION SPRING	2	.05
1869028	HINGE PIN	2	.05
1874492	WASHER	1	.05
1902494	LOCKWASHER	2	.03
1869032	STUD NUT	2	.20
1869008	CONTACT PLATE ASSEMBLY (WITH BLADES) (Includes following shown on Page 387):		
1869009	CONTACT PLATE ASSEMBLY (LESS BLADES)	1	2.00
1869033	PLUNGER	1	.10
1869022	CONTACT BLADE (L.H. WITH 3 POINTS)	1	.80
1869025	CONTACT BLADE (R.H. WITH 2 POINTS)	1	.80
1869028	HINGE PIN	2	.05
1869029	TENSION SPRING	2	.05
827912	MAIN BRUSH PLATE ASSEMBLY (LESS BRUSHES)		
826090	MAIN BRUSH PLATE ONLY	1	.50
826091	BRUSH HOLDER	2	.35
1878260	BRUSH ARM	2	.30
35777	BRUSH SPRING	2	.10
1878261	SPACE SLEEVE	2	.10
825184	BRUSH HOLDER STUD	2	.10
825185	BUSHING (STEEL IN BRUSH HOLDER)	2	.10
825190	BUSHING (IN BRUSH PLATE)	2	.10
802731	LOCKWASHER	2	.01
5024654	NUT—#10-32 x 5/32"	2	.03
132911	SCREW	2	.01
802731	LOCKWASHER	2	.01
825187	WASHER—2 HOLES	5	.05
825189	WASHER—2 HOLES	2	.05
825186	BRACKET	2	.20

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827913	THIRD BRUSH PLATE ASSEMBLY (LESS BRUSH):		
826094	THIRD BRUSH PLATE ONLY	1	.25
825183	BRUSH HOLDER (THIRD)	1	.35
34501	PIN, ADJUSTING FOR 3RD BRUSH PLATE	1	
1878260	BRUSH ARM	1	.30
35777	BRUSH SPRING	1	.10
1878261	SPACE SLEEVE	1	.10
825184	BRUSH HOLDER STUD	1	.10
825185	BUSHING (STEEL IN BRUSH HOLDER)	1	.10
825190	BUSHING (IN BRUSH PLATE)	2	.10
802731	LOCKWASHER	1	.01
5024654	NUT—#10-32 x 5/32"	1	.03
132911	SCREW—#10-32 x 5/8"	1	.01
802731	LOCKWASHER	1	.01
825187	WASHER—2 HOLES	1	.05
825189	WASHER—2 HOLES	2	.05
825186	BRACKET	1	.20

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PART No.	DESCRIPTION	PAGE	QTY.	WEIGHT Lb.	WEIGHT Oz.	PRICE EACH
C-1	CUP, BEARING	444	4		12	$ 1.20
C-7	CONE, BEARING	424,425,430, 431	8	2	10	3.95
C-8	CUP, BEARING	424,425,430, 431	8	1	10	2.55
C-9	CAP, REAR PLATE	430	1	2		1.30
C-11	CONE, BEARING	453,454	2	4	8	8.19
C-12	BEARING, STRAIGHT	438,449,451, 452	14		8	1.31
C-16	CONE, BEARING	444			14	1.90
C-40	LINING, CLUTCH	424,425	2	2	4	5.56
C-49	LINK, BRAKE	406	4		12	.28
C-51	SPRING, BRAKE	424	2	1	12	1.69
C-71	SPRING, LEVER NEUTRAL POSITION	432,459	3		6	.66
C-83	CABLE DRUM, STD.	430,431	2	40		28.50
C-131	ROLLER, MAIN TAILGATE	449	4	10	8	5.21
C-133	ROLLER, SIDE THRUST	449	4	4	4	2.96
C-134	PIN, THRUST ROLLER	449	4	3	8	1.50
C-137	WHEEL, 9½" SHEAVE	444	2	15		5.28
C-138	PIN, SINGLE SHEAVE	439,444	7	6		1.88
C-143	GEAR, MAIN	424,425	2	38		54.18
C-172	WHEEL, 9½" SHEAVE, NARROW	444	3	12		5.20
C-174	PIN, SINGLE SHEAVE	444	3	4	6	2.38
C-175	BEARING, STRAIGHT	444	5	1	8	2.38
C-177	BEARING, STRAIGHT	439,440,449	12	2		2.70
C-192	LINING, BRAKE	424	2	1	1	2.29
C-196	SPRING, CLUTCH RELEASE	430,431	4		4	.51
C-218	LINK, BRAKE	424,426	8		6	.26
C-312	LOCKWASHER, ⅜"	393,394,395, 396,397,398, 399,400,401, 406,411,419, 420,424,459	168			.01
C-315	FITTING, STRAIGHT GREASE, ⅛"		49			.06
C-320	CUP, BEARING	402,403,407, 408,409,453, 454	8	2	8	4.09
C-321	CUP, BEARING	453,454	2	6		10.58
C-336	RACE, BEARING	451,452	2		8	1.23
C-337	RACE, BEARING	427,428,429, 451,452	8		12	1.35
C-445	WEDGE, SMALL CABLE	437	1		8	.38
C-498	NUT, BEARING ADJUSTING	444	2	2		3.30
C-501	NUT, UNIVERSAL	443,450	3	1	14	1.05
C-502	WEDGE, LARGE CABLE	448	2	3	4	1.03
C-503	SOCKET, LARGE CABLE	441,448	2	2	8	1.31
C-504	SOCKET, SMALL	437,451	3	1	4	.68
C-535	BOLT, YOKE HINGE	443	2	5	8	2.79
C-620	RETAINER	453,454	2	4	8	1.86
C-1034	PLUG, PIPE 1¼"	395,424,437	4		12	.17
C-1051	KEY, COTTER, ⅜ x 5"	439,444,449	14		4	.06
C-1231	COUPLING	393	1			.06
C-1277	RING, LOCKING	410,453,454	4	5	8	3.04
C-1414	PLATE, SPRING PULL	437	1	30		8.38
C-1518	KEY, COTTER, ¼ x 2"	459	1			.01
C-1520	NUT, NC HEX 5/16"	411	34			.01
C-1521	NUT, NC HEX ⅜"	406,411,419, 420,455,456, 459,460,462, 463,464	25			.01
C-1522	NUT, NF HEX ⅜"	393,394	7			.01

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C-1523	NUT, NC HEX ½"	393,395,412, 413	6			.03
C-1524	NUT, NF HEX ½"	393,421,430, 432,455,456, 459,461,462, 463,464	28			.03
C-1525	NUT, NC HEX ⅝"	412,413,424, 426,430	18			.04
C-1526	NUT, NF HEX ⅝"	392,395,421	8			.04
C-1527	NUT, NC HEX ¾"	392,414,415, 430,442	16			.05
C-1529	NUT, NC HEX ⅞"	448	8			.08
C-1530	NUT, NF HEX ⅞"	407,453,454	6			.08
C-1531	NUT, NC HEX 1"	437,445,449, 450,455	19			.11
C-1532	NUT, NF HEX 1"	406	4			.11
C-1536	NUT, NC HEX CASTELLATED, 1¼"	465	4		12	.33
C-1538	LOCKWASHER, 5/16"	395,397,407, 411,417,421, 461,462,463, 464	70			.01
C-1540	LOCKWASHER, ½"	312,393,404, 405,412,413, 414,415,421, 430,432,433, 455,456,459, 461,462,463, 464	150			.01
C-1541	LOCKWASHER, ⅝"	392,393,394, 412,413,421, 424,426,430, 432	37			.02
C-1542	LOCKWASHER, ⅜"	402,403,414, 415,430,442, 443,455,456	40			.03
C-1543	LOCKWASHER, ⅞"	411	2			.05
C-1544	LOCKWASHER, 1"	437,439,449, 450,455	29			.07
C-1546	CUT WASHER, ¼"	411	6			C .75
C-1547	CUT WASHER, ⅜"	419,420	23			C .75
C-1549	CUT WASHER, ½"	392,414,415	16			C .75
C-1550	CUT WASHER, ⅝"	412,413,421	4			.01
C-1551	CUT WASHER, ¾"	415	2			.01
C-1552	CUT WASHER, ⅞"	448	8			.01
C-1555	KEY, COTTER, 5/32 x 1"	406,420,424, 426,461,462, 463,464	46			.01
C-1558	KEY, COTTER, ⅜ x 3½"	445,449,451, 452	7			.05
C-1577	BOLT, MACHINE & HEX NUT	449	2	3		.48
C-1581	BOLT, MACHINE & HEX NUT	437	8	3	2	.62
C-1596	FITTING, GREASE	392,393,395, 449,459	16			.10
C-1598	CAPSCREW, NC 5/16 x 1"	411,417	50			.02
C-1601	CAPSCREW, ⅜ x ¾" NC	406,419,421, 424	50			.03
C-1602	CAPSCREW, ⅜ x 1" NC	393,394,395, 397,411,419	67			.03
C-1603	CAPSCREW, ⅜ x 1¼" NC	396,398,411 419,420,459	26			.03
C-1606	CAPSCREW, ⅜ x 2" NC	396,399	4			.03
C-1612	CAPSCREW, ½ x 1" NC	447,453,454	14			.05
C-1613	CAPSCREW, ½ x 1¼" NC	411,414,416 417,424,425	36			.06

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C-1614	CAPSCREW, ½ x 1½" NC	407,412,413, 430,431	60			.06
C-1615	CAPSCREW, ½ x 1¾" NC	412,413,422, 430	9			.06
C-1616	CAPSCREW, ½ x 2" NC	422	1			.07
C-1621	CAPSCREW, ½ x 3¼" NC	453,454,455	8		4	.11
C-1629	CAPSCREW, ⅝ x 1¾" NC	412,413,432	21		4	.11
C-1634	CAPSCREW, ⅝ x 3" NC	412,413,424, 426,430	8		4	.15
C-1644	CAPSCREW, ¾ x 2" NC	455,456	20		6	.17
C-1645	CAPSCREW, ¾ x 2¼" NC	414	2		6	.18
C-1648	CAPSCREW, ¾ x 3" NC	430,442	8		8	.20
C-1668	CAPSCREW, 1 x 3" NC	445	1	1		.47
C-1673	CAPSCREW, ⅜ x 1¾" NF	393	1			.03
C-1678	CAPSCREW, ½ x ¼" NF	415	4			.06
C-1679	CAPSCREW, ½ x 1½" NF	392,393,404, 405,414,421, 433,455,456, 459	104			.06
C-1680	CAPSCREW, ½ x 1¾" NF	407,409,455, 456	20			.06
C-1681	CAPSCREW, ½ x 2" NF	418,432	13			.07
C-1682	CAPSCREW, ½ x 2¼" NF	430	4			.08
C-1690	CAPSCREW, ½ x 4¼" NF	432	2		4	.14
C-1698	CAPSCREW, ⅝ x 2¾" NF	392	2		4	.13
C-1708	CAPSCREW, ¾ x 1¾" NF	443	4		6	.16
C-1709	CAPSCREW, ¾ x 2" NF	407,409	8		6	.17
C-1714	CAPSCREW, ¾ x 3¼" NF	402,403	4		8	.23
C-1915	SPRING, TAILGATE RETURN	437	6	50		13.50
C-2283	WEDGE, CABLE	437	1		12	.38
C-2303	KEY, COTTER, ⅛ x 1"	392,406,414, 432,433,457	21			.01
C-2508	KEY, COTTER, 5/16 x 3"	443,447,450	4			.01
C-2958	HOUSING, SHEAVE	443	2	17		11.18
C-5747	CAPSCREW, 5/16 x ¾" NC	465	4			.02
C-5762	CAPSCREW, ⅝ x 1½" NC	432	5			.10
C-5768	PLUG, PIPE, ⅛"	457	1			
C-5770	PLUG, PIPE, ⅜"	412,413,419	5			.03
C-5774	LOCKWASHER, ¼"	370,396,397, 420	19			.01
C-5775	LOCKWASHER, 7/16"	459	4			.01
C-5783	NUT, 7/16" NF HEX	444	2			.03
C-5799	CAPSCREW, ⅜ x ¾" NF	406	4			.03
C-6507	GUARD, LEFT CABLE	430	2	22		7.55
C-6508	GUARD, RIGHT CABLE	430	2	22		7.55
C-7376	SPIRAL SHEAVE STRUCTURE	451,452	1	67		30.55
C-7567	CAPSCREW, 5/16 x ¾" NF	461,462,463, 464	4			.02
C-7576	CAPSCREW, ⅝ x 1¼" NF	407,408	8			.10
C-7584	CAPSCREW, ⅞ x 3½" NF	453	2		12	.36
C-7642	CAPSCREW, ⅞ x 3½"	411	2		12	.36
C-8093	SPACER, BEARING	451,452	1		12	.53
C-8310	PLUG, 1¼" PIPE—DRILLED	424	1		8	.23
C-9656	NUT, 5/16" NF HEX	395,397	1			.01
C-9771	NUT, ⅝" NF HEX JAM	395,460	9			.04
D-940	PIPE, SPIRAL SHEAVE GREASE	393,394	1		8	.11
D-1255	CAP, HUB	453,454	2	14	12	6.37
D-1257	AXLE NUT WITH BOLTS	453,454	2	1	8	.93
D-1423	PLUG, 1¼" PIPE (SOCKET)	412,413,416, 417	10		12	.12
D-1782	KEY, 3/16 x 2" COTTER	464 461,462,463,	4			.01
D-1784	CAPSCREW, 1 x 2¼" NC	450	8		12	.42
D-1957	PLOWBOLT, ⅞ x 2¼"	437	60		8	.16

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D-1958	WRENCH, SOCKET	437	1	3		3.83
D-2378	BEARING, STRAIGHT	427,429	1		12	2.63
D-2562	CUP, TAPERED	407,409	2	9	2	19.32
D-2613	LINING, BRAKE (VELVETOUCH)	424	2	3	8	8.19
D-2614	LINING, CLUTCH (VELVETOUCH)	424	2	5	8	16.52
D-2778	WASHER, 1/2" SHAKEPROOF	402,403	2			.01
D-2779	LOCKWASHER, 5/8" SHAKEPROOF	404,405,412, 413,432	26			.02
D-2889	LOCKWASHER, 1/2" SHAKEPROOF	407,412,413, 424,425,430, 431,447	87			.01
D-3184	CONE, TAPERED	407,409	2	15	14	22.68
D-3528	BEARING, STRAIGHT ROLLER	427,428	1		12	1.75
D-3677	WRENCH, SOCKETHEAD	423	1		2	.20
D-3679	RIVET, BRAKE LINING	393,424	168			C .80
D-3930	CONE, T DRIVING	424,425	2	26		26.65
D-3932	PLATE, T COVER	424	2	11	12	9.52
D-3959	NEEDLE, BEARING	424,425	2	1	4	5.59
D-3994	CAPSCREW, 1/2 x 3/4" NF	414,457	10			.05
D-4045	GEAR, REDUCTION	427,429	1	16		28.15
D-4230	PINION (23 TEETH)	427,428	1	14	12	25.12
D-4322	NUT, BRAKE SHAFT	424,426,433	4		8	.37
D-4377	BUSHING, NECK	427,428	1	5		5.38
D-4429	CONE, TAPERED	424,426,433	6		8	1.27
D-4431	FELT CLOSURE	424,426,433	8		4	.26
D-4432	CUP, TAPERED	424,426,433	6		2	.47
D-4433	BUSHING, THROW NUT	424,425	2	1	12	2.85
D-4476	NUT, RIGHT THROW	424,425	1	4	4	13.96
D-4477	NUT, LEFT THROW	424,425	1	4	4	13.96
D-4509	SHAFT, RIGHT BRAKE	424,426	1	5	8	3.89
D-4510	SHAFT, LEFT BRAKE	424,426	1	5	8	3.89
D-4534	PIN, BRAKE LINK W/COTTERS	424,426	8		2	.25
D-4535	PIN, BRAKE SPRING ARM	424	2		2	.25
D-4904	BLOCK, PINION BEARING	427	1	4	4	2.86
D-5133	SETSCREW, 1/2 x 2 1/2"	424	2		4	.16
D-5161	BLOCK, CLAMP	437	4	8	8	2.86
D-5434	CLEVIS	392,406	4		6	.46
D-6058	WRENCH, SOCKETHEAD	423	1		4	.31
D-6394	CAPSCREW, 3/4 x 1" NC SOCKETHEAD	427,441	6		4	.26
D-6538	SPACER	424	8			.10
D-6732	BAR	414	2	1		.35
D-7054	BAND, BRAKE (W/VELVETOUCH)	424	2	6		15.75
D-7134	BAND, BRAKE	424,426	2	5	8	9.89
D-7348	CONE, T VELVETOUCH DRIVING	424,425	2	30		37.63
D-8493	PLATE, REAR	430	2	50		16.90
D-9454	CAPSCREW, 3/4 x 1 1/4" NF	402,403	12		8	.17
D-9649	CAPSCREW, 1/2 x 2 1/4" NF	402,403	2		4	.20
D-9894	CABLE DRUM ASSEMBLY, L.	430	2	110		114.58
D-9895	CABLE DRUM ASSEMBLY, R.	430	2	110		114.58
E-229	SHIM, CABLE GUARD	430	4			.10
E-3598	HOUSING, SWIVEL SHEAVE, R.	443	1	17		11.18
E-3787	CABLE WEDGE	451,452	2		12	.53
E-3909	CAPSCREW, 1 x 3 1/4" NC	450,455,456	8	1		.51
E-4132	KEY, 1/8 x 2" COTTER	424,426,433	4			.01
E-4162	PIN, ROD END	392,406,432, 433	14		2	.22
E-5165	SHIM, POWER UNIT	424,425				.10
E-5251	PLUG, 1/8" PIPE	412,413,430, 431,451	4			.05
E-6687	BEARING, STRAIGHT	427,428,429	2		12	1.69
E-7888	SETSCREW, 5/8 x 1 1/4" NC	448	2			.13
E-8618	SHIM, DRUM	430,431				.10
E-8635	CONE, DRIVEN	430,431	4	38		42.20

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F-267	ROLLER, T BRAKE	424,426	2	1	4	.73
F-268	PIN, T BRAKE ROLLER	424,426	2		4	.31
F-416	SHAFT, L. DRUM	430,431	2	27	4	24.18
F-417	SHAFT, R. DRUM	430,431	2	27	4	24.18
F-883	LOCKWASHER, SHAKEPROOF ¾"	402,403	12			.03
F-1230	PIN, APRON HINGE	447	2	12		7.80
F-3121	BLADE BASE	437	1	425		100.00
F-3232	DRUM, BRAKE	455,466	8	84		40.60
F-3551	BOLT, 2 x 13⅛"	450	1	12	8	6.56
F-4022	SCREW, 12 x ½" DRIVE	460	26			.01
F-5027	PIN, ROLLER	439,449	4	7		4.18
F-5342	SHIM, DRUM	430				.10
F-5343	SHIM, GEAR	424				.10
F-7255	WEDGE, CABLE	440,447,448	4	4	12	1.57
F-7269	WHEEL, 9½" WIDE SHEAVE	439,440	8	15		5.28
F-7860	HONDO, HINGED	447	1	18	8	6.72
F-8160	SPIDER, SLIDING	404,405	2	3	10	4.84
F-8161	FINGER	404,405	8	1		1.47
F-8162	LINK	404,405	16		4	.26
F-8167	LINING, VELVETOUCH	404	2	7		19.38
F-8171	LINING, VELVETOUCH BRAKE	406	2	12		36.30
F-8230	SHAFT, SPLINE	432	1	15		22.13
F-8234	PIN, FINGER	404,405	24		2	.35
F-8235	BUSHING	404	4		2	.65
F-8236	COLLAR, CLUTCH THROWOUT	404,405	2	5	8	7.89
F-8241	YOKE, CLUTCH YOKE	404,405	2	15		8.13
F-8248	NUT, 9/16" CASTELLATED	404,405	24			.10
F-8372	NUT, ADJUSTING	402,403	2	2	12	2.82
F-8385	BLOCK, KEEPER	443	1	11	12	6.04
F-8448	PIN, HONDO HINGE	447	1	2		1.30
F-8620	PIN, PUSHBEAM HINGE	445	1	3	12	3.34
F-8820	ROLLER, PUSHBEAM	438	1	3	4	3.03
F-9203	CAPSCREW, 1 x 2" NF SOCKETHEAD	443	4		8	.62
F-9223	LINK, THROTTLE	420	2			.60
F-9233	BOX, BATTERY	414	1	28		9.45
F-9238	BOX, BATTERY	414	1	28		9.45
F-9242	COVER, INSPECTION HOLE	414	2	3		1.33
F-9319	RAIL, RUNNER	437	2	24		5.35
F-9988	BUSHING, SHEAVE	438,439,440, 441	21	1	8	2.29
F-9989	NUT, 1½" HALF NF	439,440,441, 446	6		8	.52
F-9991	PIN, SINGLE SHEAVE	439,441,446	3	1	8	2.04
H-9	HONDO, HINGED	440	1	18	8	6.71
H-13	PIN, HONDO HINGED	440	1	8	12	5.47
H-23	PIN, HONDO HINGED	440	1	6	4	3.91
H-171	WHEEL, 9½" THIN SHEAVE	438,439,440, 441,446	21	8	8	4.01
H-220	BOTTOM, SCRAPER	437	1	1540		398.50
H-225	BEARING	438,439,440, 441	16	1	4	2.38
H-270	HITCH, DETACHABLE REAR	450	1	281		89.53
H-271	HOUSING, APRON LIFT SHEAVE	439	1	31		10.28
H-272	SPACER (SMALL)	441	1		4	.31
H-273	SPACER (LARGE)	441	1		8	.47
H-290	STRUCTURE, APRON	447	1	1480		477.00
H-421	ADAPTER, BEARING	396,398	1	17		21.25
H-424	GASKET	396,399	1			.25
H-425	RETAINER SEAL	396,399	1	2	10	1.32
H-443	BRAKE STOP	406	2		10	.42

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H-467	SWITCH	420	2		2	.75
H-582	CONE, TAPERED	407,408	2	6	12	10.11
H-583	CUP, TAPERED	407,408	2	4		5.59
H-712	LINK, BRAKE	406	4		8	.37
H-722	BAND, C BRAKE—LINED	406	2	25		53.88
H-727	PLATE LOCK	407,409	2		2	40
H-738	WASHER, 1/2" COPPER	407,409,414, 457	16			.03
H-745	PIN, 3/32 x 3/4" COTTER	370,393,394, 396,397,404, 405,420	23			.01
H-748	CAPSCREW, 5/16 x 5/8" NF	407,421	16			.02
H-838	SHIM, SUPPORT	412,413				.05
H-839	SHIM, SUPPORT	412,413				.05
H-980	KEY, 1/4 x 1 1/4" WOODRUFF	392,404,405	4			.05
H-989	NUT, 1" NF JAM	407	8		2	.16
H-997	GASKET, NECK FACE	432	1			.30
H-1001	TIP, RIGHT BLADE	437	1	51		10.30
H-1003	TIP, LEFT BLADE	437	1	51		10.30
H-1111	CAPSCREW, 1 x 1 1/2" NF	439	3		10	.37
H-1112	PIN, TRIPLE SHEAVE	440	1	2		3.30
H-1113	PIN, DOUBLE SHEAVE	440	1	1	8	2.79
H-1221	PIN, SPIRAL SHEAVE	451,452	1	7	4	5.93
H-1588	CAPSCREW, TAPERED HEAD	410	32	1	10	.63
H-1771	HOUSING, SLIDING SHEAVE	440	1	60		20.25
H-2113	BUSHING, BRASS	392,459	2		2	.76
H-2125	WRENCH	423	1		14	1.98
H-2127	WRENCH	423	1	1	4	2.28
H-2128	WRENCH	423	1	1		1.53
H-2160	LEVER, R. THROW	392	1	1	8	2.05
H-2161	LEVER, L. THROW	392	1	1	8	2.05
H-2165	ROD, CLUTCH	392	1	1	12	.94
H-2176	BRACKET	370	1			
H-2183	BRACKET, SEAT	415	1	24		16.60
H-2192	COVER, BATTERY BOX	414	2	5	12	1.59
H-2257	PIN, THROTTLE HINGE	420	2		2	.36
H-2258	CLAMP	370	2			.10
H-2320	WEDGE, CABLE	441	1	4		1.35
H-2369	GASKET	414	2			.15
H-2370	GRIP, HANDLE	392	4		6	1.07
H-2378	BRACKET	433	1	10		3.85
H-2379	SHAFT, RIGHT	433	1	5	4	2.90
H-2380	SHAFT, LEFT	433	1	5	2	2.90
H-2382	HANDLE, RIGHT	433	1	8	10	5.25
H-2383	HANDLE, LEFT	433	1	7	12	5.20
H-2386	ROD, L. LEVER	432	1	2	4	1.46
H-2388	ROD, R. LEVER	432	1	1	6	1.23
H-2420	RING, SLIDING (21 x 24)	410,453,454	4	51		17.03
H-2434	BUSHING, BRONZE	404	4		6	.91
H-2456	LEVER, HORIZONTAL	392	2	2	4	3.05
H-2457	BRACKET, RIGHT	392	1	1	12	1.79
H-2458	BRACKET, LEFT	392	1	1	12	1.79
H-2461	WASHER	392	2			.03
H-2462	CLEVIS, MALE	392,406	4		8	.66
H-2465	HOUSING, SMALL ROLLER	449	4	4	8	1.76
H-2472	BEARING, BALL	393,394	1		8	4.11
H-2475	GASKET, COVER PLATE	414	1		6	1.95
H-2476	GASKET, BEARING PLATE	407	2			.15
H-2477	GASKET, WHEEL (RETAINER)	407,409	2			.50
H-2486	PIN, CLEVIS	392	4			.25
H-2633	ADAPTER, TACHOMETER	420	1	1	4	6.03
H-2640	BOLT, 1/4 x 3/4" BRASS	370,420	15			.03
H-2641	NUT, 1/4" BRASS	370,420	19			.02
H-2642	SCREW, 3/16 x 1/2" BRASS	420	6			.02
H-2643	LOCKWASHER, 3/16"	420,421,465, 466	12			.01

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H-2644	NUT, 3/16" BRASS HEX	420	6			.02
H-2655	SOCKET, 1/16" BALL	443				.40
H-2656	SOCKET, 1/8" SHIM BALL	443				.40
H-2673	SCREEN, FUEL FILTER	412,413	2	1		2.98
H-2676	CLAMP, 2" HOSE	411	3		2	.20
H-2682	GUIDE LAMP ASSEMBLY	421	2	6	8	11.50
H-2692	12 VOLT HORN ASSEMBLY	420	1	3		7.83
H-2738	CONE, MALE, W/LINING (DRILLED)	404,405	2	44		48.10
H-2739	CONE, MALE, W/LINING	404,405	2	53		54.33
H-2770	CLEVIS	432	2		8	.82
H-2812	GASKET	453,454	2			.20
H-2817	GASKET	453,454	2			.20
H-2824	GASKET	427	1			.65
H-2825	GASKET	424	2			.65
H-2840	CLEVIS	392	4		8	1.76
H-2849	SETSCREW, 3/8 x 2 1/2" NC	406	4			.15
H-2850	ADJUSTING ARM ASSEMBLY	393	1	1		2.08
H-2855	SETSCREW	393,395	2			.15
H-2857	RELEASE YOKE ASSEMBLY	393	1	2		5.20
H-2859	CAPSCREW, 3/8 x 1"	393	2			.10
H-2861	NIPPLE, OIL PIPE	393	1			.15
H-2862	ELBOW, OIL PIPE	393,394	1			.15
H-2865	GEAR, 3RD SPEED, & BUSHING ASSEMBLY	396,398	1	12	4	23.61
H-2867	BUSHING, GEAR	396,398	1		6	2.21
H-2868	GEAR & BUSHING ASSEMBLY	396,398	1	19		27.88
H-2870	GEAR, BUSHING	396	1		6	2.46
H-2872	PIN, DOWEL	393	2			.10
H-2874	STUD	395	4			.30
H-2876	STUD	393,394	6			.25
H-2877	HOUSING, CLUTCH	393,394	1	40		34.00
H-2879	NUT, 5/8"-18 SAE HIGH	393,394	6			.10
H-2882	REVERSE GEAR & BUSHING ASSEMBLY	400,401	1	9		21.38
H-2883	BUSHING	400	1		6	2.21
H-2885	BALL, GEAR SHIFT LEVER	396,397	1			.35
H-2886	PIN, SHAFT LOCK	395	2			.07
H-2887	PLATE, COVER	393,394	1		10	.45
H-2888	WASHER, LATCH	396	1			.07
H-2889	PIN, INTERLOCK CROSS	395	1			.10
H-2890	LOCK, SHAFT	400,401	1		1	.10
H-2891	GASKET	395	1			.10
H-2892	GASKET, COVER	395,459	3			.05
H-2893	SPRING, ROD	396,397	1			.05
H-2894	SPOON, LATCH	396,397	1		1	.15
H-2895	LATCH, REVERSE STOP	396,397	1		2	1.21
H-2896	RIVET, SPOON	396,397	2			.05
H-2899	THIMBLE	395	1			.05
H-2900	COVER, SPRING	396	1			.20
H-2902	SHAFT, PEDAL	393	1	2		1.25
H-2903	PIN, PIVOT	395,397	1			.10
H-2904	END, ROD	396,397	1			.20
H-2905	SPRING, LEVER	396,397	1		1	.15
H-2906	WASHER, LEVER	396,397	1			.10
H-2907	COVER	395	2		10	.40
H-2908	THIMBLE, LONG	395	3			.15
H-2909	BELL, LEVER	396,397	1		2	.40
H-2910	SCREW, LOCKING	396,397,400	4		2	.15
H-2911	LEVER, GEAR SHIFT	396,397	1	3	4	9.23
H-2912	ROD, LATCH	396,397	1		4	.46
H-2913	PLATE, COVER	393	1		7	.55
H-2914	SHAFT, SHORT CLUTCH	393	1	1	4	.73
H-2915	SPRING, OIL PIPE	393	2			.25
H-2916	NUT, BEARING	396,398	1		6	.71
H-2918	SHAFT, IDLER	400,401	1	3		3.58
H-2919	SPRING	396	3			.08

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H-2920	HOUSING, GEAR SHIFT LEVER	395,396,397	2	6	8	5.31
H-2921	SHAFT, CLUTCH	396,398	1	11		32.68
H-2922	GEAR, COUNTERSHAFT DRIVE	396,399	1	12	8	17.21
H-2923	COVER, BEARING	396	1	5		7.63
H-2924	GASKET	396	1			.10
H-2925	YOKE, 3RD & 4TH SHIFTING	396,398	1	2	4	5.06
H-2926	YOKE, 1ST & 2ND SHIFTING	396,398	1	3		5.23
H-2927	YOKE, REVERSE SPEED SHIFTING	400,401	1	4	4	7.51
H-2928	BAR, 3RD & 4TH YOKE	395	1	1	8	3.04
H-2929	BAR, 1ST & 2ND YOKE	395	1	1	10	3.04
H-2930	BAR, REVERSE YOKE	395,400,401	2	1	10	3.04
H-2931	CLUTCH, SLIDING	396,398	1	2		8.10
H-2932	GEAR, 3RD SPEED	396,399	1	9	12	14.84
H-2933	GEAR, 2ND SPEED	396,399	1	5	6	11.23
H-2934	WASHER, 2ND GEAR	396,398	1		4	1.96
H-2935	SLEEVE, 3RD SPEED GEAR	396	1	1	14	7.70
H-2936	WASHER, 3RD GEAR	396,398	1		8	2.42
H-2937	KEY, WASHER	396	1		1	1.30
H-2938	NUT, BEARING	396,399	1		8	1.51
H-2939	RING, SNAP	396,399	1			.50
H-2940	PLUG, EXPANSION	396,399	1			.35
H-2941	RING, SNAP	396,399	1		2	.55
H-2942	GASKET	395	1			.20
H-2943	PLUG, EXPANSION	395	3			.10
H-2944	SPACER, BEARING	400,401	1		6	.56
H-2945	CARRIER, BEARING	393,394	1	2		4.20
H-2946	PLUG	395	3			.15
H-2948	SPACER, GEAR	396,399	1	2		2.05
H-2949	MAINSHAFT, SPLINED	396,398	1	25		41.28
H-2952	SHIMS, ADJUSTING, SET OF	396,398	2	4		1.26
H-2953	COVER, HOUSING	396,398	1	2	12	3.57
H-2954	HOUSING, SHIFTING BAR	395	1	23		16.50
H-2955	COUNTERSHAFT	396,399	1	27		38.78
H-2956	GEAR, REVERSE IDLER	400,401	1	13	8	27.74
H-2957	GEAR, 1ST SPEED	396,398	1	18	8	28.76
H-2965	KEY, #3 WOODRUFF	396	1			.03
H-2966	KEY, #11 WOODRUFF	396	2			.10
H-2967	KEY, #29 WOODRUFF	396	3			.13
H-2968	BOLT, 3/8 x 1 3/8" THIN HEAD	396,397	1			.10
H-2969	SCREW, #12 x 3/8" MACHINE	396,397	1			.04
H-2970	CAPSCREW, 5/16 x 1/2" NC	393,394	6			.08
H-2974	CAPSCREW, 3/8 x 1 1/2"	396	2			.15
H-2977	PLUG, DRAIN 3/4"	395,396	2		3	.65
H-2980	BALL, 1/2" STEEL	396	3			.08
H-2981	BALL, 3/4" STEEL	395	2			.10
H-2982	BEARING, BALL	396,399	1	2		5.70
H-2983	BALL BEARING & SNAP RING	396,399	1	2	12	7.77
H-2984	BALL BEARING & SNAP RING	396,398	1	3	6	8.78
H-2985	BEARING, ROLLER	400,401	2		10	1.27
H-2986	BEARING, ROLLER	396,398	1	1	4	8.73
H-2987	BEARING, BALL	393,394	1	1	4	6.38
H-3014	NUT, BRASS UNION	419	1			.20
H-3015	REDUCER, BRASS	419	1			.30
H-3026	SPRING	406	2		2	.21
H-3029	BATTERY—NOT SOLD. ORDER FROM EXIDE DEALER	391	4			
H-3031	WASHER, COPPER	395	4			.04
H-3039	WASHER, 1" COPPER	406,407	6			.08
H-3043	GROMMET, RUBBER	414	10			.05
H-3047	LEVER, ACTUATOR	406	2	3	8	1.84
H-3060	CUP, BEARING	407	2	1	12	.79
H-3150	CUTTER, CABLE	434	1	8		10.70
H-3166	CLAMP, 1/4" JIFFY	460	26			.08
H-3167	CLIP, 3/8"	370,420	7			.10

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H-3175	DRIVEN DISC & FACING ASSEMBLY	393,394	1	11	10	25.29
H-3176	FACING, CLUTCH	393	2	2		4.51
H-3179	PRESSURE & STUD ASSEMBLY	393,394	1	26		25.65
H-3180	FLYWHEEL RING & STUD ASSEMBLY	393,394	1	20		21.45
H-3182	SLEEVE ASSEMBLY	393,394	1	2		8.55
H-3184	RETRACTOR SPRING	393,394	4			.10
H-3185	LEVER, PRESSURE	393,394	20		2	.25
H-3186	STRAP, ADJUSTING	393,394	6			.08
H-3187	RING, SNAP	393,394	1			.15
H-3188	RING, FULCRUM	393,394	2		6	.61
H-3189	SHIM, ADJUSTING	393,394	36			.02
H-3194	BALL, LEVER	393,394	20			.02
H-3195	STUD	393,394	4			.25
H-3196	STUD	393,394	6			.16
H-3197	SPRING STOP PIN	393	1			.15
H-3208	CLIP, SMALL U	391,419,420	11		2	.11
H-3252	BOOT	406	2		2	1.60
H-3278	HOUSING, CABLE CUTTER	434	1	5		6.90
H-3279	SHAFT, CABLE CUTTER	434	1	2	12	4.90
H-3280	BLADE, CABLE CUTTER TOP	434	1		2	1.75
H-3281	DIE, CABLE CUTTER BOTTOM	434	2		2	Pr. 1.50
H-3349	ROLLER ARM ASSEMBLY	424,426	2	5		2.08
H-3464	CONE, TAPERED	396,398	2	2	4	3.27
H-3465	CUP, TAPERED	396,398	2	1		2.12
H-3500	ARM, BRAKE SPRING ARM PIVOT	424	2	1	4	.78
H-3511	MAIN CASE STRUCTURE FOR PCU	424	1	193		99.83
H-3543	NUT, BRASS UNION	419	1			.10
H-3590	SHIM	403	4			.08
H-3594	CAM, RIGHT BRAKE	432	1	5	4	3.15
H-3596	CAM, LEFT BRAKE	432	1	5	4	3.15
H-3730	CLIP, SPRING	432	2		2	.16
H-4241	CLAMP, 7/8" CABLE	416,417	2	1		.43
H-4270	GAUGE, OIL PRESSURE	420	1		5	4.76
H-4433	WRENCH, ALLEN	423	1		12	.53
H-4434	AMMETER	420	1		4	2.76
H-4629	CAPSCREW, 3/8 x 3/4" NC	414	4			.05
H-4634	COVER, BATTERY	414	2	1	8	.79
H-4638	PEDAL, CLUTCH	393	1	2		1.05
H-4669	CLIP, CABLE	391	1		2	.15
H-5118	HOUSING, SLIDING SHEAVE	440	1	76		26.40
H-5119	SPACER	440	2	9	8	3.00
H-5288	PLATE, BUMPER	441	1	9		3.45
H-5304	LOCKWASHER, 3/8" SHAKEPROOF	393,394,421	10			.01
H-5322	CLIP	460	6		1	.10
H-5334	HEAT GAUGE	420	1	1		6.80
H-5335	CLIP	420	4			.12
H-5336	LIGHT, DASH	420	2		2	.75
H-5337	PANEL, INSTRUMENT	420	1	2		1.43
H-5409	CONE, TAPERED	453,454	2	9	2	17.19
H-5455	HEADLIGHT BODY ASSEMBLY	421	2	5		5.63
H-5456	DOOR, HEADLIGHT	421	2	1		2.03
H-5457	CLIP, LENS	421	2			.05
H-5458	SCREW	421	2			.05
H-5459	LOCKWASHER	421	2			.05
H-5460	SPRING	421	8			.05
H-5461	LENS ASSEMBLY	421	2		8	.90
H-5465	TERMINAL, PLATE	421	2			.20
H-5466	SCREW, TERMINAL	421	2			.05
H-5468	SCREW, TERMINAL	421	2		4	.05
H-5469	NUT	421	2			.05
H-5470	LOCKWASHER	421	2			.05
H-5471	CUP, WASHER	421	2			.05
H-5472	WASHER, INSULATING	421	2			.05
H-5473	BULB SOCKET & WIRE ASSEMBLY	421	2			.50

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H-5476	REFLECTOR ASSEMBLY	421	2		8	1.00
H-5477	GASKET	421	2			.10
H-5478	GASKET	421	2			.05
H-5603	NUT, 1/8"	457,460	9			.10
H-5604	HOSE, BRAKE 24"	460	2		6	3.00
H-5605	FITTING, BRASS TIE	460	1		2	.35
H-5668	BUMPER	412,413	1	62		12.80
H-5689	SHIM, BOLT PLATE	459	1		4	.20
H-5692	BRACKET, INSIDE	459	1	20		9.50
H-5694	BRACKET, OUTSIDE	459	1	15		7.40
H-5699	PEDAL, BRAKE	459	1	2		1.05
H-5765	NUT, 3/8" NF CASTELLATED	393,394,396, 397	6			.06
H-5826	CAPSCREW, 7/16 x 3/4" NF	459	2			.03
H-5827	CAPSCREW, 7/16 x 1" NF	459	4			.03
H-5830	PLIERS, NEEDLE NOSE	423	1		4	2.26
H-5831	PLIERS, CRESCENT	423	1	1		.90
H-5832	HAMMER, BALL PEIN	423	1	2	5	1.95
H-5833	DRIVER, 3" SCREW	423	1		2	.35
H-5834	DRIVER, 6" SCREW	423	1		6	.52
H-5836	CAN, OIL	423	1		6	.46
H-5837	SOCKET WRENCH SET ASSEMBLY	423	1	4	8	14.60
H-5838	WRENCH, 1/2 x 9-1/16" BOX	423	1	1		1.03
H-5839	WRENCH, END 7/16 x 5/8"	423	1		4	1.00
H-5840	WRENCH, END 1/2 x 9/16"	423	1		4	1.00
H-5841	WRENCH, 3/4 x 7/8"	423	1		12	1.03
H-5842	WRENCH, 5/16 x 1"	423	1	1		1.23
H-5843	WRENCH, 3/8 x 1/2"	423	1		2	.50
H-5844	WRENCH, 11/16 x 7/8"	423	1		10	1.03
H-5845	WRENCH, 15/16 x 1-1/16"	423	1	1	6	1.45
H-5846	WRENCH, 1 1/4 x 1 3/8"	423	1	2	12	2.90
H-5847	WRENCH, 1-5/16 x 1 1/2"	423	1	3		3.10
H-5848	WRENCH, SOCKET RATCHET	423	1	1	4	4.55
H-5849	WRENCH, EXTENSION FOR SOCKET	423	1		8	1.22
H-5891	WASHER, COPPER	460,465	4			.03
H-5892	ADAPTER, BRASS	457	1		2	.26
H-5894	HOSE, BRAKE 13"	460	2		4	.90
H-5961	CLEVIS	457	1		6	.72
H-5965	BLADE, 7/8 x 16 x 56"	437	1	186		36.15
H-5967	BLADE ASSEMBLY	437	1	288		56.75
H-6000	SOCKET, 7/16"	423	1		2	.72
H-6001	SOCKET, 1/2"	423	1		2	.72
H-6002	SOCKET, 9/16"	423	1		2	.72
H-6003	SOCKET, 19/32"	423	1		2	.72
H-6004	SOCKET, 5/8"	423	1		2	.72
H-6005	SOCKET, 21/32"	423	1		2	.72
H-6006	SOCKET, 11/16"	423	1		4	.84
H-6007	SOCKET, 3/4"	423	1		4	.90
H-6008	SOCKET, 13/16"	423	1		4	.90
H-6009	SOCKET, 7/8"	423	1		4	.90
H-6010	BOX, SOCKET WRENCH	423	1	1		.96
H-6023	BULB, DASH LIGHT	420	6			.15
H-6024	BULB, HEADLIGHT	421	2			.40
H-6025	PIN, CABLE CUTTER	434	1			.10
H-6029	ADAPTER, TACHOMETER	420	1	1	4	6.03
H-6052	PIN, 5/8" STD. CLEVIS	457	1			.20
H-6061	ELBOW, RADIATOR TOP	411	1	6	12	2.55
H-6063	CAP, FUEL TANK	412,413	2	2		1.80
H-6065	LINK, CONNECTING	462,464	4		4	1.15
H-6077	GASKET, COPPER	412,413	2			.12
H-6079	BRACKET, LEFT	443	1	44		17.10
H-6081	BRACKET, RIGHT	443	1	44		17.10
H-6127	HORN TO RELAY WIRE	391	1		2	.28

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H-6333	PIN, TRIPLE SHEAVE	438	1	2	4	4.05
H-6335	PIN, PUSHBEAM ROLLER	438	1	2	4	3.03
H-6420	PIN, DOUBLE SHEAVE	438,446	3	1	8	3.05
H-6423	HEAD STRUCTURE, SHEAVE HOUSING	446	1	133		42.35
H-6424	HOUSING, A-FRAME SHEAVE	438	1	133		42.35
H-6427	PIN, GANG SHEAVE	441	1	4	12	6.13
H-6430	L P PUSHBEAM STRUCTURE	445	1	270		86.75
H-6791	STAYBOLT	407	4	1	4	1.25
H-6849	CAPSCREW, 5/8 x 6 3/4" NC	412,413	1	1		.39
H-6864	SHIM, MASTER CYLINDER BRACKET	459	1		8	.42
H-6879	CAPSCREW, 5/8 x 5 3/4" NC	412,413	1		10	.33
H-6906	CAPSCREW, 7/16 x 5 1/2" NF	444	2		6	.11
H-6913	GRILL, RADIATOR	411	1	18		16.45
H-6915	TANK, RADIATOR TOP	411	1	60		29.50
H-6917	RADIATOR, L. SIDE	411	1	33		20.85
H-6918	RADIATOR, R. SIDE	411	1	33		20.85
H-6919	BAR, RADIATOR CENTER	411	1	6	8	8.15
H-6921	RADIATOR CAP ASSEMBLY	411	1	2		3.05
H-6923	GASKET, RADIATOR NECK	411	1			.80
H-6924	GASKET, RADIATOR HEADER	411	2			1.00
H-6935	NUT, 1/2" NC BRASS HEX	422	5			.12
H-7050	FUEL LINE, FILTER TO TANK	419	1	3		2.50
H-7052	GASKET	411	1			.20
H-7071	RIVET, VELVETOUCH LINING	424	84			C .80
H-7150	THROTTLE, L. FOOT	420	1	4		4.30
H-7155	THROTTLE, R. FOOT	420	1	4		4.30
H-7160	SEAT, BUCKET	415	1	50		41.25
H-7179	JUMPER, BATTERY	391	1	1	4	1.85
H-7181	JUMPER, BATTERY	391	1	1	10	1.85
H-7255	GASKET	411	2			.20
H-7257	CAP	411	1		4	.37
H-7277	WASHER, SPECIAL	412,413	2			.02
H-7410	WHEEL STRUCTURE	410	2	270		102.75
H-7927	BRACKET, EMERGENCY, SHUTOFF CLAMP	370	1		2	.28
H-7932	ROD, FOOT THROTTLE CROSS	420	1	2		2.85
H-7961	WIRE, HORN RELAY TO AMMETER	391	1		4	.24
H-7970	ROD, CUMMINS THROTTLE	370	1		4	.60
H-7971	SCREW, 5/8 x 3/8" NC MACHINE	411	3			.08
H-7989	CLAMP, SPRING	370	1			.20
H-7990	SCREW, 5/16 x 3/4" PHILLIP	411	6			.05
H-7991	CLIP	370	1			.08
H-7992	WASHER, 9/16" COPPER	460,465	3			.04
H-7993	BOLT, FITTING	460,465	3		2	.28
H-7994	FITTING, BENDIX BRAKE	460,465	3		4	.36
H-7997	SCREW, 1/2 x 1/4" ROUND HEAD	411	1			.01
H-7998	WASHER, CUP	411	3			.04
H-7999	WASHER, RADIATOR CORE	411	4	1		.80
H-8000	BACKING PLATE ASSEMBLY, R.	461,462	1			16.00
H-8001	BACKING PLATE ASSEMBLY, L	463,464	1			16.00
H-8004	SHOE & LINING, LEFT PRIMARY	461,462	1	12		16.65
H-8005	SHOE, BRAKE—LESS LINING	461,463	2	10		12.00
H-8006	LINING, PRIMARY	461,463	2	2		5.50
H-8007	RIVETS, BRASS	461,463	18			.03
H-8008	SHOE & LINING, R. SECONDARY	461,462	1	12		16.65
H-8009	SHOE, BRAKE—LESS LINING	461,463	2	10		12.00
H-8010	LINING, SECONDARY	461,463	2	2		5 50
H-8011	SHOE & LINING, R. PRIMARY	463,464	1	12		16.65
H-8013	SHOE & LINING, L. SECONDARY	463,464	1	12		16.65
H-8017	BRACKET, CENTRALIZER	461,462,463, 464	2			.40
H-8018	BOLT, CENTRALIZER BRACKET	461,462,463, 464	4			.20
H-8019	NUT, ADJUSTING	461,462,463, 464	2		8	1.50
H-8020	RETAINER, INNER	461,462,463, 464	4		1	.20

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H-8021	SPRING, CENTRALIZER	461,462,463, 464	4		4	.20
H-8022	RETAINER, OUTER	461,462,463 464	4		2	.25
H-8023	NUT, ADJUSTING	461,462,463 464	2		3	.50
H-8024	LOCK, RETAINER	461,462,463, 464	2			.05
H-8025	SCREW, LEFT ADJUSTING	461, 463, 464	2		6	1.40
H-8026	SCREW, RIGHT ADJUSTING	461,462,463, 464	2		6	1.40
H-8027	PIN, ANCHOR	461,462,463, 464	4	1	9	4.95
H-8028	NUT, LOCK	461,462,463, 464	4		5	.55
H-8029	LOCKWASHER	461,462,463, 464	4		1	.25
H-8031	PLATE, REINFORCEMENT	461,462,463, 464	2	1	14	2.50
H-8032	SPACER	461,462,463, 464	8		2	.45
H-8033	PIN, HOLD DOWN	461,462,463, 464	8		1	.20
H-8034	CUP, HOLD DOWN	461,462,463, 464	16			.05
H-8036	SPRING, HOLD DOWN	461,462,463, 464	8		1	.10
H-8037	SPRING, PRIMARY BRAKE SHOE	461,462,463, 464	2		3	.45
H-8038	SPRING, SECONDARY BRAKE SHOE	461,462,463, 464	2		3	.45
H-8039	SPRING	461,462,463, 464	2		2	.20
H-8040	PIN, PIVOT	461,462,463, 464	4		4	.15
H-8042	PLATE, CENTRALIZER	461,462,463, 464	2		1	.10
H-8045	PLATE, COVER	461,462,463, 464	6		2	.10
H-8048	SPRING	461,462,463, 464	2		3	.25
H-8069	ELBOW, 1/4 x 1/8" BRASS	419	1		1	.20
H-8089	RING, CLAMP	457,458	1		1	.05
H-8090	BOOT	457,458	1		2	.40
H-8091	RING, CLAMP	457,458	1		1	.05
H-8092	SCREW, 3/8 x 1" NC MACHINE	411	4			.02
H-8096	RING, LOCK	457,458	1		1	.05
H-8097	WASHER	457,458	1		1	.05
H-8098	ROD, PUSH	457,458	1		6	.40
H-8099	PISTON	457,458	1		4	1.25
H-8105	HOSE, BLEEDER	423	1		2	.30
H-8126	AIR VENT FOR FUEL TANK	419	1	4		1.30
H-8128	HOSE, UPPER RADIATOR	411	1		8	.30
H-8200	PIPE, RADIATOR OUTLET	411	1	3		1.48
H-8208	WIRE, AMMETER TO LIGHT SWITCH	391	1		4	.30
H-8241	TUBING, AIR VENT—FOR FUEL TANK	419	1		4	1.30
H-8247	FILTER TO TANK LINE	419	1	3		2.50
H-8340	BEARING, BALL	404,405	2	3	12	28.60
H-8443	BOOT	465,466	4		4	.25
H-8444	STRAP, BOOT	465,466	4			.05
H-8445	PISTON	465,466	4		2	.50
H-8446	CUP, PISTON	465,466	4		2	.25
H-8447	SPRING, RETURN	465,466	4		1	.15
H-8448	CASTING	465,466	2	1		5.50

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H-8449	VALVE, BLEEDER	465,466	2		1	.10
H-8500	SCREW, #10-32 x 1/4" MACHINE	465,466	2			.01
H-8524	CAPSCREW, 3/8 x 5/8" NC	395,396,400, 401,424	17			.04
H-8525	SPRING, PRESSURE	393,394	1	2	10	4.58
H-8549	ELBOW, FLEXIBLE	419	1		4	.80
H-8600	CAP, BENDIX MASTER CYL. CAP	457,458	1		2	.28
H-8601	GASKET, BENDIX MASTER CYL.	457,458	1			.06
H-8602	CASE, BENDIX MASTER CYL.	457,458	1	5		10.00
H-8603	VALVE, BENDIX MASTER CYL. CHECK	457,458	1			.60
H-8604	CUP, BENDIX MASTER CYL. PRIMARY	457,458	1			.28
H-8605	SPRING, BENDIX MASTER CYL.	457,458	1			.28
H-8613	TUBING ASSEMBLY	460	1	6		4.35
H-8615	TUBING ASSEMBLY	460	1	6		3.90
H-8617	TUBING ASSEMBLY	460	1	3		4.50
H-8662	BOARD, DASH	420	1	23		16.60
H-8857	CABLE, TACHOMETER	420	1		12	3.00
H-8866	BALL, HITCH	443	1	26	8	26.75
H-8867	RETAINER FOR HITCH BALL	443	1	1	4	.85
H-8943	BALL, DRAWBAR HITCH	418	2	13	8	12.55
H-8944	DRAWBAR	418	1	65		21.65
H-8945	KEEPER, DRAWBAR	418	2	3		2.68
H-8947	BLOCK, DRAWBAR HITCH	418	2	30		19.55
H-8948	KEEPER, DRAWBAR END PLUG	418	2	2		3.65
H-8949	PLUG, DRAWBAR END	418	2	4		6.90
H-9053	CAPSCREW, DRAWBAR HITCH CLAMP	443	8	1		1.43
H-9054	CLAMP, DRAWBAR HITCH	443	2	2		1.85
H-9055	HITCH, DRAWBAR	443	1	52		17.30
H-9073	PLATE, BEARING ADJUSTING	407,408	2	2	4	1.81
H-9250	SCREW, PINION LOCKING	402,403	1	2	8	1.80
H-9359	LEVER, CLUTCH	393	1	7		5.20
H-9362	FITTING, BUTTONHEAD GREASE	418	2		4	.33
H-9376	BLOCK, ADJUSTING	406	2	2	8	1.83
H-9450	BRAKE SHOE & LINING REPLACEMENT PKG.	461,463	2	50		67.80
H-9541	TOURNAROPE, 126'—1/2"	435	1	57		22.68
H-9543	TOURNAROPE, 13 1/2'—7/8"	435	1	19		5.60
H-9544	TOURNAROPE, 51'—7/8"	435	1	72		21.17
H-9545	TOURNAROPE, 17'—5/8"	435	1	12		4.06
H-9554	BRACKET, REGULATOR	420	1	1		.83
H-9596	BRACE, RIGHT RADIATOR	421	1	4	8	1.75
H-9597	BRACE, LEFT RADIATOR	421	1	4	8	1.75
H-9639	SHIM, PINION	407	1			.06
H-9660	FUSE, 20 AMP.	391	1			.04
H-9662	FUSE, 50 AMP.	391	1			.04
H-9663	PLATE, ADJUSTING	393,394	1	8		8.19
H-9667	TERMINAL ASSEMBLY	421	2		2	.60
H-9719	PLATE, AXLE BEARING ADJUSTING	407,409	2	2		1.65
H-9720	SHIM, AXLE	407				.08
H-9722	SHIM, AXLE	407				.08
H-9723	SHIM, AXLE	407				.08
H-9837	CAP, BEARING	402,403	2	4	4	1.70
H-9920	SHROUD, RADIATOR FAN	411	1	5		3.15
H-9939	HOSE, 2"x 2 1/2" RADIATOR	411	1		5	.24
H-9977	SPIDER, ADJUSTING	404,405	2	13		11.84
L-3	SEAL, OIL	404	1		2	.85
L-21	SEAL, OIL	396,399,427, 428	3		4	1.36
L-72	SEAL, OIL	396,398	1		10	2.12
L-85	SEAL, OIL	453,454	2		5	1.36
L-132	SEAL, OIL	407,409	2	2	8	12.10
L-135	SEAL, DUST	449,451,452	10		1	.30
L-323	SEAL, DUST	444,449	10		2	.50
L-1624	SEAL, OIL	424,425	4		4	.66

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L-3725	SEAL, OIL	424,425	2		3	.60
L-5754	SEAL, OIL	453,454	2		10	2.11
L-37050	SEAL, OIL	424	2	2		7.35
R-25	SHIM, DRAWBAR CLAMP	443				.05
R-28	CAPSCREW, $\frac{1}{2} \times 1\frac{3}{4}$" NF	418	8			.09
R-76	WRENCH, SOCKET	423	1		8	1.00
R-77	SETSCREW, $\frac{1}{2} \times 3\frac{1}{2}$" NC	404,405	4		2	.28
R-86	BUSHING, $\frac{1}{4} \times \frac{3}{8}$" REDUCING	419	1		2	.09
R-162	PLUG, MAGNETIC PIPE	416,417	2		8	1.00
R-194	KEY, $5/32 \times 1\frac{1}{2}$" COTTER	392	2			.01
R-209	WIRE, FRONT LIGHT	391	1		8	.85
R-211	WIRE, CRANKING MOTOR TO GROUND	391	1		8	1.20
R-212	WIRE, SOLENOID ON STARTER TO SERIES PARALLEL	391	1		1	.20
R-213	WIRE, CRANKING MOTOR SOLENOID TO SERIES PARALLEL SWITCH	391	1		1	.20
R-214	WIRE, SOLENOID TO SERIES PARALLEL	391	1		1	.20
R-215	WIRE, STARTING MOTOR TO SOLENOID	391	1		7	1.20
R-216	WIRE, R. BATTERY TO SERIES PARALLEL	391	1	4		4.70
R-217	WIRE, R. BATTERY TO STARTING MOTOR	391	1	2	12	3.65
R-218	WIRE, L. BATTERY TO SERIES PARALLEL SWITCH	391	1	2		3.30
R-219	WIRE, SCRAPER LIGHT	391	1		6	.90
R-221	WIRE, SOLENOID TO STARTER	391	1		1	.24
R-453	BAR, 30" PRY	423	1	10		1.25
R-496	KEY, $5/16 \times 4$" COTTER	440	3			.04
R-779	CAPSCREW, $\frac{1}{2} \times 2\frac{3}{4}$" NF (DRILLED)	414	2			.10
R-787	CAPSCREW, $\frac{5}{8} \times 2\frac{1}{2}$" NF SOCKETHEAD	404,405	4		4	.31
R-854	BOSS, RETAINER	407,409	2	8	12	9.85
R-855	RETAINER	407,409	2	10	12	10.10
R-874	PLATE, CLUTCH DRIVE	404,405	2	32		27.20
R-948	CONE, FEMALE	404,405	2	60		60.00
R-968	GUARD, "C" OIL TANK	412,413	1	79		17.95
R-982	NUT, $\frac{1}{8}$" NF SPECIAL HEX	392	2		8	1.32
R-983	SHAFT, CLUTCH & BRAKE LEVER	392	2	2		4.45
R-986	LEVER, L. BRAKE	392	1	7		4.12
R-987	LEVER, R. CLUTCH	392	1	7		4.75
R-988	LEVER, L. CLUTCH	392	1	7		4.75
R-990	ARM, BRAKE LEVER	459	1	7		4.20
R-1004	NECK STRUCTURE	452	1	82		42.00
R-1018	BUTTON, HORN	420	1		6	.61
R-1019	WIRE, HORN BUTTON TO RELAY	391	1			.24
R-1020	WIRE, HORN SWITCH GROUND	391	1			.16
R-1021	WRENCH, WHEEL BOLT	423	1	49		17.25
R-1203	BAR, PUSHER	450	1	150		37.50
R-1306	PIN, TAILGATE ROLLER	449	2	12		6.78
R-1605	WIRE, STARTER BUTTON GROUND	391	1		1	.12
R-1606	HARNESS, MAIN WIRING	391	1	2		8.05
R-1609	PLATE, LOCKING	407,408	2			.28
R-1664	SWITCH, "C" STARTING	420	1		8	1.25
R-1682	WEDGE CABLE	416,417	2	4	4	1.70
R-1702	WHEEL STRUCTURE, 18.00×24	452,454	2	360		78.00
R-1724	WRENCH, TOURNAPULL	423	1	2	8	3.85
R-1733	BOOT, NEOPRENE	418	4		2	1.60
R-1765	LEG, LP AXLE SUPPORT	442	2	31		9.80
R-1903	AXLE, 18×24 SGL. REAR	453,454	2	96		42.15
R-1963	CAPSCREW, $\frac{1}{2} \times 1\frac{5}{8}$" NF TAPER HEAD	414	13		2	.72
R-1964	PLATE, DECK	414	1	452		151.25
R-1993	WIRE, BATTERY TO ENGINE GROUND	391	1	2	8	3.30
R-2025	PIN, BRAKE LINK	406	10		1	.28
R-2027	NUT, $\frac{1}{2}$" NC JAM	404,405	4			.20
R-2085	SHIM, "C" MOTOR SUPPORT	412,413			12	.61
R-2086	SHIM, "C" MOTOR SUPPORT	412,413			6	.49

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R-2107	LUG, "C" BRAKE SPRING	406	2		2	.20
R-2180	CASE & TANK STRUCTURE	412	1	2300		955.00
R-2182	ADAPTER, BRAKE	455,456	2	35		14.38
R-2197	BULLGEAR, C TOURNAPULL	407,409	2	170		129.50
R-2260	RIVET, #7 x 9/16" STEEL	424	48			C.80
R-2352	INSTRUMENT PANEL ASSEMBLY	420	1	6		33.55
R-2379	SOCKET, 7/8" CABLE	416,417	2	2	2	1.45
R-3106	SHIM, 18 GA. BALL SOCKET	443				.40
R-3114	LEVER, R. BRAKE	393	1	7		4.12
R-3121	PLATE, C1 CENTER FLOOR	414	1	33		12.80
R-3122	PLATE, C1 L. FLOOR	414	1	14		4.85
R-3123	PLATE, C1 R. FLOOR	414	1	14		4.85
R-3138	SPRING, C. THROTTLE	370	1		4	.41
R-3148	YOKE STRUCTURE	443	1	2400		460.00
R-3187	PINION & RING GEAR SET	403,404	1	76		128.75
R-3193	PLUG, 1 1/4" SQ. HD. MAGNETIC PIPE	424	1		8	1.00
R-3304	PLUG, AXLE BRG. ADJUSTING	416	2	2	8	2.86
R-3305	GASKET, AXLE BRG. ADJ. PLUG	416	2			.24
R-3306	WRENCH, SPANNER	423	1		6	1.80
R-3365	SHIM, FABRIC RADIATOR BOTTOM	411			5	.60
R-3366	SHIM, METAL RADIATOR BOTTOM	411		1		.50
R-3410	AXLE NUT ASSEMBLY	453	2	9		4.49
R-3484	TANK, RADIATOR BOTTOM	411	1	112		42.35
R-3486	RADIATOR, 6 ROW CORE	411	1	94		74.40
R-3487	RADIATOR OVERFLOW TUBE ASSEMBLY	411	1	6		.97
R-3489	MAIN BODY STRUCTURE	437	1	6700		2152.00
R-3501	NUT, PINION	407,408	2	1		4.55
R-3897	WRENCH, PINION NUT	423	1	6	10	8.95
R-4210	BOX, CABLE	437	1	20		6.80
R-4212	BOLT, WING	437	1	6	7	1.51
R-4372	GUN, GREASE W/6" COUPLING	423	1	3	2	5.48
R-4375	TACHOMETER	420	1	1		14.80
R-4387	SHIM, DRAWBAR	443				.05
R-4398	TOURNAROPE, 12' 6"—78"	416,417	1	18		7.47
R-4463	CARRIER, CLUTCH	407,408	2	70		41.40
R-4604	HOOD (CUMMINS VERTICAL EXHAUST)	419	1	60		25.50
R-4617	BRACKET, MOTOR HANGER	412,413	1	10		8.70
R-4691	BLOCK, SINGLE FUSE	391	1			3.00
R-4692	WIRE, AMMETER TO FUSE BLOCK	391	1		1	.20
R-4876	PIPE, "C" VERTICAL EXHAUST	422	1	6		3.20
R-5062	SPOOL & CABLE	435	1			
R-5084	HOIST CABLE	435	1	48		18.90
R-5085	TOURNAROPE, 14 1/2'—7/8"	435		20		6.02
R-5091	GASKET, EXHAUST PIPE	422	1		8	.75
R-5115	NUT, FLEX—3/8"	419	1			.40
R-5376	GASKET, TRANS. ADAPTER	396,398	1			.20
R-5481	CONE, SLOTTED	402,403	4	4	8	8.70
R-5682	CONE, SLOTTED TAPERED	407,408	2	4	8	8.70
R-5828	SHIM	407				.06
R-6160	CLAMP, EXHAUST PIPE	422	1	4	5	2.90
R-6207	SHIM	396	12			.08
R-6217	LP TAILGATE STRUCTURE	448	1	1600		515.00
R-6501	BLOCK, ANCHOR	455	2	8		2.60
R-6609	AXLE	407,409	2	155		84.90
R-6610	PINION, C1 L.	407,408	2	15		29.40
R-6611	PINION, C1 R.	407,408	2	15		29.40
R-6612	CARRIER, C1 RING GEAR	402,403	1	104		48.50
R-6613	KEY, C1 AXLE	407,409	2			.18
R-6614	KEY, C1 CARRIER	403,402	2			.32
R-6615	KEY, C1 PINION	407,408	2			.18

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R-7013	WASHER, NEOPRENE	419	1	..	..	.12
R-7065	GASKET	417	2	..	..	.16
R-7066	INSULATOR	370	2	..	..	.04
R-7109	PLATE, COVER	417	2	2	8	.95
R-7119	CASE, MAIN	413	..	2350	..	958.00
R-7132	COVER	437	1	11	..	1.69
R-7133	CONTAINER ASSEMBLY	437	1	37	..	10.00
R-8132	LINE, PRESSURE	419	1	1	..	1.05
R-8339	NUT ASSEMBLY	402	2	2	12	2.82
R-8862	LOOM, FIBRE	419	2	..	..	.12

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PART NUMBER	DESCRIPTION	QTY.	WEIGHT Lb. Oz.	PRICE EACH
S-1116	STEERING CLUTCH ASSEMBLY	1	225	$259.00
	(Includes following parts shown on Pages 404 & 405):			
F-8236	CLUTCH THROWOUT COLLAR STRUCTURE	1		
H-8340	BEARING, BALL	1		
F-8235	BUSHING, THROWOUT COLLAR	2		
R-787	CAPSCREW, 5/8 x 2 1/2" NF	2		
D-2779	WASHER, 5/8" SHAKEPROOF	2		
F-8160	SPIDER, SLIDING	1		
F-8161	FINGERS, CLUTCH	4		
F-8162	LINKS, CLUTCH FINGER	8		
F-8234	PIN, CLUTCH FINGER LINK	12		
F-8248	NUT, LINK PIN	12		
H-745	PIN, 3/32 x 3/4" COTTER	12		
H-9977	ADJUSTING SPIDER STRUCTURE	1		
R-77	SETSCREW, 1/2 x 3 1/2" NC	2		
R-2027	NUT, 1/2" NC LOCK	2		
R-948	CONE, FEMALE	1		
H2738	CONE STRUCTURE, SPLINED DRIVING	1		
R-874	PLATE STRUCTURE, CLUTCH DRIVE	1		
C-1679	PLATE, BOLTING CLUTCH DRIVE	8		
C-1540	LOCKWASHERS, 1/2"	8		
H-2739	CONE STRUCTURE, DRIVING	1		
H-8088	MASTER CLUTCH ASSEMBLY	1	80	82.00
	(Includes following parts shown on Pages 393 & 394):			
H-3176	FACING, CLUTCH	2		
H-3175	DRIVEN DISK & FACING ASSEMBLY	1		
D-3679	RIVET, BRAKE LINING	30		
H-3185	LEVER, PRESSURE	20		
H-3194	BALL, LEVER	20		
H-3188	RING, FULCRUM	2		
H-3187	RING, SNAP	1		
H-3179	PRESSURE & STUD ASSEMBLY	1		
H-2877	HOUSING, CLUTCH	1		
H-3189	SHIM, ADJUSTING	36		
H-3186	STRAP, ADJUSTING	6		
H-3196	STUD	6		
C-1522	NUT	6		
H-5304	LOCKWASHER	6		
H-3182	SLEEVE ASSEMBLY	1		
H-3197	PIN	1		
H-8525	SPRING	1		
H-9663	PLATE	1		
H-5765	NUT	4		
H-745	COTTER PIN	4		
H-3184	SPRING	4		
H-3195	STUD	4		
H-3180	RING & STUD ASSEMBLY	1		
R-3279	RADIATOR ASSEMBLY	1	400	159.50
	(Includes following parts shown on Page 411):			
C-1603	BOLT	8		
C-1521	NUT	8		
C-312	LOCKWASHER	33		
C-1602	CAPSCREW	18		
H-6918	RADIATOR, RIGHT SIDE	1		
H-6917	RADIATOR, LEFT SIDE	1		
H-7997	SCREW	6		
C-1546	LOCKWASHER	6		
H-9920	SHROUD, FAN	1		
C-1598	BOLT	34		

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PART NUMBER	DESCRIPTION	QTY.	WEIGHT Lb.	Oz.	PRICE EACH
C-1520	NUT	16			
C-1538	LOCKWASHER	40			
H-8092	SCREW	4			
R-3487	TUBING, OVERFLOW	1			
C-7642	CAPSCREW	2			
C-1543	LOCKWASHER	2			
R-3365	SHIM	..			
R-3366	SHIM	..			
H-6915	TOP TANK	1			
H-6921	CAP ASSEMBLY	1			
H-6923	GASKET	1			
H-6924	GASKET	2			
H-7999	STRIP	4			
C-1520	NUT	18			
R-3486	CORE	1			
H-6919	BAR, CENTER	1			
H-7990	SCREW, PHILLIPS	6			
H-6913	GRILL	1			
H-7971	SCREW	3			
H-7998	CUP WASHER	3			
H-7257	COVER	1			
H-7255	GASKET	1			
R-3484	TANK, BOTTOM	1			
R-5052	DRAWBAR ASSEMBLY	1	175	..	119.20
	(Includes following parts shown on Page 418):				
C-1681	CAPSCREW	8			
H-8943	BALL STRUCTURE	2			
H-8944	DRAWBAR STRUCTURE	1			
H-8949	PLUG	2			
R-28	CAPSCREW	8			
H-8945	KEEPER	2			
H-8947	BLOCK	2			
H-9362	BUTTONHEAD	2			
R-1733	BOOT	4			
H-8948	KEEPER	2			
H-2782	HEAD LAMP ASSEMBLY	2	6	8	11.50
	(Includes following parts shown on Page 421):				
H-5456	DOOR	1			
H-748	CAPSCREW	4			
C-1538	LOCKWASHER	4			
H-5478	GASKET	1			
H-5460	SPRING	4			
H-5477	GASKET	1			
H-5461	LENS ASSEMBLY	1			
H-6024	BULB	1			
H-2682	GUIDE LAMP ASSEMBLY	1			
H-5457	CLIP	1			
H-5458	SCREW	1			
H-5459	LOCKWASHER	1			
H-5455	BODY ASSEMBLY	1			
H-5476	REFLECTOR ASSEMBLY	1			
H-5473	BULB SOCKET & WIRE ASSEMBLY	1			
H-5468	SCREW	1			
H-2643	LOCKWASHER	1			
H-5469	NUT	1			
H-5470	LOCKWASHER	1			
H-5471	CUP	1			
H-5472	WASHER	1			
H-5465	TERMINAL	1			
H-9667	TERMINAL ASSEMBLY	1			

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H-5466	SCREW	1		
H-2643	LOCKWASHER	1		
C-1550	FLATWASHER	1		
C-1541	LOCKWASHER	1		
C-1526	NUT	1		
H-8071	PUSHBEAM ASSEMBLY	1	330	143.00
	(Includes following parts shown on Pages 445 & 446):			
F-8620	HINGE PIN	1		
C-1558	COTTER KEY	1		
H-6430	PUSHBEAM STRUCTURE	1		
C-1668	BOLT	1		
C-1531	NUT	1		
H-6423	HEAD STRUCTURE, SHEAVE HOUSING	1		
F-9991	SHEAVE PIN	1		
F-9989	PIN NUT	1		
C-315	ZERK FITTING	1		
H-171	SHEAVE	5		
H-225	BEARING	5		
F-9988	BUSHING	5		
H-6420	PIN	2		
C-315	ZERK FITTING	4		
D-9894	CABLE DRUM ASSEMBLY (LEFT)	1	110	114.58
	(Includes following parts shown on Pages 430 & 431):			
E-8635	CONE (DRIVEN)	1		
C-1614	CAPSCREW	12		
D-2889	LOCKWASHER	12		
F-416	DRUM SHAFT	1		
C-196	SPRING	1		
C-83	DRUM STRUCTURE	1		
L-1624	OIL SEAL	2		
C-7	BEARING CUP	2		
C-8	CONE (BEARING)	2		
E-8618	SHIM			
F-5342	SHIM			
E-5251	PLUG	1		
D-9895	CABLE DRUM ASSEMBLY (RIGHT)	1	110	114.58
	(Includes following parts shown on Pages 430 & 431):			
F-417	DRUM SHAFT	1		
E-8635	DRIVEN CONE	1		
C-83	DRUM STRUCTURE	1		
C-7	BEARING CUP	2		
C-8	BEARING CONE	2		
L-1624	OIL SEAL	2		
E-8618	SHIM			
F-5342	SHIM			
C-1614	CAPSCREW	24		
D-2889	LOCKWASHER	24		
E-5251	PLUG	1		
H-3150	CABLE CUTTER ASSEMBLY	1	8	10.70
	(Includes following shown on Page 434):			
H-6025	PIN	1		
H-3280	BLADE	1		
H-3281	BLADE	2		
H-3279	SHAFT	1		
H-3278	HOUSING	1		

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F-6810	APRON ASSEMBLY	1	1550	503.18
	(Includes following shown on Page 447):			
H-290	APRON STRUCTURE	1		
D-2889	LOCKWASHER	6		
C-1612	CAPSCREW	6		
F-1230	PIN	2		
C-315	ZERK	2		
F-7255	WEDGE	1		
F-7860	HINGE	1		
C-2508	COTTER	1		
F-8448	PIN	1		
R-6218	TAILGATE ASSEMBLY	1	1750	616.00
	(Includes following shown on Pages 448 & 449):			
R-6217	TAILGATE STRUCTURE	1		
F-7255	CABLE WEDGE	2		
C-503	CABLE SOCKET	1		
C-502	CABLE WEDGE	1		
E-7888	SETSCREW	2		
C-1529	NUT	8		
C-1552	LOCKWASHER	8		
H-2465	HOUSING, ROLLER	4		
C-133	ROLLER	4		
C-12	BEARING	8		
L-135	DUST SEAL	8		
C-1558	COTTER KEY	4		
C-134	PIN	4		
C-1596	ZERK	4		
C-131	MAIN ROLLER	4		
C-177	BEARING	4		
L-323	DUST SEAL	8		
C-1051	COTTER	2		
F-5027	ROLLER PIN	2		
C-315	ZERK FITTING	4		
R-1306	ROLLER PIN	2		
C-1577	BOLT	2		
C-1531	NUT	2		
C-1544	LOCKWASHER	2		
H-1106	SPIRAL SHEAVE ASSEMBLY	1	80	50.75
	(Includes following parts shown on Pages 451 & 452):			
C-7376	SPIRAL SHEAVE STRUCTURE	1		
C-3787	CABLE WEDGE	1		
C-445	CABLE WEDGE	1		
C-12	BEARING	4		
C-8093	BEARING SPACER	1		
C-336	BEARING RACE	2		
C-337	BEARING RACE	2		
L-135	DUST SEAL	2		
C-1558	COTTER KEY	2		
H-1221-1	SHEAVE PIN	1		
C-315	ZERK FITTING	1		
R-5226	18 x 24 SGL. REAR BRAKE WHEEL ASSEMBLY	2	500	203.75
	(Includes following shown on Pages 453 & 454:)			
R-1702	WHEEL STRUCTURE	1		
R-1903	AXLE STRUCTURE	1		
H-2420	SLIDING RING	1		
C-1277	LOCKING RING	1		
R-3410	NUT ASSEMBLY	1		
L-85	OIL SEAL	1		
C-1621	CAPSCREW	4		
D-1255	HUB CAP STRUCTURE	1		
C-11	BEARING CONE	1		

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C-320	BEARING CUP	1		
H-2812	GASKET	1		
C-321	BEARING CUP	1		
H-5409	BEARING CONE	1		
L-5754	OIL SEAL	1		
C-620	RETAINER	1		
C-612	CAPSCREW	4		
H-2817	GASKET	1		
H-4574	BRAKE MASTER CYLINDER ASSEMBLY	1	9	13.25
	(Includes following shown on Pages 457 & 458):			
H-8091	RING	1		
H-8090	BOOT	1		
H-8089	RING	1		
H-8098	ROD	1		
H-8096	RING	1		
H-8097	WASHER	1		
H-8099	PISTON	1		
H-8600	CAP	1		
H-8601	GASKET	1		
H-8602	CASE	1		
H-8603	VALVE	1		
C-5768	PLUG	1		
H-8605	SPRING	1		
H-8604	CUP	1		
H-4575	BENDIX BRAKE ASSEMBLY (RIGHT)	1	60	74.85
	(Includes following shown on Pages 461 & 462):			
H-8001	BACKING PLATE ASSEMBLY	1		
H-9581	BRAKE SHOE ASSEMBLY	1		
H-8015	CENTRALIZER ASSEMBLY	1		
H-8027	ANCHOR PIN	2		
H-8028	ANCHOR PIN NUT	2		
H-8029	ANCHOR PIN LOCKWASHER	2		
H-8030	COTTER PIN	2		
H-8031	ANCHOR PIN REINF. PLATE	1		
H-8032	SHOE SPACER	4		
H-8033	SHOE HOLD-DOWN PIN	4		
H-8034	SHOE HOLD-DOWN SPRING CUP	8		
H-8035	COTTER PIN	4		
H-8036	SHOE HOLD-DOWN SPRING	4		
H-8037	ANCHOR TO PRIM. SHOE SPRING	1		
H-8038	ANCHOR TO SEC. SHOE SPRING	1		
H-8039	ADJUSTING SCREW SPRING	1		
H-8040	BRAKE SHOE PIVOT PIN	2		
H-8041	PIVOT PIN COTTER PIN	2		
H-8042	CENTRALIZER PLATE	1		
H-8043	NUT	2		
H-8044	LOCKWASHER	2		
H-8045	CONDUIT HOLE COVER PLATE	1		
H-8046	BOLT	2		
H-8047	LOCKWASHER	2		
H-8048	PRIM. TO SEC. SHOE SPRING	1		
H-8049	CONNECTING LINK	2		
H-8050	SCREW	2		
H-8051	LOCKWASHER	2		
H-5602	CYLINDER ASSEMBLY	1		
H-4576	BENDIX BRAKE ASSEMBLY (LEFT)	1	60	74.85
	(Includes following shown on Pages 463 & 464):			
H-8000	BACKING PLATE ASSEMBLY	1		
H-9580	BRAKE SHOE ASSEMBLY	1		
H-8015	CENTRALIZER ASSEMBLY	1		
H-8027	ANCHOR PIN	2		

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H 8028	ANCHOR PIN NUT	2			
H-8029	ANCHOR PIN LOCKWASHER	2			
H-8030	COTTER PIN	2			
H-8031	ANCHOR PIN REINF. PLATE	1			
H-8032	SHOE SPACER	4			
H-8033	SHOE HOLD-DOWN PIN	4			
H-8034	SHOE HOLD-DOWN SPRING CUP	8			
H-8035	COTTER PIN	4			
H-8036	SHOE HOLD-DOWN SPRING	4			
H-8037	ANCHOR TO PRIM. SHOE SPRING	1			
H-8038	ANÇHOR TO SEC. SHOE SPRING	1			
H-8039	ADJUSTING SCREW PIN	1			
H-8040	BRAKE SHOE PIVOT SPRING	2			
H-8041	PIVOT PIN COTTER PIN	2			
H-8042	CENTRALIZER PLATE	1			
H-8043	NUT	2			
H-8044	LOCKWASHER	2			
H-8045	CONDUIT HOLE COVER PLATE	1			
H-8046	BOLT	2			
H-8047	LOCKWASHER	2			
H-8048	PRIM. TO SEC. SHOE SPRING	1			
H-8049	CONNECTING LINK	2			
H-8050	SCREW	2			
H-8051	LOCKWASHER	2			
H-5602	CYLINDER ASSEMBLY	1			
H-5602	BRAKE WHEEL CYLINDER ASSEMBLY (Includes following shown on pages 465 & 466):	2	2	8	7.00
H-8445	PISTON	2			
H-8446	CUP	2			
H-8447	SPRING	1			
H-8500	SCREW	1			
H-2643	LOCKWASHER	1			
H-8449	VALVE	1			
H-8448	CASTING	1			
H-8444	STRAP	2			
H-8443	BOOT	2			

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